

|   |                         |  |   |   |  |   |    |
|---|-------------------------|--|---|---|--|---|----|
| <b>AWARD/CONTRACT</b>   |                         | 1 THIS CONTRACT IS A RATED ORDER UNDER DPAS (15 CFR 700) |   | RATING  | PAGE OF PAGES<br>1   37  |   |    |
| 2 CONTRACT (Proc. Inst. Ident.) NO<br>W911NF1820101   |                         | 3 EFFECTIVE DATE<br>27 Sep 2018                          |   | 4. REQUISITION/PURCHASE REQUEST/PROJECT NO<br>0011164565  |  |   |    |
| 5 ISSUED BY<br>US ARMY ACC-APG-RTP W911NF<br>800 PARK OFFICE DRIVE<br>SUITE 4229<br>RESEARCH TRIANGLE PARK NC 27709   |                         | CODE W911NF  | 6. ADMINISTERED BY (If other than Item 5)<br>DCMA ORLANDO<br>3555 MAGUIRE BLVD<br>ORLANDO FL 32803-3726   |   | CODE S1002A  |   |    |
| 7. NAME AND ADDRESS OF CONTRACTOR (No. street, city, county, state and zip code)<br>GE AVIATION SYSTEMS LLC<br>GE AVIATION<br>2706 GATEWAY DR<br>POMPANO BEACH FL 33069-4373  |                         |  |   | 8 DELIVERY<br>[ ] FOB ORIGIN [ X ] OTHER (See below)  |  |   |    |
|   |                         |  |   | 9 DISCOUNT FOR PROMPT PAYMENT<br>Net 30 Days  |  |   |    |
| CODE 97953  |                         |  |   | FACILITY CODE   |  | 10 SUBMIT INVOICES 2<br>(4 copies unless otherwise specified)<br>TO THE ADDRESS<br>SHOWN IN |    |
| 11. SHIP TO/MARK FOR<br>ADELPHI LAB. CENTER<br>ADELPHI LAB. CENTER<br>ADELPHI LAB. CENTER<br>6010 FRANKFORD STREET ATTN RDRER-STN-CO<br>ADELPHI MD 21005  |                         | CODE W71B7J  | 12. PAYMENT WILL BE MADE BY<br>DFAS COLUMBUS CENTER<br>DFAS-CO/SOUTH ENTITLEMENT<br>OPERATIONS<br>PO BOX 182264<br>COLUMBUS OH 43218-2264   |   | CODE HQ0338  |   |    |
| 13. AUTHORITY FOR USING OTHER THAN FULL AND OPEN COMPETITION:<br>[ ] 10 U.S.C. 2304(c)( ) [ ] 41 U.S.C. 253(c)( )   |                         |  | 14 ACCOUNTING AND APPROPRIATION DATA<br>See Schedule  |   |  |   |    |
| 15A. ITEM NO.   | 15B. SUPPLIES/ SERVICES | 15C. QUANTITY  | 15D. UNIT   | 15E. UNIT PRICE   | 15F. AMOUNT  |   |    |
| <b>SEE SCHEDULE</b>   |                         |  |   |   |  |   |    |
| 15G. TOTAL AMOUNT OF CONTRACT   |                         |  |   |   |  | \$  |    |
| 16. TABLE OF CONTENTS   |                         |  |   |   |  |   |    |
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| CONTRACTING OFFICER WILL COMPLETE ITEM 17 (SEALED-BID OR NEGOTIATED PROCUREMENT) OR 18 (SEALED-BID PROCUREMENT) AS APPLICABLE   |                         |  |   |   |  |   |    |
| 17 (X) CONTRACTOR'S NEGOTIATED AGREEMENT (Contractor is required to sign this document and return 4 copies to issuing office.) Contractor agrees to furnish and deliver all items or perform all the services set forth or otherwise identified above and on any continuation sheets for the consideration stated herein. The rights and obligations of the parties to this contract shall be subject to and governed by the following documents: (a) this award/contract, (b) the solicitation, if any, and (c) such provisions, representations, certifications, and specifications, as are attached or incorporated by reference herein (Attachments are listed herein.) |                         |  |   | 18 [ ] SEALED-BID AWARD (Contractor is not required to sign this document.)<br>Your bid on Solicitation Number _____<br><br>including the additions or changes made by you which additions or changes are set forth in full above, is hereby accepted as to the terms listed above and on any continuation sheets. This award consummates the contract which consists of the following documents: (a) the Government's solicitation and your bid, and (b) this award/contract. No further contractual document is necessary. (Block 18 should be checked only when awarding a sealed-bid contract.) |  |   |    |
| 19A. NAME AND TITLE OF SIGNER (Type or print)<br>Laura Lehman<br>Contracts Manager  |                         |  | 20A. NAME OF CONTRACTING OFFICER<br>Nikolaos Georgakopoulos<br>TEL: 919-541-0817 EMAIL: nikolaos.georgakopoulos.civ@mail.mil  |   |  |   |    |
| 19B. NAME OF CONTRACTOR<br>BY <i>Laura Lehman</i><br>(Signature of person authorized to sign)   |                         | 19C. DATE SIGNED<br>27 Sep 2018                          | 20B. UNITED STATES OF AMERICA<br>BY _____<br>GEORGAKOPOULOS NIKOLAOS 1260548944 Digitally signed by GEORGAKOPOULOS NIKOLAOS 1260548944<br>Date: 2018.09.27 18:01:25 -0400<br>(Signature of Contracting Officer) |   | 20C. DATE SIGNED<br>27 September 2018                            |   |    |

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Section SF 30 - BLOCK 14 CONTINUATION PAGE

COOPERATIVE AGREEMENT

BETWEEN

**GE Aviation Systems, LLC.**

AND

**U.S. Army Contracting Command-Aberdeen Proving Ground Research Triangle Park Division on behalf of  
U.S. Army Research Laboratory (ARL)**

CONCERNING

**Silicon Carbide Advanced Packaging of Power Semiconductors II**

Agreement No.: W911NF-18-2-0101

Total Estimated Amount of the Agreement: \$4,000,000

Total Estimated Government Funding of the Basic Agreement: \$4,000,000

CLIN 0001 is hereby established in the amount of \$4,000,000. Additional CLINs will be established, subject to the availability of funds, up to the Total Estimated Amount of the Agreement set forth above.

Government Funds Obligated: \$4,000,000

Authority: 10 U.S.C. 2358

Catalog of Federal Domestic Assistance (CFDA) number: 12.431

This Agreement is entered into between the United States of America, hereinafter called the Government, represented by the U.S. Army Research Laboratory (ARL), and GE Aviation Systems, LLC., hereinafter referred to as the "Recipient," pursuant to and under U.S. Federal Law.

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## ARTICLE 1 Scope of the Agreement

### 1.1 Introduction

This Agreement between the Government and the Recipient (together known as the "Parties") is a "Cooperative Agreement" (31 USC 6305) and is awarded pursuant to 10 USC 2358 Research Projects. The Parties agree that the principal purpose of this Agreement is for the "Recipient," to provide its best research efforts in the support and stimulation of research and not the acquisition of property or provision of services for the direct benefit or use of the Government. FAR and DFARS apply only as specifically referenced herein. This Agreement is not intended to be, nor shall it be construed as, by implication or otherwise, a partnership, a corporation, or other business organization between the Parties.

### 1.2 Background and Vision Statement

The U.S. Army Research Laboratory's Sensors and Electron Devices Directorate (SEDD) is concerned with research and development in sensors and electron devices. SEDD conducts innovative research to provide the Army with affordable enabling technology in electro-optic sensors, advanced radio frequency (RF) technologies, autonomous sensing, power & energy, and signature management. SEDD, in collaboration with academic and industry partners, conducts basic and applied research on electro-optic and photonic devices (including active and passive sensing technologies) and transition these technologies in support of reconnaissance, intelligence, surveillance and target acquisition (RISTA); fire control; guidance; fusing; survivability; mobility; and lethality applications.

In support of this requirement, the Recipient will apply advanced interconnect technologies, next generation thermal management strategies, additive manufacturing techniques, and special packaging materials to address issues such as; planar packaging, parasitic inductance, heat removal capability, transient thermal mitigation, and reliability.

Users of wide band gap (WBG) devices such as Silicon Carbide (SiC) and Gallium Nitride (GaN) are realizing that conventional power module packaging is not yielding the expected performance improvement SiC and GaN should be providing when compared to silicon devices. Stray inductance within the device interconnect (wire bonds), internal DC bus bar structure and external DC link busbars lead to higher voltage stresses due to higher dV/dT when switching WBG devices when compared to slower switching silicon devices. Application of advanced interconnect technologies that minimize stray inductance at the device interface and facilitate low inductance, high current connections to the DC busbars are required to enable power module packages to approach the entitlement of WBG devices.

High thermal transients seen in new hybrid vehicle architectures, directed energy and related pulse power systems further complicate module performance due to higher delta "T" demands. To these improved module packages will need to be advanced thermal management strategies that can provide safe operating temperatures for both normal operation within high temperature systems and improved transient thermal capability.

### 1.3 Goals/Objectives

GE Aviation Systems, LLC.'s overarching objective is to design and develop a module package that combines GE's Power Overlay (POL) based Silicon Carbide (SiC) MOSFET Switch assembly with ARL's Power Tower concept. In this design, coolant with high voltage insulating properties would be flowed onto or across the POL and substrate for direct impingement cooling. This design concept would be scalable in current rating to accommodate different applications that ARL may be pursuing. Each POL assembly will include a number of MOSFET die to achieve the desired current rating. GE has developed this building block approach to multi-chip power module assembly which leads to scalable and repairable power packages, previously not available. GE will use POL switch assemblies from ongoing module builds to reduce technical risks and provide hardware to the project that will accelerate module concept evaluation.

The Recipient shall participate in a program of coordinated research, development, and education with ARL in accordance with the Program Plan, which sets forth the specific goals and objectives for the program for each program period. The Program Plans will be incorporated as attachments to this Agreement. The Recipient shall also comply with the reporting requirements set forth in Attachment 4.

The Government will have continuous involvement with the Recipient. The Government will also have access to the research results and certain rights in data, computer codes developed, and patents pursuant to Article 10 and Attachment 1 to this Agreement. The Government and the Recipient are bound to each other by a duty of good faith and best research effort in achieving the goals of the Program.

As a condition of this Agreement, it is herein understood and agreed that Federal funds are to be used only for costs that: (1) a reasonable and prudent person would incur, in carrying out the research project herein; and (2) are consistent with the purposes stated in governing Congressional authorizations and appropriations.

