Beyond AMI to True Grid Intelligence with Distribution Automation

Concept Paper Identification: TA2-052-E

US Department of Energy (DOE)
Office of Clean Energy Demonstrations (OCED)
Grid Deployment Office (GDO)
BIL – Grid Resilience and Innovation Partnerships (GRIP)
Funding Opportunity Announcement: DE-FOA-0002740
Assistance Listing Number: 81.254

Topic Area 2: Smart Grid Grants

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Arkansas Valley Electric Cooperative Corporation (AVECCC)
National Rural Telecommunications Cooperative (NRTC)

Estimated Budget: $36.6 million / Cost Share: $18.3 million (50%)
Project Duration: 60 months
Project Location: AR-003 and AR-004

March 17, 2023

1. Project Overview

A. Background

Arkansas Valley Electric Cooperative Corporation (AVECC) is a not-for-profit corporation headquartered in Ozark, AR. AVECC operates three additional district offices located in Waldron and Van Buren, AR, and Pocola, OK. The Cooperative was organized in 1937 by a group of farmers and businessmen from Crawford, Logan, and Johnson Counties in west-central Arkansas. The first power line was energized in December of 1938 to provide electric service to 114 meters, with an average electric bill of $3.00. Although much has changed since 1938, the cooperative principles driving AVECC to bring its membership electricity they depend on, from a power source they can trust, at a cost that is not burdensome, has not faltered. That drive has led AVECC to expand to serve a 4,700 square-mile territory, spanning 10 counties in Arkansas and 3 counties in Oklahoma. Despite this large geographic area, AVECC serves only 62,000 meters due to its rural location, averaging only 8 members per line mile, compared to the non-cooperative industry average of 32 consumers per mile. AVECC purchased 1,402,622 MWh of electricity in 2022, classifying the cooperative as a small utility. AVECC operates under the seven guiding principles of cooperatives, one of which is concern for community, prompting AVECC to adopt the slogan “Changing the Communities we Serve.” This principle encouraged AVECC to deploy broadband services to its members, giving them access to telehealth services, online learning, remote work, and new possibilities for local business. The fiber to the home project is planned for completion in 2024 and has provided the opportunity for distribution grid enhancements, utilizing new industry technology possessing Smart Grid capabilities. AVECC seeks to capitalize on the prior investment in grid infrastructure by expanding the communication capabilities of the fiber backbone to Smart Grid downline devices and metering to automate the distribution system creating a fully deployed Smart Grid throughout the AVECC distribution territory.

B. Project Goal

The goal of Arkansas Valley Electric’s project “Beyond AMI to True Grid Intelligence with Distribution Automation” is to increase efficiency, reliability, and flexibility of AVECC’s distribution grid using grid enhancing technologies deployed throughout the grid. For the cooperative’s roughly 60,000 members, 80% of those members being in disadvantaged areas, this would correlate to energy savings, fewer and shorter power outages, and flexibility for distributed generation or electric vehicles. Other goals for the project include reduced maintenance cost, reduced environmental impact, and improved safety for line workers and consumers. This will be achieved through upgrades and additions to downline devices with advanced controls and SCADA connections. In addition, AVECC proposes to create an Advanced Metering Infrastructure which will give full visibility and control from the substations to the end energy user.

C. DOE Impact

The future of the energy infrastructure is a two-way communicative, interactive, and self-healing network which will increase reliability for the American people while providing opportunity for distributed generation and new loads. Unfortunately, the cost of making this future a reality is often out of reach for small cooperatives, whose priority is to provide affordable energy to a portion of the nation that lives in disadvantaged areas. This is the case for Arkansas Valley Electric Cooperative Corporation. AVECC has implemented the goal of a fully deployed Smart Grid throughout their service territory of disadvantaged communities, but budget constraints limit the full deployment of smart grid technology to a 30+ year project. AVECC has been implementing Smart Grid technologies for approximately 5 years and has successfully connected 112 smart grid downline devices out of the 1203 downline devices on AVECC's distribution line. A successful application for the GRIP Topic 2 Funding would allow AVECC to combine DOE funding with its own capital to replace all downline devices with smart grid technology within a 5-year timeframe. This would enhance the life of all 60,000 members by improving grid reliability and removing barriers to renewable energy and grid edge devices. If successful in securing DOE funding through FOA-0002740, AVECC plans to further invest capital into the Smart Grid to create a truly autonomous grid capable of Fault Location, Isolation, and Service Restoration (FLISR).

D. Community Benefits Plan: Job Quality and Equity and Maximizing Benefits across Disadvantaged Communities

Forty of the fifty census tracts served by AVECC (80%) are classified as Disadvantaged Communities by the Justice40 Initiative, with much of the area being classified as low-income households. Energy Burden is among the top indicators in several of the territory prompting AVECC to remain true to their commitment of supplying low-cost electricity that communities depend on from a power source they can trust. Successful deployment of the AVECC proposed Smart Grid furthers the clean energy infrastructure policy priorities including decreasing the energy burden, reducing outage events, minimizing outage duration, increasing job creation, and supplying access to added job training for disadvantaged communities. AVECC utilizes a lineman apprenticeship program and internship program as well as advanced employee benefits to attract, train, and retain a skilled labor force.

E. Constraints on Natural Resources

AVECC does not foresee any potential long-term constraints to the community's access to natural resources or Tribal cultural resources. The proposed AVECC Smart Grid deployment project uses existing infrastructure and right-of-way access causing no waste burden on the community.

F. Climate Resilience Strategy

Climate resilience has been a priority for the Cooperative and many strategies are already being applied to make our grid more resilient such as underground construction, stronger overhead material, better right of way management, and applying loop feeds. The specific climate resilience strategies of this project are:

- Utilize an Advanced Metering Infrastructure for communication and data acquisition which will allow AVECC to quickly detect weather related outage locations and overload issues. This will greatly improve response time and outage duration.
- Utilize SCADA controlled electronic breakers to improve coordination, and outage response time. The advanced controls will allow for multiple protection scheme options based on the weather and allow for future automated outage restoration.
- Utilize SCADA controlled regulators and capacitors for real time data acquisition and control to improve energy efficiency and power quality during extreme weather events.

2. Technical Description, Innovation, and Impact

A. Relevance and Outcomes

AVECC aims to increase system reliability and enhance grid flexibility within rural electric cooperative territory and Justice 40 disadvantaged communities through the aggregation and deployment of Smart Grid technologies on its distribution grid to include the following:

- Supervisory Control and Data Acquisition (SCADA) connected Smart Grid Equipment
- Advanced Metering Infrastructure (AMI) with robust edge computing capabilities
- Vacuum fault interrupter circuit recloser (SCADA connected)
- Conservative voltage reduction capable regulators (SCADA connected)
- Real time feedback switched capacitor banks (SCADA connected)

The deployment of the above-mentioned grid enhancing technologies through the proposed project will lead to the realization of a fully developed Smart Grid resulting in many benefits such as those listed below with a description of each following.

