AGREEMENT FOR PROFESSIONAL SERVICES

Project No. 200628

This AGREEMENT made and entered into this 1st day of September, 2021 by and between Carollo Engineers, Inc., (hereinafter "ENGINEER"), and **Los Angeles County Sanitation District (LACSD)** (hereinafter "SUBCONSULTANT").

WITNESSETH:

WHEREAS, the ENGINEER and the SUBCONSULTANT wish to enter into an Agreement (hereinafter "Agreement") for the furnishing of services in connection with the **Department of Energy (DOE)** (hereinafter "AGENCY"), **Transforming Aeration Energy in Water Resource Recovery Facilities (WRRFs) through Suboxic Nitrogen Removal** (hereinafter "Project"), and

WHEREAS, the SUBCONSULTANT possesses the qualifications to perform the necessary services for the ENGINEER in connection with the Project, and

NOW THEREFORE, in consideration of the mutual promises and covenants of the parties hereto, it is agreed as follows:

SECTION 1 - GENERAL

1.1 The services herein required, shall be set forth in the attached Task Order. In performance of these services, the SUBCONSULTANT shall provide qualified, and where required, licensed personnel. The Task Order shall include designation of a Project Manager and, if required by ENGINEER, a list of proposed personnel. The SUBCONSULTANT shall promptly notify the ENGINEER of any changes in his initial organization.

1.2 It is intended that each additional Task Order sequentially numbered setting forth the SUBCONSULTANT's Services, Time of Performance, and Payment, or any other conditions, shall become a supplement to and a part of this Agreement.

SECTION 2 - PAYMENT

2.1 Compensation for providing services referred to in Section 1 - shall be detailed in the attached Task Order.

2.2 Unless otherwise indicated, payments to SUBCONSULTANT shall be electronically deposited to the SUBCONSULTANT's designated bank account identified on the ACH/Direct Deposit Form attached hereto as Exhibit A. SUBCONSULTANT shall be responsible for completing and remitting the attached ACH/Direct Deposit Form upon execution of this Agreement and thereafter in the event of any changes to SUBCONSULTANT's receiving account information.

2.3 The SUBCONSULTANT shall submit invoices to the ENGINEER once per month. Invoices shall be prepared in such form and supported by documentation as the ENGINEER may reasonably require. All such invoices shall be reviewed and approved by the ENGINEER before submittal to the AGENCY and shall contain the ENGINEER's Progress Billing statement, attached to the Task Order.

2.4 Following receipt of reimbursement from the AGENCY, payment will be made to the SUBCONSULTANT within 15 days for the value of the partially completed services, less any amounts previously paid on account, less retainage, but only if required by the AGENCY.

2.5 Final payment of any balance will be made upon completion of the SUBCONSULTANT's services and acceptance by the AGENCY.

SECTION 3 - TIME OF PERFORMANCE

3.1 The Time of Performance under this Agreement shall be defined in the attached Task Order.

3.2 The SUBCONSULTANT shall report from time to time as requested by the ENGINEER, its progress under this Agreement. The SUBCONSULTANT shall plan its performance of services to accomplish its timely completion, and shall promptly notify the ENGINEER of any anticipated delay which may affect the SUBCONSULTANT's Time of Performance.

3.3 In the event the SUBCONSULTANT falls behind schedule for an unreasonable period of time for reasons within its control, the ENGINEER has the option to exercise any of the following:

a. Extend the SUBCONSULTANT's work day or work week.

b. Require additional qualified staff to be assigned to the Project.

c. Termination of Agreement.

3.4 The SUBCONSULTANT shall remain on accelerated schedule (Paragraphs a and b above), until such time as the ENGINEER determines the SUBCONSULTANT's progress conforms to Time of Performance requirements. All premium costs of the accelerated schedule shall be borne solely by the SUBCONSULTANT.

SECTION 4 - LEGAL RELATIONS

4.1 The SUBCONSULTANT is for all purposes an independent contractor. In no event shall the SUBCONSULTANT or any personnel retained by the SUBCONSULTANT be deemed to be an agent or employee of the ENGINEER or engaged by the AGENCY for the account of or on behalf of the ENGINEER. Full control of means and methods of work including provisions for required safety precautions shall be the responsibility of the SUBCONSULTANT. The SUBCONSULTANT will ensure that its employees and its subcontractors' employees observe and abide by the AGENCY's safety requirements and all safety regulations and laws, including, but not limited to, OSHA codes incident to the work while under contract to ENGINEER. The SUBCONSULTANT shall indemnify ENGINEER and AGENCY for any damages or costs incurred by ENGINEER and/or AGENCY for the SUBCONSULTANT's failure to fulfill this obligation.

4.2 The SUBCONSULTANT shall be responsible to the level of competency presently maintained by other practicing professional consultants performing the same or similar work in the state where the project is located.

4.3 The SUBCONSULTANT agrees to indemnify, hold harmless and defend the ENGINEER and the AGENCY, their principals, partners, officers, agents, and employees from and against all claims, loss, damage, attorney's fees, charge or expense to which they or any of them may be put or subjected to arising out of or caused in whole or in part by any negligent act or omission of the SUBCONSULTANT, or anyone directly or indirectly employed by the SUBCONSULTANT. In the event the subject action alleges negligence on the part of the SUBCONSULTANT and/or the ENGINEER, or any third parties not under contract with SUBCONSULTANT, SUBCONSULTANT's obligations regarding the ENGINEER's defense under this paragraph include only the reimbursement of the ENGINEER's reasonable defense costs incurred to the extent of SUBCONSULTANT's negligence as

expressly determined by a final judgment, arbitration, award, order, settlement, or other final resolution.

4.4 If the SUBCONSULTANT shall fail to complete the services as detailed in the attached Task Order, to the detriment of the ENGINEER, the SUBCONSULTANT shall reimburse the ENGINEER for any costs incurred by ENGINEER because of such default of the SUBCONSULTANT.

4.5 In the event of legal action brought by either party against the other to enforce any of the obligations hereunder or arising out of any dispute concerning the terms and conditions hereby created, the losing party shall pay the prevailing party such reasonable amount for fees, costs and expenses, including attorney's fees, as may be set by the court or the actual costs incurred by the prevailing party if the dispute does not reach final judgment.

4.6 The SUBCONSULTANT shall not make, sublet or assign any of the services covered by this Agreement, except with the prior written approval of the ENGINEER and in compliance with the terms, provisions and conditions of the Agreement. The SUBCONSULTANT shall not separately solicit or accept any assignment from the AGENCY related to the Project during the life of the Agreement without the ENGINEER's written approval or unless the ENGINEER is terminated by the AGENCY under the provisions of the Prime Agreement.

4.7 The SUBCONSULTANT shall, upon request and without cost, provide ENGINEER and the AGENCY all directly pertinent books, documents, papers and records including electronic data of the SUBCONSULTANT involving transactions related to this Agreement.

SECTION 5 - INSURANCE

5.1 Business Insurance. SUBCONSULTANT shall maintain, at its own expense, Commercial General Liability and Automobile Liability with limits at or above that which is reasonably required of other firms in the industry for their protection and management of business risks. SUBCONSULTANT shall name ENGINEER and AGENCY as additional insureds on the above required policies.

5.2 Workers' Compensation Insurance. A current Workers' Compensation and Employer's Liability insurance certificate with limits pursuant to state law is required. By initialing below, SUBCONSULTANT asserts that it is not legally required to carry Workers' Compensation Insurance:

_____ (Initials)

5.3 Professional Liability Insurance. A current Professional Liability insurance certificate with minimum limits of **$1,000,000** is required.

5.4 **SUBCONSULTANT shall attach the certificate(s) evidencing the coverages required above to the signed Agreement before returning to ENGINEER.** This Agreement is not final and invoices cannot be paid until an insurance certificate(s) evidencing all policies is received. Additionally, SUBCONSULTANT shall provide ENGINEER with updated certificates for the duration of this Project to subcerts@carollo.com listing the following address on the certificate:

Carollo Engineers
Risk Management Services
3150 Bristol Street, Suite 500
Costa Mesa, CA 92626

SECTION 6 - INDEPENDENT INVESTIGATIONS

6.1 The SUBCONSULTANT has reviewed the services required under the Agreement and has made his own investigation concerning services. The SUBCONSULTANT has

determined that he has sufficient information to enter into the Agreement and perform the services called for herein. The SUBCONSULTANT agrees and acknowledges that the ENGINEER has made no representations or warranties concerning the services provided and that the SUBCONSULTANT has relied solely upon his own review and investigation prior to entering into this Agreement.

SECTION 7 - TERMINATION OF AGREEMENT

7.1 The ENGINEER may terminate this Agreement at any time by giving the SUBCONSULTANT written notice thereof. Upon said termination, the SUBCONSULTANT will be reimbursed for that portion of the work completed prior to termination less expenses or costs incurred as a result of the SUBCONSULTANT's default.

SECTION 8 - ENTIRE AGREEMENT

8.1 This Agreement including attachments incorporated herein by reference represents the entire Agreement and understanding between the parties and any negotiations, proposals or oral agreements are intended to be superseded by this written Agreement. Any supplement or amendment to this Agreement to be effective shall be in writing and signed by the parties.

SECTION 9 - REQUIRED PROVISIONS

9.1 The SUBCONSULTANT shall, in the performance of this Agreement, comply with all federal, state and local laws; and all regulations and orders issued under any applicable law.

9.2 The SUBCONSULTANT and its subconsultants shall abide by the requirements of 41 CFR 60-741.5 (a). This regulation prohibits discrimination against qualified individuals on the basis of disability and requires affirmative action to employ and advance in employment qualified individuals with disabilities.

9.3 The SUBCONSULTANT and its subconsultants shall abide by the requirements of 41 CFR 60-300.5(a). This regulation prohibits discrimination against qualified protected veterans, and requires affirmative action to employ and advance in employment qualified protected veterans.

9.4 SUBCONSULTANT shall register and maintain the currency of its information in System for Award Management (SAM). All reviews and updates shall be completed at least annually after the initial registration, and more frequently if required by changes in its information throughout the term of this Agreement.

9.5 SUBCONSULTANT certifies it has been issued the following Data Universal Numbering System (DUNS) prior to entering into this Agreement:

DUNS Number: 067761700

The Prime Agreement between ENGINEER and AGENCY is attached as Exhibit B including attachments thereto. The following documents are hereby incorporated into this Agreement:

Exhibit B Documents
Assistance Agreement
Special Terms and Conditions
Attachment 1- Statement of Project Objectives (SOPO)
Attachment 2- Reporting Requirements and EERE Reporting Instructions
Attachment 3- Budget Information
Attachment 4- Intellectual Property Provisions
Attachment 5- Data Management Plan

All applicable terms and conditions outlined in the documents identified above shall apply equally to SUBCONSULTANT. In the event of a conflict between this Agreement and the Prime Agreement, the Prime Agreement shall prevail.

SECTION 10 - OVERNING LAW

This Agreement is to be governed and construed
in accordance with Federal law.

TASK ORDER NO. ___1__
CAROLLO ENGINEERS, INC.
AND
LOS ANGELES COUNTY SANITATION DISTRICT (LACSD)
SUBCONSULTANT

This Task Order is issued by the ENGINEER and accepted by the SUBCONSULTANT pursuant to the mutual promises, covenants and conditions contained in the Agreement between the above-named parties dated the 1st day of September, 2021, in connection with: **Transforming Aeration Energy in Water Resource Recovery Facilities (WRRFs) through Suboxic Nitrogen Removal** (Project)**.**

SECTION 11 - PURPOSE

The purpose of this Task Order is to establish SUBCONSULTANT's services, time of performance, and payment provisions in connection with the Project. SUBCONSULTANT will work with the ENGINEER to execute all proposed tasks as described in the attached agreement with the Department of Energy (DOE) (Exhibit B).

SECTION 12 - SUBCONSULTANT'S SERVICES

SUBCONSULTANT will be a major Project Team member and support ENGINEER to complete the project through the following services and activities:

1. Provide historical data on energy, GHG emissions, process performance, and operation for baseline TEA and LCA for conventional BNR treatment process.
2. Prepare the full-scale train at Pomona WRF with aeration system improvements for MPAC and required process monitoring equipment as mentioned in the agreement with the DOE (Exhibit B).
3. Implement DO/Nmaster MPAC program at the Pomona WRF and integrate into Neuros' blower programming software. Loop test and fine tune as discussed in the agreement with the DOE (Exhibit B).
4. Provide process, performance, and energy data collected during the pilot testing for mid-point LCA and TEA analysis.
5. Evaluate DO/Nmaster performance by operating full-scale system at Pomona WRF under conventional DO setpoints (i.e., 0.5 to 2 mg/L) and quantify long-term energy and carbon savings for MPAC as described in the agreement with the DOE (Exhibit B). Collect and analyze liquid, gas, and microbial samples as outlined in the agreement with the DOE (Exhibit B).
6. Conduct SNR validation testing at the full-scale testing facility at Pomona WRF as described in the agreement with the DOE (Exhibit B). Collect and analyze liquid, gas, and microbial samples as outlined in the agreement with the DOE (Exhibit B).
7. Provide process, performance, and energy data collected during the full-scale SNR and MPAC testing at Pomona WRF for final LCA and TEA analysis.
8. Provide data and information to support technology evaluation, commercialization, and marketing.
9. Participate in project meetings and workshops.
10. Any other services offered by SUBCONSULTANT as detailed in the contractual Statement of Project Objectives (SOPO).

SECTION 13 - TIME OF PERFORMANCE

The schedule will confirm to the project schedule as per the contract with the DOE (Exhibit B).

SECTION 14 - PAYMENT

SUBCONSULTANT's services will be compensated with a total payment of $954,577 in federal funds. SUBCONULTANT will provide cash cost share equivalent to $1,875,256 for Neuros' blower equipment, labor, and other equipment.

SECTION 15 - EFFECTIVE DATE

This Task Order No. 1 is effective as of the 1st day of September, 2021.

IN WITNESS WHEREOF, duly authorized representatives of the parties have signed in confirmation of this Agreement, with effective date the day and year first above written.

CAROLLO ENGINEERS, INC.

By: Tanja Rauch-Williams
Associate Vice President

By:
[Title]

SUBCONSULTANT
Los Angeles County Sanitation Districts, District #2

By:
Chairperson

Address

City State Zip

Date

Phone ( )
Fax ( )
E-mail
Fed Tax ID #
Certified MBE, WBE or SBE? _____ Yes, if so which?
_____ No

Attest:
Secretary

Approved as to Form: Lewis Brisbois Bisgaard & Smith LLP
By:
District Counsel

Exhibit A

ACH/Direct Deposit Form

Vendor ACH/Direct Deposit Enrollment Form

Electronic Funds Transfer (EFT) is Carollo's preferred form of payment as it supports "Go Green" initiatives. With EFT, payments will be electronically deposited into your company's designated bank account through ACH (Automated Clearing House). ACH remittance will be delivered via email.

Please fax or email completed & signed form to:

Fax #602-265-1422 or Email to accountspayable@carollo.com

Company Name	
Contact Name	
Email address (required to receive remittance)	
Bank Name	
Routing Account Number (9 digit number)	
Account Number	

I certify that the information above is true and correct, and that I, as a representative for the above named company, hereby authorize Carollo Engineers to electronically deposit payments to the designated bank account. This authority remains in full force until Carollo Engineers receives written notification requesting a change or cancellation.

Printed Name:	
Authorized Signature:	
Title:	
Phone Number:	
Date:	

EXHIBIT B
PRIME AGREEMENT

ASSISTANCE AGREEMENT

1. Award No. DE-EE0009509	2. Modification No.	3. Effective Date 09/01/2021	4. CFDA No. 81.086
5. Awarded To Carollo Engineers, Inc. Attn: Daniel Hadley 2795 Mitchell Dr Walnut Creek CA 945981601	6. Sponsoring Office Energy Effcy & Renewable Energy EE-1 U.S. Department of Energy 1000 Independence Avenue, S.W. Washington DC 20585		7. Period of Performance 09/01/2021 through 08/31/2022
8. Type of Agreement ☐ Grant ☒ Cooperative Agreement ☐ Other	9. Authority EPAct 2005, Section 911 (a)(2)(C)		10. Purchase Request or Funding Document No. 21EE002123
11. Remittance Address Carollo Engineers, Inc. Attn: Daniel Hadley PO BOX 30835 SALT LAKE CITY UT 841300835	12. Total Amount Govt. Share: $1,980,642.00 Cost Share : $2,477,116.00 Total : $4,457,758.00		13. Funds Obligated This action: $1,980,642.00 Total : $1,980,642.00
14. Principal Investigator	15. Program Manager Deborah L. Schultheis Phone: 720-356-1811		16. Administrator Golden Field Office U.S. Department of Energy Golden Field Office 15013 Denver West Parkway Golden CO 80401
17. Submit Payment Requests To VIPERS https://vipers.doe.gov Any questions, please contact by call/email 855-384-7377 or ViperSupport@hq.doe.gov	18. Paying Office VIPERS https://vipers.doe.gov Any questions, please contact by call/email 855-384-7377 or ViperSupport@hq.doe.gov		19. Submit Reports To See Attachment 2

20. Accounting and Appropriation Data
05450-2021-31-200835-41999-1009209-0000000-0000000-0000000

21. Research Title and/or Description of Project
Transforming Aeration Energy in Water Resource Recovery Facilities (WRRFs) through Suboxic Nitrogen Removal

For the Recipient		For the United States of America	
22. Signature of Person Authorized to Sign Tanja Rauch-Williams Ass. Vice President		25. Signature of Grants/Agreements Officer Signature on File	
23. Name and Title SENIOR VICE PRESIDENT	24. Date Signed 10-7-21	26. Name of Officer Geoffrey I. Walker	27. Date Signed 09/21/2021

NAME OF OFFEROR OR CONTRACTOR
Carollo Engineers, Inc.

ITEM NO. (A)	SUPPLIES/SERVICES (B)	QUANTITY (C)	UNIT (D)	UNIT PRICE (E)	AMOUNT (F)
	DUNS Number: 045809316 In addition to this Assistance Agreement, this award consists of the items listed on the Cover Page of the Special Terms and Conditions. The Project Period for this award is 09/01/2021 through 08/31/2023 consisting of the following Budget Periods: Budget Period 1: 09/01/2021 to 08/31/2022 Budget Period 2: 09/01/2022 to 08/31/2023 In Block 7 of the Assistance Agreement, the Period of Performance reflects the beginning of the Project Period through the end of the current Budget Period. Additional future DOE funding and additional budget periods are not contemplated under this award. Funding for all awards and future budget periods is contingent upon the availability of funds appropriated by Congress for the purpose of this program and the availability of future-year budget authority. The Special Terms and Conditions for this award contain specific funding restrictions. Please review the applicable terms for procedures required to lift the restrictions. DOE Award Administrator: Mary Murray E-mail: mary.murray@ee.doe.gov Phone: 240-562-1374 DOE Project Officer: Debbie Schultheis E-mail: debbie.schultheis@ee.doe.gov Phone: 720-356-1811 Recipient Business Officer: Rendell Lofgreen E-mail: RLofgreen@carollo.com Phone: 602.293.9500 Recipient Principal Investigator: Tanja Rauch-Williams E-mail: trauch-williams@carollo.com Phone: 720-670-0479 "Electronic signature or signatures as used in this document means a method of signing an electronic message that-- (A) Identifies and authenticates a particular				

Continued ...

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED DE-EE0009509	PAGE 3 OF 3

NAME OF OFFEROR OR CONTRACTOR
Carollo Engineers, Inc.

ITEM NO. (A)	SUPPLIES/SERVICES (B)	QUANTITY (C)	UNIT (D)	UNIT PRICE (E)	AMOUNT (F)
	person as the source of the electronic message; (B) Indicates such person's approval of the information contained in the electronic message; and, (C) Submission via FedConnect constitutes electronically signed documents." ASAP: NO: STD IMMEDIATE Extent Competed: COMPETED Davis-Bacon Act: NO PI: Rauch-Williams, Tanj Fund: 05450 Appr Year: 2021 Allottee: 31 Report Entity: 200835 Object Class: 41999 Program: 1009209 Project: 0000000 WFO: 0000000 Local Use: 0000000				

Special Terms and Conditions

Carollo Engineers, Inc. ("Recipient"), which is identified in Block 5 of the Assistance Agreement, and the Office of Energy Efficiency and Renewable Energy ("EERE"), an office within the United States Department of Energy ("DOE"), enter into this Award, referenced above, to achieve the project objectives and the technical milestones and deliverables stated in Attachment 1 to this Award.

This Award consists of the following documents, including all terms and conditions therein:

	Assistance Agreement
	Special Terms and Conditions
Attachment 1	Statement of Project Objectives and Milestone Summary Table
Attachment 2	Federal Assistance Reporting Checklist and Instructions
Attachment 3	Budget Information SF-424A
Attachment 4	Intellectual Property Provisions
Attachment 5	Data Management Plan

The following are incorporated into this Award by reference:

- DOE Assistance Regulations, 2 CFR part 200 as amended by 2 CFR part 910 at http://www.eCFR.gov.
- Research Terms & Conditions (November 12, 2020) and the DOE Agency Specific Requirements (November 2020) at http://www.nsf.gov/awards/managing/rtc.jsp. Applicable if the Award is for research and the Award is to a university or non-profit.
- National Policy Requirements (November 12, 2020) at http://www.nsf.gov/awards/managing/rtc.jsp.
- The Recipient's application/proposal as approved by EERE.

Table of Contents

Subpart A. General Provisions

Term 1. Legal Authority and Effect

A DOE financial assistance award is valid only if it is in writing and is signed, either in writing or electronically, by a DOE Contracting Officer.

The Recipient may accept or reject the Award. A request to draw down DOE funds or acknowledgement of award documents by the Recipient's authorized representative through electronic systems used by DOE, specifically FedConnect, constitutes the Recipient's acceptance of the terms and conditions of this Award. Acknowledgement via FedConnect by the Recipient's authorized representative constitutes the Recipient's electronic signature.

Term 2. Flow Down Requirement

The Recipient agrees to apply the terms and conditions of this Award, as applicable, including the Intellectual Property Provisions, to all subrecipients (and subcontractors, as appropriate), as required by 2 CFR 200.101, and to require their strict compliance therewith. Further, the Recipient must apply the Award terms as required by 2 CFR 200.327 to all subrecipients (and subcontractors, as appropriate), and to require their strict compliance therewith.

Term 3. Compliance with Federal, State, and Municipal Law

The Recipient is required to comply with applicable Federal, state, and local laws and regulations for all work performed under this Award. The Recipient is required to obtain all necessary Federal, state, and local permits, authorizations, and approvals for all work performed under this Award.

Term 4. Inconsistency with Federal Law

Any apparent inconsistency between Federal statutes and regulations and the terms and conditions contained in this Award must be referred to the DOE Award Administrator for guidance.

Term 5. Federal Stewardship

EERE will exercise normal Federal stewardship in overseeing the project activities performed under this Award. Stewardship activities include, but are not limited to, conducting site visits; reviewing performance and financial reports; providing technical assistance and/or temporary intervention in unusual circumstances to address deficiencies that develop during the project; assuring compliance with terms and conditions; and reviewing technical performance after project completion to ensure that the project objectives have been accomplished.

Term 6. Substantial Involvement

EERE has substantial involvement in work performed under this Award. EERE does not limit its involvement to the administrative requirements of this Award. Instead, EERE has substantial involvement in the direction and redirection of the technical aspects of the project as a whole. Substantial involvement includes the following:

- EERE shares responsibility with the Recipient for the management, control, direction, and performance of the Project.
- EERE may intervene in the conduct or performance of work under this Award for programmatic reasons. Intervention includes the interruption or modification of the conduct or performance of project activities.
- EERE may redirect or discontinue funding the Project based on the outcome of EERE's evaluation of the Project at the Go/No Go decision point.
- EERE participates in major project decision-making processes.

Term 7. Federal Involvement

A. Review Meetings

The Recipient, including but not limited to, the principal investigator (or, if applicable, co-principal investigators), is required to participate in periodic review meetings with EERE. Review meetings enable EERE to assess the work performed under this Award and determine whether the Recipient has timely achieved the technical milestones and deliverables stated in Attachment 1 to this Award.

EERE shall determine the frequency of review meetings and select the day, time, and location of each review meeting and shall do so in a reasonable and good faith manner. EERE will provide the Recipient with reasonable notice of the review meetings.

For each review meeting, the Recipient is required to provide a comprehensive overview of the project, including:

- The Recipient's technical progress compared to the Milestone Summary Table stated in Attachment 1 to this Award.
- The Recipient's actual expenditures compared to the approved budget in Attachment 3 to this Award.
- Other subject matter specified by the DOE Technology Manager/Project Officer.

B. Project Meetings

The Recipient is required to notify EERE in advance of scheduled tests and internal project meetings that would entail discussion of topics that could result in major changes to the baseline project technical scope/approach, cost, or schedule. Upon request by EERE, the Recipient is required to provide EERE with reasonable access (by telephone, webinar, or otherwise) to the tests and project meetings. The Recipient is not expected to delay any work under this Award for the purpose of government insight.

C. Site Visits

EERE's authorized representatives have the right to make site visits at reasonable times to review project accomplishments and management control systems and to provide technical assistance, if required. The Recipient must provide, and must require subrecipients to provide, reasonable access to facilities, office space, resources, and assistance for the safety and convenience of the government

representatives in the performance of their duties. All site visits and evaluations must be performed in a manner that does not unduly interfere with or delay the work.

D. Go/No Go Decisions

Attachment 1 to this Award establishes Go/No Go decision points. For each Go/No Go decision point, EERE must determine whether the Recipient has fully and satisfactorily completed the work described in Attachment 1 to this Award. As a result of a Go/No Go review, in its discretion, EERE may take one of the following actions:

- Authorize Federal funding for the next budget period for the Project.
- Recommend redirection of work under the Project.
- Place a hold on the Federal funding for the Project, pending further supporting data.
- Discontinue providing Federal funding for the Project beyond the current budget period as the result of insufficient progress, change in strategic direction, or lack of available funding.

E. Technical Milestones and Deliverables

Attachment 1 to this Award establishes technical milestones and deliverables. If the Recipient fails to achieve two or more technical milestones and deliverables, EERE may renegotiate the Statement of Project Objectives and/or Milestone Summary Table in Attachment 1 to this Award. In the alternative, EERE may deem the Recipient's failure to achieve these technical milestones and deliverables to be material noncompliance with the terms and conditions of this Award and take action to suspend or terminate the Award.

F. EERE Access

The Recipient must provide any information, documents, site access, or other assistance requested by EERE for the purpose of its Federal stewardship or substantial involvement.

Term 8. NEPA Requirements

DOE must comply with the National Environmental Policy Act (NEPA) prior to authorizing the use of Federal funds. Based on all information provided by the Recipient, EERE has made a NEPA determination by issuing a categorical exclusion (CX) for all activities listed in the Statement of Project Objectives (SOPO) approved by the Contracting Officer and the DOE NEPA Determination. The Recipient is thereby authorized to use Federal funds for the defined project activities, except where such activity is subject to a restriction set forth elsewhere in this Award.

This authorization is specific to the project activities and locations as described in the SOPO approved by the Contracting Officer and the DOE NEPA Determination.

If the Recipient later intends to add to or modify the activities or locations as described in the approved SOPO and the DOE NEPA Determination, those new activities/locations or modified activities/locations are subject to additional NEPA review and are not authorized for Federal

funding until the Contracting Officer provides written authorization on those additions or modifications. Should the Recipient elect to undertake activities or change locations prior to written authorization from the Contracting Officer, the Recipient does so at risk of not receiving Federal funding for those activities, and such costs may not be recognized as allowable cost share.

Term 9. Foreign National Access

The Recipient may be required to provide information to DOE in order to satisfy requirements for foreign nationals' access to DOE sites, information, technologies, equipment, programs or personnel. A foreign national is defined as any person who is not a U.S. citizen by birth or naturalization. If the Recipient (including any of its subrecipients, contractors or vendors) anticipates involving foreign nationals in the performance of its award, the Recipient may be required to provide DOE with specific information about each foreign national to ensure compliance with the requirements for access approval. National laboratory personnel already cleared for site access may be excluded.

Term 10. Notice Regarding the Purchase of American-Made Equipment and Products – Sense of Congress

It is the sense of the Congress that, to the greatest extent practicable, all equipment and products purchased with funds made available under this Award should be American-made.

Term 11. Reporting Requirements

A. Requirements

The reporting requirements for this Award are identified on the Federal Assistance Reporting Checklist, attached to this Award. Failure to comply with these reporting requirements is considered a material noncompliance with the terms of the Award. Noncompliance may result in withholding of future payments, suspension, or termination of the current award, and withholding of future awards. A willful failure to perform, a history of failure to perform, or unsatisfactory performance of this and/or other financial assistance awards, may also result in a debarment action to preclude future awards by Federal agencies.

B. Dissemination of Scientific and Technical Information

Scientific and Technical Information (STI) generated under this Award will be submitted to DOE via the Office of Scientific and Technical Information's Energy Link (E-Link) system. STI submitted under this Award will be disseminated via DOE's OSTI.gov website subject to approved access limitations. Citations for journal articles produced under the Award will appear on the DOE PAGES website.

C. Restrictions

Scientific and Technical Information submitted to E-Link must not contain any Protected Personal Identifiable Information (PII), limited rights data (proprietary data), classified information, information subject to export control classification, or other information not subject to release.

Term 12. Lobbying

By accepting funds under this Award, the Recipient agrees that none of the funds obligated on the Award shall be expended, directly or indirectly, to influence congressional action on any legislation or appropriation matters pending before Congress, other than to communicate to Members of Congress as described in 18 U.S.C. 1913. This restriction is in addition to those prescribed elsewhere in statute and regulation.

Term 13. Publications

The Recipient is required to include the following acknowledgement in publications arising out of, or relating to, work performed under this Award, whether copyrighted or not:

- *Acknowledgment:* "This material is based upon work supported by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) under the Advanced Manufacturing Office, Award Number DE-EE0009509."
- *Full Legal Disclaimer:* "This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof."

  Abridged Legal Disclaimer: "The views expressed herein do not necessarily represent the views of the U.S. Department of Energy or the United States Government."

  Recipients should make every effort to include the full Legal Disclaimer. However, in the event that recipients are constrained by formatting and/or page limitations set by the publisher, the abridged Legal Disclaimer is an acceptable alternative.