## **ARTICLE 2 General Definitions**

In addition to the Definitions set forth at 32 CFR Part 21, Subpart F and 34.2, the following definitions apply to this Agreement:

2.1 Recipient - An organization or other entity receiving a Grant or Cooperative Agreement from a DoD Component. For purposes of this Agreement, the Recipient is GE Aviation Systems, LLC.

2.2 Party - For purposes of this Agreement, the Parties are ARL and the Recipient.

2.3 Cooperative Agreement Manager (CAM) -- Is the Government's technical representative from ARL charged with the overall responsibility of management and guidance of the Cooperative Agreement. The CAM is identified at Article 3.1.

2.4 Grants Officer - Is the Government's principal point of contact for all administrative, financial or other non-technical issues arising under the Agreement. The Grants Officer is an official with the authority to enter into, administer, and/or terminate Grants and Agreements. The Grants Officer is identified at Article 8.1.

2.5 Agreements Administrator - The Agreements Administrator has authority to administer Cooperative Agreements and, in coordination with the Grants Officer, make determination and findings related to delegated administration functions. The Agreements Administrator is identified at Article 8.2.

2.6 Recipient Program Manager (RPM) - The RPM is the Recipient's technical representative charged with the Recipient's overall responsibility of management and guidance of the Cooperative Agreement. The RPM is identified at Article 3.2.

2.7 Program Plan (PP) and Budget - The PP is the annual document which details the scope, schedule, principal investigator(s), collaboration, staff rotation, and educational opportunities for the research activities envisioned under this Agreement. It also includes the financial expression of the program, which serves as the resource allocation/commitment for the research activities. The Budget will include the sum of both Federal and non-Federal shares, as appropriate. The PP and Budget is identified within Attachment 5.

## **ARTICLE 3 Program Management**

3.1 ARL Cooperative Agreement Manager (CAM). The ARL Cooperative Agreement Manager (CAM) is:

Dimeji Ibitayo  
U.S. Army Research Laboratory  
Adelphi, MD 20783-1138

Telephone: 301-394-5514  
Email: oladimeji.o.ibitayo.civ@mail.mil

3.2 Recipient Program Manager (RPM). The Recipient Program Manager (RPM) is:

Liqiang Yang  
GE Aviation Systems, LLC.  
Pomano Beach, FL 33069-4323  
Telephone: 954-984-2203  
Email: liqiangl.yang@ge.com

3.3 Cooperative Agreement Management Committee (CAMC) – The ARL CAM is responsible for the overall management and guidance of the Cooperative Agreement. The CAM, together with the RPM will form the Cooperative Agreement Management Committee (CAMC). Other advisory members may be added by either the CAM, or the RPM, by mutual agreement, when their presence will prove beneficial to the research.

3.4 Management and Program Structure – The CAMC shall be responsible for the management and integration of the Parties collaborative efforts under this Agreement including programmatic, technical and reporting.

3.5 Program Planning Process – The Program Plan for 1 year (date of award through 12 months) is incorporated as part of this Agreement.

The PP shall serve as the annual document, which details the scope, schedule, principal investigator(s), staff rotation, educational opportunities, and resource allocation/commitment of the research activities envisioned under this Agreement.

Beginning 6 months after initial award, the Program Planning Process shall begin for the following year. This process shall continue for the length of the Agreement. As part of this process, one or more site visits may be required. In addition, the ARL CAM or his representatives will have the right to make visits as needed during the year to assess or coordinate performance. Within (30) calendar days of submission, the Grants Officer, in conjunction with the RPM and ARL CAM, will approve the PP by incorporating such through a modification to this Agreement.

During the course of performance, if it appears that research milestones will not be met, the RPM will provide a proposed adjustment to the PP for approval by the ARL CAM. In addition, the ARL CAM may from time to time request that additional research be added to the PP.

#### **ARTICLE 4 Staff Rotation and On-Site Collaboration**

4.1 Salary and Travel Costs. All salary and travel costs associated with the rotation of government personnel will be borne by the Government. All salary and travel costs associated with staff rotation or on-site collaboration of Recipient personnel will be paid for with funding provided under this Agreement.

4.2 Host Facility Regulations. All Government and Recipient personnel in rotational assignments or on-site collaboration are required to comply with the safety, environmental, security, and operational regulations or requirements of the host facility. The Government will coordinate in advance with the RPM and GE Aviation Systems, LLC. To allow sufficient time to make necessary arrangements for rotational assignments or on-site collaboration.

4.3 Administrative Support. The host facility will provide adequate office space, communications connections, administrative support, and office supplies, if available, for Government and Recipient personnel in rotational assignments. Should it become necessary to procure equipment to facilitate a rotational assignment, the PP should reflect the need for said equipment, and the costs will be borne under this Agreement.

## ARTICLE 5 Fiscal Management

### 5.1 Allocation of Recipient Funds

5.1.1 Restrictions on the Use of Government Funds. Government funds provided under this Agreement must be allocated by the Recipient exclusively for the execution and operation of the PP or Agreement Scope. Government funds shall not be utilized to support the Recipient's operations or administration unrelated to this Agreement.

5.1.2 Obligation. In no case shall the Government's financial obligation exceed the amount obligated on this Agreement or by amendment to this Agreement. The total Government funding amount estimated for performance of this Base Agreement is \$██████████; subject to the availability of funds. The amount of Government funds allotted and available for payment in the Program Plan is \$██████████. The Government is not obligated to reimburse the Recipient for expenditures in excess of the amount of obligated funds allotted by the Government under this Agreement.

5.1.3 Incremental Funding. The Government may obligate funds to this Agreement incrementally. In the event that this Agreement is funded incrementally, the Government anticipates that from time to time additional amounts will be allotted to this Agreement by unilateral modification, until the total amount for performance of this Agreement has been funded. To minimize interruption of effort due to lack of Government funds, the Recipient shall notify the CAM and Grants Officer in writing whenever the amount of funds obligated under this Agreement when added to anticipated costs in the next (60) calendar days will exceed 75% of the amount allotted.

### 5.1.4 Payments.

- a. The Recipient shall submit to the Agreement Administrator (see Article 8.2 and block 6 of the cover sheet) and a copy to the CAM an original and two (2) copies of all vouchers, SF 270 "Request for Advance or Reimbursement" or other form or format prescribed by the DoD component when it (component) determines that adequate information has been provided to meet Federal needs. The Recipient shall attach additional information as reasonably requested by the Agreement Administrator. The Payment Office will make payments via EFT within 20 calendar days of receipt of transmittal.
- b. The Agreement Administrator may allow for invoices to be submitted through the Payweb or the Wide Area Work Flow (WAWF) process.
- c. Payments will be made no more frequently than monthly and will be based on reimbursement of actual expenditures as monitored against the Budget Plan contained in the PP. Once the CAM has verified that the Recipient has expended reasonable efforts towards the successful achievement of the research goals, payment will be authorized.

5.1.5 Financial Reporting. The Recipient shall submit Annual and Final Financial (SF425) reports as specified in Attachment 4.

## ARTICLE 6 Agreement Administration

6.1 Modifications to this Agreement. Any Party who wishes to modify this Agreement shall, upon reasonable notice of the proposed modification to the other Party, confer in good faith with the other Party to determine the desirability of the proposed modification. Modifications will not be effective until a written modification is signed by an authorized representative of the Recipient and by the Grants Officer for bilateral modifications and by the Grants Officer for unilateral modifications. Administrative modifications may be unilaterally executed by the Grants Officer or by the Agreements Administrator.

6.2 Requirements for Prior Approval for Changes to the Program Budget and Annual Program Plan. This provision highlights Agency decisions on the terms and conditions of 32 CFR 34.15 as applicable. During the course of

performance, the Grants Officer, in coordination with the CAM, will have approval authority for certain specific changes to the APP when such changes are requested in writing by the Recipient, including:

- 6.2.1 Changes in the scope or the objective of the program, PP, or research milestones;
- 6.2.2 Change in the key personnel specified in the proposal or award document;
- 6.2.3 The absence for more than three months, or a 25% reduction in time devoted to the project, by the approved RPM.
- 6.2.4 The need for additional Federal funding.
- 6.2.5 Any sub-award, transfer, or contracting out of substantive program performance under an award, unless described in the application/proposal and funded in the approved awards document.

6.3 No-Cost Period of Performance Extension. In accordance with the DoD Grant and Agreement Regulations (DoD 3210.6-R), the Recipient may initiate a request for a one-time no-cost extension to the period of performance. The request may not include additional Federal funds, nor change the approved objectives or scope of the program.

6.3.1 Extension requests shall be directed to the CAM. Modifications for an extension request may be completed by the Agreement Administrator listed in Article 8.2 with a courtesy copy to the Grants Officer listed in Article 8.1.

#### **ARTICLE 7 Terms of the Agreement**

The basic term of this Agreement will commence upon the effective date and continue through twelve (12) months; subject to the availability of funds.

#### **ARTICLE 8 Administrative Responsibility**

##### **8.1 The Agreements Office**

U.S. Army Contracting Command- Aberdeen Proving Ground Research Triangle Park Division  
on behalf of the U.S. Army Research Laboratory

For FedEx etc. use: 800 Park Office Drive, Suite 4229, Research Triangle Park, NC 27709  
For USPS use: P.O. Box 12211, Research Triangle Park, NC 27709

Grant Officer: Niko Georgakopoulos  
Phone: (919) 541-0817  
Fax: (919) 541-0737  
Email: nikolaos.georgakopoulos.civ@mail.mil

##### **8.2 Agreement Administrator**

Defense Contract Management Agency  
DCMA Orlando  
3555 Maguire Blvd.  
Orlando, FL 32803-3726  
Telephone: 954-217-6057  
UIC: S1002A  
Email: lynn.spinato@dcma.mil

##### **8.3 The Recipient Address and Point of Contact**

Laura Lahman  
GE Aviation Systems LLC  
Pompano Beach, FL 33069-4323  
Telephone: 954-984-2455  
Email: laura.lahman@ge.com



#### 8.4 The Payment Office:

DFAS Columbus Center – HQ0338  
DFAS-CO/SOUTH ENTITLEMENT OPERATIONS  
P.O. Box 182264  
Columbus, OH 43218-2266  
Telephone: 800-756-4571

#### 8.5 Address of Payee (see paragraph 8.3 above)

### **ARTICLE 9 Public Release or Dissemination of Information**

9.1 Open Publication Policy. Notwithstanding the reporting requirements of this Agreement, Parties to this Agreement favor an open-publication policy to promote the commercial acceptance of the research developed under this Agreement, but simultaneously recognize the necessity to protect proprietary information.