Project Deliverable / Outcomes	
i.	Improved visibility and control of electrical system to grid operators
ii.	Enhanced secure communications and data flow throughout distribution grid
iii.	Improved grid reliability
iv.	Improved grid resilience / extreme weather and natural disaster impact mitigation
v.	Localized analytics to facilitate information sharing between grid operators and consumers
vi.	Conservative Voltage Reduction (CVR) implementation
vii.	Peak load reduction program implementation / reduced energy consumption
viii.	Emergency Load Curtailment Program
ix.	Remove barriers to integration of variable renewable energy resources on the distribution grid
x.	Facilitate the aggregation and integration of grid-edge devices
xi.	Improved operator and community safety
xii.	Reduction in distribution grid maintenance costs
xiii.	Reduction in environmental exposure and impact

i. **Improved visibility of electrical system to grid operators:** The implementation of SCADA communications and controls on all downline devices throughout the distribution system provides total system visibility and remote control to immediately act on any system events. The visibility of the entire distribution grid’s vital health and load information from a remote location ensures proper load management, system balancing, voltage awareness, power factor correction, fast outage management, and early event detection. The proposed AMI system will provide grid operators and homeowners data from beyond the meter.

ii. **Enhanced secure communications and data flow throughout distribution grid:** AVECC will be a partner for all device panels and automation controllers with Schweitzer Engineering Laboratories (SEL), a utility industry leader in device security. Utilizing a layered security approach consisting of both hardware and software securities, anti-malware technology, and proprietary protocols the SEL equipment can be used in this project without concern for energy grid disruption caused by cyber attackers. Utilizing this communication equipment will allow for two-way communication and control of all devices throughout the AVECC distribution grid.

iii. **Improved grid reliability:** Proper coordination obtained by the installation of programmable vacuum reclosers set appropriately based on the results of a full system coordination study in this project ensures the fewest number of members possible are affected by outages. The proposed reclosers will be mapped in existing advanced modeling software supplying system operators with access to advanced analytics for evaluating events. Real time data acquisition from devices including event magnitudes and phasing, allows for precise fault location predictions. Fault predictions reduce outage time by guiding personnel directly to the outage cause verses searching the whole feeder. In addition to valuable data acquisition, control capabilities of all system devices from the dispatch room allow for adaptive protection technology. The protection scheme of the advanced reclosers can be shifted by the push of a button based on the weather or grid conditions. For example, if a storm is predicted for the area, the system operator can change the normal operations protection scheme to a storm mode protection scheme on all devices in the storm path. This scheme will enable a fast reclose to prevent lightning strikes from causing outages. This ability prevents outages and minimizes visible power flickers caused by storms without the consumer even realizing there was an interruption. Multiple other protection schemes are available for various situations that are also meant as preventive measures to improve resilience. This strategy allows the cooperative to be proactive to natural events rather than reactive, improving the resiliency of the distribution grid overall. The proposed AMI technology is capable of meter level outage detection and will provide immediate notification during an outage. The outage reporting of meters and application of edge computing apps will inform AVECC's outage restoration approach and lead to reducing outage impacts.

iv. **Improved grid resilience (extreme weather and natural disaster impact mitigation):** The deployment of distribution automation equipment and AMI technology will enable intelligent grid management to lessen risks during natural hazards. AVECC serves areas with significant natural hazard risks, as defined by FEMA's National Risk Index. Wildfire risk is a relatively moderate rating, amplified by a combined drought risk and a heat wave index of relatively high. Replacing outdated oil filled equipment with vacuum interrupter equipment significantly reduces wildfire risks since there is no debris or sparks during normal operation and by eliminating flammable material expulsion in the event of a failure. The ability to monitor for equipment or meter malfunctions, voltage irregularities, and impedance will allow AVECC to find grid issues before they can result in fires. Drought and heat waves are of particular concern due to the large amount of cooling loads that strain the grid in the summer. Improving power factor and voltage with advanced capacitors and regulators will improve efficiency and therefore reduce the strain on the grid during these extreme weather events. Additionally, real time meter information will limit the impact of outages for AVECC's rural cooperative members that rely on electricity for medical equipment or cooling solutions.

The frequency of severe storms, including ice storms and tornados, is also a concern with the FEMA designated risk as relatively high. The deployment of an advanced metering network and smart downline devices will aid in outage reporting, scoping, and scaling of outage events, and increase the efficiency of restoration efforts following service interruptions. Through gaining greater visibility at the meter, the negative ramifications of natural disasters, particularly large-scale events like tornados and winter storms, are partially mitigated.

v. **Localized analytics to facilitate information sharing between grid operators and consumers:** The proposed AMI provides short interval energy consumption data to consumers supplying members the possibility to review and adjust energy habits. Armed with knowledge of their own energy usage and habits, consumers can take advantage of many available resources aimed at educating individuals about energy conservation and bill reduction. The current metering platform has thermal limitations that restrict readings from the meter to 1-hour intervals, limiting the data provided to members about their energy consumption. The proposed AMI technology can provide short interval (1 minute) energy consumption data to members. This would allow AVECC to potentially move to a peak demand type rate in the future to provide further savings to members who are conscious of their energy usage. The technology also provides real time insight to members utilizing a pre-payment bill pay option enabling prepay consumers real-time insight into the remaining balance on their pre-paid account.

vi. **Conservative Voltage Reduction (CVR) implementation:** The proposed installation of smart panels and SCADA controls on all downline voltage regulators allows AVECC to implement conservative voltage reduction (CVR). This program allows the cooperative to reduce voltage during increased demand events resulting in a peak reduction. A reduction in the yearly peak demand of the cooperative is a significant reduction in the cost of purchased power. These savings would be directly passed down to the membership in the cooperative not-for-profit operating structure. The proposed AMI system will provide real time feedback of voltage conditions at the grid edge ensuring that the voltages stay in the ANSI standard range while still reducing energy demand. This meter level voltage can be programmed as an input in SCADA with alarms to prewarn of voltage issues allowing operators to adjust parameters to ensure that voltage levels stay in compliance during normal operations and CVR implementation.

vii. **Peak load reduction program implementation / reduced energy consumption:** In conjunction with CVR, AVECC proposes to install switched capacitor banks throughout the service territory with SCADA controls allowing immediate, often autonomous control of devices based on real time data. The proposed controls would measure current, voltage, and power factor in real time and automatically switch the capacitor bank on or off as needed. With these controls the capacitor banks will be much more precise on switching and provide a more proactive approach to improving power quality and thereby increasing energy efficiency by improving power factor, voltage, and power quality. Within the current power costing structure, AVECC is penalized for poor power factor which is often caused by highly inductive industrial loads. The improved power efficiency of the proposed grid enhancing technology reduces the amount of energy needed to operate the distribution grid while improving the cost-effectiveness of energy distribution, a savings directly passed down to the cooperative membership, including those in disadvantaged areas.

viii. **Emergency Load Curtailment Program:** During emergency situations, Arkansas Valley Electric Cooperative can be called upon by state or federal agencies for mandated emergency load curtailment. The proposed Smart Grid project would allow AVECC to respond quickly and efficiently to the mandate without dropping load to members with critical power needs. The Cooperative can use real time data to ensure only the necessary amount of load is dropped. The proposed remotely controlled reclosers will allow dispatch to sectionalize from the office much faster than an operator could by driving to each location. Also, the proposed AMI system has a Premise Load Shedding application, which will allow for targeted load shedding, while keeping power to critical customers such as emergency services, schools, and water treatment facilities.

ix. **Remove barriers to integration of variable renewable energy resources on the distribution grid:** With the proposed metering technology every meter will be fully capable of integrating renewable energy resources. Currently AVECC purchases a separate meter for DER's, and a member's meter must be replaced before the DER can be utilized. This new AMI platform will reduce the cost and inventory of additional meters and avoid an outage during DER commissioning. Owners of renewable energy resources can get more detailed data from the proposed AMI to aid in using their DER to the fullest potential. The proposed recloser technology will give AVECC the ability to adapt to the changes of large DER or a high density of DERs on the grid affecting power flow by adjusting the recloser settings remotely. These grid enhancing technologies ensure fewer barriers to renewable energy and remove the cost burden of upgrading equipment to accommodate DER.

x. **Facilitate the aggregation and integration of grid-edge devices:** The deployment of AMI and smart downline devices will provide the tools needed for the efficient integration of distributed energy resources. The quantity of AVECC members using these resources has increased nearly 800% in the past five years. AVECC now has over nine megawatts of distributed generation interconnected, with limited engagement beyond bi-directional metering. Through locating and engaging with behind-the-meter assets, such as distributed energy resources (DERs), including EVs, solar panels, smart inverters, smart thermostats, and grid-integrated water heaters, AVECC can electrify additional space conditioning loads. The installation of Smart Grid vacuum reclosers allows for unique, complex, and programmable protection schemes not attainable with the current protection devices, which will be necessary as distributed generation increases. The AMI's robust communication with behind-the-meter loads will provide data and meaningful consumer engagement with new electric loads, particularly electric vehicles (EVs), ensuring these flexible loads charge at optimal times to minimize the disruptive impacts of increased demand. Given the significant impacts of coincidental and non-coincidental peaks on the wholesale power cost incurred by AVECC and its members, efficient device management is a key element of controlling costs. The AMI technologies listed will offer a better member experience with behind-the-meter assets and manage energy consumption in a more environmentally friendly and budget conscious way.