The Award may include a Data Management Plan, Attachment 5, submitted by the Recipient that explains how data generated in the course of the work performed under this Award will be shared or preserved or, when justified, explains why data sharing or preservation is not possible or scientifically appropriate. In the event of a conflict between the Data Rights outlined in the Intellectual Property Provisions, Attachment 4, and the Data Management Plan, the Data Rights outlined in the Intellectual Property Provisions take precedence.

Term 14. No-Cost Extension

As provided in 2 CFR 200.308, the Recipient must provide the Contracting Officer with notice in advance if it intends to utilize a one-time, no-cost extension of this Award. The notification must include the supporting reasons and the revised period of performance. The Recipient

must submit this notification in writing to the Contracting Officer and DOE Technology Manager/ Project Officer at least 30 days before the end of the current budget period.

Any no-cost extension will not alter the project scope, milestones, deliverables, or budget of this Award.

Term 15. Property Standards

The complete text of the Property Standards can be found at 2 CFR 200.310 through 200.316. Also see 2 CFR 910.360 for additional requirements for real property and equipment for For-Profit recipients.

Term 16. Insurance Coverage

See 2 CFR 200.310 for insurance requirements for real property and equipment acquired or improved with Federal funds. Also see 2 CFR 910.360(d) for additional requirements for real property and equipment for For-Profit recipients.

Term 17. Real Property

Subject to the conditions set forth in 2 CFR 200.311, title to real property acquired or improved under a Federal award will conditionally vest upon acquisition in the non-Federal entity. The non-Federal entity cannot encumber this property and must follow the requirements of 2 CFR 200.311 before disposing of the property.

Except as otherwise provided by Federal statutes or by the Federal awarding agency, real property will be used for the originally authorized purpose as long as needed for that purpose. When real property is no longer needed for the originally authorized purpose, the non-Federal entity must obtain disposition instructions from DOE or pass-through entity. The instructions must provide for one of the following alternatives: (1) retain title after compensating DOE as described in 2 CFR 200.311(c)(1); (2) Sell the property and compensate DOE as specified in 2 CFR 200.311(c)(2); or (3) transfer title to DOE or to a third party designated/approved by DOE as specified in 2 CFR 200.311(c)(3).

See 2 CFR 200.311 for additional requirements pertaining to real property acquired or improved under a Federal award. Also see 2 CFR 910.360 for additional requirements for real property for For-Profit recipients.

Term 18. Equipment

Subject to the conditions provided in 2 CFR 200.313, title to equipment (property) acquired under a Federal award will conditionally vest upon acquisition with the non-Federal entity. The non-Federal entity cannot encumber this property and must follow the requirements of 2 CFR 200.313 before disposing of the property.

A state must use equipment acquired under a Federal award by the state in accordance with state laws and procedures.

Equipment must be used by the non-Federal entity in the program or project for which it was acquired as long as it is needed, whether or not the project or program continues to be supported by the Federal award. When no longer needed for the originally authorized purpose, the equipment may be used by programs supported by DOE in the priority order specified in 2 CFR 200.313(c)(1)(i) and (ii).

Management requirements, including inventory and control systems, for equipment are provided in 2 CFR 200.313(d).

When equipment acquired under a Federal award is no longer needed, the non-Federal entity must obtain disposition instructions from DOE or pass-through entity.

Disposition will be made as follows: (1) items of equipment with a current fair market value of $5,000 or less may be retained, sold, or otherwise disposed of with no further obligation to DOE; (2) Non-Federal entity may retain title or sell the equipment after compensating DOE as described in 2 CFR 200.313(e)(2); or (3) transfer title to DOE or to an eligible third party as specified in 2 CFR 200.313(e)(3).

See 2 CFR 200.313 for additional requirements pertaining to equipment acquired under a Federal award. Also see 2 CFR 910.360 for additional requirements for equipment for For-Profit recipients. See also 2 CFR 200.439 Equipment and other capital expenditures.

Term 19. Supplies

See 2 CFR 200.314 for requirements pertaining to supplies acquired under a Federal award. See also 2 CFR 200.453 Materials and supplies costs, including costs of computing devices.

Term 20. Property Trust Relationship

Real property, equipment, and intangible property, that are acquired or improved with a Federal award must be held in trust by the non-Federal entity as trustee for the beneficiaries of the project or program under which the property was acquired or improved. See 2 CFR 200.316 for additional requirements pertaining to real property, equipment, and intangible property acquired or improved under a Federal award.

Term 21. Record Retention

Consistent with 2 CFR 200.334 through 200.338, the Recipient is required to retain records relating to this Award.

Term 22. Audits

A. Government-Initiated Audits

The Recipient must provide any information, documents, site access, or other assistance requested by EERE, DOE or Federal auditing agencies (e.g., DOE Inspector General, Government Accountability Office) for the purpose of audits and investigations. Such assistance may include, but is not limited to, reasonable access to the Recipient's records relating to this Award.

Consistent with 2 CFR part 200 as amended by 2 CFR part 910, DOE may audit the Recipient's financial records or administrative records relating to this Award at any time. Government-initiated audits are generally paid for by DOE.

DOE may conduct a final audit at the end of the project period (or the termination of the Award, if applicable). Upon completion of the audit, the Recipient is required to refund to DOE any payments for costs that were determined to be unallowable. If the audit has not been performed or completed prior to the closeout of the award, DOE retains the right to recover an appropriate amount after fully considering the recommendations on disallowed costs resulting from the final audit.

DOE will provide reasonable advance notice of audits and will minimize interference with ongoing work, to the maximum extent practicable.

B. Annual Independent Audits (Single Audit or Compliance Audit)

The Recipient must comply with the annual independent audit requirements in 2 CFR 200.500 through .521 for institutions of higher education, nonprofit organizations, and state and local governments (Single audit), and 2 CFR 910.500 through .521 for for-profit entities (Compliance audit).

The annual independent audits are separate from Government-initiated audits discussed in part A. of this Term, and must be paid for by the Recipient. To minimize expense, the Recipient may have a Compliance audit in conjunction with its annual audit of financial statements. The financial statement audit is **not** a substitute for the Compliance audit. If the audit (Single audit or Compliance audit, depending on Recipient entity type) has not been performed or completed prior to the closeout of the award, DOE may impose one or more of the actions outlined in 2 CFR 200.338, Remedies for Noncompliance.

Subpart B. Financial Provisions

Term 23. Maximum Obligation

The maximum obligation of DOE for this Award is the total "Funds Obligated" stated in Block 13 of the Assistance Agreement to this Award.

Term 24. Funding of Budget Periods

EERE has obligated funding as shown in Block 13 of the Assistance Agreement for completion of the Project. However, only the Federal share of costs associated with the current Period of Performance is available for work performed by the Recipient. The Federal share of costs is shown on Attachment 3. The current Period of Performance is shown in Block 7 of the Assistance Agreement.

The remainder of funding is contingent upon: (1) availability of Federal funds appropriated by Congress for the purpose of this program; (2) the availability of future-year budget authority;

(3) Recipient's technical progress compared to the Milestone Summary Table stated in Attachment 1 to this Award; (4) Recipient's submittal of required reports; (5) Recipient's compliance with the terms and conditions of the Award; (6) EERE's Go/No-Go decision; (7) the Recipient's submission of a continuation application; and (8) written approval of the continuation application by the Contracting Officer.

In the event that the Recipient does not submit a continuation application for subsequent Budget Periods, or EERE disapproves a continuation application for subsequent Budget Periods, the maximum EERE liability to the Recipient is the funds that are available for the current approved Budget Period(s). In such event, EERE reserves the right to deobligate any remaining Federal funds.

Term 25. Continuation Application and Funding

A. Continuation Application

A continuation application is a non-competitive application for an additional budget period within a previously approved project period. At least 90 days before the end of each budget period, the Recipient must submit its continuation application as required in Attachment 2, Federal Assistance Reporting Checklist, with written notification to the DOE Technology Manager/Project Officer and the DOE Award Administrator that it has been submitted. The continuation application includes the following information:

i. A report on the Recipient's progress towards meeting the objectives of the project, including any significant findings, conclusions, or developments, and an estimate of any unobligated balances remaining at the end of the budget period. If the remaining unobligated balance is estimated to exceed 20 percent of the funds available for the budget period, explain why the excess funds have not been obligated and how they will be used in the next budget period.

ii. A detailed budget and supporting justification if there are changes to the negotiated budget, or a budget for the upcoming budget period was not approved at the time of award.

iii. A description of any planned changes from the negotiated Statement of Project Objectives and/or Milestone Summary Table.

B. Continuation Funding

Continuation funding is contingent on (1) the availability of funds appropriated by Congress for the purpose of this program; (2) the availability of future-year budget authority; (3) Recipient's technical progress compared to the Milestone Summary Table stated in Attachment 1 to this Award; (4) Recipient's submittal of required reports; (5) Recipient's compliance with the terms and conditions of the Award; (6) EERE's Go/No-Go decision; (7) the Recipient's submission of a continuation application; and (8) written approval of the continuation application by the Contracting Officer.

C. EERE waives prior written approval requirements to carry forward unobligated balances to subsequent periods of performance, in accordance with 2 CFR

200.308(e)(2).

Term 26. Cost Sharing

A. Cost Sharing Obligations

The Recipient must provide the "Cost Share" amount stated in Block 12 of the Assistance Agreement to this Award. EERE and the Recipient's cost share for the total estimated project costs are listed below.

Table 1

Budget Period	EERE Cost Share $ / %	Recipient Cost Share $ / %	Total Estimated Project Costs
1	$1,332,323/38.7%	$2,106,160/61.3%	$3,438,483
2	$648,319/63.6%	$370,956/36.4%	$1,019,275

The Recipient must provide its required "Cost Share" amount as a percentage of the total project costs in each invoice period for the duration of the project period. Specifically, the cumulative cost share percentage provided to date on each invoice received must reflect, at a minimum, the cost sharing percentage specified in the Award.

B. Cost Share Obligation If Award Terminated or Discontinued

If the Award is terminated or is otherwise not funded to completion, the Recipient is not required to provide the entire "Cost Share" amount stated in Block 12 of the Assistance Agreement to this Award; however, the Recipient must provide its share (i.e., percentage as shown in Table 1 above) of the total project cost reimbursed as of the date of the termination or discontinuation.

C. Source of Cost Share

The Recipient may not use Federal funds to meet its cost sharing obligations, unless otherwise allowed by Federal law.

D. Inability to Comply with Cost Sharing Obligations

If the Recipient determines that it is unable to meet its cost sharing obligations, the Recipient must notify the DOE Award Administrator in writing immediately. The notification must include the following information: (1) whether the Recipient intends to continue or phase out the project, and (2) if the Recipient intends to continue the project, how the Recipient will pay (or secure replacement funding for) the Recipient's share of the total project cost.

If the Recipient fails to meet its cost sharing obligations, EERE may recover some or all of the financial assistance provided under this Award. The amount EERE would seek to recover under this Term would be predicated on EERE's analysis of the Recipient's compliance with their cost sharing obligation under the Award.

Term 27. Refund Obligation

The Recipient must refund any excess payments received from EERE, including any costs determined unallowable by the Contracting Officer. Upon the end of the project period (or the

termination of the Award, if applicable), the Recipient must refund to EERE the difference between (1) the total payments received from EERE, and (2) the Federal share of the costs incurred. Refund obligations under this Term do not supersede the annual reconciliation or true up process if specified under the Indirect Cost Term.

Term 28. Allowable Costs

EERE determines the allowability of costs through reference to 2 CFR part 200 as amended by 2 CFR part 910. All project costs must be allowable, allocable, and reasonable. The Recipient must document and maintain records of all project costs, including, but not limited to, the costs paid by Federal funds, costs claimed by its subrecipients and project costs that the Recipient claims as cost sharing, including in-kind contributions. The Recipient is responsible for maintaining records adequate to demonstrate that costs claimed have been incurred, are reasonable, allowable and allocable, and comply with the cost principles. Upon request, the Recipient is required to provide such records to EERE. Such records are subject to audit. Failure to provide EERE adequate supporting documentation may result in a determination by the Contracting Officer that those costs are unallowable.

The Recipient is required to obtain the prior written approval of the Contracting Officer for any foreign travel costs.

Term 29. Indirect Costs

The Recipient does not have an approved Negotiated Indirect Cost Rate Agreement (NICRA) and has submitted an indirect cost rate proposal to DOE in order for proposed indirect costs to be approved. These costs shall be reconciled or trued up (actual incurred costs) on an annual basis via the annual incurred cost proposal. The preapproved indirect rate is 71.02%.

A. Lower-than-Expected Indirect Costs

The Recipient's actual indirect costs must be calculated during reconciliation at the Recipient's fiscal year end. If the Recipient's actual allowable indirect costs reflect that Recipient invoiced at a greater indirect rate than it actually incurred, the Recipient must refund the Government the over-billed amount.

B. Higher-than-Expected Indirect Costs

The Recipient understands that it is solely and exclusively responsible for managing its indirect costs. The Recipient further understands that EERE will not amend this Award solely to provide additional funds to cover increases in the Recipient's indirect cost rate.

EERE recognizes that the Recipient may not be fully reimbursed for increases in its indirect cost rate, which may result in under-recovery. In the event that the Recipient is not fully reimbursed for increases in its indirect cost rate, the Recipient may use any under-recovery as additional cost share under this Award, with prior approval from the Contracting Officer.

C. Subrecipient Indirect Costs

The Recipient must ensure its subrecipient's indirect costs are appropriately managed, allowable and otherwise comply with the requirements of this Award and

2 CFR part 200 as amended by 2 CFR part 910.

Term 30. Use of Program Income

If the Recipient earns program income during the project period as a result of this Award, the Recipient must use the program income to meet its cost sharing requirement.

Term 31. Payment Procedures

A. Method of Payment

Payment will be made by reimbursement through ACH.

B. Requesting Reimbursement

Requests for reimbursements must be made electronically through Department of Energy's Oak Ridge Financial Service Center (ORFSC) VIPERS. To access and use VIPERS, the Recipient must enroll at https://vipers.doe.gov. Detailed instructions on how to enroll are provided on the web site.

C. Timing of Submittals

Submittal of the SF-270 or SF-271 should coincide with the Recipient's normal billing pattern, but not more frequently than every two weeks. Requests for reimbursement must be limited to the amount of disbursements made during the billing period for the Federal share of direct project costs and the proportionate share of any allowable indirect costs incurred during that billing period.

D. Adjusting Payment Requests for Available Cash

The Recipient must disburse any funds that are available from repayments to and interest earned on a revolving fund, program income, rebates, refunds, contract settlements, audit recoveries, credits, discounts, and interest earned on any of those funds before requesting additional cash payments from EERE.

E. Payments

The EERE approving official will approve the invoice as soon as practical, but not later than 30 days after the Recipient's request is received, unless the billing is improper. Upon receipt of an invoice payment authorization from the EERE approving official, the ORFSC will disburse payment to the Recipient. The Recipient may check the status of payments at the VIPERS web site. All payments are made by electronic funds transfer to the bank account specified on the Bank Information Form that the Recipient filed with the U.S. Department of Treasury.

F. Supporting Documents for Agency Approval of Payments

For non-construction awards, the Recipient must submit a Standard Form SF-270, "Request for Advance or Reimbursement," at https://vipers.doe.gov and attach a file containing appropriate supporting documentation.

The following additional items are required:

- Summary cost data, for the billing period and cumulative cost data, showing all categories listed in the SF-424A and identifying Federal, non-Federal, and total amounts.
- *Applicable to for-profit recipients and subrecipients* UCC filing proof for all equipment acquired with project funds (i.e., Federal share or Recipient share)

and equipment offered as cost share.

- Invoices or summary cost data showing all categories listed in the SF-424A for Subrecipients with over $250,000 total project costs or >25% of total project costs.
- Invoices for Vendors with over $250,000 total project costs.
- Invoices/receipts for Equipment over $50,000.
- Explanation of cost share for invoicing period, including cost category and rationale if cost share exceeds or is below award requirements.
- If there are unauthorized phases and/or tasks for the current budget period in the NEPA Requirements term in these Special Terms and Conditions, a statement affirming that no invoiced costs are related to tasks or activities prohibited by the NEPA Requirements term.

The EERE payment authorizing official may request additional information from the Recipient to support the payment requests prior to release of funds, as deemed necessary. The Recipient is required to comply with these requests. Supporting documents include invoices, copies of contracts, vendor quotes, and other expenditure explanations that justify the reimbursement requests.

G. Unauthorized Drawdown of Federal Funds

For each budget period, the Recipient may not spend more than the Federal share authorized to that particular budget period, without specific written approval from the Contracting Officer. The Recipient must immediately refund EERE any amounts spent or drawn down in excess of the authorized amount for a budget period. The Recipient and subrecipients shall promptly, but at least quarterly, remit to DOE interest earned on advances drawn in excess of disbursement needs, and shall comply with the procedure for remitting interest earned to the Federal government per 2 CFR 200.305, as applicable.

Term 32. Budget Changes

A. Budget Changes Generally

The Contracting Officer has reviewed and approved the SF-424A in Attachment 3 to this Award.

Any increase in the total project cost, whether DOE share or Cost Share, which is stated as “Total” in Block 12 to the Assistance Agreement of this Award, must be approved in advance and in writing by the Contracting Officer.

Any change that alters the project scope, milestones or deliverables requires prior written approval of the Contracting Officer. EERE may deny reimbursement for any failure to comply with the requirements in this term.

B. Transfers of Funds Among Direct Cost Categories

The Recipient is required to obtain the prior written approval of the Contracting Officer for any transfer of funds among direct cost categories where the cumulative

amount of such transfers exceeds or is expected to exceed 10 percent of the total project cost, which is stated as "Total" in Block 12 to the Assistance Agreement of this Award.

The Recipient is required to notify the DOE Technology Manager/Project Officer of any transfer of funds among direct cost categories where the cumulative amount of such transfers is equal to or below 10 percent of the total project cost, which is stated as "Total" in Block 12 to the Assistance Agreement of this Award.

C. Transfer of Funds Between Direct and Indirect Cost Categories

The Recipient is required to obtain the prior written approval of the Contracting Officer for any transfer of funds between direct and indirect cost categories. If the Recipient's actual allowable indirect costs are less than those budgeted in Attachment 3 to this Award, the Recipient may use the difference to pay additional allowable direct costs during the project period so long as the total difference is less than 10% of total project costs and the difference is reflected in actual requests for reimbursement to DOE.

Subpart C. Miscellaneous Provisions

Term 33. Environmental, Safety and Health Performance of Work at DOE Facilities

With respect to the performance of any portion of the work under this Award which is performed at a DOE -owned or controlled site, the Recipient agrees to comply with all State and Federal Environmental, Safety and Health (ES&H) regulations and with all other ES&H requirements of the operator of such site.

Prior to the performance on any work at a DOE-owned or controlled site, the Recipient shall contact the site facility manager for information on DOE and site specific ES&H requirements.

The Recipient is required apply this provision to its subrecipients and contractors.

Term 34. Corporate Felony Conviction and Federal Tax Liability Assurances

This term applies to Recipients that are organized as corporations. A corporation includes any entity that has filed articles of incorporation in any of the 50 states, the District of Columbia, or the various territories of the United States, but not foreign corporations. It includes both for-profit and non-profit organizations.

By entering into this Award, the Recipient attests that its corporation has not been convicted of a felony criminal violation under Federal law in the 24 months preceding the date of signature.

The Recipient further attests that its corporation does not have any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

Term 35. Insolvency, Bankruptcy or Receivership

A. The Recipient shall immediately, but no later than five days, notify EERE of the occurrence of any of the following events: (1) the Recipient or the Recipient's parent's filing of a voluntary case seeking liquidation or reorganization under the Bankruptcy Act; (2) the Recipient's consent to the institution of an involuntary case under the Bankruptcy Act against the Recipient or the Recipient's parent; (3) the filing of any similar proceeding for or against the Recipient or the Recipient's parent, or the Recipient's consent to the dissolution, winding-up or readjustment of its debts, appointment of a receiver, conservator, trustee, or other officer with similar powers over the Recipient, under any other applicable state or Federal law; or (4) the Recipient's insolvency due to its inability to pay debts generally as they become due.

B. Such notification shall be in writing and shall: (1) specifically set out the details of the occurrence of an event referenced in paragraph A; (2) provide the facts surrounding that event; and (3) provide the impact such event will have on the project being funded by this Award.

C. Upon the occurrence of any of the four events described in paragraph A. of this term, EERE reserves the right to conduct a review of the Recipient's Award to determine the Recipient's compliance with the required elements of the Award (including such items as cost share, progress towards technical project objectives, and submission of required reports). If the EERE review determines that there are significant deficiencies or concerns with the Recipient's performance under the Award, EERE reserves the right to impose additional requirements, as needed, including (1) change of payment method; or (2) institute payment controls.

D. Failure of the Recipient to comply with this term may be considered a material noncompliance of this Award by the Contracting Officer.

Term 36. Reporting Subawards and Executive Compensation

A. Reporting of first-tier subawards

i. *Applicability*. Unless the Recipient is exempt as provided in paragraph D. of this award term, the Recipient 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).

ii. *Where and when to report*.

1. The Recipient must report each obligating action described in paragraph A.i. of this award term to https://www.fsrs.gov.
2. 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 no later than December 31, 2010.)

iii. *What to report*. The Recipient must report the information about each obligating action that the submission instructions posted at

https://www.fsrs.gov.

B. Reporting Total Compensation of Recipient Executives

i. *Applicability and what to report*. The Recipient must report total compensation for each of its five most highly compensated executives for the preceding completed fiscal year, if:

1. The total Federal funding authorized to date under this Award is $25,000 or more;
2. In the preceding fiscal year, the Recipient received;
    a. 80 percent or more of the Recipient's 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
3. 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).

ii. *Where and when to report*. The Recipient must report executive total compensation described in paragraph B.i. of this award term:

1. As part of the Recipient's registration profile at https://www.sam.gov.
2. 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

i. *Applicability and what to report*. Unless the Recipient is exempt as provided in paragraph D. of this award term, for each first-tier subrecipient under this award, the Recipient 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:

1. 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
2. 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).

ii. *Where and when to report*. The Recipient must report subrecipient executive total compensation described in paragraph C.i. of this award term:
   1. To the recipient.
   2. By the end of the month following the month during which the Recipient makes 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), the Recipient must report any required compensation information of the subrecipient by November 30 of that year.

D. Exemptions

If, in the previous tax year, the Recipient had gross income, from all sources, under $300,000, it is 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:

i. Entity means all of the following, as defined in 2 CFR Part 25:
   1. A Governmental organization, which is a State, local government, or Indian tribe.
   2. A foreign public entity.
   3. A domestic or foreign nonprofit organization.
   4. A domestic or foreign for-profit organization.
   5. A Federal agency, but only as a subrecipient under an award or subaward to a non-Federal entity.

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

iii. Subaward:
   1. This term means a legal instrument to provide support for the performance of any portion of the substantive project or program for which the Recipient received this award and that the recipient awards to an eligible subrecipient.
   2. The term does not include the Recipient's procurement of property and services needed to carry out the project or program (for further explanation, see 2 CFR 200.501 Audit requirements, (f) *Subrecipients and Contractors* and/or 2 CFR 910.501 Audit requirements, (f) *Subrecipients and Contractors*).
   3. A subaward may be provided through any legal agreement, including

an agreement that the Recipient or a subrecipient considers a contract.

iv. Subrecipient means an entity that:
   1. Receives a subaward from the Recipient under this award; and
   2. Is accountable to the Recipient for the use of the Federal funds provided by the subaward.

v. 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)):
   1. Salary and bonus.
   2. 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.
   3. 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.
   4. Change in pension value. This is the change in present value of defined benefit and actuarial pension plans.
   5. Above-market earnings on deferred compensation which is not tax-qualified.
   6. 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, perquisites or property) for the executive exceeds $10,000.

Term 37. System for Award Management and Universal Identifier Requirements

A. Requirement for Registration in the System for Award Management (SAM)

Unless the Recipient is exempted from this requirement under 2 CFR 25.110, the Recipient must maintain the currency of its information in SAM until the Recipient submits the final financial report required under this Award or receive the final payment, whichever is later. This requires that the Recipient reviews and updates the information at least annually after the initial registration, and more frequently if required by changes in its information or another award term.

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

If the Recipient is authorized to make subawards under this Award, the Recipient:

i. Must notify potential subrecipients that no entity (see definition in paragraph C of this award term) may receive a subaward from the Recipient unless the entity has provided its DUNS number to the Recipient.

ii. May not make a subaward to an entity unless the entity has provided its DUNS number to the Recipient.

C. Definitions

For purposes of this award term:

i. 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 https://www.sam.gov).

ii. 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).

iii. Entity, as it is used in this award term, means all of the following, as defined at 2 CFR Part 25, subpart C:

1. A Governmental organization, which is a State, local government, or Indian Tribe.
2. A foreign public entity.
3. A domestic or foreign nonprofit organization.
4. A domestic or foreign for-profit organization.
5. A Federal agency, but only as a subrecipient under an award or subaward to a non-Federal entity.

iv. Subaward:

1. This term means a legal instrument to provide support for the performance of any portion of the substantive project or program for which the Recipient received this Award and that the Recipient awards to an eligible subrecipient.
2. The term does not include the Recipient's procurement of property and services needed to carry out the project or program (for further explanation, see 2 CFR 200.501 Audit requirements, (f) *Subrecipients and Contractors* and/or 2 CFR 910.501 Audit requirements, (f) *Subrecipients and Contractors*).
3. A subaward may be provided through any legal agreement, including an agreement that the Recipient considers a contract.

v. Subrecipient means an entity that:

1. Receives a subaward from the Recipient under this Award; and
2. Is accountable to the Recipient for the use of the Federal funds provided by the subaward.

Term 38. Nondisclosure and Confidentiality Agreements Assurances

A. By entering into this agreement, the Recipient attests that it **does not and will not** require its employees or contractors to sign internal nondisclosure or confidentiality agreements or statements prohibiting or otherwise restricting its employees or contactors from lawfully reporting 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 further attests that it **does not and will not** use any Federal funds to implement or enforce any nondisclosure and/or confidentiality policy, form, or agreement it uses unless it contains the following provisions:

i. *''These provisions are consistent with and do not supersede, conflict with, or otherwise alter the employee obligations, rights, or liabilities created by existing statute or Executive order relating to (1) classified information, (2) communications to Congress, (3) the reporting to an Inspector General of a violation of any law, rule, or regulation, or mismanagement, a gross waste of funds, an abuse of authority, or a substantial and specific danger to public health or safety, or (4) any other whistleblower protection. The definitions, requirements, obligations, rights, sanctions, and liabilities created by controlling Executive orders and statutory provisions are incorporated into this agreement and are controlling.''*

ii. The limitation above shall 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.

iii. Notwithstanding provision listed in paragraph (a), a nondisclosure or confidentiality policy form or agreement that is to be executed by a person connected with the conduct of an intelligence or intelligence-related activity, other than an employee or officer of the United States Government, may contain provisions appropriate to the particular activity for which such document is to be used. Such form or agreement shall, at a minimum, require that the person will not disclose any classified information received in the course of such activity unless specifically authorized to do so by the United States Government. Such nondisclosure or confidentiality forms shall also make it clear that they do not bar disclosures to Congress, or to an authorized official of an executive agency or the Department of Justice, that are essential to reporting a substantial violation of law.

Term 39. Subrecipient and Vendor Approvals

A. The Recipient must obtain written approval by the Contracting Officer for reimbursement of costs associated with subrecipients/activities/vendors listed in paragraph B. below. The Recipient is restricted from expending project funds (i.e., Federal share and Recipient share) on the subrecipients' and/or vendors' supporting the tasks identified in paragraph B. below unless and until the Contracting Officer provides written approval. At its discretion, EERE may not reimburse costs incurred prior to the date of any such written approval by the Contracting Officer.

B. Contracting Officer approval as set out above is required for the following:

Task #	Activity and Subrecipients /Vendor	Total Amount ($)
4	Materials for EI&C of Aeration Tank Instrumentation	$280,000
4	Materials for EIC of for blower installation	$110,250

Task #	Activity and Subrecipients /Vendor	Total Amount ($)
6	On-Call Electrical Services Vendor for installation of conduit and supports (incl. 15% general contractor cost)	$207,000
6	Job Order Contract -Contractor for fabrication and installation of new blower discharge piping and supports. (incl. 15% general contractor cost)	$138,000

The Contracting Officer may require additional information concerning these tasks prior to providing written approval.

C. Upon written approval by the Contracting Officer, the Recipient may then receive payment for the tasks identified in paragraph B. above for allowable costs incurred, or EERE will recognize costs incurred toward cost share requirements, if any, in accordance with the payment provisions contained in the Special Terms and Conditions of this agreement.

Term 40. Subrecipient Change Notification

Except for subrecipients specifically proposed as part of the Recipient's Application for award, the Recipient must notify the Contracting Officer and Project Manager in writing 30 days prior to the execution of new or modified subrecipient agreements, including naming any To Be Determined subrecipients. This notification does not constitute a waiver of the prior approval requirements outlined in 2 CFR part 200 as amended by 2 CFR part 910, nor does it relieve the Recipient from its obligation to comply with applicable Federal statutes, regulations, and executive orders.

In order to satisfy this notification requirement, the Recipient documentation must, as a minimum, include the following:

- A description of the research to be performed, the service to be provided, or the equipment to be purchased.
- Cost share commitment letter if the subrecipient is providing cost share to the Award.
- An assurance that the process undertaken by the Recipient to solicit the subrecipient complies with their written procurement procedures as outlined in 2 CFR 200.317 through 200.329.
- An assurance that no planned, actual or apparent conflict of interest exists between the Recipient and the selected subrecipient and that the Recipient's written standards of conduct were followed.[1]

[1] It is DOE's position that the existence of a "covered relationship" as defined in 5 CFR 2635.502(a)&(b) between a member of

- A completed Environmental Questionnaire, if applicable.
- An assurance that the subrecipient is not a debarred or suspended entity.
- An assurance that all required award provisions will be flowed down in the resulting subrecipient agreement.

The Recipient is responsible for making a final determination to award or modify subrecipient agreements under this agreement, but the Recipient may not proceed with the subrecipient agreement until the Contracting Officer determines, and provides the Recipient written notification, that the information provided is adequate.

Should the Recipient not receive a written notification of adequacy from the Contracting Officer within 30 days of the submission of the subrecipient documentation stipulated above, the Recipient may proceed to award or modify the proposed subrecipient agreement.

Term 41. Conference Spending

The Recipient shall not expend any funds on a conference not directly and programmatically related to the purpose for which the grant or cooperative agreement was awarded that would defray the cost to the United States Government of a conference held by any Executive branch department, agency, board, commission, or office for which the cost to the United States Government would otherwise exceed $20,000, thereby circumventing the required notification by the head of any such Executive Branch department, agency, board, commission, or office to the Inspector General (or senior ethics official for any entity without an Inspector General), of the date, location, and number of employees attending such conference.