9.2 Prior Review of Public Releases. The Parties agree to confer and consult with each other prior to publication or other disclosure of the results of the fundamental research under this Agreement to ensure that no classified or proprietary information is released. Prior to submitting a manuscript for publication or before any other public disclosure, each Party will offer the other Party ample opportunity (not to exceed (60) calendar days) to review such proposed publication or disclosure, to submit objections, and to file application letters for patents in a timely manner. It is herein agreed that except for the disclosure of basic information regarding this Agreement such as membership, purpose and a general description of the technical work, the Recipient will submit all proposed public releases to the ARL CAM for comment prior to release. Public releases include press releases, specific publicity or advertisement, and articles for proposed publication or presentation.

9.3 Publication Legend. In addition, articles for publication or presentation will contain an acknowledgement of support and a disclaimer. These statements may be placed either at the bottom of the first page or at the end of the paper and should read as follows: "Research was sponsored by the Army Research Laboratory and was accomplished under Cooperative Agreement Number **W911NF-18-2-0101**. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the official policies, either expressed or implied, of the Army Research Laboratory or the U.S. Government. The U.S. Government is authorized to reproduce and distribute reprints for Government purposes notwithstanding any copyright notation herein."

### **ARTICLE 10 Intellectual Property & Data Rights**

The Intellectual Property Rights contained in 32 CFR 34.25, and patent rights clause 37 CFR 401.14, are incorporated by reference into this Agreement. In addition, the participants recognize that this program may result in intellectual property that is generated by the Recipient or Sub-Recipient personnel and Government personnel. Should this occur, the Parties agree to use their reasonable efforts to mutually agree to an equitable distribution of property rights and distribution of filing fees or other administrative costs. Should the Parties reach an impasse in determining the distribution of property rights, the Parties shall resort to the Disputes, Claims, and Appeals Process as set forth at 32.CFR 22.815.

The Recipient has asserted Rights in Technical Data that was developed at the Recipient's own expense. As a result, this Agreement includes DFARS 252.227-7013 below, and the specific assertions are set forth in Attachment 6 of this Agreement. The DFARS clause 252.227-7013 does not apply to data first produced under this Cooperative Agreement.

(a) Definitions – The definitions set forth in paragraph "(a)" of the DFARS clause at 252.227.7013, Rights in Technical Data – Noncommercial Items (Sep. 2011) apply to this article.

(b) Rights in technical data – The Recipient grants or shall obtain for the Government the following royalty free, world-wide, nonexclusive, irrevocable license rights in technical data other than computer software documentation:

(1) Unlimited rights – The Government shall have unlimited rights in technical data that are:

- (i) Data pertaining to an item, component, or process which has been or will be developed exclusively with Government funds;
- (ii) Studies, analyses, test data, or similar data produced for this contract, when the study, analysis, test, or similar work was specified as an element of performance;
- (iii) Created exclusively with Government funds in the performance of a contract or agreement that does not require the development, manufacture, construction, or production of items, components, or processes;
- (iv) Form, fit, and function data;
- (v) Necessary for installation, operation, maintenance, or training purposes (other than detailed manufacturing or process data);
- (vi) Corrections or changes to technical data furnished to the Recipient by the Government;
- (vii) Otherwise publicly available or have been released or disclosed by the Recipient or subrecipient without restrictions on further use, release or disclosure, other than a release or disclosure resulting from the sale, transfer, or other assignment of interest in the technical data to another party or the sale or transfer of some or all of a business entity or its assets to another party;
- (viii) Data in which the Government has obtained unlimited rights under another Government contract or agreement or as a result of negotiations; or
- (ix) Data furnished to the Government, under this or any other Government contract/agreement or subcontract/subaward there under, with:
  - (A) Government purpose license rights or limited rights and the restrictive condition(s) has/have expired; or
  - (B) Government purpose rights and the Recipient's exclusive right to use such data for commercial purposes has expired.

(2) Government purpose rights.

- (i) The Government shall have government purpose rights for a five-year period, or such other period as may be negotiated, in technical data:
  - (A) That pertain to items, components, or processes developed with mixed funding except when the Government is entitled to unlimited rights in such data as provided in paragraphs (b)(ii) and (b)(iv) through (b)(ix) of this article; or
  - (B) Created with mixed funding in the performance of a contract that does not require the development, manufacture, construction, or production of items, components, or processes.
- (ii) The five-year period, or such other period as may have been negotiated, shall commence upon execution of the contract, subcontract, letter contract (or similar contractual instrument), contract modification, or option exercise that required development of the items, components, or processes or creation of the data described in paragraph (b)(2)(i)(B) of this article. Upon expiration of the five-year or other negotiated period, the Government shall have unlimited rights in the technical data.
- (iii) The Government shall not release or disclose technical data in which it has government purpose rights unless:

(A) Prior to release or disclosure, the intended recipient is subject to the non-disclosure agreement at 227.7103-7 of the Defense Federal Acquisition Regulation Supplement (DFARS); or

(B) The Recipient is a Government contractor receiving access to the data for performance of a Government contract that contains the clause at DFARS 252.227-7025, Limitations on the Use or Disclosure of Government-Furnished Information Marked with Restrictive Legends.

(iv) The Recipient has the exclusive right, including the right to license others, to use technical data in which the Government has obtained government purpose rights under this Cooperative Agreement for any commercial purpose during the time period specified in the government purpose rights legend prescribed in paragraph (f)(2) of this article.

(3) Limited rights.

(i) Except as provided in paragraphs (b)(1)(ii) and (b)(1)(iv) through (b)(1)(ix) of this article, the Government shall have limited rights in technical data:

(A) Pertaining to items, components, or processes developed exclusively at private expense and marked with the limited rights legend prescribed in paragraph (f) of this article; or

(B) Created exclusively at private expense in the performance of a contract that does not require the development, manufacture, construction, or production of items, components, or processes.

(ii) The Government shall require a recipient of limited rights data for emergency repair or overhaul to destroy the data and all copies in its possession promptly following completion of the emergency repair/overhaul and to notify the Recipient that the data have been destroyed.

(iii) The Recipient, its subrecipients, and suppliers are not required to provide the Government additional rights to use, modify, reproduce, release, perform, display, or disclose technical data furnished to the Government with limited rights. However, if the Government desires to obtain additional rights in technical data in which it has limited rights, the Recipient agrees to promptly enter into negotiations with the Grants Officer to determine whether there are acceptable terms for transferring such rights. All technical data in which the Recipient has granted the Government additional rights shall be listed or described in a license agreement made part of the Cooperative Agreement. The license shall enumerate the additional rights granted the Government in such data for purposes of this Agreement.

(4) Specifically negotiated license rights – The standard license rights granted to the Government under paragraphs (b)(1) through (b)(3) of this article, including the period during which the Government shall have government purpose rights in technical data, may be modified by mutual agreement to provide such rights as the Parties consider appropriate but shall not provide the Government lesser rights than are enumerated in paragraph (b)(3) of this article. Any rights so negotiated shall be identified in a license agreement made part of this Cooperative Agreement.

(5) Prior government rights – Technical data that will be delivered, furnished, or otherwise provided to the Government under this Cooperative Agreement, in which the Government has previously obtained rights shall be delivered, furnished, or provided with the pre-existing rights, unless:

(i) The Parties have agreed otherwise; or

(ii) Any restrictions on the Government's rights to use, modify, reproduce, release, perform, display, or disclose the data have expired or no longer apply.

(6) Release from liability – The Recipient agrees to release the Government from liability for any release or disclosure of technical data made in accordance with paragraph (b)(13) or (b)(2)(iii) of this article, in accordance with the terms of a license negotiated under paragraph (b)(4) of this article, or by others to whom the recipient has

released or disclosed the data and to seek relief solely from the party who has improperly used, modified, reproduced, released, performed, displayed, or disclosed Recipient data marked with restrictive legends.

(c) Recipient rights in technical data – All rights not granted to the Government are retained by the Recipient.

(d) Third party copyrighted data – The Recipient shall not, without the written approval of the Grants Officer, incorporate any copyrighted data in the technical data to be delivered under this Cooperative Agreement unless the Recipient is the copyright owner or has obtained for the Government the license rights necessary to perfect a license or licenses in the deliverable data of the appropriate scope set forth in paragraph (b) of this article, and has affixed a statement of the license or licenses obtained on behalf of the Government and other persons to the data transmittal document.

(e) Identification and delivery of data to be furnished with restrictions on use, release, or disclosure.

(1) This paragraph does not apply to restrictions based solely on copyright.

(2) Except as provided in paragraph (e)(3) of this article, technical data that the Recipient asserts should be furnished to the Government with restrictions on use, release, or disclosure are identified in an attachment to this Cooperative Agreement (Attachment 6). The Recipient shall not deliver any data with restrictive markings unless the data are listed on the Attachment.

(3) In addition to the assertions made in the Attachment, other assertions may be identified after award when based on new information or inadvertent omissions unless the inadvertent omissions would have materially affected the source selection decision. Such identification and assertion shall be submitted to the Grants Officer as soon as practicable prior to the scheduled date for delivery of the data, and signed by an official authorized to contractually obligate the Recipient.

(4) When requested by the Grants Officer, the Recipient shall provide sufficient information to enable the Grants Officer to evaluate the Recipient's assertions. The Grants Officer reserves the right to add the Recipient's assertions to the Attachment and validate any listed assertion, at a later date.

(f) Marking requirements – The Recipient, and its subrecipients or suppliers, may only assert restrictions on the Government's rights to use, modify, reproduce, release, perform, display, or disclose technical data to be delivered under this Cooperative Agreement by marking the deliverable data subject to restriction. Except as provided in paragraph (f)(5) of this article, only the following legends are authorized under this Cooperative Agreement: the government purpose rights legend at paragraph (f)(2) of this article; the limited rights legend at paragraph (f)(3) of this article; or the special license rights legend at paragraph (f)(4) of this article; and/or a notice of copyright as prescribed under 17 U.S.C. 401 or 402.

(1) General marking instructions – The Recipient, or its subrecipients or suppliers, shall conspicuously and legibly mark the appropriate legend on all technical data that qualify for such markings. The authorized legends shall be placed on the transmittal document or storage container and, for printed material, each page of the printed material containing technical data for which restrictions are asserted. When only portions of a page of printed material are subject to the asserted restrictions, such portions shall be identified by circling, underscoring, with a note, or other appropriate identifier. Technical data transmitted directly from one computer or computer terminal to another shall contain a notice of asserted restrictions. Reproductions of technical data or any portions thereof subject to asserted restrictions shall also reproduce the asserted restrictions.