xi. **Improved operator and community safety:** Electrical line work is rated as one of the most dangerous professions in the United States, continuously ranking in the top ten most dangerous jobs based on incident rates. AVECC has implemented strict safety standards, but the proposed project could transform AVECC's distribution grid with device integrated safety features. The reclosers will have ground level controls and remote control via the dispatch center, which will reduce employees' exposure to electrical lines. The technology will reduce the duration of electrical faults and efficiently isolate downed power lines which will decrease the risk for the community to encounter hot lines on the ground. Additionally, the reclosers can be programmed with a "hotline tag" setting used when line personnel are working on the lines, and will trip instantaneously as a fault occurs, which will significantly reduce the risk of injury for lineman. The proposed AMI technology features remote disconnects and meter bypass detection which can keep line personnel from entering dangerous situations.

xii. **Reduction in distribution grid maintenance costs:** Since the Cooperative operates a not-for-profit business model the reduction in operating costs is passed down to the membership thereby reducing the energy burden on individuals in disadvantaged communities. The proposed AMI technology offers advanced features such as active transformer load monitoring and management, active transformer voltage monitoring, temperature monitoring, high impedance detection, and remote disconnect capability. These features allow the meter to detect and alarm for any issues that may cause energy loss, power quality issues, or outages. For example, high impedance detection and temperature monitoring can detect and identify bad secondary connections, meter jaw issues, or micro arcing, leading to scheduled maintenance and correction before more damage to the system occurs. The remote meter disconnect feature prevents a service technician from being dispatched to disconnect a meter for non-payment or electrical work, which saves the cost of a truck roll. The proposed recloser technology and improved coordination available through the project reduces the number of line workers dispatched to reclose temporary faults such as lightning and animal contacts. Also, the vacuum reclosers have a much longer maintenance interval compared to the three-year interval of the oil reclosers. This would eliminate the significant cost of having them replaced, rebuilt, and inspected every three years.

xiii. **Reduction in environmental exposure and impact:** Replacing oil reclosers and oil capacitor banks with the current vacuum technology eliminates safety and environmental concerns with oil leaks and spills as well as reducing the impact of waste oil accumulation. The oil reclosers must undergo triennial maintenance regardless of operation count requiring construction crew personnel's time, cost for maintenance and labor, leading to the creation of waste oil from the maintenance process. The replacement of the outdated oil reclosers eliminates over 2,800 gallons of waste oil per year from maintenance efforts as well as eliminates over 8,600 gallons of oil from installation on the distribution grid, some of which is over national forest, state parks, tribal lands, and major waterways.

B. Innovation and Impact

The deployment of Smart Grid technologies proposed provides robust grid-benefitting outcomes with varying applications including system safety, environmental impact, maintenance schedules, reliability, outage management, and new and robust use cases in grid operations, consumer engagement, and distributed energy resource (DER) management. Each innovative technology used in the proposed project to accomplish the previously mentioned outcomes is listed below with an explanation of the current technology on the AVECC distribution grid and the advantages of the innovative technology proposed.

Current State Technology / Practices	Proposed Technology	Advantage of Proposed Technology	Overall Impact with Successful Project	More Detail
Outage Prevention: • Set Protection Scheme • Poor Device Coordination • Lack of Grid Flexibility	• Adaptive Protection (Reclosers) • Feeder Level Coordination • SCADA Controlled Devices	• Eliminate Outage due to Temporary Fault • Minimize Number Affected by Outage	Cooperative Membership will experience fewer outages as a result of greater grid flexibility	2.A.iii 2.A.iv
Outage Restoration: • Outage Reported by Member • Critical grid info at Substation Only • No Remote Power Flow Control • Manual Labor Restoration • Manual Search for Fault Location	• AMI Outage Detection • SCADA Controlled Devices	• Auto Meter Outage Detection • Grid Visibility at all Levels • Grid Control to System Operators for Remote Restoration • Outage Location Prediction	Grid visibility and control to precisely predict outage location, restore power quickly, and prevent personnel dispatched to outage location	2.A.i 2.A.iii 2.A.iv
System Visibility/Communications: • Substation Critical Info Only • Remote Control of Substation Only	• SCADA Controlled Devices • SEL Secure Communication	• Visibility at all Levels/Devices • Grid Control to Operators for Remote Sectionalizing	Increase grid flexibility and reliability with real time grid health information and operator control	2.A.i 2.A.ii
Energy Conservation: • Temperature Controlled Capacitors • Manually Controlled Capacitors • Non-Controllable Regulators • No Live Energy Usage Visibility	• CVR Regulators • Power Factor Correction Capacitor Banks	• Peak Demand Reduction • Dispatch Controlled CVR • Power Factor Correction • Voltage Monitor/Control All Grid • Energy Savings	Reduction of Energy Usage translated to direct savings, energy burden reduction, and increased capital credits for members	2.A.vi 2.A.vii 2.A.viii
Environment: • Oil Filled Devices	• Vacuum Fault Reclosers • Vacuum Capacitor Banks	• Wildfire Risk Reduction • Eliminate Oil from Grid • Elimination of Waste Oil	Removal of environmental hazards on distribution grid and waste oil as well as reduction in maintenance expense	2.A.iv 2.A.xiii
Maintenance: • 3 Year Maintenance Rotation (Labor, Costs, Waste Oil)	• Vacuum Fault Reclosers	• Main Based on Operations • Reduced Cost	Removal of environmental hazards on distribution grid and waste oil as well as reduction in maintenance expense	2.A.xii
Safety: • Hotline Tag Fault Protection at Substation Only • Device Control at Top of Pole	• Vacuum Fault Reclosers • Vacuum Capacitor Banks	• Instantaneous Hotline Tag Fault Protection Close to Operator • Ground Level Controls (No Stick Work or Climbing)	Reduce the interaction between line workers and live electrical lines during normal ops, but especially during a fault, potentially saving a life	2.A.xi
Meter Reading / Control: • Powerline Data Carrier • Thermal Limitations (1 Hr. Interval) • Manual Disconnect • Manual Bypass Detection • No Beyond Meter Visibility/Control	• AMI	• 1 Minute Usage Intervals • DER Ready • Remote Disconnect / Control • Bypass Detection and Alert • Consumption Awareness	Better member experience with behind-the-meter assets and management of their energy consumption	2.A.v 2.A.viii 2.A.ix 2.A.x

C. Feasibility

The work of the previous five years undertaken by AVECC to deploy a fiber backbone throughout the service territory has laid the groundwork for the AVECC grid to be ready to accept these grid enhancing technologies and establish Smart Grid communications at once. The AVECC Fiber to the Home project, to be completed in 2024, essentially creates a plug and play network for the communications required to facilitate a full Smart Grid as proposed with this project request.

All proposed Smart Grid technologies to be implemented as part of the proposed project are industry proven, commercially available products ready for order allowing the project to commence without delay once funding is available. AVECC has communicated the project scope and size with all applicable vendors and has received no hesitancy in the ability to meet the required delivery schedules proposed for materials. AVECC has deployed all technology proposed on a small scale in the past few years to prove project viability and understand the work necessary to complete a successful launch of the proposed Smart Grid. As a result, AVECC has a full understanding of the scope of the proposed project and is ready to meet the requirements.

