Other Attachment File(s)

*** Mandatory Other Attachment Filename:** 1234-TechnicalVolume_TA2-171-E.pdf

Add Mandatory Other Attachment | Delete Mandatory Other Attachment | View Mandatory Other Attachment

To add more "Other Attachment" attachments, please use the attachment buttons below.

Add Optional Other Attachment | Delete Optional Other Attachment | View Optional Other Attachment

Project/Performance Site Location(s)

Project/Performance Site Primary Location

☐ I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name: Electric Power Research Institute (EPRI)

UEI: JBV2SMLRBK29

* Street1: 942 Corridor Park Blvd.

Street2:

* City: Knoxville County:

* State: TN: Tennessee

Province:

* Country: USA: UNITED STATES

* ZIP / Postal Code: 37932-3723 * Project/ Performance Site Congressional District: TN-002

Project/Performance Site Location 1

☐ I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name: Electric Power Research Institute (EPRI)

UEI: JBV2SMLRBK29

* Street1: 1300 West W.T. Harris Blvd.

Street2:

* City: Charlotte County:

* State: NC: North Carolina

Province:

* Country: USA: UNITED STATES

* ZIP / Postal Code: 28262-0000 * Project/ Performance Site Congressional District: NC-012

Project/Performance Site Location 2

☐ I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name: Electric Power Research Institute (EPRI)

UEI: JBV2SMLRBK29

* Street1: 3420 Hillview Avenue

Street2:

* City: Palo Alto County:

* State: CA: California

Province:

* Country: USA: UNITED STATES

* ZIP / Postal Code: 94304-1382 * Project/ Performance Site Congressional District: CA-018

Project/Performance Site Location(s)

Project/Performance Site Location 3

☐ I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name: Vermont Transco LLC (Velco)

UEI: VQY5CRWNJZQ5

* Street1: 366 Pinnacle Ridge Road

Street2:

* City: Rutland County:

* State: VT: Vermont

Province:

* Country: USA: UNITED STATES

* ZIP / Postal Code: 05701-9475 * Project/ Performance Site Congressional District: VT-001

Project/Performance Site Location 4

☐ I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name: Vermont Transco LLC (Velco)

UEI: VQY5CRWNJZQ5

* Street1: 586 Bear Trap Road

Street2:

* City: Milton County:

* State: VT: Vermont

Province:

* Country: USA: UNITED STATES

* ZIP / Postal Code: 05468-3205 * Project/ Performance Site Congressional District: VT-001

Project/Performance Site Location 5

☐ I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name: Smart Wires

UEI: D9E2S7X8V917

* Street1: 1035 Swabia Court

Street2: Suite 130

* City: Durham County:

* State: NC: North Carolina

Province:

* Country: USA: UNITED STATES

* ZIP / Postal Code: 27703-0963 * Project/ Performance Site Congressional District: NC-004

Project/Performance Site Location(s)

Project/Performance Site Location 6

☐ I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name: JABIL

UEI:

* Street1: 10560 Dr. Martin Luther King Jr. St. N.

Street2:

* City: St. Petersburg County:

* State: FL: Florida

Province:

* Country: USA: UNITED STATES

* ZIP / Postal Code: 33716-2307 * Project/ Performance Site Congressional District: FL-014

Additional Location(s) Add Attachment Delete Attachment View Attachment

OMB Number: 4040-0004
Expiration Date: 11/30/2025

Application for Federal Assistance SF-424

* 1. Type of Submission:
- [ ] Preapplication
- [x] Application
- [ ] Changed/Corrected Application

* 2. Type of Application:
- [x] New
- [ ] Continuation
- [ ] Revision

* If Revision, select appropriate letter(s):

* Other (Specify):

* 3. Date Received: 03/17/2023

4. Applicant Identifier: TA2-171-E

5a. Federal Entity Identifier:

5b. Federal Award Identifier:

State Use Only:

6. Date Received by State:

7. State Application Identifier:

8. APPLICANT INFORMATION:

* a. Legal Name: Electric Power Research Institute, Inc.

* b. Employer/Taxpayer Identification Number (EIN/TIN): 23-7175375

* c. UEI: JBV2SMLRBK29

d. Address:

* Street1: 3420 Hillview Ave
Street2:
* City: Palo Alto
County/Parish:
* State: CA: California
Province:
* Country: USA: UNITED STATES
* Zip / Postal Code: 94304-1355

e. Organizational Unit:

Department Name:

Division Name:

f. Name and contact information of person to be contacted on matters involving this application:

Prefix:

* First Name: (b) (4)

Middle Name:

* Last Name: (b) (4)

Suffix:

Title: Government Contracts Administrator III

Organizational Affiliation:

* Telephone Number: (b) (4)

Fax Number:

* Email: (b) (4)

Application for Federal Assistance SF-424

*** 9. Type of Applicant 1: Select Applicant Type:**

M: Nonprofit with 501C3 IRS Status (Other than Institution of Higher Education)

Type of Applicant 2: Select Applicant Type:

Type of Applicant 3: Select Applicant Type:

* Other (specify):

*** 10. Name of Federal Agency:**

National Energy Technology Laboratory

11. Catalog of Federal Domestic Assistance Number:

81.254

CFDA Title:

Grid Infrastructure Deployment and Resilience

*** 12. Funding Opportunity Number:**

DE-FOA-0002740

* Title:

BIL Grid Resilience and Innovation Partnerships (GRIP)

13. Competition Identification Number:

Title:

14. Areas Affected by Project (Cities, Counties, States, etc.):

Add Attachment | Delete Attachment | View Attachment

*** 15. Descriptive Title of Applicant's Project:**

Optimizing Interregional Transfer Capacity Using Advanced Power Flow Control (TA2-171-E)

Attach supporting documents as specified in agency instructions.

Add Attachments | Delete Attachments | View Attachments

Application for Federal Assistance SF-424

16. Congressional Districts Of:

* a. Applicant: CA-016 * b. Program/Project: US-all

Attach an additional list of Program/Project Congressional Districts if needed.

Add Attachment | Delete Attachment | View Attachment

17. Proposed Project:

* a. Start Date: 01/01/2024 * b. End Date: 12/31/2026

18. Estimated Funding ($):

* a. Federal	18,017,358.00
* b. Applicant	18,017,358.00
* c. State	0.00
* d. Local	0.00
* e. Other	0.00
* f. Program Income	0.00
* g. TOTAL	36,034,716.00

*** 19. Is Application Subject to Review By State Under Executive Order 12372 Process?**

☐ a. This application was made available to the State under the Executive Order 12372 Process for review on .

☐ b. Program is subject to E.O. 12372 but has not been selected by the State for review.

☒ c. Program is not covered by E.O. 12372.

*** 20. Is the Applicant Delinquent On Any Federal Debt? (If "Yes," provide explanation in attachment.)**

☐ Yes ☒ No

If "Yes", provide explanation and attach

Add Attachment | Delete Attachment | View Attachment

21. *By signing this application, I certify (1) to the statements contained in the list of certifications and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances** and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 18, Section 1001)**

☒ ** I AGREE

** The list of certifications and assurances, or an internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

Authorized Representative:

Prefix: * First Name: (b) (4)

Middle Name:

* Last Name: (b) (4)

Suffix:

* Title: (b) (4)

* Telephone Number: (b) (4) Fax Number:

* Email: (b) (4)

* Signature of Authorized Representative: (b) (4) * Date Signed: 03/17/2023

BUDGET INFORMATION - Non-Construction Programs

OMB Number: 4040-0006
Expiration Date: 02/28/2025

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. (b) (4)	81.254	$	$	$ 18,017,358.00	$ 18,017,358.00	$ 36,034,716.00
2.						
3.						
4.						
5. Totals		$	$	$ 18,017,358.00	$ 18,017,358.00	$ 36,034,716.00

Standard Form 424A (Rev. 7- 97)
Prescribed by OMB (Circular A -102) Page 1

SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY (1)	(2)	(3)	(4)	Total (5)
a. Personnel	$ [redacted]		$	$	$ [redacted]
b. Fringe Benefits					
c. Travel					
d. Equipment					
e. Supplies					
f. Contractual					
g. Construction					
h. Other					
i. Total Direct Charges (sum of 6a-6h)					$
j. Indirect Charges					$
k. TOTALS (sum of 6i and 6j)	$ 36,034,716.00	$	$	$	$ 36,034,716.00
7. Program Income	$	$	$	$	$

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Prescribed by OMB (Circular A -102) Page 1A

SECTION C - NON-FEDERAL RESOURCES

(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e)TOTALS
8. (b) (4)	$	$	$ 18,017,358.00	$ 18,017,358.00
9.				
10.				
11.				
12. TOTAL (sum of lines 8-11)	$	$	$ 18,017,358.00	$ 18,017,358.00

SECTION D - FORECASTED CASH NEEDS

	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	$ 4,212,291.00	$ 1,053,072.75	$ 1,053,072.75	$ 1,053,072.75	$ 1,053,072.75
14. Non-Federal	$				
15. TOTAL (sum of lines 13 and 14)	$				

SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT

(a) Grant Program	FUTURE FUNDING PERIODS (YEARS) (b)First	(c) Second	(d) Third	(e) Fourth
16. (b) (4)				
17.				
18.				
19.				
20. TOTAL (sum of lines 16 - 19)	$ (b) (4)			

SECTION F - OTHER BUDGET INFORMATION

21. Direct Charges: (b) (4)

22. Indirect Charges: (b) (4)

23. Remarks: 2023 provisional DOE approved indirect rates

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DISCLOSURE OF LOBBYING ACTIVITIES

Complete this form to disclose lobbying activities pursuant to 31 U.S.C.1352

OMB Number: 4040-0013
Expiration Date: 02/28/2025

1. * Type of Federal Action:
- [ ] a. contract
- [ ] b. grant
- [x] c. cooperative agreement
- [ ] d. loan
- [ ] e. loan guarantee
- [ ] f. loan insurance

2. * Status of Federal Action:
- [ ] a. bid/offer/application
- [x] b. initial award
- [ ] c. post-award

3. * Report Type:
- [x] a. initial filing
- [ ] b. material change

4. Name and Address of Reporting Entity:

[x] Prime [ ] SubAwardee

* Name: Electric Power Research Institute

* Street 1: 3402 Hillview Ave Street 2:

* City: Palo Alto State: CA: California Zip: 94304

Congressional District, if known: CA-018

5. If Reporting Entity in No.4 is Subawardee, Enter Name and Address of Prime:

6. * Federal Department/Agency:

Department of Energy

7. * Federal Program Name/Description:

Grid Infrastructure Deployment and Resilience

CFDA Number, *if applicable:* 81.254

8. Federal Action Number, *if known:*

DE-FOA-0002740

9. Award Amount, *if known:*

$

10. a. Name and Address of Lobbying Registrant:

Prefix * First Name: EPRI DOESN'T LOBBY W/ FEDERAL FUNDS Middle Name

* Last Name: EPRI DOESN'T LOBBY W/ FEDERAL FUNDS Suffix

* Street 1: EPRI DOESN'T LOBBY W/ FEDERAL FUNDS Street 2

* City: EPRI DOESN'T LOBBY W/ FEDERAL FUNDS State Zip

b. Individual Performing Services (including address if different from No. 10a)

Prefix * First Name: EPRI DOESN'T LOBBY W/ FEDERAL FUNDS Middle Name

* Last Name: EPRI DOESN'T LOBBY W/ FEDERAL FUNDS Suffix

* Street 1: EPRI DOESN'T LOBBY W/ FEDERAL FUNDS Street 2

* City: EPRI DOESN'T LOBBY W/ FEDERAL FUNDS State Zip

11. Information requested through this form is authorized by title 31 U.S.C. section 1352. This disclosure of lobbying activities is a material representation of fact upon which reliance was placed by the tier above when the transaction was made or entered into. This disclosure is required pursuant to 31 U.S.C. 1352. This information will be reported to the Congress semi-annually and will be available for public inspection. Any person who fails to file the required disclosure shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

*** Signature:** (b) (4)

***Name:** Prefix * First Name: (b) (4) Middle Name: (b) (4)

* Last Name: (b) (4) Suffix

Title: (b) (4) **Telephone No.:** **Date:** 03/17/2023

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Standard Form - LLL (Rev. 7-97)

Project Title: Optimizing Interregional Transfer Capacity Using Advanced Power Flow Control

DE-FOA-0002740: Department of Energy (DOE) Grid Deployment Office (GDO) Office of Clean Energy Demonstrations (OCED) BIL – Grid Resilience and Innovation Partnerships (GRIP)

Topic Area 2: Smart Grid Grants (40107)

Concept Paper Identification Code: TA2-171-E

March 17, 2023

Entity Type: Non-profit

Technical Point of Contact:

(b) (6)

(b) (6) | Electric Power Research Institute (EPRI)

Work Address

Email: (b) (6) | Phone: (b) (6)

Business Point of Contact:

(b) (6)

(b) (6) | Electric Power Research Institute (EPRI)

942 Corridor Park Blvd., Knoxville, TN 37932

(b) (6) | Phone: (b) (6)

Team Members:

Team Member Organizations	Senior/Key Personnel	Project Location(s)
Electric Power Research Institute, Inc.	(b) (6)	Knoxville, TN
VELCO	(b) (6)	Rutland, VT
Smart Wires	(b) (6)	Raleigh, NC

Project Overview

Background

Grid-enhancing technologies—in particular, advanced power flow control (APFC)—are installed in transmission grids to optimize network flows and increase automation, visibility, and controllability of the grid, improving the utilization and efficiency of existing transmission assets. The proposed project will consist of APFC installations at interregional tie lines to systematically increase the transfer capacity across regional borders. This project will directly meet the first objective of Topic Area 2: Increase the capacity of transmission facilities or the capability of the transmission system to reliably transfer increased amounts of electric energy. In addition, APFC bolsters the fourth program objective: enabling the integration of variable renewable energy resources at the transmission level. APFC devices are explicitly mentioned in IIJA Section 40107 as a qualifying Advanced Transmission Technology investment.

The project team comprises all expertise and capabilities required to accomplish the proposed objective. This demonstration project will combine the strengths of the three partner institutions. EPRI will leverage its technical expertise, experience, and ability to manage large collaborative R&D projects, as demonstrated by its accomplishments on power system planning and integration of advanced transmission technologies. Smart Wires Inc. is highly experienced in developing innovative technology solutions to modernize and optimize the transmission grid. The electric utility partner, VELCO, will host the APFC installation and provide the necessary engineering and management support for successful implementation. Figure 1 illustrates the roles and responsibilities of the entities that participate in this project.

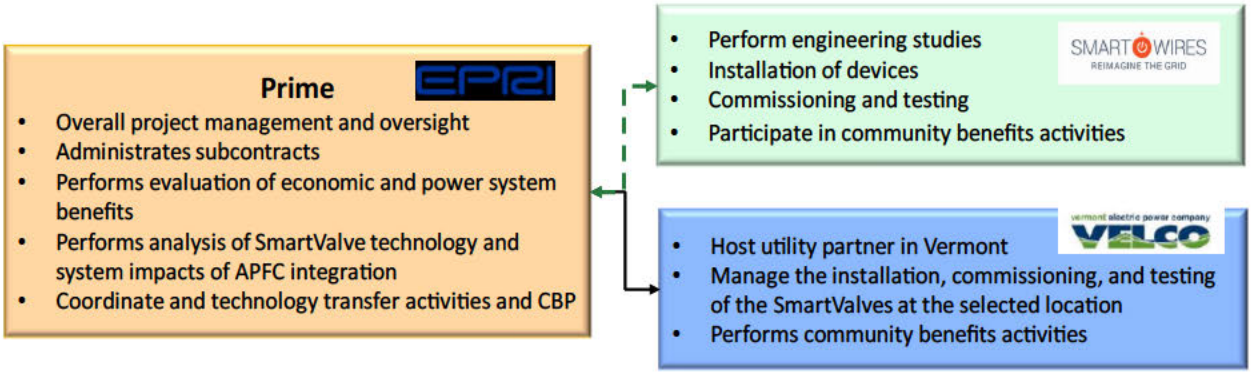

Figure 1 - Roles and responsibilities of the entities that participate in this project

Project Goal

The following are the main goals of this project:

- **Attain economic, environmental, and societal benefits derived from the installation and operation of APFC** devices in the transmission system of the utility partner, VELCO. The APFC devices will increase the transmission capacity of the selected interregional tie.

  The enhanced transmission capacity will be vital to secure a reliable energy supply to the increasing demand in Vermont and will facilitate increased energy dispatch of renewable energy, allowing the state to achieve the renewable energy target.

In addition, VELCO has a phase shifting transformer (PST) on the border with New York State that is experiencing high levels of tap changing and a subsequent increase in maintenance costs. This project leverages APFCs to optimize cross-border flows with Vermont while reducing PST maintenance costs. Due to VELCO's co-op style financial structure, the economic benefits derived from the reduced generation cost will directly return to energy consumers.

- **Reduce barriers to large-scale adoption of APFC technology**. Documenting the successful installation, commissioning, and operation of the APFCs at VELCO transmission system, along with a comprehensive evaluation of the technology, will help transmission planners and engineers better understand the features, capabilities, and implementation considerations of these devices. Further, a system study to assess the economic, reliability, and environmental benefits of APFCs will provide useful insight and guidance to evaluate transmission solutions based on the use of this technology. This activity will help utilities make a risk-informed decision on the use of APFCs for more cost-effective transmission expansion by enabling higher utilization of the existing network infrastructure.
- **Advance numerous community benefits** including workforce training, the creation of new jobs leading to long-term careers, increased energy resilience, and enhanced interregional cooperation. APFC deployments will support community decarbonization and grid resilience by allowing the incorporation of additional renewables into the transmission system—and by helping to ensure that decarbonization and equitable community benefits are realized once projects become operational. These deployments will catalyze deployments of the technology to help spur future renewable investment, accelerate the greening of the grid, and resolve similar issues across the United States.

DOE Impact

DOE funding for a commercialized technology such as the SmartValve provides a significant endorsement for the U.S. applicability of this technology and minimizes the informal but prevalent barrier of perceived risk with operators and utilities. Second, the DOE cost-matching mechanism improves project economics, reducing the perceived investment risk in a technology that is widely used globally but relatively uncommon in the United States. The demands of the energy transition are also increasingly constraining the capital budgets of utilities. Capital expenditure has resultantly been noted as a key barrier to widespread APFC adoption across the U.S., particularly in municipally owned utilities such as VELCO. The DOE investment can unlock the feasibility of APFCs for smaller utilities that are incentivized to implement innovative, efficient solutions such as APFCs but may not have available capital. In addition, the investment provides utilities with the opportunity to implement and quantify the financial benefits of APFCs for future deployments on their networks. Widespread, quantified evidence of financial investment can accelerate the adoption process of grid-enhancing technologies. Ultimately, increased investments in the technology by utilities and the DOE can lead to greater private investment in the technology and more widespread deployment.

Community Benefits Plan: Job Quality and Equity

The key benefits this project anticipates are reduced need for new transmission lines and therefore less impact on historically red-lined communities where those lines may have been

built, facilitating further renewable generation deployment and the economic development associated with improved grid operability.

The community benefits plan highlights aspects of job quality and equity through workforce engagement, using unionized labor, training opportunities, and working with the educational system to promote interest in STEM and develop energy-systems curricula. This project provides opportunities for high-tech jobs in manufacturing, installation, and maintenance. The utility workers involved in this project can provide lessons learned to their counterparts at future demonstration locations. Project milestones include the opportunity for workforce training around smart wires technology and installation.

Equity-driven job opportunities are primarily protected through workplace cultural norms within the project partners, including pledges for diverse hiring practices and a healthy respect for the value of empowered and organized labor. The Community Benefits Plan (CBP) describes such commitments in greater detail. Beyond that, the project partners have internal and external pledges toward identifying service contractors and new hires including incentives for minority- or women-owned businesses, veteran-owned, and disability-owned, among others.

Strategy for Sharing and Maximizing the Project's Benefits Across Disadvantaged Communities

The project activities are primarily on the installation of SmartValve systems at the location in Milton, Vermont. This community is primarily rural and not disadvantaged, so the project team has included milestones around engaging nearby communities beyond the installation sites. These activities address education opportunities and partnerships for early STEM exposure with the development of energy systems curricula and on-site presentations.

The community will be engaged through several channels: chambers of commerce, end-user listening sessions, awareness through education systems, and local job training and workforce development mechanisms such as VEEP. These channels already exist between the utility partner and its host communities, and this project raises the bar for communication, listening, and consideration of all stakeholder needs.

Potential Long-Term Constraints the Project Will Have on the Community's Access to Natural Resources and Tribal Cultural Resources

SmartValve devices can optimize power flows, which reduces or mitigates the need for large capital investments for infrastructure projects. The SmartValve is an asset that can be placed on the existing transmission system to optimize flows. Not only does this technology increase a community's access to low-cost energy, but it also reduces the environmental and community disruption associated with building new transmission infrastructure to accelerate the energy transition and meet growing demands.

Climate Resilience Strategy

Stability issues are caused when elements of the system become overloaded under contingency conditions, such as those caused by extreme weather or natural disasters. Anticipating future disruptions, the SmartValve technology operates in a "normally on" mode. When extreme weather or a natural disaster occurs, the presence of the SmartValves improves the system's ability to respond to the outages caused by these types of events, enabling post-fault voltage

recovery and helping to prevent further cascading system failures. In addition, the APFC deployments in this project enhance interregional coordination, which bolsters power system reliability after a severe event outage.

Technical Description, Innovation, and Impact

Relevance and Outcomes

The SmartValve is the Smart Wires modular static synchronous series compensators (M-SSSC) device, which qualifies as an advanced transmission technology as a form of APFC By injecting a variable voltage (leading or lagging) in quadrature with the line current, the SmartValve can pull power toward or push power away from the installed circuit. Smart Wires uses a proprietary end-to-end communication and control (E2E) system. The E2E system interfaces with the utility's energy management systems (EMS) and manages the operation of deployed M--SSSC devices. Utility operators control the amount of reactance output by the fleet of M-SSSCM devices at the EMS level. EMS commands are then transmitted to the PowerLine Gateway, an IT/SCADA device located at the substation, over a secure SCADA communication channel. The PowerLine Gateway provides configuration, observation, control, and asset management services for the M-SSSC devices. The gateway also supports multiple communication protocols, including DNP3, IEC 61850, and 60870-5-104. Utility EMS commands are transmitted to the PowerLine Coordinator, an IT/SCADA device located either in the substation or in the field, which manages the secure radio frequency network that is used for communication with the M-SSSCM devices. The E2E system enables the utility to track system performance and circuit-level impact of the M-SSSC. The SmartValve is installed in series with existing transmission lines to increase power transfer either through a capacitive or inductive reactance injection. This effectively pushes power from overloaded lines or pulls power onto underloaded lines. APFCs fall under two categories of priority investments in Topic Area 2:

- Increasing transmission capacity and operational transfer capacity through grid-enhancing technologies such as dynamic line rating, flow control devices, advanced conductors, and network topology optimization to improve system efficiency and reliability.
- Improving the visibility of the electrical system to grid operators to help quickly rebalance the electrical system with autonomous controls through data analytics, software, and sensors.

The installation is expected to provide multiple benefits, including:

- Reduce transmission congestion cost
- Reduce maintenance costs and failure rate of phase-shifting transformers
- Increase transmission capacity of the transmission corridors where the devices will be installed
- Enhance interregional cooperation through increased flow between New York and Vermont power systems

Because of VELCO's unique ownership structure, these savings will be passed directly to consumers through its 17 local cooperative distribution utility owners.

Past Evidence of Success

As the technology vendor for this project, Smart Wires has an extensive history of successes with project installations, which is indicative of their capacity to deliver this project in a timely and efficient manner in adherence with the stated objectives in the SOPO. A summary of select key past results includes:

- National Grid Electric Transmission (UK): Like NYS, NGET was experiencing congestion on its north-south transmission backbone, responsible for delivering renewable generation in Scotland and Northern England to the load centers in the London region. By installing M-SSSC devices on five circuits, National Grid was able to unlock 1.5 GW in its existing grid, resulting in $435M in customer savings.
- Transgrid (Australia): This project resolved 170–270 MW of boundary constraints in Australia to enable rapid renewable integration. This resulted in $170M in consumer savings.
- Alberta (Canada): M-SSSC deployment was used to remove congestion equivalent to 3% of the total line rating, facilitating renewable integration.
- GEB (Colombia): This project was installed on a 220-kV line in Colombia to enable 252 MW of firm transfer capacity on the grid.
- EPM (Colombia): This is a two-phase project. In the first phase, a small deployment showed the capacity to unlock 400 MW in capacity on the grid. Phase 2 is in the process of commissioning.
- APG (Austria): This M-SSSC project was installed to balance asymmetrical loads on parallel lines connected to a hydro power plant.

Collectively, Smart Wires' projects have resulted in 3.5 GW in unlocked network capacity and $1.6B in customer savings.

Feasibility

The SmartValve devices will be manufactured in St. Petersburg, Florida at the facility of Smart Wires' contract manufacturer, JABIL. JABIL is highly experienced in the production of SmartValve devices and is ISO 9001 certified. Component procurement will be scheduled 12 months before procurement and manufacturing, with a 30% surplus over typical timelines to account for schedule delays. The longest lead-time items may require up to 12 months. To ensure project timeline feasibility in a rapidly shifting supply chain environment, long-lead-time items will be ordered with a 30% margin of additional time. This will mitigate the impact of supply chain delays on project feasibility. In total, Smart Wires has installed over 200 devices on almost 40 circuits across four continents. As a result, the process for manufacturing the project devices is not only feasible but well established.

The SmartValve devices are installed on existing transmission facilities, typically in the substation or in right-of-way environments. Historically, there are approximately 148 person-hours of subcontractor labor requirements to operationalize each SmartValve project in this program. Typically, Smart Wires engages utility labor to complete site preparation and labor, but subcontracting will be evaluated as an option depending on the availability of personnel.

Innovation and Impacts

SmartValves are a form of APFC technology. These devices are installed on transmission assets to optimize network flows and increase grid automation, visibility, and controllability. The

SmartValve is considered an advanced form of power flow control technology because it employs power electronics, which differentiates it from other forms of flow control available in the market. Power electronics provide the real-time power system visibility and control required to optimize power flows and energy dispatch. The SmartValve is installed in series with existing transmission lines to increase power transfer either through a capacitive or inductive reactance injection. The device injects a leading or lagging voltage in quadrature with the line current, providing the functionality of a series capacitor or series reactor, respectively.

Furthermore, the SmartValve™ does not have the negative characteristics of these passive devices, such as the risk of sub-synchronous resonance (SSR) with series capacitors or the constant reactive power consumption of series reactors. This is significant because series compensation using traditional elements in series with the transmission lines can introduce resonance in the network impedance at frequencies below the fundamental frequency of the system. Traditional passive elements such as fixed-series capacitors have a proportional relationship between voltage and current across the element at all frequencies. This attribute of series-passive elements is responsible for forming SSRs that could interact detrimentally with the oscillatory modes in the turbine shaft of the generators, causing system damage and eventually supply interruption to electricity users.

SSR is a critical issue that can cause multi-million-dollar damage to grid infrastructure and generation assets. Series capacitors installed in transmission lines with nearby generation tend to pose the highest SSR risks. The most common impact of an SSR event is the damage to generation shafts, wind turbines, and series the capacitors itself. These events have occurred in multiple places in the world such as in Minnesota in 2007 where there was resonance between combustion turbines and a fixed-series capacitor in the 345-kV transmission system. Other incidents occurred in Texas in 2009 and 2017. In the 2009 event, the series capacitors and the wind turbine crowbar circuits were damaged as a result of the rapid sub-synchronous current oscillations in the 20–30 Hz range following the trip of the Ajo–Lon Hill 345-kV line (http://power.eng.usf.edu/docs/papers/2022/IBRSSO_TF1.pdf).

SmartValves are voltage source converter (VSC) based devices that inject series voltage across their terminals. The voltage injected by the SmartValve is determined by control systems, and its injection is performed at the fundamental frequency of the line. For all other frequencies, the SmartValve becomes an electrically shorted element incapable of inducing reactance. For this reason, it does not generate conditions in the network that could lead to SSRs. In addition, given the robustness of the DC link control of the equipment already demonstrated in detailed studies, SmartValve devices do not exchange power with the AC networks at frequencies below the fundament frequency—making it impossible to stimulate new resonances in the system. Smart Wires can provide reports supporting such claims under non-disclosure agreement.

The SmartValve can be deployed rapidly—in 12 to 18 months—or flexibly. The devices can be deployed and used in the field within one year from the time of order. SmartValves increase system flexibility in various ways, including:

1) Operational flexibility: This is the ability to adapt to various operating scenarios. An operating scenario is the result of a specific combination of generation dispatch, demand profile, and topology. A more flexible power system can maintain system parameters within

its safe limits under more operation scenarios, including extreme weather events, outages, and faults. A more flexible system tends to be more robust, reliable, and capable of operating at lower production costs for consumers. System congestion makes a system less flexible because it limits the way power can flow (congestion needs to be avoided to prevent damage to grid infrastructure). Traditional tools for system operators to manage congestion are shedding load and using more costly generation sources to limit congestion. SmartValves allow utilities and operators to manage congestion by providing the ability to manipulate the transmission lines' impedance, redirect power, and adapt to different operational scenarios. Until the development of APFC using power electronics, real-time impedance control was not possible—therefore, SmartValve solutions add a control variable to operators that did not previously exist.

2) Planning flexibility: This is the ability to foresee future grid needs. Because traditional infrastructure solutions have lead times on the order of 5–10 years, assumptions about future system needs and capital investments in transmission infrastructure are made far in advance. However, high renewable penetration and electrification have complicated the prediction of future needs. This complex landscape contributes to stranded asset risk, which is escalated because of the high capital cost of transmission projects. Because SmartValve solutions are standardized, modular, and much faster to implement than traditional solutions, system planners can focus investments on the near-term needs that have high likelihood of materializing and scale up the solution or relocate it entirely depending on the future needs. This reduces stranded asset risk as well as the need to oversizing the solutions to future-proof the solution for emerging future needs.

Overall, flexibility increases reliability and reduces system operation and expansion costs to consumers.

Project Support for State, Local, Tribal, Regional, and National Resilience; Decarbonization; or Other Energy Goals, Strategies, and Plans

As intermittent generation and fossil fuel baseload retirement become more prevalent in the coming decades, interregional power flow will become increasingly critical to maintain supply adequacy and stability. From a regional resilience perspective, APFC can provide a higher level of control and coordination across borders despite increasingly uncertain conditions. From a renewable integration perspective, unlocking available capacity on the grid can enable additional renewable penetration. In the case of contingencies caused by extreme events, it will be important to ensure that the grid is planned to minimize the risk that low-probability contingencies involving two critical elements of the grid (e.g., NERC P7 [N-2] and P6 [N-1-1]) result in stranded generation capacity that could avert the need for load curtailments.

Vermont has a comprehensive energy plan to achieve 90% renewable energy by 2050. Vermont also consumes threefold the energy that it produces. As a result, the state is expected to become increasingly dependent on interregional flows to maintain supply adequacy. In addition, by 2030, Vermont expects to see an additional 675 MW of demand in summer and 2,472 MW in winter. According to the Comprehensive State Energy Plan [**Link**], the "Dynamic reactive control devices will need to be deployed grid-wide to mitigate the risk of loss" by 2030 with the integration of more intermittent generation.

In general, enhancing interregional integration using APFC can unlock capacity, increase state exports of renewable energy, and accelerate state climate plans.

Potential Impact of the Project to Reduce Perceived Risk for Deployment and Lead to Private Sector Investments

SmartValve deployments will result in cost savings, increased interregional flows and cooperation, and grid resilience. Municipal and government-owned utilities with relatively small budgets and limited ability to fund large projects such as transmission builds will benefit from the use of scalable, modular, and redeployable APFC technology. The studies to be conducted by EPRI in this project will provide valuable analytics for the utilities and system operators to plan out the optimal installation of APFCs, determine whether APFCs can be used to solve transmission constraints, and assess the benefits of wide-scale APFC deployments. EPRI will also evaluate the communication system, protection, asset management, and reliability of the SmartValve. This is critical to provide a platform of technical assurance for widespread adoption.

The cost-share mechanism of the funding program improves project economics and subsequent project attractiveness, which reduces the adoption barrier for utilities. This can help resource-constrained utilities provide reliable, low-emitting electricity to their customers. Without the DOE funding, VELCO may experience challenges receiving financial approval from its ownership and ISO-NE for this project because of cost. DOE funding reduces capital costs and simplifies this approval.

DOE funding for a commercialized technology such as the APFC provides a significant endorsement for the U.S. applicability of this technology and minimizes the informal but prevalent barrier of unfamiliarity to operators and transmission planners. Furthermore, the DOE cost-matching mechanism improves project economics, reducing the perceived investment risk in a technology that is widely used globally but relatively uncommon in the United States. The demands of the energy transition are also increasingly constraining utilities' capital budgets.

In addition, EPRI is a widely respected leader in the utility field. An EPRI-conducted study documenting risks, mitigation strategies, technical features, and potential economic benefits of APFC installations will provide information and knowledge to help overcome barriers to wider scale adoption and private investment in the technology.

Topic Area 2 Requirements

The project will have a significant effect in encouraging and facilitating the development of Smart Grid Functions because it meets the following Topic Area 2 objectives:

*Objective 1: Increasing **transmission capacity and operational transfer capacity** through grid-enhancing technologies such as dynamic line rating, **flow control devices**, advanced conductors, and network topology optimization to improve system efficiency and reliability.*

Through deployment of SmartValves, a modular static synchronous series compensator, the project will significantly increase the effective transmission capacity and operational transfer capacity between the New York–Vermont border. The low cost of this technology compared

to traditional solutions such as building new transmission lines as well as the dynamic and autonomous nature of the control will improve system efficiency and reliability.

Objective 2: *Improving the **visibility of the electrical system to grid operators** to **help quickly rebalance the electrical system with autonomous controls** through data analytics, software, and sensors.*

SmartValve is installed in series with existing lines to provide greater available transmission or distribution network capacity. It does this by either injecting a leading or lagging voltage in quadrature with the line current or providing the functionality of a series capacitor or series reactor, respectively. Capable of dynamic and autonomous control, the SmartValves provide another tool to grid operators to help quickly rebalance the electrical system. In addition, the SmartValve does not have the negative characteristics of past passive devices, such as the risk of SSR with series capacitors or the constant volt-ampere-reactive (VAR) consumption of series reactors.

This project will enhance system flexibility in various ways. APFC devices offer flexibility from three perspectives: operability, siting, and stability. Smart Wires' APFC devices enable grid operators to monitor and adjust power flows across their networks in real time, which enhances the operator's capacity to optimize power flows. SmartValve's transformer-free design is also a modular, standard offering that reduces cost and size requirements, sometimes by 70% or more.[1] The flexibility in the deployment of SmartValves means that installations can be tailored to meet specific substations or site restrictions. Because the power transfer on a single line or through a network is often determined by transient stability limits, deploying SmartValves also improves system capability and flexibility, resulting in increased stability of the power system.[2] The devices are also voltage agnostic and can be redeployed on a transmission system between 69 kV and 500 kV after a project is completed. The ability to redeploy mitigates stranded asset risk.

Workplan

Project Objectives

This project proposes an investment into technologies prioritized under GRIP Topic Area 2—Smart Grid Grants—that directly meets two of the objectives of that topic area: 1) increase the capacity of transmission facilities or the capability of the transmission system to reliably transfer increased amounts of electric energy and 2) enable the integration of variable renewable energy resources at the transmission level. The objectives of this project are:

1) **Successfully install APFC devices.** This encompasses the installation of APFCs in the transmission systems of the partner electric utility VELCO.
2) **Increase transmission capacity and operational transfer capacity.** The deployment of these devices will systematically increase the transmission capacity of the selected interregional ties, allowing an increased amount of electric energy to be reliably

[1] "Improving Transfer Capability Without Series Compensation Challenges," available on www.smartwires.com

transferred between regions. This will bring direct and quantifiable economic and environmental benefits by maximizing renewable dispatch capabilities and reducing energy costs to customers. Consequently, it will reduce the financial and pollution energy burden for marginalized customers, as defined by the Climate and Economic Justice Screening Tool.