(2) Government purpose rights markings – Data delivered or otherwise furnished to the Government with government purpose rights shall be marked as follows:

#### GOVERNMENT PURPOSE RIGHTS

Agreement No.:  
 Recipient Name:  
 Recipient Address:  
 Expiration Date:

The Government's rights to use, modify, reproduce, release, perform, display, or disclose these technical data are restricted by paragraph (b)(2) of the Rights in Technical Data article contained in the above identified Cooperative Agreement. No restrictions apply after the expiration date shown above. Any reproduction of technical data or portions thereof marked with this legend must also reproduce the markings.

(End of legend)

(3) Limited rights markings – Data delivered or otherwise furnished to the Government with limited rights shall be marked with the following legend:

#### LIMITED RIGHTS

Agreement No.:  
 Recipient Name:  
 Recipient Address:

The Government's rights to use, modify, reproduce, release, perform, display, or disclose these technical data are restricted by paragraph (b)(3) of the Rights in Technical Data article contained in the above identified Cooperative Agreement. Any reproduction of technical data or portions thereof marked with this legend must also reproduce the markings. Any person, other than the Government, who has been provided access to such data must promptly notify the above named Recipient.

(End of legend)

(4) Special license rights markings.

(i) Data in which the Government's rights stem from a specifically negotiated license shall be marked with the following legend:

#### SPECIAL LICENSE RIGHTS

The Government's rights to use, modify, reproduce, release, perform, display, or disclose these data are restricted by Cooperative Agreement No. \_\_\_\_\_(Insert Cooperative Agreement number)\_\_\_\_, License No. \_\_\_\_ (Insert license identifier)\_\_\_\_. Any reproduction of technical data or portions thereof marked with this legend must also reproduce the markings.

(End of legend)

(ii) For purposes of this article, special licenses do not include government purpose license rights acquired under a prior contract (see paragraph (b)(5) of this article).

(5) Pre-existing data markings – If the terms of a prior contract/agreement or license permitted the Recipient to restrict the Government's rights to use, modify, reproduce, release, perform, display, or disclose technical data deliverable under this Cooperative Agreement, and those restrictions are still applicable, the Recipient may mark such data with the appropriate restrictive legend for which the data qualified under the prior contract or license. The marking procedures in paragraph (f)(1) of this article shall be followed.

(g) Recipient procedures and records – Throughout performance of this Cooperative Agreement, the Recipient and its subrecipient or suppliers that will deliver technical data with other than unlimited rights, shall:

(1) Have, maintain, and follow written procedures sufficient to assure that restrictive markings are used only when authorized by the terms of this article; and

(2) Maintain records sufficient to justify the validity of any restrictive markings on technical data delivered under this Cooperative Agreement.

(h) Relation to patents – Nothing contained in this article shall imply a license to the Government under any patent or be construed as affecting the scope of any license or other right otherwise granted to the Government under any patent.

(i) Limitation on charges for rights in technical data.

(1) The Recipient shall not charge to this Cooperative Agreement any cost, including, but not limited to, license fees, royalties, or similar charges, for rights in technical data to be delivered under this Cooperative Agreement when:

- (i) The Government has acquired, by any means, the same or greater rights in the data; or
- (ii) The data are available to the public without restrictions.

(2) The limitation in paragraph (i)(1) of this article:

- (i) Includes costs charged by a subrecipient or supplier, at any tier, or costs incurred by the Recipient to acquire rights in subrecipient or supplier technical data, if the subrecipient or supplier has been paid for such rights under any other Government contract/agreement or under a license conveying the rights to the Government; and
- (ii) Does not include the reasonable costs of reproducing, handling, or mailing the documents or other media in which the technical data will be delivered.

(j) Applicability to subrecipients or suppliers.

(1) The Recipient shall ensure that the rights afforded its subrecipients and suppliers under 10 U.S.C. § 2320, 10 U.S.C. § 2321, and the identification, assertion, and delivery processes of paragraph (e) of this article are recognized and protected.

(2) Whenever any technical data for noncommercial items is to be obtained from a subrecipient or supplier for delivery to the Government under this Cooperative Agreement, the Recipient shall use this same article in the subrecipient or other contractual instrument, and require its subrecipients or suppliers to do so, without alteration, except to identify the Parties. No other clause shall be used to enlarge or diminish the Government's, the Recipient's, or a higher-tier subrecipient's or supplier's rights in a subrecipient's or supplier's technical data.

(3) Technical data required to be delivered by a subrecipient or supplier shall normally be delivered to the next higher-tier awardee/subrecipient, or supplier. However, when there is a requirement in the prime award for data which may be submitted with other than unlimited rights by a subrecipient or supplier, then said subrecipient or supplier may fulfill its requirement by submitting such data directly to the Government, rather than through a higher-tier awardee/contractor, subcontractor, or supplier.

(4) The Recipient and higher-tier subrecipients or suppliers shall not use their power to award subawards as economic leverage to obtain rights in technical data from their subcontractors or suppliers.

(5) In no event shall the Recipient use its obligation to recognize and protect subrecipient or supplier rights in technical data as an excuse for failing to satisfy its contractual obligation to the Government.

#### **ARTICLE 11 Entire Agreement**

This Agreement, along with all Attachments, constitutes the entire Agreement between the Parties concerning the subject matter hereof and supersedes any prior understanding or written or oral agreement relative to said matter. In the event of a conflict between the terms of the Agreement and its attachments, the terms of the Agreement shall govern.

#### **ARTICLE 12 Governing Law/Order of Precedence**

The Agreement shall be enforced in accordance with applicable federal law and regulations, directives, circulars or other guidance as specified in this Agreement. When signed, this Agreement shall become binding on the Recipient and the Government to be administered in accordance with the DoD Grant and Agreement Regulations as they apply to the particular recipient concerned. In the event a conflict exists between the provisions of this Agreement and the applicable law, regulations, directives, circulars or other guidance, the Agreement provisions are subordinate.

#### **ARTICLE 13 Waiver of Rights**

Any waiver of any requirement contained in this Agreement shall be by mutual agreement of the Parties hereto. Any waiver shall be reduced to writing and a copy of the waiver shall be provided to each Party. Failure to insist upon strict performance of any of the terms and conditions hereof, or failure or delay to exercise any rights provided herein or by law, shall not be deemed a waiver of any rights of any Party hereto.

#### **ARTICLE 14 Use of Technical Facilities**

To the maximum extent practical, the Recipient agrees to use the technical reference facilities of the Defense Technical Information Center, 8725 John J. Kingman Road, Suite 0944, Ft. Belvoir, VA 22060-6218 (Internet address: <http://www.dtic.mil>) and all other sources, whether United States Government or private, for purpose of surveying existing knowledge and avoiding needless duplication of scientific and engineering effort.

#### **ARTICLE 15 Metric System of Measurement**

The Metric Conversion Act of 1975 as amended by the Omnibus Trade and Competitiveness Act of 1988 and implemented by Executive Order 12770 gives preference to the metric system. The Recipient shall ensure that the metric system is used to the maximum extent practicable in performance of this Agreement.

#### **ARTICLE 16 Liability**

No Party to this Agreement shall be liable to the other Party for any property the other Party has consumed, damaged, or destroyed in the performance of this Agreement, unless it is due to the negligence or misconduct of the other Party or an employee or agent of that Party.

#### **ARTICLE 17 Non-Assignment**

This Agreement may not be assigned by any Party except by operation of law resulting from the merger of a Party into, or with, another corporate entity. The Recipient may assign its accounts receivables under this Agreement to GE Capital after written notification of this assignment to Agreements Officer. This specific assignment is not a waiver or alteration of any other rights and/or obligations owed the Recipient under this award, including the Recipient's obligations to complete all work and fulfill any and all warranties as required.

#### **ARTICLE 18 Severability**

If any article, clause, provision or section of this Agreement shall be held illegal or invalid by any court, the invalidity of such article, clause, provision or section shall not affect any of the remaining articles, clauses,

provisions or sections herein and this Agreement shall be construed and enforced as if such illegal or invalid article, clause, provision or section had not been contained herein.

#### **ARTICLE 19 Force Majeure**

Neither Party shall be in breach of this Agreement for any failure of performance caused by any event beyond its reasonable control and not caused by the fault or negligence of that Party. In the event such a force majeure event occurs, the Party unable to perform shall promptly notify the other Party and shall in good faith maintain such partial performance as is reasonably possible and shall resume full performance as soon as is reasonably possible.

#### **ARTICLE 20 Notices**

All notices and prior approvals required hereunder shall be in writing and shall be addressed to the Parties identified on the Agreement cover page and Article 8. Notices and prior approvals shall be effective upon signature of the Grants Officer.

#### **ARTICLE 21 Access Guidance**

Should a Recipient's performance require access to DoD facilities, the Recipient shall coordinate with their CAM or designated point of contact providing access in order to obtain the most current access guidance. Commencement of access coordination should occur at least (10) calendar days prior to the date of required access.

#### **ARTICLE 22 System for Award Management (formerly Central Contractor Registration and Universal Identifier Requirements)**

##### **A. Requirement for System for Award Management (SAM)**

Unless you are excepted from this requirement under 2 CFR 25.110, you as the recipient must maintain the currency of your information in the SAM until you submit the final financial report required under this award or receive the final payment, whichever is later. This requires that you review and update the information at least annually after the initial registration, and more frequently if required by changes in your information or another award term.

##### **B. Requirement for Data Universal Numbering System (DUNS) Numbers**

If you are authorized to make subawards under this award, you:

1. Must notify potential subrecipients that no entity (see definition in paragraph C of this award term) may receive a subaward from you unless the entity has provided its DUNS number to you.
2. May not make a subaward to an entity unless the entity has provided its DUNS number to you.

##### **C. Definitions**

For purposes of this award term:

1. System for Award Management (SAM) means the Federal repository into which an entity must provide information required for the conduct of business as a recipient. Additional information about registration procedures may be found at the SAM Internet site (currently at <http://www.sam.gov>).

2. Data Universal Numbering System (DUNS) number means the nine-digit number established and assigned by Dun and Bradstreet, Inc. (D&B) to uniquely identify business entities. A DUNS number may be obtained from D&B by telephone (currently 866-705-5711) or the Internet (currently at <http://fedgov.dnb.com/webform>).

3. Entity, as it is used in this award term, means all of the following, as defined at 2 CFR part 25, subpart C:
- a. A Governmental organization, which is a State, local government, or Indian tribe;
  - b. A foreign public entity;



- c. A domestic or foreign nonprofit organization;
- d. A domestic or foreign for-profit organization; and
- e. A Federal agency, but only as a subrecipient under an award or subaward to a non-Federal entity.