Term 42. Recipient Integrity and Performance Matters

A. General Reporting Requirement

If the total value of your currently active Financial Assistance awards, cooperative agreements, and procurement contracts from all Federal awarding agencies exceeds $10,000,000 for any period of time during the period of performance of this Federal award, then you as the recipient during that period of time must maintain the currency of information reported to the System for Award Management (SAM) that is made available in the designated integrity and performance system (currently the Federal Awardee Performance and Integrity Information System (FAPIIS)) about civil, criminal, or administrative proceedings described in paragraph 2 of this term. This is a statutory requirement under section 872 of Public Law 110-417, as amended (41 U.S.C. 2313). As required by section 3010 of Public Law 111-212, all information posted in the designated integrity and performance system on or after April 15,

---

the Recipient's owners or senior management and a member of a subrecipient's owners or senior management creates at a minimum an apparent conflict of interest that would require the Recipient to notify the Contracting Officer and provide detailed information and justification (including, for example, mitigation measures) as to why the subrecipient agreement does not create an actual conflict of interest. The Recipient must also notify the Contracting Officer of any new subrecipient agreement with: (1) an entity that is owned or otherwise controlled by the Recipient; or (2) an entity that is owned or otherwise controlled by another entity that also owns or otherwise controls the Recipient, as it is DOE's position that these situations also create at a minimum an apparent conflict of interest.

2011, except past performance reviews required for Federal procurement contracts, will be publicly available.

B. Proceedings About Which You Must Report

Submit the information required about each proceeding that:

i. Is in connection with the award or performance of a Financial Assistance, cooperative agreement, or procurement contract from the Federal Government;

ii. Reached its final disposition during the most recent five-year period; and

iii. Is one of the following:

1. A criminal proceeding that resulted in a conviction, as defined in paragraph E of this award term and condition;
2. A civil proceeding that resulted in a finding of fault and liability and payment of a monetary fine, penalty, reimbursement, restitution, or damages of $5,000 or more;
3. An administrative proceeding, as defined in paragraph E of this term, that resulted in a finding of fault and liability and your payment of either a monetary fine or penalty of $5,000 or more or reimbursement, restitution, or damages in excess of $100,000; or
4. Any other criminal, civil, or administrative proceeding if:
    a. It could have led to an outcome described in paragraph B.iii.1, 2, or 3 of this term;
    b. It had a different disposition arrived at by consent or compromise with an acknowledgment of fault on your part; and
    c. The requirement in this term to disclose information about the proceeding does not conflict with applicable laws and regulations.

C. Reporting Procedures

Enter in the SAM Entity Management area the information that SAM requires about each proceeding described in paragraph B of this term. You do not need to submit the information a second time under assistance awards that you received if you already provided the information through SAM because you were required to do so under Federal procurement contracts that you were awarded.

D. Reporting Frequency

During any period of time when you are subject to the requirement in paragraph A of this term, you must report proceedings information through SAM for the most recent five-year period, either to report new information about any proceeding(s) that you have not reported previously or affirm that there is no new information to report. Recipients that have Federal contract, Financial Assistance awards, (including cooperative agreement awards) with a cumulative total value greater than $10,000,000, must disclose semiannually any information about the criminal, civil, and administrative proceedings.

E. Definitions

For purposes of this term:

i. Administrative proceeding means a non-judicial process that is adjudicatory in nature in order to make a determination of fault or liability (e.g., Securities and Exchange Commission Administrative proceedings, Civilian Board of Contract Appeals proceedings, and Armed Services Board of Contract Appeals proceedings). This includes proceedings at the Federal and State level but only in connection with performance of a Federal contract or Financial Assistance awards. It does not include audits, site visits, corrective plans, or inspection of deliverables.

ii. Conviction means a judgment or conviction of a criminal offense by any court of competent jurisdiction, whether entered upon a verdict or a plea, and includes a conviction entered upon a plea of *nolo contendere*.

iii. Total value of currently active Financial Assistance awards, cooperative agreements and procurement contracts includes—

1. Only the Federal share of the funding under any Federal award with a recipient cost share or match; and
2. The value of all expected funding increments under a Federal award and options, even if not yet exercised.

Term 43. Export Control

The U.S. government regulates the transfer of information, commodities, technology, and software considered to be strategically important to the U.S. to protect national security, foreign policy, and economic interests without imposing undue regulatory burdens on legitimate international trade. There is a network of federal agencies and regulations that govern exports that are collectively referred to as "Export Controls." To ensure compliance with Export Controls, it is the Recipient's responsibility to determine when its project activities trigger Export Controls and to ensure compliance.

Certain information, technology or material under an award may be considered export-controlled items that cannot be released to any foreign entity (organization, company, or person) without a license. All recipients, including subrecipients, must take the appropriate steps to obtain any required licenses, monitor and control access to restricted information and material, and safeguard all controlled items to ensure compliance with Export Controls. Under no circumstances may any foreign entity (organizations, companies, or persons) receive access to an export-controlled item unless proper export procedures have been satisfied and such access is authorized pursuant to law or regulation.

The Recipient shall immediately report to DOE any export control violations related to the project funded under this award, at the recipient or subrecipient level, and provide the corrective action(s) to prevent future violations.

Term 44. Table of Personnel

Prior to award, the Recipient submitted the Table of Personnel, which lists individuals performing work on the project, both at the recipient and subrecipient level. During the life of the Award, the Recipient must notify DOE of changes to personnel performing work on the

project and submit an updated Table of Personnel as personnel changes occur. The updated Table of Personnel must include the individuals' names, job titles, role in the project, and their organization.

Term 45. Current and Pending Support

Prior to award, the Recipient was required to provide current and pending support disclosure statements for each principal investigator (PI) and senior/key personnel, including subrecipients, regardless of funding source. In accordance with the Federal Assistance Reporting Checklist, throughout the life of the award, the Recipient must submit current and pending support disclosure statements for any new PI and senior/key personnel, including subrecipients, added to the project funded under this Award within thirty (30) days of the individual joining the project. In addition, if there are any changes to current and pending support disclosure statements previously submitted to DOE, the Recipient must submit updated current and pending disclosure statements within thirty (30) days of the change. The Recipient must ensure the PI and senior/key personnel, including subrecipients, are aware of the requirement to submit updated current and pending support disclosure statements to DOE.

Current and pending support is intended to allow the identification of potential duplication, overcommitment, potential conflicts of interest or commitment, and all other sources of support. Each PI and senior/key person at the recipient and subrecipient level must provide a list of all sponsored activities, awards, and appointments, whether paid or unpaid; provided as a gift with terms or conditions or provided as a gift without terms or conditions; full-time, part-time, or voluntary; faculty, visiting, adjunct, or honorary; cash or in-kind; foreign or domestic; governmental or private-sector; directly supporting the individual's research or indirectly supporting the individual by supporting students, research staff, space, equipment, or other research expenses. All foreign government-sponsored talent recruitment programs must be identified in current and pending support.

For every activity, list the following items:

- The sponsor of the activity or the source of funding.
- The award or other identifying number.
- The title of the award or activity. If the title of the award or activity is not descriptive, add a brief description of the research being performed that would identify any overlaps or synergies with the proposed research.
- The total cost or value of the award or activity, including direct and indirect costs and cost share. For pending proposals, provide the total amount of requested funding.
- The award period (start date – end date).
- The person-months of effort per year being dedicated to the award or activity.
- Identify any overlap, duplication of effort, or synergistic efforts, with a description of the other award or activity to the current and pending support.
- Details of any obligations, contractual or otherwise, to any program, entity, or organization sponsored by a foreign government must be provided to DOE.

Each PI and senior/key personnel must provide a separate disclosure statement listing the

required information above regarding current and pending support. The individual must sign and date their respective disclosure statement and include the following certification statement:

> I, [Full Name and Title], certify to the best of my knowledge and belief that the information contained in this Current and Pending Support Disclosure Statement is true, complete and accurate. I understand that any false, fictitious, or fraudulent information, misrepresentations, half-truths, or omissions of any material fact, may subject me to criminal, civil or administrative penalties for fraud, false statements, false claims or otherwise. (18 U.S.C. §§ 1001 and 287, and 31 U.S.C. 3729-3730 and 3801-3812). I further understand and agree that (1) the statements and representations made herein are material to DOE's funding decision, and (2) I have a responsibility to update the disclosures during the period of performance of the award should circumstances change which impact the responses provided above.

The information may be provided in the format approved by the National Science Foundation (NSF), which may be generated by the Science Experts Network Curriculum Vita (SciENcv), a cooperative venture maintained at https://www.ncbi.nlm.nih.gov/sciencv/, and is also available at https://www.nsf.gov/bfa/dias/policy/nsfapprovedformats/cps.pdf. The use of a format required by another agency is intended to reduce the administrative burden to researchers by promoting the use of common formats. If the NSF format is used, the individual must still include a signature, date, and a certification statement using the language included in the paragraph above.

Term 46. Financial Conflict of Interest

The Recipient must have a written and enforced administrative process to identify and manage Financial Conflicts of Interest (FCOI) with respect to all projects for which DOE funding is sought or received. When requested, the Recipient must promptly make information available to the DOE Contracting Officer relating to any disclosure of financial interests and the Recipient's review of, and response to, such disclosure, whether or not the disclosure resulted in the Recipient's determination of an FCOI.

The Recipient is responsible for ensuring subrecipient compliance with this term and reporting identified financial conflicts of interests for the subrecipient to the DOE Contracting Officer. The Recipient must incorporate as part of a written agreement with a subrecipient terms that establish whether the Financial Conflict of Interest policy of the Recipient Institution or that of the subrecipient will apply to subrecipient.

Term 47. Organizational Conflict of Interest

If the Recipient has a parent, affiliate, or subsidiary organization that is not a state, local government, or Indian tribe, the Recipient must also maintain written standards of conduct covering organizational conflicts of interest. Organizational conflicts of interest are those where, because of relationships with a parent company, affiliate, or subsidiary organization, the

Recipient is unable or appears to be unable to be impartial in conducting an award or procurement action involving a related organization.

The Recipient must disclose in writing any potential organizational conflict of interest to the DOE Contracting Officer. If the effects of the potential or actual organizational conflict of interest cannot be avoided, neutralized, or mitigated before award, the entity must recuse themselves from participating in the award. If an organizational conflict of interest is identified after award and the effects cannot be avoided, neutralized or mitigated, DOE may terminate the award unless continued performance is determined to be in the best interest of the Federal government.

The Recipient is responsible for ensuring subrecipient compliance with this term and reporting identified financial conflicts of interests for the subrecipient to the DOE Contracting Officer. The Recipient must incorporate as part of a written agreement with a subrecipient terms that establish whether the Organizational Conflict of Interest policy of the Recipient Institution or that of the subrecipient will apply to subrecipient.

Term 48. Prohibition on Certain Telecommunications and Video Surveillance Services or Equipment

As set forth in 2 CFR 200.116, recipients and subrecipients are prohibited from obligating or expending project funds (federal funds and recipient cost share) to:

(1) Procure or obtain;

(2) Extend or renew a contract to procure or obtain; or

(3) Enter into a contract (or extend or renew a contract) to procure or obtain equipment, services, or systems that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. As described in Public Law 115-232, section 889, covered telecommunications equipment is telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities).

(i) For the purpose of public safety, security of government facilities, physical security surveillance of critical infrastructure, and other national security purposes, video surveillance and telecommunications equipment produced by Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities).

(ii) Telecommunications or video surveillance services provided by such entities or using such equipment.

(iii) Telecommunications or video surveillance equipment or services produced or provided by an entity that the Secretary of Defense, in consultation with the Director of the National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

See Public Law 115-232, section 889 for additional information.

Statement of Project Objectives
Carollo Engineers, Inc.
Transforming Aeration Energy in Water Resource Recovery Facilities (WRRFs) through Suboxic Nitrogen Removal

A. Project Objectives

Goals

This project advances two technological components associated with suboxic nitrogen removal (SNR) through the following three project goals:

1. Advancing the model predictive aeration control (MPAC) technology DO/Nmaster from its first 2018 pilot implementation at the Chico Water Resource Recovery Facility (WRRF)), CA, to full-scale integration with the Blower Technology Commercialization Partner for U.S. wide commercialization.
2. Filling fundamental process knowledge gaps of SNR process operation under controlled pilot-tests at the Pilot Testing Facility to develop kinetic relationships for process modeling and reliable SNR control, operation, and design.
3. Advancing low Dissolved Oxygen (DO)/SNR coupled with MPAC from pilot to full-scale demonstration for flow-through BNR activated sludge treatment for U.S. wide commercialization.

Objectives

These goals are met by completing our project objectives, which we have grouped into three areas:

1. **Scientific Process Understanding.** Address critical questions related to SNR:
   a. Successful operational strategies for microbial acclimation to low DO.
   b. Kinetic and process limitations.
   c. Key microbial populations and metabolic functions.
   d. Aeration control performance specifications.
   e. Process stability and resilience over a range of wastewater temperatures.
   f. Sludge settleability and mitigation strategies.
   g. Enhanced biological phosphorus removal stability (i.e., Phosphorus (P) uptake kinetics).
   h. Greenhouse gas emissions.
   i. Organic carbon demand distribution and carbon diversion potential.

These objectives will be addressed in Phase 1 during pilot-scale investigations at the Pilot Testing Facility.

2. **Engineering Design and Operational Boundary Conditions.** Define engineering and operational technology factors for successful technology commercialization:
   a. Process modeling kinetic rates, stochiometric parameters, and switching functions for process modeling and design.
   b. Oxygen transfer efficiencies and design sludge volume indices (SVI).
   c. Capacity rating (minimum sludge residence times (SRTs) vs. temperature vs. DO, volumetric loading rates, minimum hydraulic residence time, footprint).
   d. Standard operating procedures for process transitioning/adaptation/MPAC tuning.
   e. Aeration control system performance specifications.

f. Process optimization and troubleshooting guidance.
g. Mixer, diffuser, tank layout design.
h. Process EI&C, and suitable sensor technology (i.e., reliable low DO sensors).
i. Draft specifications, control descriptions, and operation and maintenance (O&M) manuals.

These objectives will all be addressed in Phases 1 and 2 during pilot- and full-scale investigations at the Pilot Testing Facility and the Full-Scale Testing Facility.

3. **Technology Evaluation and Commercialization.** This objective includes:
   a. Techno-Economic Analysis (TEAs) and Life-Cycle Analysis (LCAs) after Phase 1 and 2, respectively. Refine preliminary assessments.
   b. Technology packaging for commercialization.

These efforts will be led by Carollo Engineers, and the Blower Technology Commercialization Partner and Process Commercialization Partner, with support from Water Research Foundation (WRF) and both WRRF operations team.

End of Project Milestones

This project will be successfully completed when our team has achieved the following specific, measurable, achievable, relevant, and timely (SMART) technical milestones.

Milestone M11.1 (M 24): Documentation, publication, and dissemination of research findings through various channels, including WRF, the Process Commercialization Partner, and Blower Technology Commercialization Partner.

Milestone M11.2 (M24): Energy reduction for aeration in flow-through BNR secondary processes of domestic WRRFs by 30-50% through the implementation of MPAC and SNR, while reliably meeting stringent nutrient discharge limits without external carbon addition (NH4-N <1 mg/L, total inorganic nitrogen (TIN) <6 mg/L, total phosphorus (TP) <1 mg/L).

Milestone M11.3 (M24): Integration of MPAC DO/Nmaster as a standard programming component into the Blower Technology Commercialization Partner's blower control logic, achieving a control accuracy of less than 10% covariance of control setpoints (DO or ammonia).

Milestone M11.4 (M24): Demonstrate carbon savings of at least 15% through MPAC and SNR operation in the liquid stream treatment process of domestic BNR WRRFs. The carbon saved through this approach then can be utilized for (1) additional nitrogen and phosphorus removal, minimizing the external carbon (i.e., methanol, acetic acid, or MicroC) supplementation requirement and/or (2) energy recovery in the solids treatment process.

B. Technical Scope Summary

.

Budget and Performance Period 1: Tasks 0 through 6 – (0 to 12 Months)

Task 0 - Task Summary: Conduct project management tasks, team coordination calls and (virtual) meetings, scope, budget, and schedule control, and progress reporting and invoicing for DOE.

Task 1 - Task Summary: Complete baseline TEA and LCA for the Pilot Testing Facility and the Full-Scale Testing Facility's secondary treatment prior to SNR and MPAC implementation.
Task 2 - Task Summary: Complete modifications to new pilot train for process testing at the Pilot Testing Facility. Install sensor and control integration. Finalize testing plan, quality assurance / quality control (QA/QC) procedures, and data managements protocols.
Task 3 - Task Summary: Initiate Phase 1 of the pilot-scale testing plan to adapt the BNR process to low DO under steady-state conditions to address objectives listed in Section A.

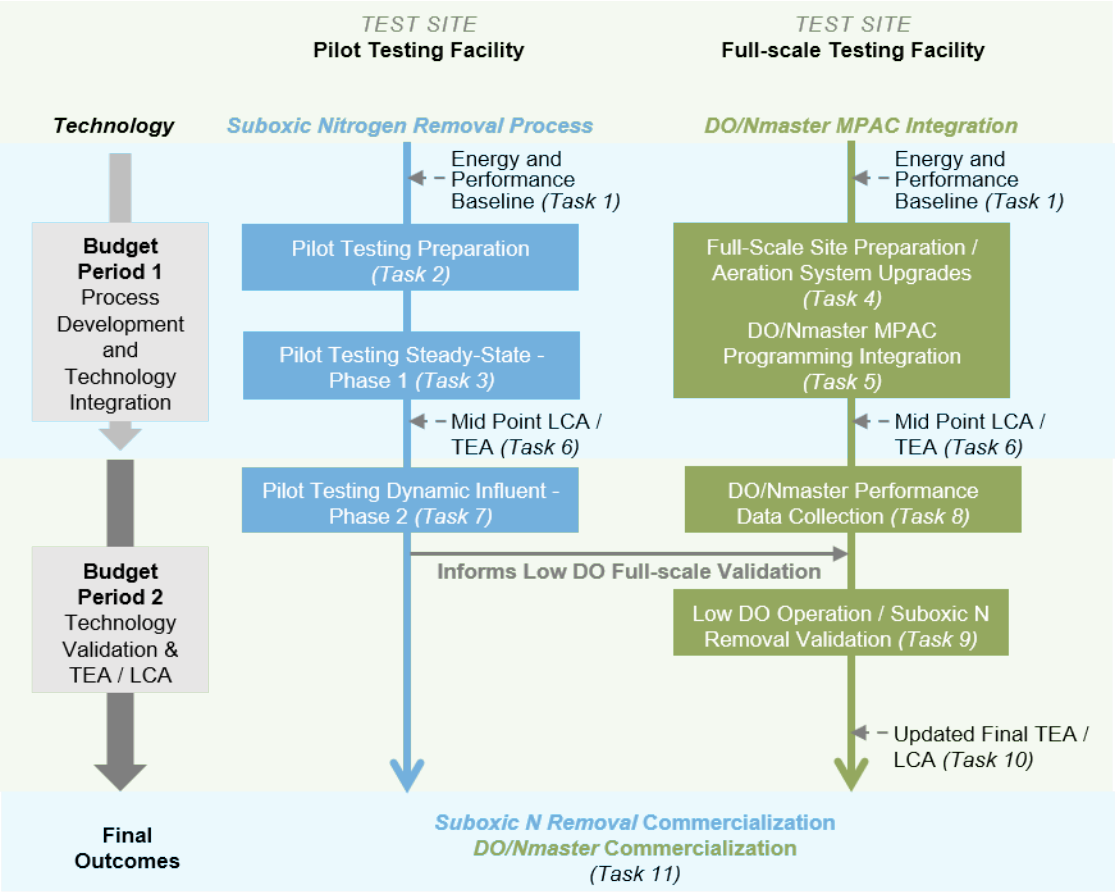

Figure 1: Research and commercialization workplan overview

Project Critical Go/No-go Decision Point 1

Assessment of pilot train process performance metrics based on targets listed in Table 1.

TABLE 1 Targeted improvements to the baseline technology and critical success factors in achieving project goals.

Figure 1: Research and commercialization workplan overview

TARGETED IMPROVEMENTS	UNITS	BASELINE STATUS	TARGET METRIC	CRITICAL SUCCESS FACTORS
Demonstrating SNR at full-scale for commercialization.	--	Extensive pilot-scale experience	Full-scale demonstration for flow through BNR in warm and cold climates (13 to 25°C).	• Operational procedures for transition to low DO. • Accurate aeration control.
Commercialization of model predictive control.	--	Limited to first pilot implemen-tation at Chico, CA	Software integration into standard Blower Technology Commercialization Partner's blower control software.	• Full-scale demonstration at recognized WRRF. • Adequate aeration system. Infrastructure.
Aeration control accuracy.	% co-variance around DO setpoint	20-40%	< 6 %	• Adequate aeration system infrastructure and online sensors.
Maximum DO concentration while maintaining full nitrification.	mg/L	1.5-4 in some or all aeration zones	< 0.5 in all aeration zones throughout the year under SNR operation	• Maintain effluent NH4-N< 1 mg/L.
Energy requirement for BNR aeration.	kWh/MG	850-1,500 (varies widely by WRRF)	< 650	• Predictive aeration control. • Power monitoring and submetering.
Energy equivalent of organic carbon diversion capacity.	Influent biochemical oxygen demand (BOD_5) /nitrogen removal; Influent chemical oxygen demand (COD)/nitrogen removal	Typically about BOD_5/TKN = 3 to 4	At least 15% primary carbon savings for energy recovery no/less carbon addition needed in form of chemicals (methanol, MicroC, etc.) to supplement for N & P removal.	• Carbon, N and P mass balance. • GHG emission testing.

Task 4 - Task Summary: Prepare the full-scale train at Pomona WRP with aeration system improvements for MPAC and required process monitoring equipment, data collection, and power monitoring. Full-Scale Testing Facility to implement a new high efficiency blower made by the Blower Technology Commercialization Partner (outside of this project funding), air flow meters and, as required, new air control valves in support of this testing.

Task 5 - Task Summary: Implement the DO/Nmaster MPAC at the Pomona WRP and integration into the Blower Technology Commercialization Partner's blower programming software. Loop testing and tuning

Performance Decision Points

- *Confirm accuracy of the air flow control is within specification limits stated in Table 1.*

Task 6 - Task Summary: Perform LCA and TEA using mid-point results from pilot testing of SNR at the Pilot Testing Facility. LCA and TEA for full-scale results from DO/Nmaster & the Blower Technology Commercialization Partner's blower control at the Full-scale Testing Facility for conventional DO setpoint operation.

Performance Decision Points

- *Preliminary assessment of full-scale process performance metrics based on targets listed in Table 2 and Table 3 for SNR at the Pilot Testing Facility and DO/Nmaster integration into Blower Technology Commercialization Partner's Blower programming at Pomona WRP.*

Expected End Results

- SNR performance targets and final effluent quality (Table 1) are reliably met at pilot-scale.
- Understanding which aeration control strategy (DO control vs. ammonia-based aeration control (ABAC)) is most successful in adapting microbiology to suboxic nitrification.
- Successful integration and operation of the DO/Nmaster MPAC technology into the Blower Technology Commercialization Partner's blower program.

Project Critical Go/No-go Decision Point 2

Assessment of performance results of Tasks 1 through 6 based on performance metrics summarized in Table 1.

Budget and Performance Period 2: Tasks 7 through 11 – (12 to 24 Months)

Task 7 - Task Summary: Conduct Phase 2 of the pilot-scale performance data collection under dynamic influent and SNR operation with focus on metrics listed in Table 1 and objectives listed in A. Test SNR performance under cold wastewater temperatures (as low as 13°C).

HYPOTHESIS #1: *Ammonia and nitrite oxidizing bacteria (ammonia oxidizing bacteria (AOB) and nitrite oxidizing bacteria (NOB)) will acclimate to low DO (Ko decreases while μ_{max} remains constant). Capacity is not impacted and SRT will not need to increase compared to conventional DO operation.*

Phase 1 Pilot Testing Approach: Pilot in VIP or anaerobic/anoxic/aerobic (A2O) configuration at steady aeration basin influent loading and constant average wastewater temperature (20°C), acclimate to low DO steadily and carefully. Maintain SRT while measuring Ko and μ_{max}.

HYPOTHESIS #2: *Nitrifiers acclimated to low DO conditions can buffer short-term ammonia peak loadings through (small) DO adjustments, similar to AOB and NOB acclimated to high DO concentrations, given sufficient steady-state SRT for the given wastewater temperature. It is critical to understand whether this is true to design adequate control responses that allow WRRFs to handle diurnal and other influent ammonia peaks.*

Phase 2 Pilot Testing Approach: After acclimation in Phase 1 Pilot Testing, apply normal diurnal loading and even slug load conditions to test response. Conduct dynamic processes

modelling of pilot test data. Test various aeration and operational control strategies for peak load handling.

Performance Decision Points

- *Kinetics are adequately described for a range of wastewater temperatures and process model is calibrated.*
- *Effluent quality meets specifications.*
- *Organic carbon demand is quantified.*
- *Pilot process performance meets target metrics listed in Table 1.*

Task 8- Task Summary: Full-scale process and performance data collection under "steady-state" MPAC operation at the Pomona WRP under conventional DO setpoints (0.5-2 mg/L).

Performance Decision Points

- *MPAC performance metrics meets reliability and accuracy requirements listed in Table 1 after calibration and tuning.*
- *Power savings of at least 10-30% with MPAC compared to baseline conditions prior to project initiation using conventional DO setpoints at the Pomona WRP.*

Task 9 - Task Summary: Decrease DO setpoints in the aerated zones in Pomona WRP's BNR process in a slow, gradual, and controlled fashion, while closely monitoring real-time process and secondary effluent quality, especially ammonia. Adapt the process to suboxic conditions.

Performance Decision Points

- *Effluent quality, process stability and reliability under low DO operation at full-scale (compared to target metrics listed in Table 1).*
- *Process saves between 30 and 50% electricity demand for blower operation compared to conventional baseline aeration. (established in Tasks 1 & 8)*
- *Carbon savings indicated by reduced N in final effluent.*

Task 10 - Task Summary: Perform LCA and TEA using based on results from pilot and full-scale testing.

Task 11 - Task Summary: Document relevant information needed for commercialization (see objectives in Section A). Outreach activities.

Expected End Results and Commercialization Go/No-go Decision Point 3

1. SNR performance targets and target criteria (Table 1) are achieved in full-scale operation at the Pilot and Validation site.
2. Power savings for aeration at the Pomona WRP of at least 20-50% compared to baseline conditions using conventional DO setpoints (see Figure 2).
3. Increase in organic carbon available for energy recovery or additional nutrient removal by at least 15%.

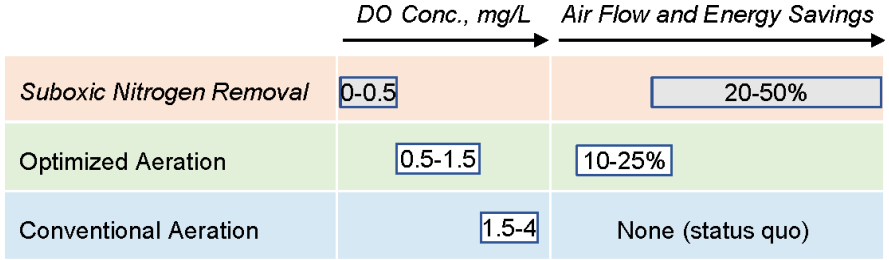

Figure 2: Target operating DO concentrations and energy savings of SNR compared to conventional and optimized BNR process operation at WRRFs.

C. Tasks To Be Performed

Budget and Performance Period 1: Tasks 0 through 6 – (0 to 12 Months)

Task 0 - Project Management and Reporting (Month 0-24): Under this task Carollo will plan, conduct, and document bimonthly team coordination calls and virtual meetings to facilitate and advance each task in agreement with scope, budget, and schedule. This task also includes coordination and updates for DOE, progress reporting, and invoicing per DOE requirements.

Milestone: M0.1 (M 1) Fully developed Project Management Plan (Deliverable).

Task 1- Energy and Performance Baseline (Month 0-2): Complete baseline TEA and LCA for the Pilot Testing Facility, and the secondary treatment at the Pomona WRP, CA, prior to SNR and MPAC implementation. The site selection represents a geographic diversity of BNR treatment processes with effluent quality requirements typical for domestic WRRFs other regions in the U.S. All LCAs and TEAs in this project will be conducted by Carollo Engineers, Inc., supported by its large database on operational expenditures (OPEX), capital expenditures (CAPEX), designs, carbon mass balances, and energy assessments. Process modeling will be conducted at both field sites to simulate baseline process operation and SNR process kinetics and performance. The open structure model Sumo© will be used by the Pilot Testing Facility & Carollo, Biowin will be used for the Pomona WRP.
TEA and LCA assessments will be conducted in DOE's prescribed format and refine the initial assessment summarized in Table 3 of the Technical Summary. The evaluation will be supported through historical data shared by the pilot and full-scale testing facilities on energy, greenhouse gas (GHG) emissions, process performance and operation.

Deliverable: Refined and completed Baseline TEA and LCA for Conventional BNR treatment (High DO and Proportional-Integral-Derivative (PID) based aeration control) at Pomona WRP, , CA and other representative WRRFs.

Milestone 1.1 (M 2): Baseline TEA and LCA completed. This includes the quantification of baseline metrics for typical activated sludge treatment processes used in the industry, including aeration demand (scfm per lbs N removal, scfm per lbs ammonia-N removal, etc.), effluent quality achieved (ammonia, nitrate, phosphorus, BOD_5, TSS), sludge settleability (sludge volume index (SVI), energy input (kwh/lbs N removed, kwh/mgd treated, etc.), and DO control variability, reliability, and accuracy. These baseline metrics will be use in later tasks as comparison to demonstrate the performance of SNR and the MPAC aeration control system.

Task 2 – Pilot Testing Preparation (Month 0-3): A new pilot-scale system with anoxic/oxic (A/O) configuration will be constructed at the Pilot Testing Facility. Complete construction and modifications to the Pilot Testing Facility's pilot train for process testing. Install additional sensors (nutrient, DO, ORP, etc.) and program advanced aeration control (DO, AvN, ABAC) for testing alternative aeration control strategies for best success with SNR microbial acclimatization

and process control. Establish Quality Assurance Project Plan (QAPP). Establish QA/QC procedures between different labs involved (Columbia University and Pilot Testing Facility), and data managements protocols. Finalize the testing plan for pilot experiments sequence and anticipated duration, hypothesis, analytical approach, timeline, and number of samples. Acquire materials and set up protocols for all analytical methods. Train MS student. Suitable sensor equipment for low DO monitoring and aeration control have already been identified by the Pilot Testing Facility.