3) **Reduce maintenance and outage costs of existing PSTs in the system.** This reduces the cost of service to customers and the impact of prolonged outages due to maintenance and failures.
4) **Assess potential economic, operation, and reliability benefits of larger adoption of APFCs across the system**. The comprehensive power system study proposed in this project to evaluate the economic, reliability, and environmental benefits of large-scale adoption of APFCs will help demonstrate the role of this technology in the grid of the future and will provide guidance for designing transmission solutions based on APFCs.
5) **Demonstrate how the APFC can enhance grid flexibility in various ways.**
6) **Help reduce barriers to wider use of APFC technology on the United States transmission grid.** Through the installation of APFCs in the VELCO system—along with a thorough assessment of APFC technology and system impacts—this project seeks to demonstrate the capability, performance, and integration of these devices, providing knowledge and experience to facilitate large-scale adoption of the technology.
7) **Attain multiple benefits to the community derived from the investment.**

These objectives contribute to DOE's GRIP Program strategic goals in various ways, as described in the following chart.

DOE's GRIP Program Goal	Project Objectives
Transform community, regional, interregional, and national resilience, including in consideration of future shifts in generation and load	Objectives 1 and 2. The deployment of APFCs will increase interregional electricity transfer capacity, which in turn will facilitate clean energy deployment, generation mix diversity, and other system benefits.
Catalyze and leverage private sector and non-federal public capital for impactful technology and infrastructure deployment	Objectives 1, 4, and 6 will help leverage federal infrastructure funding with the private sector and non-federal public capital to maximize deployment of smart grid infrastructure at scale.
Advance community benefits	Objectives 1, 2, 3, and 7 encompass workforce training, creation of new jobs leading to long-term careers, increased energy resilience, and enhanced interregional cooperation.

Technical Scope Summary

This project comprises four main activities designed to accomplish the seven project objectives described above. Figure 2 illustrates how the activities map with the specific objectives and describes the tasks composing each activity.

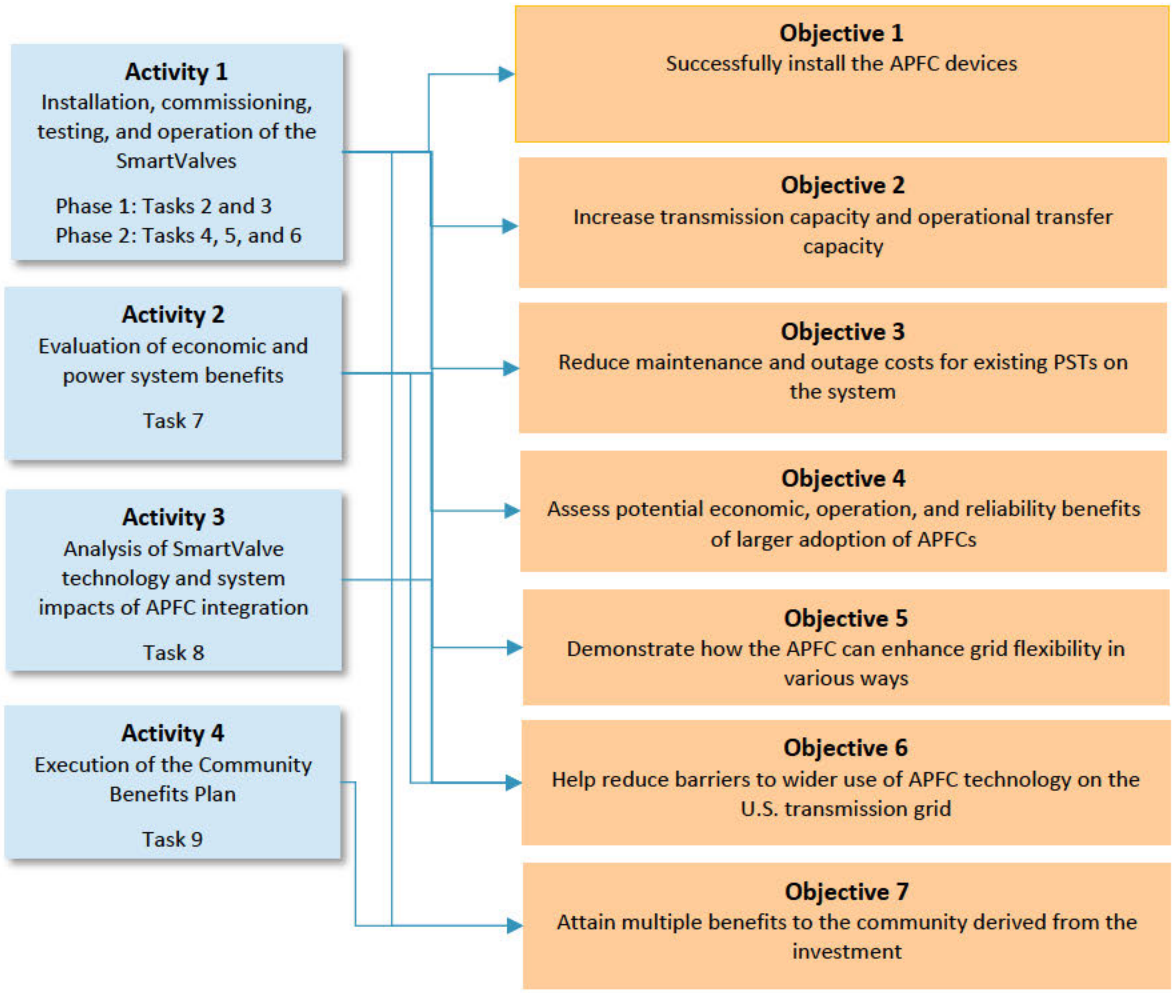

Figure 2 - Mapping project activities into project objectives

Activity 1 is the core of this project. It entails the installation, commissioning, testing, and operation of the SmartValve devices at the selected locations in VELCO's transmission system. Smart Wires will manufacture the devices and perform the engineering and procurement, installation, commissioning, and testing of the devices in the transmission system. This activity will be performed in two phases. The first phase is the planning phase in which the detailed engineering analysis is performed and includes the process related to approvals and permits. The second phase is the field implementation, which includes the SmartValve installation, commissioning, and in-service operation.

Activity 2 is the evaluation of economic and power system benefits. This project encompasses a series of studies and analyses of the benefits and value of APFCs, implementation considerations and challenges, and potential impact to the power system. The tasks grouped under Activity 2 are intended to assess various types of benefits for the electric system that can be realized with the use of APFCs. These devices could serve a transmission system in various ways, including mitigating congestion, managing loop flow and cross-border flow, improving transient stability, deferring transmission investment, enabling flexible/adaptable transmission expansion, facilitating maintenance outages, and improving the integration of renewable

generation. These tasks will focus on some of the most relevant benefits of APFCs for transmission: a) improved system operations to reduce congestion, b) optimization of transmission investment, and c) improved flexibility and adaptability of the transmission system.

Activity 3, analysis of SmartValve technology and system impacts of APFC integration, seeks to evaluate various relevant aspects of SmartValve technologies and their impact on power system operations and control. The intent is to provide planners and transmission system engineers with information and knowledge to help them make a risk-informed decision about the integration, operation, and management of APFCs.

Activity 4, execution of the Community Benefits Plan, covers all the activities contained in the CBP to maximize the benefits to the affected communities.

WBS and Task Description Summary
Table 1 summarizes the tasks included in the four main activities of the project. Task 1 is the project management and planning activity and follows the structure described in the FOA. A description of the scope and approach of the other project tasks follows. Further details are provided in the SOPO. Task 9 is the execution of the CBP; the details of the plan—including specific activities, milestones, and deliverables—are described in the CBP.

Tasks 2 and 3 correspond to the Planning Phase (Phase 1) of the installation, commissioning, testing, and operation of the SmartValves. Prior to implementation, two key tasks must be accomplished to adequately prepare for field installation activities: 1) approvals and permits and 2) engineering and procurement. The planning phase is a coordinated, proactive effort to mitigate installation risk and prepare the site for implementation. The projects in this program are in an advanced stage; as a result, there are very few outstanding technical studies to be performed in this stage. Those that remain help the host utility identify preferred SmartValve operational settings.

Tasks 4, 5, and 6 correspond to the Implementation Phase (Phase 2). This phase includes SmartValve installation, commissioning, and in-service operation. The installation task includes Smart Wires–led training for system operators on the operability of the devices, including integration and operation within SCADA and EMS architecture. The commissioning task is used to validate the device performance in the field, while the in-service operation task will provide performance data on the functionality of the devices.

Task 7 is the evaluation of economic and power system benefits. The objective of this task is to assess various types of benefits for electricity system users that can be realized with APFCs. It includes the following subtasks:

Task 7.1 - Assessment of the use of APFCs to improve transmission system operations
The analysis will focus on the use of APFCs to reduce congestion by diverting line flows and consequently increasing the transmission capability of critical transmission paths as well as the associated economic benefits and improved integration of renewables. A system model for production cost and economic dispatch simulations will be set up to assess these benefits. The EPRI team will use production cost and market simulation software Polaris Systems Optimization (PSO) or Energy Exemplar's PLEXOS for this analysis. The operation

and control of APFCs will be represented in the system model to evaluate their impact on transmission capacity.

Task 7.2 - Use of APFCs to optimize transmission investment
This task will analyze the use of APFCs as alternative or complementary solutions for transmission expansions needed for reliability or for the interconnection of renewable generation. EPRI-developed software CPLANET will be used to identify the optimal location and size of power flow control devices to mitigate thermal overloads in a transmission system over a considered range of operating scenarios.

Task 7.3 - Use of APFCs to improve the flexibility and adaptability of transmission systems
The APFCs are modular and scalable and can be redeployed to different locations. This task will evaluate how these salient characteristics of APFCs can be exploited to design highly adaptable and flexible transmission expansion plans, which are critical to mitigate capital losses and reduce reliability risks associated with possible system future changes and unforeseen situations. EPRI has developed an approach and software tools for this purpose, which are planned for use in this task.

Task 8 encompasses the analysis of SmartValve technology and system impacts of APFC integration. It includes the following subtasks:

Task 8.1 - Evaluation of the communication system
SmartValves use fiber-optic communications for control and protection. This task will analyze the resiliency of the SmartValves' communications system and its impact on reliability. The analysis will include a review of communication technology used in the SmartValves system, including on-site measurements during installation and commissioning.

Task 8.2 - Evaluation of protection impacts
The SmartValve has different protection and control modes, including bypass of the unit under high-fault current conditions. The operation of SmartValves can affect the settings and performance of the transmission system protection; this task will evaluate those potential impacts and provide recommendations to mitigate them.

Task 8.3 - Asset management
SmartValve devices are modular, scalable, and redeployable. EPRI will analyze and describe the conditions under which these devices can be used to take advantage of these features. EPRI will also analyze the replacement strategies for each component in the SmartValve based on the life expectancy of each component obtained by surveying existing installations. EPRI has developed life extension guidelines for HVDC and FACTS that may be useful to provide estimates of the life expectancy of some power electronic components.

Task 8.4 - Reliability assessment
As with any other device or control equipment, SmartValves may experience several failure modes that may pose a risk to the operation and safety of the system in which they are installed. This task will evaluate the potential impacts on the system due to misoperation or failure of SmartValve functions.

Task 9 includes the activities related to the execution of the CBP. This task involves the specific activities intended to advance the community benefits that will derive from this project. EPRI will take on the role of CBP coordinator. The subtasks are organized to cover all required community benefits aspects: Subtask 9.1 - Community Engagement; Subtask 9.2 - Investing in the American Workforce; Subtask 9.3 - Advancing diversity, equity, inclusion, and accessibility (DEIA); and Subtask 9.4 - Justice40 Benefits. The subtasks' approaches, outcomes, milestones, and timeline are described in detail in the CBP.

WBS, Task Description, and Milestone Summary

Table 1 describes the tasks and associated project milestones and deliverables. More details about task description and duration are provided in the SOPO. Also, details regarding the community benefits activities are provided in the CBT.

Table 1 - Project Milestone and Deliverables

Name	Sub-Items	Deliverable/*Milestone*	End Date/Date
Task 1.0 - Project Management and Planning	Subtask 1.1 - Project Management Plan (PMP)	Project Management Plan (PMP)	Jan 2024
	Subtask 1.2 - National Environmental Policy Act (NEPA) Compliance	National Environmental Policy Act (NEPA) Compliance	Jan 2024
	Subtask 1.3 - Cybersecurity Plan (CSP)	Cybersecurity Plan (CSP)	Jan 2024
	Subtask 1.4 - Continuation Briefing(s)	Continuation Briefing(s)	Jan 2024– Dec 2026
Task 2.0 - Approvals and Permits	Subtask 2.1 - Purchase Order	*Smart Wires PO received*	Jan 2024
	Subtask 2.2 - Land Acquisition	*Land titles acquired*	Jun 2024
	Subtask 2.3 - Environmental Permitting	*Environmental permits acquired*	Nov 2024
Task 3.0 - Engineering and Procurement	Subtask 3.1 - Long-Lead-Time Ordering	*Long-lead-time items ordered*	*Jun 2025*
	Subtask 3.2 - Advanced Studies		Apr 2025
	Subtask 3.3 - Installation and Line Connection Design		*July 2025*
	Subtask 3.4 - Device Manufacturing	*EOL test reports completed*	*Sept 2025*
		30% design	*Jan 2025*
		60% design	*Mar 2025*
		90% design	*May 2025*
Task 4.0 – Installation	Subtask 4.1 - Site Preparation	*Site-readiness report*	*Oct 2025*
	Subtask 4.2 - Equipment Installation	*Post-installation report*	*Mar 2026*
Task 5.0 - Commissioning	Subtask 5.1 - On-Site Commissioning	Commissioning Report Accepted by Host Utility	May 2026
Task 6.0 - In-Service	Subtask 6.1 - In-Service Testing	*In-service test report complete*	*Oct 2026*
Task 7.0 - Evaluation of Benefits	Subtask 7.1 - Asses the Use of APFCs to Improve Transmission System Operations		Dec 2024

Name	Sub-Items	Deliverable/*Milestone*	End Date/Date
	Subtask 7.2 - Assess the Use of APFCs to Optimize Transmission Investment		Jan 2025
	Subtask 7.3 - Assess the Use of APFCs to Improve the Flexibility and Adaptability of Transmission Systems	**Study Report**	**Mar 2025**
Task 8.0 - Assessment of SmartValve Technology	Subtask 8.1 - Evaluate the Communication System		Jun 2026
	Subtask 8.2 - Evaluate the Impact on Protection		Mar 2025
	Subtask 8.3 - Asset Management Analysis		Aug 2025
	Subtask 8.4 - Reliability Assessment	**Study Report**	**Sep 2025**
Task 9.0 - Execution of the Community Benefits Plan	Subtask 9.1 - Community Engagement	*Workforce and community benefits agreements executed*	*Dec 2024*
		Community listening sessions conducted quarterly	*Jun 2026*
		On-site education presentations on Smart Wires and grid/grid stability technologies	*Jun 2026*
	Subtask 9.2 - Investing in the American Workforce	*Training sessions on SmartValve technology, installation, and lessons learned*	*Dec 2025*
	Subtask 9.3 - Advancing DEIA	*Create energy-related project curriculum for and in collaboration with VEEP*	*Sep 2026*
	Subtask 9.4 - Justice40 Benefits	*Create environment-related project curriculum for local groups showing the impact of this project*	*Sep 2026*

Go/No-Go Decision Points

The criteria for go/no-go decisions will enable process compliance and availability of all information to make an informed decision to take the next step in the project execution. The completion of the 30% installation and line connection design will act as a go/no-go decision point for the involved parties to evaluate the project progress, feasibility of implementation, and adherence to the proposed budget. At this stage, the majority of commercial and technical challenges will have been identified and either addressed or assigned a mitigation strategy. This period in the project timeline is a natural decision point for all parties to align on continued progress or an alternative path.

Table 2 – Go/No-Go Decision Points

Decision Point	Metric/Criteria	Time (month)
Milestone 3.3.1 - 30% design completed	The validation that the installation and line connection design has achieved at least 30% completion status will act as a go/no-go decision point for the involved parties to evaluate the project progress. Acceptance criteria will be based on the inclusion, at a minimum, of geotechnical report for site, including resistivity; general arrangement	13

Decision Point	Metric/Criteria	Time (month)
	drawings for layout; elevation drawings for layout; interconnection and electrical drawings; foundation design and details; anchor bolt plan; grounding design and details; detailed bill of material; calculation package showing loading and capacity of all materials included in design; and review and support for insulator specification and testing as applicable.	
Milestone 5.1 - On-site commissioning	SmartValve proper communication is verified when line current is reported within 10% of the field test system-reported value. SmartValve injection is verified when all units correctly report injected voltage, line current, and injection status while injection is gradually set from 10% to 100% and from -10% to -100%. Further acceptance criteria for decision making will be documented in the commissioning plan to be agreed upon between Smart Wires and the host utility.	29

End-of-Project Goal

With the successful completion of this project, the seven objectives formulated for this project will be accomplished. These objectives are closely aligned with Topic Area 2 purposes and the overall goals of the DOE's GRIP Program.

SmartValve devices—the advanced power flow controllers developed and commercialized by Smart Wires Inc.—will be installed in the transmission system of the electric utility partner VELCO. Once installed, the operation of these devices will increase the transmission capacity of the selected interregional tie. This will open the possibility of securely transferring more energy between the connected regions, increasing the dispatch of renewable generation—which will result in environmental and economic benefits to customers and society.

The installation of APFC devices at the selected location will also help reduce the operation and maintenance (O&M) as well as operation costs of existing PSTs installed in the system, derived from less frequent use of the PST tap changers. This O&M cost reduction will directly benefit electricity customers. In addition, the limited use of PST tap changers will reduce failure rates and forced outages of the units, improving reliability and operations security.

The system study and APFC technology assessment, along with the lessons learned from the installation and operation of the APFC devices, will provide valuable information and documentation to transmission planners, asset managers, and system operators to better understand APFC technology, its benefits, operation risks, and implementation challenges. This will help them make informed decisions about the implementation and use of these devices, helping reduce one of the most important barriers to the adoption of new technology.

Finally, the implementation of the CBP will realize numerous benefits to the impacted communities, including workforce training, the creation of new jobs leading to long-term careers, increased energy resilience, and enhanced interregional cooperation.

Project Schedule

The project timeline of the main tasks is provided in the following Gantt chart. The milestones and deliverables are not included in this chart because they are listed in Table 1.

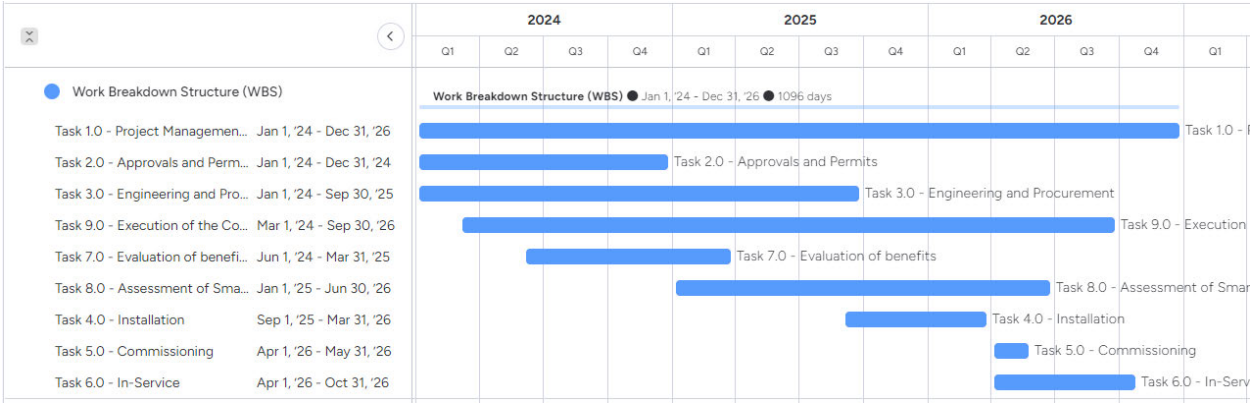

Figure 3 - Timeline of Project Tasks

Buy America Requirements

Smart Wires Inc. (UEI D9E2S7X8V917) is seeking a *Nonavailability Waiver* for the use of the SmartValve, a digital power flow control technology that quickly solves transmission grid issues to create extra capacity. The SmartValve is a unique technology that is manufactured in the United States by only one company (Smart Wires), but component parts are both domestically and internationally sourced. The following is a list of Items/goods described in the waiver.

Name	Cost	Country of Origin	PSC and NAICS Codes
SmartValve 10-1800 v1.04	$286,396 (TBD based on budget workbook)	United States with component parts from U.S., Belgium, China, England, Germany, South Korea, Thailand, Bulgaria, Japan, and Mexico	335311

Project Management

Approach to and Organization for Managing the Work

EPRI will use a comprehensive *project management plan* reflecting industry best practices and incorporating the key project elements of scope, schedule, budget, risk, communication, quality, and resource management. This *project management plan* will serve as the guiding document for project execution, will be published and reviewed at the project kickoff meeting, and will be updated as appropriate. The use of the *project management plan* will promote alignment and drive continuity of effort across phases and members. As part of this plan, EPRI will use a disciplined approach to deliverables management, detailing deliverables' requirements and their critical milestones. The deliverables management process will be supplemented with formal tools and processes for managing change, assessing risk, and communicating status.

This project will involve DOE, EPRI, utility, vendor, and community members at several geographical locations. To facilitate the efficient collaboration of such a diverse group, EPRI will use a formal stakeholder management process, incorporating tools such as the responsibility assignment matrix (RAM) and the responsible, accountable, consulted, informed (RACI) matrix to make explicitly clear the roles and responsibilities of all project members.

Work will be detailed in a work breakdown structure (WBS) in which the project will be decomposed into its constituent work packages with milestones, constraints, and dependencies, clearly identified for efficient management; this in turn will be output to a Gantt chart. This process further enables EPRI to closely monitor the requirements of, changes to, and status of milestones and deliverables.

Project Team Member Roles

Figure 1 shown in the Project Overview section illustrates the roles and responsibilities of the entities that participate in this project. EPRI will serve as the project *Prime*, providing high-level oversight of the work of the transmission utility VELCO and the technology vendor Smart Wires. In this role, EPRI serves as the point of contact (POC) for DOE, maintaining scope and schedule and ensuring that budget elements are met and lines of communication used effectively. In addition, EPRI technical staff will lead some scope elements—in particular, the evaluation of economic and power system benefits, and the evaluation of SmartValve technology and system impacts of APFC integration. Throughout this effort, EPRI will reference and align its efforts to the CBP service contract with Smart Wires for the planning, installation, commissioning, and testing of the SmartValves at the selected location.

EPRI will use a RAM to define the roles and preferred communication needs of those participating in the project. To provide further clarification and alignment among the team members, EPRI will use tools such as Monday.com for distribution of the detailed RACI chart, combining elements of the WBS and RAM to provide visibility into and real-time tracking of activities and owners. The use of Monday.com allows the project manager to identify, assign, and track tasks and subtasks; archive comments; track effort; and send alerts and reminders. Key personnel of each institution and their corresponding roles are described in the following section.

Technical and Management Aspects of the Management Plan

EPRI's Project Management Office (PMO) functions to build rigor, visibility, professionalism, and collaboration into its project management plans and processes; EPRI's PMO develops standardized best practices, processes, and tools for use in project management and acts as a project management SME by leveraging its Project Management Institute (PMI)-PMP (project management professional) certified personnel. In addition, EPRI uses several platforms for technical and financial management, e.g., SAP for cost management, ECM (enterprise content management) for information management, Box for records retention, and a formal data governance policy for data management.

Approach to Project Risk Management

EPRI uses a multi-step process of risk identification and management. In the proposal (RFP) stage, EPRI follows a formal internal risk review process referred to as the proposal development process (PDP), a component of which is the project risk assessment (PRA) in which major potential project risks are identified and assessed in the context of the business decision of whether to pursue the opportunity. Upon award—and as a part of the project management plan—the EPRI project manager creates the formal ***risk management plan*** in which risks are identified, assessed, prioritized, and managed. For an identified risk, EPRI will assign values for likely probability and impact and construct a management plan that may

include internalizing its acceptance or developing a mitigation strategy that may trigger the change management process (i.e., change orders). For this project, likely risks to be managed may include the procurement of long-lead-time items, cost fluctuations, obtaining permits and licenses, and weather and other environmental factors. Table 3 is a preliminary analysis of risks associated with the different activities and facets of the project and the proposed mitigation actions.

Table 3 - Risk Identification and Mitigation Plan

Phase 1: Planning				
Risk Category	Risk Description	Risk Probability	Risk Impact	Mitigation Plan
Material delay	Delay in receiving long-lead-time materials for device manufacturing	Medium	Medium	As outlined in the proposal, long-lead-time materials will be ordered with a 30% margin on time to mitigate supply chain–induced delays and ensure timely manufacturing.
Manufacturing of APFC devices is delayed	Delay in manufacturing at partner site due to resource or production constraints	Low	Medium	Coordinate proactively with the Smart Wires internal product management team to secure manufacturing capacity for this program with 15% margin in 2024.
Siting constraints	Land acquisition increases cost of the project	Low	Medium	In this proposal, worked with utilities to identify sites with existing space for device installation and added land acquisition costs to the budget to mitigate budgetary inflation.
Phase 2: Implementation				
Risk Category	Risk Description	Risk Probability	Risk Impact	Mitigation Plan
Units arrive damaged at site	Some APFC units could arrive with physical damage after transportation to site, which is a risk with the transportation of any large equipment	Low	Medium	Smart Wires uses transportation partners that prioritize the physical integrity of the devices in transit to site.
Product functionality upon delivery or commissioning	Unforeseen device functionality issues	Low	Medium	A commissioning spares plan will be created.
Logistical delays in shipping	Logistical problems and shipping leads to delays in delivery	Medium	Medium	A dedicated resource will be allocated to create a clear list of tasks and owners for each leg of the shipping route. A margin of 15% will be added to the shipping time estimate.

How Project Changes Will Be Handled; Approach to Quality Assurance/Control

As part of the comprehensive project management plan, EPRI will include a ***requirements register*** with a requirements traceability matrix; this will allow EPRI to identify and catalog the requirements of the deliverables, monitor them, and track any changes to them. A

subcomponent of this process is to use an issues log/actions log (sometimes referred to as a *RAID log*) to track the progress of deliverables; in this way, the status of each deliverable, its requirements, any issues encountered, changes requested, and decisions made can be recorded. For further granularity, a separate ***change management plan*** and tool may be used.

Project Team Communications

As described previously, communications are facilitated by EPRI through elements of the project management plan that include the schedule, WBS, and RAM and RACI; further guidance can come from the use of a ***communications plan*** in which the respective participants, frequency/date, channel, content, etc. of key communication events (meetings, reports, etc.) are detailed. Through the Monday.com tool, EPRI can publicize to the team a dashboard of project key performance indices (KPIs) and other important metrics and in this way promote awareness, collaboration, and accountability among team members. Although the above-described tools are useful for **pulling** information, frequent meaningful, direct communication between the DOE PI, EPRI PI and PM, and the POCs of the utilities and vendors will be crucial to **push** information and confirm understanding—particularly for time-sensitive content.

Technical Qualifications and Resources

Project Team's Unique Qualifications and Expertise

The project team from the three partnering entities comprises all expertise and capabilities required to accomplish the goals proposed for this project.

EPRI conducts research and development relating to the generation, delivery, and use of electricity for the benefit of the public. EPRI also provides technology, policy, and economic analyses to drive long-range research and development planning and supports research in emerging technologies. EPRI will bring to the team experts on other areas relevant to this project, such as transmission and substation equipment and asset management as well as cyber security. Apart from the technical team, EPRI's PMO will also participate in this project. The PMO staff comprises project management specialists with PMP and Certified Associate Project Management (CAPM) certifications. EPRI's emphasis on project management excellence is rooted in this centralized PMO in which a team of project specialists provides oversight and best practice guidance to research and technical staff's project managers or, in certain (and often for large, complex project) cases, works as the project manager on government contracts.

Smart Wires Inc., the technology manufacturing partner for this project, is a U.S.-based company founded on October 27, 2010. It is headquartered in Durham, North Carolina. Smart Wires manufactures the SmartValve—an APFC device—and is the global leader in APFC solutions, having deployed over 1 GVAR of devices since the first deployment in 2012. It directly employs 120 people in the United States, Europe, Latin America, and Australia. SmartValve deployments have historically resulted in 170–1500 MW of unlocked capacity on existing transmission assets, including across interregional boundaries. The SmartValve device is installed on 24 circuits across four continents, with over 800 MVAR injected onto the grid. Collectively, this has resulted in 3.5 GW in unlocked network capacity and $1.6B in customer savings.

VELCO has managed safe, reliable, and cost-effective electric transmission networks in Vermont for over 60 years. VELCO is a small, transmission-only business with a unique financial structure for the United States; although VELCO is a for-profit company, its profits flow back through its 17 Vermont distribution utility owners to directly benefit each respective utility's customers. The company's asset base has grown significantly over the last decade to more than $1B in transmission assets that include a statewide fiber-optic network. This expansion provided learning opportunities and a wealth of experience to the VELCO team. Within Vermont and at the regional level, the company has a well-earned reputation among all stakeholders for safe operations, disciplined fiscal management, sound environmental stewardship, and advancement of grid innovations. VELCO provides accurate and timely information and works collaboratively to advance its projects. Specific to this project, an existing project team consisting of experienced and qualified staff has been formed to evaluate the condition and suitability of the existing substation facility that will be the location to site the APFC devices.

Table 4 describes the project team members, their affiliation, areas of expertise, and main roles in the project.

Table 4 - Project Key Personnel

Company	Team Member	Position	Role in the Project
EPRI	(b) (6)	Program Manager	Principal investigator
	[redacted]	Engineer/Scientist III	Power system studies/software development
	[redacted]	Engineer/Scientist III	Power systems studies/transmission planning
	[redacted]	Project Specialist	Project management
	[redacted]	Project Specialist	Project management
	[redacted]	Technical Executive	SmartValve technology evaluation/ asset management analysis
	[redacted]	Technical Leader	Power system operation analysis
	[redacted]	Technical Leader	Power system operation analysis
	[redacted]	Principal Technical Leader	SmartValve technology evaluation/ communication system analysis
	[redacted]	Technical Leader	SmartValve technology evaluation/ protection system analysis
Smart Wires Inc.	[redacted]	Commercial Team Lead in the Americas	Project lead from Smart Wires
	[redacted]	Commercial Team Member	Commercial implementation support
	[redacted]	SVP of Products and Solutions	Advisor

Company	Team Member	Position	Role in the Project
	[redacted]	Director of Product and Solution Analytics	Advisor
	[redacted]	Senior Director of Engineering	Oversees and directs engineering and SmartValves deployment
	[redacted]	Director of Business Development	Coordinates the funding logistics, third-party evaluation, and external relationships
VELCO	[redacted]	Senior Director of Transmission Services	VELCO project manager
	[redacted]	Manager of Communications and Strategy	Executes the community benefits plan
	[redacted]	Construction Manager	Supervises fieldwork
	[redacted]	Principal Engineer	Reviews studies and documentation
	[redacted]	Director of Planning	Supervises planning and engineering studies

Equipment and Facilities

Smart Wires is an ISO-9001:2015 registered company, with headquarters in Durham, North Carolina and a dedicated manufacturing facility in St. Petersburg, Florida. The manufacturer is highly experienced in the production of SmartValve devices. To date, over 150 devices have been manufactured and deployed in the field. The headquarters include extensive laboratory space for high-current testing and real-time digital simulator (RTDS) analyses, both of which are key capabilities enabling SmartValve installations for utilities around the world. The proximity of Durham and St. Petersburg also allows for rapid iteration to ensure that advancements produced by the engineering team can be quickly incorporated into the manufacturing line. The dedicated manufacturing facility is owned and staffed by JABIL, a global manufacturing company with more than 260,000 employees across 100 locations in 30 countries. This is a core strength of the teaming partners, who have access to existing supply chains and assembly facilities to guarantee predictable delivery of SmartValve installations on time and on budget.

Relevant Previous Work and Demonstrated Innovations

EPRI has experience across the industry in managing large-scale field demonstration studies in which its project managers have consistently achieved scope alignment, project execution, and closeout with proven valuable results for multiple vendors, organizations, and stakeholders. EPRI's project management expertise is built on a foundation of hundreds of research staff who have—for the past 50 years—been managing thousands of complex, collaborative projects. EPRI has recently partnered with the U.S. DOE, DOD, NASA, CEC, and many other organizations to execute field demonstration projects. The following are relevant examples of collaborative R&D and demonstration projects as well as large industrywide initiatives led by EPRI:

- Low-Carbon Resources Initiative: EPRI and Gas Technology Institute (GTI) have created the Low-Carbon Resources Initiative (LCRI) to accelerate the development and deployment of low- and zero-carbon energy technologies: www.LowCarbonLCRI.com
- Battery storage demonstration projects: [Link]
- Green Hydrogen Demonstration Project: First-of-its-kind demonstration project led by NYPA in collaboration with EPRI, GE, Airgas (an Air Liquide company), and Fresh Meadow Power
- EPRI Smart Grid Demonstration Initiative: This initiative included 48 case studies produced by 17 collaborating and host utilities [Link]
- Data Analytics Initiatives for Transmission and Distribution: [Link] [Final summary brochure]
- Improved Power Grid Adaptability and Responsiveness with Modular and Scalable Transmission Devices: NYSERDA funded project
- Renewable Integration Study—Gulf Coordinating Council Interconnection Authority (GCCIA): EPRI performed this project with GCCIA to examine renewable integration into the GCCIA and its member grids (including Abu Dhabi, Saudi Arabia, Bahrain, Qatar, Oman, and Kuwait)

Smart Wires

At its inception, Smart Wires began with funding from the Advanced Research Project Agency – Energy (ARPA-E) Green Electricity Network Integration (GENI) program for two highly successful deployments with U.S. utilities. Since then, the company has made major strides in advancing product and project impacts. The Smart Wires team has significant experience managing multi-party government-funded electric grid projects through its work with the European Commission Horizon 2020 FLEXITRANSTORE program. Smart Wires involvement in the program included conducting analyses, identifying suitable deployment locations, managing logistics and installation with partners in two European countries, and tracking budget allocations across a three-year timeline. The team was sufficiently successful in this effort to secure follow-on funding as part of the FARCROSS program, for which Smart Wires was also engaged as a technology demonstration partner with transmission utilities in the same two countries. Smart Wires is also a NYSERDA Program Opportunity Notice 4074 – High-Performing Grid funding recipient, underscoring the experience of the team in establishing meaningful partnerships with U.S. funding agencies and project partners to deliver impactful outcomes for stakeholders.

Smart Wires has previously collaborated with EPRI. EPRI observed an installation of SmartValve devices on a 115-kV Central Hudson Gas and Electric transmission line and published a 68-page report in 2020 detailing its observations of the installation. Smart Wires has been engaged with VELCO to develop a solution for the PST augmentation project. Smart Wires is actively engaged with the relevant Pacific Northwest utilities to study how SmartValves could help co-optimize reliable load service and interregional transfers.

Time Commitment of the Key Team Members

Table 5 shows the estimated time commitment of key team members per budget period, as a percentage of workable hours.