AVECC has a skilled engineering team trained in the software and hardware necessary to program devices and establish communications. AVECC also has a highly skilled workforce of line workers who train through a lineman apprenticeship program to ensure the necessary skills required for their daily work requirements and the proposed project. Any work not performed in-house by AVECC employed engineering or line personnel will be accomplished using licensed and trained contract workforces who employ local skilled line workers that undergo their own apprenticeship program. AVECC has all the required infrastructure to complete the proposed project without the necessity of acquiring any additional infrastructure besides the proposed technology to be installed. AVECC has existing legal access to all rights-of-way where work would be performed. The fiber used as the project's communication backbone is owned and operated by AVECC eliminating all third-party communications interaction. AVECC owns existing warehouse space and yard space for all storage and assembly work required by the technology materials. AVECC also owns the necessary equipment and tools to execute the installation of the proposed grid enhancing technologies.

D. Support of Energy Goal

The proposed project further enhances the energy goals of federal, state, and local agencies and has no conflict with any existing initiatives of these departments. All proposed technology is innovative technology which enhances the reliability, resiliency, and security of the existing energy infrastructure by increasing visibility and control to the distributions grid’s edge which is a previously hidden asset. Directly supporting the Department of Energy’s goals of grid visibility, reliability, DER integration, natural disaster effect mitigation, and energy usage transparency is the focus and result of the proposed project. In addition, the project not only aligns, but also enhances, the State of Arkansas Energy Assurance Plan authored by the Arkansas Department of Energy and Environment, particularly the plan for Smart Grids, innovative technologies, energy alternatives, and grid reliability goals.

E. Project Deployment Assurance and Future Private Investment Opportunities

Support from the DOE for the proposed AVECC project would not only lead to a distribution energy grid improvement in a rural, disadvantaged area but would also lead to the future investment in area infrastructure to upgrade the grid to a fully automated Smart Grid. AVECC aims to deploy a self-healing grid capable of advanced power flow control and topology optimization on the distribution level, further enhancing grid flexibility. Without DOE funding, AVECC would not be able to start working on these features for 20+ years. The proposed project would implement the first stage of the fully automated Smart Grid. Once complete, AVECC plans to move to the second phase of a fully automated Smart Grid by installing automated switching and a Fault Location, Isolation, and Service Restoration program. This program would create an advanced power flow control system capable of automatically controlling the power flow via auto switches to identify the location of a fault, isolate it as tightly as possible, and ensure outage impacts are minimized. Funding aid to accomplish the first step of the fully automated Smart Grid program would free up the future private investment funds from AVECC to continue to build on the Smart Grid to ensure the best energy infrastructure.

F. Smart Grid Priority Focus Area Alignment

As discussed throughout this technical volume, the Smart Grid project proposed by AVECC aligns and enhances current energy goals and focus areas of the national energy infrastructure and the Department of Energy. A summary of the alignment areas is listed below.

i. Prevent faults that may lead to wildfires or other system disturbances: The proposed downline equipment technologies replace existing oil filled equipment throughout the distribution grid and prevent sparks and equipment failures that lead to wildfires and/or environmental hazards (Section 2. A. iv, 2.B.ii). The vacuum reclosers improve system device coordination and reliability ensuring the impact of any natural disaster is suffered by the fewest number of people possible (Section 2.A.iii).
ii. Integrate variable renewable energy resources at the distribution level: The proposed AMI and the capabilities of the proposed downline device technology provides the tools for immediate integration of energy resources through meter level DER detection and adaptable protection schemes (Section 2.A.x and 2.B.v)
iii. Facilitate the aggregation and integration (edge-computing) of electric vehicles and other grid-edge devices or electrified loads: The deployment of AMI with edge computing capabilities and smart downline devices facilitates the aggregation and integration of grid-edge devices by locating and engaging with behind-the-meter assets, such as distributed solar and controllable loads (EVs) with no barriers to integration (Section 2.A.x and 2.B.v).

G. System Flexibility

The addition of the proposed grid enhancing technologies would provide flexibility for foreseen and unforeseen changes to the future of the grid. AVECC would be fully prepared for foreseen changes discussed above, like increased renewable generation, two-way power flow, and electric vehicle charging. The Cooperative would also have the flexibility to adjust to unforeseen changes to the grid due to the visibility provided by SCADA and the programmable remote-controlled devices.

3. Workplan

A. Project Objectives

The Smart Grid Implementation project throughout the AVECC network would increase efficiency, reliability, flexibility, and resiliency of the distribution grid through the implementation of grid-enhancing technologies that prevent faults and system disturbances, allow for the integration of variable renewable energy resources at the distribution level, and facilitate the aggregation and integration of grid-edge devices. A successful project would transition all major downline devices on the AVECC distribution grid to "Smart" grid devices with two-way communications and control capabilities with the intent to improve system reliability and flexibility, provide full grid visibility to operators, implement autonomous controls for rebalancing and natural disaster mitigation and recovery, and reduce consumer energy burden by reducing operating and maintenance costs.

B. Technical Scope Summary

AVECC will utilize industry proven grid enhancing technologies to create a smart gird network of devices throughout the AVECC distribution grid enabling two-way communication between all downline devices and dispatch centers, remote control of devices, and leveraging proven industry practices to implement autonomous control of devices to improve gird functionality, reliability, flexibility, and reduce energy burden to individuals in Justice40 disadvantaged communities. The installation of grid enhancing technology devices will be tracked on an annual basis throughout the 60-month project timeline once devices are fully commissioned, communications are live, and autonomous controls are operating on that device if applicable. The autonomous controls will allow AVECC to take advantage of peak load shedding, power factor correction, and conservative voltage reduction without manual intervention which in turn will reduce the energy burden to members of AVECC.

C. Buy America Requirements

The proposed project discussed in this technical volume includes the alteration of public infrastructure in the United States by way of upgrading infrastructure affixed devices that transport and distribute energy throughout the electric distribution grid which is publicly owned and serves a public function. No construction of public infrastructure will occur throughout the lifecycle of the proposed project.

AVECC fully supports the Buy America Requirements and commits to ensuring all manufactured products used in the project are manufactured in the Unites States in accordance with Buy America Requirements Section B.2. The proposed project would include the purchase of the following infrastructure affixed devices and their manufacture locations:

- G&W Viper Reclosers – Headquarters and Manufactured in Bolingbrook, IL
- Schweitzer Engineering Laboratories (SEL) Relay Panels – Headquartered in Pullman, WA and Manufactured in Lewiston, ID; Lake Zurich ID, and West Lafayette, IN
- Hubbell Capacitors – Headquarters in Columbia, SC and Manufactured in Leeds, AL
- Itron Gen 5 Meters – Manufactured in West Union, SC

D. WBS and Task Description Summary

The AVECC Smart Grid Implementation is divided into 5 different device categories (Regulators, Capacitor Panels, Capacitor Banks, Reclosers, and AMI) and the project execution is planned in three project phases: Design, Installation, and Commissioning. Each of the device types has tasks and subtasks that are categorized into the three project phases. A WBS overview is displayed below, and an explanation of each task required to complete the phase for each device follows the chart.