4. Subaward:

- a. This term means a legal instrument to provide support for the performance of any portion of the substantive project or program for which you received this award and that you as the recipient award to an eligible subrecipient.
- b. The term does not include your procurement of property and services needed to carry out the project or program (for further explanation, see Sec. \_\_.210 of the attachment to OMB Circular A-133, "Audits of States, Local Governments, and Non-Profit Organizations").
- c. A subaward may be provided through any legal agreement, including an agreement that you consider a contract.

5. Subrecipient means an entity that:

- a. Receives a subaward from you under this award; and
- b. Is accountable to you for the use of the Federal funds provided by the subaward.

**ARTICLE 23 Prohibition on Using Funds Under Grants and Cooperative Agreements with Entities that Require Certain Internal Confidentiality Agreements**

- A. The recipient may not require its employees, contractors, or subrecipients seeking to report fraud, waste, or abuse to sign or comply with internal confidentiality agreements or statements prohibiting or otherwise restricting them from lawfully reporting that waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information.
- B. The recipient must notify its employees, contractors, or subrecipients that the prohibitions and restrictions of any internal confidentiality agreements inconsistent with paragraph (a) of this award provision are no longer in effect.
- C. The prohibition in paragraph (a) of this award provision does not contravene requirements applicable to Standard Form 312, Form 4414, or any other form issued by a Federal department or agency governing the nondisclosure of classified information.
- D. If the Government determines that the recipient is not in compliance with this award provision, it:
  - 1. Will prohibit the recipient's use of funds under this award, in accordance with section 743 of Division E of the Consolidated and Further Continuing Resolution Appropriations Act, 2015, (Pub. L. 113-235) or any successor provision of law; and
  - 2. May pursue other remedies available for the recipient's material failure to comply with award terms and conditions.

**ATTACHMENT 1**  
**Standard Terms and Conditions Applicable to For-Profit Entities Department of Defense Grant and Agreement Regulations (DoDGARS) DoD 3210.6-R and 32 CFR Parts 21-37**

Award, administration, and performance under this Agreement is subject to the requirements of the DoD Grant and Agreement Regulations (32 CFR Parts 21 – 37) as these requirements are incorporated as part of this Agreement. The following references indicate the Government's decision on specific issues. These Narratives are also incorporated as part of this Agreement.

**32 CFR 22.815 and 32 CFR 34.53. Claims, Disputes and Appeals**

The Government and Recipient will employ Alternative Dispute Resolution to resolve issues which arise during the performance of the Agreement. The Government and Recipient recognize that disputes arising under this Agreement are best resolved at the local working level by the Parties directly involved. All Parties are encouraged to be imaginative in designing mechanisms and procedures to resolve disputes at this level. Any dispute arising under the Agreement, which is not disposed of by agreement of the Parties at the working level shall be submitted jointly to the Grants Officer and a senior manager of the Recipient or their designee(s) for resolution (see section 815(c)(2)). The Grant Appeal Authority is the Director of ARL (see section 815(e)(2)). Pending the resolution of any dispute or claim pursuant to this Article, the Parties agree that performance of all obligations shall be pursued diligently in accordance with the Agreement.

**32 CFR 34.1(b)(2)(ii) Sub-Awards**

For-profit organizations that receive prime awards covered by this part shall apply to each sub-award the administrative requirements that are applicable to the particular type of subrecipient (see 32 CFR parts 32 and 34)

**32 CFR 34.11 Standards for Financial Management Systems**

The Government does not guarantee or insure the repayment of money borrowed by the Recipient (see section 11(b)). Fidelity bond coverage is not required (see section 11(c)).

**32 CFR 34.12 Payment**

This Agreement will employ the reimbursement method of payment (see 32 CFR 34.12(a)(1)). This Agreement does not provide for advance payments (see section 12(a)(2)). See Article 5 – Fiscal Management for specifics concerning the payment process.

**32 CFR 34.13 Cost Sharing or Matching**

This provision is applicable only if cost sharing or matching is included in the Recipient's proposal and the subsequent award document. Should cost sharing or matching be included, the Parties to this Agreement will mutually agree to its allowability, valuation and necessary documentation.

**32 CFR 34.14 Program Income**

Should this Agreement result in the generation of program income, the Recipient shall account for said funds, add them to the funds committed to the project, and they shall be used to further the program objectives. The Recipient shall have no obligation to the Government for program income earned after the expiration of the program. Costs incident to the generation of program income may be deducted from gross income to determine program income, provided these costs have not been charged to the award document.

**32 CFR 34.15 Revision of Budget and Program Plans**

See Article 6 of this Agreement.

**32 CFR 34.16 Audit**

Any Recipient that expends \$500,000.00 or more in a year under Federal awards shall have an audit made for that year (reference 32 CFR 34.16). The Recipient is required to submit audit reports to the Grants Officer (see Article 8.2), the Agreement Administrator (See article 8.2) and the DCAA office listed below. Audits that do not meet the requirements, must address the issues and resolve them prior to additional funding being obligated to this Agreement.

DCAA New Jersey Branch Office  
10 Melrose Avenue, Suite 200  
Cherry Hill, NJ 08003-3647  
Telephone: 856-354-7550  
Email: [dcaa-fao1341@dcaa.mil](mailto:dcaa-fao1341@dcaa.mil)

#### 32 CFR 34.17 Allowable Costs

The For-Profit costs principles in 48 CFR parts 31 and 231 (Federal Acquisition Regulation and Defense Acquisition Regulations Supplement) as well as the supplemental information on allowability of audit costs in the 32 CFR 34.16(f) are applicable.

#### 32 CFR 34.18 Fee and Profit

This Agreement does not provide for the payment of fee or profit to the recipient or subrecipients.

#### 32 CFR 34.20 through 34.25 Property Standards

Sections 34.21 through 34.25 set forth uniform standards for management, use, and disposition of property. DoD Components shall encourage recipients to use existing property-management systems, to the extent that the systems meet these minimum requirements.

#### 32 CFR 34.30 through 34.31 Procurement Standards

Section 34.31 sets forth requirements necessary to ensure: (a) Compliance of recipients' procurements that use Federal funds with applicable Federal statutes and executive orders. (b) Proper stewardship of Federal funds used in recipients' procurements.

#### 32 CFR 34.41 Monitoring and Reporting Program and Financial Performance

See Attachment 4 of this Agreement.

#### 32 CFR 34.42 Retention and Access Requirements for Records.

Reference DoDGARs website <http://www.dtic.mil/whs/directives/corres/html/321006r.htm> Part 34

#### 32 CFR 34.50 through 34.52 Termination and Enforcement

Reference DoDGARs website <http://www.dtic.mil/whs/directives/corres/html/321006r.htm> Part 34

#### 32 CFR 34.61 through 34.63 After-the-Award Requirements

Reference DoDGARs website <http://www.dtic.mil/whs/directives/corres/html/321006r.htm> Part 34

#### Appendix A to Part 34 – Contract Provisions

All contracts awarded by the Recipient, including those for amounts less than the simplified acquisition threshold, shall contain the following provisions as applicable:

1. Equal Employment Opportunity E.O. 11246 (3 CFR, 1964-1965 Comp., p. 339), "Equal Employment Opportunity," as amended by E.O. 11375 (3 CFR, 1966-1970 Comp., p. 684), "Amending Executive Order 11246 Relating to Equal Employment Opportunity," and as supplemented by regulations at 41 CFR chapter 60, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor
2. Copeland "Anti-Kickback" Act (18 U.S.C. 874 and 40 U.S.C. 276c)
3. Contract Work Hours and Safety Standards Act (40 U.S.C. 327-333)
4. Rights to Inventions Made Under a Contract, Grant, or Cooperative Agreement (37 CFR Part 401)
5. Clean Air Act (42 U.S.C. 7401 et seq.) and the Federal Water Pollution Control Act (33 U.S.C. 1251 et. seq.)
6. Byrd Anti-Lobbying Amendment (31 U.S.C. 1352)
7. Debarment and Suspension (E.O.s 12549 and 12689)

## ATTACHMENT 2 National Policy Requirements

By signing this Agreement or accepting funds under this Agreement, the recipient assures that it will comply with applicable provisions of the national policies on the following topics:

### 1. NONDISCRIMINATION.

- a. On the basis of race, color, or national origin, in Title VI of the Civil Rights Act of 1964 (42 U.S.C. 2000d, et seq.), as implemented by DoD regulations at 32 CFR part 195.
- b. On the basis of sex or blindness, in Title IX of the Education Amendments of 1972 (20 U.S.C. 1681, et seq.) (Applicable to Educational Institutions only)
- c. On the basis of age, in the Age Discrimination Act of 1975 (42 U.S.C. 6101, et seq.), as implemented by Department of Health and Human Services regulations at 45 CFR part 90.
- d. On the basis of handicap, in Section 504 of the Rehabilitation Act of 1973 (29 U.S.C. 794), as implemented by Department of Justice regulations at 28 CFR part 41 and DoD regulations at 32 CFR part 56.

### 2. LIVE ORGANISMS.

(a) *For human subjects*, the Common Federal Policy for the Protection of Human Subjects, codified by the Department of Health and Human Services at 45 CFR part 46 and implemented by the Department of Defense at 32 CFR part 219.

(b) *For animals*:

- a. (*Research, experimentation or testing involving the use of animals*) Rules on animal acquisition, transport, care, handling, and use in 9 CFR parts 1-4, Department of Agriculture rules implementing the Laboratory Animal Welfare Act of 1966 (7 U.S.C. 2141-2156), and guidelines in the National Academy of Sciences (NAS) "Guide for the Care and Use of Laboratory Animals" (1996), including the Public Health Service Policy and Government Principles Regarding the Care and Use of Animals in Appendix D to the guide.
- b. (*DoD appropriations for training on treatment of wounds*) Prohibitions on the purchase or use of dogs or cats for certain medical training purposes, in Section 8019 (10 U.S.C 2241 note) of the Department of Defense Appropriations Act, 1991 (Pub. Law 101-511)
- c. (*Activities that may involve or impact wildlife and plants*) Rules of the Departments of Interior (50 CFR parts 10-24) and Commerce (50 CFR parts 217-227) implementing the laws and conventions on the taking, possession, transport, purchase, sale, export, or import of wildlife and plants, including the: Endangered Species Act of 1973 (16 U.S.C. 1531-1543); Marine Mammal Protection Act (16 U.S.C. 1361-1384); Lacey Act (18 U.S.C. 42) and Convention on International Trade in Endangered Species of Wild Fauna and Flora.