Table 5 - Time Commitment of Key Team Members

Company	Team Member	BP1	BP2	BP3
EPRI	(b) (6)	40%	35%	30%
	[redacted]	30%	30%	
	[redacted]	30%	30%	
	[redacted]	40%	40%	30%
	[redacted]	30%	30%	30%
	[redacted]	20%	20%	10%
	[redacted]	20%	20%	
	[redacted]	20%	20%	
	[redacted]	20%	20%	10%
	[redacted]	20%	10%	
Smart Wires Inc.	[redacted]	20%	20%	20%
	[redacted]	10%	10%	10%
	[redacted]	5%	5%	5%
	[redacted]	5%	5%	5%
	[redacted]	15%	5%	0%
	[redacted]	10%	10%	10%
VELCO	[redacted]	4.2%	4.2%	8.4%
	[redacted]	4.2%	4.2%	8.4%
	[redacted]	1.2%	1.2%	2.4%
	[redacted]	0.5%	0.5%	1.0%
	[redacted]	0.5%	0.5%	1.0%
	[redacted]	0.5%	0.5%	1.0%

(b) (6)
Electric Power Research Institute (EPRI)
(b) (6)

EDUCATION:

Ph.D, Electrical Engineering, National University of San Juan, San Juan, Argentina, 2001.
Diploma of Electromechanical Engineering, National Technological University, Mendoza, Argentina. 1995

RESEARCH AND PROFESSIONAL EXPERIENCE:

EPRI, Program Manager, 2007 – Present.

Manage a variety of R&D and engineering projects related to transmission planning, integration of HVDC and FACTS devices, transmission system operation optimization, voltage control and reactive power management, and data analytics applications to support transmission operations and planning, among others.

- Improved Power Grid Adaptability and Responsiveness with Modular and Scalable Transmission Devices – (2021-2023) NYSERDA Project 159616 - PON 4074 High Performing Grid. Principal Investigator/PM.
- Coordinated Reactive Power and Voltage Control for Reliable Offshore Wind Integration (2021-2022).
- Development of Advanced Methods for Evaluating Grid Stability Impacts by HVAC and HVDC Interconnected Offshore Wind Power Plants.
- HVDC Planning: Multi-year R&D projects under the annual EPRI research portfolio. This project develops methodologies, guidelines, modeling and software tools for planners to evaluate and design HVDC projects.
- Integration of Grid-enhancing technologies: Multi-year R&D projects under the annual EPRI research portfolio. This project develops methodologies, software tools and reference guides to help planners evaluate and design cost-effective solution for transmission with Grid-enhancing technologies, including power flow controllers, FACTS devices and large-scale energy storage.
- Benefits and Value of New Power Flow Controllers. U.S. Department of Energy. July 2016. Contract DE-AR0000554 (Contracted through ARPA-E).
- System Voltage and Reactive Power Management: Multi-year project part of the annual R&D EPRI research portfolio. The objective of this project set is to develop strategies, methodologies, and software tools to assist utilities in dealing with various Volt/VAR issues encountered in system operations and planning.
- High-Performance Hybrid Simulation/Measurement-Based Tools for Proactive Operator Decision-Support (2013-2014) – Project funded by the US. Department of Energy under the Advanced Computational and Modeling Research for the Electric Power System program. DOE DE-OE0000628.
- Compact Dynamic Phase Angle Regulators (CD-PAR) for Transmission Power Routing – 3-year projects initiated in 2011. This project was funded under the ARPA-E GENI program.

Performed as Principal Investigator for EPRI – EPRI role: articulate value proposition for CD-PAR for electric systems through simulation and analytical studies

Energy Market Group (EMG), Senior Consultant/Project Manager, 2001 – 2007

Performed as Senior Consultant and Project Manager in a variety of engineering project related with power system analysis, planning and operation in several countries in Latin America, Europe and Asia.

AWARDS AND HONORS:

- CIGRE Pioneer 2020 e-session Achievement Award (https://electra.cigre.org/317-august-2021/life-of-association/cigre-pioneer-2020-e-session-achievement-award.html)
- 2016 EPRI Performance Recognition Award: Presented to (b) (6) for providing strategic guidance and technical support in the development if the National Smart Grid Program for Mexico (October 31, 2016).
- 2012 EPRI Performance Recognition Award: Presented to (b) (6) for diligence in supporting transmission efficiency projects with Con Edison by developing computational tool for optimal schedule of reactive power and voltage control
- 2010 EPRI Performance Recognition Award: Presented to (b) (6) for diligence in his support work on Efficient Transmission by providing background analysis and fact checking that kept EPRI credible.

SELECTED PUBLICATIONS:

1. (b) (6), "Alternating Optimization Approach for Voltage-Secure Multi-Period Optimal Reactive Power Dispatch", IEEE Transaction on Power Systems.
2. (b) (6), "Power Flow Control Solutions for the Bonneville Power Administration Transmission System", CIGRE US National Committee, 2018 Grid of the Future Symposium, Reston VA, October 28-31, 2018.
3. (b) (6), "HVDC Planning Considerations for Offshore Wind Integration", CIGRE US National Committee, 2018 Grid of the Future Symposium, Reston VA, October 28-31, 2018.

SELECTED SYNERGISTIC ACTIVITIES:

- IEEE: Chair of Voltage Optimization Working Group, IEEE Power Energy Society Transmission Subcommittee
- Member of the Industry Advisory Board formed for the R&D project "Energy Positioning: Control and Economics", developed under the Green Electricity Network Integration (GENI) program of the Advanced Research Project Agency-Energy (ARPA-E), U.S. Department of Energy.
- Institute of Electrical and Electronic Engineering (IEEE): Chair of Transmission and Distribution Energy Efficiency Working Group, under the Subcommittee on Climate Change Technology (CCTSC) - Energy Development & Power Generation Committee (EDPGC)

(b) (6)
Electric Power Research Institute (EPRI)
(b) (6)

EDUCATION:

Ph.D., Electrical Engineering, University of Waterloo, Ontario, CA, 1986
M.S., Electrical Engineering, Indian Institute of Technology Kanpur, India, 1981
B.S., Electrical & Electronics Engineering, Jawaharlal Nehru Technological University, India, 1979
Registered Professional Engineer (PE)

RESEARCH AND PROFESSIONAL EXPERIENCE:

EPRI, Technical Leader, 1989 – Present.

Technical Executive, 2001 – Present

Technical Executive at Electric Power Research Institute in the Transmission Substations area conducting research in HVDC and FACTS areas and assisting utilities adapting to the new technologies as well as training utility engineers. A description of applicable activities include:

- AC Line Conversion to HVDC – studied typical AC configurations for HVDC conversion to increase the transmission capacity on the existing corridors as well as some utility AC systems for prospective conversions.
- Coordinated the efforts of developing the EPRI HVDC Reference Book with 30 chapters including all aspects of HVDC (planning, operations, maintenance, and decommissioning).
- Developed new innovative concepts - voltage source converters to limit fault currents for dc line faults, single arm voltage source converters, and transformer-less voltage source converters.
- Developed DC grid methodologies and controls for possible offshore and onshore renewable integration with existing AC grids. Proposed dc circuit breaker concepts for DC grid applications.
- Involved with the development of FACTS as well as assisting utilities to make the proper selection of FACTS controllers for the utility applications.
- Provided training to utility engineers in HVDC and FACTS areas.

Product Line Leader, 1997 – 2001

Product Line Leader at Electric Power Research Institute in the Transmission, Substations, and Grid Operations areas developing the research plans and conducting research in the overhead transmission, substations, grid planning, and grid operations areas.

Manager, 1989 – 1997

Manager at Electric Power Research Institute in the Grid Operations and Planning areas working on many projects addressing the needs of the utilities. Some of the projects include – FACTS and HVDC application studies, electric utility restructuring, dynamic thermal circuit ratings, grid equipment reliability performance metrics, Increased Power-flow Guidebook, dynamic load modeling using real-time measurements, development of sagging line mitigator, development

of fault current limiters, development of power system analysis package (PSAPAC – load flow, transient stability, small signal stability, voltage stability, dynamic reduction program, and load modeling program), EMTP development, Electric Generation Expansion Analysis System (EGEAS) for long range planning, Transmission Reliability Evaluation Program for large scale systems (TRELSS), and Harmonic Analysis (HARMFLO) program.

McGraw-Edison Power Systems, Power Systems Staff Engineer, 1986 – 1989.

Worked on the McGraw-Edison HVDC model verification study. This work included simulation of the Chateauguay dc intertie on the TNA and subsequent development of microprocessor based HVDC model for the TNA and the EMTP. Was involved in several digital and analog studies which include transient, harmonic, and insulation coordination studies performed for electric utilities.

PUBLICATIONS (SELECTED):

1. (b) (6) **"**High-Wire Act: HVDC Technology - The State of the Art**"**, IEEE Power & Energy Magazine, November/December 2012.
2. (b) (6) **,"**Transmission Reliability Performance and Impact Metrics", EPRI Report 1013959, 2007.
3. (b) (6), "A new approach to dynamic analysis of ac networks incorporating detailed modeling of dc systems. Part I: Principles and implementation, Part II: Application to interaction of dc and weak ac systems", *IEEE Transactions on Power Delivery*, Vol. 3, No. 4, 1988, pp. 2005-2019.
4. **R. Adapa,** L.O. Barthold, and D. Woodford, "Technical and Economic Incentives for AC to DC Line Conversion", *Study Committee B2 HVDC Preferential Subject*, CIGRE General Session, Paris, August 2010.
5. (b) (6), "Thyristor Controlled Series Compensation Application Study – Control Interaction Considerations", *IEEE Transactions on Power Delivery*, Vol. 10, No. 2, April 1995, pp. 1031-1037.
6. (b) (6), "FACTS System Studies", *IEEE Power Engineering Review*, December 2002, pp. 17-22.
7. (b) (6), et al, "Feasibility Studies for application of a FACTS device on the New York State Transmission System", *Group 14 Preferential Subject, CIGRE*, 1998
8. (b) (6), "Alternative method for evaluation of damping circuit losses in HVDC thyristor valves", *IEEE Transactions on Power Delivery*, Vol. 3, No. 4, October 1988, pp. 1823-1831.

SYNERGISTIC ACTIVITIES:

- IEEE Fellow, honored by the IEEE for his outstanding contributions to the profession
- IEEE Distinguished Lecturer
- Member of CIGRE,
- Technical Advisor of IEC TC115 – HVDC Transmission Standards development

(b) (6)
Electric Power Research Institute (EPRI)
(b) (6)

EDUCATION:

M.B.A., Capella University, 2021
B.A., Political Science, University of Missouri, 1993
Project Management Professional (PMP); PMI, 2016
Organizational Transformation (credential); PMI, 2022
Agile Hybrid Project Pro (credential); PMI, 2023
Value Stream Management (credential); PMI, 2023
Diploma (Polish Language); Defense Language Institute, Foreign Language Center, 1990

RESEARCH AND PROFESSIONAL EXPERIENCE:

EPRI, Project Specialist, 2022 – Present

As a project specialist, (b) (6) manages project activities by working with the technical teams. He plans and directs schedules and monitor budget; organizes and facilitates external and interdepartmental activities to ensure completion of the project or product on schedule and within budget.

Legion Solutions, Director of PMO, 2022

- Legion Solutions LLC is an engineering and construction company specializing in corrosion mitigation (cathodic protection), working primarily in the O&G sector.
- Responsible for the formation and implementation of a project management office (PMO) to provide project-related structure and support.
- As the organizational-transformation and improvement SME for the company, (b) (6) was responsible for working closely with key stakeholders to drive operational improvement and change initiatives.
- As portfolio manager, (b) (6) coordinated all projects, to include multiple critical-infrastructure projects for a major California utility.
- As the project manager, (b) (6) also managed complex, high-value, projects.

Corrpro, Construction Manager and Project Manager, 2016-2017

- As the Construction Manager, (b) (6) served as the functional head of the construction department, responsible for the management of 10+ project managers, admins, and construction personnel
- Served as the lead project manager for a $1M+ critical infrastructure project for a major utility, operating under tight quality, safety, and schedule constraints
- Working closely with the CEO, (b) (6) led a company-wide organizational-change initiative (which included personnel in the UK and Canada) to develop and implement a PMO and grow a formal project-management culture. As the recognized project-management SME, (b) (6) served as a key resource for the entire organization.

Roeslein, Project Manager, 2015-2016

- Project Manager for a global leader in the engineering, procurement, modular fabrication, and construction, of can-making and industrial plant facilities, employing the company's specialized approach – Prefabrication, Preassembly, and Modularization.

Layne Christensen, Project Manager, 2007-2012

- Responsible for the management of environmental, geotechnical, and water-production drilling projects throughout the US:
    - Geotechnical borings; environmental sampling and wells; water wells; cathodic-protection wells.
    - Rigs included mud and air-rotary; reverse circulation; dual-rotary; auger; coring; percussion; and direct-push.

(b) (6)
Electric Power Research Institute
(b) (6)

EDUCATION:

B.S., Electrical Engineering, University of Tennessee Knoxville, 2012

RESEARCH AND PROFESSIONAL EXPERIENCE:

EPRI, Engineer Scientist II, 2017 – Present.

Contribute to cyber security research for public benefit to help secure domestic and international power grids. Research in an independent, unbiased results based style and produce quality documentation of the findings. Research includes exploring new technologies, vulnerabilities and solutions to existing equipment and examining security gaps in network architectures.

- Served as a principal investigator and contributing author for Evaluation of SDN in Utility OT Networks deliverable (3002013403).
- Served as test bed lead and contributing investigator for Systems and Security Monitoring: KEPCO implementation of the IEC 62351-7 Standard deliverable (3002010587).
- Served as primary technical resource and tester on Integrating Cyber and Physical Security for Power Delivery Systems (An NEC Case Study) deliverable (3002010593).

Bristol Tennessee Essential Services (BTES), System Engineer, 2013 – 2017.

- Contributed to the delivery of high-quality services for this electrical utility, cable, phone, and Internet services provider by fulfilling a broad scope of project management and lead engineering roles related to system/equipment design, implementation, maintenance, upgrades/migrations, technical analysis, security, and optimization. Earned recognition for achieving cost savings, improving system quality, and designing/deploying products to expand service capabilities and generate new revenue for BTES.
- Served as Lead Engineer in upgrading a mission-critical tertiary generator ($200,000 + project), supporting BTES primary operations and data center that improved electrical power redundancy, allowed for future power upgrades, and reduced chances for system downtime.
- Functioned as Lead Engineer on a project that added standby generators at all substation Point of Presence sites, improving reliability and continuity of services during power outages.
- Selected as Primary Engineer on geo-redundancy planning for Meta-Switch Class 5 softswitch and installation project valued at nearly $1 million.

- Recognized for resolving security issues (passwords, sip authentication, fraud prevention, etc.) and adding automated fraud prevention solution that reduced fraud costs from $75,000 in 2013 to under $500 annually.
- Designed hosted VoIP template/recipes used in BTES Hosted Voice solutions that improved build/deployment efficiency and reduced time-to-market from 3 weeks to 7 days from receipt of customer order until implementation.
- Substantially reduced hardware costs by $2,000+ for each Hosted Voice solution that increased marketability and market penetration rates, resulting in a 300% increase in VoIP services over the past 30 months.
- Collaborated with Networks Supervisor in redesigning the IP Delivery Network that significantly increased customer phone system security and improved BTES's ability to diagnose and resolve technical issues.
- Provided customers with easy-to-use step-by-step instructions on use of telecom system functions by editing vendor documentation to align with BTES message and end-user instructional requirements.
- Completed a project that included evaluating VoIP call recording solutions, recommending the best option, and overseeing implementation, documentation, and training of staff on the new technology.
- Designed the new MDU triple play (cable, Internet & phone) bundled-services deployment template that was an entirely new product offering resulting in a significant competitive advantage in the marketplace.
- Designed SQL databases to streamline operations that were used for tracking/analyzing call patterns for multiple departments, and for automating audit consumer telephone services.
- Held a key role on additional projects including planning/designing the BTES Wi-Fi solution that currently blankets downtown Bristol; and redesigning/streamlining provisioning and 911 call routing.

Comcast, Maintenance Technician, 2002 – 2008.

- Provided comprehensive technical support, hardware upgrades, and troubleshooting, beginning in a Technical Support Specialist role and earning promotions into position as Maintenance Technician.
- Exceeded performance expectations on a regular basis by ranking Top 5 in production and Top 3 in lowest repeat percentage annually.

(b) (6)
Electric Power Research Institute (EPRI)
(b) (6)

EDUCATION:

Ph.D., Electrical Engineering, University of Minnesota, 2020
M.S., Electrical Engineering, University of Minnesota, 2014
B.Tech, Electrical Engineering, Veermata Jijabai Technological Institute, 2013

RESEARCH AND PROFESSIONAL EXPERIENCE:

EPRI, Engineer Scientist II & Engineer Scientist III, 2019 – Present.

- Developing an optimization tool for transmission expansion planning application to determine the location and size of new power flow controllers. Perform case studies to validate the models.
- Development of high-performance power system grid analysis tools using python.
- Provide general support with identifying issues/bugs with software and fixing them which involves using tools like Python, Cython, GitHub, C programming and Software Development.

Projects Delivered from 2019-2021:

- [CPLANET Software] Controlled Transmission Expansion Planning tool which explores various mathematical modeling and numerical optimization approaches for transmission expansion planning considering power flow control devices, transmission lines, smart wires and batteries.
- [VCA Software] Voltage Control Areas Studio is a versatile tool that can be used for various applications such as day-ahead var resource scheduling, offline studies to develop guidelines for Volt/var control and scheduling, identify reactive power deficiency in the system, etc.
- [GAT] Grid analysis toolkit is EPRI's steady state power flow analysis and optimization tool. The features include python-based architecture, modular flexible design, graphical user interface, performs AC and DC power flow, performs AC and DC optimal power flow, Contingency analysis. This tool is the foundation for many other projects at EPRI including CPLANET and VCA described earlier.

EPRI, Summer Researcher, 2018.

- Extend power network modeling capabilities of PFNET (Open Source Python Package) tool to handle items such as HVDC lines, voltage-dependent loads and FACTS devices.
- Perform model validations with commercial tools such as PSSE.
- Provide general support with identifying issues/bugs with software and fixing them which in- volved using tools like Python, Cython, GitHub, C programming and Software Development.

National Renewable Energy Laboratory, Summer Researcher, 2015, 2016.

- Investigated optimization and control techniques for networks of PV inverters in distribution systems.
- Developed a framework where networks of PV inverters can exchange relevant information through a communication network (Arduino and BeagleBoneBlack Microcontrollers).
- Formulating above approaches, such that it will be computationally affordable and can be implemented on microcontrollers embedded within PV inverters.

Siemens Infrastructure and Cities, Summer Intern, 2014, Part Time – Fall 2014.

- Investigated optimization and control techniques for networks of PV inverters in distribution systems.

AWARDS AND HONORS:

- 2021 – IEEE Power and Energy Society Prize Paper Award
- 2021 – IEEE Transactions on Power Systems Best Paper Award
- 2011 – 2013 Ratan Tata Trust Scholarship
- 2010 – 2013 Meritorious Performance Scholarship, VJTI

SELECTED PUBLICATIONS:

1. (b) (6) , "EPRI-CPLANET: Controlled Planning Expansion Tool with Corrective and Preventive Control", CIGRE, 2022 Grid of the Future Symposium, in proceedings.
2. (b) (6) , "EPRI- VCA: Optimal Reactive Power Dispatch Tool," 2022 IEEE Power and Energy Society General Meeting (PESGM), in proceedings.
3. (b) (6) . "Alter- nating Optimization Approach for Voltage-Secure Multi-Period Optimal Reactive Power Dispatch". IEEE Transactions on Power Systems. 2021 Dec 9.
4. (b) (6) "Dynamics-aware Continuous- time Economic Dispatch: A Solution for Optimal Frequency Regulation". Hawaii International Conference on System Sciences, pp. 1-10, Jan 2020.
5. (b) (6) , "Optimizing DER Participation in Inertial and Primary-frequency Response," IEEE Transac- tions on Power Systems, vol. 33, no. 5, pp. 5194-5205, Sept 2018.
6. (b) (6) , "Optimizing Power-frequency Droop Characteristics of Distributed Energy Resources," IEEE Transactions on Power Systems, vol. 33, no. 3, pp. 3076-3086, May 2018.
7. (b) (6) , "Optimal Regulation of Virtual Power Plants," IEEE Transactions on Power Systems, Aug, 2017.

(b) (6)
Electric Power Research Institute (EPRI)
(b) (6)

EDUCATION:

M.S., Telecommunications, University of Colorado at Boulder
B.S., Electrical Engineering, University of Nevada, Las Vegas, 1988

RESEARCH AND PROFESSIONAL EXPERIENCE:

EPRI, Principal Technical Leader, Information and Comms Technology, 2016 – Present.

- Researcher responsible for design, leading and executing research projects to address challenges faced by utilities in telecommunications.
- Author and contributor on numerous technical reports and white papers. See addendum.
- Project manager on supplemental research in emergency communications and resiliency.
- Originator and lead on a technology innovation project for investigating the feasibility and development of fiber optic primary power cable.

Black & Veatch, Senior Project Engineer, Telecommunications Division, 2010 – 2016.

- Technical specialist in the application of advanced concepts, principles, and methods in the field of telecommunications for utilities, public safety agencies and other private network clients.
- Completed numerous telecom master plans for a variety of utility clients.
- Lead project engineer on implementation projects of various sizes and complexity.

Westin Engineering, Senior Engineer, Telecommunications, 1998 – 2010.

- Conceptual design of SCADA and mobile radio systems.
- Master planning for utility telecommunications in support of infrastructure capital improvement program for a regional water utility.

JT3, LLC, Engineer, Sustainment, 2004 – 2006.

- Provided sustainment engineering relating to all areas of telecommunications in support of a remote test and training range.
- Developed a road map for deployment of additional fiber optic infrastructure.
- Researched, tested, and evaluated state of the art video compression solutions for transmission of real time camera feeds across an encrypted fiber optic network.
- Created documentation for existing microwave, and fiber optic infrastructure.
- Resolved DC power issues in a central office facility and eliminated grounding problems in field sites.

Nevada Power Company, Engineer, Communications, 1995 – 1998.

- Detailed design of communications facilities, equipment, and systems for secure and reliable voice and data communications and protective relaying.
- Executed RFPs for PBX and dispatch telephone systems.

- Developed network architecture with dual tandem PBX switches for added reliability of the internal private network.
- Performed role of owner's engineer and single point of contact for PCS-2 GHz incumbent microwave relocation project. This included development of the network plan and completion of the cost estimate for the replacement of 17 microwave links with a hybrid design consisting of SONET fiber ring upgrades, digital microwave, and other network additions.
- Produced detailed engineering design and construction documents for the Crystal 500KV transmission substation communications system consisting of a DC power plant, microwave radio links, SONET multiplexers, and OPGW fiber optic lines.

Sprint, Senior Engineer, Transmission Equipment, 1989 – 1995.

- Engineered and prepared design layouts records for special circuits which included local and access, voice and data, switched and non-switched.
- Utilized computerized operational support systems (OSS) for administration and inventory of circuits and equipment and various OAM&P systems for the provisioning of the network elements including digital cross connects and channel banks.
- Engineered data bridging solutions for customers with unique requirements; engineered the implementation of a VHF rural radio telephone system; and evaluated and selected CODEC equipment for the transmission of program audio circuits.

AWARDS AND HONORS:

- EPRI Performance Recognition Award for:
  - Support of ESCC Resilient Communications Working Group, 2018
- Westin Presidential Excellence Awards for:
  - Project management on Telecommunications Systems at SNWA, December 2003
  - SNWA WAN, December 2000

SELECTED PUBLICATIONS:

- Strategic Fiber Guidebook (Dec 2022)
- Wide Area Network (WAN) Modernization Guidebook (Dec 2022
- FirstEnergy 6 GHz Additive Interference Study (Oct 2022)
- Private Long-Term Evolution Guidebook (Dec 2021)
- Teleprotection over Packet Guidebook (Dec 2019)
- Telecom Standards Guidebook (Oct 2019)
- Communications Connectivity Technology Newsletter, 11th Issue (Oct 2019)

SYNERGISTIC ACTIVITIES:

- Institute of Electrical and Electronics Engineers (IEEE)
  - IEEE Member, 35 years
  - IEEE Power & Energy Society, 6 years
  - IEEE Standards Association, 3 years
- American Radio Relay League (ARRL)
  - FCC Amateur Radio license K7COM

(b) (6)
Electric Power Research Institute (EPRI)
(b) (6)

EDUCATION:

MS, Energy Systems, University of Alberta, Edmonton, AB, 2020
BS, Electrical (Power) Engineering, University of Saskatchewan, Saskatoon, SK, 2013

RESEARCH AND PROFESSIONAL EXPERIENCE:

EPRI, Technical Leader – Protection, Jan 2022 – Present.

- Worked on a project of EMT protection relay modeling for transmission lines
- Reviewed the existed 12 kV and 35 kV protection standards for ComEd and provided feedback to update the standards in order to accommodate Distribution Energy Resources

Stantec Consulting, Senior Electrical Engineer, 2018 – 2022.

- Prepared logic diagrams for 69, 138, 230 and 500 kV transmission lines for ring bus and breaker and half substations using SEL-411L and SEL-421 protection relays for PPL Electrical Utilities
- Performed coordination studies for 69 kV & 230 kV transmission lines using Cape, prepared protection calculation sheets and relay settings files for PPL Electrical Utilities
- Performed equipment duty study for Enbridge 138:6.9 kV substation for the addition of 20 MW generation using SKM software.
- Prepared IEC-61850 GOOSE setting files for GE F35 and N60 protection relays for Suncor Fort Hills Load Shed scheme upgrade
- Prepared protection and control philosophy for University of British Columbia 69:12.47kV secondary selective substation
- Performed connection impact studies and prepared PDUP packages for Penekoam wind farm, Airdrie solar farm, Neutrien Cogen facility, and IPL Cogen facility
- Prepared PSS/E dynamic models for two different solar farms for Saskpower
- Performed load flow, short circuit, harmonic, arc flash and coordination studies for different solar farms to meet Fortis AB interconnection requirements
- Performed short circuit, protection, coordination, and arc flash studies for Manitoba Hydro KCS substation, DC excitation system for 4 X 250MVAR synchronous condenser at RCS substation and TransAlta KH3 Wind farm
- Performed breaker transient recovery voltage (TRV) study as per the system operator's specification for EL Smith solar farm and Enbridge Cogen facility in EMTP-RV
- Performed temporary overvoltage studies (TOV) for different solar farms to meet the connection requirements of the grid operator using PSCAD

SEL Engineering, Specialist II – Protection, 2017 – 2018**.**

- Reviewed the existing 115KV transmission line protection settings for Public New Mexico Utilities and recommended solutions to rectify coordination and relay setting issues
- Prepared logic diagrams, control schematics, relay protection settings, relay settings reports, and transfer trip schemes using IEC61850 GOOSE and Mirrored Bits protocol
- Tested relays and automatic synchronization schemes using Doble primary injection and SEL's secondary injection test sets and participated in the factory acceptance test (FAT) of protection & control system for Metro Vancouver
- Reviewed breaker control schematics, wiring diagrams, automatic transfer scheme logics, and performed transfer trip timing tests for GOOSE and Mirrored Bits protocol

Dynamo Electric, Electrical Engineering in Training, 2016 – 2017.

- Performed load flow studies, short circuit analysis, coordination studies, arc flash studies on systems up to 138KV, and prepared technical reports
- Prepared relay protection settings, control schematics, and wiring diagrams, protection philosophies and reports, and programmed protection relays
- Reviewed relay test results, tested relays, and participated in testing and commissioning of substations

Keywest Projects, Junior Electrical Engineer, 2013 – 2016.

- Prepared complete electrical engineering drawing construction packages for multi-million-dollar Pembina Pipeline Corp., Encana Corp., Bellatrix Exploration, Progress Energy, and Apache Canada Ltd. Projects
- Performed power system short circuit, load flow, arc flash, and harmonic studies
- Reviewed vendor designs and ensured their compliance with Keywest and client standards, and the Canadian Electric Code
- Developed single line drawings, motor control schematics, VFD control schematics, wiring drawings, loop drawings, junction box layouts, panel schedules, and power equipment datasheets
- Upheld project schedules and kept track of budget for successful completion of projects

(b) (6)
Electric Power Research Institute (EPRI)
(b) (6)

EDUCATION:

Ph.D., Electrical Engineering, Arizona State University, 2016
M.S., Electrical Engineering, Arizona State University, 2013
B.Tech., Electrical Engineering, Malaviya National Institute of Technology, 2007

RESEARCH AND PROFESSIONAL EXPERIENCE:

EPRI, Senior Engineer/Scientist III, (now Technical Leader), 2016 – Present.

- (b) (6) manages and conducts engineering studies on various issues including the integration of variable renewable generation, development of load and variable generation models, frequency response, and contingency analysis in bulk power systems.

Arizona State University, Research Associate, 2013 – 2016.

- (b) (6) doctoral research focused on the development of tools for efficient power system analysis.

Arizona State University, Research Assistant, 2011 – 2013.

- (b) (6) worked on a DOE-funded project intended to study the impact of high penetration of photovoltaic generation on distribution systems.

Siemens Energy, India, Executive Engineer, 2007 – 2011.

- (b) (6) was a part of the protection and control group and worked on numerous projects involving construction and designing of high to medium voltage substations.

PUBLICATIONS:

1. (b) (6), "Load sensitivity studies in power systems with non-smooth load behavior," IEEE Tans. on Power Sys., vol. 32, no. 1, Jan 2017.
2. (b) (6), "A systematic approach to n-1-1 analysis for power system security assessment," IEEE Power and Energy Tech. Systems Journal, vol.3, no. 2, June, 2016.
3. (b) (6), "Role of sensitivity analysis in load model parameter estimation," Accepted for publication in the IEEE PES General Meeting, Chicago, Il., Jul. 2017.
4. (b) (6), "Reactive power markets, a possible future?" *Proc. IEEE North American Power Symposium,* Kansas City, KS., 2013.
5. (b) (6), "The impact of distributed photovoltaic generation on residential distribution systems," *Proc. IEEE North American Power Symposium,* Urbana-Champaign, Il., 2012.

SYNERGISTIC ACTIVITIES:

- Reviewer of IEEE Transactions on Power Systems, Power Delivery, and Sustainable Energy
- Reviewer of IEEE Power Energy Technology Systems Journal
- Member of NERC Load Modelling Task Force
- Member of WECC Load Modelling Task Force

(b) (6)
Electric Power Research Institute (EPRI)
(b) (6)

EDUCATION:

Hotel and Restaurant Management, Centro de Estudos Turísticos e Hoteleiros, Brazil, 1997
BS in Tourism, Pontifícia Universidade Católica do Rio Grande do Sul, Brazil, 1995

RESEARCH AND PROFESSIONAL EXPERIENCE:

EPRI, Project Operations Coordinator, 2021 – Present

- Work in conjunction with Project Managers providing administrative and business support from project planning to completion, coordinating and disseminating project information to stakeholders, monitoring and reporting costs, results, and time sensitive deadlines.

EPRI, Financial Analyst / Finance Supervisor, 2013 – 2021

- Prepared quarterly forecasts and annual budgets for EPRI US and its international subsidiaries. Reported monthly results to senior management identifying risks and opportunities. Worked closely with the technical team on project management. Provided support to controller and guidance to staff.

CB&I, Federal Billing / Assistant Supervisor, 2003 – 2013

- Monitored government projects' financial activities in conjunction with project controls team. Prepared invoices to government agencies such as DOE and DOD while ensuring compliance to DCAA requirements. Served as senior resource to staff providing training and guidance.

Crowne Plaza Resort HHI, Income Auditor / Accounts Payable, 2002 – 2003

- Audited all revenue generating departments daily. Reconciled Point of Sales system and Property Management system, allocating revenue to appropriate departments. Processed invoices, expense reports and PCard for payment.

(b) (6)
Electric Power Research Institute (EPRI)
(b) (6)

EDUCATION:

M.S., Electrical Engineering, Power Systems, Mississippi State University, 2002
BTech, Electrical & Electronics Engineering, Jawaharlal Nehru Technological University, 1999

RESEARCH AND PROFESSIONAL EXPERIENCE:

EPRI, Senior Project Engineer/Scientist, Grid Operations and Planning, 2010 – Present.

- (b) (6) is a Senior Project Engineer/Scientist at the Electric Power Research Institute (EPRI). Her current research activities focus on developing a framework to balance reliability and economics in transmission planning using Value Based planning philosophy. The purpose of the project is to provide transmission planner with a framework in making system project scoping/plan decisions. The framework uses Expected Unserved Energy as the reliability measure and the project construction cost as the economic measuring while comparing the reliability and economics aspects of a project. The project uses EPRI's TransCARE to determine the EUE costs.
- (b) (6) is also working with a team of 2 on projects that are looking at ways to improve distribution systems efficiency (lowering and managing loses) as much as economically feasible. This project is a field demonstration on a handful of circuits converted to Green Circuits through various loss reduction methods to determine if losses can be reduced significantly. Loss-reduction approaches could include optimal var reduction using switched capacitors, voltage control, targeted equipment changes (efficient transformers), and targeted design changes (re-conductoring or reconfiguring). This project will advance upon the field demonstrations ongoing with the North West Energy Efficiency Alliance and their Distribution Efficiency Initiative.
- (b) (6) working with a team of 3 on "Measurement-based Voltage Stability Monitoring and Control", which is able to continuously calculate the voltage stability margin with respect to the power transferred to a load center area, using measured voltage and current waveforms at the substation level.
- Worked with a team of 3 on proposing a methodological framework for evaluating the benefits and costs of transmission projects that improve transmission efficiency and utilization without diminishing reliability. The proposed 8 step methodology for benefit assessment would provide a valuable perspective to all stakeholders involved in transmission planning, operations, and ownership.
- Worked in a project (a team of 3) which was looking at different storage technologies to increase transmission capability. The goal of the project was to examine the technical feasibility and assess the potential benefits of the utilization of storage technologies to increase transmission capability of transmission networks.

ITC Holdings Corp, Senior Engineer, System Planning, Transmission Planning, 2008 – 2010.

- Developed plans for the bulk transmission system plan to assure adequate capability and performance to meet future load growth
- Conducted near term and long-range transmission planning assessment studies to define annual capital plans and system improvement projects and to meet Midwest ISO (MISO) requirements for reliability assessments.
- Represented ITC Planning department in MISO Midwest Transmission Expansion Planning (MTEP) discussions in regional and sub-regional working groups of the MISO.
- Lead the effort in preparing documentation for infrastructure improvement projects for MISO MTEP approvals.
- Provided analyses and technical assistance to System Operations, as required, for resolution of operating problems.
- Represented ITC Planning department at local township meetings for township and county planning commission approvals for ITC projects (station site and land rights acquisitions).

Interconnections, Engineer, 2007 – 2008.

- Performed planning studies and developed plans required for a new interconnection (transfer studies, network interconnections or generator interconnections – wind farms and synchronous machine plants)
- Communicated and coordinated the studies with the interconnection requesting Party/Parties
- Played lead role in a team of 3 members in building a user-friendly planning analysis MS database tool which interacted with PTI MUST to automate the process of performing various planning studies.

Interconnections, Engineer, 2007 – 2008.

- Performed planning studies and developed plans required for a new interconnection (transfer studies, network interconnections or generator interconnections – wind farms and synchronous machine plants)
- Communicated and coordinated the studies with the interconnection requesting Party/Parties
- Played lead role in a team of 3 members in building a user-friendly planning analysis MS database tool which interacted with PTI MUST to automate the process of performing various planning studies.

Michigan Electric Transmission Co. LLC, Planning Engineer I, 2004 – 2007.

- Performed planning studies and developed plans required for new interconnection requests (transfer studies, network interconnections or generator interconnections – wind farms and synchronous machine plants)
- Communicated and coordinated the studies with the interconnection requesting Party/Parties
- Performed the annual off-site power supply study for a nuclear power plant (steady state and transient stability).

(b) (6)
Electric Power Research Institute
(b) (6)

EDUCATION:

B.S., Materials Science and Engineering, Case Western University, 2005

RESEARCH AND PROFESSIONAL EXPERIENCE:

EPRI, Engineer III/Senior Technical Leader, Fossil Materials & Repair, 2013 – Present.