Milestone 2.1 (M 3): 100% completion of the following deliverables: Fully equipped and functionally tested pilot train at the Pilot Testing Facility; extension of full-scale plant DCS to pilot established and functionally tested; testing and monitoring plan for pilot operation including the list of target operational conditions (influent flows and loads, SRT, wastewater temperature, effluent quality (BOD, TSS, COD, TIN, ammonia, TP), DO, and design criteria); Quality Assurance Project Plan (QAPP) completed.
Analytical methods and protocols set up. Baseline kinetic rates and greenhouse gas emission testing successfully completed. Aeration control performance testing completed and accuracy and reliability demonstrated per criteria listed in Table 1 (% co-variance around DO setpoint< 20 %).

Task 3 – SNR Pilot Testing at the Pilot Testing Facility/Phase 1 (Month 4-8): Initiate pilot-scale testing plan to address objectives listed in Section A. Experiments in Phase 1 will be conducted under steady state influent flows and loads, and under controlled wastewater temperature to collect fundamental kinetic information on nitrifier activity, nutrient removal, carbon mass balance, and other process and operational parameters.

- *Task 3.1. Pilot-scale Testing*
  The following phases will be included in the pilot-scale testing:

Baseline operation: The skid will be operated under normal DO condition (i.e., ~2.0 mg/L) and ABAC operation. The constant influent flow rate (1 gpm) will be used. and the temperature will be controlled at 20°C. The SRT will be controlled accordingly. Duration 2-4 weeks.
Transition to suboxic DO conditions: The system will be transitioned sequentially by approximately 0.2 mg/L to suboxic DO conditions, targeting a final DO concentration of 0.1–0.5 mg/L in all aerated zones. The following hypothesis will be tested:

HYPOTHESIS #1: *Ammonia and nitrite oxidizing bacteria (AOB and NOB) will acclimate to low DO (Ko decreases while μ_{max} remains constant). The treatment capacity will not impacted and SRT will not need to increase compared to conventional DO operation.*

The testing will verify this hypothesis addressing SNR performance uncertainties and will focus on the following areas. The Analytical Testing and Sampling Plan is proposed under Task 3.2.

a. Recommended operational strategies for microbial acclimation to low DO.
b. Most suitable aeration control strategy to maintain stable SNR performance (DO control vs. ABAC, PID aeration control vs. MPAC/machine learning).
c. Required aeration control performance accuracy for stable SNR control.

d. Process and nitrification stability and resilience at constant influent flows and loads, and average annual wastewater temperature.
e. Treatment capacity impact based on relationships of DO and SNR performance with kinetics, SRT, and sludge settleability.
f. Removal pathways for N and organic carbon and impact on GHG emissions.
g. Dominant signature microbial populations and functional roles under conventional DO operation and SNR.
h. Organic carbon demand, role of specific carbon fractions for SNR (e.g. rbCOD), and carbon diversion potential.
i. Sludge settleability impacts, dominant filaments (as applicable), and settling mitigation strategies.
j. Enhanced biological phosphorus removal stability (i.e., P uptake kinetics).

With support from the Pilot Testing Facility, Carollo Engineers will use SUMO to model the pilot train operation and performance and calibrate to steady-state conditions.

- *Task 3.2 Lab Analysis*
  The proposed Experimental and Analysis Plan is summarized in Table 2. The plan will be refined as part of Task 2.

TABLE 2 Task 3.2 Analytical Testing and Sampling Plan

Parameter	Location	Frequency	Responsibility
DO, ammonia, nitrate, air flow, temperature, TSS, N_2O	Aerobic zones	Online sensors	Pilot Testing Facility
Kinetic tests (NOB, AOB, OHO, PAOs), minimum substrate concentration (S_{min}), DO half saturation (K_{DO}), maximum growth rate (μ_{max}), nitrifier biomass yields, oxygen uptake rates (OUR), nitrifier OUR, simultaneous nitrification denitrification (SND) kinetics.	Mixed liquor	Weekly	Pilot Testing Facility, Academic Method Advisor
Genomics to characterize functional community groups and metabolism.	Mixed liquor	Biweekly Monthly	Academic Method Advisor
Offgas testing (GHGs - N_2O)	Mixed liquor	Biweekly Monthly	Academic Laboratory / Academic Method Advisor
SVI	Mixed liquor	Daily	Pilot Testing Facility
COD, nitrate, nitrite, ammonia, TP, OP, pH, alkalinity, TSS	Pilot influent, primary effluent, and secondary effluent	2-3x per week	Pilot Testing Facility
Phase contrast microscopy	Mixed liquor	1-2 per month	Pilot Testing Facility/ Carollo

Parameter	Location	Frequency	Responsibility
Ammonia, nitrate, nitrite, OP profile testing	Secondary influent, all aerated zones, secondary effluent	Weekly	Pilot Testing Facility
COD fractionation (and other process modeling calibration parameters)	Influent	2-3 Replicates	Pilot Testing Facility
TS, VS, flow	Primary and secondary waste sludges	Weekly	Pilot Testing Facility
Operating parameters, SRT, HRT, N, and COD volumetric loading rates	Full process	Daily	Pilot Testing Facility

Milestone 3.1 (M 8): Successful biological acclimation of the pilot operation to SNR conditions with the SRT used under normal BNR operating conditions at the full-scale VIP plant without compromising effluent quality per criteria established in Task 2, Milestone 2.1. Successful acclimatization characterized by the following criteria: DO in all aerobic zones >1 mg/L, SVI<150 mL/g, effluent ammonia <1 mg/L, at least 15% primary carbon savings for energy recovery while achieving equal or better N and P removal. GHG emissions (i.e. nitrous oxide) of the pilot aeration basins are quantified not significantly higher compared to baseline operational conditions measured in Task 2,

Performance Decision Points

- *Assessment of pilot train process performance metrics based on targets listed in Table 1.*

Go/no-go Decision Point 1: End of Task 3 – Month 6. Successful steady state pilot performance of SNR at Pilot Testing Facility. Technical criteria: Reliable effluent quality (see Table 1) at consistent conventional DO concentrations (>1-2 mg/L) in all aerated activated sludge zones.

Task 4 - Full-Scale Site Preparation (Month 0-6): Prepare the full-scale treatment train at Pomona WRP with aeration system improvements for MPAC and required process monitoring equipment, data collection, and power monitoring systems. The Full-Scale Testing Facility will implement a new high-efficiency blower made by the Blower Technology Commercialization Partner (outside of this project funding), air flow meters and, as required, new air control valves to support this testing. Aeration system upgrades will be implemented. The MPAC and real time SRT control will be implemented along with necessary infrastructures, including NO_3 probes, DO probes, ammonia probes, airflow valves, TSS probes, fast air flow meters. The Full-Scale Testing Facility will implement additional aeration system improvements that are planned independently from this project (e.g. blower implementation). Figure 3 shows one of the three parallel basins at this site. The necessary infrastructure and EI&C improvements will start immediately upon notice to proceed and are estimated to be completed within approximately 6 months.

Deliverables: NA

Milestone 4.1 (M 6): 100% completion of the integration and functional testing of process monitoring probes and sensors and the data collection system through SCADA.

Testing and monitoring plan for full-scale operation. Definition of target operational conditions (influent flows and loads, SRT, wastewater temperature, effluent quality (BOD, TSS, COD, TIN, ammonia, TP), DO in all aeration zones and performance metrics for SNR and MPAC technology); Quality Assurance Project Plan (QAPP) completed. Baseline kinetic rates and greenhouse gas emission testing successfully completed.

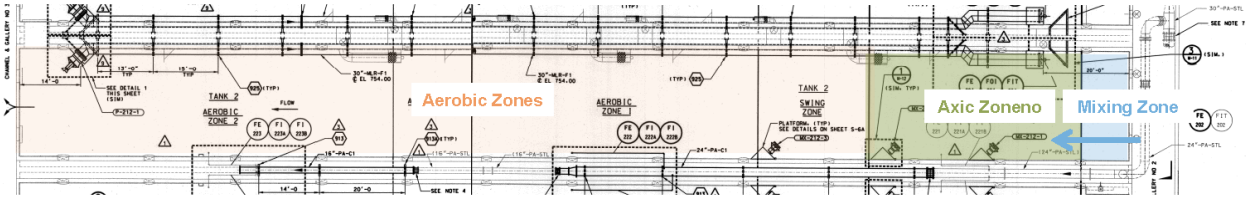

Figure 3: Pomona WRP Aeration Basins Layout (Typical of Three).

Task 5 - DO/Nmaster MPAC Programming Integration at the Full-Scale Testing Facility (Month 7-12): Implementation of the DO/Nmaster MPAC at the Pomona WRP and integration into the Blower Technology Commercialization Partner's blower programming software. Loop testing and tuning.

- *Task 5.1: Implementation of the DO/Nmaster / Integration into the Blower Technology Commercialization Partner's Blowers Programming*

  MPAC at the Pomona WRP will be integrated with the Blower Technology Commercialization Partner's blower programming software. Implementation of the DO/Nmaster involves implementing the controller hardware and software into the existing EI&C and SCADA infrastructure. Carollo will perform Biowin process modeling, which will be calibrated with the data from the Pomona WRP. The Biowin modeling will inform the initial set up of the Blower Technology Commercialization Partner's blower controller. This task is supported by the APC System Commercialization Partner.

- *Task 5.2: Air Flow Loop Set Up*

  The APC System Commercialization Partner will lead this task. The airflow will be controlled using traditional PID control algorithm. For a period of two months or less they will collect data, such as valve positions, airflow for each valve, and pressure and blower speed for blowers. Using a Random Forest and Case Base Reasoning algorithms, they will develop non-formal models and optimization tools that will allow precisely controlling airflow while maintaining the lowest possible pressure in the aeration system. The algorithms will be calibrated with the DO/Nmaster database to the client SCADA. The goal is achieving median airflow accuracy of 6% or better.

- *Task 5.3: DO Loop Set Up*

  Relationships between airflow and DO will be established through step tests and process performance data will be collected for approximately a month. Using historical data and special tests results, time-series analysis will be conducted to customize DO control algorithms. A10% median accuracy or 0.15 mg/L (whatever is higher) at constant DO set

point will be achieved with a 50% or less excess at the change of the set point. The goal will be to achieve new DO set point within 30 minutes after a change of the set point.

- *Task 5.4: Ammonia Loop Set Up*

  Following the same approach as in task 5.3, relationships between airflow, DO, and ammonia will be established with a median accuracy of 1 mg/L.

Milestone M5.1 (M 12): Successful integration and testing of DO/Nmaster into the Blower Technology Commercialization Partner's blower programming with median airflow accuracy of equal or greater than 6%, median DO control accuracy of 10% or 0.15 mg/L (whichever is higher) and median ammonia control accuracy of 1 mg/L N. Successful functional testing of aeration control under the following strategies: DO setpoint control, ammonia setpoint control, air flow setpoint control. Process SRT and aeration operation controlled by the Blower Technology Commercialization Partner's program from hereon without interruption.

Performance Decision Points

- *Confirm accuracy of the air flow control is within specification limits stated in Table 1.*

Go/no-go Decision Point 2: End of Task 5 – Month 12. Successful integration of DO/Nmaster into the Blower Technology Commercialization Partner's blower programming. Accurate scfm, DO, and ammonia control loop setup and tuning.

Task 6- Mid Point LCA and TEA (Month 13-14): Midpoint LCA and TEA will be completed using mid-point results from pilot and full-scale test results for SNR and MPAC at the Pilot Testing Facility and the Full-Scale Testing Facility for conventional DO setpoint operation (i.e., with ~ 2 mg/L DO). Process, performance, and energy data will be collected, stored, and transferred to Carollo Engineers, Inc. by the Pilot Testing Facility and the Full-Scale Testing Facility for evaluation as part of the LCA and TEA assessments. The analysis will be conducted following DOE's established format and procedures.

Performance Decision Points

- *Assessment of baseline process and GHG performance and stability metrics based on targets listed in Table 1 and Milestone 3.1 for SNR at the Pilot Testing Facility compared to ultimate test conditions for SNR process performance.*
- *Assessment of baseline process, GHG, and energy performance and stability metrics based on targets listed in Table 1 and Milestone 5.1 for SNR and MPAC at Pomona WRP compared to ultimate test conditions for SNR process performance.*
- *Assessment of level of effort and costs for SRT Master and DO/Nmaster control integration and tuning as part of the Blower Technology Commercialization Partner's blower software for future pricing development of the commercialized technology.*

Expected End Results

- SNR performance targets and final effluent quality (Table 1 and Milestones 3.1) are reliably met at pilot-scale.

- Based on pilot testing at HSRD, understanding which aeration control strategy (DO control versus ABAC) is most successful in adapting microbiology to suboxic nitrification.
- Successful integration and operation of the DO/Nmaster MPAC technology into the Blower Technology Commercialization Partner's blower program.
- Energy saving for blower operation with MPAC at conventional DO setpoints of at least 20-30%.

Milestone M6.1 (M 14): The pilot process is able to achieve full nitrification (effluent ammonia < 1 mg/L) at DO concentrations (<0.7 mg/L, stretch goal <0.5), while keeping SVI<150 mL/g) at steady state conditions at similar SRTs operated under baseline conditions. GHG emissions are not significantly higher compared to conventional treatment (established in Milestone 3.1), Demonstrating aeration saving of at least 20-30% compare to conventional operation established in Task 3.

TABLE 3 Summarizes feasible risks and mitigation strategies for tasks conducted under Performance Period 1.

Task	Budget Period 1 – Risks and Challenges	Mitigation Strategies
Task 5	Aeration infrastructure limitations. Oversized equipment at the Full-Scale Testing Facility's Pomona WRP resulting in aeration control limitations.	DOE funding reserved for necessary aeration improvements to assure sufficient control accuracy.
Task 5	Lack of SRT control at the Full-Scale Testing Facility's Pomona WRP resulting in loss of nitrification unrelated to air supply.	DOE funding reserved to add necessary sensors to allow real-time solids inventory control and monitoring.
Task 4	Project schedule delays during construction.	Prioritization of construction and upgrade tasks in the project. Task orders for the Pilot Testing Facility and the Full-Scale Testing Facility sites will be executed in parallel with dedicated staffing resources.
Task 3	Difficulties to acclimate biomass to SNR conditions in the pilot system within the task timeline due to limitations characteristics to the scale of the pilot test system.	Start SNR acclimatization under steady state flows and load conditions and medium wastewater temperature to better understand process kinetics and operational boundary conditions, prior to adding more complexity.
Task 3	SNR results from pilot scale may not convince WRRFs because pilots are not truly representatives of the complexity and challenges encountered at full scale.	Even though the pilot facility satisfies DOEs requirements under this FOA SNR and MPAC operation need to be validated at full-scale and be operated by WRRFs operations staff (not researchers) in order to prove to the wastewater industry that this technology is ready for commercialization. This will be tested in Budget Period 2.

Budget and Performance Period 2: Tasks 7 through 11 – (12 to 24 Months)

Task 7- SNR Pilot Testing at the Pilot Testing Facility/Phase 2 (Month 9-14): In Phase 2 the SNR pilot tests at the Pilot Testing Facility will be modified to assess performance under realistic BNR operating conditions, testing the impact of diurnal flow and load variations, seasonal temperature changes, and resilience to influent ammonia slug loads. The testing plan for this phase will be finalized after completion of Task 3 (Phase 1) testing. Data collection in Phase 2 follows in general the same parameters listed in Table 3. One key hypothesis addresses SNR resilience and capacity impacts. *It is critical to verify this hypothesis to design adequate control responses that allow WRRFs to handle diurnal and other influent ammonia peaks.*

HYPOTHESIS #2**:** *Nitrifiers acclimated to low DO conditions can buffer short term ammonia peak loadings through (small) DO adjustments, similar to AOB and NOB acclimated to high DO concentrations, (given sufficient long SRT that is wastewater temperature dependent).*

The dynamic process testing will be conducted along with dynamic processes modelling of the SNR pilot performance. Various aeration, SRT, and other operational control strategies (e.g., for mixed liquor recycling, intermittent aeration, etc.) can be tested to determine best process stability, resilience, and ability for peak load handling.

Phase 2 of the pilot testing will focus on the evaluation of design concepts and operational process boundary conditions listed in Section A under the project objectives, specifically:

a. Process modeling kinetic rates, stochiometric parameters, and switching functions for process modeling and design.
a. Oxygen transfer efficiencies as a function of DO concentration and microbial floc characteristics.
b. Design sludge volume indices (SVI), floc morphology, prevalent filaments (if any) and settling behavior.
c. Capacity rating design guidance based on fundamental process kinetics and resulting rule-of-thumb design criteria: Minimum SRTs vs. temperature vs. DO, volumetric loading rates for ammonia and COD, minimum hydraulic residence time, relationship between COD load, HRT, SRT, MLSS, and clarifier SLR.
d. Standard operating procedures for process transitioning and adaptation.
e. Process EI&C, and suitable sensor technology (i.e., reliable low DO sensors).

These preliminary design findings from pilot scale will be further refined with data from full-scale validation testing in Task 9.

Milestone M7.1 (M 14): The pilot process is able to achieve full nitrification (effluent ammonia < 1 mg/L) at DO concentrations (<0.7 mg/L, stretch goal <0.5), while keeping SVI<150 mL/g) at dynamic influent flow and load conditions and seasonal variations in wastewater temperatures . Demonstration of 20-50% air flow with SNR compared to conventional operation with ~ 2 mg/L DO. This milestone validates SNR technology readiness for full-scale testing in Task 8 and defines process and design conditions for full-scale operation at the Pomona WRP.

Performance Decision Points

- *Kinetics are adequate understood for a range of wastewater temperatures.*
- *Pilot process performance meets target metrics listed in Table 1.*

- *Effluent quality meets specification even under dynamic influent conditions representative of full-scale BNR WRRFs.*
- *Organic carbon savings are quantified.*

Task 8 - DO/Nmaster Performance Testing at the Full-Scale Testing Facility (Month 14-16): Full-scale process and performance data collection under MPAC operation at the Pomona WRP under conventional DO setpoints (0.5-2 mg/L) in order to assess and quantify long-term energy and carbon savings for MPAC under conventional aeration setpoints. During the two months of process testing, the Full-Scale Testing Facility will collect air flows electricity consumption (from blower submeters), and process performance data listed in Table 4. In addition, kinetic, genomic, and offgas testing will be conducted to characterize the baseline process performance prior to Task 9 and in comparison, to the subsequent operation under low DO conditions.

TABLE 4 Task 8 Analytical and Sampling Plan for full scale testing at Pomona WRP.

Parameter	Location	Frequency	Responsibility
DO, airflow, ammonia, nitrate, air flow, temperature, TSS.	Aerobic zones	Online sensors	Full-Scale Testing Facility
Kinetic tests (NOB, AOB, HOB), minimum substrate concentration (S_{min}), DO half saturation (K_{DO}), maximum growth rate (μ_{max}), oxygen uptake rates (OUR), nitrifier OUR, simultaneous nitrification denitrification (SND) kinetics.	Mixed liquor	Once a month	Academic Method Advisor
Genomics to characterize functional community shifts.	Mixed liquor	Biweekly Monthly	Academic Method Advisor
Offgas testing (GHGs - N_2O).	Mixed liquor	Once a month	Academic Contractor and Academic Method Advisor
SVI	Mixed liquor	Daily	Full-Scale Testing Facility
COD, nitrate, nitrite, ammonia, pH, alkalinity, TSS.	Influent, primary effluent, and secondary effluent	2-3x per week	Full-Scale Testing Facility
Phase contrast microscopy.	Mixed liquor	1x per month	Carollo/Full-Scale Testing Facility
Ammonia, nitrate, nitrite, profile testing .	Secondary influent, all aerated zones, secondary effluent	Weekly	Full-Scale Testing Facility
COD fractionation (and other process modeling calibration parameters)	Influent	Once	Full-Scale Testing Facility
TS, VS, flow	Primary and secondary waste sludges	Weekly	Full-Scale Testing Facility
Operating parameters, SRT, HRT, N and BOD volumetric loading rates,	Full process	Daily	Full-Scale Testing Facility

Milestone 8.1 (M 16): Successful demonstration of aeration control with the implementation of MPAC at the full-scale system at Pomona WRP under conventional operating conditions with DO concentrations ranging from 0.5 to 2 mg/L. Demonstration of

anticipated energy savings for aeration of 10-30% compared to the baseline performance established in Task 4. This Milestone will demonstrate the technology performance of MPAC for utilities who may choose to implement this technology without SNR biological process operation.

Performance Decision Points

- *MPAC performance metrics meets reliability and accuracy requirements listed in Table 1 after calibration and tuning.*
- *Power savings of at least 10-30% with MPAC compared to baseline conditions prior to project initiation using conventional DO setpoints at the Pomona WRP.*

Task 9 - SNR Validation Testing at the Full-Scale Testing Facility (Month 17-22): Lower DO setpoints in the aerated zones in Pomona WRP's BNR process in a slow and controlled fashion while closely monitoring real-time process and secondary effluent quality, especially ammonia. Adapt the process to suboxic low DO conditions based on lessons learned from Task 3 (SNR Pilot test at the Pilot Testing Facility).

Process monitoring during the acclimatization will be conducted according to the same list of parameters and frequency listed in Table 4. Any full-scale testing plan and execution is ultimately subject to the final decision making of facility operations staff holding responsibility for facility operation and final effluent quality. The Pomona WRP site was selected among all of the Full-Scale Testing Facility's WRRFs as effluent at this facility can be by-passed discharge if it does not meet discharge requirements. This lowers the full-scale testing risk.

Carollo Engineers will use full-scale testing results to develop the following documents supporting design and commercialization of the SNR technology:

a. Draft specifications, control descriptions, and O&M manuals, aeration control system performance specifications
b. Process optimization and troubleshooting guidance.
c. Mixer, diffuser, tank layout design recommendations.

Milestone M9.1 (M 22): Successful transitioning of the full-scale system at Pomona WRP from conventional BNR system (DO 0.5–2 mg/L) to SNR system (DO < 0.7 mg/L, stretch goals 0.5 mg/L) after controlled, stepwise lowering of DO setpoints through MPAC controlled aeration while maintaining full nitrification (<1 mg/L ammonia-N) and stable SVI conditions (<150 mL/g). This milestone validates the technology readiness of the MPAC and SNR technology at full scale conditions in relevant and dynamic process conditions for a minimum length of three (3) SRT cycles.

Performance Decision Points

- *Effluent quality, process stability and reliability under low DO operation at full-scale (compared to target metrics listed in Table 1).*
- *Process saves between 30 and 50% electricity demand for blower operation compared to conventional baseline aeration (established in Tasks 1 & 8).*

- *Carbon savings indicated by reduced N in final effluent. (The Pomona WRP does not remove phosphorus.)*

Go/no-go Decision Point 3: End of Task 9 – Month 22. Successful pilot testing and full-scale validation of low DO / SNR, TEA and LCA under varying influent flows and loads and seasonally changing temperatures. supportive for successful commercialization.

Task 10 - Updated Final LCA & TEA (Month 23-24): Final LCA and TEA using results from full-scale Pomona WRF test site for SNR and MPAC for low DO operation. Process, performance, and energy data will be collected, stored, transferred by the Full-Scale Testing Facility to Carollo Engineers for evaluation as part of the LCA and TEA. The analysis will be conducted following DOE's established format and procedures.

Performance Decision Points

- *Final assessment of full-scale process performance metrics based on targets listed in Table 1 for SNR and DO/Nmaster integration into the Blower Technology Commercialization Partner's Blower programming at Pomona WRP.*

Milestone M10.1 (M 24): Using the data generated at the full-scale system Pomona WRP with system operation under SNR conditions (Milestone 9.1), demonstrate 20–50% energy saving and at least 15% primary carbon saving (for energy recovery).

Task 11 - Commercialization Plan (Month 23-24)

Summary documentation of relevant information needed for commercialization (see objectives in Section A). The outreach effort will be supported by The Water Research Foundation (WRF) and the Leadership Innovation Forum Technology (LIFT). The Water Research Foundation will distribute results to utilities throughout the U.S. and around the world. The commercialization plan by our Process Commercialization Partner and Blower Technology Commercialization Partner involves a series of activities, including: 1) Validating intellectual property for the sub-oxic concept, followed by 2) Defining the core equipment and knowhow for developing a workable solution, and finally 3) Developing the technology approach and the associated performance characteristics. The intellectual property associated with the sub-oxic concept may combine disclosures and additional means and methods that could be coded into an overall control concept within the control and equipment approach. The combination of equipment will be developed into an overall 'open source' technology approach for sub-oxic nitrogen removal that focuses on process intensification as well as reducing energy use. In addition, key design parameter ranges will be developed using a mathematical model, including SRT requirements, desired ranges of influent C/N ratio, treatment efficiency and typical effluent nitrogen ranges.

Expected End Results and Commercialization Go/No-go Decision Point

1. MPAC and SNR performance targets (accuracy metrics, process effluent performance and reliability target criteria listed in Table 1) are achieved in full-scale operation at the Pilot and Validation site.
2. Power savings for aeration at both facilities of at least 20-50% compared to baseline conditions using conventional DO setpoints (see Figure 2).

3. Increase in organic carbon available for energy recovery or additional nutrient removal by at least 15%.
4. MPAC technology as part of the Blower Technology Commercialization Partner's blower and software package can be commercialized at a cost competitive price to other facilities.

Milestone M11.1 (M 24): Documentation, publication, and dissemination of research findings through various channels, including WRF, our Process Commercialization Partner, and Blower Commercialization Partner.

Milestone M11.2 (M24): Energy reduction for aeration in flow-through BNR secondary processes of domestic WRRFs by 30-50% through the implementation of MPAC and SNR, while reliably meeting stringent nutrient discharge limits without external carbon addition (NH4-N <1 mg/L, total inorganic nitrogen (TIN) <6 mg/L, total phosphorus (TP) <1 mg/L).

Milestone M11.3 (M24): Integration of MPAC DO/Nmaster as a standard programming component into the Blower Technology Commercialization Partner's blower control logic, achieving a control accuracy of less than 10% covariance of control setpoints (DO or ammonia).

Milestone M11.4 (M24): Demonstrate carbon savings of at least 15% through MPAC and SNR operation in the liquid stream treatment process of domestic BNR WRRFs. The carbon saved through this approach then can be utilized for (1) additional nitrogen and phosphorus removal, minimizing the external carbon (i.e., methanol, acetic acid, or MicroC) supplementation requirement and/or (2) energy recovery in the solids treatment process.

TABLE 5 Risk and mitigation strategies for Performance Period 2.

Scope	Budget Period 2 – Risks and Challenges	Mitigation Strategies
Task 7	Aeration and process control may not be accurate enough at the pilot scale and under dynamic influent and wastewater temperatures to allow for stable SNR performance.	This may be due to challenges related to the small-scale operation of pilot facilities. Pilot-scale operation could be reduced to steady state operation at discrete conditions (e.g., high and low temperatures). Full scale testing can be used to assess SNR performance under variable operational conditions.
Task 9	SNR operation works at pilot scale but not in the field.	Full-scale testing and operation by operators is anticipated to bring new challenges. This is the intention of the full-scale validation work. If the technology is too complex to be operated by WRRF staff, it will not be ready for successful commercialization. These challenges will be discussed and solved collaboratively with operators, engineers, commercialization partners, and academia.
Task 9	Full-scale testing results in effluent exceedances of permit limits.	Effluent can be temporarily diverted to protect receiving water and water reuse. Funding under this grant will be used to install online sensors that provide early warning detection of process upset conditions. Plant staff maintain the ultimate decision on plant operation.

D. Project Management and Reporting

Progress/Technical and Financial Reporting: Periodic reports of technical and financial progress will be made to DOE Technology Manager and Technical Project Officer as required. Reports and other deliverables will be provided in accordance with the Federal Assistance Reporting Checklist following the instructions included therein.

DOE Project Kick-Off and Review Meetings: The Principal Investigator will prepare and make presentations to the DOE and awardee project teams to kick-off the project, present status of the project and results at periodic meetings with DOE during the course of the project, and present results and accomplishments at the annual Advanced Manufacturing Office Program Review meeting held either in Washington, DC, or at another location to be determined.

Final Technical Report and Presentation: The recipient will provide a draft of the Final Technical Report to the DOE Technology Manager and Technical Project Officer for review. Once approved, the recipient will upload the report to the address identified in the DOE Reporting Checklist to be released to the public (identified as unlimited rights data). This Report will not contain any protected data generated during the award, limited rights data (proprietary data), classified information, information subject to export control classification, Personally Identifiable Information (PII), or other information not subject to release. If the award results in the development of protected data, a second Final Technical Report will also be uploaded to the address identified in the DOE Reporting Checklist that contains the protected data, which will be protected and not available to the public for 5 years following their development. In addition, the recipient may be requested to prepare and present their findings to DOE at an end of project in a webinar or in-person meeting.