3. **DEBARMENT AND SUSPENSION:** The Recipient agrees to comply with the requirements regarding debarment and suspension in Subpart C of the OMB guidance in 2 CFR part 180, as implemented by the Department of Defense in 2 CFR part 1125. The Recipient also agrees to communicate the requirement to comply with Subpart C to the persons at the next lower tier with whom the recipient enters into transactions that are "covered transactions" under Subpart B of 2 CFR part 180 and the DoD implantation in 2 CFR part 1125.

### 4. ENVIRONMENTAL STANDARDS.

- a. Comply with the applicable provisions of the Clean Air Act (42 U.S.C. 7401, et. Seq.) and Clean Water Act (33 U.S.C. 1251, et. seq.), as implemented by Executive Order 11783 [3 CFR, 1971-1075 Comp., p. 799] and Environmental Protection Agency (EPA) rules at Subpart J of 40 CFR part 32.
- b. Identify to the awarding agency any impact this award may have on:
  1. The quality of the human environment, and provide help the agency may need to comply with the National Environmental Policy Act (NEPA, at 42 U.S.C. 4231, et. seq.) and to prepare Environmental Impact Statements or other required environmental documentation. In such cases, the recipient agrees to take no action that will have an adverse environmental impact (e.g., physical disturbance of a site such as breaking of ground) until the agency provides written notification of compliance with the environmental impact analysis process.
  2. (*Awards that may affect the coastal zone*) Coastal zones, and provide help the agency may need to comply with the Coastal Zone Management Act of 1972 (16 U.S.C 1451, et. Seq.), concerning the protection of U.S. coastal resources.

3. *(Awards that may affect barriers along the Atlantic and Gulf coasts and Great Lakes shores)* Coastal barriers, and provide help the agency may need to comply with the Coastal Barriers Resource Act (16 U.S.C. 3501, et. Seq.), concerning preservation of barrier resources.

4. *(Awards that may affect existing or proposed elements of the National Wild and Scenic Rivers system)* Any existing or proposed component of the National Wild and Scenic Rivers system, and provide help the agency may need to comply with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. 1271, et. Seq)

5. DRUG FREE WORKPLACE – The recipient agrees to comply with the requirements regarding drug-free workplace requirements in Subpart B (or Subpart C, if the recipient is an individual) of 32 CFR part 26, which implements sec. 5151-5160 of the Drug-Free Workplace Act of 1988 (Pub Law 100-690, Title V, Subtitle D; 41 U.S.C. 701, et. Seq)

6. OFFICIALS NOT TO BENEFIT. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this Agreement or to any benefit arising from it, in accordance with 41 U.S.C. 22.

7. PREFERENCE FOR U.S. FLAG CARRIERS. Travel supported by U.S. Government funds under this Agreement shall use U.S. -flag air carriers (air carriers holding certificates under 49 USC 41102) for international air transportation of people and property to the extent that such service is available, in accordance with the International Air Transportation Fair Competitive Practices Act of 1974 (49 USC 40118) and the interpretative guidelines issued by the Comptroller General of the United States in the March 31, 1981, amendment to the Comptroller General Decision B138942.

8. CARGO PREFERENCE. The recipient agrees that it will comply with the Cargo Preference Act of 1954 (46 U.S.C. 1241), as implemented by Department of Transportation regulations at 46 CFR 381.7, which require that at least 50 percent of equipment, materials or commodities procured or otherwise obtained with U.S. Government funds under this Agreement, and which may be transported by ocean vessel, shall be transported on privately owned U.S.-flag commercial vessels, if available.

9. Trafficking Victims Protection Act of 2000 as amended (22 U.S.C. 7104)

Trafficking in Persons - By signing or accepting funds under the agreement, the recipient agrees that it will comply with Trafficking Victims Protection Act of 2000 (22 U.S.C. 7104(g)) as implemented by 2 CFR 175

175.15 - Award term.

(a) To implement the trafficking in persons requirement in section 106(g) of the TVPA, as amended, a Federal awarding agency must include the award term in paragraph (b) of this section in—

(1) A grant or cooperative agreement to a private entity, as defined in § 175.25(d); and

(2) A grant or cooperative agreement to a State, local government, Indian tribe or foreign public entity, if funding could be provided under the award to a private entity as a subrecipient.

(b) The award term that an agency must include, as described in paragraph (a) of this section, is:

I. Trafficking in persons.

a. Provisions applicable to a recipient that is a private entity.

1. You as the recipient, your employees, subrecipients under this award, and subrecipients' employees may not—

i. Engage in severe forms of trafficking in persons during the period of time that the award is in effect;

ii. Procure a commercial sex act during the period of time that the award is in effect; or

iii. Use forced labor in the performance of the award or subawards under the award.

2. We as the Federal awarding agency may unilaterally terminate this award, without penalty, if you or a subrecipient that is a private entity —

i. Is determined to have violated a prohibition in paragraph a.1 of this award term; or

ii. Has an employee who is determined by the agency official authorized to terminate the award to have violated a prohibition in paragraph a.1 of this award term through conduct that is either—

A. Associated with performance under this award; or

B. Imputed to you or the subrecipient using the standards and due process for imputing the conduct of an individual to an organization that are provided in 2 CFR part 180, “OMB Guidelines to Agencies on Governmentwide Debarment and Suspension (Nonprocurement),” as implemented by our agency at [agency must insert reference here to its regulatory implementation of the OMB guidelines in 2 CFR part 180 (e.g., “2 CFR part XX”)].

b. Provision applicable to a recipient other than a private entity. We as the Federal awarding agency may unilaterally terminate this award, without penalty, if a subrecipient that is a private entity—

1. Is determined to have violated an applicable prohibition in paragraph a.1 of this award term; or

2. Has an employee who is determined by the agency official authorized to terminate the award to have violated an applicable prohibition in paragraph a.1 of this award term through conduct that is either—

i. Associated with performance under this award; or

ii. Imputed to the subrecipient using the standards and due process for imputing the conduct of an individual to an organization that are provided in 2 CFR part 180, “OMB Guidelines to Agencies on Governmentwide Debarment and Suspension (Nonprocurement),” as implemented by our agency at [agency must insert reference here to its regulatory implementation of the OMB guidelines in 2 CFR part 180 (e.g., “2 CFR part XX”)].

c. Provisions applicable to any recipient.

1. You must inform us immediately of any information you receive from any source alleging a violation of a prohibition in paragraph a.1 of this award term.

2. Our right to terminate unilaterally that is described in paragraph a.2 or b of this section:

i. Implements section 106(g) of the Trafficking Victims Protection Act of 2000 (TVPA), as amended (22 U.S.C. 7104(g)), and

ii. Is in addition to all other remedies for noncompliance that are available to us under this award.

3. You must include the requirements of paragraph a.1 of this award term in any subaward you make to a private entity.

d. Definitions. For purposes of this award term:

1. “Employee” means either:

i. An individual employed by you or a subrecipient who is engaged in the performance of the project or program under this award; or

ii. Another person engaged in the performance of the project or program under this award and not compensated by you including, but not limited to, a volunteer or individual whose services are contributed by a third party as an in-kind contribution toward cost sharing or matching requirements.

2. "Forced labor" means labor obtained by any of the following methods: the recruitment, harboring, transportation, provision, or obtaining of a person for labor or services, through the use of force, fraud, or coercion for the purpose of subjection to involuntary servitude, peonage, debt bondage, or slavery.

3. "Private entity":

i. Means any entity other than a State, local government, Indian tribe, or foreign public entity, as those terms are defined in 2 CFR 175.25.

ii. Includes:

A. A nonprofit organization, including any nonprofit institution of higher education, hospital, or tribal organization other than one included in the definition of Indian tribe at 2 CFR 175.25(b).

B. A for-profit organization.

4. "Severe forms of trafficking in persons," "commercial sex act," and "coercion" have the meanings given at section 103 of the TVPA, as amended (22 U.S.C. 7102).

(c) An agency may use different letters and numbers to designate the paragraphs of the award term in paragraph (b) of this section, if necessary, to conform the system of paragraph designations with the one used in other terms and conditions in the agency's awards.

**ATTACHMENT 3**  
**Other Certifications**

The following Certifications, which have been executed by the Recipient prior to award of this Agreement are on file with the issuing office, and are hereby incorporated herein by reference:

- a. Certification at Appendix A to 32 CFR Part 28 Regarding Lobbying



**ATTACHMENT 4**  
**Reporting Requirements**

**A. QUARTERLY REPORT**

Throughout the term of the Agreement, the Recipient shall submit or otherwise provide a quarterly report (government fiscal quarter). Two (2) copies shall be submitted or otherwise provided to the CAM, and one (1) copy shall be submitted or otherwise provided to the Agreements Administration Office. A copy of the letter of transmittal shall be submitted or otherwise provided to the Agreements Office. The report shall contain two (2) major sections:

1. **Technical Status Report.** The technical status report will detail technical progress to date on research milestones, all problems, technical issues or major developments during the reporting period. The technical status report will include a report on the status of the collaborative activities during the reporting period. The technical status report will include the utilization of subject inventions by the Recipient. Submit Form DD882 for each invention to the Grants Officer and CAM and submit Form DD882 with "NONE" if none have been made at the end of the Agreement.
2. **Business Status Report.** The business status report will provide summarized details of the resource status of this Agreement, including the status of contributions by the Recipient. This report should compare the resource status with any payment and expenditure schedules or plans provided in the original Agreement. Any major deviations shall be explained along with discussion of adjustment actions proposed.

**B. JOINT PAPERS AND PRESENTATIONS:**

When determined necessary by the CAM periodic joint papers and presentations will be given.

**C. JOURNAL ARTICLES**

Journal articles in general and joint ARL/Recipient journal articles are strongly encouraged as a major reporting mechanism of this research effort.

**D. ANNUAL AND FINAL REPORTS**

1. The Recipient shall submit an Annual Report making full disclosure of all major technical developments and progress for the preceding 12 months of effort within sixty (60) calendar days of completion of the effort and for each additional 12 months of effort, through the life of this Agreement. The report will also provide an accounting of all Federal funds expended during the term of the Agreement. With the approval of the Cooperative Agreement Manager, reprints of published articles may be attached to the Final Report.

The Recipient shall make distribution of the Final report as follows:

Cooperative Agreement Manager - 1 original plus 1 copy;

Agreement Administration Office - 1 copy, and the

Grants Officer - 1 copy of the letter of transmittal only.