- Lead materials science research projects in power generation areas focused on steam and gas turbine materials degradation, life management, field heat treatment, and processing. Projects range from ~$50k to ~$500k and may include collaboration with government agencies and national labs, external contractors, and internal resources.
- Coordinate and manage relationship with utility members directly including communication, site visit, presentations at large meetings and conferences, and one-on-one meetings related to general industry topics down to site-specific issues. These presentations also include ~10 formal and informal webcasts.
- Developed and critically evaluated non-standard mechanical testing methods at in-house laboratories. Trained and mentored younger staff in the proper operation of these test methods. Coordinated these results with external labs, such as research universities, and promoted the test methods for standardization.
- Presented at national and international conferences EPRI research of my own as well as standing in on related projects as needed.

GE Energy, Engineer/Lead Engineer, Materials and Processes Engineering, 2005 – 2013.

- Managed and tracked up to $2M per year for mechanical testing and microstructural characterization of cast, wrought, and welded advanced steels and superalloys consistently delivering on-schedule and on-budget
- Assisted steam turbine and generator design teams in materials selection across all components, application temperatures, and manufacturing processes through characterization and analysis
- Provided metallurgical guidance for the development of fatigue, creep, and fatigue-creep interaction lifing models for steam turbine components including a microstructure and nitride evolution model for predicting creep strain
- Performed fracture and failure analysis of steam turbine and generator components
- Created and implemented efficiency-increasing and cost-reducing technologies in steam turbine, gas turbine, and wind turbine products by leveraging innovations from other businesses and other industries
- Mentored both junior and senior engineers' metallurgy, project management, and process improvement (including traditional quality)
- Authored over seventy internal reports, process specifications, and patent applications

CWRU, Department of Materials Science and Engineering Research Assistant, 2004 – 2005.

- Developed thermodynamics equations to model solubility of carbon and nitrogen in steels
- Modeled carbide precipitation and growth kinetics in carbon supersaturated austenitic steels
- Assisted with the publishing of journal articles and symposia presentations

AWARDS AND HONORS:

- Chauncy Award – September 2017 – EPRI
- Engineering Award for Manufacturing Technology – February 2011 – GE Energy
- Direct Materials Productivity Project of the Month Award – September 2009 – GE Energy
- Contributor to eight pending patents – GE Energy

(b) (6)
Electric Power Research Institute (EPRI)
(b) (6)

EDUCATION:

MS, Electrical Power Engineering, Rensselaer Polytechnic Institute, Troy, New York, 1997
BS, Electrical Engineering, Cornell University, Ithaca, NY, 1990

RESEARCH AND PROFESSIONAL EXPERIENCE:

EPRI, Technical Executive, Integration of DER, 2018 – Present.

(b) (6) is involved in distributed energy resource (DER) integration, working primarily on improving the modeling and simulation aspects of DER integration and understanding how autonomous and managed DER capabilities impact distribution systems.

GE Energy Consulting, Managing Director (Software Product Manager), 2007 – 2018.

- Responsible for GE Energy Consulting's software business and a team of power system engineers and software developers.
- Led the strategic direction of product development, sales and marketing, annual user group conferences, research and development efforts, and consulting engagements.

DSTAR, Program Manager, 2002 – 2007.

- Led the DSTAR (www.dstar.org) research organization and completed numerous electric distribution research projects.
- Worked closely with over 15 utility customers to develop scopes and complete complex engineering research.
- Developed a variety of engineering software tools to enable utility engineers to complete their jobs more efficiently.
- Performed resource allocation and financial reporting to end customers.

PUBLICATIONS:

1. (b) (6), "Evaluating the value of DERMS: Methods and Mitigation to increase feeder hosting capacity", 2019 CIRED International Conference, June 2019
2. (b) (6), "DER Flexible Interconnection Framework and Case Study", 2019 CIRED International Conference, June 2019
3. (b) (6), "The impact of geomagnetic disturbances on power system voltage and reactive power reserves: a comparative study considering uniform and non-uniform E-fields," CIGRE US National Committee 2013 Grid of the Future Symposium.
4. (b) (6), "Evaluating Cloud Computing Techniques for Smart Power Grid Design Using Parallel Scripting." 10.1109/CCGrid.2013 26.
5. (b) (6). (2005). "Using a probabilistic design process to maximize reliability and minimize cost in urban central business districts." 1 - 5. 10.1049/cp:20051368.

(b) (6)
Vermont Electric Power Company, Inc. (VELCO) | Power Utilities
(b) (6)

EDUCATION:

B.S., Business Finance, Skidmore College, 2000

RESEARCH AND PROFESSIONAL EXPERIENCE:

VELCO, Manager, Communications and Strategy, 2019 – Present.

- Providing leadership to VELCO teams advancing critical diversity, equity, and inclusion initiatives, innovation initiatives, and strategic policy initiatives
- Engaging with stakeholders to promote no-regret investments in transmission infrastructure
- Preparing communications for internal and external corporate leadership

Green Mountain Power (GMP), Director, Business Innovation | 2018 – 2019.

- Engaging with business customers and town personnel to promote energy transformation as an economic development tool
- Leading the implementation of innovative programs to transform the way commercial customers use energy
- Preparing presentations for use at Board of Director meetings and the Legislature

Energy Innovation Center, Director / Member of the GMP Leadership Team, 2013 – 2018.

- Led the implementation of innovative programs to transform the way Vermonters use energy in their homes -- saving money, increasing comfort and reducing carbon
- Managed a team of 8 staff members
- Empowered staff development through engagement, accountability, and communication
- Participated in weekly strategy meetings as a member of the leadership team
- Prepared presentations for use at Board of Director meetings, the Department of Public Service and the Public Utility Commission
- Provided data for testimony and drafted answers to discovery questions for rate cases
- Created web content to advance the messaging of GMP's residential energy transformation offerings
- Managed $7 million multi-faceted budget including capital projects and O&M expenses
- Strengthened community relationships and engaged stakeholder groups

PROFESSIONAL, INSTITUTIONAL APPOINTMENTS:

1. Rutland Redevelopment Authority (RRA), Secretary, 2015 - Present
2. Vermont Symphony Orchestra, Governing Board of Directors, 2015 - Present
3. Rutland Young Professionals, Governance Committee Member, 2014 - Present

(b) (6)
Vermont Electric Power Co., Inc. (VELCO) | Electric Transmission Utility
(b) (6)

EDUCATION:

University of Michigan Law School, J.D., *cum laude* (Dec. 1995)
M.A., East Asian Studies, Yale University, University and Cheng Lee Fellow (May 1993)
B.A., Chinese Literature, Yale College, cum laude and with distinction in the major (May 1991)

RESEARCH AND PROFESSIONAL EXPERIENCE:

VELCO, Senior Vice President and Chief Operating Officer, 2022 – Present.

Oversee all field, engineering, planning and operations functions and cross-functional strategy team for this electric transmission utility with $220 million in annual revenue.

Franklin Energy, Head of Strategy and General Counsel, 2020 – 2022.

Led planning and implementation of growth strategy for this energy services company with $300 million in annual revenue after recent acquisition by private equity firm Abry Partners.

VELCO, General Counsel, Chief Compliance Officer & Corporate Secretary, 2016 – 2020.

Served as chief legal officer overseeing Legal, Company Secretary, Human Resources and Compliance Departments at Vermont's electricity transmission company and state-wide system operator.

Office of Attorney General Maura Healey, Boston, MA. Deputy Attorney General, 2015 – 2016.

Appointed by and reporting directly to the Attorney General to oversee approximately 250 Assistant Attorneys General and staff in the Criminal Bureau and the Public Protection and Advocacy Bureau that include fraud and financial services, public integrity, cybercrimes, gaming enforcement, human trafficking, appeals, enterprise and major crimes, data privacy, consumer protection, insurance and unemployment fraud, civil rights and fair labor divisions. Provided direct counsel to the Attorney General on all significant legal and strategic priorities across the office. Served as chief administrative officer overseeing human resources and information technology departments.

National Grid USA, Senior Vice President of Regulation & General Counsel, 2009 – 2015.

Oversaw US legal and regulation team of approximately 180 professional and support staff, including approximately 70 attorneys and 80 regulation and pricing analysts. Major legal practice areas included finance and securities, mergers and acquisitions, federal and state energy regulatory and compliance, litigation, environmental, real property, labor and employment, and commercial transactions. Also served as Corporate Secretary, FERC Chief Compliance Officer and Chair of the U.S. Regulatory Compliance Committee and the U.S. Business Conduct Committee of the NGUSA Board of Directors. Drove down budget by 15% while adding 20% headcount at 47% female and 35% people of color.

ACADEMIC, PROFESSIONAL, INSTITUTIONAL APPOINTMENTS:

1. **Champlain College**, Burlington, VT. *Member (volunteer), Board of Trustees*, July 2018-present.
2. Serve as Vice Chair of the Board and past Chair of the Financial Sustainability Committee.
3. **Regulatory Assistance Project**, Montpelier, VT. *Member (stipend waived), Board of Directors,* June 2022-present. Serve on Board and Finance Committee for this energy advisory firm to policy makers globally.
4. **NEFCU IT Committee**, South Burlington, VT. *Member (volunteer), Board IT Committee,* March 2023-present. Serve on Board IT Committee for this credit union.

(b) (6)
Vermont Electric Power Company, Inc. (VELCO) | Power Utilities
(b) (6)

EDUCATION:

Bachelor of Science, Electrical Engineering, Northeastern University, 1989
Master of Business Administration, University of Oregon, 1999

RESEARCH AND PROFESSIONAL EXPERIENCE:

VELCO, Manager of Project Management, 2018 – Present.

- Provides leadership and direction to the Project Management Team in the execution of all aspects of VELCO capital projects.
- Supervises staff and contractors to ensure the successful performance of work in accordance with project plans and company requirements.
- Develops work plans and schedules to effectively manage projects assigned to the Project Management Team.
- Plans for, budgets, coordinates and manages work necessary to support the goals of the team and the company.
- Oversees and assists in the development of systems, processes and tools necessary for the success of the team and the company as a whole.
- Develops and leads knowledge sharing and training for the Project Management Team; including personal development and technical training in support of VELCO's succession management expectations.
- Develops annual capital budgets and directly support the forecasting and capital budget management effort.
- Manages the successful execution of projects, as necessary, in accordance with the project scope, schedule and budget.

Connecticut River Valley Project (CRVP), Program Manager, 2015 – 2018.

- Provides leadership and direction to the project team in the execution of all aspects of the CRVP.
- Responsible for the schedule, scope management and financial performance of the CRVP.
- Responsibilities include: Preparing statements of work, capital budgets, financial forecasts, development of bid documents, facilitation of design, commissioning plans, management of contracts, interface with other utilities, project status reports and project close out documentation.

Manager of Engineering, 2010 – 2015.

- Provided leadership and direction to the Electrical and Civil Engineering Departments in the design and support of VELCO's substation and transmission facilities.
- Managed the procurement, coordination and scheduling of contracted engineering firms performing design and testing services for VELCO.

- Responsible for regulatory compliance regarding the National Electric Safety Code and certain requirements of the North American Electric Reliability Corporation (NERC).
- Responsible for the specification and procurement of all major equipment and materials such as power transformers, reactors, and capacitors.
- Performs Root Cause Investigations for incidents involving system mis-operations.
- Developed and implemented a corporate commissioning process to ensure that new projects are constructed according to design and are functionally correct prior to being put into service

PROFESSIONAL, INSTITUTIONAL APPOINTMENTS:

1. Registered Professional Electrical Engineer in the State of Vermont (License #018-000(b) (6)

(b) (6)
Vermont Electric Power Company, Inc. (VELCO) | Power Utilities
(b) (6)

EDUCATION:

Master of Business Administration, Boston College, 2001
M.S., Power Systems, Northeastern University, 1991
B.S., Electrical Engineering, Northeastern University, 1989

RESEARCH AND PROFESSIONAL EXPERIENCE:

VELCO, 2008 – Present.

Director of Transmission System Planning, 2022 – Present.

Manager, System Planning, 2018 – 2022.

Principal, System Planning, 2015 – 2018.

Team Lead, System Planning, 2008 – 2015.

- Prepare the triennial 20-year long range plan and conduct the public review process for the plan
- Prepare annual transmission study work plans
- Perform load flow and stability studies, using the GE PSLF software and SIEMENS PTI PSS/E software, to evaluate the effects of proposed projects on the New England system performance of the local Vermont system ability to proceed with planned transmission outages system conditions that could require under-voltage load shedding operation
- Determine transfer limits into and out of Vermont
- Represent VELCO on the Vermont System Planning Committee and its subcommittees, the Northeast Power Coordinating Council Reliability Coordinating Committee, New England Power Pool transmission and stability task forces, the Reliability Committee, and other regional planning committees
- Testified in support of transmission reinforcement projects

PROFESSIONAL, INSTITUTIONAL APPOINTMENTS:

1. VELCO Representative, ISO-NE Reliability Committee
2. VELCO Representative, NPCC Reliability Coordinating Committee

(b) (6)
Vermont Electric Power Company, Inc. (VELCO) | Power Utilities
(b) (6)

EDUCATION:

Bachelor of Science, Computer Engineering, Vermont Technical College, 2002

RESEARCH AND PROFESSIONAL EXPERIENCE

VELCO, Principal Engineer, 2015 – Present.

- Continued involvement, support and training in previous engineering areas
- NERC CIP, OT SME – In concert with IT, livened the engineering side of NERC CIP compliance program
- System integration for relay targets into Operations, new PI data path and associated data/analytics programs that are being built out and expanded today

VELCO, Electrical, Systems Engineer, 2002 – 2015.

- Continued work on the Facility Ratings System and trained others in its use and administration
- Design/Performed/Managed D25 SCADA RTU programming, SCADA telemetry, Watt-hour metering and integration with MV90, Digital Fault Recorders, Substation Protection and control design.
- Power Transformer, Subject Matter Expert – Specification, Technical/Commercial evaluation, Design Review, Inspection & Witness Testing
- HVDC/FACTS/Sync. Cond., SME – Key contributor to specification, evaluation, design/study, Fundamentals of operation, testing & commissioning of systems (Granite Synchronous Condensers, Highgate HVDC controls replacement, Essex Statcom replacement and Ascutney SVC)

VELCO, Planning and Electrical Intern, 2001 – 2002.

- Developed *VELCO's* Facility Ratings System

PROFESSIONAL, INSTITUTIONAL APPOINTMENTS:

1. IEEE PES Chapter Outstanding Engineer Award, Green Mountain Section, 2015
2. IEEE PES Chapter Chair, Green Mountain Section, 2016 & 2017
3. IEEE Senior Member, 2017
4. IEEE PES Chapter Outstanding Chapter Volunteer Award, Green Mountain Section, 2018

(b) (6)
Vermont Electric Power Company, Inc. (VELCO) | Power Utilities
(b) (6)

EDUCATION:

A.S., Vermont Technical College, Electrical and Electronics Engineering, 1989

RESEARCH AND PROFESSIONAL EXPERIENCE:

VELCO, Construction Manager, 2014 – Present.

- Responsible for all construction capital project activities

Green Mountain Power (GMP), Manager, Resource Scheduling, 2012 – 2014.

- T&D Capital Project planning and Resource Allocations
- Electric Service Outage Management restoration and planning
- Mutual Aid management

(b) (6)
Vermont Electric Power Company, Inc. (VELCO) | Power Utilities
(b) (6)

EDUCATION:

B.S., Environmental Science, Unity College, 2000

- Certified Professional in Erosion Prevention and Sediment Control
- OSHA 40 Hour HAZWOPER Incident Command System at 100,200 & 402 levels
- CPR/First Aid and Wilderness First Responder
- Stevens Advanced Driver Training
- Boating Certificate-National Association of Safe Boating

RESEARCH AND PROFESSIONAL EXPERIENCE:

VELCO, Environmental and Fleet Manager, 2006 – Present.

- Oversight, scheduling, data management, review, and submittals associated with environmental and cultural resource assessments, State and Federal permitting, environmental compliance, spill response, hazardous waste site remediation, agency reporting, and HAZWOPER, SPCC, and general environmental trainings.
- Environmental lead for PV-20 Cable Replacement, which included the replacement of seven oil filled submarine cables with four new submarine cables crossing Lake Champlain, construction of two new terminal stations (one in VT and one in NY), overhead transmission line modifications to connect the new stations with the existing overhead lines, and the decommissioning of pre-existing cables and terminal stations.

(b) (6)
Smart Wires Inc.
(b) (6)

EDUCATION:

Dartmouth College, Engineering Management, MEM, 2017
Universidad de Montevideo, Electromechanical Engineering, Master's Degree, 2017
Lean Six Sigma Green Belt Certified

RESEARCH AND PROFESSIONAL EXPERIENCE:

Smart Wires, 2017 – Present.

General Manager – Americas, 2022-Present.

- Regional Director for the Americas region (North, Central, and South America.

Commercial Manager – Latin America, 2018-2022.

- Lead Smart Wires commercial activity in Latin America driving over 50% year to year growth each year.
- Managed customer satisfaction through project execution.
- Engaged with customers to understand business needs and opportunities for Smart Wires technology to solve a variety of challenges facing the utility industry.

Strategy & Business Development, 2017-2018

- Worked on technical sales activities with utilities in the US, Spain and Latin America. Directly engaged in technical and strategic interactions with clients for multi-million-dollar deals
- Day-to-day collaboration with C-level management on strategic projects regarding sales, international expansion, business development and project execution
- Co-lead Smart Wires expansion into Latin American markets such as Colombia, Mexico, Chile, Argentina and Brazil
- Co-lead EU-funded FLEXITRANSTORE implementation of the first deployment of mobile power flow control in the world in Greece and Bulgaria

Navigant, Energy Consultant, 2017

BERKES, Project Engineer, 2015-2016.

Pintado Wind Farm, Engineering Associate, 2015.

Bioner S.A Biomass Co-generation power plant at Urufor, Engineering Associate, 2015.

Tracoviax S.C., Quality Engineer, 2012-2014.

(b) (6)
Smart Wires Inc.
(b) (6)

EDUCATION:
Washington State University, Civil Engineering, BS, 2011
Whitworth University, Applied Physics, BA, 2011

RESEARCH AND PROFESSIONAL EXPERIENCE:

Smart Wires, Senior Director of Engineering, 2019 – Present.

Oversee and directed all engineering efforts for deployment of Smart Wire's static synchronous series compensator devices around the globe. Contracted, managed, and reviewed work of numerous sub consultants to support all aspects related to deployment for successful installation of numerous projects. Collaborated with multidisciplinary teams to successfully install complex and diverse projects in substations and on transmission lines. Interface with utilities to provide design, installation, and constructability assurance.

A2Z Engineering, Project Manager, 2013 – 2019.

Project manager facilitating all aspects of the engineering process from finding clients, proposal writing, engineering, drafting, submittals, and billing. My responsibilities working with the private sector have made me very versatile in the entirety of the engineering process, stating with communications to win projects and build relationships with clients, understanding business strategy and the building market to competitively price engineering services, performing engineering analysis and design to current code requirements, and supplying a professional and complete design package. Proficient at civil engineering design including storm water, wastewater, site development and water system design, as well as structural engineering including high-end residential and light commercial.

Nomad GCS, Design Engineer, 2012 – 2013.

Designed custom and complex trucks or trailers for first responders, military, fire, and police. Nomad is a custom shop that builds all their own designs which allowed me to work directly with the production floor to efficiently troubleshoot or optimize intricate design challenges involved in each build. Designed for efficient builds, provided experience in thinking through the manufacturing process during a design. Interfaced with clients to provide technical expertise to support the sales team and ensure their confidence in our product was high.

Black & Veatch, Civil Engineer, 2011 – 2012.

Design engineer on high voltage transmission line team to model, analyze, and design transmission lines for key clients including Pacific Gas & Electric, PacifiCorp, and Portland General Electric. Performed structural analysis on steel and wood structures for reconductor projects and new construction. Collaborated with electrical engineers, drafters, construction teams, environmental companies, and geotechnical firms to complete multimillion dollar contracts.

(b) (6)
Smart Wires Inc.
(b) (6)

EDUCATION:

MPhil, Engineering for Sustainable Development, University of Cambridge, 2020
BEng, Biomedical Engineering, University of Guelph, 2018

RESEARCH AND PROFESSIONAL EXPERIENCE:

Smart Wires, Business Development Associate, 2021 – Present.

- Collaborate with North American utilities, governments, and trade associations to implement Grid Enhancing Technology
- Authored a report to quantify the GHG-reduction potential of Grid Enhancing Technologies in 7 Canadian markets by 2030.

Hydro Ottawa, Engineering in Training, 2018 – 2019.

- Developed 7 business cases to request $35M from the Ontario Energy Board for asset renewal programs from 2021-2025
- Prepared monthly reliability reports to summarize the performance of 49,000 assets and prioritize future capital projects.

Veteran's Affairs Canada, Student Historical Interpreter, 2017.

- Delivered over 500 dynamic historical presentations in English and French to 10,000 visitors of 14 nationalities.

(b) (6)
Smart Wires Inc.
(b) (6)

EDUCATION:

M.S., Civil and Environmental Engineering, Stanford University, 2017
B.S., Mechanical Engineering, University of Maryland, 2012

PROFESSIONAL EXPERIENCE:

Smart Wires, Director of Business Development, 2016 – Present.

- Lead federal and state policy and regulatory efforts to create and improve market dynamics that support commercial goals.
- Develop and execute strategy for engaging stakeholders and participate in funding opportunities that facilitate commercial project success.
- Chair the Working for Advanced Transmission Technologies (WATT) Coalition, a 501c(6) nonprofit trade association for Grid Enhancing Technologies, focused on federal regulator lobbying and industry education.

Calstart, Associate Project Manager, 2013 – 2015.

- Conducted field testing of advanced technology commercial vehicles, contributing major component sections to public-facing technical reports, market commercialization roadmaps, and white papers.

(b) (6)
Smart Wires Inc.
(b) (6)

EDUCATION:

PhD, Electrical Engineering, North Carolina State University, Raleigh, 2015
M.S., Electrical Engineering, North Carolina State University, Raleigh, 2011
B.A., Physics (Honors), Kalamazoo College, Kalamazoo, 2009

RESEARCH AND PROFESSIONAL EXPERIENCE:

Smart Wires, Sr Director of Analytics, 2019 – Present.

- Grew a high performing globally distributed team of power system and software engineers from 4 to 25+ in three years.
- Founded Smart Wires Analytics consulting services business with its own P&L with nearly $1.5M in annual revenue in 2022.
- Expanded team impact from power system planning and automation to also include power electronics product and controls evaluation, development, and testing.

MIT, Postdoctoral Associate, 2015 – 2016.

- Led an innovative project developing transactive control–using markets as a control signal–for combined heat and power microgrids energy management systems.
- Developed a novel framework to evaluate resilience of interconnected natural gas and electric power grids.
- Won NSF EAGER award to study resilient human-machine automatic control systems worth $300k over three years.

North Carolina State University, Research Assistant, 2011 – 2014.

- Developed novel real-time disturbance localization algorithms in wide-area power grids using the algebraic graph theory, resulting in two journal publications.

vermont electric power company
VELCO

366 Pinnacle Ridge Road
Rutland, Vermont 05701
802.773.9161 ▪ velco.com

March 16, 2023

(b) (6)
[redacted]
Electric Power Research Institute (EPRI)
942 Corridor Park Blvd., Knoxville TN 37922

Subject: Letter of Commitment for the Electric Power Research Institute, Inc.'s (EPRI) Proposal in Response to DE-FOA-0002740 "Bipartisan Infrastructure Law Section 40107. Grid Resilience and Innovation Partnerships (GRIP)" Topic Area 2 – Deployment of Technologies to Enhance Grid Flexibility (Smart Grid Grants)

(b) (6)
[redacted]

Vermont Transco LLC, through its manager, Vermont Electric Power Company, collectively referred to as VELCO, is excited to offer this letter of commitment for EPRI's proposal titled "Optimizing Interregional Transfer Capacity Using Advanced Power Flow Control".

For over sixty years VELCO has managed the safe, reliable, cost-effective and environmentally sound transmission of electrical energy throughout Vermont. The company's goal is to provide an optimal system of electric transmission facilities as part of an integrated regional network designed to meet both current and future energy needs. Uniquely in the nation, VELCO is a for-profit structured to deliver cooperative-type benefits to its distribution company owners. These 17 local utilities then apply these earnings to reduce their respective customers' bills. In this way, when VELCO succeeds, every grid-connected customer in the state benefits.

The company's asset base has grown significantly over the last decade to more than $1 billion. This expansion provided learning opportunities and a wealth of experience to the VELCO team. Within Vermont and at the regional level, the company has a well-earned reputation among all stakeholders for safe operations, disciplined fiscal management, sound environmental stewardship, and advancement of grid innovations. Undergirding all our work is a driving vision to serve as a trusted partner in pursuit of helping to create a sustainable Vermont. It is in furtherance of this vision that we provide this conditional letter of support of the project described below.

Consistent with this pursuit, VELCO submits this proposal to enhance grid flexibility and improve power system resilience. Northeast New York is connected to northwest Vermont via a 115 kV tie line, whose flow is controlled with a phase shifting transformer. A previous phase shifting transformer located at the New York end of the tie line failed several times before being replaced by the phase shifting transformer at the Vermont end. The Vermont transformer failed in 2021 after nearly 16 years of service, and was replaced with a spare. The failure was likely associated with a very high number of tap changes in response to variable wind generation and system conditions in both New York and Vermont. It is anticipated that flow control will become more

challenging after the New York system is upgraded later this year to allow the installation of a large amount of additional wind generation. Installing a continuous flow control device on this important interregional tie line will increase renewable energy production, improve operator response to system concerns, and maintain flow control following a transformer failure. The VELCO team has been actively engaged with our EPRI partners to provide a comprehensive application that demonstrates the value of the proposed grid enhancement project. This effort has included the development of a project cost estimate which totals $31.8M. If the requested funds are awarded, VELCO's cost share would be about $18M.

VELCO has not yet secured the funds necessary to support the requisite cost share for this proposal, company staff are actively engaged with ISO-New England (ISO-NE) staff to earn their support by providing clear evidence of the interregional benefits the proposed project[1] will provide. Even as these discussions continue, VELCO believes that this project could be considered as a regulated project that would serve as an additional pool transmission facility (PTF). The required cost share would thus be eligible for regional cost support. VELCO has a long history of collaboration with ISO-NE staff, as well as with regional transmission owners (TOs) and expects to continue this collaboration in order to earn regional cost support for the project through the cost allocation review process.

This process includes preliminary discussions with system planning personnel and will involve project presentations to the ISO-NE committees, including the Planning Advisory Committee (PAC) and the Reliability Committee (RC). If support is provided at the committees, VELCO would submit a transmission cost allocation (TCA) request. Although we are committed to engaging in this process, if support of the project is not achieved during this process VELCO would not be able to provide the cost share amount, and thus would have to remove itself from consideration. Any other potential support provided by VELCO is further conditioned upon the successful negotiation of mutually acceptable contractual arrangements that may be required as well as the receipt of necessary project permits.

The objectives of the proposed project is consistent with VELCO's vision of creating a sustainable Vermont by leveraging our people, assets, relationships and operating model, all the while in alignment with our mission of serving as a trusted partner. VELCO looks forward to continuing to participate with the EPRI Team in this effort. If you have any questions, please feel free to contact me at (b) (6) or (b) (6)

Sincerely,

(b) (6)

[1] ISO-NE is an independent, non-profit Regional Transmission Organization (RTO), headquartered in Massachusetts, serving the New England states of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont.

TOWN OF MILTON

43 Bombardier Road • Milton, Vermont 05468
TELEPHONE: 802-893-6655 • FAX: 802-893-1005 • www.miltonvt.gov

March 13, 2023

(b) (6)
Electric Power Research Institute (EPRI)
942 Corridor Park Blvd., Knoxville, TN 37932

Subject: Letter of Support for the Electric Power Research Institute, Inc.'s (EPRI) Proposal in Response to DE-FOA-0002740 "Bipartisan Infrastructure Law Section 40107. Grid Resilience and Innovation Partnerships (GRIP)" Topic Area 2 – Deployment of Technologies to Enhance Grid Flexibility (Smart Grid Grants)

The Town of Milton, Vermont is pleased to offer this letter of support for EPRI and VELCO's subject proposal titled "Optimizing Interregional Transfer Capacity Using Advanced Power Flow Control". The Town of Milton supports the goals of this proposal to enhance grid flexibility, improve power system resilience, and increase renewable energy production through the installation of SmartValve technology on Vermont's electric transmission grid.

The Town of Milton hosts three hydro dams and four wind turbines and is in the process of developing two solar fields. The mission of the proposed project is consistent with Town of Milton's interests and overall goal of sustainable power.

If you have any questions, please feel free to contact me at (b) (6) or (b) (6)

Sincerely,

(b) (6)

Town of Milton, VT
43 Bombardier Rd.
Milton, VT 05468

STATEMENT OF PROJECT OBJECTIVES (SOPO)

OPTIMIZING INTERREGIONAL TRANSFER CAPACITY USING ADVANCED POWER FLOW CONTROL

A. OBJECTIVES

The objectives of this project are:

- Successful installation of Advanced Power Flow Control (APFC) Devices at utility partners
- Increase transmission capacity and operational transfer capacity of the interregional ties where the devices will be installed
- Reduce maintenance costs and failure of existing phase-shifting transformers (PST) in the system
- Assess potential economic, operation, and reliability benefits of larger adoption of APFC across the system
- Demonstrate how the APFC can enhance grid flexibility in various aspects
- Attain multiple benefits to the community derived from the investment

B. SCOPE OF WORK

This project is a partnership between EPRI and a host transmission utility to install APFC installations at interregional ties to systematically increase the transfer capacity across regional borders. SmartValve is a revolutionary modular form of a Static Synchronous Series Compensator (SSSC) technology and is part of the flexible AC transmission systems (FACTS) line of technologies. This project also includes other activities aimed at accomplishing the described project objectives. These activities include the evaluation of economic and power system benefits, analysis of SmartValve technology and system impacts of APFC integration, and the execution of the Community Benefits Plan. The installation, commissioning, testing, and operation of the SmartValves consist of two phases:

Phase 1: Technical Planning. Prior to implementation, two key tasks to prepare for field installation are: 1) approvals and permits, and 2) engineering and procurement. The SmartValve technology is in an advanced stage, having passed technology due diligence and initial solution sizing stage gates. The host utility will identify preferred SmartValve operational settings.

Phase 2: Technical Implementation. The implementation phase includes site preparation, SmartValve installation, commissioning, and in-service operation. The installation task includes Smart Wires-led training for system operators, including integration and operation within supervisory control and data acquisition (SCADA) and energy management system (EMS) architecture. Commissioning will validate that device performance in the field matches that at the assembly facility. The in-service operation task will provide performance data on the functionality of SmartValve.

C. TASKS TO BE PERFORMED

Task 1 — Project Management and Planning (M1 – M36) (M=month)

This task includes all activities related to project management, planning, and reporting.

Subtask 1.1 *– Project Management Plan (PMP) (M1 – M24):*

Within 30 days of the award, EPRI will submit a Project Management Plan (PMP) to the designated Federal Project Officer (FPO). The PMP will be revised and resubmitted as needed. EPRI will manage, direct, and coordinate the project

following the accepted PMP, ensuring that project plans, results, and decisions are documented, and that reporting and briefing requirements are satisfied.

Subtask 1.2 *- National Environmental Policy Act (NEPA) Compliance (M1):*

EPRI will provide the documentation necessary for NEPA compliance.

Subtask 1.3 *- Cybersecurity Plan (CSP)* (M1):*

EPRI will revise and resubmit the CSP as often as necessary to capture any major/significant changes.

Subtask 1.4 *- Continuation Briefing(s) (M1 – M36):*

EPRI will brief DOE on roughly an annual basis on the plans, progress and results of the technical effort and Community Benefits Plan implementation. The briefing will also describe performance relative to project success criteria, milestones, and the Go/No-Go Decision point as documented in the PMP.

PHASE I – TECHNICAL PLANNING (TASKS 2-3)

The technical planning phase encompasses project activities to prepare for successful fieldwork. The primary objective is to complete all commercial, technical, and logistical tasks in a timely manner while ensuring adherence to project cost goals.

Task 2.0 – Approvals and Permits (M1 – M12): This task ensures that equipment is procured and work can be performed.

Subtask 2.1 *– Purchase Order (M1):*

This subtask formally launches the project with contractual agreements between Smart Wires and the subrecipient procuring SmartValve equipment.

Milestone 2.1.1 (*M1*) – Purchase orders received by the contractor, verified by the contractor

Subtask 2.2 *– Land acquisition (M1 – M6):*

Substation sites will be evaluated and the land acquired for SmartValve installation footprint. This task may be waived if the land acquisition is unnecessary.

Milestone 2.2.1 (*M6*) – Land title(s) acquired (if necessary), verified by host utility

Subtask 2.3 *– Environmental Permitting (M1 – M12):*

If the land is acquired outside the substation fence for the SmartValve installation, necessary environmental permits will be acquired, or documentation will be provided detailing that no permits are necessary for the installation work.

Milestone 2.3.1 (M12) – Environmental permits acquired (if necessary), verified by host utility

Task 3.0 – Engineering and Procurement (M1 – M22): This task includes the technical design of equipment installation, component purchasing, and assembly of SmartValve devices.

Subtask 3.1 *– Long lead-time ordering (M1 – M18):*

All long lead-time items (12+ months) will be purchased to ensure a timely and successful installation and will include a safety time factor to ensure meeting the project schedule.

Milestone 3.1.1 (M18) – Long lead-time items ordered, verified by the contractor

Subtask 3.2 *– Advanced Studies (M10 – M16):*

This subtask includes any feasibility, dynamic performance, protection, and other advanced studies that the host utility requires to meet internal standards of operation.

Subtask 3.3 *– Installation and Line Connection Design (M12 – M19):*

This subtask includes civil, structural, electrical, and mechanical engineering design activities associated with installation.

Milestone 3.3.1 (M13) – 30% design completed, verified by host utility

Milestone 3.3.2 (M15) – 60% design completed, verified by host utility

Milestone 3.3.3 (M17) – 90% design completed, verified by host utility

Milestone 3.3.4 (M19) – Issued for Construction (IFC) design completed, verified by host utility

Subtask 3.4 *– Device Manufacturing (M15– M21):*

This subtask covers the SmartValve assembly at the facility of Smart Wires' contract manufacturer, JABIL, in St. Petersburg, Florida.

SMART Milestone 3.4.1 (M21) – All manufactured devices meet End-of-Line test requirements, including verification of operation at rated current >= 1800A and operation at rated voltage of 5660 V +/- 5%, based on End-of-Line test requirements.

Go/No-Go Decision Point (M13)

The validation that the installation and line connection design has achieved at least 30% completion status will act as a go/no-go decision point for the involved parties to evaluate the project progress. Acceptance criteria will be based on the inclusion at a minimum of a Geotechnical report for the site, including resistivity, General arrangement drawings for layout, Elevation drawings for layout, Interconnection and electrical drawings, Foundation design and details, Anchor bolt plan, Grounding design and details, Detailed bill of material, Calculation package showing loading and capacity of all materials included in design, Review, and support for insulator specification and testing as applicable.

PHASE 2 – TECHNICAL IMPLEMENTATION (TASKS 4-6)

The technical implementation phase encompasses all project activities that occur in the field, prior to, including, and following SmartValve installation. The primary objective is to complete all technical and logistical tasks in a timely manner while ensuring adherence to project cost goals.

Task 4.0 – Installation (M21– M27): This task covers both the on-site preparation and installation activities associated with the SmartValve implementation.

Subtask 4.1 *– Site Preparation (M21 – M22):*

This subtask covers all host utility (or subcontractor) and Smart Wires (or subcontractor) on-site preparation prior to SmartValve installation, including but not limited to: reinforced concrete foundation pours, transmission-class post insulator installation, overhead line or electrical bus connection support structure erection, communication equipment installation, and assorted pre-commissioning test activities.