Deliverables project management are described in Task 0 and report tasks include the following as indicated in the task/subtask descriptions above:

1. Task 0 – Project Management Plan (PMP).
2. Task 1 – Technical Dataset (Refined and completed Baseline TEA and LCA for Conventional BNR treatment (High DO and PID based aeration control)).
3. Task 2 - Other (Quality Assurance Project Plan (QAPP))
4. Task 2 – Other (Pilot Testing Plan)
5. Task 2 – Technical Dataset (Performance comparison of DO probes in low concentration range)
6. Task 3 - Progress Report (Pilot Testing Phase 1 Results Report)
7. Task 6 - Mid-point LCA and TEA for suboxic N removal and MPAC integration.
8. Task 6 – Financial Report
9. Task 7 – Progress Report (Pilot Testing Phase 2 Results Report)
10. Task 8 - Technical Dataset / Technical Report (Full-Scale “MAPC with Conventional DO’s” Testing Report)
11. Task 8 - Financial Report
12. Task 9 – Technical Dataset / Technical Report (Full-Scale “MAPC with Low DO Operation” Testing Report)

13. Task 10 - Final Scientific / Technical Report (LCA and TEA for suboxic N removal and MPAC operation in full-scale BNR WRRF)
14. Task 11 – Invention Utilization Report (EERE 356)/ U.S. Manufacturing Report (EERE 358) / Software Deliverable Submission (Commercialization plan)
15. Task 11 – Financial Report

Milestone Summary Table	
Recipient Name:	Carollo Engineers, Inc.
Project Title:	Transforming Aeration Energy in WRRFs through Suboxic Nitrogen Removal

Task Number	Task Title	Milestone Type	Milestone Number*	Milestone Description (Go/No-Go Decision Criteria)	Milestone Verification Process	Anticipated Months from Start of the Project	Anticipated Quarters from Start of the Project
0	Project Management	Milestone	M0.1	Project Management Plan	Projection management, communication, information procedures.	2	1
1	Energy and Performance Baseline	Milestone	M1.0	Baseline TEA and LCA	Refined TEA and LCA at onset of project to establish anticipated technology benefits for Conventional BNR treatment (High DO and PID based aeration control.	2	1
2	Pilot Testing Preparation	Milestone	M2.1	Quality Assurance Project Plan (QAPP)	Establishes quality protocols for all testing conducted at the Pilot Testing Facility and the Full-Scale Testing Facility for all team members	3	1
2	Pilot Testing Preparation	Milestone	M2.1	Pilot Testing Plan	Refines the analytical and sampling protocols, and frequencies for all laboratory testing at the Academic Laboratory, the Pilot Testing Facility, and Full-Scale Testing Facility	3	1
2	Pilot Testing Preparation	Milestone	M2.1	Pilot Testing Facility pilot train commissioning	Pilot train and SCADA control successfully commissioned	3	1
2	Pilot Testing Preparation	Milestone	M2.1	Analytical methods and protocols set up.	Documentation of analytical methods and procedures for all team members and pilot and validation sites.	3	1
3	SNR Pilot Testing at the Pilot Testing Facility (Phase 1)	Milestone	M3.1	Pilot Testing Phase 1 Results Report	Summary evaluation of testing results of SNR pilot under steady state conditions.	8	2
3	SNR Pilot Testing at the Pilot Testing Facility (Phase 1)	Milestone Decision	M3.1	Successful Acclimatization to SNR conditions, effluent quality meets specs	Decide with independent technical project advisors on whether performance meets requirements for next project testing phase.	8	2
3	SNR Pilot Testing at the Pilot Testing Facility (Phase 1)	Milestone	M3.1	Calibrated process model	Independent tech advisor review of process model calibration quality to SNR performance data under steady state conditions.	8	2

Task Number	Task Title	Milestone Type	Milestone Number*	Milestone Description (Go/No-Go Decision Criteria)	Milestone Verification Process	Anticipated Months from Start of the Project	Anticipated Quarters from Start of the Project
3	SNR Pilot Testing at the Pilot Testing Facility (Phase 1)	Go/No-Go Decision Point	G/NG 1	Performance verification for steady state SNR performance at pilot scale.	Benchmarking to performance criteria established in Table 1 for this Task.	8	2
4	Full-scale Site Preparation	Milestone	M4.1	Completion of the integration and functional testing of process monitoring probes and sensors and the data collection system through SCADA.	Functional Performance Tests after commissioning.	6	. 2
5	Full-scale Site Preparation	Milestone	M5.1	Integration and testing of DO/Nmaster into the Blower Technology Commercialization Partner's blower programming with target airflow accuracy. Aeration control integration under the defined strategies.	Successful functional testing of aeration control under the following strategies: DO setpoint control, ammonia setpoint control, air flow setpoint control. Process SRT and aeration operation controlled by Blower Technology Commercialization Partner's program from hereon without interruption.	6	2
5	DO/Nmaster MPAC Programming Integration at Full-Scale Testing Facility	Go/No-Go Decision Point	G/NG 2	MPAC DO/Nmaster commissioning w/ Blower Technology Commercialization Partner's Blower Programming at the Full-Scale Testing Facility	Successful commissioning and performance testing of MPAC DO/Nmaster into Blower Technology Commercialization Partner's blower control program. Tuning meets performance criteria from Table 1.	15	5
6	Mid-Point TEA and LCA	Milestone	M6.1	Mid-point LCA and TEA	Mid-point development of LCA and TEA for SNR and MPAC integration at the he Pilot Testing Facility and MPAC at the Full-Scale Testing Facility.	14	5
6	Mid-Point TEA and LCA	Milestone Decision	M6.1	Energy savings benchmark comparison	Independent tech advisor review of energy saving with MPAC at conventional DO setpoints of at least 20-30%.	14	5

Task Number	Task Title	Milestone Type	Milestone Number*	Milestone Description (Go/No-Go Decision Criteria)	Milestone Verification Process	Anticipated Months from Start of the Project	Anticipated Quarters from Start of the Project
6	Mid-Point TEA and LCA	Milestone	M6.1	Financial Report	Review of project financial report after Budget Period 1.	12	4
7	SNR Pilot Testing at Piloti Testing Facility/Phase 2	Milestone	M7.1	Progress Report (Pilot Testing Phase 2 Results Report)	Summary evaluation of testing results of SNR pilot under dynamic conditions.	14	5
7	SNR Pilot Testing at Testing Facility /Phase 2	Milestone Decision	M7.1	Successful SNR operation under dynamic pilot conditions	Decide with independent technical project advisors on whether successful operation of SNR under dynamic conditions is met. Use pilot results to help set up the full-scale plant process model.	14	5
7	SNR Pilot Testing at Testing Facility /Phase 2	Milestone	M7.1	Calibrated dynamic process model.	Independent tech advisor review of process model calibration quality to SNR performance data under dynamic state conditions.	14	5
8	DO/Nmaster Performance Testing at the Full-Scale Testing Facility	Milestone	M8.1	MAPC with Conventional DO's Testing Report	MAPC under conventional DO settings meets target aeration control criteria under full scale dynamic process conditions.	16	5
8	DO/Nmaster Performance Testing at the Full-Scale Testing Facility	Milestone	M8.1	Successful SNR operation under dynamic full-scale conditions	Successful performance testing of MAPC at full-Scale Testing Facility validation site based on accuracy criteria defined in Table 1.	16	5
8	DO/Nmaster Performance Testing at the Full-Scale Testing Facility	Milestone Decision	M8.1	Financial Report	Review of project financial report prior to last long-term full-scale test.	16	5
9	SNR Validation Testing at the Full-Scale Testing Facility	Deliverable	M9.1	MAPC with Low DO Full scale Operation Testing Report	Define design criteria, O&M specifications and other technical information needed for commercializing.	22	8
9	SNR Validation Testing at the Full-Scale Testing Facility	Go/No-Go Decision Point	G/NG 3	Final technology performance verification for long-term full-scale SNR / MPAC.	Independent tech advisor review of validation results of low DO / SNR, TEA and LCA under varying influent flows and loads and seasonally changing	22	8

Task Number	Task Title	Milestone Type	Milestone Number*	Milestone Description (Go/No-Go Decision Criteria)	Milestone Verification Process	Anticipated Months from Start of the Project	Anticipated Quarters from Start of the Project
					temperatures supporting technology commercialization.		
10	Final LCA & TEA	Milestone	M10.1	Using the data generated at the full-scale system Pomona WRP with system operation under SNR conditions (Milestone 9.1), demonstrate 20–50% energy saving and at least 15% primary carbon saving (for energy recovery).	Final development of LCA and TEA for SNR and MPAC integration based on long-term full-scale performance data.	24	8
11	Commercialization	End of Project Goal	M11.1	Documentation, publication, and dissemination of research findings through various channels, including WRF, our Process Commercialization Partner, and Blower Technology Commercialization Partner.	Conference Proceedings and Peer Review Publications, Team publications at national conference and national peer review trade and industry journals. Webcasts. Invention Utilization Report, U.S. Manufacturing Report, Software Deliverable Submission, Commercialization plan and materials for commercialization partners.	24	8
11	Commercialization	End of Project Goal	M11.2	Verification of energy, water quality, process control and carbon savings goals.	LCA & TEA. Peer review process.	24	8
11	Commercialization	End of Project Goal	M11.3	Integration of MPAC DO/Nmaster as a standard programming component into the Blower Technology Commercialization Partner's blower control logic, achieving a control accuracy of less than 10% covariance of control	Invention Utilization Report, U.S. Manufacturing Report, Interest from other utilities to employ this technology.	24	8

Task Number	Task Title	Milestone Type	Milestone Number*	Milestone Description (Go/No-Go Decision Criteria)	Milestone Verification Process	Anticipated Months from Start of the Project	Anticipated Quarters from Start of the Project
				setpoints (DO or ammonia).			
11	Commercialization	End of Project Goal	M11.4	Demonstrate carbon savings of at least 15% through MPAC and SNR operation in the liquid stream treatment process of domestic BNR WRRFs.	Data evaluation from pilot and field condition, process modeling verification, measurement of increased nutrient removal or increase carbon diversion potential in primary clarifiers.	24	8

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

1. Award Number:

DE-EE0009509.0000; Attachment 2

2. Program/Project Title:

Transforming Aeration Energy in Water Resource Recovery Facilities (WRRFs) through Suboxic Nitrogen Removal

3. Recipient:

Carollo Engineers, Inc.

4. Reporting Requirements (see Attached "EERE Reporting Instructions"):	Frequency	Addressees* *See attached "EERE Reporting Instructions" for complete submission instructions.
I. PROJECT MANAGEMENT REPORTING		
A. Research Performance Progress Report (RPPR) (RD&D Projects)	**Q**	A. https://www.eere-pmc.energy.gov/SubmitReports.aspx
☐ B. Progress Report (Non-RD&D)		B. https://www.eere-pmc.energy.gov/SubmitReports.aspx
☑ C. Financial Report (SF-425)	**FQ**	C. https://www.eere-pmc.energy.gov/SubmitReports.aspx
☑ D. Special Status Report	**A**	D. https://www.eere-pmc.energy.gov/SubmitReports.aspx
☑ E. Continuation Application	**A**	E. https://www.eere-pmc.energy.gov/SubmitReports.aspx
☐ F. Other (see Special Instructions)		F. https://www.eere-pmc.energy.gov/SubmitReports.aspx
II. SCIENTIFIC/TECHNICAL REPORTING		
☑ A. Final Scientific/Technical Report	**F**	A. http://www.osti.gov/elink-2413
☑ B. Accepted Manuscript of Journal Article	**A**	B. http://www.osti.gov/elink-2413
☑ C. Scientific/Technical Conference Paper/Presentation/Proceeding	**A**	C. http://www.osti.gov/elink-2413
☑ D. Scientific/Technical Software & Manual	**A**	D. https://www.osti.gov/elink/241-4.jsp https://www.otsi.gov/doecode
☑ E. Scientific/Technical Dataset	**A**	E. https://www.osti.gov/elink/2416-submission.jsp
☑ F. Other STI (Dissertation/Thesis, see Special Instructions)	**A**	F. http://www.osti.gov/elink-2413
III. CLOSEOUT REPORTING		
☑ A. Invention Certification (DOE F 2050.11)	**F**	A. https://www.eere-pmc.energy.gov/SubmitReports.aspx
☑ B. Final Property Report (SF-428 & SF-428B)	**F**	B. https://www.eere-pmc.energy.gov/SubmitReports.aspx
☐ C. Other (see Special Instructions)		C. https://www.eere-pmc.energy.gov/SubmitReports.aspx
IV. OTHER REPORTING		
☑ A. Intellectual Property Reporting	**A**	A. http://www.iEdison.gov/
☑ B. Invention Utilization Report	**A**	B. http://www.iEdison.gov/
☐ C. Project Management Plan (PMP)		C. https://www.eere-pmc.energy.gov/SubmitReports.aspx
☑ D. Annual Incurred Cost Proposal	**Y180**	D. See section IV. D for instructions and due dates
☑ E. DOE For-Profit Compliance Audit	**O**	E. See section IV. E for instructions and due dates
☐ F. Single Audit: States, Locals, Tribal Governments, and Non-Profits		F. See section IV. F for instructions and due dates
☐ G. Annual Property Inventory (SF-428 & SF-428A)		G. https://www.eere-pmc.energy.gov/SubmitReports.aspx
☑ H. Property Disposition Request/Report (SF-428 & SF-428C)	**A**	H. https://www.eere-pmc.energy.gov/SubmitReports.aspx
☑ I. Uniform Commercial Code (UCC) Financing Statements	**A**	I. See section IV. I for instructions and due dates
☑ J. Federal Subaward Reporting System (FSRS)	**A**	J. See section IV. J for instructions and due dates https://www.fsrs.gov/
☐ K. Other (see Special Instructions)		K. https://www.eere-pmc.energy.gov/SubmitReports.aspx

FREQUENCY CODES AND DUE DATES:

A - Within (5) calendar days after the event, or as specified.

F - Final; within 90 calendar days after expiration or termination of the award.

Y - Yearly; within 90 calendar days after the end of the annual reporting period.

S - Semiannually; within 30 days after the end of the reporting period.

Q - Quarterly; within 30 calendar days after the end of the quarterly reporting period.

Y180 - Yearly: within 180 calendar days after the close of the recipient's fiscal year.

O - Other: See instructions for further details.

5. EERE Special Instructions:

Table of Contents

EERE Reporting Instructions

*** ***Throughout award negotiations and the performance of the project, it is important that you mark Protected Data/Limited Rights Data as described in Appendix A. It is equally important that you not submit Protected Personally Identifiable Information (Protected PII) to EERE. See Appendix A for guidance on Protected PII.*** ***

Report Templates Link: http://energy.gov/eere/funding/eere-funding-application-and-management-forms

I. Project Management Reporting

A. Research Performance Progress Report (RPPR) (RD&D Projects)

Submit to:	https://www.eere-pmc.energy.gov/SubmitReports.aspx
Submission deadline:	Within 30 calendar days after the end of the quarterly reporting period (January 30, April 30, July 30, October 30)

Every quarter, the prime recipient is required to submit a Research Performance Progress Report for the project – i.e., the entirety of work performed by the prime recipient, subrecipients, and contractors – to EERE. The Research Performance Progress Report must include the following information.

Standard Cover Page Data Elements and Reporting Categories

The standard cover page data elements and components shown below comprise the complete research performance progress report format. Each category in the RPPR is a separate reporting component.

1. Cover Page

a. Federal Agency and Organization Element to Which Report is Submitted
b. Federal Grant or Other Identifying Number Assigned by Agency
c. Project Title
d. PD/PI Name, Title and Contact Information (e-mail address and phone number)
e. Name of Submitting Official, Title, and Contact Information (e-mail address and phone number), if other than PD/PI
f. Submission Date
g. DUNS Number
h. Recipient Organization (Name and Address)
i. Project/Grant Period (Start Date, End Date)
j. Reporting Period End Date

k. Report Term or Frequency (annual, semi-annual, quarterly, final, other)
l. Signature of Submitting Official (electronic signatures (i.e., Adobe Acrobat) are acceptable)

2. Accomplishments:

What was done? What was learned?
The information provided in this section allows the agency to assess whether satisfactory progress has been made during the reporting period. The PI is reminded that the grantee is required to obtain prior written approval from the Contracting Officer whenever there are significant changes in the project or its direction. Requests for prior written approval must be submitted to the Contracting Officer.

a. What are the major goals and objectives of this project?
List the major goals of the project as stated in the approved application or as approved by the agency. Describe the proposed technical approach to obtain those goals. If the application lists milestones/target dates for important activities or phases of the project, identify these dates and show actual completion dates or the percentage of completion.
Generally, the goals will not change from one reporting period to the next. However, if the awarding agency approved changes to the goals during the reporting period, list the revised goals and objectives. Also explain any significant changes in approach or methods from the agency approved application or plan.

b. What was accomplished under these goals?
For this reporting period describe: 1) major activities; 2) specific objectives; 3) significant results or key outcomes, including major findings, developments, or conclusions (both positive and negative); and/or 4) other achievements. Include a discussion of stated goals not met. As the project progresses, the emphasis in reporting in this section should shift from reporting activities to reporting accomplishments.

c. What opportunities for training and professional development has the project provided?
Describe opportunities for training and professional development provided to anyone who worked on the project or anyone who was involved in the activities supported by the project. “Training” activities are those in which individuals with advanced professional skills and experience assist others in attaining greater proficiency. Training activities may include, for example, courses or one-on-one work with a mentor. “Professional development” activities result in increased knowledge or skill in one’s area of expertise and may include workshops, conferences, seminars, study groups, and individual study. Include participation in conferences, workshops, and seminars not listed under major activities.

If the project was not intended to provide training and professional development opportunities or there is nothing significant to report during this reporting period, state “Nothing to Report.”

d. How have the results been disseminated to communities of interest?
Describe how the results have been disseminated to communities of interest. Include any outreach activities that have been undertaken to reach members of communities who are not usually aware of these research activities, for the purpose of enhancing public understanding and increasing interest in learning and careers in science, technology, and the humanities.

If there is nothing significant to report during this reporting period, state "Nothing to Report."

e. What do you plan to do during the next reporting period to accomplish the goals and objectives?
Describe briefly what you plan to do during the next reporting period to accomplish the goals and objectives.

If there are no changes to the agency-approved application or plan for this project or if this is the final report, state "Nothing to Report."

3. Products:

What has the project produced?
Publications are the characteristic product of research. Agencies evaluate what the publications demonstrate about the excellence and significance of the research and the efficacy with which the results are being communicated to colleagues, potential users, and the public, not just the number of publications. Many projects (though not all) develop significant products other than publications. Agencies assess and report both publications and other products to Congress, communities of interest, and the public.

List any products resulting from the project during the reporting period. Examples of products include: publications, conference papers, and presentations; website(s)); technologies or techniques; inventions, patent applications, and/or licenses; and other products, such as data or databases, physical collections, audio or video products, software or NetWare, models, educational aids or curricula, instruments or equipment, research material, interventions (e.g., clinical or educational), new business creation or any other public release of information related to the project.

If there is nothing significant to report or if no products were developed during this reporting period, state "Nothing to Report."

a. Publications, conference papers, and presentations
Report the publication(s) resulting from the work under this award. There is no restriction on the number. However, agencies are most interested in those publications that most reflect the work under this award in the following categories:

Please note: Recipients must use the EERE acknowledgement and legal disclaimer language as described in the Special Terms and Conditions (additional information can be found at the EERE Communications Standards website: https://www.energy.gov/eere/communicationstandards/eere-branded-publications-developed-third-parties).

The recipient is also reminded that all data produced under the award should comply with the award's data management plan (DMP). The DMP provides a plan for making all research data displayed in publications resulting from the proposed work digitally accessible at the time of publication. This

includes data that are displayed in charts, figures, images, etc. In addition, the underlying digital research data used to generate the displayed data should be made as accessible as possible in accordance with the principles stated above. This requirement could be met by including the data as supplementary information to the published article, or through other means. The published article should indicate how these data can be accessed.

i. Accepted Manuscripts of Journal Article . List peer-reviewed articles or papers that have been submitted for publication in scientific, technical, or professional journals. Include any paper submitted for peer-reviewed publication in the periodically published proceedings of a scientific society, a conference, or the like. A publication in the proceedings of a one-time conference, not part of a series, should be reported under "Books or other non-periodical, one-time publications."

Identify for each publication: Author(s); title; journal; volume: year; page numbers; status of publication (published; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no); legal disclaimer language (yes/no). Also see instructions under **II. Scientific/Technical Reporting** regarding the submission of accepted manuscripts and other STI as appropriate.

ii. Books or other non-periodical, one-time publications. Report any book, monograph, dissertation, abstract, or the like published as or in a separate publication, rather than a periodical or series. Include any significant publication in the proceedings of a one-time conference or in the report of a one-time study, commission, or the like.

Identify for each one-time publication: author(s); title; editor; title of collection, if applicable; bibliographic information; year; type of publication (book, thesis or dissertation, other); status of publication (published; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no); legal disclaimer language (yes/no).

iii. Other publications, conference papers and presentations. Identify any other publications, conference papers and/or presentations not reported above. Specify the status of the publication as noted above.

b. Website(s)

List the URL for any Internet site(s) that disseminates the results of the research activities. A short description of each site should be provided. It is not necessary to include the publications already specified above in this section.

c. Technologies or techniques

Identify technologies or techniques that have resulted from the research activities. Describe the technologies or techniques and how they are being shared.

d. Inventions, patent applications, and/or licenses

Identify inventions, patent applications with date, and/or licenses that have resulted from the research. Submission of this information as part of an interim report or Final Technical Report is not a substitute for any other invention reporting required under the terms and conditions of an award.

e. Other products

Identify any other significant products that were developed under this project. Describe the product and how it is being shared. Examples of other products are: Data or databases; Physical collections; Audio or video products; Software or NetWare; Models; Educational aids or curricula; Instruments or equipment; Research material (e.g., germplasm, cell lines, DNA probes, animal models); Interventions (e.g clinical, educational); new business creation; and Other.

4. Participants & Other Collaborating Organizations:

Who has been involved?

Agencies need to know who has worked on the project to gauge and report performance in promoting partnerships and collaborations. The following information on participants and other collaborating organizations during this reporting period must be provided:

a. What individuals have worked on the project?

Provide the following information for: (1) Project director(s)/Principal investigator(s) (PDs/PIs); and (2) each person who has worked at least 160 hours on the project during the reporting period, regardless of the source of compensation. Please note that such reporting does not constitute a formal institutional report of effort on the project, but rather is used by agency program staff to evaluate the progress of the project during a given reporting period.

i. Provide the name and identify the role the person played in this project.

Indicate the total number of months (including partial months) (Calendar, Academic, Summer) that the individual worked on this project. Using the project roles identified below, select the most senior role in which the person worked on the project for any significant length of time. For example, if an undergraduate student graduated, entered graduate school, and continued to work on the project, show that person as a graduate student, preferably explaining the change in involvement.

ii. Project Roles:

PD/PI
Co PD/PI
Faculty
Community College Faculty
Technical School Faculty
K-12 Teacher
Postdoctoral (scholar, fellow or other postdoctoral position)
Other Professional
Technician
Staff Scientist (doctoral level)
Statistician

Graduate Student (research assistant)
Non-Student Research Assistant
Undergraduate Student
Technical School Student
High School Student
Consultant
Research Experience for Undergraduates (REU) Participant
Other (specify)

iii. Describe briefly how this person contributed to this project.
If information is unchanged from a previous progress report, provide the name only and indicate "no change."

iv. Identify the person's state, U.S. territory, and/or country of residence.
State whether this person has collaborated internationally.
If the participant was U.S.-based, state whether this person collaborated internationally with an individual located in a foreign country, and specify whether the person traveled to the foreign country as part of that collaboration, and, if so, what the duration of stay was. The foreign country(ies) should be identified.

If the participant was not U.S.-based, state whether this person traveled to the U.S. or another country as part of a collaboration, and, if so, what the duration of stay was. The destination country should be identified.

Example:
1. Name: Mary Smith
2. Total Number of Months: 5.5
3. Project Role: Graduate Student
4. Researcher Identifier: 1234567
5. Contribution to Project: Ms. Smith has performed work in the area of combined error-control and constrained coding.
6. State, U.S. territory, and/or country of residence: Michigan, U.S.A.
7. Collaborated with individual in foreign country: Yes
8. Country(ies) of foreign collaborator: China
9. Travelled to foreign country: Yes
10. If traveled to foreign country(ies), duration of stay: 5 months

b. Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?
Describe active other support for the PD/PI(s) or senior/key personnel whose support has changed and what the change has been (e.g., a previously active grant that has closed, a previously pending grant that is now active). Active other support includes all financial resources, whether federal, non-federal, commercial or organizational, available in direct support of an individual's research endeavors,

including, but not limited to, research grants, cooperative agreements, contracts, or organizational awards, (e.g., federal, state, local or foreign government agencies, public or private foundations, industrial or other commercial organizations). Annotate this information so it is clear what has changed from the previous submission. Other support does not include prizes or gifts.

Submission of active other support information is not necessary for pending changes or for changes in the level of effort for active support reported previously. EERE requires prior written approval if a change in active other support significantly impacts the effort on this award.

If there is nothing significant to report during this reporting period or no change from the previous reporting period, state "Nothing to Report."

c. What other organizations have been involved as partners?

Describe partner organizations – academic institutions, other nonprofits, industrial or commercial firms, state or local governments, schools or school systems, or other organizations (foreign or domestic) – that have been involved with the project. Partner organizations may provide financial or in-kind support, supply facilities or equipment, collaborate in the research, exchange personnel, or otherwise contribute.

Provide the following information for each partnership:

1. Organization Name:
2. Location of Organization: (if foreign location list country)
3. Partner's contribution to the project: (identify one or more)
    i. Financial support;
    ii. In-kind support (e.g., partner makes software, computers, equipment, etc., available to project staff);
    iii. Facilities (e.g., project staff use the partner's facilities for project activities);
    iv. Collaborative research (e.g., partner's staff work with project staff on the project);
    v. Personnel exchanges (e.g., project staff and/or partner's staff use each other's facilities, work at each other's site).
    vi. Other
4. More detail on partner and contribution (foreign or domestic).

If there is nothing significant to report during this reporting period, state "Nothing to Report."

d. Have other collaborators or contacts been involved?

Some significant collaborators or contacts within the recipient's organization may not be covered by "What people have worked on the project?" Likewise, some significant collaborators or contacts outside the recipient's organization may not be covered under "What other organizations have been involved as partners?"

For example, describe any significant:

1. collaborations with others within the recipient's organization, especially interdepartmental or interdisciplinary collaborations;
2. collaborations or contact with others outside the organization; and
3. collaborations or contacts with others outside the United States or with an international organization.

Identify the state(s), U.S. territory(ies), or country(ies) of collaborations or contacts.

It is likely that many recipients will have no other collaborators or contacts to report.

If there is nothing significant to report during this reporting period, state "Nothing to Report."

5. Impact:

What is the impact of the project? How has it contributed?

Over the years, this base of knowledge, techniques, people, and infrastructure is drawn upon again and again for application to commercial technology and the economy, to health and safety, to cost-efficient environmental protection, to the solution of social problems, to numerous other aspects of the public welfare, and to other fields of endeavor.

The taxpaying public and its representatives deserve a periodic assessment to show them how the investments they make benefit the nation. Through this reporting format, and especially this section, recipients provide that assessment and make the case for federal funding of research and education.

Agencies use this information to assess how their research programs: increase the body of knowledge and techniques; enlarge the pool of people trained to develop that knowledge and techniques or put it to use; and improve the physical, institutional, and information resources that enable those people to get their training and perform their functions.

This component will be used to describe ways in which the work, findings, and specific products of the project have had an impact during this reporting period. Describe distinctive contributions, major accomplishments, innovations, successes, or any change in practice or behavior that has come about as a result of the project relative to: the development of the principal discipline(s) of the project; other disciplines; the development of human resources; teaching and educational experiences; physical, institutional, and information resources that form infrastructure; technology transfer (include transfer of results to entities in government or industry, adoption of new practices, or instances where research has led to the initiation of a startup company); society beyond science and technology; or foreign countries.

a. What was the impact on the development of the principal discipline(s) of the project?
Describe how findings, results, and techniques that were developed or extended, or other products from the project made an impact or are likely to make an impact on the base of knowledge, theory, and research and/or pedagogical methods in the principal disciplinary field(s) of the project. Summarize using language that a lay audience can understand (Scientific American style). How the field or

discipline is defined is not as important as covering the impact the work has had on knowledge and technique. Make the best distinction possible, for example, by using a "field" or "discipline", if appropriate, that corresponds with a single academic department (i.e., physics rather than nuclear physics).

If there is nothing significant to report during this reporting period, state "Nothing to Report."

b. What was the impact on other disciplines?
Describe how the findings, results, or techniques that were developed or improved, or other products from the project made an impact or are likely to make an impact on other disciplines.

If there is nothing significant to report during this reporting period, state "Nothing to Report."

c. What was the impact on the development of human resources?
Describe how the project made an impact or is likely to make an impact on human resource development in science, engineering, and technology. For example, how has the project: provided opportunities for research and teaching in the relevant fields; improved the performance, skills, or attitudes of members of underrepresented groups that will improve their access to or retention in research, teaching, or other related professions; developed and disseminated new educational materials; provided scholarships; or provided exposure to science and technology for practitioners, teachers, young people, or other members of the public?

If there is nothing significant to report during this reporting period, state "Nothing to Report."

d. What was the impact on teaching and educational experiences?
Describe how the project made an impact or is likely to make an impact on teaching and educational experiences. For example, has the project: developed and disseminated new educational materials; led to ideas for new approaches to course design or pedagogical methods; or developed online resources that will be useful for teachers and students and other school staff?

If there is nothing significant to report during this reporting period, state "Nothing to Report."

e. What was the impact on physical, institutional, and information resources that form infrastructure?
Describe ways, if any, in which the project made an impact, or is likely to make an impact, on physical, institutional, and information resources that form infrastructure, including: physical resources such as facilities, laboratories, or instruments; institutional resources (such as establishment or sustenance of societies or organizations); or information resources, electronic means for accessing such resources or for scientific communication, or the like.

If there is nothing significant to report during this reporting period, state "Nothing to Report."

f. What was the impact on technology transfer?

Describe ways in which the project made an impact, or is likely to make an impact, on commercial technology or public use, including: transfer of results to entities in government or industry; instances where the research has led to the initiation of a start-up company; or adoption of new practices.

If there is nothing significant to report during this reporting period, state "Nothing to Report."

g. What was the impact on society beyond science and technology?
Describe how results from the project made an impact, or are likely to make an impact, beyond the bounds of science, engineering, and the academic world on areas such as: improving public knowledge, attitudes, skills, and abilities; changing behavior, practices, decision making, policies (including regulatory policies), or social actions; or improving social, economic, civic, or environmental conditions.

If there is nothing significant to report during this reporting period, state "Nothing to Report."

h. What percentage of the award's budget was spent in foreign country(ies)?
Describe what percentage of the award's budget was spent in foreign country(ies). If more than one foreign country is involved, identify the distribution between the foreign countries.

U.S.-based recipients should provide the percentage of the budget spent in the foreign country(ies) and/or, if applicable, the percentage of the budget obligated to foreign entities as first-tier subawards.

Recipients that are not U.S.-based should provide the percentage of the direct award received, excluding all first-tier subawards to U.S. entities. If applicable, provide separately the percentage of the budget obligated to non-U.S. entities as first-tier subawards.

6. Changes/Problems:

The PD/PI is reminded that the grantee is required to obtain prior written approval from the Contracting Officer whenever there are significant changes in the project or its direction. Requests for prior written approval must be submitted to the Contracting Officer. If not previously reported in writing, provide the following additional information, if applicable: Changes in approach and reasons for change; Actual or anticipated problems or delays and actions or plans to resolve them; Changes that have a significant impact on expenditures; Significant changes in use or care of animals, human subjects, and/or biohazards.

