

**Special Notice N00014-18-R-SN02**  
**Special Program Announcement for 2018 Office of Naval Research**  
**Basic and Applied Research Opportunity:**  
**“Enhanced Superconductors for Future Naval Applications”**

**I. INTRODUCTION**

This announcement describes a research thrust entitled “Enhanced Superconductors for Future Naval Applications” to be launched under the Fiscal Year (FY) 18 Long Range Broad Agency Announcement (BAA) for Navy and Marine Corps Science and Technology, N00014-18-S-B001, ” which can be found at <https://www.onr.navy.mil/en/Contracts-Grants/Funding-Opportunities/Broad-Agency-Announcements>.

The research opportunity described in this announcement falls under the following section of the BAA: Appendix 1 “Program Description,” Section IV, entitled “Sea Warfare and Weapons Department (Code 33),” specific thrusts and focused research areas

- Paragraph A. “Ship Systems and Engineering Research,” subparagraph 3, entitled “Electrical and Thermal Systems”
- Paragraph D. entitled, “Naval Energy Resiliency and Sustainability.”

The purpose of this announcement is to (1) focus the attention of the scientific and technical community on specific areas of interest related to the advancement of superconductors, (2) encourage dialogue amongst those interested in this area with the Office of Naval Research (ONR), and (3) provide a timetable for the submission of white papers and proposals.

**II. TOPIC DESCRIPTION**

ONR is interested in receiving white papers and proposals in support of advancing high temperature superconducting wire technology for future naval applications. Work under this program will consist of basic and applied research, and it will be funded under Budget Activity 1 and 2 (as defined in DoD Financial Management Regulation Vol. 2B, Ch. 5). The overall S&T effort is envisioned to be conducted at the Technology Readiness Level (TRL) 1-3 stage.

**Background and Objectives:**

The overall objective of this program is to advance the state of art characteristics of high temperature superconductors to support applications demanding power delivery, pulsed current delivery, alternating current (AC) and direct current (DC) magnetic fields, and magnetic energy storage.

Superconducting materials exhibit lossless DC current transport properties that have potential to enable a wide range of high power density applications including motors, generators, and power cables. The Naval Power & Energy Systems Technology Development Roadmap

(NPES TDR)<sup>1</sup> recommends research in advanced conductors development to further reduce size, weight, and cost of conductors used in electrical equipment, and recommends further advancement towards room temperature superconductivity by applying advances in material science. The characteristics of superconductors also permit unique capabilities and unprecedented efficiency in producing and trapping magnetic fields, storing magnetic energy, and integrating inherent fault current limiting capability in conductors and cable topologies. While superconductors have unique and beneficial characteristics for a novel technological capability, the performance is limited by the requisite cryogenic environment and further reduced by the presence of magnetic field. Superconducting based technology aligns with the priority of Operational Endurance identified in the Naval Research and Development Framework<sup>2</sup>. Progress in the basic and applied research topic areas below enhance the efficiency for sustained warfighter operations and platform level energy storage and efficiency for propulsion and weapon systems.

Interested parties are welcome to propose against one or more topics listed below.

#### Topic Area 1: Superconducting Materials

- 1.1 Path to higher temperature superconductors.
  - Development of predictive models for new superconducting materials with superconducting state transitions temperatures higher than present 2G conductors.
  - Synthesis of designed high temperature superconductors (HTS).
- 1.2 High flexibility, high current density ( $J_c$ ) HTS conductors.
  - Mechanisms and methods of exfoliating, stacking, and re-stabilizing superconducting tapes for increased engineering current density.
- 1.3 Magnetic-field-orientation independent superconductors.
  - Round high temperature superconductor with isotropic in-field performance.
  - Methods of HTS layer deposition on round substrates.
- 1.4 Novel formulation of Rare earth - Barium - Copper Oxide (ReBCO) and associated manufacturing processes.
  - ReBCO tape formulations with highly efficient consumption of precursors.
- 1.5 Enhanced flux pinning for improved in-field performance.
  - Investigation in novel forms of imparting microdefects into coated conductors to increase lift factor.