Milestone 4.1.1 (M22) – Host utility (or subcontractor) site readiness report completed, verified by the contractor

Subtask 4.2 *– Equipment Installation (M23 – M27):*

This subtask includes all host utility (or subcontractor) and Smart Wires (or

subcontractor) physical installation activities associated with the SmartValve installation, including but not limited to: SmartValve placement on transmission-class post insulators, overhead line or electrical bus connection to SmartValve devices, intra-phase inter-SmartValve electrical bus connections, and communication connections between SmartValve and pre-installed communication equipment.

Milestone 4.2.1 (M27) – Smart Wires post-installation report completed, verified by host utility

Task 5.0 – Commissioning (M29): This task covers the post-installation SmartValve commissioning activities prior to placing the SmartValve devices in service.

Subtask 5.1 *– On-site Commissioning (M29):*

This subtask includes training for system operators on the operability of the devices and commissioning individual devices as well as the entire SmartValve installation.

Milestone 5.1.1 (M29) – Commissioning report accepted by host utility

Go/No-Go Decision Point (M29)

SmartValve proper communication is verified when line current is reported within 10% of the field test system-reported value. SmartValve injection is verified when all units correctly report injected voltage, line current, and injection status while the injection is gradually set from 10% to 100% and from -10% to -100%. Further acceptance criteria for decision-making will be documented in the commissioning plan, to be agreed upon between Smart Wires and the host utility.

Task 6.0 – In-Service (M29 – M32): This task covers the operationalizing of the SmartValve installation.

Subtask 6.1 *– In-service testing (M29 – M32):*

This subtask covers initial testing requested by the host utility to determine power system impacts from the SmartValve installation under one or more network scenarios.

Milestone 6.1.1 (M32) – In-service test report completed

Task 7.0 – Evaluation of Economic and Power System Benefits: The objective of this task is to assess various types of benefits for electricity system users that can be realized with APFC

Subtask 7.1 - Asses the use of APFC to improve transmission system operations

This task will analyze the use of APFC to reduce congestion by increasing the transmission capability of critical transmission paths. The economic and environmental benefits (improved integration of renewables) derived from the enhanced transmission capacity will be evaluated. A system model for production cost and economic dispatch simulations will be set up to assess these benefits.

Subtask 7.2 - Assess the use of APFC to optimize transmission investment

This task will analyze the use of APFC as an alternative or complementary solution for transmission expansions needed for reliability purposes, or for interconnection of renewable generation. Cases on actual power system models will be used for the analysis

Subtask 7.3 - Assess the use of APFC to improve the flexibility and adaptability of transmission systems.

The analysis of this task will focus on how the modular, scalable, redeployable

characteristics of APFC can be exploited to design highly adaptable and flexible transmission expansion plans.

Task 8 encompasses the analysis of SmartValve technology and system impacts of APFC integration.

Subtask 8.1: Evaluation of the communication system

This task will analyze the resiliency of the SmartValves communications system and its impact on reliability. The analysis will include a review of communication technology employed in the SmartValves system, including on-site measurements.

Subtask 8.2 – Evaluation of protection impacts

The potential impact of SmartValve operation on protection setting and performance, and possible mitigation measures will be analyzed in this task.

Subtask 8.3 - Asset management assessment

The objective of this task is to evaluate SmartValve technology from asset management perspective, including maintenance, life expectancy analysis, and replacement strategies for the different components. EPRI-developed life extension guidelines for HVDC and FACTS will be used for this purpose.

Subtask 8.4 - Reliability assessment

This task will analyze the failure modes of SmartValve devices and evaluate the potential impacts on the system due to misoperation or failure of SmartValves functions.

Task 9 – Includes all the activities related to the execution of the Community Benefits Plan

This task involves all the specific activities intended to advance the community benefits that will derive from this project. EPRI will take on the role of CBP coordinator.

Subtask 9.1 - Community Engagement: This includes execution of community agreements, community listening sessions, and on-site presentations.

Milestone 9.1.1 (M12) – Community agreements
Milestone 9.1.2 (M18) – Community fora
Milestone 9.1.2 (M30) – On-site presentations

Subtask 9.2 – Investing in the American Workforce

Milestone 9.2.1 (M24) – workforce training

Subtask 9.3 – Advancing DEIA: Create energy-related project curriculum

Milestone 9.3.1 (M33) – Energy Curriculum

Subtask: 9.4 – Justice40 Benefits: Create environment-related project curriculum

Milestone 9.4.1 (M24) – Cost Impact White Paper
Milestone 9.4.2 (M30) – Environment Curriculum

D. DELIVERABLES

Subtask 1.1: Project Management Plan, Subtask 1.3 – Cybersecurity Plan
Subtask 1.4 - Pre-Continuation Briefing Document(s)
Subtasks 7.1 - 7.3: Study report
Subtasks 8.1 -8.4: Study report
Subtask 9.4.1 – White paper

E. BRIEFINGS/TECHNICAL PRESENTATIONS

The Recipient shall prepare, and present periodic briefings, technical presentations and demonstrations as requested by the Federal Project Officer.

Summary for Public Release

Applicant: Electric Power Research Institute, Inc. (EPRI)

Program/Project Manager: (b) (6)

Major Participants: EPRI, VELCO, and Smart Wires Inc.

Title: Optimizing Interregional Transfer Capacity Using Advanced Power Flow Control

This project consists of the installation of Advanced Power Flow Control (APFC) at interregional tie lines to systematically increase the transfer capacity across regional borders. In this way this project will meet two of the objectives of Topic Area 2: a) Increase the capacity of transmission facilities to reliably transfer increased amounts of electric energy, and b) enable the integration of variable renewable energy resources at the transmission level.

The APFC devices to install are the Modular Static Synchronous Series Compensators (M-SSSC), or SmartValve™, developed and manufactured Smart Wires Inc. The devices will be installed on VELCO transmission system to increase the transmission capacity of the selected interregional tie. The enhanced transmission capacity will be vital to secure a reliable energy supply to the increasing demand in Vermont and will facilitate increased energy dispatch of renewable energy, thus allowing the state to achieve the renewable energy target. The APFC will also help optimize the cross-border flows with Vermont while reducing the maintenance and outage costs of the existing phase-shifting transformers on the border with New York. Due to VELCOs co-op style financial structure, the economic benefits derived from the reduced generation cost will directly return to energy consumers.

This project also encompasses a series of power system studies to assess the economic, operational, and reliability benefits of larger adoption of APFC in the system, and a comprehensive analysis of SmartValve technology and system impacts of APFC integration. Documenting the successful installation, commissioning, and operation of the APFC at VELCO transmission system, along with the results of these studies, will help transmission planners and engineers better understand the features, capabilities, and implementation considerations of these devices. It will also provide useful insight and guidance to evaluate transmission solutions based on the use of this technology. Altogether, this activity will help utilities make a risk-informed decision on the use of APFC for more cost-effective transmission expansion by enabling higher utilization of the existing network infrastructure.

Furthermore, this project will advance numerous community benefits including workforce training, the creation of new jobs leading to long-term careers, increased energy resilience and enhanced interregional cooperation. APFC deployments will support community decarbonization and grid resilience by allowing the incorporation of additional renewables into the transmission system—and by helping to ensure that decarbonization and equitable community benefits are realized once projects become operational. These deployments will catalyze deployments of the technology to help spur future renewable investment, accelerate the greening of the grid, and resolve similar issues across the US.

DOE funding for a commercialized technology like the SmartValve provides a significant endorsement for the US applicability of this technology and minimizes the informal but prevalent barrier of perceived risk with operators and utilities.

Control Number

Optimizing Interregional Transfer Capacity Using Advanced Power Flow Control

[redacted] / EPRI

Technology Summary

The SmartValve is the Smart Wires Modular Static Synchronous Series Compensators (M-SSSC) device, which qualifies as an Advanced Transmission Technology as a form of Advanced Power Flow Control (APFC). By injecting a variable voltage (leading or lagging) in quadrature with the line current, the SmartValve can pull power towards or push power away from the installed circuit.

APFCs are installed in transmission grids to optimize network flows and increase automation, visibility, and controllability of the grid, thus improving the utilization and efficiency of existing transmission assets.

Key Personnel

[redacted]

Project Summary

Period of performance:
36 months

Federal funds:	$18,017,358
Cost-share:	$18,017,358
Total budget:	$36,034,716

Project Activities & Outcomes
• Installation, commissioning, testing, and operation of SmartValves on VELCO transmission system
• Evaluation of economic and power system benefits of APFC
• Analysis of SmartValve technology and system impacts of APFC integration
• Accomplish derived community benefits

Technology Impact

SmartValves will be installed on the VELCO transmission system to increase the transmission capacity of interregional ties.

Direct benefits will include securing energy supply to Vermont, increased dispatch of renewable energy, and optimized cross-border flows with Vermont.

Studies to assess benefits and evaluation of the technology, along with operation experience, will help reduce barriers to larger adoption of AFPC technology.

Install, test, and assess benefits and use of APFC technology

U.S. DEPARTMENT OF ENERGY

Instructions and Summary

OMB Control Number: 1910-5162
Expiration Date: 04/30/2025

Award Number: _____ **Date of Submission:** _____

Award Recipient: _____ **Form submitted by:** _____

(May be award recipient or sub-recipient)

Please read the instructions on each worksheet tab before starting. If you have any questions, please ask your EERE contact!
Do not modify this template or any cells or formulas!

1. If using this form for award application, negotiation, or budget revision, fill out the blank white cells in workbook tabs a. through j. with total project costs.
2. Blue colored cells contain instructions, headers, or summary calculations and should not be modified. Only blank white cells should be populated.
3. Enter detailed support for the project costs identified for each Category line item within each worksheet tab to autopopulate the summary tab.
4. The total budget presented on tabs a. through i. must include both Federal (DOE) and Non-Federal (cost share) portions.
5. All costs incurred by the preparer's sub-recipients, contractors, and Federal Research and Development Centers (FFRDCs), should be entered only in section f. Contractual. All other sections are for the costs of the preparer only.
6. Ensure all entered costs are allowable, allocable, and reasonable in accordance with the administrative requirements prescr bed in 2 CFR 200, and the applicable cost principles for each entity type: FAR Part 31 for For-Profit entities; and 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.
7. Add rows as needed throughout tabs a. through j. If rows are added, formulas/calculations may need to be adjusted by the preparer. Do not add rows to the Instructions and Summary tab. If your project contains more than three budget periods, consult your EERE contact before adding additional budget period rows or columns.
8. ALL budget period cost categories are rounded to the nearest dollar.

BURDEN DISCLOSURE STATEMENT
Public reporting burden for this collection of information is estimated to average 24 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of his collection of information, including suggestions for reducing this burden, to Office of Informa ion Resources Management Policy, Plans, and Oversight, AD-241-2 - GTN, Paperwork Reduction Project (1910-5162), U.S. Department of Energy 1000 Independence Avenue, S.W., Washington, DC 20585; and to the Office of Management and Budget, Paperwork Reduction Project (1910-5162), Washington, DC 20503.

SUMMARY OF BUDGET CATEGORY COSTS PROPOSED

The values in this summary table are from entries made in subsequent tabs, only blank white cells require data entry

Section A - Budget Summary

	Federal	Cost Share	Total Costs	Cost Share %	Proposed Budget Period Dates
Budget Period 1	$2,997,989	$3,772,075	$6,770,064	55.72%	01/01/2024 - 12/31/2024
Budget Period 2	$5,878,272	$7,396,053	$13,274,325	55.72%	01/01/2025 - 12/31/2025
Budget Period 3	$5,205,740	$6,549,872	$11,755,612	55.72%	01/01/2026 - 12/31/2026
Total	$14,082,000	$17,718,000	$31,800,000	55.72%	

Section B - Budget Categories

CATEGORY	Budget Period 1	Budget Period 2	Budget Period 3	Total Costs	% of Project	Comments (as needed)
a. Personnel	(b) (4)	[redacted]	[redacted]	[redacted]	[redacted]	
b. Fringe Benefits	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
c. Travel	$0	$0	$0	$0	0.00%	
d. Equipment	$0	[redacted]	[redacted]	[redacted]	[redacted]	
e. Supplies	$0	$0	$0	$0	0.00%	
f. Contractual						
Sub-recipient	$0	$0	$0	$0	0.00%	
Contractor	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
FFRDC	$0	$0	$0	$0	0.00%	
Total Contractual	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
g. Construction	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
h. Other Direct Costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
Total Direct Costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
i. Indirect Charges	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
Total Costs	$6,770,064	$13,274,325	$11,755,612	$31,800,000	100.00%	

Additional Explanation (as needed):

a. Personnel

INSTRUCTIONS - PLEASE READ!!!

1. List project costs solely for employees of the entity completing this form. All personnel costs for subrecipients and contractors must be included under f. Contractual.
2. All personnel should be identified by position title and not employee name. Enter the amount of time (e.g., hours or % of time) and the base hourly rate and the total direct personnel compensation will automatically calculate. Rate basis (e.g., rate negotiated for each hour worked on the project, labor distribution report, state civil service rates, etc.) must also be identified.
3. If loaded labor rates are utilized, a description of the costs the loaded rate is comprised of must be included in the Additional Explanation section below. DOE must review all components of the loaded labor rate for reasonableness and unallowable costs (e.g. fee or profit).
4. If a position and hours are attr buted to multiple employees (e.g. Technician working 4000 hours) the number of employees for that position title must be identified.
5. Each budget period is rounded to the nearest dollar.

SOPO Task #	Position Title	Budget Period 1			Budget Period 2			Budget Period 3			Project Total Hours	Project Total Dollars	Rate Basis
		Time (Hrs)	Hourly Rate ($/Hr)	Total Budget Period 1	Time (Hrs)	Hourly Rate ($/Hr)	Total Budget Period 2	Time (Hrs)	Hourly Rate ($/Hr)	Total Budget Period 3			
1	Sr. Engineer **(EXAMPLE!!!)**	2000	$85.00	$170,000	200	$50.00	$10,000	200	$50.00	$10,000	2400	$190,000	
2	Technicians (2)	4000	$20.00	$80,000	0	$0.00	$0	0	$0.00	$0	4000	$80,000	
	Capital Project Manager	[redacted]	(b) (4)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	Construction	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	Right of Way	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	Compliance Manager	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	Planning	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	EMS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	EMS Manager	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	Engineering Civil	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	Engineering Electrical	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	Electrical Sr.	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	Engineering Protection Engineering	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	Asset Maintenance Engineering Salary	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	Environmental Salary	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	Legal Salary	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	Asset Maintenance Substation Hourly	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	Substation Sr. Maintenance Non	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	Construction Field Hourly	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	Line Crew Sr. Non Sal	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	Asset Maintenance LC non Salary	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	Telecom Management	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	Telecom Field Hourly	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	System Protection Manager	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	Communication	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
	System Protection	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	estimated cost of service
				$0			$0			$0	0	$0	
	TOTAL PERSONNEL	[redacted]		[redacted]	[redacted]		[redacted]	[redacted]		[redacted]	[redacted]	[redacted]	

Additional Explanation (as needed): estimated cost of service rate= actual cost of service rate escalated to 2024. Cost of service rates do not include any profit.

b. Fringe Benefits

INSTRUCTIONS - PLEASE READ!!!

1. Fill out the table below by position title. If all employees receive the same fringe benefits, you can show "Total Personnel" in the Labor Type column instead of listing out all position titles.
2. The rates and how they are applied should not be averaged to get one fringe cost percentage. Complex calculations should be described/provided in the Additional Explanation section below.
3. The fringe benefit rates should be applied to all positions, regardless of whether those funds will be supported by Federal Share or Recipient Cost Share.
4. Each budget period is rounded to the nearest dollar.

Labor Type	Budget Period 1			Budget Period 2			Budget Period 3			Total Project
	Personnel Costs	Rate	Total	Personnel Costs	Rate	Total	Personnel Costs	Rate	Total	
EXAMPLE!!! Sr. Engineer	$170,000	20%	$34,000	$10,000	20%	$2,000	$10,000	20%	$2,000	$38,000
Total Personnel	(b) (4)									
			$0			$0			$0	$0
			$0			$0			$0	$0
			$0			$0			$0	$0
			$0			$0			$0	$0
TOTAL FRINGE	(b) (4)									

A federally approved fringe benefit rate agreement, or a proposed rate supported and agreed upon by DOE for estimating purposes is required at the time of award negotiation if reimbursement for fringe benefits is requested. Please check (X) one of the options below and provide the requested information if not previously submitted.

_____ A fringe benefit rate has been negotiated with, or approved by, a federal government agency. A copy of the latest rate agreement is/was included with the project application.*

__X____ There is not a current federally approved rate agreement negotiated and available.**

*Unless the organization has submitted an indirect rate proposal which encompasses the fringe pool of costs, please provide the organization's benefit package and/or a list of the components/elements that comprise the fringe pool and the cost or percentage of each component/element allocated to the labor costs identified in the Budget Justification.

**When this option is checked, the entity preparing this form shall submit an indirect rate proposal in the format provided in the Sample Rate Proposal at https://www.energy.gov/eere/funding/downloads/sample-indirect-rate-proposal-and-profit-compliance-audit, or a format that provides the same level of information and which will support the rates being proposed for use in the performance of the proposed project.

Additional Explanation (as necessary): Please use this box (or an attachment) to list the elements that comprise your fringe benefits and how they are applied to your base (e.g. Personnel) to arrive at your fringe benefit rate.

c. Travel

INSTRUCTIONS - PLEASE READ!!!

1. Identify Foreign and Domestic Travel as separate items. Examples of Purpose of Travel are subrecipient site visits, DOE meetings, project mgmt. meetings, etc. Examples of Basis for Estimating Costs are past trips, travel quotes, GSA rates, etc.
2. All listed travel must be necessary for performance of the Statement of Project Objectives.
3. Only travel that is directly associated with this award should be included as a direct travel cost to the award.
4. Federal travel regulations are contained within the applicable cost principles for all entity types.
5. Travel costs should remain consistent with travel costs incurred by an organization during normal business operations as a result of the organizations written travel policy. In absence of a written travel policy, organizations must follow the regulations prescribed by the General Services Administration.
6. Columns E, F, G, H, I, J, and K are per trip.
7. The number of days is inclusive of day of departure and day of return.
8. Recipients should enter City and State (or City and Country for International travel) in the Depart from and Destination fields.
9. Each budget period is rounded to the nearest dollar.

SOPO Task #	Purpose of Travel	Depart From	Destination	No. of Days	No. of Travelers	Lodging per Traveler	Flight per Traveler	Vehicle per Traveler	Per Diem Per Traveler	Cost per Trip	Basis for Estimating Costs
	Domestic Travel	**Budget Period 1**									
1	**EXAMPLE!!!** Visit to PV manufacturer			2	2	$250	$500	$100	$80	$2,520	Current GSA rates
	n/a									$0	
										$0	
										$0	
										$0	
	International Travel										
										$0	
	Budget Period 1 Total									**$0**	
	Domestic Travel	**Budget Period 2**									
										$0	
										$0	
										$0	
										$0	
	International Travel										
										$0	
	Budget Period 2 Total									**$0**	
	Domestic Travel	**Budget Period 3**									
										$0	
										$0	
										$0	
										$0	
	International Travel										
										$0	
	Budget Period 3 Total									**$0**	
	TOTAL TRAVEL									**$0**	

Additional Explanation (as needed):

d. Equipment

INSTRUCTIONS - PLEASE READ!!!

1. Equipment means tangible personal property (including information technology systems) having a useful life of more than one year and a per-unit acquisition cost which equals or exceeds the lesser of the capitalization level established by the non-Federal entity for financial statement purposes, or $5,000. Please refer to the applicable Federal regulations in 2 CFR 200 for specific equipment definitions and treatment.

2. List all equipment below, providing a basis of cost (e.g. contractor quotes, catalog prices, prior invoices, etc.). Briefly justify items as they apply to the Statement of Project Objectives. If it is existing equipment, provide logical support for the estimated value shown.

3. During award negotiations, provide a contractor quote for all equipment items over $50,000 in price. If the contractor quote is not an exact price match, provide an explanation in the additional explanation section below. If a contractor quote is not practical, such as for a piece of equipment that is purpose-built, first of its kind, or otherwise not available off the shelf, provide a detailed engineering estimate for how the cost estimate was derived.

4. Each budget period is rounded to the nearest dollar.

SOPO Task #	Equipment Item	Qty	Unit Cost	Total Cost	Basis of Cost	Justification of need
Budget Period 1						
3,4,5	**EXAMPLE!!!** Thermal shock chamber	2	$70,000	$140,000	Contractor Quote - Attached	Reliability testing of PV modules- Task 4.3
				$0.00		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 1 Total			$0		
Budget Period 2						
	Land	[redacted]	(b) (4)	[redacted]		A siting alternatives analysis may identify the need for more land
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 2 Total			[redacted]		
Budget Period 3						
	Fiber Equipment	[redacted]	[redacted]	[redacted]		For monitoring purposes
				$0.00		
				$0.00		
				$0.00		
				$0.00		
				$0		
	Budget Period 3 Total			(b) (4)		
	TOTAL EQUIPMENT			[redacted]		

Additional Explanation (as needed):

e. Supplies

INSTRUCTIONS - PLEASE READ!!!

1. Supplies are generally defined as an item with an acquisition cost of $5,000 or less and a useful life expectancy of less than one year. Supplies are generally consumed during the project performance. Please refer to the applicable Federal regulations in 2 CFR 200 for specific supplies definitions and treatment. A computing device is a supply if the acquisition cost is less than the lesser of the capitalization level established by the non-Federal entity for financial statement purposes or $5,000, regardless of the length of its useful life.

2. List all proposed supplies below, providing a basis of costs (e.g. contractor quotes, catalog prices, prior invoices, etc.). Briefly justify the need for the Supplies as they apply to the Statement of Project Objectives. Note that Supply items must be direct costs to the project at this budget category, and not duplicative of supply costs included in the indirect pool that is the basis of the indirect rate applied for this project.

3. Multiple supply items valued at $5,000 or less used to assemble an equipment item with a value greater than $5,000 with a useful life of more than one year should be included on the equipment tab. If supply items and costs are ambiguous in nature, contact your DOE representative for proper categorization.

4. Add rows as needed. If rows are added, formulas/calculations may need to be adjusted by the preparer.

5. Each budget period is rounded to the nearest dollar.

SOPO Task #	General Category of Supplies	Qty	Unit Cost	Total Cost	Basis of Cost	Justification of need
Budget Period 1						
4,6	**EXAMPLE!!!** Wireless DAS components	10	$360.00	$3,600	Catalog price	For Alpha prototype - Task 2.4
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 1 Total			**$0**		
Budget Period 2						
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 2 Total			$0		
Budget Period 3						
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 3 Total			$0		
	TOTAL SUPPLIES			**$0**		

Additional Explanation (as needed):

f. Contractual

INSTRUCTIONS - PLEASE READ!!!

1. The entity completing this form must provide all costs related to subrecipients, contractors, and FFRDC partners in the applicable boxes below.

2. Subrecipients (partners, sub-awardees): Subrecipients shall submit a Budget Justifica ion describing all project costs and calculations when their total proposed budget exceeds ei her (1) $250,000 or (2) 25% of total award costs. These subrecipient forms may be completed by either the subrecipients themselves or by the preparer of this form. The budget totals on the subrecipient's forms must match the subrecipient entries below. A subrecipient is a legal entity to which a subaward is made, who has performance measured against whether the objec ives of the Federal program are met, is responsible for programmatic decision making, must adhere to applicable Federal program compliance requirements, and uses the Federal funds to carry out a program of the organization. All characteris ics may not be present and judgment must be used to determine subrecipient vs. contractor status.

3. Contractors: List all contractors supplying commercial supplies or services used to support the project. For each Contractor cost with total project costs of $250,000 or more, a Contractor quote must be provided. A contractor is a legal entity contracted to provide goods and services within normal business operations, provides similar goods or services to many different purchasers, operates in a competitive environment, provides goods or services that are ancillary to the operation of the Federal program, and is not subject to compliance requirements of the Federal program. All characteristics may not be present and judgment must be used to determine subrecipient vs. contractor status.

4. Federal Funded Research and Development Centers (FFRDCs): FFRDCs must submit a signed Field Work Proposal during award application. The award recipient may allow the FFRDC to provide this information directly to DOE, however project costs must also be provided below.

5. Each budget period is rounded to the nearest dollar.

SOPO Task #	Subrecipient Name/Organization	Subrecipient Unique Entity Identifier (UEI)	Purpose and Basis of Cost	Budget Period 1	Budget Period 2	Budget Period 3	Project Total
2,4	EXAMPLE!!! XYZ Corp.		Partner to develop optimal lens for Gen 2 product. Cost estimate based on personnel hours.	$48,000	$32,000	$16,000	$96,000
							$0
							$0
							$0
							$0
							$0
							$0
			Sub-total	$0	$0	$0	$0

SOPO Task #	Contractor Name/Organization	Purpose and Basis of Cost	Budget Period 1	Budget Period 2	Budget Period 3	Project Total
6	EXAMPLE!!! ABC Corp.	Contractor for developing robotics to perform lens inspection. Estimate provided by contractor.	$32,900	$86,500	$0	$119,400
	SmartWires	Contractor for designing SmartValve product. Es imate provided by contractor escalated by VELCO	(b) (4)	[redacted]	[redacted]	[redacted]
	tbd	below grade contractor - es imate based on current projects	[redacted]	[redacted]	[redacted]	[redacted]
	tbd	engineering contractor - estimate based on other projects	[redacted]	[redacted]	[redacted]	[redacted]
	tbd	environmental contractor - estimate based on other projects	[redacted]	[redacted]	[redacted]	[redacted]
	tbd	misc contractors - es imate based on other projects	[redacted]	[redacted]	[redacted]	[redacted]
						$0
						$0
		Sub-total	[redacted]	[redacted]	[redacted]	$25,053,966

SOPO Task #	FFRDC Name/Organization	Purpose and Basis of Cost	Budget Period 1	Budget Period 2	Budget Period 3	Project Total
						$0
						$0
		Sub-total	$0	$0	$0	$0

TOTAL CONTRACTUAL	(b) (4)	[redacted]	[redacted]	$25,053,966

Additional Explana ion (as needed):

g. Construction

PLEASE READ!!!

1. Construction, for the purpose of budgeting, is defined as all types of work done on a particular building, including erecting, altering, or remodeling. Construction conducted by the award recipient is entered on this page. Any construction work that is performed by a contractor or subrecipient should be entered under f. Contractual.

2. List all proposed construction below, providing a basis of cost such as engineering estimates, prior construction, etc., and briefly justify its need as it applies to the Statement of Project Objectives.

3. Each budget period is rounded to the nearest dollar.

Overall description of construction activities: Example Only!!! - Build wind turbine platform

SOPO Task #	General Description	Cost	Basis of Cost	Justification of need
		Budget Period 1		
3	EXAMPLE ONLY!!! Three days of excavation for platform site	$28,000	Engineering estimate	Site must be prepared for construction of platform.
	Prepare site and infrastructure	(b) (4)	Conceptual estimate	Site must be prepared fpr installation of equipment
	Budget Period 1 Total			
		Budget Period 2		
	Prepare site and infrastructure		Conceptual estimate	Site must be prepared fpr installation of equipment
	Budget Period 2 Total			
		Budget Period 3		
	Prepare site and infrastructure		Conceptual estimate	Site must be prepared fpr installation of equipment
	Budget Period 3 Total			
	TOTAL CONSTRUCTION			

Additional Explanation (as needed):

h. Other Direct Costs

INSTRUCTIONS - PLEASE READ!!!

1. Other direct costs are direct cost items required for the project which do not fit clearly into other categories. These direct costs must not be included in the indirect costs (for which the indirect rate is being applied for this project). Examples are: tuition, printing costs, etc. which can be directly charged to the project and are not duplicated in indirect costs (overhead costs).

2. Basis of cost are items such as contractor quotes, prior purchases of similar or like items, published price list, etc.

3. Each budget period is rounded to the nearest dollar.

SOPO Task #	General Description and SOPO Task #	Cost	Basis of Cost	Justification of need
		Budget Period 1		
5	**EXAMPLE!!!** Grad student tuition - tasks 1-3	$16,000	Established UCD costs	Support of graduate students working on project
	Shipping/equipment rental	(b) (4)	Conceptual estimate	
	Budget Period 1 Total			
		Budget Period 2		
	Shipping/equipment rental		Conceptual estimate	
	Budget Period 2 Total			
		Budget Period 3		
	Shipping/equipment rental		Conceptual estimate	
	Budget Period 3 Total			
	TOTAL OTHER DIRECT COSTS			

Additional Explanation (as needed):

i. Indirect Costs

INSTRUCTIONS - PLEASE READ!!!

1. Fill out the table below to indicate how your indirect costs are calculated. Use the box below to provide additional explanation regarding your indirect rate calculation.
2. The rates and how they are applied should not be averaged to get one indirect cost percentage. Complex calculations or rates that do not do not correspond to the below categories should be descr bed/provided in the Additional Explanation section below. If questions exist, consult with your DOE contact before filling out this section.
3. The indirect rate should be applied to both the Federal Share and Recipient Cost Share.
4. NOTE: A Recipient who elects to employ the 10% de minimis Indirect Cost rate **cannot claim resulting costs as a Cost Share contribution, nor can the Recipient claim "unrecovered indirect costs" as a Cost Share contribution.** Neither of these costs can be reflected as actual indirect cost rates realized by the organization, and therefore are not verifiable in the Recipient records as required by Federal Regulation (§200.306(b)(1)).
5. Each budget period is rounded to the nearest dollar.

	Budget Period 1	Budget Period 2	Budget Period 3	Total	Explanation of BASE
Provide ONLY Applicable Rates:					
Overhead Rate	0.00%	0.00%	0.00%		*Example: Labor + Fringe*
General & Administrative (G&A)	0.00%	0.00%	0.00%		*Example: Total Cost Input*
FCCM Rate, if applicable	0.00%	0.00%	0.00%		
OTHER Indirect Rate	0.00%	0.00%	0.00%		**AFUDC**
Indirect Costs (As Applicable):					
Overhead Costs				**$0**	
G&A Costs	(b) (4)	[redacted]	[redacted]	[redacted]	**Total Direct cost**
FCCM Costs, if applicable				**$0**	
OTHER Indirect Costs	[redacted]	[redacted]	[redacted]	[redacted]	**Total Direct Cost**
Total Indirect Costs Requested:	[redacted]	[redacted]	[redacted]	[redacted]	

A federally approved indirect rate agreement, or rate proposed (supported and agreed upon by DOE for estimating purposes) is required if reimbursement of indirect costs is requested. Please check (X) one of the options below and provide the requested information if it has not already been provided as requested, or has changed.

_____ An indirect rate has been approved or negotiated with a federal government agency. A copy of the latest rate agreement is included with this application and will be provided electronically to the Contracting Officer for this project.
_____ The organization does not have a current, federally approved indirect cost rate agreement and has provided an indirect rate proposal in support of the proposed costs.
_____ This organization has elected to apply a 10% de minimis rate in accordance with 2 CFR 200.414(f).

Provide an explanation of how your indirect cost rate was applied.

*Additional Explanation (as needed): *IMPORTANT: Please use this box (or an attachment) to further explain how your total indirect costs were calculated. If the total indirect costs are a cumulative amount of more than one calculation or rate application, the explanation and calculations should identify all rates used, along with the base they were applied to (and how the base was derived), and a total for each (along with grand total).*

Cost Share

PLEASE READ!!!

1. A detailed presentation of the cash or cash value of all cost share proposed must be provided in the table below. All items in the chart below must be identified within the applicable cost category tabs a. through i. in addition to the detailed presentation of the cash or cash value of all cost share proposed provided in the table below. Identify the source organization & amount of each cost share item proposed in the award.

2. Cash Cost Share - encompasses all contributions to the project made by the recipient, subrecipient, or third party (an entity that does not have a role in performing the scope of work) for costs incurred and paid for during the project. This includes when an organization pays for personnel, supplies, equipment, etc. for their own company with organizational resources. If the item or service is reimbursed for, it is cash cost share. All cost share items must be necessary to the performance of the project. **Contractors may not provide cost share.** Any partial donation of goods or services is considered a discount and is not allowable.

3. In Kind Cost Share - encompasses all contributions to the project made by the recipient, subrecipient, or third party (an entity that does not have a role in performing the scope of work) where a value of the contribution can be readily determined, verified and justified but where no actual cash is transacted in securing the good or service comprising the contribution. In Kind cost share items include volunteer personnel hours, the donation of space or use of equipment, etc. The cash value and calculations thereof for all In Kind cost share items must be justified and explained in the Cost Share Item section below. All cost share items must be necessary to the performance of the project. If questions exist, consult your DOE contact before filling out In Kind cost share in this section. Contractors may not provide cost share. Any partial donation of goods or services is considered a discount and is not allowable.

4. Funds from other Federal sources MAY NOT be counted as cost share. This prohibition includes FFRDC sub-recipients. Non-Federal sources include any source not originally derived from Federal funds. Cost sharing commitment letters from subrecipients and third parties must be provided with the original application.

5. Fee or profit, including foregone fee or profit, **are not allowable** as project costs (including cost share) under any resulting award. The project may only incur those costs that are allowable and allocable to the project (including cost share) as determined in accordance with the applicable cost principles prescribed in FAR Part 31 for For-Profit entities and 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.

6. NOTE: A Recipient who elects to employ the 10% de minimis Indirect Cost rate **cannot claim the resulting indirect costs as a Cost Share contribution.**

7. NOTE: A Recipient **cannot claim "unrecovered indirect costs"** as a Cost Share contribution, **without prior approval.**

8. Each budget period is rounded to the nearest dollar.

Organization/Source	Type (Cash or In Kind)	Cost Share Item	Budget Period 1	Budget Period 2	Budget Period 3	Total Project Cost Share
ABC Company **EXAMPLE!!!**	Cash	Project partner ABC Company will provide 20 PV modules for product development at the price of $680 per module	$13,600			**$13,600**
tbd	Cash	subject to ISO-NE process for rate- based PTF additions	$3,772,075	$7,396,053	$6,549,872	**$17,718,000**
						$0
						$0
						$0
						$0
						$0
						$0
						$0
						$0
						$0
		TOTAL COST SHARE	**$3,772,075**	**$7,396,053**	**$6,549,872**	**$17,718,000**
		Cost Share Percentage per Budget Period	**55.7%**	**55.7%**	**55.7%**	

Total Project Cost: $31,800,000 **Total Project Cost Share Percent: 55.7%**

Additional Explanation (as needed):

Applicant Name: 0 Award Number: 0

Budget Information - Non Construction Programs

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				$2,997,988.65	$3,772,075.00	$6,770,064.00
2. Budget Period 2				$5,878,271.94	$7,396,053.00	$13,274,325.00
3. Budget Period 3				$5,205,739.59	$6,549,872.00	$11,755,612.00
4.						
5. Totals				$14,082,000.00	$17,718,000.00	$31,800,001.00

Section B - Budget Categories

6. Object Class Categories	Grant Program, Function or Activity				Total (5)
	Budget Period 1	Budget Period 2	Budget Period 3		
a. Personnel	(b) (4) [redacted]	[redacted]	[redacted]		[redacted]
b. Fringe Benefits	[redacted]	[redacted]	[redacted]		[redacted]
c. Travel	$0.00	$0.00	$0.00		$0.00
d. Equipment	$0.00	[redacted]	[redacted]		[redacted]
e. Supplies	$0.00	$0.00	$0.00		$0.00
f. Contractual	[redacted]	[redacted]	[redacted]		[redacted]
g. Construction	[redacted]	[redacted]	[redacted]		[redacted]
h. Other	[redacted]	[redacted]	[redacted]		[redacted]
i. Total Direct Charges (sum of 6a-6h)	[redacted]	[redacted]	[redacted]		[redacted]
j. Indirect Charges	[redacted]	[redacted]	[redacted]		[redacted]
k. **Totals** (sum of 6i-6j)	[redacted]	[redacted]	[redacted]		[redacted]
7. Program Income					$0

Previous Edition Usable

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Applicant Name: 0 Award Number: 0

Budget Information - Non Construction Programs

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		
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Section B - Budget Categories

6. Object Class Categories	Grant Program, Function or Activity				Total (5)
	Budget Period 1	Budget Period 2	Budget Period 3		
a. Personnel	(b) (4) [redacted]	[redacted]	[redacted]		[redacted]
b. Fringe Benefits	[redacted]	[redacted]	[redacted]		[redacted]
c. Travel	$0.00	$0.00	$0.00		$0.00
d. Equipment	$0.00	[redacted]	[redacted]		[redacted]
e. Supplies	$0.00	$0.00	$0.00		$0.00
f. Contractual	[redacted]	[redacted]	[redacted]		[redacted]
g. Construction	[redacted]	[redacted]	[redacted]		[redacted]
h. Other	[redacted]	[redacted]	[redacted]		[redacted]
i. Total Direct Charges (sum of 6a-6h)	[redacted]	[redacted]	[redacted]		[redacted]
j. Indirect Charges	[redacted]	[redacted]	[redacted]		[redacted]
k. **Totals** (sum of 6i-6j)	[redacted]	[redacted]	[redacted]		[redacted]
7. Program Income					$0

Previous Edition Usable

SF-424A (Rev. 4-92)
Prescribed by OMB Circular A-102

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NETL F 451.1-1/3
Revised: 12/3/2014
Reviewed: 12/3/2014
(Previous Editions Obsolete)

U.S. DEPARTMENT OF ENERGY

ENVIRONMENTAL QUESTIONNAIRE

I. INSTRUCTIONS

The proposer shall prepare this Environmental Questionnaire (EQ) as accurately and completely as possible. Supporting information can be provided as attachments. The proposer must identify the location of the project and specifically describe the activities that would occur at that location. The proposer must provide specific information and quantities, regarding air emissions, wastewater discharges, solid wastes, etc., to facilitate the necessary review. In addition, the proposer must submit with this EQ a FINAL copy of the project's statement of work (SOW) or statement of project objective (SOPO) that will be used in the contract/agreement between the proposer and the U.S Department of Energy (DOE).