	WBS	Name	Duration	Start	Finish
1	1	⊟AVECC Smart Grid	1305days	10/02/2023	09/29/2028
2	1.1	⊟Design	1185.5days	10/02/2023	04/17/2028
3	1.1.1	⊞Capacitors - Panels	34.25days	10/02/2023	11/17/2023
16	1.1.2	⊞Regulators	37.13days	10/25/2023	12/15/2023
29	1.1.3	⊞Capacitors - Banks	848.5days	01/01/2025	04/03/2028
126	1.1.4	⊞Reclosers	924.5days	10/01/2024	04/17/2028
271	1.1.5	⊞AMI	160days	01/01/2024	08/09/2024
276	1.2	⊟Installation	1207.38days	10/10/2023	05/25/2028
277	1.2.1	⊞Capacitors - Panels	68.5days	10/13/2023	01/17/2024
294	1.2.2	⊞Regulators	119.5days	10/10/2023	03/26/2024
307	1.2.3	⊞Capacitors - Banks	852days	01/01/2025	04/07/2028
404	1.2.4	⊞Reclosers	944.5days	10/11/2024	05/25/2028
513	1.2.5	⊞AMI	600days	08/12/2024	11/27/2026
515	1.3	⊟Commissioning	1228days	10/02/2023	06/14/2028
516	1.3.1	⊞Capacitors - Panels	131.88days	11/09/2023	05/13/2024
529	1.3.2	⊞Regulators	269.13days	10/02/2023	10/11/2024
542	1.3.3	⊞Capacitors - Banks	854.25days	01/03/2025	04/13/2028
639	1.3.4	⊞Reclosers	933days	11/18/2024	06/14/2028
748	1.3.5	⊞AMI	100days	11/30/2026	04/16/2027
752	1.4	⊞Project Closing	77days	06/15/2028	09/29/2028

The Arkansas Valley Electric Cooperative territory is subdivided into 4 districts, each having their own office with dedicated construction crews and service technicians. In addition to the district divisions, the entire AVECC territory has 36 substations whose control and maintenance are divided between the districts. All AVECC engineering activities are completed from a single engineering department headquartered in the Ozark District but serving all districts. The engineering department resources include engineers, substation technicians, meter technicians, and dedicated SCADA personnel. Each device type being installed as part of the AVECC Smart Grid Deployment project had its tasks subdivided into either districts or substations based on the number of devices, resources required for each device, and device lead times. Each of the devices installed brings their own project deliverables that come together to make the fully developed Smart Grid. As a result, each of the device types can proceed through the design, installation, and commissioning phase on its own without interaction from the other device types. Although the completion of the commissioning phase of a single device type marks a milestone in the project completion, the Smart Grid is not fully realized until all devices are installed and commissioned with two-way communications back to the dispatch centers of AVECC.

i. Capacitor Panels

The capacitor panels to be installed onto the AVECC distribution grid as part of the Smart Grid deployment are subdivided into districts for tracking purposes. The Ozark District will install 38 capacitor panels, the Pocola District 28 capacitor panels, the Van Buren District 44 capacitor panels, and the Waldron District 27 capacitor panels. The design phase for the capacitor panels will include the programming of the panel by an AVECC engineer and the programming of the Real-Time Automation Controller (RTAC) which will enable two-way communications by an individual from the AVECC SCADA department. The design phase of the capacitor panels will only require resources from within the AVECC engineering department. The installation phase for the capacitor panels will include the engineering department and construction crews from each district. Within the installation phase, the engineering department will be responsible for installing the previously programmed capacitor panel and building and installing the hardware required for the SCADA communications. The construction crews from each district must be on site during the panel installation to complete hardware installation on the energized electrical line. The scheduling coordination between the necessary resources from the engineering department and the districts during panel installation will be managed by the project manager with input from the district superintendents. After the physical installation of hardware completes the installation phase for the capacitor panels, the communications between the hardware and the dispatch center are required to complete the commissioning phase. This phase only involves resources from the engineering department and will consist of fiber drops from the main line to each of the capacitor panels, assigning IP addresses, and ensuring communications. After communications are established, a full SCADA test of each device is required prior to device "go-live" and integration with the dispatch center where the device can then be controlled by personnel with credentials. The completion of the commissioning phase for each capacitor allows that capacitor to be considered a "smart device" that can be counted toward project completion.

ii. Regulators

The regulators to be connected onto the AVECC distribution grid as part of the Smart Grid deployment are subdivided into districts for tracking purposes. The AVECC distribution grid has existing regulators throughout the grid, but these devices are not connected in any manner and cannot be controlled to aid in project goals such as conservative voltage reduction and peak load shedding. Some of the existing regulators on the AVECC distribution grid have digital panels already and some have old, mechanical panels. The regulator work tasks for this project will include upgrading the regulator panels to digital, controllable panels on regulators without them and connecting all regulators as "smart devices" with two-way communications, regardless of which panel is currently existing on the device. The RTAC used for this project has 4 ports allowing up to 4 devices to be connected with two-way communications, therefore when there is an installation of three regulators in the same location on a three-phase line, one for each phase, a single RTAC will be used for the communications. The Ozark District has 97 total regulators on their line, 29 of those require new digital panels, and connecting all regulators within the district to the Smart Grid will require 39 SCADA connections. The Pocola District has 13 total regulators on their line, 8 of those require new digital panels, and connecting all regulators within the district to the Smart Grid will require 7 SCADA connections. The Van Buren District has 57 total regulators on their line, 40 of those require new digital panels, and connecting all regulators within the district to the Smart Grid will require 24 SCADA connections. The Waldron District has 28 total regulators on their line, 6 of those require new digital panels, and connecting all regulators within the district to the Smart Grid will require 10 SCADA connections.

The design phase for the regulators will include the programming of the panel by an AVECC engineer and the programming of the Real-Time Automation Controller (RTAC) which will enable two-way communications by an individual from the AVECC SCADA department. The design phase of the regulators will only require resources from within the AVECC engineering department. Within the installation phase, the engineering department will be responsible for installing the previously programmed regulator panel in the regulators that require upgrade to digital panels as well as building and installing the hardware required for the SCADA communications for all regulators. The installation phase for the regulators will include resources from the engineering department only. After the physical installation of hardware completes the installation phase for the regulators, the communications between the hardware and the dispatch center are required to complete the commissioning phase. The engineering department will complete fiber drops from the main line to each of the regulators, assign IP addresses, and ensure communications. After communications are established, a full SCADA test of each device is required prior to device “go-live” and integration with the dispatch center where the device can then be controlled by personnel with credentials. The completion of the commissioning phase for each regulator allows that capacitor to be considered a “smart device” that can be counted toward project completion. Once all regulators are commissioned, AVECC can utilize the devices for conservative voltage reduction and peak load shedding as listed in the project goals and objectives.

iii. Capacitor Banks

The capacitor banks to be installed onto the AVECC distribution grid as part of the Smart Grid deployment are subdivided into substations, rather than districts, for tracking purposes due to the lead time constraints, resources required, installation time, and the device project timeline. The AVECC distribution grid has 32 substations that require a capacitor bank installation for this Smart Grid deployment project, each substation having between 1 and 6 capacitor banks to be installed and commissioned for a total of 85 capacitor banks. The design phase for the capacitor banks will include the programming of the panel by an AVECC engineer and the programming of the Real-Time Automation Controller (RTAC) which will enable two-way communications by an individual from the AVECC SCADA department. The design phase of the capacitor banks will only require resources from within the AVECC engineering department. The installation phase for the capacitor banks will include the engineering department and construction crews from each district. Within the installation phase, the engineering department will be responsible for installing the previously programmed capacitor bank panel and building and installing the hardware required for SCADA communications. The construction crews from each district must be on site during the installation to complete capacitor bank hardware installation on the energized electrical line. The scheduling coordination between the necessary resources from the engineering department and the districts during capacitor bank installation will be managed by the project manager with input from the district superintendents. After the physical installation of hardware completes the installation phase for the capacitor banks, the communications between the hardware and the dispatch center are required to complete the commissioning phase. This phase includes resources from the engineering department. Engineering will complete fiber drops from the main line to each of the capacitor banks, assign IP addresses, and ensure communications. After communications are established, a full SCADA test of each device is required prior to device "go-live" and integration with the dispatch center where the device can then be controlled by personnel with credentials. The completion of the commissioning phase for each capacitor allows that capacitor to be considered a "smart device" that can be counted toward project completion. Once all capacitors (panels and banks) are commissioned, AVECC can utilize the devices for power factor correction and real-time line feedback as listed in the project goals and objectives.