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<sup>1</sup> 2015 Naval Power and Energy Systems Technology Development Roadmap (NPES TDR) ([http://www.navsea.navy.mil/Portals/103/Documents/Naval Power and Energy Systems Technology Development Roadmap.pdf](http://www.navsea.navy.mil/Portals/103/Documents/Naval_Power_and_Energy_Systems_Technology_Development_Roadmap.pdf))

<sup>2</sup> Naval Research and Development Framework (<https://www.onr.navy.mil/en/our-research/naval-research-framework>)

## Topic Area 2: Superconducting Tape Processing and Modification

- 2.1 Advanced substrates for coated conductors.
  - Electrically insulating, thermally stabilizing substrates for high temperature superconductors.
- 2.2 High frequency and pulsed current loss mechanisms and reduction in medium and high temperature superconductors.
  - Development of novel conductor topologies to reduce AC loss components of conductors in alternating current applications.
- 2.3 High resistance normal-state superconducting wires.
  - Development of conductor topologies that exhibit very high normal state resistance.
- 2.4 Enhancement mechanisms for normal zone propagation during quench.
  - Investigation into distributed and uniform quenching of superconducting wire or coils for elimination or minimization of localized heating during a quench event.

## Topic Area 3: Superconductors for Novel Applications

- 3.1 Superconducting power switching device targeting high blocking voltage and no on-state resistance, no/low switching loss.
  - Investigation into superconducting nano-wires arrangements terminal device (source, drain, gate) scalable to power switching applications.
  - Novel concepts of cryogenic power switching devices with greater than 2 orders of magnitude reduction in losses in a superconducting or cryogenic environment compared to ambient power switching devices.
- 3.2 Theory, advanced materials, or approaches for low-loss or loss-less power delivery through a warm to cold cryogenic current transition.
  - Materials development with characteristically high electrical to thermal conductivity ratio.
- 3.3 Materials, topologies, concepts in superconducting or cryogenic capacitors.

## Topic Area 4: Superconducting State Protections

- 4.1 Novel cryogenic refrigeration cycles
  - Investigation into novel cryogenic refrigeration cycles scalable in capacity from 0.5 to 2 kilowatt (kW) with cycle efficiency greater than 30% of Carnot.
- 4.2 Novel vacuum-less thermal insulation paradigm to achieve multi-layer insulation (MLI) levels of effective thermal conductivity.
  - Investigation into novel materials or metamaterials with characteristically low thermal conductivity approaching the effective thermal conductivity of vacuum enabled multi-layer insulation.
- 4.3 Mechanisms for early onset of quench.
  - Investigation into detectable phenomena prior to onset of superconducting quench.

- Exploitation of early detection indications using fiber optics, acoustic emissions, radio frequency (RF) approaches, or other novel quench detection approaches.
- 4.4 Mechanisms for rapid establishment of superconducting state.
- Investigation into novel approaches to establish the superconductive state in cables or coils prior to reaching conventional thermal equilibrium at cryogenic temperatures.

### **III. NO EVENTS ARE PLANNED**

### **IV. WHITE PAPER SUBMISSION**

Although not required, white papers are strongly encouraged for all offerors seeking funding. White Papers will be evaluated by the Government to determine whether the technology advancement proposed appears to be of particular value to the Department of the Navy. Initial Government evaluations and feedback will be issued via e-mail notification from the Technical Point of Contact. The initial white paper appraisal is intended to give entities a sense of whether or not their concepts are likely to be funded.

A detailed Full Proposal (Technical and Cost Volumes) will be subsequently encouraged from those Offerors whose proposed technologies have been identified through the above referenced email as being of “particular value” to the Government. However, any such encouragement does not assure a subsequent award. Full proposals may also be submitted by any Offeror whose white paper was not identified as being of particular value to the Government or any Offeror who did not submit a white paper.

For white papers proposing efforts that are considered of particular value to the Navy, but either exceed available budgets or contain certain tasks or applications that are not desired by the Navy, ONR may suggest a full proposal with reduced effort to fit within expected available budgets or an effort that refocuses the tasks or application of the technology to maximize the benefit to the Navy.

White papers should not exceed 5 single-sided pages, exclusive of cover page, references, and resume(s) of principal investigator(s), and should be in 12-point Times New Roman font with margins not less than one inch. White papers shall be in Adobe PDF format (preferred) or in Microsoft Word format compatible with MS Office 2010.