If there is nothing significant to report during this reporting period, state "Nothing to Report."

a. Changes in approach and reasons for change
Describe any changes in approach during the reporting period and reasons for these changes. Remember that significant changes in objectives and scope require prior approval of the Contracting Officer.

If there is nothing significant to report during this reporting period, state "Nothing to Report."

b. Actual or anticipated problems or delays and actions or plans to resolve them
Describe problems or delays encountered during the reporting period and actions or plans to resolve them.

If there is nothing significant to report during this reporting period, state "Nothing to Report."

c. Changes that have a significant impact on expenditures
Describe changes during the reporting period that may have a significant impact on expenditures, for example, delays in hiring staff or favorable developments that enable meeting objectives at less cost than anticipated.

If there is nothing significant to report during this reporting period, state "Nothing to Report."

d. Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents
Describe significant deviations, unexpected outcomes, or changes in approved protocols for the use or care of human subjects, vertebrate animals, biohazards and/or select agents during the reporting period. If required, were these changes approved by the applicable institution committee and reported to the agency? Also specify the applicable Institutional Review Board/Institutional Animal Care and Use Committee approval dates.

If there is nothing significant to report during this reporting period, state "Nothing to Report."

e. Change of primary performance site location from that originally proposed
Identify any change to the primary performance site location identified in the proposal, as originally submitted.

If there is nothing significant to report during this reporting period, state "Nothing to Report."

7. Special Reporting Requirements:
Respond to any special reporting requirements specified in the award terms and conditions, as well as any award specific reporting requirements.

8. Budgetary Information:
This component will be used to collect budgetary data from the recipient organization. The information will be used in conducting periodic administrative/budgetary reviews. Budgetary data identified and required by the Contracting Officer should be submitted in an Excel spreadsheet format.

B. Progress Report (Non-RD&D Projects)

Submit to:	https://www.eere-pmc.energy.gov/SubmitReports.aspx
Submission deadline:	Within 30 calendar days after the end of the quarterly reporting period (January 30, April 30, July 30, October 30)

The recipient must provide a concise narrative assessment of the status of work and include the following information and any other information identified under Special Instructions on the Federal Assistance Reporting Checklist:

1. **Cover Page**

   a. The DOE Award Number (as it appears on the award face page)
   b. Recipient Name (as it appears on the award face page)
   c. Project Title
   d. Project Director / Principal Investigator (PD/PI) Name, Title and Contact Information (e-mail address and phone number)
   e. Name of Submitting Official, Title, and Contact Information (e-mail address and phone number), if other than PD/PI
   f. Project Period (Start Date, End Date)
   g. Report Submission Date
   h. Reporting Period Start and End Date

1. **Project Overview**
   A written comparison of the actual project accomplishments with the project goals and objectives established for the reporting period**;** if goals and/or objectives for the reporting period were not met, a detailed description of the variance shall be provided.

2. **Accomplishments**
   A discussion of what was accomplished under these goals and objectives established for this reporting period, including major activities, significant results, major findings or conclusions, key outcomes, or other achievements. This section should not contain any proprietary data or other information not subject to public release. If such information is important to reporting progress, do not include the information, but include a note in the report advising the reader to contact the Principal Investigator or the Project Director for further information.

3. **Budgetary Information**
   A comparison of the approved budget by budget period and the actual costs incurred during the reporting period shall be provided. If cost sharing is required, the cost breakdown shall show the DOE share, recipient share, and total costs.

4. **Schedule Status**
   List milestones, anticipated completion dates and actual completion dates. If you submitted a project management plan with your application, you must use this plan to report schedule and budget variances. You may use your own project management system to provide this information.

5. **Changes/Problems**
   Describe any changes during the reporting period in project approach and the reasons for these changes. Remember, significant changes to the project objectives and scope require prior approval

by the Contracting Officer. Describe any actual or anticipated problems or delays and any actions taken or planned to resolve them.

6. **Participants & Other Collaborating Organizations**
   Describe any absence or changes of key personnel or changes in consortium/teaming arrangement during the reporting period.

7. **Products**
   List and describe any product produced or technology transfer activities accomplished during this reporting period, such as:

   a. **Publications, conference papers, and presentations**. List peer-reviewed articles or papers that have been submitted for publication in scientific, technical, or professional journals. Include any papers submitted for peer-reviewed publication in the periodically published proceedings of a scientific society, a conference, or the like. A publication in the proceedings of a one-time conference, not part of a series, should be reported under "Books or other non-periodical, one-time publications."

      Identify for each publication: Author(s); title; journal; volume: year; page numbers; status of publication (published; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no); legal disclaimer language (yes/no). Also see instructions under **II. Scientific/Technical Reporting** regarding the submission of AM and other STI as appropriate.

      Please note: Recipient must use the EERE acknowledgement and legal disclaimer language as described in the Special Terms and Conditions (additional information can be found at the EERE Communications Standards website: https://www.energy.gov/eere/communicationstandards/eere-branded-publications-developed-third-parties).

      The recipient is also reminded that all data produced under the award should comply with the award's data management plan (DMP). The DMP provides a plan for making all research data displayed in publications resulting from the proposed work digitally accessible at the time of publication. This includes data that are displayed in charts, figures, images, etc. In addition, the underlying digital research data used to generate the displayed data should be made as accessible as possible in accordance with the principles stated above. This requirement could be met by including the data as supplementary information to the published article, or through other means. The published article should indicate how these data can be accessed.

   b. **Website(s)** (list the URL) that reflect the results of this project.

   c. **Networks or collaborations** fostered.

d. Technologies or techniques (Identify and Describe).

e. Other products, such as data or databases, physical collections, audio or video, software or NetWare, models, educational aid or curricula, instruments or equipment (Identify and Describe).

C. Financial Report SF-425 Federal Financial Report

Submit to:	https://www.eere-pmc.energy.gov/SubmitReports.aspx
Submission deadline:	Within 30 calendar days after the end of the quarterly reporting period (January 30, April 30, July 30, October 30) **and** within 90 calendar days after expiration or termination of the award

Every quarter, the prime recipient is required to submit a completed SF-425 for the project – i.e., the entirety of work performed by the prime recipient, subrecipients, and contractors – to EERE. A fillable version of the SF-425 is available at https://www.energy.gov/eere/funding/eere-funding-application-and-management-forms.

D. Special Status Reports

Submit to:	https://www.eere-pmc.energy.gov/SubmitReports.aspx
Submission deadline:	Within five (5) calendar days after the event, or as specified

Problems, delays, or adverse conditions which materially impair the recipient's ability to meet the objectives of the award or which may require DOE to respond to questions relating to such events from the public. The recipient must report any of the following incidents and include the anticipated impact and remedial action to be taken to correct or resolve the problem/condition.

The prime recipient is required to report the following events to EERE:

1. Any notices or claims of patent or copyright infringement arising out of or relating to the performance of the EERE award;
2. Refusal of a subrecipient to accept flowdown requirements in the Special Terms and Conditions and/or any Attachment to the EERE award;
3. Potential or actual violations of federal, state, and municipal laws arising out of or relating to work under the award;
4. Any improper claims or excess payments arising out of or relating to work under the award;
5. Potential or actual violations of the cost share requirements under the award;
6. Potential or actual noncompliance with EERE or DOE reporting requirements under the award;
7. Potential or actual violations of the lobbying restrictions in the award;

8. Potential or actual bankruptcy/insolvency of the prime recipient or subrecipient;

9. Potential or actual violation of U.S. export control laws and regulations arising out of or relating to the work under the award;

10. Any fatality or injuries requiring hospitalization arising out of or relating to work under the award;

11. Potential or actual violations of environmental, health, or safety laws and regulations, any significant environmental permit violation, and any incident which causes a significant process or hazard control system failure;

12. Any event which is anticipated to cause a significant schedule slippage or cost increase;

13. Any damage to Government-owned equipment in excess of $50,000;

14. Developments that have a significant favorable impact on the project; and,

15. Any incident arising out of or relating to work under the award that has the potential for high visibility in the media.

E. Continuation Application

Submit to:	https://www.eere-pmc.energy.gov/SubmitReports.aspx
Submission deadline:	Within five (5) calendar days after the event, or as specified

A continuation application is a non-competitive application for an additional budget period within a previously approved project period. The continuation application should be submitted at least ninety (90) calendar days before the end of each budget period, or as specified in the Special Terms and Conditions of the award.

F. Other (see Special Instructions)

Submit to:	https://www.eere-pmc.energy.gov/SubmitReports.aspx
Submission deadline:	Within five (5) calendar days after the event, or as specified

II. Scientific and Technical Reporting

The dissemination of scientific and technical information (STI) ensures public access to the results of federally funded research. STI refers to information products in any medium or format used to convey results, findings, or technical innovations from research and development or other scientific and technological work that are prepared with the intention of being preserved and disseminated in the

broadest sense applicable (i.e., to the public or, in the case of controlled unclassified information or classified information, disseminated among authorized individuals). Access to and archival of DOE-funded STI are managed by the DOE Office of Scientific and Technical Information (OSTI). For information about OSTI see http://www.osti.gov.

For more information on STI submittals, see http://www.osti.gov/stip/submittal.

By properly notifying DOE OSTI about the published results, the information will be made publicly accessible and discoverable through DOE web-based products.

NOTE: SCIENTIFIC/TECHNICAL PRODUCTS INTENDED FOR PUBLIC RELEASE MUST NOT CONTAIN PROTECTED PERSONALLY IDENTIFIABLE INFORMATION (PII).

PII is defined as any information about an individual which can be used to distinguish or trace an individual's identity. Some information that is considered to be PII is available in public sources such as telephone books, public websites, university listings, etc. This type of information is considered to be Public PII and includes, for example, first and last name, address, work telephone number, e-mail address, home telephone number, and general educational credentials. In contrast, Protected PII is defined as an individual's first name or first initial and last name in combination with any one or more of the following types of information: social security number, passport number, credit card numbers, clearances, bank numbers, biometrics, date and place of birth, mother's maiden name, criminal, medical and financial records, educational transcripts, etc., which could be mis-used if made publicly available.

A. Final Scientific/Technical Report

Submit to:	DOE Energy Link System (E-Link) available at http://www.osti.gov/elink-2413
Submission deadline:	Within 90 calendar days after expiration or termination of the award

The prime recipient must submit a Final Scientific/Technical Report to DOE for all projects.

The scientific/technical report is intended to increase the diffusion of knowledge gained by DOE-funded research, and all requirements shall be interpreted in that light.

Content: Research findings and other significant STI resulting from the DOE-sponsored projects shall be included in the final scientific/technical report, subject to the following provisions:

1. The scientific/technical report is to cover the entire project period. For Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) awards, a final scientific/technical report must be submitted after the completion of each phase, e.g., Phase I, Phase II, and sequential Phase II, as described in the Special Instructions.

2. STI that is publicly accessible need not be duplicated in the report if a citation with a link to where

the information may be found is included in the report. For example, articles found in PAGES (i.e., DOE's Public Access Gateway for Energy and Science, http://www.osti.gov/pages/) are accessible to the public.

3. Provide identifying information: the EERE award number; sponsoring program office; name of recipient; project title; name of project director/principal investigator; and consortium/team members.

4. Include the EERE acknowledgement and legal disclaimer language as described in the Special Terms and Conditions (additional information can be found at the EERE Communications Standards website: https://www.energy.gov/eere/communicationstandards/eere-branded-publications-developed-third-parties).

5. Include any limitations on public release of the report, if authorized by the award agreement. If the document being submitted contains patentable material or protected data (i.e., data first produced in the performance of the award that is protected from public release for a period of time by terms of the award agreement) as set forth in the award agreement, then (1) prominently display on the cover of the report any authorized distribution limitation notices, such as patentable material or protected data and (2) clearly identify patentable or protected data on each page of the report. Reports delivered without such notices or with restrictive notices not authorized by the award agreement may be deemed to have been furnished with unlimited rights, and the Government assumes no liability for the disclosure, use or reproduction of such reports. Any restrictive markings must also be noted in the distribution limitation section of the Announcement Notice (AN) 241.3. No protected PII should be included.

6. Provide an abstract or executive summary, which should be a minimum of one paragraph and written in terms understandable by an educated layperson. (Refer to http://www.osti.gov/stip/standards for ANSI/NISO guidance as needed.) The abstract included in an application may serve as a model for this.

7. Summarize project activities for the entire period of funding, including original hypotheses, approaches used, and findings. Include, if applicable, facts, figures, analyses, and assumptions used during the life of the project to support the results in a manner that conveys to the scientific community the STI created during the project. To minimize duplication, the report may reference STI, including journal articles, that is publicly accessible. See also #2.

8. For guidance offered by the National Information Standards Organization on typical attributes and content of a technical report, if needed, refer to ANSI/NISO Z39.18-2005 (R2010), Scientific and Technical Reports – Preparation, Presentation, and Preservation (see http://www.osti.gov/stip/standards).

Electronic Submission Process: The final scientific/technical report must be submitted via the DOE Energy Link System (E-Link) with a completed electronic version of DOE Announcement Notice (AN) 241.3, "U.S. Department of Energy (DOE), Announcement of Scientific and Technical Information

(STI)." The recipient can complete, upload, and submit the DOE AN 241.3 online via E-Link (https://www.osti.gov/elink-2413).

The recipient must mark the appropriate block in the "Intellectual Property/Distribution Limitations" Section of the DOE AN 241.3. Reports that are electronically uploaded must not contain any limited rights data (proprietary data), classified information, protected PII, information subject to export control classification, or other information not subject to release. During the upload process, the recipient must self-certify that no content of this nature is being submitted. For assistance with reports containing such content, contact the Contracting Officer.

Text documents must be submitted in Adobe Portable Document Format (PDF) and be one integrated PDF file that contains all text, tables, diagrams, photographs, schematics, graphs, and charts. Please refer to http://www.osti.gov/stip/best-practices-portable-document-format-pdf-creation for PDF document creation.

B. Accepted Manuscript of Journal Article

Submit to:	DOE Energy Link System (E-Link) available at http://www.osti.gov/elink-2413
Submission deadline:	No later than the published online date of the article

Public access to scholarly publications is enabled by providing the Accepted Manuscript (AM) of the Journal Article to DOE OSTI and is consistent with the U.S. Government's retained license to published results of federally-funded research. If the recipient has a journal article accepted for publication which includes information/data produced under the award, then the recipient must submit an AN 241.3, as described below, no later than the published online date of the article. .

The recipient is reminded that all data produced under the award should comply with the award's data management plan (DMP). The DMP provides a plan for making all research data displayed in publications resulting from the proposed work digitally accessible at the time of publication. This includes data that are displayed in charts, figures, images, etc. In addition, the underlying digital research data used to generate the displayed data should be made as accessible as possible in accordance with the principles stated above. This requirement could be met by including the data as supplementary information to the published article, or through other means. The published article should indicate how these data can be accessed. The federal government's right to use the data produced under a federal award is established in 2 CFR 200.315(d), U.S. Government's retained license to published results of federally funded research.

Content. The recipient is to provide the final peer-reviewed AM, i.e., the version of a journal article that has been peer reviewed and accepted for publication in a journal. Do NOT submit the journal's published version of the article, i.e., do NOT submit a copyrighted reprint. Do not submit the content of peer reviews or a commitment to publish. The recipient should provide only the AM content intended to be the published article.

DOE will make no additional review of the content of an AM because the AM is a version of the journal article with the content to be published (i.e., publicly released) by the journal publisher. The recipient is responsible for ensuring the suitability of the content for public release and ensuring proper EERE acknowledgement and legal disclaimer language as described in the Special Terms and Conditions (additional information can be found at the EERE Communications Standards website: https://www.energy.gov/eere/communicationstandards/eere-branded-publications-developed-third-parties). The terms and conditions of award provide that submissions must not contain any Protected Personally Identifiable Information (PII), limited rights data (proprietary data), classified information, information subject to export control classification, or other information not subject to release.

The recipient must self-certify at the time of submission to EERE via E-Link that the content is appropriate and that it is not a copyrighted reprint, i.e., the final version of the published article. Recipients are reminded that the article is to include an acknowledgement of federal support and a legal disclaimer as required in the "Publications" Term in the award Special Terms and Conditions.

Electronic Submission Process. The AM of the Journal Article must be provided electronically via the DOE Energy Link System (E-Link) and must be accompanied by a completed DOE Announcement Notice (AN) 241.3 (http://www.osti.gov/elink-2413).

Within the AN 241.3, provide relevant journal information (article title, journal name, volume, issue, and any other pertinent publication information). Also, provide a persistent link to the repository location of the AM. An example of a persistent link is a URL to the specific location of the Accepted Manuscript of Journal Article hosted on a public, openly accessible university research publications website. If a persistent link is not available or if the website has access restrictions (preventing public access), then the recipient should upload the full-text of the AM using the AN 241.3 and E-Link instructions.

Full-text of the AM must be in the Adobe Portable Document Format (PDF) and be one integrated PDF file that contains all text, tables, diagrams, photographs, schematic, graphs, and charts. Please refer to http://www.osti.gov/stip/best-practices-portable-document-format-pdf-creation for PDF document creation.

C. Scientific / Technical Conference Papers / Presentation /Proceeding

Submit to:	DOE Energy Link System (E-Link) available at http://www.osti.gov/elink-2413
Submission deadline:	Within five (5) calendar days after the event, or as specified

The prime recipient must submit a copy of any scientific/technical conference papers/proceedings.

Content: The content should include: (1) name of conference; (2) location of conference; (3) date of conference; and (4) conference sponsor. Also include an acknowledgement of federal support and a legal disclaimer as described in the Special Terms and Conditions (additional information can be found at the EERE Communications Standards website:

https://www.energy.gov/eere/communicationstandards/eere-branded-publications-developed-third-parties).

Electronic Submission Process: Scientific/technical conference papers/presentations or proceedings must be submitted via the DOE Energy Link System (E-Link) with a completed DOE Announcement Notice (AN) 241.3 (https://www.osti.gov/elink-2413).

DOE will not review conference papers or presentations prior to making publicly available via OSTI since they were already presented in a public setting during a conference. The recipient is responsible for ensuring the suitability of the content for public release. The terms and conditions of award provide that submissions must not contain any Protected Personally Identifiable Information (PII), limited rights data (proprietary data), classified information, information subject to export control classification, or other information not subject to release.

Scientific/technical conference papers or proceedings that are textual documents must be submitted in Adobe Portable Document Format (PDF) and be one integrated PDF file that contains all text, tables, diagrams, photographs, schematics, graphs, and charts. Please refer to http://www.osti.gov/stip/best-practices-portable-document-format-pdf-creation for PDF document creation**.** Audiovisual formats, such as PowerPoint (PPT) or video presentations, may be submitted as a Microsoft PPT file or audiovisual file by selecting the appropriate format on the AN 241.3 for the file to be uploaded or, in the case of videos posted on a publicly available website, by providing a link to the specific video. Format options and other instructions can be found at http://www.osti.gov/stip/audiovisualsti.

D. Scientific / Technical Software & Manual

Submit to:	Energy Science and Technology Software Center P.O. Box 62 Oak Ridge, TN 37831 **OR** **E-Link:** https://www.osti.gov/elink/241-4.jsp **OR** DOE CODE: https://www.osti.gov/doecode/
Submission deadline:	Within five (5) calendar days after the event, or as specified

The prime recipient must submit all software deliverables created under the award, as well as any accompanying documentation or manuals. Recipients have two choices for submitting software to DOE:

1. Submission through the Energy Science and Technology Software Center (ESTSC).

Content. Unless otherwise specified in the award, the following must be delivered: source code, the executable object code and the minimum support documentation needed by a competent user to understand and use the software and to be able to modify the software in subsequent development efforts.

Submission Process. The software submission must be accompanied by a completed DOE Announcement Notice (AN) 241.4 "Announcement of U.S. Department of Energy Computer Software." The form and instructions are available on E-Link at http://www.osti.gov/elink/241-4.jsp. The AN 241.4 may be filled online and submitted electronically with a printed copy or note accompanying the shipped software package.

Software (including user guide or manual) must be submitted on computer disk (CD) shipped via regular mail to:

Energy Science and Technology Software Center
P.O. Box 62
Oak Ridge, TN 37831

2. Submission through DOE CODE

DOE CODE is DOE's new software services platform for submitting and searching for software resulting from DOE-funded research, and provides alternative to submitting software through ESTSC. Through submission to DOE CODE, users have the option to obtain a Digital Object Identifier (DOI) for the code, making it more easily discoverable, citable and shared.

Content. When a recipient submits software to OSTI through DOE CODE, a set of required metadata elements and a link to the software repository must be provided.

Submission Process. Recipients will submit software by going to https://www.osti.gov/doecode/. Before submissions can be made, the recipient will be required to create an account. The recipient may create an account by visiting the top right of the DOE CODE homepage. Once the account is created, submissions may be made through the submit software/code link on the homepage. For more information about DOE CODE please visit https://www.osti.gov/doecode/faq.

E. Scientific / Technical Datasets

Submit to:	DOE Energy Link System (E-Link) available at https://www.osti.gov/elink/241-6-submission.jsp
Submission deadline:	Within five (5) calendar days after the event, or as specified

Scientific/technical datasets (data-streams, data files, etc.) support the technical reports and published literature resulting from DOE-funded research. They are also recognized as valuable information entities in their own right that, now and in the future, need to be available for citation, discovery, retrieval, and reuse. The assignment and registration of a Digital Object Identifier (DOI) is a free service for DOE-funded researchers which is provided by OSTI to enhance access to this important resource. In order to obtain a DOI, provide to OSTI the specific data elements relevant to the dataset, as specified in DOE AN 241.6.

Content. If the recipient generates publicly available datasets resulting from work funded by DOE, they may announce these datasets to OSTI and have them registered with DataCite to obtain a DOI, which ensures long-term linkage between the DOI and the dataset's location. To register and publicly announce a dataset, the recipient must provide an AN 241.6, including the required data elements needed for describing the dataset. Note: Do NOT submit the dataset itself, only the metadata for registering the dataset, obtaining a DOI, and announcing its availability.

Electronic Submission Process. Notification of scientific datasets must be submitted electronically via the DOE Energy Link System (E-Link) and must be accompanied by a completed DOE Announcement Notice (AN) 241.6 (https://www.osti.gov/elink/241-6-submission.jsp). Within the AN 241.6, provide relevant information about the dataset as well as the URL where the dataset can be accessed.

F. Other STI (Dissertation / Thesis, see Special Instructions)

Submit to:	http://www.osti.gov/elink-2413
Submission deadline:	Within five (5) calendar days after the event, or as specified

Recipients are encouraged to announce other forms of STI especially if they are the primary means by which certain research results are disseminated or if they contain research results not already announced to DOE by the recipient in technical reports, accepted journal articles, or other STI.

Other types of scientific and technical information produced which may be for used for public dissemination of project results include: dissertation/thesis, patent, book, or other similar products. These types of STI may also be announced using DOE AN 241.3 by following instructions on the E-Link website (http://www.osti.gov/elink-2413).

III. Closeout Reporting

A. Final Invention Certification DOE F 2050.11

Submit to:	https://www.eere-pmc.energy.gov/SubmitReports.aspx
Submission deadline:	Within 90 calendar days after expiration or termination of the award

The prime recipient is required to submit an Invention Certification DOE F 2050.11. The Invention Certification form is available at http://energy.gov/eere/funding/eere-funding-application-and-management-forms.

The Invention Certification must include a list of all subcontracts at any tier containing a patent rights clause (or state that there were none).

B. Final Property Reports SF-428 & SF-428B

Submit to:	https://www.eere-pmc.energy.gov/SubmitReports.aspx
Submission deadline:	Within 90 calendar days after expiration or termination of the award

The prime recipient must submit a final inventory of and request disposition instructions for any federally-owned property and/or property or equipment acquired with project funds with an acquisition cost above $5,000, whether the property is/was in the possession of the prime recipient or subrecipients.

The prime recipient must complete an SF-428 and SF-428B, available at http://energy.gov/eere/funding/eere-funding-application-and-management-forms.

If disposition occurs at any time other than award closeout, the prime recipient must complete an SF-428 and SF-428C (see IV. Other Reporting H. Property Disposition Request/Report).

Only the EERE Contracting Officer has authority to approve disposition requests and issue disposition instructions.

C. Other (see Special Instructions)

Submit to:	https://www.eere-pmc.energy.gov/SubmitReports.aspx
Submission deadline:	Within 90 calendar days after expiration or termination of the award

IV. Other Reporting

A. Intellectual Property Reporting

Submit to:	http://www.iEdison.gov
Submission deadline:	Within five (5) calendar days after the event, or as specified

iEdison requires a login and password. If the recipient's organization does not already have an iEdison administrator account, the recipient may register for one at: iEdison Registration

In accordance with the patent rights clause of the award, the recipient and subrecipient(s), if any, must complete the following intellectual property reports in iEdison when applicable:

(1) Disclosing a subject invention, including anticipated uses and sales (use iEdison's Invention Report);

(2) Reporting publications, manuscript submissions, or other public disclosures concerning a subject invention (add documents to the Invention Report);

(3) If authorized by the award agreement, electing (or declining) to retain title to a subject invention (modify the Invention Report and input "Title Election Date" or "Not Elect Title Reason");

(4) Disclosing the filing or termination of patent applications on a subject invention (i.e., patent applications disclosing or claiming a subject invention). Patent disclosures must be made (using iEdison's Patent Report) for filing the following patent applications:
- An initial domestic patent application (including provisional or non-provisional);
- A domestic divisional or continuation patent application;
- A domestic continuation-in-part application; and
- A foreign patent application.

(5) Discontinuing prosecution of a patent application, maintenance of a patent, or defense in a patent reexamination or opposition proceeding, regardless of jurisdiction (modify the Patent Report);

(6) Requesting an extension of time to:
- Elect (or decline) to retain title to a subject invention (modify the Invention Report); and
- File an initial domestic or foreign patent application (modify the Invention Report).

Failure to submit Intellectual Property Reporting Forms in a timely manner may result in forfeiture of the recipient's or subrecipient's rights in the subject inventions and related patent applications.

B. Invention Utilization Report

Submit to:	http://www.iEdison.gov
Submission deadline:	Reports are due one year after the disclosure date of each subject invention and must continue to be provided for 10 years after the date of disclosure

The recipient and subrecipient(s), if any, must provide Invention Utilization Reports for any subject inventions made under the award. Reports are due one year after the disclosure date of each subject invention and must continue to be provided for 10 years after the date of disclosure. Failure to submit Invention Utilization Reports in a timely manner may result in forfeiture of the recipient's or subrecipient's rights in the subject inventions.

C. Project Management Plan (PMP)

Submit to:	https://www.eere-pmc.energy.gov/SubmitReports.aspx
Submission deadline:	Within six (6) weeks of the effective date of the EERE award

Iterations and Maintenance

The recipient is required to develop, update, and adhere to a project management plan. The purpose of the plan is to establish cost, schedule, and technical performance baselines, and to formalize the processes by which the project will be managed. These processes include considerations such as risk

management, change management, and communications management. While it is primarily the project recipient's responsibility to maintain the plan, federal staff may request changes. The plan is intended to be a living document, modified as necessary, and comprising the following iterations:

Application Draft
The recipient must submit a draft of the project management plan with the initial application for financial assistance.

Negotiation Draft
The selected recipient may be called upon by the selecting Office to revise its project management plan during the negotiation phase.

Active Plan
Following formal award of the financial assistance agreement, the recipient must submit an updated project management plan, to include any changes requested during negotiation and a timeline based upon the actual award date.

a. Revised Plan(s)

During the life of the project the recipient must submit a revised project management plan based on the following circumstances:

1. Developments that have a significant favorable impact on the project.

2. Problems, delays, or adverse conditions which materially impair the recipient's ability to meet the objectives of the award or which may require the program office to respond to questions relating to such events from the public. Specifically, the recipient must update the plan when any of the following incidents occur:

    a) Any event which is anticipated to cause significant schedule or cost changes, such as changes to the funding and costing profile or changes to the project timeline.
    b) Any change to Technology Readiness Level.
    c) Any significant change to risk events (including both potential and realized events) or to risk management strategies
    d) Failure to meet a milestone or milestones; any dependencies should be adjusted.
    e) Any changes to partnerships.
    f) Any significant change to facilities or other project resources.
    g) Any other incident that has the potential for high visibility in the media.

b. Content of revised PMP:

Project Title: The DOE award number and project title
Recipient Organization: Official name of the recipient organization
Principal Investigator: The name and title of the project director/ principal investigator
Date of Plan: The date the plan or plan revision was completed

The revised PMP must describe changes to any of the following sections of the PMP as well as provide updated versions of any logs, tables, charts, or timelines.

1. Executive Summary: Provide a description of the project that includes the objective, project goals, and expected results. The description should include a high level description of the technology, potential use or benefit of the technology, location of work sites and a brief discussion of work performed at each site, along with a description of project phases (if the project includes phases).

2. Technology Readiness Levels (TRLs): Identify the readiness level of the technology associated with the project as well as the planned progression during the course of project execution. A detailed explanation of the rationale for the estimated technology readiness level should be provided. Specific entry criteria for the next higher technology readiness level should be identified. The following definitions apply:

    a) TRL-1. Basic principles observed and reported: Scientific problem or phenomenon identified. Essential characteristics and behaviors of systems and architectures are identified using mathematical formulations or algorithms. The observation of basic scientific principles or phenomena has been validated through peer-reviewed research. Technology is ready to transition from scientific research to applied research.

    b) TRL-2. Technology concept and/or application formulated: Applied research activity. Theory and scientific principles are focused on specific application areas to define the concept. Characteristics of the application are described. Analytical tools are developed for simulation or analysis of the application.

    c) TRL-3. Analytical and experimental critical function and/or characteristic proof of concept: Proof of concept validation has been achieved at this level. Experimental research and development is initiated with analytical and laboratory studies. System/integrated process requirements for the overall system application are well known. Demonstration of technical feasibility using immature prototype implementations are exercised with representative interface inputs to include electrical, mechanical, or controlling elements to validate predictions.

    d) TRL-4. Component and/or process validation in laboratory environment- Alpha prototype (component) Standalone prototyping implementation and testing in laboratory environment demonstrates the concept. Integration and testing of component technology elements are sufficient to validate feasibility.

    e) TRL-5. Component and/or process validation in relevant environment- Beta prototype (component): Thorough prototype testing of the component/process in relevant environment to the end user is performed. Basic technology elements are integrated with reasonably realistic supporting elements based on available technologies. Prototyping implementations conform to the target environment and interfaces.

f) TRL-6. System/process model or prototype demonstration in a relevant environment- Beta prototype (system): Prototyping implementations are partially integrated with existing systems. Engineering feasibility fully demonstrated in actual or high fidelity system applications in an environment relevant to the end user.

g) TRL-7. System/process prototype demonstration in an operational environment- Integrated pilot (system): System prototyping demonstration in operational environment. System is at or near full
scale (pilot or engineering scale) of the operational system, with most functions available for demonstration and test. The system, component, or process is integrated with collateral and ancillary systems in a near production quality prototype.

h) TRL-8. Actual system/process completed and qualified through test and demonstration- Pre-commercial demonstration: End of system development. Full-scale system is fully integrated into operational environment with fully operational hardware and software systems. All functionality is tested in simulated and operational scenarios with demonstrated achievement of end-user specifications. Technology is ready to move from development to commercialization.