iv. Reclosers

The reclosers to be installed onto the AVECC distribution grid as part of the Smart Grid deployment are subdivided into substations, rather than districts, for tracking purposes due to the lead time constraints, resources required, installation time, and the device project timeline. The AVECC distribution grid has 36 substations that require recloser installation for this Smart Grid deployment project, each substation having between 1 and 77 reclosers to be installed and commissioned for a total of 674 recloser. The design phase for the reclosers will include a full coordination study completed per substation by an AVECC engineer, the programming of the recloser panel by an AVECC engineer and the programming of the Real-Time Automation Controller (RTAC) which will enable two-way communications by an individual from the AVECC SCADA department. The design phase of the reclosers will only require resources from within the AVECC engineering department. The installation phase for the reclosers will include the engineering department and construction crews from each district. Within the installation phase, the engineering department will be responsible for installing the previously programmed recloser panel and building and installing the hardware required for SCADA communications. The construction crews from each district must be on site during the installation to complete the installation of recloser hardware on the energized electrical line. The scheduling coordination between the necessary resources from the engineering department and the districts during recloser installation will be managed by the project manager with input from the district superintendents. After the physical installation of hardware completes the installation phase for the reclosers, the communications between the hardware and the dispatch center are required to complete the commissioning phase. The engineering department will complete fiber drops from the main line to each of the reclosers, assign IP addresses, and ensure communications. After communications are established, a full SCADA test of each device is required prior to device "go-live" and integration with the dispatch center where the device can then be controlled by personnel with credentials. The completion of the commissioning phase for each recloser allows that recloser to be considered a "smart device" that can be counted toward project completion. Once all reclosers are commissioned, AVECC can utilize the devices for outage management, sectionalizing, and load control as listed in the project goals and objectives.

v. AMI

AVECC will outsource the design phase and commissioning phase of the AMI network to a third-party AMI expert while AVECC will complete the installation phase of the AMI deployment portion of the AVECC Smart Grid deployment project with in-house labor. At the time of this proposal, AVECC has approximately 62,600 active meters on their distribution grid. The design phase of the AMI deployment includes the Field Network Design, Project Plan, First Article Testing, Environment Setup, UIQ Integration, and training for AVECC employees in various aspects of the new AMI platform. All work in the design phase will be completed by contract with NRTC who will manage project plans and schedules with AVECC oversight in monthly planning meetings. The environment setup includes integration of the AMI software platform on the AVECC network. Field Network Design includes a mapping plan with proposed locations for all communications equipment to ensure all meters on the AVECC system can be communicated with. Training from NRTC to AVECC employees will include site survey training, AMI software training, HDW 101 training, installation training, and troubleshooting training. The AVECC contact for NRTC and project coordinator on the AVECC deliverables for the AMI deployment will be the meter coordinator. The scheduling coordination between the necessary resources from AVECC and NRTC during AMI design will be managed by the meter coordinator with input from the managers of each required department (Member services for AMI software, meter technicians for installation, engineering for troubleshooting, etc.).

The installation phase of the AMI deployment will be executed by AVECC personnel, managed by the meter coordinator with oversight from the Smart Grid deployment project manager and support from NRTC. The installation phase will include the Field Network Deployment and installation of all Fiber MiniAP devices to enable communication and all Itron Gen 5 Riva meters. AVECC service technicians will complete the installations and supply the installation results to the member services department to activate the meter in the billing system. After the physical installation of hardware completes the installation phase for the AMI system, NRTC will execute the commissioning phase which includes optimization of the network communications, a final network design, and final system acceptance testing. The completion of the commissioning phase for the AMI system allows each meter to be considered a “smart device” that can be counted toward project completion. Once all meters and the full software system is commissioned, AVECC can use the AMI for outage management, customer knowledge, and real-time network feedback for system devices as listed in the project goals and objectives.

E. Milestone Summary

The AVECC Smart Grid deployment project has its milestones centered on the number of devices that are SCADA connected meaning they are actively participating in two-way communications and can be remotely controlled by the AVECC dispatch center by authorized personnel. The total number of devices to be commissioned throughout the AVECC distribution grid is 1203 devices including 112 existing connected devices, 195 regulators to connect, 222 capacitors to connect, and 674 reclosers to connect. The project is considered complete when all devices are SCADA connected and communicating allowing AVECC to take advantage of programs like conservative voltage reduction, peak power reduction, etc., therefore, the major milestone tracked throughout the life of the project is the % of the AVECC system that is SCADA connected. A quarterly breakdown of the SMART milestone is shown below. At the end of year 1, 35% of all AVECC downline devices will be connected to the Smart Grid, 54% at the end of year 2, 72% at the end of year 3, 88% at the end of year 4, and 100% of the AVECC grid will be SCADA connected and considered as part of a Smart Grid.

Project Timeline		Devices Connected this Quarter	SCADA Connected Devices	% DL System SCADA Connected
Existing (Pre-Project)			112	9%
Year 1	Quarter 1	80	192	16%
	Quarter 2	86	278	23%
	Quarter 3	47	325	27%
	Quarter 4	91	416	35%
Year 2	Quarter 1	72	488	41%
	Quarter 2	51	539	45%
	Quarter 3	56	595	49%
	Quarter 4	51	646	54%
Year 3	Quarter 1	59	705	59%
	Quarter 2	54	759	63%
	Quarter 3	54	813	68%
	Quarter 4	48	861	72%
Year 4	Quarter 1	51	912	76%
	Quarter 2	50	962	80%
	Quarter 3	49	1011	84%
	Quarter 4	49	1060	88%
Year 5	Quarter 1	52	1112	92%
	Quarter 2	47	1159	96%
	Quarter 3	44	1203	100%
	Quarter 4			
TOTAL:		**1091**		

Further, milestones are documented based on the individual devices and their project phases, with a milestone occurring at the end of each phase (design, installation, and commissioning) for each device type. A yearly breakdown of when each of these milestones is accomplished is shown below with the quarter of achievement listed in the column on the right.

Work Group	Project Phase	Year 1	Year 2	Year 3	Year 4	Year 5	End Date
Regulators	Design	100%					Year 1 Q1
	Installation	100%					Year 1 Q4
	Commissioning	85%	100%				Year 2 Q1
Capacitors - Panels	Design	100%					Year 1 Q1
	Installation	100%					Year 1 Q4
	Commissioning	100%					Year 1 Q4
Capacitors - Banks	Design	-	35%	50%	80%	100%	Year 5 Q2
	Installation	-	35%	50%	80%	100%	Year 5 Q2
	Commissioning	-	35%	50%	80%	100%	Year 5 Q2
Reclosers	Design	-	25%	50%	80%	100%	Year 5 Q2
	Installation	-	25%	50%	80%	100%	Year 5 Q2
	Commissioning	-	25%	50%	80%	100%	Year 5 Q3
AMI	Design	100%					Year 1 Q4
	Installation	5%	38%	72%	100%		Year 4 Q1
	Commissioning	-	-	-	40%	100%	Year 4 Q2

Project Progress will be tracked via a Gannt Chart that includes all task timelines and resources. More specifically, AVECC has a work order system that they currently operate for all work completed throughout any district including service orders, line improvements, new construction, service upgrades, etc. A work order will be created for each device and all materials and labor will be charged to that work order. All work order metrics can be tracked, and a report generated for updating the Gannt chart, tracking project progress, and creating budget reports.

F. Go/No-Go Decision Points

AVECC has assigned a budget period annually to the 5-year project duration making 5 review points and reporting periods throughout the project. Each of these reporting periods there will be a project review held which incorporates a decision point where the team, along with the DOE, will determine whether the project has made adequate progress, remains on track with regards to timeline and budget, and should continue as planned, continue with adjustments, or be aborted. The main decision factor in this review will be available funding and project progress. At each annual review, the project team will evaluate the number of devices connected to the SCADA system which will essentially reveal the percentage of the Smart Grid that is deployed throughout the AVECC territory as approval to move forward. The expectation is below:

	Review 1	Review 2	Review 3	Review 4	Review 5
Smart Grid Completion	30%	50%	70%	85%	100%
AMI Installation Completion	5%	35%	70%	100%	

G. End of Project Goal

The AVECC Smart Grid Deployment project is considered complete when all downline regulators, capacitors, and reclosers are SCADA connected and communicating and the new AMI platform is installed at every meter and the final system acceptance testing is completed and signed.