One (1) copy of the Final Report shall be provided to:

Defense Technical Information Center (DTIC)

8725 John J. Kingman Road, Suite 0944

Ft. Belvoir, VA 22060-6218.

**E. FINANCIAL REPORTING: Federal Financial Report (SF 425): Annual and Final Reports**

1. Reporting period end dates fall on the end of the calendar year for annual reports (12/31) and the end date of the grant project or period for the final report. Annual reports are due 30 days after the reporting period end date, and the final report is due 90 days after the end date of the grant.

All financial reports shall be submitted to the Grant Administration Office identified in Block 6 of the SF 26. Copies of the forms and instructions may be found on the Internet at <http://www.aro.army.mil/forms/forms2.htm>.

The Recipient shall make distribution of the Annual and Final (SF425) Reports as follows:

- Cooperative Agreement Manager - 1 original plus 1 copy;
- Agreement Administration Office - 1 copy, and

Note: The SF 425 is a single form that consolidates and replaces the Federal Cash Transaction Report (FACTOR or SF 272/SF 272A) and the Financial Status Report (FSR or SF 269/SF 269A).

## F. FEDERAL FUNDING ACCOUNTABILITY AND TRANSPARENCY ACT (FFATA) REPORTING

### Appendix A to Part 170 - Award Term

#### I. Reporting Subawards and Executive Compensation.

##### A. Reporting of first-tier subawards.

1. Applicability. Unless you are exempt as provided in paragraph d. of this award term, you must report each action that obligates \$25,000 or more in Federal funds that does not include Recovery funds (as defined in section 1512(a)(2) of the American Recovery and Reinvestment Act of 2009, Pub. L. 111-5) for a subaward to an entity (see definitions in paragraph e of this award term).

2. Where and when to report.

- i. You must report each obligating action described in paragraph a.1. of this award term to [www.frs.gov](http://www.frs.gov).
- ii. For subaward information, report no later than the end of the month following the month in which the obligation was made. (For example, if the obligation was made on November 7, 2010, the obligation must be reported by no later than December 31, 2010.)

3. What to report. You must report the information about each obligating action that the submission instructions posted at [www.frs.gov](http://www.frs.gov) specify.

##### B. Reporting Total Compensation of Recipient Executives.

1. Applicability and what to report. You must report total compensation for each of your five most highly compensated executives for the preceding completed fiscal year, if—

- i. The total Federal funding authorized to date under this award is \$25,000 or more;
- ii. In the preceding fiscal year, you received—
  - (a) 80 percent or more of your annual gross revenues from Federal procurement contracts (and subcontracts) and Federal financial assistance subject to the Transparency Act, as defined at 2 CFR 170.320 (and subawards); and
  - (b) \$25,000,000 or more in annual gross revenues from Federal procurement contracts (and subcontracts) and Federal financial assistance subject to the Transparency Act, as defined at 2 CFR 170.320 (and subawards); and
- iii. The public does not have access to information about the compensation of the executives through periodic reports filed under section 13(a) or 15(d) of the Securities Exchange Act of 1934 (15 U.S.C. 78m(a), 78o(d)) or section 6104 of the Internal Revenue Code of 1986. (To determine if the public has access to the compensation information, see the U.S. Security and Exchange Commission total compensation filings at <http://www.sec.gov/answers/excomp.htm>.)

2. Where and when to report. You must report executive total compensation described in paragraph b.1. of this award term:

- i. As part of your registration profile at [www.ccr.gov](http://www.ccr.gov).

ii. By the end of the month following the month in which this award is made, and annually thereafter.

C. Reporting of Total Compensation of Subrecipient Executives.

1. Applicability and what to report. Unless you are exempt as provided in paragraph D. of this award term, for each first-tier subrecipient under this award, you shall report the names and total compensation of each of the subrecipient's five most highly compensated executives for the subrecipient's preceding completed fiscal year, if -

i. In the subrecipient's preceding fiscal year, the subrecipient received -

(a) 80 percent or more of its annual gross revenues from Federal procurement contracts (and subcontracts) and Federal financial assistance subject to the Transparency Act, as defined at 2 CFR 170.320 (and subawards); and

(b) \$25,000,000 or more in annual gross revenues from Federal procurement contracts (and subcontracts), and Federal financial assistance subject to the Transparency Act (and subawards); and

ii. The public does not have access to information about the compensation of the executives through periodic reports filed under section 13(a) or 15(d) of the Securities Exchange Act of 1934 (15 U.S.C. 78m(a), 78o(d)) or section 6104 of the Internal Revenue Code of 1986. (To determine if the public has access to the compensation information,

see the U.S. Security and Exchange Commission total compensation filings at

<http://www.sec.gov/answers/execomp.htm>.)

2. Where and when to report. You must report subrecipient executive total compensation described in paragraph C.1. of this award term:

i. To the recipient.

ii. By the end of the month following the month during which you make the subaward. For example, if a subaward is obligated on any date during the month of October of a given year (i.e., between October 1 and 31), you must

report any required compensation information of the subrecipient by November 30 of that year.

D. Exemptions.

1. If, in the previous tax year, you had gross income, from all sources, under \$300,000, you are exempt from the requirements to report:

i. subawards, and

ii. The total compensation of the five most highly compensated executives of any subrecipient.

E. Definitions. For purposes of this award term:

1. Entity means all of the following, as defined in 2 CFR part 25:

i. A Governmental organization, which is a State, local government, or Indian tribe;

ii. A foreign public entity;

iii. A domestic or foreign nonprofit organization;

iv. A domestic or foreign for-profit organization;

v. A Federal agency, but only as a subrecipient under an award or subaward to a non-Federal entity.

2. Executive means officers, managing partners, or any other employees in management positions.

3. Subaward:

i. This term means a legal instrument to provide support for the performance of any portion of the substantive project or program for which you received this award and that you as the recipient award to an eligible subrecipient.

ii. The term does not include your procurement of property and services needed to carry out the project or program (for further explanation, see Sec. --.210 of the attachment to OMB Circular A-133, "Audits of States, Local Governments, and Non-Profit Organizations").

iii. A subaward may be provided through any legal agreement, including an agreement that you or a subrecipient considers a contract.

4. Subrecipient means an entity that:

- i. Receives a subaward from you (the recipient) under this award; and
- ii. Is accountable to you for the use of the Federal funds provided by the subaward.

5. Total compensation means the cash and noncash dollar value earned by the executive during the recipient's or subrecipient's preceding fiscal year and includes the following (for more information see 17 CFR 229.402(c)(2)):

- i. Salary and bonus.
- ii. Awards of stock, stock options, and stock appreciation rights. Use the dollar amount recognized for financial statement reporting purposes with respect to the fiscal year in accordance with the Statement of Financial Accounting Standards No. 123 (Revised 2004) (FAS 123R), Shared Based Payments.
- iii. Earnings for services under nonequity incentive plans. This does not include group life, health, hospitalization or medical reimbursement plans that do not discriminate in favor of executives, and are available generally to all salaried employees.
- iii. Earnings for services under non-equity incentive plans. This does not include group life, health, hospitalization or medical reimbursement plans that do not discriminate in favor of executives, and are available generally to all salaried employees.
- iv. Change in pension value. This is the change in present value of defined benefit and actuarial pension plans.
- v. Above market earnings on deferred compensation which is not tax-qualified.
- vi. Other compensation, if the aggregate value of all such other compensation (e.g. severance, termination payments, value of life insurance paid on behalf of the employee, prerequisites or property) for the executive exceeds \$10,000.00.

**ATTACHMENT 5**  
**Program Plan and Budget**

**Task 1.1 – Engineering Design of Cooling Concept for a single POL Device**

- Description –
  - Perform conjugate heat transfer CFD analysis of a combined POL circuit board and attached or enclosed liquid cooling concept to identify arrangements of surface features, turbulators, microjets, and other heat transfer enhancement geometry that enables superior thermal performance for a single POL device.
  - Perform mechanical analysis on the most promising designs to assess structural integrity and confirm options for assembly sealing.
  - This work will be done in conjunction with NREL efforts to support thermo-mechanical modeling.
  - This work will also be done in conjunction with ARL using its Para Power code for design optimization.
- Deliverable –
  - CAD file for initial cooling concept design(s).
  - Initial estimates of expected thermal performance enabled by cooling concept design(s).
  - Design calculations confirming mechanical integrity of proposed solution

**Task 1.2 – Additive Manufacturing of Cooling Concept for a single POL Device**

- Description –
  - Translate CAD design identified in Task 1.1 to a structure that can be used in Task 1.3 to demonstrate base thermal capability of proposed cooling concept (s). This task will include an assessment of mechanical integrity, confirmation of assembly sealing, and design of flow connections to an external liquid cooling circuit.
  - Perform simple bench tests on additive manufacturing parts to confirm basic assembly and flow integrity of design.
  - Modify and refine design as needed to address mechanical and flow issues as they arise
- Deliverable –
  - Additive manufactured cooling test part that will connect to a single POL device and available hydraulic test circuit

**Task 1.3 – Experimental Confirmation of Cooling Concept for a single POL Device**

- Description –
  - Measure die temperatures, heat transfer rates, coolant flow rates, and coolant pressure drops for single POL device fitted with cooling concept from Task 1.2
  - This work could be done in conjunction with NREL efforts and test facilities.
- Deliverable –
  - Experimental data showing thermal performance of cooling concept

**POL packaging**

**Task 2.1 – Engineering Design of single POL Device for thermal integration**

- Description –
  - Perform electrical analysis of 1up POL building block structure for integration into thermal housing.
  - Identify electrical routing/interconnect schemes for optimum electrical Performance to “housing” integration, such as feed throughs and bus bars.
  - Identify POL material sets that are compatible with thermal integration solution, such as alternate solders for DBC attach, and protective overcoating for immersive cooling.
- Deliverable –
  - CAD file for POL modular building block design(s).
  - Report on selected POL design approach(s)

- Initial estimates of expected electrical performance when assembled into thermal “housing”.

#### **Task 2.2 –Prototype of POL 1up module and materials down select**

- Description –
  - From Task 2.1, gather suggested materials and conduct short loop experiments to verify material compatibility for thermal integration.
  - Fabricate POL type samples and apply protective coating to verify compatibility with cooling fluid, both electrically and chemically.
  - Fabricate and assemble electrical interconnect/feed through concepts to validate design assumptions.
  - In conjunction with Task 1.2, Perform simple bench tests to confirm basic assembly and integrity of design.
  - In conjunction with ARL, show how this scheme is compatible with ARL’s multi-layer power tower concept.
- Deliverable –
  - Report on down selected material sets and findings
  - Finalized design concept, drawings and material sets identified

#### **Task 2.3 – POL 1up module fabrication**

- Description –
  - From the out puts of Task 2.1 and 2.2 and using existing POL modules from GEAS, assemble at least (3) 1up POL modules for integration into the thermal “housing”.
    - Apply down selected coatings/material sets to these parts for integration.
    - Attach/assemble electrical feed throughs/interconnects for thermal integration.
- Deliverable –
  - GE Aviation to provide at least (3) 1up POL modules to GE Research Center for thermal integration, testing and analysis. Resultant data to be shared with ARL.