II. QUESTIONNAIRE

A. PROJECT SUMMARY

1. Solicitation/Project Number: DE-FOA-0002740 Proposer: EPRI
2. This Environmental Questionnaire pertains to a: ☒ Recipient or Prime Contractor ☐ Sub-recipient or Subcontractor
3. Principal Investigator: (b) (6) Telephone Number: (b) (6)
4. Project Title: Optimizing Interregional Transfer Capacity Using Advanced Power Flow Control
5. Expected Project Duration: 36 months
6. Location of Activities covered by **this** Environmental Questionnaire: (City/Township, County, State):
   Knoxville TN, Palo Alto CA
7. List the full scope of activities planned (only for the location that is the subject of this Environmental Questionnaire).
   Power system studies using simulation software.
   Evaluation of SmartValve technology based on information and material to be provided by the manufacturer Smart Wires.
8. List all other locations where work would be performed by the primary contractor of the project and subcontractor(s). Each of the following must have an individual Environmental Questionnaire.

Subcontractor or sub-recipient	Location of activities for this project
Vermont Transco LLC (VELCO)	Rutland VT and Milton VT
Smart Wires	Durham NC
JABIL	St. Petersburg FL

9. Identify and select the checkbox with the predominant project work activities under Group A, B, or C

Group A

☑ Routine administrative, procurement, training, and personnel actions. Contract activities/awards for management support, financial assistance, and technical services in support of agency business, programs, projects, and goals. Literature searches and information gathering, material inventories, property surveys; data analysis, computer modeling, analytical reviews, technical summary, conceptual design, feasibility studies, document preparation, data dissemination, and paper studies. Technical assistance including financial planning, assistance, classroom training, public meetings, management training, survey participation, academic contribution, technical consultation, and stakeholders surveys. Workshop and conference planning, preparation, and implementation which may involve promoting energy efficiency, renewable energy, and energy conservation.

STOP! ***If all work activities related to this project can be classified and described within categories under Group A, proceed directly to Section III CERTIFICATION BY PROPOSER. No additional information is required.***
If project work activities are described in either Group(s) B or C; then continue filling out questionnaire.

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ENVIRONMENTAL QUESTIONNAIRE

Group B

☐ Laboratory Scale Research, Bench Scale Research, Pilot Scale Research, Proof-of-Concept Scale Research, or Field Test Research. Work DOES NOT involve new building/facilities construction and site excavation/groundbreaking activities. This work typically involves routine operation of existing laboratories, commercial buildings/properties, offices and homes, project test facilities, factories/power plants, vehicles test stands and components, refueling facilities, utility systems, or other existing structures/facilities. Work will NOT involve major change in facilities missions and operations, land use planning, new/modified regulatory/operating permit requirements. Includes work specific to routine DOE Site operations and Lab research work activities, but NOT building construction and site preparation. DOE work typically involves laboratory facilities and lab equipment operations, buildings and grounds management activities; and buildings and facilities maintenance, repairs, reconfiguration, remodeling, equipment use and replacement.

Group C

☐ Pilot Test Facilities Construction, Pilot Scale Research, Field Scale Demonstration, or Commercial Scale Application. Work typically involves facility construction, site preparation/excavation/groundbreaking, and/or demolition. This work would include construction, retrofit, replacement, and/or major modifications of laboratories, test facilities, energy system prototypes, and power generation infrastructure. Work may also involve construction and maintenance of utilities system right-of-ways, roads, vehicle test facilities, commercial buildings/properties, fuel refinery/mixing facilities, refueling facility, power plants, underground wells, and pipelines, and other types of energy research related facilities. This work may require new or modified regulatory permits, environmental sampling and monitoring requirements, master planning, public involvement, and environmental impact review. Includes work specific to DOE Site Operations and Lab operation activities involving building and facilities construction, replacement, decommissioning/demolition, site preparation, land use changes, or change in research facilities mission or operations.

B. PROPOSED PROJECT ALTERNATIVES

1. If applicable, list any project alternatives considered to achieve the project objectives.

C. PROJECT LOCATION

1. Provide a brief description of the project location (physical location, surrounding area, adjacent structures).

2. **Attach** a project site location map of the project work area.

D. ENVIRONMENTAL IMPACTS

NEPA procedures require evaluations of possible effects (including land use, energy resource use, natural, historic and cultural resources, and pollutants) from proposed projects on the environment.

1. Land Use

a. Characterize present land use where the proposed project would be located.

☐ Urban ☐ Industrial ☐ Commercial ☐ Agricultural
☐ Suburban ☐ Rural ☐ Residential ☐ Research Facilities
☐ Forest ☐ University Campus ☐ Other: _____

b. Identify the total size of the facility, structure, or system and what portion would be used for the proposed project.

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ENVIRONMENTAL QUESTIONNAIRE

c. Describe planned construction, installation, and/or demolition activities, i.e., roads, utilities system right-of-ways, parking lots, buildings, laboratories, storage tanks, fueling facilities, underground wells, pipelines, or other structures.
☐ No construction would be anticipated for this project.

d. Describe how land use would be affected by operational activities associated with the proposed project.
☐ No land areas would be affected.

e. Describe any plans to reclaim areas that would be affected by the proposed project.
☐ No land areas would be affected.

f. Would the proposed project affect any unique or unusual landforms (e.g., cliffs, waterfalls, etc.)?
☐ No ☐ Yes (describe)

g. Would the proposed project be located in or near local, state, or federal parks; forests; monuments; scenic waterways; wilderness; recreation facilities; or tribal lands? ☐ No ☐ Yes (describe)

2. Construction Activities and/or Operation

a. Identify project structure(s), power line(s), pipeline(s), utilities system(s), right-of-way(s) or road(s) that will be constructed and clearly mark them on a project site map or topographic map as appropriate. ☐ None

b. Would the proposed project require the construction of waste pits or settling ponds?
☐ No ☐ Yes (describe and identify location, and estimate surface area disturbed)

c. Would the proposed project affect any existing body of water? ☐ No ☐ Yes (describe)

d. Would the proposed project impact a floodplain or wetland? ☐ No ☐ Yes (describe)

e. Would the proposed project potentially cause runoff/sedimentation/erosion? ☐ No ☐ Yes (describe)

f. Would the proposed project include activities located on perma-frost, near fault zones, or involve fracturing, well drilling, geologic stimulation, sequestration, active seismic data collection, and/or deepwater operations?
☐ No ☐ Yes (describe)

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ENVIRONMENTAL QUESTIONNAIRE

g. Would the proposed project involve any of the following: nanotechnology; recombinant DNA or genetic engineering; facility decommissioning or disposition of equipment/materials; or management of radioactive wastes/materials?
☐ No ☐ Yes (describe)

3. Biological Resources

a. Identify any State or Federally listed endangered or threatened plant or animal species potentially affected by the proposed project.
☐ None

b. Would any designated critical habitat be affected by the proposed project? ☐ No ☐ Yes (describe)

c. Describe any impacts that construction would have on any other types of sensitive or unique habitats.
☐ No planned construction ☐ No habitats ☐ None ☐ Impact (describe)

d. Would any foreign substances/materials be introduced into ground or surface waters, soil, or other earth/geologic resource because of project activities? How would these foreign substances/materials affect the water, soil, biota, and geologic resources? ☐ No ☐ Yes (describe)

e. Would any migratory animal corridors be impacted or disrupted by the proposed project? ☐ No ☐ Yes (describe)

4. Socioeconomic and Infrastructure Conditions

a. Would local socio-economic changes result from the proposed project? ☐ No ☐ Yes (describe)

b. Would the proposed project generate increased traffic use of roads through local neighborhoods, urban or rural areas?
☐ No ☐ Yes (describe)

c. Would the proposed project require new transportation access (roads, rail, etc.)? Describe location, impacts, costs.
☐ No ☐ Yes (describe)

d. Would the proposed project create a significant increase in local energy usage? ☐ No ☐ Yes (describe)

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ENVIRONMENTAL QUESTIONNAIRE

5. Historical/Cultural Resources

a. Describe any historical, archaeological, or cultural sites in the vicinity of the proposed project; note any sites included on the National Register of Historic Places. ☐ None

b. Would construction or operational activities planned under the proposed project disturb any historical, archaeological, or cultural sites? ☐ No planned construction ☐ No historic sites ☐ Yes (describe) ☐ No Impact (discuss)

c. Has the State Historic Preservation Office been contacted with regard to this project? ☐ No ☐ Yes (describe)

d. Would the proposed project interfere with visual resources (e.g., eliminate scenic views) or alter the present landscape?
☐ No ☐ Yes (describe)

e. Would the proposed project be located on or adjacent to tribal lands, lands considered to be sacred, or lands used for traditional purposes? Describe any known tribal sensitivities for the proposed project area.

6. Atmospheric Conditions/Air Quality

a. Identify air quality conditions in the immediate vicinity of the proposed project with regard to attainment of National Ambient Air Quality Standards (NAAQS). This information is available under the Green Book Non-Attainment Areas for Criteria Pollutants located at http://www.epa.gov/air/oaqps/greenbk/astate.html

	Attainment	Non-Attainment
O_3 - 1 Hour	☐	☐
O_3 - 8 Hour	☐	☐
SO_x	☐	☐
PM - 2.5	☐	☐
PM - 10	☐	☐
CO	☐	☐
NO_2	☐	☐
Lead	☐	☐

b. Would proposed project require issuance of new or modified local, state, or federal air permits to perform project related work and activities? ☐ No ☐ Yes (describe)

c. Would the proposed project be in compliance with local and state air quality requirements? ☐ Yes
If not, please explain.

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d. Would the proposed project be classified as either a New Source or a major modification to an existing source?
☐ No ☐ Yes (describe)

e. What types of air emissions, including fugitive emissions, would be anticipated from the proposed project, and what would be the maximum annual rate of emissions for the project?

	Maximum per Year	Total for Project
☐ SO_x		
☐ NO_x		
☐ PM - 2.5		
☐ PM - 10		
☐ CO		
☐ CO_2		
☐ Lead		
☐ H_2S		
☐ Organic solvent vapors or other volatile organic compounds--List:		
☐ Hazardous air pollutants -- List:		
☐ Other -- List:		
☐ None		

f. Would any types of emission control or particulate collection devices be used?
☐ No ☐ Yes (describe, including collection efficiencies)

g. How would emissions be vented?

7. Hydrologic Conditions/Water Quality

a. What nearby water bodies may be affected by the proposed project? Provide distance(s) from the project site.

b. What sources would supply potable and process water for the proposed project?

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ENVIRONMENTAL QUESTIONNAIRE

c. Quantify the wastewater that would be generated by the proposed project.

	Gallons/day	Gallons/year
☐ Non-contact cooling water		
☐ Process water		
☐ Sanitary		
☐ Other -- describe:		
☐ None		

d. What would be the major components of each type of wastewater (e.g., coal fines)? ☐ No wastewater produced

e. Identify the local treatment facility that would receive wastewater from the proposed project.
☐ No discharges to local treatment facility

f. Describe how wastewater would be collected and treated. ☐ No wastewater produced

g. Would any run-off or leachates be produced from storage piles or waste disposal sites? ☐ No ☐ Yes (describe source)

h. Would project require issuance of new or modified water permits to perform project work or site development activities?
☐ No ☐ Yes (describe)

i. Where would wastewater effluents from the proposed project be discharged? ☐ No wastewater produced

j. Would the proposed project be permitted to discharge effluents into an existing body of water?
☐ No ☐ Yes (describe water use and effluent impact)

k. Would a new or modified National Pollutant Discharge Elimination System (NPDES) permit be required?
☐ No ☐ Yes (describe)

l. Would the proposed project adversely affect the quality or movement of groundwater? ☐ No ☐ Yes (describe)

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ENVIRONMENTAL QUESTIONNAIRE

m. Would the proposed project require issuance of an Underground Injection Control (UIC) permit?
☐ No ☐ Yes (describe)

n. Would the proposed project be located in or near a wellhead protection area, drinking water protection area, or above a sole source aquifer or underground source of drinking water (USDW)?
☐ No ☐ Yes (describe)

8. Solid and Hazardous Wastes

a. Identify and estimate wastes that would be generated from the project. Solid wastes are defined as any solid, liquid, semi-solid, or contained gaseous material that is discarded, has served its intended purpose, or is a manufacturing or mining by-product (See EPA Municipal Solid Waste and Municipal Solid Waste by State).

	Annual Quantity
☐ **Municipal solid waste (e.g., paper, plastic, etc.)**	
☐ **Coal or coal by-products**	
☐ **Other -- Identify:**	
☐ **Hazardous waste – Identify:**	
☐ **None**	

b. Would project require issuance of new or modified solid waste and/or hazardous waste related permits to perform project work activities? ☐ No ☐ Yes (explain)

c. How and where would solid waste disposal be accomplished?
☐ None generated
☐ On-site (identify and describe location)
☐ Off-site (identify location and describe facility and treatment)

d. How would wastes for disposal be transported?

e. Describe hazardous wastes that would be generated, treated, handled, or stored under this project. Hazardous waste information can be found at EPA Hazardous Waste website. ☐ None

f. How would hazardous or toxic waste be collected and stored? ☐ None used or produced

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g. If hazardous wastes would require off-site disposal, have arrangements been made with a certified TSD (Treatment, Storage, and Disposal) facility?

☐ Not required ☐ Arrangements not yet made ☐ Arrangements made with a certified TSD facility (identify)

9. Health/Safety Factors

a. Identify hazardous or toxic materials that would be used in the proposed project.

☐ None ☐ Hazardous or toxic materials that would be used (identify):

b. Describe the potential impacts of this project's hazardous materials on human health and the environment.

☐ None

c. Would there be any special physical hazards or health risks associated with the project? ☐ No ☐ Yes (describe)

d. Does a worker safety program exist at the location of the proposed project? ☐ No ☐ Yes (describe)

e. Would additional safety training be necessary for any new laboratory, equipment, or processes involved with the project?

☐ No ☐ Yes (describe)

f. Describe any increases in ambient noise levels to the public from construction and operational activities.

☐ None ☐ Increase in ambient noise level (describe)

g. Would project construction result in the removal of natural or other barriers that act as noise screens?

☐ No construction planned ☐ No ☐ Yes (describe)

h. Would hearing protection be required for workers? ☐ No ☐ Yes (describe)

10. Environmental Restoration and/or Waste Management

a. Would the proposed project include CERCLA removals or similar actions under RCRA or other authorities?

☐ No ☐ Yes (describe)

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b. Would the proposed project include siting, construction, and operation of temporary pilot-scale waste collection and treatment facilities or pilot-scale waste stabilization and containment facilities? ☐ No ☐ Yes (describe)

c. Would the proposed project involve operations of environmental monitoring and control systems?
☐ No ☐ Yes (describe)

d. Would the proposed project involve siting, construction, operation, or decommissioning of a facility for storing packaged hazardous waste for 90 days or less? ☐ No ☐ Yes (describe)

E. REGULATORY COMPLIANCE

1. For the following laws, describe any existing permits, new or modified permits, manifests, responsible authorities or agencies, contacts, etc., that would be required for the proposed project

a. Resource Conservation and Recovery Act (RCRA): ☐ None ☐ New Required ☐ Modification Required
Describe:

b. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA):
☐ None ☐ New Required ☐ Modification Required
Describe:

c. Toxic Substance Control Act (TSCA): ☐ None ☐ New Required ☐ Modification Required
Describe:

d. Clean Water Act (CWA): ☐ None ☐ New Required ☐ Modification Required
Describe:

e. Underground Storage Tank Control Program (UST): ☐ None ☐ New Required ☐ Modification Required
Describe:

f. Underground Injection Control Program (UIC): ☐ None ☐ New Required ☐ Modification Required
Describe:

g. Clean Air Act (CAA): ☐ None ☐ New Required ☐ Modification Required
Describe:

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h. Endangered Species Act (ESA): ☐ None ☐ New Required ☐ Modification Required
Describe:

i. Floodplains and Wetlands Regulations: ☐ None ☐ New Required ☐ Modification Required
Describe:

j. Fish and Wildlife Coordination Act (FWCA): ☐ None ☐ New Required ☐ Modification Required
Describe:

k. National Historic Preservation Act (NHPA): ☐ None ☐ New Required ☐ Modification Required
Describe:

l. Coastal Zone Management Act (CZMA): ☐ None ☐ New Required ☐ Modification Required
Describe:

2. Identify any other environmental laws and regulations (Federal, state, and local) for which compliance would be necessary for this project, and describe the permits, manifests, and contacts that would be required.

F. DESCRIBE ANY ISSUES THAT WOULD GENERATE PUBLIC CONTROVERSY REGARDING THE PROPOSED PROJECT. ☐ None

G. WOULD THE PROPOSED PROJECT PRODUCE ADDITIONAL DEVELOPMENT, OR ARE OTHER MAJOR DEVELOPMENTS PLANNED OR UNDERWAY, IN THE PROJECT AREA?

☐ No ☐ Yes (describe)

H. SUMMARIZE THE SIGNIFICANT IMPACTS THAT WOULD RESULT FROM THE PROPOSED PROJECT.

☐ None (provide supporting detail) ☐ Significant impacts (describe)

U.S. DEPARTMENT OF ENERGY

ENVIRONMENTAL QUESTIONNAIRE

I. PROVIDE A DESCRIPTION OF HOW THE PROJECT WOULD BE DECOMMISSIONED, INCLUDING THE DISPOSITION OF EQUIPMENT AND MATERIALS.

III. CERTIFICATION BY PROPOSER

I hereby certify that the information provided herein is current, accurate, and complete as of the date shown immediately below.

Signature: (b) (6) Date (mm/dd/yyyy): 03/16/2023

Typed Name: (b) (6)

Title: (b) (6)

Organization: EPRI

IV. REVIEW AND APPROVAL BY DOE

I hereby certify that I have reviewed the information provided in this questionnaire, have determined that all questions have been appropriately answered, and judge the responses to be consistent with the efforts proposed.

DOE Project Manager

Signature: Date (mm/dd/yyyy):

Typed Name:

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Reviewed: 12/3/2014
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U.S. DEPARTMENT OF ENERGY

ENVIRONMENTAL QUESTIONNAIRE

I. INSTRUCTIONS

The proposer shall prepare this Environmental Questionnaire (EQ) as accurately and completely as possible. Supporting information can be provided as attachments. The proposer must identify the location of the project and specifically describe the activities that would occur at that location. The proposer must provide specific information and quantities, regarding air emissions, wastewater discharges, solid wastes, etc., to facilitate the necessary review. In addition, the proposer must submit with this EQ a FINAL copy of the project's statement of work (SOW) or statement of project objective (SOPO) that will be used in the contract/agreement between the proposer and the U.S Department of Energy (DOE).

II. QUESTIONNAIRE

A. PROJECT SUMMARY

1. Solicitation/Project Number: _____ Proposer: Vermont Transco
2. This Environmental Questionnaire pertains to a: ☐ Recipient or Prime Contractor ☒ Sub-recipient or Subcontractor
3. Principal Investigator: (b) (6) Telephone Number: (b) (6)
4. Project Title: PV20 Power Flow Control Device
5. Expected Project Duration: 2024-2026
6. Location of Activities covered by **this** Environmental Questionnaire: (City/Township, County, State):
   Town: Milton County: Chittenden State: Vermont
7. List the full scope of activities planned (only for the location that is the subject of this Environmental Questionnaire).
   Complete natural and cultural resource assessments, apply for and obtain all necessary regulatory approvals/permits, develop access to the site, clear and dispose of trees and woody vegetation, perform site grading and below grade construction, construct steel and install Smart Valve Equipment, complete site restoration and commissioning.
8. List all other locations where work would be performed by the primary contractor of the project and subcontractor(s). Each of the following must have an individual Environmental Questionnaire.

Subcontractor or sub-recipient	Location of activities for this project
VT Transco LLC	Rutland VT & Milton VT

9. Identify and select the checkbox with the predominant project work activities under Group A, B, or C

Group A

☐ Routine administrative, procurement, training, and personnel actions. Contract activities/awards for management support, financial assistance, and technical services in support of agency business, programs, projects, and goals. Literature searches and information gathering, material inventories, property surveys; data analysis, computer modeling, analytical reviews, technical summary, conceptual design, feasibility studies, document preparation, data dissemination, and paper studies. Technical assistance including financial planning, assistance, classroom training, public meetings, management training, survey participation, academic contribution, technical consultation, and stakeholders surveys. Workshop and conference planning, preparation, and implementation which may involve promoting energy efficiency, renewable energy, and energy conservation.

STOP! *If all work activities related to this project can be classified and described within categories under Group A, proceed directly to Section III CERTIFICATION BY PROPOSER. No additional information is required.*
If project work activities are described in either Group(s) B or C; then continue filling out questionnaire.

U.S. DEPARTMENT OF ENERGY

ENVIRONMENTAL QUESTIONNAIRE

Group B

☐ Laboratory Scale Research, Bench Scale Research, Pilot Scale Research, Proof-of-Concept Scale Research, or Field Test Research. Work DOES NOT involve new building/facilities construction and site excavation/groundbreaking activities. This work typically involves routine operation of existing laboratories, commercial buildings/properties, offices and homes, project test facilities, factories/power plants, vehicles test stands and components, refueling facilities, utility systems, or other existing structures/facilities. Work will NOT involve major change in facilities missions and operations, land use planning, new/modified regulatory/operating permit requirements. Includes work specific to routine DOE Site operations and Lab research work activities, but NOT building construction and site preparation. DOE work typically involves laboratory facilities and lab equipment operations, buildings and grounds management activities; and buildings and facilities maintenance, repairs, reconfiguration, remodeling, equipment use and replacement.

Group C

☑ Pilot Test Facilities Construction, Pilot Scale Research, Field Scale Demonstration, or Commercial Scale Application. Work typically involves facility construction, site preparation/excavation/groundbreaking, and/or demolition. This work would include construction, retrofit, replacement, and/or major modifications of laboratories, test facilities, energy system prototypes, and power generation infrastructure. Work may also involve construction and maintenance of utilities system right-of-ways, roads, vehicle test facilities, commercial buildings/properties, fuel refinery/mixing facilities, refueling facility, power plants, underground wells, and pipelines, and other types of energy research related facilities. This work may require new or modified regulatory permits, environmental sampling and monitoring requirements, master planning, public involvement, and environmental impact review. Includes work specific to DOE Site Operations and Lab operation activities involving building and facilities construction, replacement, decommissioning/demolition, site preparation, land use changes, or change in research facilities mission or operations.

B. PROPOSED PROJECT ALTERNATIVES

1. If applicable, list any project alternatives considered to achieve the project objectives.

Not applicable as we believe that the smartvalve device is the only equipment that meets the needs of the project.

C. PROJECT LOCATION

1. Provide a brief description of the project location (physical location, surrounding area, adjacent structures).

Located in northwestern Vermont in a rural and primarily forested area. Surrounding land use includes transmission lines and associated ROW's, substation and residential parcels.

2. **Attach** a project site location map of the project work area.

See attached.

D. ENVIRONMENTAL IMPACTS

NEPA procedures require evaluations of possible effects (including land use, energy resource use, natural, historic and cultural resources, and pollutants) from proposed projects on the environment.

1. Land Use

a. Characterize present land use where the proposed project would be located.

☐ Urban	☐ Industrial	☐ Commercial	☐ Agricultural
☐ Suburban	☐ Rural	☐ Residential	☐ Research Facilities
☑ Forest	☐ University Campus	☑ Other: Electrical transmission facilities	

b. Identify the total size of the facility, structure, or system and what portion would be used for the proposed project.

The project size is estimated to be one acre, with up to 5 acres of clearing and disturbance required for access, material storage, site preparation, construction activities, ROW expansion, and maintain necessary clearances.

U.S. DEPARTMENT OF ENERGY

ENVIRONMENTAL QUESTIONNAIRE

c. Describe planned construction, installation, and/or demolition activities, i.e., roads, utilities system right-of-ways, parking lots, buildings, laboratories, storage tanks, fueling facilities, underground wells, pipelines, or other structures.
☐ No construction would be anticipated for this project.

Develop access to the site, clear and dispose of trees and woody vegetation, perform site grading and below grade construction, construct steel and install Smart Valve equipment.

d. Describe how land use would be affected by operational activities associated with the proposed project.
☐ No land areas would be affected.

Beyond the developed area on the parcel, land use would be impacted by the Project. Surrounding land use would not be impacted.

e. Describe any plans to reclaim areas that would be affected by the proposed project.
☐ No land areas would be affected.

All areas of disturbance associated with the construction of the project that are not developed, would be restored with seed and mulch following construction activities.

f. Would the proposed project affect any unique or unusual landforms (e.g., cliffs, waterfalls, etc.)?
☑ No ☐ Yes (describe)

The proposed project area consists primarily of northern hardwood forest with ledge hummocks and areas of steep terrain.

g. Would the proposed project be located in or near local, state, or federal parks; forests; monuments; scenic waterways; wilderness; recreation facilities; or tribal lands? ☐ No ☑ Yes (describe)

The proposed project location is a company-owned parcel that is adjacent to State of Vermont Sandbar Wildlife Management Area. The two parcels are seperated by Bear Trap Road.

2. Construction Activities and/or Operation

a. Identify project structure(s), power line(s), pipeline(s), utilities system(s), right-of-way(s) or road(s) that will be constructed and clearly mark them on a project site map or topographic map as appropriate. ☑ None

The exact project location and structures has not been determined. It is anticipated that the project will be sited on 136 acre parcel owned by VT Transco in Milton Vermont.

b. Would the proposed project require the construction of waste pits or settling ponds?
☑ No ☐ Yes (describe and identify location, and estimate surface area disturbed)

c. Would the proposed project affect any existing body of water? ☑ No ☐ Yes (describe)

The Lamoille River is located to the south and east of the parcel, but it would not be impacted by this project.

d. Would the proposed project impact a floodplain or wetland? ☑ No ☐ Yes (describe)

Although there are wetlands and floodplains located on the south and east areas of the proposed parcel, no impacts are anticipated to these resources.

e. Would the proposed project potentially cause runoff/sedimentation/erosion? ☐ No ☑ Yes (describe)

Although this is a possibility with any significant construction project, this area is well drained with rocky and sandy soils. The project would also obtain necessary permits.

f. Would the proposed project include activities located on perma-frost, near fault zones, or involve fracturing, well drilling, geologic stimulation, sequestration, active seismic data collection, and/or deepwater operations?
☑ No ☐ Yes (describe)

The only possibility would be the need to drill a ground water well, but that is not anticipated to be needed at this time.

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ENVIRONMENTAL QUESTIONNAIRE

g. Would the proposed project involve any of the following: nanotechnology; recombinant DNA or genetic engineering; facility decommissioning or disposition of equipment/materials; or management of radioactive wastes/materials?
☑ No ☐ Yes (describe)

3. Biological Resources

a. Identify any State or Federally listed endangered or threatened plant or animal species potentially affected by the proposed project.
☐ None

Northern Long-Eared Bat (NLEB) and several different plant species listed in Vermont occur on this parcel. All will be avoided or permits obtained as needed.

b. Would any designated critical habitat be affected by the proposed project? ☑ No ☐ Yes (describe)

There is potential Northern Long-Eared Bat habitat at the site, which could be impacted by tree clearing. Time of year restrictions or other permit conditions would mitigate impacts.

c. Describe any impacts that construction would have on any other types of sensitive or unique habitats.
☐ No planned construction ☑ No habitats ☐ None ☐ Impact (describe)

d. Would any foreign substances/materials be introduced into ground or surface waters, soil, or other earth/geologic resource because of project activities? How would these foreign substances/materials affect the water, soil, biota, and geologic resources? ☑ No ☐ Yes (describe)

e. Would any migratory animal corridors be impacted or disrupted by the proposed project? ☑ No ☐ Yes (describe)

4. Socioeconomic and Infrastructure Conditions

a. Would local socio-economic changes result from the proposed project? ☑ No ☐ Yes (describe)

b. Would the proposed project generate increased traffic use of roads through local neighborhoods, urban or rural areas?
☐ No ☑ Yes (describe)

Traffic would increase during construction. Transportation impacts would be considered as part of state permitting efforts.

c. Would the proposed project require new transportation access (roads, rail, etc.)? Describe location, impacts, costs.
☑ No ☐ Yes (describe)

d. Would the proposed project create a significant increase in local energy usage? ☑ No ☐ Yes (describe)

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ENVIRONMENTAL QUESTIONNAIRE

5. Historical/Cultural Resources

a. Describe any historical, archaeological, or cultural sites in the vicinity of the proposed project; note any sites included on the National Register of Historic Places. ☑ None

b. Would construction or operational activities planned under the proposed project disturb any historical, archaeological, or cultural sites? ☐ No planned construction ☑ No historic sites ☐ Yes (describe) ☐ No Impact (discuss)

c. Has the State Historic Preservation Office been contacted with regard to this project? ☑ No ☐ Yes (describe)

Not for this project, but they have been contacted with regard to a previous project at this location and have concurred that there are no historic sites present at the location.

d. Would the proposed project interfere with visual resources (e.g., eliminate scenic views) or alter the present landscape?
☐ No ☑ Yes (describe)

The project includes siting equipment on a parcel with existing electric infrastructure. Aesthetic impacts will be considered as part of state permitting.

e. Would the proposed project be located on or adjacent to tribal lands, lands considered to be sacred, or lands used for traditional purposes? Describe any known tribal sensitivities for the proposed project area.

There are no known sacred or tribal lands or lands used for traditional purposes within or adjacent to the proposed location. There are no known tribal sensitivities for this area.

6. Atmospheric Conditions/Air Quality

a. Identify air quality conditions in the immediate vicinity of the proposed project with regard to attainment of National Ambient Air Quality Standards (NAAQS). This information is available under the Green Book Non-Attainment Areas for Criteria Pollutants located at http://www.epa.gov/air/oaqps/greenbk/astate.html

	Attainment	Non-Attainment
O_3 - 1 Hour	☑	☐
O_3 - 8 Hour	☑	☐
SO_x	☑	☐
PM - 2.5	☑	☐
PM - 10	☑	☐
CO	☑	☐
NO_2	☑	☐
Lead	☑	☐

b. Would proposed project require issuance of new or modified local, state, or federal air permits to perform project related work and activities? ☑ No ☐ Yes (describe)

c. Would the proposed project be in compliance with local and state air quality requirements? ☑ Yes
If not, please explain.

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ENVIRONMENTAL QUESTIONNAIRE

d. Would the proposed project be classified as either a New Source or a major modification to an existing source?
☑ No ☐ Yes (describe)

e. What types of air emissions, including fugitive emissions, would be anticipated from the proposed project, and what would be the maximum annual rate of emissions for the project?

	Maximum per Year	Total for Project
☐ SO_x		
☐ NO_x		
☐ PM - 2.5		
☐ PM - 10		
☐ CO		
☐ CO_2		
☐ Lead		
☐ H_2S		
☐ Organic solvent vapors or other volatile organic compounds--List:		
☐ Hazardous air pollutants -- List:		
☐ Other -- List:		
☐ None		

f. Would any types of emission control or particulate collection devices be used?
☑ No ☐ Yes (describe, including collection efficiencies)

g. How would emissions be vented?

Power flow control devices do not involve combustion sources and therefore there are no emissions to be vented.

7. Hydrologic Conditions/Water Quality

a. What nearby water bodies may be affected by the proposed project? Provide distance(s) from the project site.

None. The Lamoille River is located near the south and eastern edge of the proposed site, however no impacts are anticipated to the River as part of this project.

b. What sources would supply potable and process water for the proposed project?

There are no anticipated requirements for potable or process water related to the project. However, if water is required it would be obtained through a permitted bedrock well.

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ENVIRONMENTAL QUESTIONNAIRE

c. Quantify the wastewater that would be generated by the proposed project.

	Gallons/day	Gallons/year
☐ Non-contact cooling water		
☐ Process water		
☐ Sanitary		
☐ Other -- describe:		
☑ None		

d. What would be the major components of each type of wastewater (e.g., coal fines)? ☑ No wastewater produced

e. Identify the local treatment facility that would receive wastewater from the proposed project.
☑ No discharges to local treatment facility

f. Describe how wastewater would be collected and treated. ☑ No wastewater produced

g. Would any run-off or leachates be produced from storage piles or waste disposal sites? ☑ No ☐ Yes (describe source)

h. Would project require issuance of new or modified water permits to perform project work or site development activities?
☑ No ☐ Yes (describe)

i. Where would wastewater effluents from the proposed project be discharged? ☑ No wastewater produced

j. Would the proposed project be permitted to discharge effluents into an existing body of water?
☑ No ☐ Yes (describe water use and effluent impact)

k. Would a new or modified National Pollutant Discharge Elimination System (NPDES) permit be required?
☐ No ☑ Yes (describe)

Possibly for stormwater runoff, but not for the discharge of process water or discharge of other pollutants from a point source.

l. Would the proposed project adversely affect the quality or movement of groundwater? ☑ No ☐ Yes (describe)

U.S. DEPARTMENT OF ENERGY

ENVIRONMENTAL QUESTIONNAIRE

m. Would the proposed project require issuance of an Underground Injection Control (UIC) permit?
☑ No ☐ Yes (describe)

n. Would the proposed project be located in or near a wellhead protection area, drinking water protection area, or above a sole source aquifer or underground source of drinking water (USDW)?
☑ No ☐ Yes (describe)

8. Solid and Hazardous Wastes

a. Identify and estimate wastes that would be generated from the project. Solid wastes are defined as any solid, liquid, semi-solid, or contained gaseous material that is discarded, has served its intended purpose, or is a manufacturing or mining by-product (See EPA Municipal Solid Waste and Municipal Solid Waste by State).