The cover page shall be labeled “WHITE PAPER” and include BAA Number N00014-18-R-SN02, proposed title, technical points of contact, telephone number, facsimile number, and E-mail address.

The 5-page body of the white paper should include the following information:

1. Principal Investigator(s);
2. Relevance of the proposed effort to the research areas described in Section II; relationship of the proposed work to current state of art.

3. Technical objective of the proposed effort;
4. Technical approach that will be pursued to meet the objective;
5. A summary of recent relevant technical breakthroughs; and
6. A funding plan showing requested funding per fiscal year.

Resume(s) of the principal investigator(s), not to exceed 1 page per principal investigator, should also be included after the 5-page body of the white paper.

White papers should be submitted via email to harold.coombe@navy.mil with “WHITE PAPER” in the subject line.

White Papers shall otherwise comply with requirements of the ONR Long Range BAA, N00014-18-S-B001.

To ensure full, timely consideration for funding, white papers should be submitted **no later than 10 FEB 2018**. White papers received after that date will be considered as time and availability of funding permit.

The planned date for completing the review of white papers is **10 March 2018**.

## **V. FULL PROPOSAL SUBMISSION AND AWARD INFORMATION**

Full proposals should be submitted under N00014-18-S-B001 by **10 April 2018**. Full proposals received after that date will be considered as time and availability of funding permit. Full proposals should be submitted in accordance with the requirements of the FY18 Long Range BAA, N00014-18-S-B001.

ONR anticipates that grants or contracts will be issued for this effort.

Full proposals for contracts should be submitted in accordance with the instructions of the FY18 Long Range BAA. The Technical Proposal/Content shall be single spaced and not exceed 20 pages. The cover page, resumes, bibliographies, project schedule, and table of contents are excluded in the page count.

Full proposals for grants should be submitted via grants.gov. The following information must be completed as follows in the SF424 to ensure that the application is directed to the correct individual for review: Block 4a, Federal Identifier: Enter N00014; Block 4b, Agency Routing Number, Enter the three (3) digit Program Office Code and the Program Officer’s name: (331 [Coombe, Scott]). All attachments to the application should also include this identifier to ensure the proposal and its attachments are received by the appropriate Program Office.

ONR plans to fund up to four (4) awards with an approximate value of up to \$150,000 per year, using research funds. However, lower and higher cost proposals will be considered.

The period of performance for projects may be from 24 to 36 months.

Although ONR expects the above described program plan to be executed, ONR reserves the right to make changes.

Funding decisions should be made by 10 May 2018. Selected projects will have an estimated award date of 1 August 2018.

**VI. SIGNIFICANT DATES AND TIMES**

<b>Event</b>	<b>Date</b>	<b>Time</b>
White Paper Submission	10 February 2018	1400 Eastern Local Time
Notification of White Paper Valuation*	10 March 2018	
Full Proposal Submission	10 April 2018	1400 Eastern Local Time
Full Proposal Selections*	10 May 2018	
Awards*	1 August 2018	

Note: \*These are approximate dates

**VII. POINTS OF CONTACT**

In addition to the points of contract listed in N00014-18-S-B001, the specific points of contract for this announcement are listed below.

Technical Point of Contact:

H. Scott Coombe

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Primary Business Point of Contact:

Elizabeth Bray

Contract Specialist, Code 252

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Secondary Business Point of Contact:

Lynn Christian

Contracting Officer, Code 252

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**VIII. SUBMISSION OF QUESTIONS**

Any questions regarding this announcement must be provided to the Technical Point of Contact and Business Point of Contact listed in Section VII above. All questions shall be submitted in writing by electronic mail.

Answers to questions submitted in response to this Special Notice will be addressed in the form of an Amendment and will be posted to the following web pages:

- Federal Business Opportunities (FEDBIZOPPS) Webpage- <https://www.fbo.gov/>
- ONR Special Notice Webpage- [http://www.onr.navy.mil/Contracts-Grants/FundingOpportunities/ Special-Notices.aspx](http://www.onr.navy.mil/Contracts-Grants/FundingOpportunities/Special-Notices.aspx)

Questions regarding White papers or Full proposals should be submitted no later than two weeks before the dates recommended for receipt of White papers and/or Full Proposals. Questions after these dates may not be answered.