3. Risk Management: Provide a summary description of the proposed approach to identify, analyze, and respond to potential risks associated with the proposed project. Project risk events are uncertain future events that, if realized, impact the success of the project. At a minimum, include the initial identification of significant technical, resource, and management issues that have the potential to impede project progress and strategies to minimize impacts from those issues. The risk management approach should be tailored to the TRL. If a project or task is expected to progress to a higher TRL, then the risk plan should address the retirement of any risks associated with the first TRL and identify new risks related to moving to the next TRL. Additionally, the risk management approach should include risk opportunities that if realized, could benefit the project.

4. Milestone Log: Provide milestones for each budget period (or phase) of the project. Each milestone should include a title and planned completion date. Milestones should be quantitative (e.g., a date, a decision to be made, a key event) and show progress toward budget period and/or project goals. Milestones should also be important and few. Higher TRL projects (Demonstration and Deployment) typically have the most detailed milestone logs compared to lower TRL level projects (Research and Development). If applicable, milestones chosen should clearly reflect progress through various TRL stages.

Note: The Milestone Status must present actual performance in comparison with the Milestone Log, and include:
a) The actual status and progress of the project,
b) Specific progress made toward achieving the project's milestones, and,
c) Any proposed changes in the project's schedule required to complete milestones.

5. Funding and Costing Profile: Provide a table (the Project Funding Profile) that shows, by budget period, the amount of government funding going to each project team member. Also a table (the Project Costing Profile) which projects, by month, the expenditure of both government and recipient funds for the first budget period, at a minimum. The Funding and Costing Profile should show the relationships with the Milestone Log (Item 4 above) and Project Timeline (Item 6 below); for example, Funding and Costing information could be shown as an overlay on milestone or timeline charts.

6. Project Timeline: Provide a timeline of the project (similar to a Gantt chart) broken down by each task and subtask, as described in the Statement of Project Objectives. The timeline should include a start date and end date for each task, as well as interim milestones. The timeline should also show interdependencies between tasks and include the milestones that are identified in the Milestone Log (Item 4 above). The timeline should also show the relationship to the Project Costing Profile (Item 5 above). If applicable, the timeline should include activities and milestones related to achieving succeeding TRLs.

7. Success Criteria at Decision Points: Provide well-defined success criteria for each decision point in the project, including go/no-go decision points and the conclusions of budget periods and the entire project. The success criteria should be objective and stated in terms of specific, measurable, and repeatable data. Usually, the success criteria pertain to desirable outcomes, results, and observations from the project. Key milestones can be associated with success criteria. If applicable, the success criteria should include exit criteria for progressing from one TRL to the next.

8. Key Partnerships, Teaming Arrangements and Team Members: Provide a list of key team members in the project as well as the role and contact information of each. A hierarchical project organization and structure chart should be provided along with a description of the role and responsibilities of each team member in terms of contribution to project scope. The section should also include key team members who fulfill single or multiple roles within a project as well as the contact information for each.

9. Facilities and Resources: Provide a list of project locations along with a discussion of capabilities and activities performed at each site in terms of contribution to project scope. The address of each work site should be provided.

10. Communications Management: Describe the communications needs and expectations for the project team members. The communications plan may be simple or detailed, depending on the complexity of the project. At a minimum, the plan should include contact information, methods of communicating and anticipated frequency.

11. Change Management: Provide a description of the process for managing change on the project. Describe how change will be monitored, controlled and documented within the project. This includes, but is not limited to, changes to the Scope, Schedule, and Budget. If applicable, Change Management should include assessing how changes impact TRLs.

D. Annual Incurred Cost Proposals

Submit to:	If DOE is the Cognizant Federal Agency, send the Annual Incurred Cost Proposal to: • CostPrice@ee.doe.gov (for awards administered by the Golden Field Office); or • PricingGroup@netl.doe.gov (for awards administered by NETL) Otherwise, submit the proposal to the Cognizant Federal Agency
Submission deadline:	Within 180 calendar days after the close of the recipient's fiscal year

The prime recipient must submit an Annual Incurred Cost Proposal, reconciled to its financial statements unless the award is based on negotiated fixed indirect cost rate(s) or a fixed amount for indirect or facilities and administration (F&A) costs. The prime recipient must submit an annual incurred cost proposal directly to the Cognizant Federal Agency for negotiating and approving indirect costs.

E. DOE For-Profit Compliance Audit

Submit to:	Send a copy of the annual DOE For-Profit Compliance Audit to: • DOE-Audit-Submission@hq.doe.gov and • The DOE Contracting Officer In addition: Email to: PricingGroup@netl.doe.gov (for awards administered by NETL)
Submission deadline:	Within the earlier of 30 days after receipt of the auditor's report(s) or 9 months after the end of the audit period (recipient's fiscal year-end)

As required by 2 CFR parts 910.500 through 910.521, a For-Profit entity which expends $750,000 or more during their fiscal year in DOE awards must have a compliance audit conducted for that year.

The DOE For-Profit Compliance Audit must be conducted in accordance with the regulations at 2 CFR 910.500-521. It must also refer to the appropriate regulations used by the auditor in their examination.

The compliance audit report(s) must be submitted to DOE within the earlier of thirty days after receipt of the auditor's report(s) or nine months after the end of the audit period (recipient's fiscal year-end). The compliance audit report must be submitted, along with audited financial statements (if applicable).

F. Single Audit: States, Local Government, Tribal Governments, Institution of Higher Education (IHE), or Non-Profit Organization

Submit to:	Federal Audit Clearinghouse - https://harvester.census.gov/facweb/Default.aspx

Submission deadline:	Within the earlier of 30 days after receipt of the auditor's report(s) or 9 months after the end of the audit period (recipient's fiscal year-end)

As required by 2 CFR 200 Subpart F, non-federal entities that expend $750,000 or more during the recipient entity's fiscal year in federal awards must have a single or program-specific audit conducted. The single audit must be conducted in accordance with §200.514 Scope of audit, except when it elects to have a program-specific audit conducted.

For most single audits, the requirement is for annual single audits. However, there are occasions where a single audit is not required annually. Per 2 CFR 200.504 - Frequency of audits, a state, local government, or Indian tribe that is required by constitution or statute to undergo its audits less frequently than annually, is permitted to undergo its audits biennially. Also, any nonprofit organization that had biennial audits for all biennial periods ending between July 1, 1992, and January 1, 1995, is permitted to undergo its single audits biennially.

For a program-specific audit, when a recipient expends federal award funds under only one federal program (excluding R&D) and the federal program's statutes, regulations, or the terms and conditions of the federal award do not require a financial statement audit of the auditee, the auditee may elect to have a program-specific audit conducted. A program-specific audit may not be elected for R&D unless all of the federal awards expended were received from the same federal agency, or the same federal agency and the same pass-through entity, and that federal agency, or pass-through entity in the case of a subrecipient, approves in advance a program-specific audit.

The single audit report (including audited financial statements) must be submitted, along with the data collection form to the Federal Audit Clearinghouse website within the earlier of thirty days after receipt of the auditor's report(s) or nine months after the end of the audit period (recipient's fiscal year-end).

G. Annual Property Inventory Report SF-428 & SF-428A

Submit to:	https://www.eere-pmc.energy.gov/SubmitReports.aspx
Submission deadline:	Within 90 calendar days after the end of the annual reporting period

The prime recipient must submit an annual inventory of federally-owned property (government-furnished) **where the award specifies that title to the property vests with the federal government**, whether it is in the possession of the prime recipient or subrecipient(s). The prime recipient must complete an SF-428 and SF-428A, available at https://www.energy.gov/eere/funding/eere-funding-application-and-management-forms.

H. Property Disposition Request/Report SF-428 & SF-428C

Submit to:	https://www.eere-pmc.energy.gov/SubmitReports.aspx
Submission deadline:	Within 5 calendar days of the event or as specified

The prime recipient must request disposition instructions for or report disposition of federally-owned property or equipment acquired with project funds, whether the property or equipment is/was in the possession of the prime recipient or subrecipient(s). Recipients may also be required to provide compensation to the awarding agency when acquired equipment is sold or retained for use on activities not sponsored by the federal government. Any equipment with an acquisition cost above $5,000 must be included in the inventory.

If disposition occurs at any time other than award closeout (i.e., at any time throughout the life of the project or after project completion and closeout as long as the federal government retains an interest in the item), the prime recipient must complete an SF-428 and SF-428C, available at https://www.energy.gov/eere/funding/eere-funding-application-and-management-forms.

If disposition instructions are requested at the time of award closeout, the prime recipient must submit the SF-428 and SF-428B (see III. Closeout Reporting B. Closeout Reports).

Only the EERE Contracting Officer has authority to approve disposition requests and issue disposition instructions.

I. Uniform Commercial Code (UCC) Financing Statements

Submit to:	https://www.eere-pmc.energy.gov/SubmitReports.aspx
Submission deadline:	Within five (5) calendar days after the event, or as specified.

If a for-profit recipient or subrecipient desires to purchase a piece of equipment for their project, and the per-unit dollar value of said equipment is $5,000 or more, and the federal share of the financial assistance agreement is more than $1M, the recipient or subrecipient must file a UCC financing statement.

A UCC financing statement provides public notice that the federal government has an undivided reversionary interest in the equipment, and as such the equipment cannot be sold or used as collateral for a loan (encumbered).

The for-profit recipient or subrecipient must file the UCC financing statement(s) with the Secretary of State where the equipment will be physically located and must pay any associated costs for such filings.

The initial UCC financing statement may also be referred to as a UCC1. For additional pieces of equipment not specified in the award budget, TBD equipment, or equipment needed in future budget periods, the recipient can file an amendment to the original UCC1 financing statement, by submitting the UCC3 financing statement amendment.

Each UCC financing statement or amendment is to be filed with the appropriate Secretary of State office, where the equipment will be physically located.

Note: All costs associated with filing UCC financing statements, UCC financing statement amendments, and UCC financing statement terminations, are allowable and allocable costs which can be charged to the federal award.

At a minimum, the recipient must have stated in their UCC financing statement in block 4. (collateral) the following:

1) "Title to all equipment (not real property) purchased with federal funds under this financial assistance agreement is conditional pursuant to the terms of 2 CFR 910.360, and the federal government retains an undivided reversionary interest in the equipment at the federal cost-share proportion specified in the award terms and conditions."

2) Federal Award Identification Number (e.g., DE-EE000XXXX)

J. Federal Subaward Reporting System (FSRS)

Submit to:	https://www.fsrs.gov/
Submission deadline:	The prime recipient is required to file a FFATA sub-award report by the end of the month following the month in which the prime recipient awards any sub-grant greater than or equal to $25,000.

The Federal Subaward Reporting System (FSRS) is the reporting tool prime recipients use to capture and report subaward and executive compensation data regarding their first-tier subrecipients to meet the FFATA reporting requirements. Prime recipients will report against subrecipients' awards. The subrecipient information entered in FSRS will then be displayed on USASpending.gov associated with the prime recipient's award furthering federal spending transparency.

The prime recipient is required to file a FFATA sub-award report by the end of the month following the month in which the prime recipient awards any sub-award greater than or equal to $25,000.

K. Other (see Special Instructions)

Submit to:	https://www.eere-pmc.energy.gov/SubmitReports.aspx
Submission deadline:	Within five (5) calendar days after the event, or as specified

Appendix A: Notice To Recipients (Prime Recipients And Subrecipients) Regarding Protected Data, Limited Rights Data And Protected Personally Identifiable Information

I. PROTECTED DATA AND LIMITED RIGHTS DATA

The recipient is required to mark protected data and limited rights data in accordance with the IP clause set of the award agreement. Failure to properly mark data may result in its public disclosure under the Freedom of Information Act (FOIA, 5 U.S.C. § 552) or otherwise.

A. Protected Data - Technical Data or Commercial or Financial Data First Produced in the Performance of the Award

The U.S. Government normally retains unlimited rights in any technical data or commercial or financial data produced in performance of Government financial assistance awards, including the right to distribute to the public.

However, under certain EERE awards, the recipient may mark certain categories of data produced under the award as protected from public disclosure for up to five years after the data is produced ("Protected Data"). If the award agreement provides for protected data and the recipient wants the data to be protected, the recipient must properly mark any documents containing Protected Data as set forth in the IP clause set of the award agreement.

B. Limited Rights Data - Data Produced Outside of the Award at Private Expense

Limited Rights Data is data (other than computer software) developed at private expense outside any Government financial assistance award or contract that embody trade secrets or are commercial or financial and confidential or privileged. Prior to including any Limited Rights Data in any documents to EERE, the recipient should review the award agreement. In most EERE awards, the recipient should not deliver any limited rights data to EERE if the recipient wants to protect the Limited Rights Data. If the EERE award does allow and require the delivery of limited rights data, then the recipient must properly mark any documents containing Limited Rights Data as set forth in the IP clause of the award agreement.

II. PROTECTED PERSONALLY IDENTIFIABLE INFORMATION

The recipient should not include any Protected Personally Identifiable Information (Protected PII) in their submissions to EERE. Protected PII is defined as any data that, if compromised, could cause harm to an individual such as identify theft. Protected PII includes, but is not limited to:

- Social Security Numbers in any form;
- Place of Birth associated with an individual;
- Date of Birth associated with an individual;
- Mother's maiden name associated with an individual;
- Biometric record associated with an individual;
- Fingerprint;
- Iris Scan;
- DNA;
- Medical history information associated with an individual;
- Medical conditions, including history of disease;
- Metric information, e.g., weight, height, blood pressure;
- Criminal history associated with an individual;
- Ratings;
- Disciplinary actions;
- Passport number;
- Educational transcripts;
- Financial information associated with an individual;
- Credit card numbers; and
- Security clearance history or related information (not including actual clearances held).

Appendix B: Research Performance Progress Report (RPPR)

DEMOGRAPHIC INFORMATION FOR SIGNIFICANT CONTRIBUTORS

Agencies may require that recipients provide demographic data about significant contributors for a variety of purposes, including the following:

- to gauge whether our programs and other opportunities are fairly reaching and benefiting everyone regardless of demographic category;
- to ensure that those in under-represented groups have the same knowledge of and access to programs, meetings, vacancies, and other research and educational opportunities as everyone else;
- to gauge and report performance in promoting partnerships and collaborations;
- to assess involvement of international investigators or students in work we support;
- to track the evolution of changing science, technology, engineering and mathematics (STEM) fields at different points in the pipeline (e.g., medicine and law demographics have recently changed dramatically);
- to raise investigator and agency staff awareness of the involvement of under-represented groups in research;
- to encourage the development of creative approaches for tapping into the full spectrum of talent of the STEM workforce;
- to respond to external requests for data of this nature from a variety of sources, including the National Academies, Congress, etc.; and
- to respond to legislatively-required analysis of workforce dynamics. Legislation requires at least one agency to routinely estimate scientific workforce needs. This analysis is accomplished through reviewing demographic data submitted for the existing workforce.

Demographic data (i.e., gender, ethnicity, race, and disability status) should be provided directly by significant contributors, with the understanding that submission of such data is voluntary. There are no adverse consequences if the data are not provided. Confidentiality of demographic data will be in accordance with agency's policy and practices for complying with the requirements of the Privacy Act.

Gender: Male
Female
Do not wish to provide

Ethnicity: Hispanic or Latina/o
Not-Hispanic or not-Latina/o
Do not wish to provide

Race (select one or more): American Indian or Alaska Native
Asian
Black or African American
Native Hawaiian or other Pacific Islander

White
Do not wish to provide

Disability Status:

Yes (check yes if any of the following apply to you)

- Deaf or serious difficulty hearing
- Blind or serious difficulty seeing even when wearing glasses
- Serious difficulty walking or climbing stairs
- Other serious disability related to a physical, mental, or emotional condition.

No

Do not wish to provide

This measure is designed as a binary measure; it encompasses all self-reported disabilities. Please do not use it to report the number of individuals who have different types of disabilities (e.g., hearing impairments).

Note: This construct is not designed to be used at an individual-level (i.e., it should not be used for determining accommodation needs or disability status for particular individuals associated with the project).

Applicant Name: Carollo Engineers, Inc. Award Number: DE-EE0009509.0000

Budget Information - Non Construction Programs

Attachment 3

OMB Approval No. 0348-0044

Section A - Budget Summary

Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. Budget Period 1	81.086			$1,332,323	$2,106,160	$3,438,483
2. Budget Period 2	81.086			$648,319	$370,956	$1,019,275
3.						
4.						
5. Totals				$1,980,642	$2,477,116	$4,457,758

Section B - Budget Categories

6. Object Class Categories	Grant Program, Function or Activity				Total (5)
	Budget Period 1	Budget Period 2			
a. Personnel	$114,421	$114,421			$228,842
b. Fringe Benefits	$52,828	$52,828			$105,656
c. Travel	$9,100	$9,100			$18,200
d. Equipment	$0	$0			$0
e. Supplies	$0	$0			$0
f. Contractual	$3,006,162	$712,835			$3,718,997
g. Construction	$0	$0			$0
h. Other	$0	$0			
i. Total Direct Charges (sum of 6a-6h)	$3,182,511	$889,184			$4,071,695
j. Indirect Charges	$255,972	$130,091			$386,063
k. **Totals** (sum of 6i-6j)	$3,438,483	$1,019,275			$4,457,758
7. Program Income	$0	$0			$0

Intellectual Property Provisions
Cooperative Agreement – Special Data Statute
Research, Development, or Demonstration
Domestic Large Business

01.	FAR 52.227-1	Authorization and Consent (DEC 2007) Alternate I (APR 1984)
02.	FAR 52.227-2	Notice and Assistance Regarding Patent and Copyright Infringement (DEC 2007)
03.	2 CFR 910 Appendix A of Subpart D	Rights in Data – Programs Covered under Special Data Statutes
04.	W(C) 2016-004 Class Patent Waiver	Patent Rights – Waiver (JUL 1996)

NOTE: In reading these provisions, any reference to "contractor" shall mean "recipient," and any reference to "contract" or "subcontract" shall mean "award" or "subaward."

01. FAR 52.227-1 Authorization and Consent (DEC 2007) Alternate I (APR 1984)

(a) The Government authorizes and consents to all use and manufacture of any invention described in and covered by a United States patent in the performance of this contract or any subcontract at any tier.

(b) The Contractor shall include the substance of this clause, including this paragraph (b), in all subcontracts that are expected to exceed the simplified acquisition threshold. However, omission of this clause from any subcontract, including those at or below the simplified acquisition threshold, does not affect this authorization and consent.

(End of clause)

02. FAR 52.227-2 Notice and Assistance Regarding Patent and Copyright Infringement (DEC 2007)

(a) The Contractor shall report to the Contracting Officer, promptly and in reasonable written detail, each notice or claim of patent or copyright infringement based on the performance of this contract of which the Contractor has knowledge.

(b) In the event of any claim or suit against the Government on account of any alleged patent or copyright infringement arising out of the performance of this contract or out of the use of any supplies furnished or work or services performed under this contract, the Contractor shall furnish to the Government, when requested by the Contracting Officer, all evidence and information in the Contractor's possession pertaining to such claim or suit. Such evidence and information shall be furnished at the expense of the Government except where the Contractor has agreed to indemnify the Government.

(c) The Contractor shall include the substance of this clause, including this paragraph (c), in all subcontracts that are expected to exceed the simplified acquisition threshold.

(End of clause)

03. 2 CFR 910, Appendix A of Subpart D, Rights in Data - Programs Covered Under Special Data Statutes

(a) Definitions

Computer Data Bases, as used in this clause, means a collection of data in a form capable of, and for the purpose of, being stored in, processed, and operated on by a computer. The term does not include computer software.

Computer software, as used in this clause, means

(i) computer programs which are data comprising a series of instructions, rules, routines, or statements, regardless of the media in which recorded, that allow or cause a computer to perform a specific operation or series of operations and

(ii) data comprising source code listings, design details, algorithms, processes, flow charts, formulae and related material that would enable the computer program to be produced, created or compiled. The term does not include computer data bases.

Data, as used in this clause, means recorded information, regardless of form or the media on which it may be recorded. The term includes technical data and computer software. The term does not include information incidental to administration, such as financial, administrative, cost or pricing or management information.

Form, fit, and function data, as used in this clause, means data relating to items, components, or processes that are sufficient to enable physical and functional interchangeability as well as data identifying source, size, configuration, mating and attachment characteristics, functional characteristics, and performance requirements except that for computer software it means data identifying source, functional characteristics, and performance requirements but specifically excludes the source code, algorithm, process, formulae, and flow charts of the software.

Limited rights data, as used in this clause, means data (other than computer software) developed at private expense that embody trade secrets or are commercial or financial and confidential or privileged.

Restricted computer software, as used in this clause, means computer software developed at private expense and that is a trade secret; is commercial or financial and confidential or privileged; or is published copyrighted computer software; including modifications of such computer software.

Protected data, as used in this clause, means technical data or commercial or financial data first produced in the performance of the award which, if it had been obtained from and first produced by a non-federal party, would be a trade secret or commercial or financial information that is privileged or confidential under the meaning of 5 U.S.C. 552(b)(4) and which data is marked as being protected data by a party to the award.

Protected rights, as used in this clause, mean the rights in protected data set forth in the Protected Rights Notice of paragraph (g) of this clause.

Technical data, as used in this clause, means that data which are of a scientific or technical nature. Technical data does not include computer software, but does include manuals and instructional materials and technical data formatted as a computer data base.

Unlimited rights, as used in this clause, means the right of the Government to use, disclose, reproduce, prepare derivative works, distribute copies to the public, and perform publicly and display publicly, in any manner and for any purpose whatsoever, and to have or permit others to do so.

(b) Allocation of Rights

(1) Except as provided in paragraph (c) of this clause regarding copyright, the Government shall have unlimited rights in—

(i) Data specifically identified in this agreement as data to be delivered without restriction;

(ii) Form, fit, and function data delivered under this agreement;

(iii) Data delivered under this agreement (except for restricted computer software) that constitute manuals or instructional and training material for installation, operation, or routine maintenance and repair of items, components, or processes delivered or furnished for use under this agreement; and

(iv) All other data delivered under this agreement unless provided otherwise for protected data in accordance with paragraph (g) of this clause or for limited rights data or restricted computer software in accordance with paragraph (h) of this clause.

(2) The Recipient shall have the right to—

(i) Protect rights in protected data delivered under this agreement in the manner and to the extent provided in paragraph (g) of this clause;

(ii) Withhold from delivery those data which are limited rights data or restricted computer software to the extent provided in paragraph (h) of this clause;

(iii) Substantiate use of, add, or correct protected rights or copyrights notices and to take other appropriate action, in accordance with paragraph (e) of this clause; and

(iv) Establish claim to copyright subsisting in data first produced in the performance of this agreement to the extent provided in paragraph (c)(1) of this clause.

(c) Copyright

(1) Data first produced in the performance of this agreement. Except as otherwise specifically provided in this agreement, the Recipient may establish, without the prior approval of the Contracting Officer, claim to copyright subsisting in any data first produced in the performance of this agreement. If claim to copyright is made, the Recipient shall affix the applicable copyright notice of 17 U.S.C. 401 or 402 and acknowledgment of Government sponsorship

(including agreement number) to the data when such data are delivered to the Government, as well as when the data are published or deposited for registration as a published work in the U.S. Copyright Office. For such copyrighted data, including computer software, the Recipient grants to the Government, and others acting on its behalf, a paid-up nonexclusive, irrevocable, worldwide license to reproduce, prepare derivative works, distribute copies to the public, and perform publicly and display publicly, by or on behalf of the Government, for all such data.

(2) Data not first produced in the performance of this agreement. The Recipient shall not, without prior written permission of the Contracting Officer, incorporate in data delivered under this agreement any data that are not first produced in the performance of this agreement and that contain the copyright notice of 17 U.S.C. 401 or 402, unless the Recipient identifies such data and grants to the Government, or acquires on its behalf, a license of the same scope as set forth in paragraph (c)(1) of this clause; provided, however, that if such data are computer software, the Government shall acquire a copyright license as set forth in paragraph (h)(3) of this clause if included in this agreement or as otherwise may be provided in a collateral agreement incorporated or made a part of this agreement.

(3) Removal of copyright notices. The Government agrees not to remove any copyright notices placed on data pursuant to this paragraph (c), and to include such notices on all reproductions of the data.

(d) Release, Publication and Use of Data

(1) The Receipt shall have the right to use, release to others, reproduce, distribute, or publish any data first produced or specifically used by the Recipient in the performance of this contract, except to the extent such data may be subject to the Federal export control or national security laws or regulations, or unless otherwise provided in this paragraph of this clause or expressly set forth in this contract.

(2) The Recipient agrees that to the extent it receives or is given access to data necessary for the performance of this agreement which contain restrictive markings, the Recipient shall treat the data in accordance with such markings unless otherwise specifically authorized in writing by the Contracting Officer.

(e) Unauthorized Marking of Data

(1) Notwithstanding any other provisions of this agreement concerning inspection or acceptance, if any data delivered under this agreement are marked with the notices specified in paragraph (g)(2) or (g)(3) of this clause and use of such is not authorized by this clause, or if such data bears any other restrictive or limiting markings not authorized by this agreement, the Contracting Officer may at any time either return the data to the Recipient or cancel or ignore the markings. However, the following procedures shall apply prior to canceling or ignoring the markings.

(i) The Contracting Officer shall make written inquiry to the Recipient affording the Recipient 30 days from receipt of the inquiry to provide written justification to substantiate the propriety of the markings;

(ii) If the Recipient fails to respond or fails to provide written justification to substantiate the propriety of the markings within the 30-day period (or a longer time not exceeding 90 days approved in writing by the Contracting Officer for good cause shown), the Government shall have the right to cancel or ignore the markings at any time after said period and the data will no longer be made subject to any disclosure prohibitions.

(iii) If the Recipient provides written justification to substantiate the propriety of the markings within the period set in subdivision (e)(1)(i) of this clause, the Contracting Officer shall consider such written justification and determine whether or not the markings are to be cancelled or ignored. If the Contracting Officer determines that the markings are authorized, the Recipient shall be so notified in writing. If the Contracting Officer determines, with concurrence of the head of the contracting activity, that the markings are not authorized, the Contracting Officer shall furnish the Recipient a written determination, which determination shall become the final agency decision regarding the appropriateness of the markings unless the Recipient files suit in a court of competent jurisdiction within 90 days of receipt of the Contracting Officer's decision. The Government shall continue to abide by the markings under this subdivision (e)(1)(iii) until final resolution of the matter either by the Contracting Officer's determination become final (in which instance the Government shall thereafter have the right to cancel or ignore the markings at any time and the data will no longer be made subject to any disclosure prohibitions), or by final disposition of the matter by court decision if suit is filed.

(2) The time limits in the procedures set forth in paragraph (e)(1) of this clause may be modified in accordance with agency regulations implementing the Freedom of Information Act (5 U.S.C. 552) if necessary to respond to a request thereunder.

(f) Omitted or Incorrect Markings

(1) Data delivered to the Government without either the limited rights or restricted rights notice as authorized by paragraph (g) of this clause, or the copyright notice required by paragraph (c) of this clause, shall be deemed to have been furnished with unlimited rights, and the Government assumes no liability for the disclosure, use, or reproduction of such data. However, to the extent the data has not been disclosed without restriction outside the Government, the Recipient may request, within 6 months (or a longer time approved by the Contracting Officer for good cause shown) after delivery of such data, permission to have notices placed on qualifying data at the Recipient's expense, and the Contracting Officer may agree to do so if the Recipient—

(i) Identifies the data to which the omitted notice is to be applied;

(ii) Demonstrates that the omission of the notice was inadvertent;

(iii) Establishes that the use of the proposed notice is authorized; and

(iv) Acknowledges that the Government has no liability with respect to the disclosure, use, or reproduction of any such data made prior to the addition of the notice or resulting from the omission of the notice.

(2) The Contracting Officer may also:

(i) Permit correction at the Recipient's expense of incorrect notices if the Recipient identifies the data on which correction of the notice is to be made, and demonstrates that the correct notice is authorized; or

(ii) Correct any incorrect notices.

(g) Rights to Protected Data

(1) The Recipient may, with the concurrence of DOE, claim and mark as protected data, any data first produced in the performance of this award that would have been treated as a trade secret if developed at private expense. Any such claimed “protected data” will be clearly marked with the following Protected Rights Notice, and will be treated in accordance with such Notice, subject to the provisions of paragraphs (e) and (f) of this clause.

> Protected Rights Notice
> These protected data were produced under agreement no. DE-EE0009509 with the U.S. Department of Energy and may not be published, disseminated, or disclosed to others outside the Government until five (5) years after the date the data were first produced, unless express written authorization is obtained from the recipient. Upon expiration of the period of protection set forth in this Notice, the Government shall have unlimited rights in this data. This Notice shall be marked on any reproduction of this data, in whole or in part.
>
> (End of notice)

(2) Any such marked Protected Data may be disclosed under obligations of confidentiality for the following purposes:

(a) For evaluation purposes under the restriction that the “Protected Data” be retained in confidence and not be further disclosed; or

(b) To subcontractors or other team members performing work under the Government's (insert name of program or other applicable activity) program of which this award is a part, for information or use in connection with the work performed under their activity, and under the restriction that the Protected Data be retained in confidence and not be further disclosed.

(3) The obligations of confidentiality and restrictions on publication and dissemination shall end for any Protected Data:

(a) At the end of the protected period;

(b) If the data becomes publicly known or available from other sources without a breach of the obligation of confidentiality with respect to the Protected Data;

(c) If the same data is independently developed by someone who did not have access to the Protected Data and such data is made available without obligations of confidentiality; or

(d) If the Recipient disseminates or authorizes another to disseminate such data without obligations of confidentiality.