	Annual Quantity
☐ **Municipal solid waste (e.g., paper, plastic, etc.)**	
☐ **Coal or coal by-products**	
☑ **Other -- Identify:** construction and shipping	3.21 tons
☐ **Hazardous waste – Identify:**	
☐ **None**	

b. Would project require issuance of new or modified solid waste and/or hazardous waste related permits to perform project work activities? ☑ No ☐ Yes (explain)

c. How and where would solid waste disposal be accomplished?
☐ None generated
☐ On-site (identify and describe location)
☑ Off-site (identify location and describe facility and treatment)

Construction debris would be shipped off site for disposal at a permitted solid waste facility.

d. How would wastes for disposal be transported?

Roll off dumpsters.

e. Describe hazardous wastes that would be generated, treated, handled, or stored under this project. Hazardous waste information can be found at EPA Hazardous Waste website. ☑ None

f. How would hazardous or toxic waste be collected and stored? ☑ None used or produced

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ENVIRONMENTAL QUESTIONNAIRE

g. If hazardous wastes would require off-site disposal, have arrangements been made with a certified TSD (Treatment, Storage, and Disposal) facility?

☑ Not required ☐ Arrangements not yet made ☐ Arrangements made with a certified TSD facility (identify)

9. Health/Safety Factors

a. Identify hazardous or toxic materials that would be used in the proposed project.

☑ None ☐ Hazardous or toxic materials that would be used (identify):

b. Describe the potential impacts of this project's hazardous materials on human health and the environment.

☑ None

c. Would there be any special physical hazards or health risks associated with the project? ☐ No ☑ Yes (describe)

Energized electrical equipment.

d. Does a worker safety program exist at the location of the proposed project? ☐ No ☑ Yes (describe)

The operating entity would be an electrical transmission company with an established Safety Program including trainings, qualified workers, safety meetings, tailboards, manuals, etc.

e. Would additional safety training be necessary for any new laboratory, equipment, or processes involved with the project?

☐ No ☑ Yes (describe)

Workers would be trained on how to install, operate, and maintain the project equipment with particular emphasis on electrical safety concerns.

f. Describe any increases in ambient noise levels to the public from construction and operational activities.

☐ None ☑ Increase in ambient noise level (describe)

Noise emitted from SmartValves ranges from 57 to 82 dBA at the origin point. However,since sound pressure is inversely proportional to distance,it is significantly reduced at/beyond the substation fenceline. Smart Wires has achieved 45 dBA at the fenceline for past projects

g. Would project construction result in the removal of natural or other barriers that act as noise screens?

☐ No construction planned ☐ No ☑ Yes (describe)

Removal of trees and other woody vegetation would be necessary to perform the project. However, the remaining forest and trees would provide barriers and noise screening.

h. Would hearing protection be required for workers? ☐ No ☑ Yes (describe)

Hearing protection is required when using impact guns for steel erection.

10. Environmental Restoration and/or Waste Management

a. Would the proposed project include CERCLA removals or similar actions under RCRA or other authorities?

☑ No ☐ Yes (describe)

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b. Would the proposed project include siting, construction, and operation of temporary pilot-scale waste collection and treatment facilities or pilot-scale waste stabilization and containment facilities? ☑ No ☐ Yes (describe)

c. Would the proposed project involve operations of environmental monitoring and control systems?
☑ No ☐ Yes (describe)

d. Would the proposed project involve siting, construction, operation, or decommissioning of a facility for storing packaged hazardous waste for 90 days or less? ☑ No ☐ Yes (describe)

E. REGULATORY COMPLIANCE

1. For the following laws, describe any existing permits, new or modified permits, manifests, responsible authorities or agencies, contacts, etc., that would be required for the proposed project

a. Resource Conservation and Recovery Act (RCRA): ☑ None ☐ New Required ☐ Modification Required
Describe:

b. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA):
☑ None ☐ New Required ☐ Modification Required
Describe:

c. Toxic Substance Control Act (TSCA): ☑ None ☐ New Required ☐ Modification Required
Describe:

d. Clean Water Act (CWA): ☑ None ☐ New Required ☐ Modification Required
Describe:

e. Underground Storage Tank Control Program (UST): ☑ None ☐ New Required ☐ Modification Required
Describe:

f. Underground Injection Control Program (UIC): ☑ None ☐ New Required ☐ Modification Required
Describe:

g. Clean Air Act (CAA): ☑ None ☐ New Required ☐ Modification Required
Describe:

U.S. DEPARTMENT OF ENERGY

ENVIRONMENTAL QUESTIONNAIRE

h. Endangered Species Act (ESA): ☑ None ☐ New Required ☐ Modification Required
Describe:

No ESA permit is anticipated, however changes to bat regulations could change this in the future before the project is constructed. State T&E Takings Permit may be required.

i. Floodplains and Wetlands Regulations: ☑ None ☐ New Required ☐ Modification Required
Describe:

It is not anticipated that floodplain or wetland permits will be needed for this project.

j. Fish and Wildlife Coordination Act (FWCA): ☑ None ☐ New Required ☐ Modification Required
Describe:

It is not anticipated that Fish and Wildlife Coordination Act will be required for this Project.

k. National Historic Preservation Act (NHPA): ☑ None ☐ New Required ☐ Modification Required
Describe:

It is not anticipated that any historic properties are present within the proposed project location.

l. Coastal Zone Management Act (CZMA): ☑ None ☐ New Required ☐ Modification Required
Describe:

N/A

2. Identify any other environmental laws and regulations (Federal, state, and local) for which compliance would be necessary for this project, and describe the permits, manifests, and contacts that would be required.

Vermont Section 248 Petition for Certificate of Public Good, VT Construction General Permit or NPDES Individual Permit for Construction sites, and possibly VT T&E Takings Permit.

F. DESCRIBE ANY ISSUES THAT WOULD GENERATE PUBLIC CONTROVERSY REGARDING THE PROPOSED PROJECT. ☐ None

Potential public and/or regulatory concerns could include aesthetics, noise, tree clearing, and or relocating (Taking) of State listed threatened or endangered species (if required).

G. WOULD THE PROPOSED PROJECT PRODUCE ADDITIONAL DEVELOPMENT, OR ARE OTHER MAJOR DEVELOPMENTS PLANNED OR UNDERWAY, IN THE PROJECT AREA?

☑ No ☐ Yes (describe)

H. SUMMARIZE THE SIGNIFICANT IMPACTS THAT WOULD RESULT FROM THE PROPOSED PROJECT.

☑ None (provide supporting detail) ☐ Significant impacts (describe)

Tree and woody vegetation clearing (potential impacts on NLEB), potential relocation of State listed Threatened or Endangered Species (if required), Site grading and excavation, transmission ROW expansion, aesthetic impacts, and noise impacts. VELCO would seek state and federal permits to authorize impact. Permits would also include special mitigation activities such as transplanting state listed plant species away from the work area. NLEB impacts would likely be mitigated by clearing during special times of the year,

U.S. DEPARTMENT OF ENERGY

ENVIRONMENTAL QUESTIONNAIRE

I. PROVIDE A DESCRIPTION OF HOW THE PROJECT WOULD BE DECOMMISSIONED, INCLUDING THE DISPOSITION OF EQUIPMENT AND MATERIALS.

Removal of all above grade material and equipment (Smart Valve equipment, switches, poles, wires, fencing, etc.), which will be recycled or taken to an approved disposal facility. Below grade foundations will be broken up and removed to at least two feet below grade. Remaining yard surface will be covered with top soil seeded and mulched. Upon herbaceous vegetation establishment the area(s) will be allowed to re-vegetate with woody species provided the area is not re-purposed requiring additional vegetation maintenance.

III. CERTIFICATION BY PROPOSER

I hereby certify that the information provided herein is current, accurate, and complete as of the date shown immediately below.

Signature: (b) (6) Date (mm/dd/yyyy): 03/10/2023

Typed Name: (b) (6)

Title: (b) (6)

Organization: VELCO

IV. REVIEW AND APPROVAL BY DOE

I hereby certify that I have reviewed the information provided in this questionnaire, have determined that all questions have been appropriately answered, and judge the responses to be consistent with the efforts proposed.

DOE Project Manager

Signature: Date (mm/dd/yyyy):

Typed Name:

(b) (4)

DISCLOSURE OF LOBBYING ACTIVITIES

Complete this form to disclose lobbying activities pursuant to 31 U.S.C.1352

OMB Number: 4040-0013
Expiration Date: 02/28/2022

1. * Type of Federal Action:
- [ ] a. contract
- [ ] b. grant
- [x] c. cooperative agreement
- [ ] d. loan
- [ ] e. loan guarantee
- [ ] f. loan insurance

2. * Status of Federal Action:
- [x] a. bid/offer/application
- [ ] b. initial award
- [ ] c. post-award

3. * Report Type:
- [x] a. initial filing
- [ ] b. material change

4. Name and Address of Reporting Entity:

[x] Prime [ ] SubAwardee

*Name: Electric Power Research Institute (EPRI)

*Street 1: 942 Corridor Park Blvd. Street 2:

*City: Knoxville State: TN: Tennessee Zip: 37932

Congressional District, if known: CA-016

5. If Reporting Entity in No.4 is Subawardee, Enter Name and Address of Prime:

6. * Federal Department/Agency:

U. S. Department of Energy

7. * Federal Program Name/Description:

Grid Deployment Office (GDO)
Office of Clean Energy Demonstrations (OCED)

CFDA Number, *if applicable:*

8. Federal Action Number, *if known:*

DE-FOA-0002740

9. Award Amount, *if known:*

$

10. a. Name and Address of Lobbying Registrant:

Prefix: *First Name: Funds will not be used for lobbying Middle Name:

*Last Name: Funds will not be used for lobbying Suffix:

*Street 1: Street 2:

*City: State: Zip:

b. Individual Performing Services (including address if different from No. 10a)

Prefix: *First Name: Funds will not be used for lobbying Middle Name:

*Last Name: Funds will not be used for lobbying Suffix:

*Street 1: Street 2:

*City: State: Zip:

11. Information requested through this form is authorized by title 31 U.S.C. section 1352. This disclosure of lobbying activities is a material representation of fact upon which reliance was placed by the tier above when the transaction was made or entered into. This disclosure is required pursuant to 31 U.S.C. 1352. This information will be reported to the Congress semi-annually and will be available for public inspection. Any person who fails to file the required disclosure shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

*** Signature:** (b) (6)

***Name:** Prefix: * First Name: (b) (6) Middle Name:

*Last Name: (b) (6) Suffix:

Title: (b) (6) **Telephone No.:** **Date:** 03/13/2023

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Standard Form - LLL (Rev. 7-97)

DISCLOSURE OF LOBBYING ACTIVITIES

Complete this form to disclose lobbying activities pursuant to 31 U.S.C.1352

OMB Number: 4040-0013
Expiration Date: 02/28/2022

1. * Type of Federal Action:
- [ ] a. contract
- [x] b. grant
- [ ] c. cooperative agreement
- [ ] d. loan
- [ ] e. loan guarantee
- [ ] f. loan insurance

2. * Status of Federal Action:
- [x] a. bid/offer/application
- [ ] b. initial award
- [ ] c. post-award

3. * Report Type:
- [x] a. initial filing
- [ ] b. material change

4. Name and Address of Reporting Entity:

[ ] Prime [x] SubAwardee Tier if known:

* Name: Vermont Transco LLC
* Street 1: 366 Pinnacle Ridge Road
Street 2:
* City: Rutland
State: VT: Vermont
Zip: 05763
Congressional District, if known: VT-001

5. If Reporting Entity in No.4 is Subawardee, Enter Name and Address of Prime:

* Name: Electric Power Research Institute (EPRI)
* Street 1: 942 Corridor Park Blvd.
Street 2:
* City: Knoxville
State: TN: Tennessee
Zip: 37932
Congressional District, if known:

6. * Federal Department/Agency:

U. S. Department of Energy

7. * Federal Program Name/Description:

DE-FOA-0002740 "Bipartisan Infrastructure Law Section 40107. Grid Resilience and Innovation Partnerships (GRIP)

CFDA Number, *if applicable:*

8. Federal Action Number, *if known:*

9. Award Amount, *if known:*

$

10. a. Name and Address of Lobbying Registrant:

Prefix:
* First Name: Funds will not be used for lobbying
Middle Name:
* Last Name: Funds will not be used for lobbying
Suffix:
* Street 1:
Street 2:
* City:
State:
Zip:

b. Individual Performing Services (including address if different from No. 10a)

Prefix:
* First Name: Funds will not be used for lobbying
Middle Name:
* Last Name: Funds will not be used for lobbying
Suffix:
* Street 1:
Street 2:
* City:
State:
Zip:

11. Information requested through this form is authorized by title 31 U.S.C. section 1352. This disclosure of lobbying activities is a material representation of fact upon which reliance was placed by the tier above when the transaction was made or entered into. This disclosure is required pursuant to 31 U.S.C. 1352. This information will be reported to the Congress semi-annually and will be available for public inspection. Any person who fails to file the required disclosure shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

* Signature: (b) (6)

*Name: Prefix: * First Name: (b) (6) Middle Name:

* Last Name: (b) (6) Suffix:

Title: SENIOR DIRECTOR OF TRANSMISSION Telephone No.: (b) (6) Date: (b) (6)

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Waiver of the Buy America Requirement for Infrastructure Projects

Electric Power Research Institute, Inc. (EPRI), UEI # JBV2SMLRBK29, is seeking a *Nonavailability Waiver* for the use of SmartValves, a digital power flow control technology that quickly solves transmission grid issues to create extra capacity. It is a patented and award-winning device that can push power off overloaded lines and pull power onto underutilized lines. Distinct from legacy technologies based on copper and steel, SmartValve leverages a modular, transformerless approach, sealed forced air cooling, integrated fast–acting bypass, and deployment flexibility to deliver greater solution value.

SmartValves are a unique technology that is manufactured in the United States by only one company, Smart Wires Inc., UEI # D9E2S7X8V917. Therefore, Smart Wires Inc. is the sole potential supplier for this technology. The component parts for the SmartValves are both domestically and internationally sourced.

The total estimated project cost, DOE and subrecipient cost-share amounts are summarized below:

Total Project Cost	DOE Request	Subrecipient Cost-Share
$36,034,716	$18,017,358	$18,017,358

The project would be located in Vermont where the existing Phase Shifting Transformer (PST) has been required to operate in a condition that is exceeding the limitations of the unit and likely contributed to a recent failure of the PST. An estimated 21 SmartValve units would be installed. The use of SmartValve technology would provide continuous and more precise flow control to maximize power flows across the interface. The value of the enhanced power flows would maximize the value of renewable generation in northern New York, as well as increase the power flow capabilities across the regional interface.

List of Items/Goods to Waive:

Name	Cost	Country of Origin	PSC and NAICS codes
SmartValve 10-1800 v1.04	(b) (4) [redacted] per unit (b) (4) [redacted] total	U.S. with component parts from U.S., Belgium, China, England, Germany, South Korea, Thailand, Bulgaria, Japan, Mexico	335311

Without a waiver, it is unlikely the project would move forward and the transmission challenges facing the communities that might be mitigated with SmartValves would go unmet. Smart Wires deployments have historically resulted in 170 to 1500 MW of unlocked capacity on existing transmission assets. Use of SmartValves in this project supports the objectives of this FOA to potentially increase efficiency and transmission grid reliability.

Community Benefits Plan

Applicant: Electric Power Research Institute, Inc. (EPRI)

Principal Investigator: (b) (6)

Major Participants: EPRI, VELCO, Smart Wires

Title: Optimizing Interregional Transfer Capacity Using Advanced Power Flow Control

Community and Labor Engagement

This project aims to collaborate with and install Smart Wires advanced power flow control equipment (SmartValve) in one location. In collaboration with Vermont Electric Power Company (VELCO), the target community is Milton, VT (Chittenden County). This location bridges inter-state transmission and faces challenges with fluctuation in renewable energy generation. In addition, the SmartValve equipment will be assembled in St. Petersburg, FL (Pinellas County).

The impact of large renewable generation projects to the local and regional economy can be far-reaching. This project will advance numerous community benefits including workforce training, the creation of new jobs leading to long-term careers, increased energy resilience, and enhanced interregional cooperation for outage management. Utility-scale improvements to transmission systems leveraging Smart Wires technology in Vermont will support community decarbonization and grid resilience by spurring the incorporation of additional renewables onto the transmission system locally, and in the future across the US.

Background

Vermont Electric Power Company

VELCO is aligned with DOE's view of stakeholder engagement as an effective mechanism to strengthen project outcomes and seeks to implement a stakeholder engagement process that ensures all stakeholders have an opportunity for early, ongoing, and meaningful participation in discussions about reliability and resilience-driven, infrastructure projects. In addition to the inclusion of community officials, local residents, and landowners, VELCO coordinates and seeks input from specialized organizations with varying interests ranging from environmental protection, economic growth, and rural resilience. Incorporating the voice of these organizations helps meet the short- and long-term needs of the broader community.

In order to keep stakeholders informed, VELCO's community engagement staff develop project messaging about the need and benefits, conduct public meetings and one-one-one meetings with community stakeholders before, during, and after construction, including media outlets. VELCO also maintains project websites for public consumption of project information, including progress updates, public meeting calendars, and stakeholder feedback forms. In addition, VELCO manages a statewide grid reliability, the Vermont System Planning Committee (VSPC)

comprised of a diverse stakeholder body which includes representatives from electric distribution and energy efficiency, supply and demand, transmission, and public-appointed members (residential consumers, commercial and industrial consumers, environmental protection and justice, and town and regional planning commissions).

Smart Wires

Smart Wires will be the key vendor of SmartValve advanced power flow control equipment and will engage with its workforce partners that assemble and install SmartValve devices as part of this project. SmartValve assembly takes place in St. Petersburg, FL, a municipality with several districts designated as disadvantaged communities by the US Climate and Economic Justice Screening Tool. These districts primarily face challenging health and workforce development issues, which are compounded by historical practices that limit resident access to reliable jobs. SmartValve installation activities in the LRGV occur in a wide swath of districts across multiple counties that have also been designated as disadvantaged communities. These districts face a wider range of challenges around health, housing, and energy burdens, including particulate matter in the air. The project will continue to conduct outreach to both economic development and environmental justice organizations.

Social Characterization Assessment

The preliminary siting evaluated the placement of the Smart Valve device on parcels of land owned by the local transmission utility company, which will result in less landowner impacts as site acquisition is not necessary. The actual siting of the project will be determined as part of alternatives analyses including the evaluation of other sites along key circuits, for example VELCO's K20 circuit connecting VT and NY.

EPRI will coordinate with utility partners to engage with impacted communities and landowners to solicit feedback, understand impacts, and concerns and develop strategies to lessen and mitigate project impacts. The engagement efforts will also include listening sessions to further explain the benefits of the project. Input from community leaders on topical priorities will be imperative to guiding further communication about project benefits.

VELCO has worked closely with the town of Milton in the past and more recently as part of upgrades to a local substation, as well as through coordination with the community. VELCO has secured interest from the Town of Milton for this project, as outlined in their letter of support. The high voltage transmission line running through Milton is a key location for the technical aspects of managing grid stability. Milton, VT, can benefit from the jobs and job-training opportunities this proposal can provide. In Vermont, VELCO will leverage existing relationships with community-based non-profits to engage underserved and under-represented populations.

Initial Stakeholder Analysis Summary and Engagement Methods and Timeline Table

Location	Name of Org.	Type	Engagement Methods
Milton, VT and Chittenden County	Town of Milton	Town Manager Select Board	2 Select Board Meetings 2 on-site tours
	Development Review Board	Municipal Committee	1 meeting, more if required
	Milton Public Schools St. Albans Public Schools Burlington Public Schools S. Burlington Public	Education	1 classroom visit 1 on-site tour
	University of Vermont	Land grant university	1 virtual learning opportunity 1 on-site tour
Northfield, VT	Norwich University	Nation's oldest private military college	1 virtual learning opportunity 1 on-site tour
Randolph, VT	Vermont Technical College	State college	1 virtual learning opportunity 1 on-site tour
Vermont Statewide	Vermont Energy Education Partnership (VEEP)	Non-profit	Develop curriculum for state-wide distribution (M9.3.1) 1 on-site tour
	Vermont Works for Women (VWW)	Labor, training, community organization	1 on-site tour 1 virtual learning opportunity Write-up on project to include in careers material
	Vermont Distribution Utilities	17 utilities: 1 investor-owned 2 cooperatives 14 municipals	1 presentation at VELCO-led and DU-member Operating Committee 1 on-site tour
	Efficiency Vermont	Energy Efficiency Utility	1 virtual briefing 1 on-site tour
	Vermont Department of Public Service	State government	1 virtual briefing 1 on-site tour
	Vermont System Planning Committee	Statewide electric grid reliability planning group	1 presentation at quarterly meeting

VELCO has a decade-long partnership with the Vermont Energy Education Program (VEEP) which helps Vermont students, teachers, and school communities build a deep understanding of energy and climate with interactive workshops, equipment, and action programs. VEEP and VELCO will develop an Advanced Power Flow Control Technology (APFC) curriculum to bring the Smartwires technology into Vermont's classrooms in some of our most underserved communities.

VELCO has recently established a partnership with Vermont Works for Women (VWW). VWW is a statewide nonprofit working to promote economic justice by advancing gender equity and supporting women and youth at every stage of their career journeys. The SmartValves installation presents a new opportunity for engagement with VWW to scope, design, permit, install, and leverage the resulting data from controlling power flows with VWW participants.

Workforce and Community Agreements Table

#	Organization	Type	Date
1	Town of Milton, VT	Letter of Support (conditional)	March 14, 2023

Engagement Evaluation Strategy & Resource Summary

The project partners are committed to community engagement, building on a strong track record to lower customer costs, improve system reliability, and giving ratepayers an opportunity to shape our shared energy future. Stakeholder concerns and questions will be tracked during public meetings, as described in the Stakeholder Analysis Table. Outreach practices are integrated into the project management process, which include strategies to earn stakeholder support in advance of a regulatory filing. Team members will engage community partners while there is still time to make accommodations in projects execution. This will include construction timelines, scheduling, and aesthetic impacts. Transparency and engagement around the management of this technology project will inspire a new generation of Vermont workers.

The project has structured Task 9 to encompass the management and execution of Community Benefits Plan activities. All CBP resources and milestones are summarized at the end.

Investing in the American Workforce

Plan to Attract, Train, and Retain a Skilled and Well Qualified Workforce

Smart Wires

Smart Wires will allocate on-the-ground resources to train the local workforce, both utility workers and subcontractors, on the installation, operations, and maintenance of the SmartValve devices, including the advanced data management practices for a digital grid operation. Smart Wires will also expand domestic manufacturing and jobs and diversify component supply chains from local and regional suppliers. Smart Wires will also elicit capital infusions for manufacturing expansion required to accommodate increased demand.

VELCO

- VELCO actively seeks to hire locally as well as from underrepresented groups through the Vermont State sponsored job board as well as a variety of sites targeting specific applicant pools including: BIPOC, disabled individuals, military veterans, etc.
- VELCO sponsors a robust paid summer internship program, which primarily engages Vermont youth. Recruiting efforts are helped in part by regularly attendance at local high school, college, and university job fairs and information sessions.
- VELCO's retention efforts focus primarily on providing competitive pay and benefits, actively encouraging and supporting employee engagement, and providing career development opportunities and support.
- VELCO offers many opportunities for employees to be involved and to provide input about

working conditions and workplace culture. For example, our Transform Team is focused on culture broadly and over the past couple of years on diversity, equity, inclusion and belonging.

Violation Disclosures

EPRI has never had any violations related to labor policies. EPRI has a history of supporting our workforce and potential workforce through fair labor practices. EPRI has stringent standards and policies in place to ensure that EPRI is compliant with all labor laws and regulations and exceeds many requirements.

VELCO has also indicated that they have no violations to pertinent labor laws to disclose.

Job Retention and/or Transition

VELCO anticipates the majority of the work scope in this project will use internal labor for the substation-based civil and electrical work associated with SmartValve installations which will require ongoing labor and training involved in its operation including advanced data management training, and maintenance of the SmartValve devices. Based on expected resources to be engaged as part of the project, VELCO intends on leveraging its existing vendor list, of which about 45% of the vendors are in-state.

This project aims to unlock significant amounts of renewable power deliverability through SmartValve projects in two distinct U.S. energy markets, thereby establishing broader adoption of SmartValves to address the myriad of similar network constraints affecting these systems. This continual relevance and necessity for SmartValve installations ensures that the initial labor engagements for these SmartValve deployments will retain their importance and provide ongoing job opportunities as additional SmartValve installations are pursued. The number of SmartValve installations will be propelled to even higher levels by the increasing number of contemplated renewable energy projects. The increasing number of SmartValve installations will in turn help to support the increasing numbers of jobs by allowing renewable energy projects to move forward.

Workforce Development Opportunities

Training and education of qualified electrical workers on the safe and proper installation, operation, and maintenance practices of SmartValve units will be supported for all deployments. The project team and Smart Wires will engage local qualified electrical worker leadership, including union labor, to ensure their participation and expertise to guide required substation modifications. Establishing these labor relationships at the onset of the project will also help inform plans for regional activity, as this program has been designed to catalyze further adoption and SmartValve installations across these regions, as the initial deployments solve common issues that grid operators across the country face in integrating and operating systems with increasing levels of renewable generation.

To provide proper training on installation, operation and maintenance, the project team will host multiple training sessions, M9.2.1, in coordination with workforce leadership. Workforce

leadership will be expected to review training material ahead of dissemination.

The project team will work with the utility and local labor organizations to augment communication around the in-built apprenticeship programs associated with electrical transmission work which will clearly highlight the career advancement opportunities associated with this line of work. Given unemployment demographics in these districts such information must be effectively communicated to ensure residents are made aware of such opportunities.

All partners in this project are committed to creating a learning environment for employees to provide them opportunities to develop their strengths, broaden their experiences, and take on new roles and responsibilities within the company.

Worker's Rights

VELCO does not have a union-based workforce. VELCO provides each employee with an Employee Manual which covers a myriad of rights and expectations including conduct, ethics, whistleblower protections, anti-harassment, employee concerns, equal opportunity, nondiscrimination, pay transparency, ADA accommodations, as well as information on employment policies, employee benefits, compensation, paid time off, employee development, health, safety, security, and sustainability.

Strategies, Milestones and Timelines & Resource Summary

The project has structured Task 9 to encompass the management and execution of Community Benefits Plan activities. All CBP resources and milestones are summarized at the end.

Diversity, Equity, Inclusion, and Accessibility (DEIA)

A firm commitment to diversity has been fundamental to EPRI's continued success over the past 50 years and we are pleased to partner with organizations that share that commitment. DEIA measures will primarily be driven through several workforce development and community engagement activities.

Background

EPRI has established a Diversity, Equity, and Inclusion (DE&I) Council with the mission to drive organizational change through the implementation of initiatives and provision of results-oriented governance and oversight in support of EPRI's DE&I vision. In alignment with EPRI's commitment, the DE&I Council is dedicated to: (1) building cultural awareness both internally and externally in our business engagements through consideration and respect for the unique perspectives, experiences, and needs of employees, members, research partners, and communities (2) fostering an environment that retains and attracts diverse talent, provides equitable access to opportunities for (and outcomes from) professional growth and career advancement, and values diversity of life experiences and perspectives, and (3) fully integrating diversity and inclusion into all aspects of our business strategy and operations including workforce development, career advancement, member and collaborator engagement, training, corporate communications, recruitment and hiring practices, and our research portfolio.

- EPRI is fully committed to fostering an inclusive, supportive, and equitable environment for all employees, contractors, vendors, members, and collaborators. We are strongly committed to a culture where individuals are valued for their unique backgrounds, skillsets, and experiences, and are empowered to reach their fullest potential.
- EPRI has an employee-led Diversity, Equity, and Inclusion Council with a mission to drive organizational change through results-oriented oversight including hosting an education page on our employee intranet that provides information and resources to foster greater understanding of what diversity, equity, and inclusion mean in practice.
- EPRI provides mandatory employee training annually on various DE&I related topics through a trusted external Ethics and Compliance Training partner. Previous topics include: "A Look at Unconscious Bias at Work," "Respectful Communication," and "Understanding and Preventing Microaggressions."

During the past year, with determination, focus, and the dedicated multi-disciplinary Transform Team, VELCO advanced our Diversity, Equity, and Inclusion efforts. This year, VELCO's Transform Team made DEI their core focus as they organized, recruited, and created a team to guide VELCO's initial steps into this critical work. 2022 work included using a proven tool, *The Global, Diversity, Equity, and Inclusion Benchmark* framework to complete 14 assessments covering much of our corporate structure to learn where we are in our DEI journey.

In a concerted effort to increase diversity of candidates within the hiring pool, VELCO is engaging with different platforms to share our position openings beyond our usual posting areas. Some of the organizations VELCO now partners with include Vermont Professionals of Color Network, Vermont Works for Women, and Handshake. In addition, VELCO's procurement policy supports several priority metrics to emphasize vendors that provide demonstrable evidence that they have a binding, implemented sustainability policy that governs its business practices and considers Vermont-based BIPOC and women-owned vendors.

Smart Wires has established a Diversity, Equity, Inclusion, and Belonging (DEIB) Committee comprised of employees from a broad mix of backgrounds and seniority who are committed to identifying and breaking down barriers to DEI in our workspace and beyond. The committee and company writ large strive to promote diversity by fostering relationships, drawing representation, and encouraging leadership in the communities in which we live and work. Foundational to the mission is promoting a culture of safety, respect, and appreciation for all employees, regardless of race, gender, religion, ethnicity, disability, or sexual orientation. That means taking on an explorative process, both qualitatively and quantitatively, to focus efforts and establish DEIB baselines while developing the training and systems we need to move beyond equality and promote equity in employee opportunities for success and growth.

Strategies, Milestones, and Timelines & Resource Summary

The project has structured Task 9 to encompass the management and execution of Community Benefits Plan activities. All CBP resources and milestones are summarized at the end.

Justice40 Initiative

Identification of Disadvantaged Communities

Based on the criteria recognized by the Council on Environmental Quality Climate and Economic Justice Screening Tool, numerous disadvantaged communities are in and around the proposed SmartValve installation and manufacturing sites.

Over 15 census tracks in Vermont are identified as disadvantaged communities in the Climate and Economic Justice Screening Tool. Impacted communities in Vermont would be the host town of Milton and neighborhood around the location where this equipment will be installed. The proposed Milton site is located in northwestern Vermont in a rural and primarily forested area. Surrounding land use includes transmission lines and associated right-of-ways, substation and residential parcels. The project size is estimated to be one acre, with up to five acres of clearing and disturbance will be required for access, material storage, site preparation, construction activities, right-of-way expansion, and maintain necessary clearances.

Location	DAC	Environmental and Socioeconomic Factors
Milton, VT	N	Some areas are >95th percentile Unemployment (EJScreen)
Burlington, VT	Y	Some areas are >95th percentile Low Income, Superfund Proximity, Asthma Some areas are >90th percentile Unemployment (EJScreen)
St. Petersburg, FL	Y	Historic underinvestment Some areas are >95th percentile Low Income, Unemployment, Low Life Expectancy, Asthma, and more

Identification of Applicable Benefits

This proposed project can significantly and directly benefit disadvantaged communities. SmartValve installations represent a superior economic and environmental solution to unlocking renewable energy deliverability and enhancing interregional cooperation between Vermont and New York State.

Disadvantaged communities tend to bear a disproportionate share of the burden associated with the development of traditional network upgrades. The excess costs of unnecessary transmission line construction and upgrades drive up energy costs which disproportionally harm disadvantaged communities whose residents pay a larger proportion of their total income towards utility bills.

- SmartValve installations can be orders of magnitude less expensive than traditional solutions. Transmission lines have also historically been sited and constructed right through these very same disadvantaged communities. SmartValve installations are flexibly sited in existing substations, avoiding the environmental impact and community disruption of mobilizing, and conducting utility infrastructure work in the midst of a community.
- The SmartValve's facilitation of the deployment of more renewable generation, expediting renewable generation's ability to connect with the grid, and ensuring its continuing ability to produce power, will help reduce the need for fossil fuel-based energy generation.

- As SmartValve installations proliferate, the growing interconnection capacity and improved operating transfer capability of the system will attract more capital from industry, and lead to more economic development in the impacted communities. More economic development in impacted communities will lead to spin-off effects growing other support businesses and industries in the area.

There is the potential for this installation of SmartValves to beneficially impact end-user electricity bills. Determining and validating this impact is a challenge to be addressed in M9.4.1.

Discussion of Anticipated Negative and Cumulative Environmental Impacts

There are very few negative impacts stemming from these SmartValve installations because they can be installed on or adjacent to existing substation land. Unlike conventional transmission line upgrades, installation crews will not need to access transmission line rights-of-way, which can be damaging to the environment and a frustrating inconvenience for community members. The operational noise of the SmartValve devices when in-service can be noticeable to individuals walking near the substation, but this is strictly defined by and set to match standards of other substation equipment, and therefore legally mitigated by the perimeter fence line of the substation. Some installation activities will require construction equipment to travel to and access the substation, which may slightly increase traffic in the area, though this will be for a limited period of time and contained within the substation land footprint. The frustration of construction will be mitigated through coordination with the town, their permitting processes, and listening to their needs.

VELCO's site in Milton adjacent to the Sandbar substation has been selected as the proposed site for development for the SmartValve installation, pending the completion of a siting alternatives analysis. Regardless of the actual siting, it is expected that the project area will be disturbed to clear and dispose of trees and woody vegetation, equipment to perform site grading and below-grade construction and install the supporting steel and SmartValve equipment. While land use would be impacted as part of the construction phase, operation activities are not anticipated to disrupt surrounding land use.

How and When Anticipated Benefits Are Expected to Flow to Disadvantaged Communities

In Vermont, VELCO will seek to offer education programs to disadvantaged communities near the project location, Milton, VT. This will include public schools the cities of Burlington, South Burlington, and St. Albans – each are in the 80th or above percentile for low-income population.

The installation at VELCO's Sandbar station in the Town of Milton will benefit from increased property tax payments. As an example, the first year of tax payments for the proposed facility are expected to be over $500K. Tax revenues associated with electrical facilities provide tremendous value to rural communities with a low population and associated tax base.

Several strategies exist to model production cost savings and translating these to end-user electricity bills, however this has not been done to-date for SmartValve network upgrades that support increased renewable energy deliverability and interconnection. Support from DOE and

several project team partners to model these impacts and validate them with community members is a high priority for the project team to ensure Justice 40 initiatives are met through this project.

Implementation Plan

The impact of large renewable generation projects to the local and regional economy can be far-reaching. Locally, the construction, operation and maintenance and/or future expansions will lead to new green and permanent career jobs based on new training programs in advanced power generation, transmission and distribution of complex networks. The long-term impact of these proposed projects on communities within the broader networks will include more resilience during severe weather events and a more reliable electricity.

The following strategies will be utilized in the implementation of the Justice 40 plan:

- Comprehensive workforce and community agreements negotiated with utility, local labor organizations, municipalities, environmental justice and economic development organizations, and universities (M9.1.1).
- Listening sessions with utility and local labor organizations, contractors, municipalities, environmental justice and economic development organizations, academic partners (M9.1.2).
- Training sessions for utility and local labor organizations on SmartValve installation, operation, and maintenance topics (M9.2.1).

Milestones and Timelines

The following timeline and milestones detail the Justice 40 tasks associated with the project are listed on the last page.

Assessment of Risks to Realizing Benefits and Minimizing Negative Impacts

The passage of the Inflation Reduction Act of 2022 provided a level of certainty to renewable energy developers to increase their pace of development and commitments to workforce expansion in regions of high renewable energy potential. The renewable growth and electricity bill reductions are inherent in the project and not reliant on many external factors. Barriers to benefits accruing to end users could be tied up in the financial structures and accounting mechanisms of some electricity markets.

One potential barrier to minimizing any negative impacts could be a lack of available footprint in selected substations, necessitating land acquisitions. This barrier is being addressed by siting feasibility into the selection process. This allows substation engineers and surveyors to provide on-the-ground knowledge of substation equipment and flexibility for the new equipment.