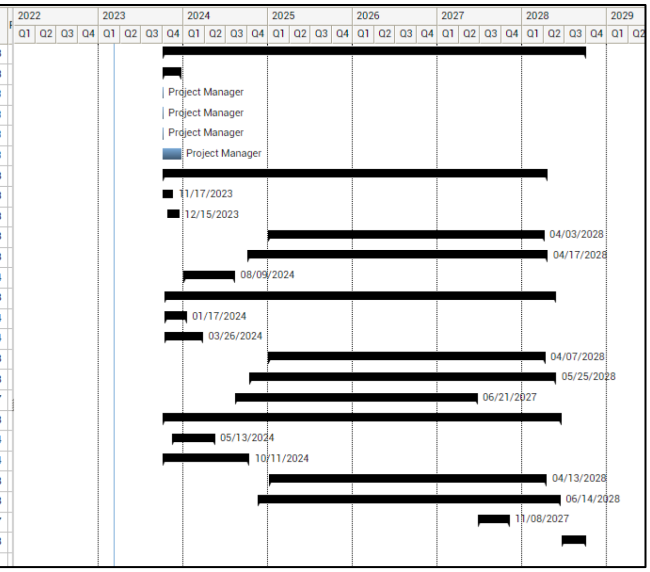
The programming in the new device relays will include conservative voltage reduction for regulators and the capacitors will be programmed to automatically correct poor power factor making these project objectives considered completed upon SCADA commissioning of each device. The peak load shedding program will be a continual process year over year, with the first year of peak load shedding to begin in the first winter or summer following the project completion.

H. Project Schedule

Assuming the funding becomes available in Quarter 4 of 2023 for project start, AVECC will immediately begin the project in Q4 2023 with a start date of 10/01/2023. On the project start date, AVECC will begin purchasing long lead items (capacitor banks and reclosers) and start the design and installation of short lead time items such as regulator and capacitor panels. The schedule proposed below, based on the available resources to complete the project, concludes the device portion of the project in Q3 2028 with end date of 09/29/2028. Q3 of 2028 will allow for final project reporting to be completed for project close-out making the project duration 5 year, from Q4 2023 to Q3 2028. The planned budget reporting periods are scheduled yearly, and all milestones and go/no-go decision points are based yearly on that budget reporting schedule.

The schedule overview shown below details the duration, start date, and end date of each project phase. The device type under each project phase is a milestone and shows the milestone completion date to the right of the chart. A fully expanded Gannt chart is available for review and details all tasks and subtasks to be completed within each milestone but was summarized for this report due to space constraints. All resources have been assigned in this schedule and resources have been levelized to ensure the project SMART goals were attainable and time bound.

	WBS	Name	Duration	Start	Finish
1	1	⊟AVECC Smart Grid	1305days	10/02/2023	09/29/2028
2	1.1	⊟Project Initiation	60days	10/02/2023	12/22/2023
3	1.1.1	Project Management Plan	40hrs	10/02/2023	10/06/2023
4	1.1.2	NEPA Compliance	40hrs	10/02/2023	10/06/2023
5	1.1.3	Cybersecurity Plan	40hrs	10/02/2023	10/06/2023
6	1.1.4	Continuation Briefings	3mons	10/02/2023	12/22/2023
7	1.2	⊟Design	1185.5days	10/02/2023	04/17/2028
8	1.2.1	⊞Capacitors - Panels	34.25days	10/02/2023	11/17/2023
21	1.2.2	⊞Regulators	37.13days	10/25/2023	12/15/2023
34	1.2.3	⊞Capacitors - Banks	848.5days	01/01/2025	04/03/2028
131	1.2.4	⊞Reclosers	924.5days	10/01/2024	04/17/2028
276	1.2.5	⊞AMI	160days	01/01/2024	08/09/2024
281	1.3	⊟Installation	1207.38days	10/10/2023	05/25/2028
282	1.3.1	⊞Capacitors - Panels	68.5days	10/13/2023	01/17/2024
299	1.3.2	⊞Regulators	119.5days	10/10/2023	03/26/2024
312	1.3.3	⊞Capacitors - Banks	852days	01/01/2025	04/07/2028
409	1.3.4	⊞Reclosers	944.5days	10/11/2024	05/25/2028
518	1.3.5	⊞AMI	745.25days	08/12/2024	06/21/2027
520	1.4	⊟Commissioning	1228days	10/02/2023	06/14/2028
521	1.4.1	⊞Capacitors - Panels	131.88days	11/09/2023	05/13/2024
534	1.4.2	⊞Regulators	269.13days	10/02/2023	10/11/2024
547	1.4.3	⊞Capacitors - Banks	854.25days	01/03/2025	04/13/2028
644	1.4.4	⊞Reclosers	933days	11/18/2024	06/14/2028
753	1.4.5	⊞AMI	100days	06/21/2027	11/08/2027
757	1.5	⊞Project Closing	77days	06/15/2028	09/29/2028



I. Project Management

The AVECC Smart Grid Deployment project will have a single point of contact project manager responsible for ensuring project delivery within budget and timeline constraints. There will be a project team of support personnel, detailed in section 4 of this technical volume, responsible for execution of individual pieces of the project with oversight from the project manager. Each team member was selected for their knowledge and experience in a certain aspect or device required for project completion. Critical handoffs between departments or project teams will be handled with oversight from the project manager to ensure the project plan is adhered to. Critical interdependencies include the handoff of each device design from the engineering department to the operations department for installation phase as well as the handoff from the operations department after installation back to the engineering department for commissioning. More challenging is the collaboration between NRTC and AVECC while designing and installing the AMI network. To combat this potential project delay due to failed interdependency, NRTC and AVECC have developed specific statement of work and responsibility documentation for each task of the AMI deployment ensuring all partied understand their responsibilities and the project timeline.

AVECC currently houses all company operations, projects, and work activities within their network management electric utility software designed for planning, design, and workflow management specifically developed for electric utilities and their unique processes. The Smart

Grid deployment project would utilize this existing infrastructure for project management activities creating workorders for each task or subtask and digitally tracking all materials and labor assigned to that task or subtask. This allows for the creation of digital reports based on project criteria ensuring accurate project tracking for all parties such as operations and accounting.

The most significant risk to the Smart Grid deployment project is a lack of resources to complete the work resulting in a project delay. AVECC plans to utilize in house labor including substation technicians, service technicians, and construction crews to complete the installation work due to the familiarity with the distribution grid the listed personnel possess. AVECC has multiple personnel filling each of the listed positions creating redundancy in the knowledge required to complete the project. In addition, AVECC works with several local contractors to complete overflow line work and deploy the fiber to the home project that are available for contract if the project timeline comes into jeopardy. With regards to engineering labor, AVECC has multiple personnel who possess the knowledge of the system and engineering practices required to complete the project creating redundancy in engineering knowledge and abilities. If resources become constrained for the design or commissioning portion of the project, the project manager can shift workload between individuals within the department with no consequence to project timeline or quality. In the event an engineering resource is lost or constrained beyond correction within the project timeline, AVECC contracts with a local engineering firm for project overflow who possesses the knowledge of the AVECC distribution system who can complete project design tasks with no consequence to project timeline or quality. A quarterly project meeting will be held to review the project timeline and project risks taking any necessary action preemptively to correct constraints and prevent project risks from affecting project timeline, project budget, or project quality.

All project changes will be tracked through a change management form and filed within the project document library. Any actions resulting from the project change management will be implemented to the project scope, timeline, and budget immediately by the project manager and communicated to the necessary parties of the project team. All team members will be granted access to a dedicated project team SharePoint / MS Teams location where all project files will be kept. Individuals can communicate with any team member directly or with all team members simultaneously through this location. Project updates will be posted within this location for immediate distribution to the team. The project updates including schedule, budget, changes, progress, and status will be made publicly available to all team members for viewing at any time.