(4) However, the Recipient agrees that the following types of data are not considered to be protected and shall be provided to the Government when required by this agreement without any claim that the data are Protected Data: (a) general test or performance results demonstrating technical breakthroughs, milestones or achievements; (b) general data demonstrating progress toward meeting DOE's technical targets and (c) any research data contained in publications resulting from the work under the agreement. The parties agree that notwithstanding the foregoing list of types of data, nothing precludes the Government from seeking delivery of additional data in accordance with this agreement, or from making publicly available additional non-protected data, nor does the foregoing list constitute any admission by the Government that technical data not on the list is Protected Data.

(5) The Government's sole obligation with respect to any protected data shall be as set forth in this paragraph (g).

(h) Protection of Limited Rights Data

When data other than that listed in paragraphs (b)(1)(i), (ii), and (iii) of this clause are specified to be delivered under this agreement and such data qualify as either limited rights data or restricted computer software, the Recipient, if the Recipient desires to continue protection of such data, shall withhold such data and not furnish them to the Government under this agreement. As a condition to this withholding the Recipient shall identify the data being withheld and furnish form, fit, and function data in lieu thereof.

(i) Subaward/Contract

The Recipient has the responsibility to obtain from its subrecipients/contractors all data and rights therein necessary to fulfill the Recipient's obligations to the Government under this agreement. If a subrecipient/contractor refuses to accept terms affording the Government such

rights, the Recipient shall promptly bring such refusal to the attention of the Contracting Officer and not proceed with subaward/contract award without further authorization.

(j) Additional Data Requirements

In addition to the data specified elsewhere in this agreement to be delivered, the Contracting Officer may, at any time during agreement performance or within a period of 3 years after acceptance of all items to be delivered under this agreement, order any data first produced or specifically used in the performance of this agreement. This clause is applicable to all data ordered under this subparagraph. Nothing contained in this subparagraph shall require the Recipient to deliver any data the withholding of which is authorized by this clause or data which are specifically identified in this agreement as not subject to this clause. When data are to be delivered under this subparagraph, the Recipient will be compensated for converting the data into the prescribed form, for reproduction, and for delivery.

(k) The Recipient agrees, except as may be otherwise specified in this agreement for specific data items listed as not subject to this paragraph, that the Contracting Officer or an authorized representative may, up to three years after acceptance of all items to be delivered under this contract, inspect at the Recipient's facility any data withheld pursuant to paragraph (h) of this clause, for purposes of verifying the Recipient's assertion pertaining to the limited rights or restricted rights status of the data or for evaluating work performance. Where the Recipient whose data are to be inspected demonstrates to the Contracting Officer that there would be a possible conflict of interest if the inspection were made by a particular representative, the Contracting Officer shall designate an alternate inspector.

(l) Data Management Plan

The Recipient was required to submit a Data Management Plan that explains how data generated in the course of the work performed under this agreement will be shared or preserved or, when justified, explains why data sharing or preservation is not possible or scientifically appropriate. In the event of a conflict between this Data Rights clause and the Data Management Plan, this Data Rights clause takes precedence.

(End of clause)

04. W(C) 2016-004 Class Patent Waiver

(a) Definitions.
As used in this clause:

Background patent means a domestic patent covering an invention or discovery which is not a Subject Invention and which is owned or controlled by the Contractor at any time through the completion of this contract:

(i) Which the Contractor, but not the Government, has the right to license to others without obligation to pay royalties thereon, and

(ii) Infringement of which cannot reasonably be avoided upon the practice of any specific process, method, machine, manufacture or composition of matter (including relatively minor modifications thereof) which is a subject of the research, development, or demonstration work performed under this contract.

Contract means any contract, grant, agreement, understanding, or other arrangement, which includes research, development, or demonstration work, and includes any assignment or substitution of parties.

DOE patent waiver regulations means the Department of Energy patent waiver regulations at 10 CFR Part 784.

Invention as used in this clause, means any invention or discovery which is or may be patentable or otherwise protectable under Title 35 of the United States Code or any novel variety of plant that is or may be protectable under the Plant Variety Protection Act (7 U.S.C. 2321 et seq.).

Made when used in relation to any invention means the conception or first actual reduction to practice of such invention.

Nonprofit organization means a university or other institution of higher education or an organization of the type described in section 501(c)(3) of the Internal Revenue Code of 1954 (26 U.S.C. 501(c)) and exempt from taxation under section 501(a) of the Internal Revenue Code (26 U.S.C. 501(a)) or any nonprofit scientific or educational organization qualified under a state nonprofit organization statute.

Patent Counsel means the Department of Energy Patent Counsel assisting the procuring activity.

Practical application means to manufacture, in the case of a composition or product; to practice, in the case of a process or method; or to operate, in the case of a machine or system; and, in each case, under such conditions as to establish that the invention is being utilized and that its benefits are, to the extent permitted by law or Government regulations, available to the public on reasonable terms.

Secretary means the Secretary of Energy.

Small business firm means a small business concern as defined at Section 2 of the Pub. L. 85-536 (15 U.S.C. 632) and implementing regulations of the Administrator of the Small Business Administration. For the purpose of this clause, the size standards for small business concerns involved in Government procurement and subcontracting at 13 CFR 121.3-8 and 13 CFR 121.3-12, respectively, will be used.

Subject invention means any invention of the Contractor conceived or first actually reduced to practice in the course of or under this contract, provided that in the case of a variety of plant, the date of determination (as defined in section 41(d) of the Plant Variety Protection Act (7 U.S.C. 2401(d)) must also occur during the period of contract performance.

(b) Allocation of principal rights.

Whereas DOE has granted a waiver of rights to subject inventions to the Contractor, the Contractor may elect to retain the entire right, title, and interest throughout the world to each subject invention subject to the provisions of this clause and 35 U.S.C. 202 and 203. With respect to any subject invention in which the Contractor elects to retain title, the Federal Government shall have a nonexclusive, nontransferable, irrevocable, paid-up license to practice or have practiced for or on behalf of the United States the subject invention throughout the world.

(c) Invention disclosure, election of title, and filing of patent applications by Contractor.

(1) The Contractor shall disclose each subject invention to the Patent Counsel within six months after conception or first actual reduction to practice, whichever occurs first in the course of or under this contract, but in any event, prior to any sale, public use, or public disclosure of such invention known to the Contractor. The disclosure to the Patent Counsel shall be in the form of a written report and shall identify the inventors and the contract under which the invention was made. It shall be sufficiently complete in technical detail to convey a clear understanding, to the extent known at the time of the disclosure, of the nature, purpose, operation, and physical, chemical, biological, or electrical characteristics of the invention. The disclosure shall also identify any publication, on sale, or public use of the invention and whether a manuscript describing the invention has been submitted for publication and, if so, whether it has been accepted for publication at the time of disclosure. In addition, after disclosure to the Patent Counsel, the Contractor shall promptly notify the Patent Counsel of the acceptance of any manuscript describing the invention for publication or of any on sale or public use planned by the Contractor.

(2) The Contractor shall elect in writing whether or not to retain title to any such invention by notifying the Patent Counsel at the time of disclosure or within 8 months of disclosure, as to those countries (including the United States) in which the Contractor will retain title; provided, that in any case where publication, on sale, or public use has initiated the 1-year statutory period wherein valid patent protection can still be obtained in the United States, the period of election of title may be shortened by the Agency to a date that is no more than 60 days prior to the end of the statutory period. The Contractor shall notify the Patent Counsel as to those countries (including the United States) in which the Contractor will retain title not later than 60 days prior to the end of the statutory period.

(3) The Contractor shall file its United States patent application on an elected invention within 1 year after election, but not later than at least 60 days prior to the end of any statutory period wherein valid patent protection can be obtained in the United States after a publication, on sale, or public use. The Contractor shall file patent applications in additional countries (including the European Patent Office and under the Patent Cooperation Treaty) within either 10 months of the corresponding initial patent application or 6 months from the date permission is granted by the Commissioner of Patents and Trademarks to file foreign patent applications where foreign filing has been prohibited by a Secrecy Order.

(4) Requests for extension of the time for disclosure to the Patent Counsel, election, and filing may, at the discretion of DOE, be granted, and will normally be granted unless the Patent Counsel has reason to believe that a particular extension would prejudice the Government's interest.

(d) Conditions when the Government may obtain title notwithstanding an existing waiver.

The Contractor shall assign and hereby assigns to DOE, upon written request from DOE, title to any subject invention--

(1) If the Contractor elects not to retain title to a subject invention;

(2) If the Contractor fails to disclose or elect the subject invention within the times specified in paragraph (c) of this clause (provided that DOE may only request title within 60 days after learning of the Contractor's failure to report or elect within the specified times);

(3) In those countries in which the Contractor fails to file patent applications within the times specified in paragraph (c) of this clause; provided, however, that if the Contractor has filed a patent application in a country after the times specified in paragraph (c) of this clause, but prior to its receipt of the written request of DOE, the Contractor shall continue to retain title in that country;

(4) In any country in which the Contractor decides not to continue the prosecution of any application for, to pay the maintenance fees on, or defend in reexamination or opposition proceeding on, a patent on a subject invention;

(5) If the waiver authorizing the use of this clause is terminated as provided in paragraph (p) of this clause; or

(6) Upon a breach of paragraph (h) or paragraph (t) of this clause.

(e) Minimum rights to Contractor when the Government retains title.

(1) The Contractor shall retain a nonexclusive, royalty-free license throughout the world in each subject invention to which the Government obtains title under paragraph (d) of this clause

except if the Contractor fails to disclose the subject invention within the times specified in paragraph (c) of this clause or breaches paragraph (h) or (t). The Contractor's license extends to its domestic subsidiaries and affiliates, if any, within the corporate structure of which the Contractor is a part and includes the right to grant sublicenses of the same scope to the extent the Contractor was legally obligated to do so at the time the contract was awarded. The license is transferable only with the approval of DOE except when transferred to the successor of that part of the Contractor's business to which the invention pertains.

(2) The Contractor's domestic license may be revoked or modified by DOE to the extent necessary to achieve expeditious practical application of the subject invention pursuant to an application for an exclusive license submitted in accordance with applicable provisions in 37 CFR part 404 and DOE licensing regulations. This license shall not be revoked in that field of use or the geographical areas in which the Contractor has achieved practical application and continues to make the benefits of the invention reasonably accessible to the public. The license in any foreign country may be revoked or modified at the discretion of DOE to the extent the Contractor, its licensees, or its domestic subsidiaries or affiliates have failed to achieve practical application in that foreign country.

(3) Before revocation or modification of the license, DOE shall furnish the Contractor a written notice of its intention to revoke or modify the license, and the Contractor shall be allowed 30 days (or such other time as may be authorized by DOE for good cause shown by the Contractor) after the notice to show cause why the license should not be revoked or modified. The Contractor has the right to appeal, in accordance with applicable agency licensing regulations and 37 CFR part 404 concerning the licensing of Government-owned inventions, any decision concerning the revocation or modification of its license.

(f) Contractor action to protect the Government's interest.

(1) The Contractor agrees to execute or to have executed and promptly deliver to DOE all instruments necessary to:

(i) establish or confirm the rights the Government has throughout the world in those subject inventions to which the Contractor elects to retain title, and

(ii) convey title to DOE when requested under paragraphs (d) and (n)(2) of this clause, and to enable the Government to obtain patent protection throughout the world in that subject invention.

(2) The Contractor agrees to require, by written agreement, its employees, other than clerical and nontechnical employees, to disclose promptly in writing to personnel identified as responsible for the administration of patent matters and in a format suggested by the Contractor each subject invention made under contract in order that the Contractor can comply with the disclosure provisions of paragraph (c) of this clause, and to execute all papers necessary to file patent applications on subject inventions and to establish the Government's

rights in the subject inventions. This disclosure format should require, as a minimum, the information required by paragraph (c)(1) of this clause. The Contractor shall instruct such employees through employee agreements or other suitable educational programs on the importance of reporting inventions in sufficient time to permit the filing of patent applications prior to U.S. or foreign statutory bars.

(3) The Contractor shall notify DOE of any decision not to continue the prosecution of a patent application, pay maintenance fees, or defend in a reexamination or opposition proceeding on a patent, in any country, not less than 30 days before the expiration of the response period required by the relevant patent office.

(4) The Contractor agrees to include, within the specification of any United States patent application and any patent issuing thereon covering a subject invention, the following statement: "This invention was made with Government support under (identify the contract) awarded by DOE. The Government has certain rights in this invention."

(5) The Contractor shall establish and maintain active and effective procedures to assure that subject inventions are promptly identified and disclosed to Contractor personnel responsible for patent matters within 6 months of conception and/or first actual reduction to practice, whichever occurs first in the course of or under this contract. These procedures shall include the maintenance of laboratory notebooks or equivalent records and other records as are reasonably necessary to document the conception and/or the first actual reduction to practice of subject inventions, and records that show that the procedures for identifying and disclosing the inventions are followed. Upon request, the Contractor shall furnish the Patent Counsel a description of such procedures for evaluation and for determination as to their effectiveness.

(6) The Contractor agrees, when licensing a subject invention, to arrange to avoid royalty charges on acquisitions involving Government funds, including funds derived through Military Assistance Program of the Government or otherwise derived through the Government; to refund any amounts received as royalty charges on the subject invention in acquisitions for, or on behalf of, the Government; and to provide for such refund in any instrument transferring rights in the invention to any party.

(7) The Contractor shall furnish the Patent Counsel the following:

(i) Interim reports every 12 months (or such longer period as may be specified by the Patent Counsel) from the date of the contract, listing subject inventions during that period and certifying that all subject inventions have been disclosed or that there are no such inventions.

(ii) A final report, within 3 months after completion of the contracted work, listing all subject inventions or certifying that there were no such inventions, and listing all

subcontracts at any tier containing a patent rights clause or certifying that there were no such subcontracts.

(8) The Contractor shall promptly notify the Patent Counsel in writing upon the award of any subcontract at any tier containing a patent rights clause by identifying the subcontractor, the applicable patent rights clause, the work to be performed under the subcontract, and the dates of award and estimated completion. Upon request of the Patent Counsel, the Contractor shall furnish a copy of such subcontract, and no more frequently than annually, a listing of the subcontracts that have been awarded.

(9) The Contractor shall provide, upon request, the filing date, serial number and title, a copy of the patent application (including an English-language version if filed in a language other than English), and patent number and issue date for any subject invention for which the Contractor has retained title.

(10) Upon request, the Contractor shall furnish the Government an irrevocable power to inspect and make copies of the patent application file.

(g) Subcontracts.

(1) The Contractor shall include this patent rights clause in all subcontracts with the domestic affiliate of APG Neuros.

(2). The Contractor shall include the patent rights clause required by 2 CFR 910.362(b), suitably modified to identify the parties, in all subcontracts, regardless of tier, for experimental, developmental, or research work to be performed by a small business firm or nonprofit organization, except where the work of the subcontract is subject to an Exceptional Circumstances Determination by DOE.

(3) In all other subcontracts, regardless of tier, for experimental, developmental, demonstration, or research work, the Contractor shall include the patent rights clause required by 2 CFR 910.362(c), suitably modified to identify the parties.

(4) The Contractor shall not, as part of the consideration for awarding the subcontract, obtain rights in the subcontractor's subject inventions.

(5) In the case of subcontractors at any tier, the Department, the subcontractor, and Contractor agree that the mutual obligations of the parties created by this clause constitute a contract between the subcontractor and the Department with respect to those matters covered by this clause.

(6) The Contractor shall promptly notify the Contracting Officer in writing upon the award of any subcontract at any tier containing a patent rights clause by identifying the subcontractor, the applicable patent rights clause, the work to be performed under the subcontract, and the

dates of award and estimated completion. Upon request of the Contracting Officer, the Contracting Officer shall furnish a copy of such subcontract, and, no more frequently than annually, a listing of the subcontracts that have been awarded.

(h) Reporting on utilization of subject inventions.

(1) The Contractor agrees to submit on request periodic reports no more frequently than annually on the utilization of each waived subject invention or on efforts at obtaining such utilization that are being made by the Contractor and any of its licensees or assignees including compliance with paragraph (t) of this clause. Each report shall include information regarding the status of development, date of first commercial sale or use, products that embody or are made through the use of the waived such invention, manufacturing locations of such products and such other data and information as DOE may reasonably specify. The report shall further include a certification from the Contractor that the Contractor, including its licensees, is in compliance with the requirements of this clause.

(2) The Contractor also agrees to provide additional reports as may be requested by DOE in connection with any march-in proceedings undertaken by DOE in accordance with paragraph (j) of this clause.

(3) To the extent data or information supplied under this paragraph is considered by the Contractor, its licensee or assignee to be privileged and confidential and is so marked, DOE agrees that, to the extent permitted by law, it shall not disclose such information to persons outside the Government.

(i) Preference for United States industry.

Notwithstanding any other provision of this clause, the Contractor agrees that neither it nor any assignee will grant to any person the exclusive right to use or sell any subject invention in the United States unless such person agrees that any products embodying the subject invention will be manufactured substantially in the United States. However, in individual cases, the requirement for such an agreement may be waived by DOE upon a showing by the Contractor or its assignee that reasonable but unsuccessful efforts have been made to grant licenses on similar terms to potential licensees that would be likely to manufacture substantially in the United States or that under the circumstances domestic manufacture is not commercially feasible.

(j) March-in rights.

The Contractor agrees that with respect to any subject invention in which it has acquired title, DOE has the right in accordance with the procedures in 48 CFR 27.304-1(g) to require the Contractor, an assignee, or exclusive licensee of a subject invention to grant a nonexclusive, partially exclusive, or exclusive license in any field of use to a responsible applicant or applicants, upon terms that are reasonable under the circumstances, and if the Contractor,

assignee, or exclusive licensee refuses such a request, DOE has the right to grant such a license itself if DOE determines that--

(1) Such action is necessary because the Contractor or assignee has not taken, or is not expected to take within a reasonable time, effective steps to achieve practical application of the subject invention in such field of use;

(2) Such action is necessary to alleviate health or safety needs which are not reasonably satisfied by the Contractor, assignee, or their licensees;

(3) Such action is necessary to meet requirements for public use specified by Federal regulations and such requirements are not reasonably satisfied by the Contractor, assignee, or licensees; or

(4) Such action is necessary because the agreement required by paragraph (i) of this clause has not been obtained or waived or because a licensee of the exclusive right to use or sell any subject invention in the United States is in breach of such agreement.

(k) Background Patents [reserved]

(l) Communications.
Unless other directed by Patent Counsel, all reports and notifications required by this clause shall be submitted in accordance with the instructions provided in the Federal Assistance Reporting Checklist (FARC) of this contract.

(m) Other inventions.
Nothing contained in this clause shall be deemed to grant to the Government any rights with respect to any invention other than a subject invention, except with respect to Background Patents, above.

(n) Examination of records relating to inventions.

(1) The Contracting Officer or any authorized representative shall, until 3 years after final payment under this contract, have the right to examine any books (including laboratory notebooks), records, and documents of the Contractor relating to the conception or first actual reduction to practice of inventions in the same field of technology as the work under this contract to determine whether--

(i) Any such inventions are subject inventions;

(ii) The Contractor has established and maintains the procedures required by paragraphs (f)(2) and (f)(5) of this clause; and

(iii) The Contractor and its inventor have complied with the procedures.

(2) If the Contracting Officer determines that an inventor has not disclosed a subject invention to the Contractor in accordance with the procedures required by paragraph (f)(5) of this clause, the Contracting Officer may, within 60 days after the determination, request title in accordance with paragraphs (d)(2) and (d)(3) of this clause. However, if the Contractor establishes that the failure to disclose did not result from the Contractor's fault or negligence, the Contracting Officer shall not request title.

(3) If the Contracting Officer learns of an unreported Contractor invention which the Contracting Officer believes may be a subject invention, the Contractor may be required to disclose the invention to DOE for a determination of ownership rights.

(4) Any examination of records under this paragraph shall be conducted in such a manner as to protect the confidentiality of the information involved.

(o) Withholding of payment.
NOTE: This paragraph does not apply to subcontracts or grants.

(1) Any time before final payment under this contract, the Contracting Officer may, in the Government's interest, withhold payment until a reserve not exceeding $50,000 or 5 percent of the amount of the contract, whichever is less, shall have been set aside if, in the Contracting Officer's opinion, the Contractor fails to--

(i) Establish, maintain, and follow effective procedures for identifying and disclosing subject inventions pursuant to paragraph (f)(5) of this clause;
(ii) Disclose any subject invention pursuant to paragraph (c)(1) of this clause;
(iii) Deliver acceptable interim reports pursuant to paragraph (f)(7)(I) of this clause;
(iv) Provide the information regarding subcontracts pursuant to paragraph (f)(6) of this clause; or
(v) Convey to the Government, using a DOE-approved form, the title and/or rights of the Government in each subject invention as required by this clause.

(2) Such reserve or balance shall be withheld until the Contracting Officer has determined that the Contractor has rectified whatever deficiencies exist and has delivered all reports, disclosures, and other information required by this clause.

(3) Final payment under this contract shall not be made before the Contractor delivers to the Patent Counsel all disclosures of subject inventions required by paragraph (c)(1) of this clause, an acceptable final report pursuant to paragraph (f)(7)(ii) of this clause, and all past due confirmatory instruments, and the Patent Counsel has issued a patent clearance certification to the Contracting Officer.

(4) The Contracting Officer may decrease or increase the sums withheld up to the maximum authorized above. If the maximum amount authorized above is already being withheld under other provisions of the contract, no additional amount shall be withheld under this paragraph.

The withholding of any amount or the subsequent payment thereof shall not be construed as a waiver of any Government right.

(p) Waiver Terminations.

Any waiver granted to the Contractor authorizing the use of this clause (including any retention of rights pursuant thereto by the Contractor under paragraph (b) of this clause) may be terminated at the discretion of the Secretary or his designee in whole or in part, if the request for waiver by the Contractor is found to contain false material statements or nondisclosure of material facts, and such were specifically relied upon by DOE in reaching the waiver determination or the cost share requirement as set forth in the applicable statement of considerations is not met. Prior to any such termination, the Contractor will be given written notice stating the extent of such proposed termination and the reasons therefor, and a period of 30 days, or such longer period as the Secretary or his designee shall determine for good cause shown in writing, to show cause why the waiver of rights should not be so terminated. Any waiver termination shall be subject to the Contractor's minimum license as provided in paragraph (e) of this clause.

(q) Atomic Energy.

No claim for pecuniary award or compensation under the provisions of the Atomic Energy Act of 1954, as amended, shall be asserted by the Contractor or its employees with respect to any invention or discovery made or conceived in the course of or under this contract.

(r) Publication.

It is recognized that during the course of work under this contract, the contractor or its employees may from time to time desire to release or publish information regarding scientific or technical developments conceived or first actually reduced to practice in the course of or under this contract. In order that public disclosure of such information will not adversely affect the patent interests of DOE or the contractor, approval for release of publication shall be secured from Patent Counsel prior to any such release or publication. In appropriate circumstances, and after consultation with the contractor, Patent Counsel may waive the right of prepublication review.

(s) Forfeiture of rights in unreported subject inventions.

(1) The contractor shall forfeit and assign to the Government, at the request of the Secretary of Energy or designee, all rights in any subject invention which the contractor fails to report to Patent Counsel within six months after the time the contractor:

(i) Files or causes to be filed a United States or foreign patent application thereon; or

(ii) Submits the final report required by paragraph (f)(7)(ii) of this clause, whichever is later.

(2) However, the Contractor shall not forfeit rights in a subject invention if, within the time specified in paragraph (n)(1) of this clause, the contractor:

(i) Prepares a written decision based upon a review of the record that the invention was neither conceived nor first actually reduced to practice in the course of or under the contract and delivers the decision to Patent Counsel, with a copy to the Contracting Officer; or

(ii) Contending that the subject invention is not a subject invention, the contractor nevertheless discloses the subject invention and all facts pertinent to this contention to the Patent Counsel, with a copy to the Contracting Officer, or

(iii) Establishes that the failure to disclose did not result from the contractor's fault or negligence.

(3) Pending written assignment of the patent application and patents on a subject invention determined by the Contracting Officer to be forfeited (such determination to be a Final Decision under the Disputes clause of this contract), the contractor shall be deemed to hold the invention and the patent applications and patents pertaining thereto in trust for the Government. The forfeiture provision of this paragraph shall be in addition to and shall not supersede any other rights and remedies which the Government may have with respect to subject inventions.

(t) U. S. Competitiveness

The Contractor agrees that any products embodying any waived invention or produced through the use of any waived invention will be manufactured substantially in the United States, unless the Contractor can show to the satisfaction of DOE that it is not commercially feasible to do so. In the event DOE agrees to foreign manufacture, there will be a requirement that the Government's support of the technology be recognized in some appropriate manner, e.g., recoupment of the Government's investment, etc. The Contractor further agrees to make the above condition binding on any assignee or licensee or any entity otherwise acquiring rights to any waived invention, including subsequent assignees or licensees. Should the Contractor or other such entity receiving rights in any waived invention undergo a change in ownership amounting to a controlling interest, then the waiver, assignment, license, or other transfer of rights in any waived invention is suspended until approved in writing by DOE.

(End of clause)

Data Management Plan

Carollo Engineers, Inc.

Transforming Aeration Energy in Water Resource Recovery Facilities (WRRFs) through Suboxic Nitrogen Removal

Data Types and Sources

The following provides a brief, high-level description of the data to be generated or used through the course of the proposed research. We have indicated which of these are considered digital research data necessary to validate our research findings.

Project Task	Data Type	Data Source	Generated in project	Used in Project	Necessary for Validation
Energy and performance baseline data (Task 1)	Utility data	laboratory, SCADA, DMR, reports, bills	No (prior)	Yes	Yes
Pilot testing data (Task 3 and Task 7)	Utility and pilot test data	Online instruments, laboratory, SCADA	Yes	Yes	Yes
DO/Nmaster MPAC Programming Integration - (Task 5)	Control algorithm and tuning parameters	SRTmaster and DO/Nmaster (control program)	Yes and No	Yes	No
	Utility online and lab data	SCADA, laboratory / SQL database	Yes	Yes	Yes
Mid Point LCA & TEA (Task 6)	Utility and pilot test data	laboratory, SCADA, online instrumentation, bills	Yes	Yes	Yes
DO/Nmaster Performance Data Collection (Task 8)	Utility online and lab data	SCADA, laboratory / SQL database	Yes	Yes	Yes
Low DO Operation / Suboxic N Removal Validation (Task 9)	Utility online and lab data	SCADA, laboratory / SQL database	Yes	Yes	Yes
Updated Final TEA & LCA (Task 10)	Utility and pilot test data	laboratory, SCADA, online instrumentation, bills	Yes	Yes	Yes

Content and Format

The following describes the team's plans for data and metadata content and format, data documentation and annotation of relevant software as applicable, and appropriate community standards.

Data Type	Data content	Format & Software	Documentation Plan	Community Standards
Utility laboratory data, operational data	Water quality parameter, operational data	Excel	Period downloads from data management system for storage, analysis, and evaluation	Data can be published per utility regulations.
Utility Online Sensor data	Water quality parameters, equipment and instrument status, energy consumption	Excel	Period downloads from data management system for storage, analysis, and evaluation	Data can be published per utility regulations.
Control algorithm and tuning parameters	Tuning parameters and algorithm	SRTmaster and DO/Nmaster	Program internal with commercialization partners	Proprietary
Laboratory and field data by University	Kinetic parameters, water quality, offgas test results, genomic data etc.	Excel	Data management system for storage, analysis, and evaluation	Data can be published.
Pilot test laboratory data	laboratory, SCADA, online instrumentation, bills	Excel	Data management system for storage, analysis, and evaluation	Data can be published per utility regulations.
Pilot test instrumentation / sensor data	SCADA, laboratory / SQL database	Excel	Data management system for storage, analysis, and evaluation	Data can generally be published per utility regulations.

Sharing and Preservation
The following describes the plans for data sharing and preservation.

Data Type	Means for Data Sharing	Responsible Contact Information	Access Restrictions	Reservation Timeline
Utility laboratory data, operational data	Periodic (e.g. monthly) downloads as customized reports	Tanja Rauch-Williams (Carollo) Charles Bott (HRSD) Tom Weiland (LACSD)	None anticipated	Several years in plant historian. Downloaded project data: > 5 years with Carollo Engineers.
Utility Online Sensor data	Same as above			
Control algorithm and tuning parameters	Not intended to be shared.	Alex Ekster (Ekster & Associates), Omar Hammoud (APG Neuros)	NA	NA
Laboratory and field data by University	Periodic (e.g. monthly) downloads of metadata and data	Kartik Chandran (Columbia University)	None anticipated	
Pilot test laboratory data	Periodic (e.g. monthly) downloads as customized, standadized reports	Charles Bott (HRSD)	None anticipated	Downloaded project data: > 5 years with Carollo Engineers and HRSD.
Pilot test instrumentation / sensor data	Same as above			

Protection
Protect of confidentiality, personal privacy, personally identifiable information, and U.S. national, homeland, and economic security is not appropriate and necessary in this project. Data collected under this project is not pertinent to this type of protection.

Proprietary interests, business confidential information, intellectual property rights apply to certain data uses and development by our commercialization partners to avoid significant negative impact on innovation and U.S. competitiveness and is indicated where applicable above.

Special requirements for data sharing

APG-Neuros will provide upgrades (software and hardware) to its blower Master Control Panel to accommodate the deployment of the MPC for the aeration system. The aeration system data (DO, flow, valve's position, etc) will be collected by the APG-Neuros MCP and made available to the various partners.

Instrument data from SCADA and historians at the utility testing sites will be periodically downloaded and processed via excel, R, Python, or other publically available software packages.

Metadata from utilities and pilot testing can be made available as justified, evaluated data can be accessed and is publishable unless specific utility regulation prohibit data sharing.

Utility data will be preserved in SCADA historians, typically for several years at minimum. Any experimental data will also be downloaded in periodic intervals by Carollo Engineers and preserved on Carollo's data server for at least 10 years. Our team has not plans and does not see a need to transfer research data to a third party after project completion.

Publications

For the deliverables under the award, the recipient does not plan on making the underlying research data supporting the findings in the deliverables publicly-available for up to five (5) years after the data were first produced because such data will be considered protected under the award. The results from the DOE deliverables can be validated by DOE who will have access, upon request, to the research data. Other than providing deliverables as specified in the award, the recipient does not intend to publish the results from the project. However, in an instance where a publication includes results of the project, the underlying research data will be made available according to the policies of the publishing media. Where no such policy exists, the recipient will indicate on the publication a means for requesting and digitally obtaining the underlying research data. This includes the research data necessary to validate any results, conclusions, charts, figures, images in the publications.