#### **Task 2.4– POL 1up module integration**

- Description –
  - Using the POL fabricated in 2.3, support the integration of POL module into thermal “housing” for final validation and test.
- Deliverable –
  - GE Aviation to provide assembled 1 up POL module for thermal testing at GE Aviation/GE Research Center or ARL. Resultant data to be shared with ARL.

#### **Heat Dissipation and Transient Thermal Mitigation Design**

GE will design and develop a module package in collaboration with ARL that combines GE’s POL based SiC MOSFET Switch assembly with ARL’s Power Tower concept. In this design, coolant with high voltage insulating properties would be flowed onto or across the POL and substrate for direct impingement cooling.

ARL will leverage its experience and expertise in phase change materials (PCMs) research and incorporate these into the final package for transient thermal mitigation. ARL will explore both metallic and organic PCM options.

Deliverables: GE will provide POL SiC MOSFET switch assemblies to ARL to which ARL will apply thermal energy storage techniques (i.e. using PCMs) for further testing and evaluation (ARL will perform testing similar to those performed on ARL-designed devices and packaging).

#### **System Optimization**

A low inductance DC Link Busbar will be designed and low equivalent series resistance (ESR) capacitors will be selected to evaluate the performance of the module.

**NREL Tasks**

**1.1 Thermal Modeling**

NREL will perform thermal modeling of the power module configurations (including heat exchanger) to compute the junction-to-coolant thermal resistance for the different configurations of interest. Both transient and steady-state modeling will be performed. These configurations could involve differences in device structure, packaging materials, layers and interfaces, the heat exchanger design, as well as the coolant and cooling technique used. Single-phase liquid cooling using water-ethylene glycol (WEG) will be considered as the default coolant and cooling configuration to be used, but other coolants and techniques will also be considered. Both finite element modeling as well as computational fluid dynamics modeling will be performed. These modeling results will be utilized to make go/no-go decisions on whether to proceed to experimental fabrication and characterization of the power modules with specific package configurations and heat exchanger designs for module cooling.

*Milestone (Task 1.1):* Quantify via modeling the thermal performance of the various passive stack and cooling technologies/heat exchanger configurations.

**1.2 Thermomechanical Modeling**

For the power module/package design(s), thermomechanical modeling will be performed to predict the stress, strain and strain energy density in various layers of interest within the package – in particular for the planar electrical interconnects and bonded interface materials. These parameters (stress, strain energy density) can often be indicators of the reliability of the package, and hence serve a useful purpose in package/power module design. In this task, numerous package designs and parameters will be investigated, and the impact on thermomechanical behavior for these various designs will be quantified.

*Milestone (Task 1.2):* Quantify via modeling the thermomechanical behavior of various power module configurations, and behavior of different elements within the power module.

**Program Plan Budget**

| Cost Element                   | Program Plan  | Total         |
|--------------------------------|---------------|---------------|
| <b>Labor</b>                   | \$ [REDACTED] | \$ [REDACTED] |
| Labor                          | \$ [REDACTED] | \$ [REDACTED] |
| <b>Other Direct Totals</b>     | \$ [REDACTED] | \$ [REDACTED] |
| Subawards                      | \$ [REDACTED] | \$ [REDACTED] |
| Other                          | \$ [REDACTED] | \$ [REDACTED] |
| <b>Total Direct</b>            | \$ [REDACTED] | \$ [REDACTED] |
| <b>Indirect Total</b>          | \$ [REDACTED] | \$ [REDACTED] |
| Material Overhead              | \$ [REDACTED] | \$ [REDACTED] |
| Engineer Overhead              | \$ [REDACTED] | \$ [REDACTED] |
| Product Support Cost (PSC)     | \$ [REDACTED] | \$ [REDACTED] |
| Product Service Military (PMS) | \$ [REDACTED] | \$ [REDACTED] |
| Group Government Factor (GGF)  | \$ [REDACTED] | \$ [REDACTED] |
| G&A                            | \$ [REDACTED] | \$ [REDACTED] |
| FCCM                           | \$ [REDACTED] | \$ [REDACTED] |
| <b>Total</b>                   | \$ [REDACTED] | \$ [REDACTED] |

**ATTACHMENT 6 Intellectual Property Rights Assertion**

| Technical Data furnished with Restrictions                                | Corresponding Item, Component, or Process  | Asserted Rights Category | Basis for Assertion   |
|---|--|--------------------------|---|
| Performance Data Reports and details below the Interface Control Drawing  | <ol style="list-style-type: none"> <li>1. Test Data and Performance for modules as in GE report numbered: 4V1-TRPOARL01</li> <li>2. Sub-Assembly components:               <ol style="list-style-type: none"> <li>a) 9D7479G1 – POL Assembly with Direct Bonded Copper (DBC).</li> <li>b) 9D7311G1 – Current 8up POL</li> <li>c) GE1209003 – GE MOSFET Part Number</li> <li>d) 9C7214 – Resistor Part Number</li> <li>e) 9C7291 – Shim Part Number</li> <li>f) 9C7243 – Shim Part Number</li> <li>g) 9C7242 – Shim Part Number</li> <li>h) GE12N45- GE MOSFET P/N</li> <li>i) 9D7226G1 – GEN 1 6 UP POL</li> <li>j) 9D7292G1 – GEN 1 8 UP POL</li> </ol> </li> </ol> | Limited Rights           | Funded Exclusively at Private Expense Under IR&D at GE Aviation Systems and the GE Global Research Center |
| Internal Construction Details or Computer Aided Drafting (CAD) models     | GEAS to provide to its sub-contractors (NREL) on this cooperative agreement Internal Construction Details and/or Computer Aided Drafting (CAD) models.   | Limited Rights           | Funded Exclusively at Private Expense Under IR&D at GE Aviation Systems and the GE Global Research Center |
| Cold Plate with Integrated Thermal Management Features - GE Docket 327920 | Thermal Management Design Data as provided in GE Report 4V1-TRPOARL01  | Limited Rights           | Developed exclusively at private expense by the GE Global Research Center                                 |

\*“Limited Rights” are defined in accordance with the Department of Defense FAR Supplement (DFARS) Clause at 252.227-7013 entitled “Rights in Technical Data – Noncommercial Items (Sep. 2011.)”

\*\*\*Due to system error, please disregard FAR 252.232-7007, Limitation of Government's Obligation, as it is not applicable to assistance awards. \*\*\*

\*\*\*Due to system error, please disregard FAR 52.232-18, Availability of Funds, as it is not applicable to assistance awards. \*\*\*

\*\*\*Due to system error, please disregard FAR 52.232-19, Availability of Funds for the Next Fiscal Year, as it is not applicable to assistance awards. \*\*\*

\*\*\*Due to system error, please disregard FAR 52.232-22, Limitation of Funds, as it is not applicable to assistance awards. \*\*\*



Section B - Supplies or Services and Prices

| ITEM NO | SUPPLIES/SERVICES   | QUANTITY | UNIT | UNIT PRICE     | AMOUNT        |
|---------|---|----------|------|----------------|---------------|
| 0001    | New Cooperative Agreement<br>New Cooperative Agreement ICO GE Aviation Systems titled: "Silicon Carbide Advanced Packaging of Power Semiconductors II"<br>FOB: Destination<br>PURCHASE REQUEST NUMBER: 0011164565<br>PSC CD: AZ11 | 1        | Lot  | \$ [REDACTED]  | \$ [REDACTED] |
|         |   |          |      | ESTIMATED COST | \$ [REDACTED] |

| ITEM NO | SUPPLIES/SERVICES   | QUANTITY | UNIT | UNIT PRICE     | AMOUNT |
|---------|---|----------|------|----------------|--------|
| 000101  | New Cooperative Agreement<br>New Cooperative Agreement ICO GE Aviation Systems titled: "Silicon Carbide Advanced Packaging of Power Semiconductors II"<br>PURCHASE REQUEST NUMBER: 0011164565 |          |      |                | \$0.00 |
|         | ACRN AA<br>CIN: GFEB001116456500001   |          |      | ESTIMATED COST | \$0.00 |

Section E - Inspection and Acceptance

INSPECTION AND ACCEPTANCE TERMS

Supplies/services will be inspected/accepted at:

| CLIN   | INSPECT AT  | INSPECT BY | ACCEPT AT   | ACCEPT BY  |
|--------|-------------|------------|-------------|------------|
| 0001   | Destination | Government | Destination | Government |
| 000101 | N/A         | N/A        | N/A         | N/A        |

## Section F - Deliveries or Performance

## DELIVERY INFORMATION

| CLIN   | DELIVERY DATE                     | QUANTITY | SHIP TO ADDRESS   | DODAAC /<br>CAGE |
|--------|-----------------------------------|----------|---|------------------|
| 0001   | POP 27-SEP-2018 TO<br>26-SEP-2019 | N/A      | ADELPHI LAB. CENTER<br>ADELPHI LAB. CENTER<br>ADELPHI LAB. CENTER<br>6010 FRANKFORD STREET ATTN:RDER-<br>STN-CO<br>ADELPHI MD 21005<br>FOB: Destination | W71B7J           |
| 000101 | N/A                               | N/A      | N/A   | N/A              |

Section G - Contract Administration Data

ACCOUNTING AND APPROPRIATION DATA

AA: 02120172018204000006626222550040494976R.0025912.2 6100.9000021001  
COST CODE: A60FJ  
AMOUNT: \$ [REDACTED]

| ACRN | CLIN/SLIN | CIN                 | AMOUNT        |
|------|-----------|---------------------|---------------|
| AA   | 000101    | GFEB001116456500001 | \$ [REDACTED] |

Section I - Contract Clauses

CLAUSES INCORPORATED BY REFERENCE

|              |  |          |
|--------------|--|----------|
| 52.232-18    | Availability Of Funds                          | APR 1984 |
| 52.232-19    | Availability Of Funds For The Next Fiscal Year | APR 1984 |
| 52.232-22    | Limitation Of Funds                            | APR 1984 |
| 252.232-7007 | Limitation Of Government's Obligation          | APR 2014 |