The project plans will also accommodate impacts to the surrounding wetlands, such as the nearby Lamoille River and the State of Vermont Sandbar Wildlife Management Area. The project will seek to avoid any disturbances to protected classes of flora and fauna and will obtain permits as needed.

Resource Summary (for all CBP Activities)

The project has structured Task 9 to encompass the management and execution of Community Benefits Plan activities. Resources for these activities are rolled into the Task 9 summary and involve personnel from all project partners. EPRI will take on the role of coordinator while utility partners engage community organizations to solicit feedback, providing educational STEM opportunities, and more and have dedicated a portion of our budget to do so. About 2% of the total project budget has been set aside for these activities (estimated as $0.60M below) as the project partners realize the value of an engaged and informed community for this project success and SmartValve's continued deployment nation-wide.

Subtask 9.1 – Community Engagement; Subtask 9.2 – Investing in the American Workforce; Subtask 9.3 – Advancing DEIA; and Subtask 9.4 – Justice40 Benefits

Mile-stone	Name	Description	Responsible Party	Target Quarter	Measure of Completion	Supporting Budget
9.1.1	Community Agreements	Workforce and community benefit agreements executed with primary localities and related unions	VELCO	Q4	At least 3 agreements signed	$50k
9.1.2	Community Fora	Community listening sessions conducted quarterly to inform and engage primary localities in project implementation	VELCO	Q3-Q6	At least 4 meetings held	$50k
9.1.3	On-site Presentations	On-site education (high school) presentations on Smart Wires and grid / grid stability technologies	VELCO	Q9-Q10	At least 4 presentations held	$100k
9.2.1	Workforce Training	Organize and conduct utility and trade organization training sessions on SmartValve technology, installation, and lessons learned	VELCO, EPRI	Q7-Q8	At least 4 sessions held	$200k
9.3.1	Energy Curriculum	Create energy-related project curriculum for and in collaboration with VEEP	VELCO / Smart Wires	Q11	Educational groups acknow-ledge receipt	$100k
9.4.1	Cost Impact White Paper	White paper on SmartValve impact to electricity bills completed	Smart Wires, EPRI	Q8	White Paper published	$50k
9.4.2	Environment Curriculum	Create environment-related project curriculum for local groups showing the impact of this project	VELCO	Q11	Educational groups acknow-ledge receipt	$50k

Potentially Duplicative Funding

EPRI has no potentially duplicative funding on any current awards related to the activities to be funded under this FOA". If EPRI receives an award under this FOA and receives another award for activities that potentially overlap with the activities funded under this FOA, we will promptly notify DOE in writing of the potential overlap and state whether project funds from any of those other federal awards have been, are being or are to be used (in whole or in part) for one or more of the identical cost items under the DOE award. EPRI has stringent accounting systems in place to ensure federal funding is not used for cost share and to ensure there is no overlap in activities or costs that could result in potentially duplicative funding.

Locations of Work (DE-FOA-0002740)				
Prime or Sub	**Name**	**City**	**State**	**Zip Code + 4**
Prime	EPRI	Knoxville	TN	37932-3723
Prime	EPRI	Charlotte	NC	28262-0000
Prime	EPRI	Palo Alto	CA	94304-1382
Sub	VELCO	Rutland	VT	05701-9475
Sub	VELCO	Milton	VT	05468-3205
Sub	Smart Wires	Durham	NC	27703-0963
Sub	JABIL	St. Petersburg	FL	33716-2307

PROJECT DESCRIPTION AND ASSURANCES DOCUMENT TEMPLATE (PDAD)

Project title: Optimizing Interregional Transfer Capacity Using Advanced Power Flow Control (TA2-171-E)

Applicant Name: Electric Power Research Institute, Inc.

Applicant Address: 3420 Hillview Avenue, Palo Alto, CA 94304

Names of all team member organizations (if applicable): VELCO and Smart Wires Inc.

Principal Investigator (Name, Address if different than Applicant's, Phone Number, E-mail):

(b) (6) Program Manager

942 Corridor Park Blvd., Knoxville, TN 37932

(b) (6)

Business Point of Contact (Name, Address if different than Applicant's, Phone Number, E-mail):

(b) (6), Manager, Government Contracts

942 Corridor Park Blvd., Knoxville, TN 37932,

(b) (6)

Include any statements regarding confidentiality: N/A

Federal Share: $18,017,358
Cost Share: $18,017,358
Total Estimated Project Cost: $36,034,716

Item 1: Specify (mark with "X")" the FOA Topic Area and as applicable the Area of Interest (AOI):

_____Topic Area 1: **Grid Resilience Grants** (BIL section 40101(c))

___X___Topic Area 2: **Smart Grid Grants** (BIL section 40107)

_____Topic Area 3: **Grid Innovation Program** (BIL section 40103(b)) – Area of Interest 1 (**Transmission** System Applications)

_____Topic Area 3: **Grid Innovation Program** (BIL section 40103(b)) – Area of Interest 2 (**Distribution** System Applications)

_____Topic Area 3: **Grid Innovation Program** (BIL section 40103(b)) – Area of Interest 3 (**Combination** System Applications)

TOPIC AREA 1 Specific Items:

Item 2: Specify (mark with "X")" the entity type of the applicant organization:

_____electric grid operator

_____electricity storage operator

_____electricity generator

_____transmission owner or operator

_____distribution provider

_____fuel supplier

If further description is needed for the specified entity type, please provide below:

Item 3: Please provide the total amount (USD) of qualifying resilience investments (as outlined in DE-FOA-00002740) that has been spent for the previous 3 years. Please also provide the time period utilized for calculation of this amount.

Total Amount:
Time Period for Resilience Investments:

Note: Topic Area 1 applicants must submit as part of their application, a report detailing past, current, and future efforts by the eligible entity to reduce the likelihood and consequences of disruptive events. This report should include efforts over at least the previous 3 years and at least the next 3 years and any broader resilience strategy used by the applicant.

Item 4: Is the eligible entity a Small Utility as defined in DE-FOA-0002740 (sells no more than 4,000,000 MWh of electricity per year)? If NO is selected, skip to Item 7.

_____Yes

_____No

Note: If YES, applicant must provide their Form 861 for the last reporting year submitted to the Energy Information Administration (EIA).

Item 5: Per BIL section 40101(e)(2) (C) APPLICATION LIMITATIONS.—An eligible entity may not submit an application for a grant provided by the Secretary under subsection (c) and a grant provided by a State or Indian Tribe pursuant to subsection (d) during the same application cycle.

Therefore, is the eligible entity a Subaward/Subcontract recipient for an application submitted under IIJA Section 40101(d), ALRD 2736? If "YES", please describe the differences between the GRIP FOA 2740 application [40101(c)] and the ALRD 2736 [40101(d)] applications in the box below:

_____Yes
_____No

TOPIC AREA 2 Specific
No items

TOPIC AREA 3 Specific

Item 6: Specify (mark with "X")" the entity type of the applicant organization:

_____a State

_____a combination of 2 or more States

_____an Indian Tribe

_____a unit of local government

_____a public utility commission

If further description is needed for the specified entity type, please provide below:

Item 7:

Authorized Organizational Representative (AOR): please provide name, address, phone number and e-mail address for the authorized agent to bind the entity

Authorized Organizational Representative (AOR): Name:

(b) (6), Manager, Government Contracts

Address: 942 Corridor Park Blvd., Knoxville, TN 37932

Phone: (b) (6)

E-mail: (b) (6)

Item 8: Signature of Authorized Organizational Representative (AOR)

(b) (6)

Manager, Government Contracts

Instructions and Summary

Award Number: (b) (4)
Award Recipient: Electric Power Research Institute

Date of Submission: 3/16/2023
Form submitted by: Electric Power Research Institute
(May be award recipient or sub-recipient)

Please read the instructions on each worksheet tab before starting. If you have any questions, please ask your DOE contact!
Do not modify this template or any cells for formulas!

1. If using this form for award application, negotiation, or budget revision, fill out he blank white cells in workbook tabs a. through j. with total project costs.
2. Blue colored cells contain instructions, headers, or summary calculations and should not be modified. Only blank white cells should be populated.
3. Enter detailed support for the project costs identified for each Category line item within each worksheet tab to autopopulate he summary tab.
4. The total budget presented on tabs a. through i. must include both Federal (DOE) and Non-Federal (cost share) portions.
5. All costs incurred by the preparer's sub-recipients, contractors, and Federal Research and Development Centers (FFRDCs), should be entered only in section f. Contractual. All other sec ions are for the costs of the preparer only.
6. Ensure all entered costs are allowable, allocable, and reasonable in accordance wi h the administrative requirements prescribed in 2 CFR 200, and the applicable cost principles for each entity type: FAR Part 31 for For-Profit entities; and 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal enti ies.
7. Add rows as needed throughout tabs a. through j. If rows are added, formulas/calculations may need to be adjusted by the preparer. Do not add rows to the Instructions and Summary tab. If your project contains more than five budget periods, consult your DOE contact before adding additional budget period rows and columns.
8. ALL budget period cost categories are rounded to the nearest dollar.

BURDEN DISCLOSURE STATEMENT
Public reporting burden for this collection of information is estimated to average 24 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Office of Information Resources Management Policy, Plans, and Oversight, AD-241-2 - GTN, Paperwork Reduction Project (1910-5162), U.S. Department of Energy 1000 Independence Avenue, S.W., Washington, DC 20585; and to the Office of Management and Budget, Paperwork Reduction Project (1910-5162), Washington, DC 20503.

SUMMARY OF BUDGET CATEGORY COSTS PROPOSED

The values in this summary table are from entries made in subsequent tabs, only blank white cells require data entry

Section A - Budget Summary

	Federal	Cost Share			Total Costs	Cost Share %	Proposed Budget Period Dates
Budget Period 1	$4,212,291	$3,835,807			$8,048,098	47.66%	01/01/2024 - 12/31/2024
Budget Period 2	$7,533,864	$7,521,014			$15,054,878	49.96%	01/01/2025 - 12/31/2025
Budget Period 3	$6,271,204	$6,660,537			$12,931,741	51.51%	01/01/2026 - 12/31/2026
Budget Period 4	$0	$0			$0	0.00%	
Budget Period 5	$0	$0			$0	0.00%	
Total	$18,017,358	$18,017,358			$36,034,716	50.00%	

Section B - Budget Categories

CATEGORY	Budget Period 1	Budget Period 2	Budget Period 3	Budget Period 4	Budget Period 5	Total Costs	% of Project	Comments (as needed)
a. Personnel	(b) (4)			$0	$0			
b. Fringe Benefits				$0	$0			
c. Travel	$0	$0	$0	$0	$0	$0	0.00%	
d. Equipment	$0	$0	$0	$0	$0	$0	0.00%	
e. Supplies	$0	$0	$0	$0	$0	$0	0.00%	
f. Contractual								
Sub-recipient	(b) (4)			$0	$0			
Contractor	$0	$0	$0	$0	$0	$0	0.00%	
FFRDC	$0	$0	$0	$0	$0	$0	0.00%	
Total Contractual				$0	$0			
g. Construction	$0	$0	$0	$0	$0	$0	0.00%	
h. Other Direct Costs	$0	$0	$0	$0	$0	$0	0.00%	
Total Direct Costs				$0	$0			
i. Indirect Charges				$0	$0			
Total Costs	$8,048,098	$15,054,878	$12,931,741	$0	$0	$36,034,716	100.00%	

Additional Explanation (as needed):

a. Personnel

INSTRUCTIONS - PLEASE READ
1. List project costs solely for employees of the entity completing this form. All personnel costs for subrecipients and contractors must be included under f. Contractual.
2. All personnel should be identified by position title and not employee name. Enter the amount of time (e.g., hours or % of time) and the base hourly rate and the total direct personnel compensation will automatically calculate. Rate basis (e.g., rate negotiated for each hour worked on the project, labor distribution report, state civil service rates, etc.) must also be identified.
3. If loaded labor rates are utilized, a description of the costs the loaded rate is comprised of must be included in the Additional Explanation section below. DOE must review all components of the loaded labor rate for reasonableness and unallowable costs (e.g. fee or profit).
4. If a position and hours are attributed to multiple employees (e.g. Technician working 4000 hours) the number of employees for that position title must be identified.
5. Each budget period is rounded to the nearest dollar.

SOPO Task #	Position Title	Budget Period 1			Budget Period 2			Budget Period 3			Budget Period 4			Budget Period 5			Project Total Hours	Project Total Dollars	Rate Basis
		Time (Hrs)	Hourly Rate ($/Hr)	Total Budget Period 1	Time (Hrs)	Hourly Rate ($/Hr)	Total Budget Period 2	Time (Hrs)	Hourly Rate ($/Hr)	Total Budget Period 3	Time (Hrs)	Hourly Rate ($/Hr)	Total Budget Period 4	Time (Hrs)	Hourly Rate ($/Hr)	Total Budget Period 5			
1	Sr. Engineer (EXAMPLE)	2000	$85.00	$170,000	200	$50.00	$10,000	200	$50.00	$10,000	200	$50.00	$10,000	200	$50.00	$10,000	2400	$190,000	
2	Technicians (2)	4000	$20.00	$80,000	0	$0.00	$0	0	$0.00	$0	0	$0.00	$0	0	$0.00	$0	4000	$80,000	
1, 7, 8, 9	Alberto Del Rosso, Program Manager	[redacted]	(b) (4)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			[redacted]			[redacted]	[redacted]	[redacted]	
1, 9	Daniel Purdy, Project Specialist	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			[redacted]			[redacted]	[redacted]	[redacted]	
1, 9	Cary Brammer, Project Specialist	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			[redacted]			[redacted]	[redacted]	[redacted]	
1	Cristina Tiernan, Project Operations Coordinator	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			[redacted]			[redacted]	[redacted]	[redacted]	
8	Gregory Drewry, Engineer/Scientist III	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			[redacted]			[redacted]	[redacted]	[redacted]	
7, 8	Rambabu Adapa, Technical Executive	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			[redacted]			[redacted]	[redacted]	[redacted]	
7	Swaroop Guggilam, Engineer/Scientist III	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			[redacted]			[redacted]	[redacted]	[redacted]	
7	Sunitha Uppalapati, Engineer/Scientist III	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			[redacted]			[redacted]	[redacted]	[redacted]	
7	Nikita Singhal, Technical Leader	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			[redacted]			[redacted]	[redacted]	[redacted]	
7	brahim Krad, Technical Leader	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			[redacted]			[redacted]	[redacted]	[redacted]	
8	Jay Herman, Technical Leader, Principal	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			[redacted]			[redacted]	[redacted]	[redacted]	
1	TBD - Subrecipient Compliance Coordinator	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			[redacted]			[redacted]	[redacted]	[redacted]	
				$0			$0			$0			$0			$0	0	$0	
				$0			$0			$0			$0			$0	0	$0	
				$0			$0			$0			$0			$0	0	$0	
				$0			$0			$0			$0			$0	0	$0	
				$0			$0			$0			$0			$0	0	$0	
				$0			$0			$0			$0			$0	0	$0	
				$0			$0			$0			$0			$0	0	$0	
				$0			$0			$0			$0			$0	0	$0	
				$0			$0			$0			$0			$0	0	$0	
				$0			$0			$0			$0			$0	0	$0	
				$0			$0			$0			$0			$0	0	$0	
				$0			$0			$0			$0			$0	0	$0	
	Total Personnel Costs	[redacted]		[redacted]	[redacted]		[redacted]	[redacted]		[redacted]	[redacted]		[redacted]	[redacted]		[redacted]	[redacted]	[redacted]	

Additional Explanation (as needed):

b. Fringe Benefits

INSTRUCTIONS - PLEASE READ!!!

1. Fill out the table below by position title. If all employees receive the same fringe benefits, you can show "Total Personnel" in the Labor Type column instead of listing out all position titles.
2. The rates and how they are applied should not be averaged to get one fringe cost percentage. Complex calculations should be described/provided in the Additional Explanation section below.
3. The fringe benefit rates should be applied to all positions, regardless of whether those funds will be supported by Federal Share or Recipient Cost Share.
4. Each budget period is rounded to the nearest dollar.

Labor Type	Budget Period 1			Budget Period 2			Budget Period 3			Budget Period 4			Budget Period 5			Total Project
	Personnel Costs	Rate	Total	Personnel Costs	Rate	Total	Personnel Costs	Rate	Total	Personnel Costs	Rate	Total	Personnel Costs	Rate	Total	
EXAMPLE!!! Sr. Engineer	$170,000	20%	$34,000	$10,000	20%	$2,000	$10,000	20%	$2,000	$10,000	20%	$2,000	$10,000	20%	$2,000	$38,000
All Personnel Classifications	(b) (4)	[redacted]		[redacted]	[redacted]		[redacted]	[redacted]				$0			$0	$579,172
			$0			$0			$0			$0			$0	$0
			$0			$0			$0			$0			$0	$0
			$0			$0			$0			$0			$0	$0
			$0			$0			$0			$0			$0	$0
Total	(b) (4)		[redacted]	[redacted]		[redacted]	[redacted]		[redacted]	$0		$0	$0		$0	$579,172

A federally approved fringe benefit rate agreement, or a proposed rate supported and agreed upon by DOE for estimating purposes is required at the time of award negotiation if reimbursement for fringe benefits is requested. Please check (X) one of the options below and provide the requested information if not previously submitted.

X **A fringe benefit rate has been negotiated with, or approved by, a federal government agency. A copy of the latest rate agreement is/was included with the project application.***

There is not a current federally approved rate agreement negotiated and available.**

*Unless the organization has submitted an indirect rate proposal which encompasses the fringe pool of costs, please provide the organization's benefit package and/or a list of the components/elements that comprise the fringe pool and the cost or percentage of each component/element allocated to the labor costs identified in the Budget Justification (Form EERE 335.1).

**When this option is checked, the entity preparing this form shall submit an indirect rate proposal in the format provided in the Sample Rate Proposal at https://www.energy.gov/eere/funding/downloads/sample-indirect-rate-proposal-and-profit-compliance-audit, or a format that provides the same level of information and which will support the rates being proposed for use in the performance of the proposed project.

Additional Explanation (as necessary): Fringe rates are based on EPRI's Cognizant Federal Contracting Agency the DOE/NETL approved provisional 2023 indirect rates. A copy of the letter can be provided upon request.

c. Travel

INSTRUCTIONS - PLEASE READ!!!

1. Identify Foreign and Domestic Travel as separate items. Examples of Purpose of Travel are subrecipient site visits, DOE meetings, project mgmt. meetings, etc. Examples of Basis for Es imating Costs are past trips, travel quotes, GSA rates, etc.
2. All listed travel must be necessary for performance of the Statement of Project Objectives.
3. Only travel that is directly associated with this award should be included as a direct travel cost to the award.
4. Federal travel regulations are contained within the applicable cost principles for all entity types.
5. Travel costs should remain consistent with travel costs incurred by an organization during normal business operations as a result of the organizations written travel policy. In absence of a written travel policy, organizations must follow the regulations prescribed by the General Services Administration.
6. Columns E, F, G, H, I, J, and K are per trip.
7. The number of days is inclusive of the day of departure and the day of return.
8. Recipients should enter City and State (or City and Country for Interna ional travel) in he Depart from and Destination fields.
9. Each budget period is rounded to he nearest dollar.

SOPO Task #	Purpose of Travel	Depart From	Destination	No. of Days	No. of Travelers	Lodging per Traveler	Flight per Traveler	Vehicle per Traveler	Per Diem Per Traveler	Cost per Trip	Basis for Estimating Costs
	Domestic Travel	**Budget Period 1**									
1	**EXAMPLE!!!** Visit to PV manufacturer			2	2	$250	$500	$100	$160	$2,020	Current GSA rates
										$0	
										$0	
										$0	
										$0	
	International Travel										
										$0	
	Budget Period 1 Total									**$0**	
	Domestic Travel	**Budget Period 2**									
										$0	
										$0	
										$0	
										$0	
	International Travel										
										$0	
	Budget Period 2 Total									**$0**	
	Domestic Travel	**Budget Period 3**									
										$0	
										$0	
										$0	
										$0	
	International Travel										
										$0	
	Budget Period 3 Total									**$0**	
	Domestic Travel	**Budget Period 4**									
										$0	
										$0	
										$0	
										$0	
	International Travel										
										$0	
	Budget Period 4 Total									**$0**	
	Domestic Travel	**Budget Period 5**									
										$0	
										$0	
										$0	
										$0	
	International Travel										
										$0	
	Budget Period 5 Total									**$0**	
	PROJECT TOTAL									**$0**	

Additional Explanation (as needed):

d. Equipment

INSTRUCTIONS - PLEASE READ!!!

1. Equipment is generally defined as an item with an acquisition cost greater than $5,000 and a useful life expectancy of more than one year. Please refer to the applicable Federal regulations in 2 CFR 200 for specific equipment definitions and treatment.

2. List all equipment below, providing a basis of cost (e.g. contractor quotes, catalog prices, prior invoices, etc.). Briefly justify items as they apply to the Statement of Project Objectives. If it is existing equipment, provide logical support for the estimated value shown.

3. During award negotiations, provide a contractor quote for all equipment items over $50,000 in price. If the contractor quote is not an exact price match, provide an explanation in the additional explanation section below. If a contractor quote is not practical, such as for a piece of equipment that is purpose-built, first of its kind, or otherwise not available off the shelf, provide a detailed engineering estimate for how the cost estimate was derived.

4. Each budget period is rounded to the nearest dollar.

SOPO Task #	Equipment Item	Qty	Unit Cost	Total Cost	Basis of Cost	Justification of need
Budget Period 1						
3,4,5	**EXAMPLE!!!** Thermal shock chamber	2	$70,000	$140,000	Vendor Quote - Attached	Reliability testing of PV modules- Task 4.3
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 1 Total			$0		
Budget Period 2						
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 2 Total			$0		
Budget Period 3						
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 3 Total			$0		
Budget Period 4						
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 4 Total			$0		
Budget Period 5						
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 5 Total			$0		
	TOTAL EQUIPMENT			**$0**		

Additional Explanation (as needed):

e. Supplies

INSTRUCTIONS - PLEASE READ

1. Supplies are generally defined as an item with an acquisition cost of $5,000 or less and a useful life expectancy of less than one year. Supplies are generally consumed during the project performance. Please refer to the applicable Federal regulations in 2 CFR 200 for specific supplies definitions and treatment.
2. List all proposed supplies below, providing a basis of costs (e.g. contractor quotes, catalog prices, prior invoices, etc.). Briefly justify the need for the Supplies as they apply to the Statement of Project Objectives. Note that Supply items must be direct costs to the project at this budget category, and not duplicative of supply costs included in the indirect pool that is the basis of the indirect rate applied for this project.
3. Multiple supply items valued at $5,000 or less used to assemble an equipment item with a value greater than $5,000 with a useful life of more than one year should be included on the equipment tab. If supply items and costs are ambiguous in nature, contact your DOE representative for proper categorization.
4. Add rows as needed. If rows are added, formulas/calculations may need to be adjusted by the preparer.
5. Each budget period is rounded to the nearest dollar.

SOPO Task #	General Category of Supplies	Qty	Unit Cost	Total Cost	Basis of Cost	Justification of need
Budget Period 1						
4,6	EXAMPLE Wireless DAS components	10	$360 00	$3,600	Catalog price	For Alpha prototype - Task 2.4
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 1 Total			$0		
Budget Period 2						
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 2 Total			$0		
Budget Period 3						
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 3 Total			$0		
Budget Period 4						
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 4 Total			$0		
Budget Period 5						
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 5 Total			$0		
	TOTAL SUPPLIES			$0		

Additional Explanation (as needed):

f. Contractual

INSTRUCTIONS - PLEASE READ

1. The entity completing this form must provide all costs related to sub-recipients, contractors, and FFRDC partners in the applicable boxes below.

2. Sub-recipients (partners sub-awardees): Subrecipients shall submit a Budget Justification describing all project costs and calculations when their total proposed budget exceeds either (1) $100 000 or (2) 25% of total award costs. These sub-recipient forms may be completed by either the sub-recipients themselves or by the preparer of this form. The budget totals on the sub-recipient's forms must match the sub-recipient entries below. A subrecipient is a legal entity to which a subaward is made, who has performance measured against whether the objectives of the Federal program are met, is responsible for programmatic decision making, must adhere to applicable Federal program compliance requirements, and uses the Federal funds to carry out a program of the organization. All characteristics may not be present and judgment must be used to determine subrecipient vs. contractor status.

3. Contractors: List all contractors supplying commercial supplies or services used to support the project. For each Contractor cost with total project costs of $100,000 or more, a Contractor quote must be provided. A contractor is a legal entity contracted to provide goods and services within normal business operations, provides similar goods or services to many different purchasers, operates in a competitive environment, provides goods or services that are ancillary to the operation of the Federal program, and is not subject to compliance requirements of the Federal program. All characteristics may not be present and judgment must be used to determine subrecipient vs.contractor status.

4. Federal Funded Research and Development Centers (FFRDCs): FFRDCs must submit a signed Field Work Proposal during award application. The award recipient may allow the FFRDC to provide this information directly to DOE, however project costs must also be provided below.

5. Each budget period is rounded to the nearest dollar.

SOPO Task #	Sub-Recipient Name/Organization	Sub-Recipient Unique Entity Identifier (UEI)	Purpose and Basis of Cost	Budget Period 1	Budget Period 2	Budget Period 3	Budget Period 4	Budget Period 5	Project Total
2,4	EXAMPLE XYZ Corp.		Partner to develop optimal lens for Gen 2 product. Cost estimate based on personnel hours.	$48,000	$32,000	$16,000			$96,000
2, 3, 4, 5, 6	Velco		The project will install SmartValve devices on VELCO system to increase transmission capacity of interregional ties.	(b) (4)					$31,800,000
									$0
									$0
									$0
									$0
									$0
			Sub-total	(b) (4)			$0	$0	$31,800,000

SOPO Task #	Contractor Name/Organization	Purpose and Basis of Cost	Budget Period 1	Budget Period 2	Budget Period 3	Budget Period 4	Budget Period 5	Project Total
6	EXAMPLE ABC Corp.	Contractor for developing robotics to perform lens inspection. Estimate provided by contractor.	$32,900	$86,500				$119,400
								$0
								$0
								$0
								$0
								$0
		Sub-total	$0	$0	$0	$0	$0	$0

SOPO Task #	FFRDC Name/Organization	Purpose and Basis of Cost	Budget Period 1	Budget Period 2	Budget Period 3	Budget Period 4	Budget Period 5	Project Total
								$0
								$0
		Sub-total	$0	$0	$0	$0	$0	$0

Total Contractual	(b) (4)	$0	$0	$31,800,000

Additional Explanation (as needed):

g. Construction

PLEASE READ!!!

1. Construction, for the purpose of budgeting, is defined as all types of work done on a particular building, including erecting, altering, or remodeling. Construction conducted by the award recipient is entered on this page. Any construction work that is performed by a contractor or subrecipient should be entered under f. Contractual.

2. List all proposed construction below, providing a basis of cost such as engineering estimates, prior construction, etc., and briefly justify its need as it applies to the Statement of Project Objectives.

3. Each budget period is rounded to the nearest dollar.

Overall description of construction activities: Example Only!!! - Build wind turbine platform

SOPO Task #	General Description	Cost	Basis of Cost	Justification of need
Budget Period 1				
3	EXAMPLE ONLY!!! Three days of excavation for platform site	$28,000	Engineering estimate	Site must be prepared for construction of platform.
	Budget Period 1 Total	$0		
Budget Period 2				
	Budget Period 2 Total	$0		
Budget Period 3				
	Budget Period 3 Total	$0		
Budget Period 4				
	Budget Period 4 Total	$0		
Budget Period 5				
	Budget Period 5 Total	$0		
	TOTAL CONSTRUCTION	**$0**		

Additional Explanation (as needed):

h. Other Direct Costs

INSTRUCTIONS - PLEASE READ!!!

1. Other direct costs are direct cost items required for the project which do not fit clearly into other categories. These direct costs must not be included in the indirect costs (for which the indirect rate is being applied for this project). Examples are: tuition, printing costs, etc. which can be directly charged to the project and are not duplicated in indirect costs (overhead costs).

2. Basis of cost are items such as vendor quotes, prior purchases of similar or I ke items, published price list, etc.

3. Each budget period is rounded to the nearest dollar.

SOPO Task #	General Description and SOPO Task #	Cost	Basis of Cost	Justification of need
		Budget Period 1		
5	**EXAMPLE!!!** Grad student tuition - tasks 1-3	$16,000	Established UCD costs	Support of graduate students working on project
	Budget Period 1 Total	$0		
		Budget Period 2		
	Budget Period 2 Total	$0		
		Budget Period 3		
	Budget Period 3 Total	$0		
		Budget Period 4		
	Budget Period 4 Total	$0		
		Budget Period 5		
	Budget Period 5 Total	$0		
	TOTAL OTHER DIRECT COSTS	**$0**		

Additional Explanation (as needed):

i. Indirect Costs

INSTRUCTIONS - PLEASE READ

1. Fill out the table below to indicate how your indirect costs are calculated. Use the box below to provide additional explanation regarding your indirect rate calculation.
2. The rates and how they are applied should not be averaged to get one indirect cost percentage. Complex calculations or rates that do not do not correspond to the below categories should be described/provided in the Additional Explanation section below. If questions exist, consult with your DOE contact before filling out this section.
3. The indirect rate should be applied to both the Federal Share and Recipient Cost Share.
4. NOTE A Recipient who elects to employ the 10% de minimis Indirect Cost rate **cannot claim resulting cost as a Cost Share contribution, nor can the Recipient claim "unrecovered indirect costs" as a Cost Share contribution.** Neither of these costs can be reflected as actual indirect cost rates realized by the orgnaization, and therefore are not verifiable in the Recipient records as required by Federal Regulation (200.306(b)(1))
5.. Each budget period is rounded to the nearest dollar.

	Budget Period 1	Budget Period 2	Budget Period 3	Budget Period 4	Budget Period 5	Total	Explanation of BASE
Provide ONLY Applicable Rates:							
Overhead Rate	(b) (4)	[redacted]	[redacted]	0.00%	0.00%		*Example: Labor + Fringe*
General & Administrative (G&A)	[redacted]			0.00%	0.00%		
FCCM Rate, if applicable	0.00%	0.00%	0.00%	0.00%	0.00%		
OTHER Indirect Rate	[redacted]	[redacted]	[redacted]	0.00%	0.00%		
Indirect Costs (As Applicable):							
Overhead Costs	(b) (4)	[redacted]	[redacted]			[redacted]	
G&A Costs						$0	
FCCM Costs, if applicable	[redacted]	[redacted]	[redacted]			[redacted]	
OTHER Indirect Costs	[redacted]	[redacted]	[redacted]			[redacted]	
Total indirect costs requested:	[redacted]	[redacted]	[redacted]	$0	$0	[redacted]	

A federally approved indirect rate agreement, or rate proposed (supported and agreed upon by DOE for estimating purposes) is required if reimbursement of indirect costs is requested. Please check (X) one of the options below and provide the requested information if it has not already been provided as requested, or has changed.

X An indirect rate has been approved or negotiated with a federal government agency. A copy of the latest rate agreement is included with this application and will be provided electronically to the Contracting Officer for this project.
The organization does not have a current, federally approved indirect cost rate agreement and has provided an indirect rate proposal in support of the proposed costs.
This organization has elected to apply a 10% de minimis rate in accordance with 2 CFR 200.414(f).

You must provide an explanation (below or in a separate attachment) and show how your indirect cost rate was applied to this budget in order to come up with the indirect costs shown.

Additional Explanation (as needed): Indirect rates are based on EPRI's Cognizant Federal Contracting Agency the DOE/NETL approved provisional 2023 indirect rates. A copy of the letter can be provided upon request.

Cost Share

PLEASE READ!!!

1. A detailed presentation of the cash or cash value of all cost share proposed must be provided in the table below. All items in the chart below must be identified within the applicable cost category tabs a. through i. in addition to the detailed presentation of the cash or cash value of all cost share proposed provided in the table below. Identify the source organization & amount of each cost share item proposed in the award.

2. Cash Cost Share - encompasses all contributions to the project made by the recipient, subrecipient, or third party (an entity that does not have a role in performing the scope of work) for costs incurred and paid for during the project. This includes when an organization pays for personnel, supplies, equipment, etc. for their own company with organizational resources. If the item or service is reimbursed for, it is cash cost share. All cost share items must be necessary to the performance of the project. **Contractors may not provide cost share.** Any partial donation of goods or services is considered a discount and is not allowable.

3. In Kind Cost Share - encompasses all contributions to the project made by the recipient, subrecipient, or third party (an entity that does not have a role in performing the scope of work) where a value of the contribution can be readily determined, verified and justified but where no actual cash is transacted in securing the good or service comprising the contribution. In Kind cost share items include volunteer personnel hours, the donation of space or use of equipment, etc. The cash value and calculations thereof for all In Kind cost share items must be justified and explained in the Cost Share Item section below. All cost share items must be necessary to the performance of the project. If questions exist, consult your DOE contact before filling out In Kind cost share in this section. **Contractors may not provide cost share**. Any partial donation of goods or services is considered a discount and is not allowable.

4. Funds from other Federal sources MAY NOT be counted as cost share. This prohibition includes FFRDC sub-recipients. Non-Federal sources include any source not originally derived from Federal funds. Cost sharing commitment letters from subrecipients and third parties must be provided with the original application.

5. Fee or profit, including foregone fee or profit, **are not allowable** as project costs (including cost share) under any resulting award. The project may only incur those costs that are allowable and allocable to the project (including cost share) as determined in accordance with the applicable cost principles prescribed in FAR Part 31 for For-Profit entities and 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.

6. NOTE: A Recipient who elects to employ the 10% de minimis Indirect Cost rate **cannot claim the resulting indirect costs as a Cost Share contribution.**

7. NOTE: A Recipient **cannot claim "unrecovered indirect costs"** as a Cost Share contribution, **without prior approval.**

8. Each budget period is rounded to the nearest dollar.

Organization/Source	Type (Cash or In Kind)	Cost Share Item	Budget Period 1	Budget Period 2	Budget Period 3	Budget Period 4	Budget Period 5	Total Project Cost Share
ABC Company **EXAMPLE!!!**	Cash	Project partner ABC Company will provide 20 PV modules for product development at the price of $680 per module	$13,600					$13,600
VELCO	Cash	Subject to ISO-NE process for rate-based PTF additions.	$3,835,807	$7,521,014	$6,660,537			$18,017,358
								$0
								$0
								$0
								$0
								$0
								$0
								$0
								$0
								$0
		TOTAL COST SHARE	$3,835,807	$7,521,014	$6,660,537	$0	$0	$18,017,358

Total Project Cost: $36,034,716 **Cost Share Percent of Award: 50.0%**

Additional Explanation (as needed):

Applicant Name: Electric Power Research Institute Award Number: (b) (4) [redacted]

Budget Information - Non Construction Programs

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				$4,212,291	$3,835,807		$8,048,098
2. Budget Period 2				$7,533,864	$7,521,014		$15,054,878
3. Budget Period 3				$6,271,204	$6,660,537		$12,931,741
4. Budget Period 4				$0	$0		$0
5. Budget Period 5				$0	$0		$0
6. Totals				$18,017,358	$18,017,358		$36,034,717

Section B - Budget Categories

6. Object Class Categories	Grant Program, Function or Activity					Total (5)
	Budget Period 1	Budget Period 2	Budget Period 3	Budget Period 4	Budget Period 5	
a. Personnel	(b) (4) [redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
b. Fringe Benefits	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
c. Travel	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
d. Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
e. Supplies	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
f. Contractual	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
g. Construction	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
h. Other	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
i. Total Direct Charges (sum of 6a-6h)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
j. Indirect Charges	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
k. **Totals** (sum of 6i-6j)	$8,048,098	$15,054,878	$12,931,741	$0	$0	$36,034,716
7. Program Income						$0