4. Technical Qualifications and Resources

A. Project Team Qualifications

AVECC had the knowledge , skills, and abilities for successful project completion as demonstrated by previous successful projects including the Fiber to the Home project, which has team members overlap with the current proposed project. The main project team is comprised of personnel from various departments who possess specialized skills to complete the required work. Amongst the team members is a wealth of project and personnel management knowledge which will aid in ensuring the proposed project is completed within the given time and budget constraints. Chris Howe was selected to be the project manager due to his extensive personnel management experience and his involvement with prior large scale projects undertaken by AVECC. In addition, the engineering department at AVECC has engineers with degrees in power system analysis and training in power system coordination and relay programming. The SCADA representative has an Information Technology (IT) background with experience developing and maintaining the current SCADA communications the AVECC substations. The AMI deployment will be completed with the assistance of NRTC, who has prior experience in AMI deployment and the AVECC AMR Coordination who had a great understanding of the current AVECC metering platform. All budgeting and record keeping will be accomplished by a certified accountant with years of experience in cooperative finances and specialties in government funding projects.

Team Member	Title	Company	Expertise	Project Responsibilities
Barret Ewing	Operations and Engineering Manager	AVECC	Engineering / Management	Project Sponsor / Business Point of Contact
Chris Howe	Engineering Manager	AVECC	Engineering / Management	Project Manager / Technical Point of Contact
Lauren Robinson	Accounting and Finance Manager	AVECC	Accounting / Finance	Project Financial Analysis
Alex Dickerson	Planning Engineer	AVECC	Engineering / Coordination	Engineering / Coordination
Samantha Renard	System Engineer	AVECC	Engineering / Relay Programming	Engineering / Relay Programming
Brian Dedmon	Engineering Technician	AVECC	Communications	SCADA Communications
Kevin McGuire	AMR Coordinator	AVECC	Metering	AVECC Metering Point of Contact / Meter Installation Management
Chad Dose	Director, AMI Solutions	NRTC	AMI Deployment	AMI Deployment Management

AMI: AVECC has chosen to partner with NRTC on this Itron Gen5 Riva AMI solution with Distributed Intelligence based on the direct experience NRTC has in the implementation and utilization of this technology as a cooperative partner with other electric cooperatives. AVECC will contract directly with NRTC on this project, providing contracting, programming, order processing, training test plans and project management throughout the deployment. It is NRTC's experience in technology and project management that will benefit AVECC's Smart Grid deployment. NRTC project managers are certified Project Management Professionals with years of experience in the deployment of AMI systems.

B. Existing Equipment and Facilities

As an electric distribution utility, AVECC is well-positioned to access the equipment and provide the necessary resources, including facilities, to successfully deploy and maintain the proposed project. AVECC is in possession of all tools and equipment necessary to complete the installation of innovative technology hardware including bucket trucks, cranes, tooling, and infrastructure. AVECC also has the facilities to complete all the work required for the project including a technology lab where all device programming is completed, and subcomponents are built when necessary. AVECC is already operating all the required engineering software necessary to complete necessary reliability studies, design distribution systems, and program equipment.

No new equipment or facilities will be requested or required for the physical installation to accomplish successful project completion. New grid enhancing technology devices such as smart panels, new capacitor banks with smart controls, and vacuum reclosers with remote operation capabilities will be purchased as part of the Smart Grid deployment. This equipment will remain on the electric grid power line as a grid asset owned, operated, and maintained by AVECC.

The Lineman apprenticeship program ensures AVECC has the employees with knowledge, skills, and abilities to complete all line work and equipment installation necessary for project achievement of downline device deployment. AVECC employs meter technicians trained to aid in the deployment of AMI technology infrastructure. Ongoing training and education ensure all employees on the project team remain abreast of innovative technologies and are capable of the work required to complete the project. In the event resources become constrained, the local contractors partnered with AVECC adhere to strict training and apprenticeship programs for their line personnel ensuring they have the knowledge, skills, and abilities to assist AVECC with grid technology deployment without consequence to project timeline or quality.

C. Previous Work Efforts

Over the past few years, AVECC has successfully managed a $200 million fiber to the home deployment encompassing 6,027 miles of fiber across the AVECC territory reaching 100% of the cooperative membership. Throughout this project, AVECC was responsible for the planning, design, and installation of the fiber network, including working with each member who signed up for service. The fiber to the home buildout is a partially federally funded 5-year project that brought internet access to rural cooperative members who had no access to internet services prior. AVECC hopes to capitalize on this experience and further increase the quality of life of cooperative members by providing Smart Grid technologies throughout the distribution grid. The successful fiber project shows AVECC can not only manage but excel in full grid innovative technology deployment as required to provide the cooperative membership safe electricity they can rely on utilizing industry competitive technology.

Over the past five or more years, AVECC has been testing different technologies and manufacturers' equipment in attempts to begin moving closer to a Smart Grid. Over that 5+ year period, AVECC has connected communications to their substation breakers and has also connected 112 downline devices, mainly reclosers and a few regulators. This experience has allowed AVECC to determine which technologies and manufacturers work best for their distribution grid and gain experience in the implementation of the technology. Various members of the AVECC workforce have attended training on the equipment proposed for implementation in this project and several have taken advanced classes on the functionality, programming, and advanced features of the proposed products. This prior work utilizing the proposed technology provides AVECC an advantage going into the full-scale Smart Grid deployment project as the project initiation phase will not require employee training and AVECC can bypass typical first-time user errors using the innovative technology. Templates have already been developed for panel programming and all linemen are familiar with the SEL panel varieties to be installed throughout the distribution grid. Although the initial training and a few devices have been implemented, the AVECC budget constricts large scale Smart Grid deployment allowing the DOE to make a significant impact in small communities by bringing Smart Grids to rural America.

In the past, AVECC deployed its existing AMR system that uses a powerline carrier solution AMI meter reading, but the lack of real time data for outage detection and member service is not acceptable to the long-term Smart Grid plans of AVECC. As a member-owner of NRTC, AVECC benefits from the experience of the broader electric co-op community. Over the last decade, NRTC has continually evaluated the AMI technologies available on the market to ensure it brings the most advanced applications and solutions to its members. NRTC has leveraged its experience deploying AMI systems across various technologies in the support of its members grid modernization efforts to continually develop process improvements and best practices. It is this first-hand experience and subject matter expertise that NRTC brings to its partnership with AVECC on its Itron Gen5 Riva AMI with Distributed Intelligence solution.

D. Team Member Time Commitment

The project schedule was created to ensure no resources necessary for successful project deployment are over-allocated, threatening the project timeline and success. Each necessary resource has an alternate plan including personnel who can complete the required work without interruption to the project if one resource is no longer available or becomes constrained. The resources needed for project completion include the AVECC engineering department, the AVECC SCADA department, AVECC Substation Technicians, AVECC Construction Crews, AVECC Meter/Service Technicians, and NRTC allocated resources. A breakdown of the project resource time commitments required for full project completion over the next five years is shown below with the time each resource has available over the next five years. This chart shows that most resources would only need to dedicate less than 50% of their time to the project for successful completion. The SCADA connections will require a resource to commit 73% of their time to the project but this resource will be 100% committed to this project with no other time constraints affecting their availability. The Meter Technicians completing the meter installations for the AMI installation phase will require a resource to commit 99% of their time to the project but this resource will be 100% committed to this project with no other time constraints affecting their availability. There are currently 7 Meter/Service Technicians dedicated to the project with additional resources available that already possess the required training to step in as backup or additional resources as the project needs.

Project Resource	Project Hours	Available Hours	Utilization
Engineering	1,805	20,000	9%
SCADA Communications	7,275	10,000	73%
Substation Technician	13,680	40,000	34%
Construction Crew	17,752	160,000	11%
Engineering Technician	2,252	10,000	23%
Meter/Service Technician	41,734	42,000	99%

E. Technical Services from DOE/NNSA FFRDCs

AVECC anticipates no technical services will be required from the Department of Energy or any Research Centers before, during, or after this project to ensure successful project completion.