North Dakota Transmission Authority

North Dakota Industrial Commission

BIL 40101(d) Application

Project Title: Sectionalizing and Protective Devices

Applicant: KEM Electric Cooperative

Date of Application: 9/27/2024

Amount of Grant Request:
$620,000
Total Amount of Proposed Project:

$835,000

Duration of Project:

3 years including waiting for devices.

Point of Contact (POC):

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Applicant Description

KEM Electric Cooperative, Inc. provides electricity to rural members in Emmons, Kidder, McIntosh, and Logan Counties in south-central North Dakota. KEM has a headquarters office in Linton, North Dakota along with an outpost in Steele, North Dakota. KEM's service territory is approximately 3,693 square miles and serves 4,065 meters. The Cooperative owns 122 miles of transmission lines, 2,233 miles of overhead distribution line, 690 miles of underground distribution, and 13 distribution substations. The Cooperative sells approximately 115,000 MWhs per year. The location of KEM's service area is shown in Figure 1 below.

KEM's membership consists mostly of rural residential and rural agricultural members. KEM has some seasonal recreational members, some small commercial members, and a few small industrial members. KEM's service area has continued to see population decline since the 1930's and has many areas of low income and lower than average education levels. Kidder County is considered a Disadvantaged Community and Emmons County is considered a Partially Disadvantaged Community according to the Justice40 Screening Tool.

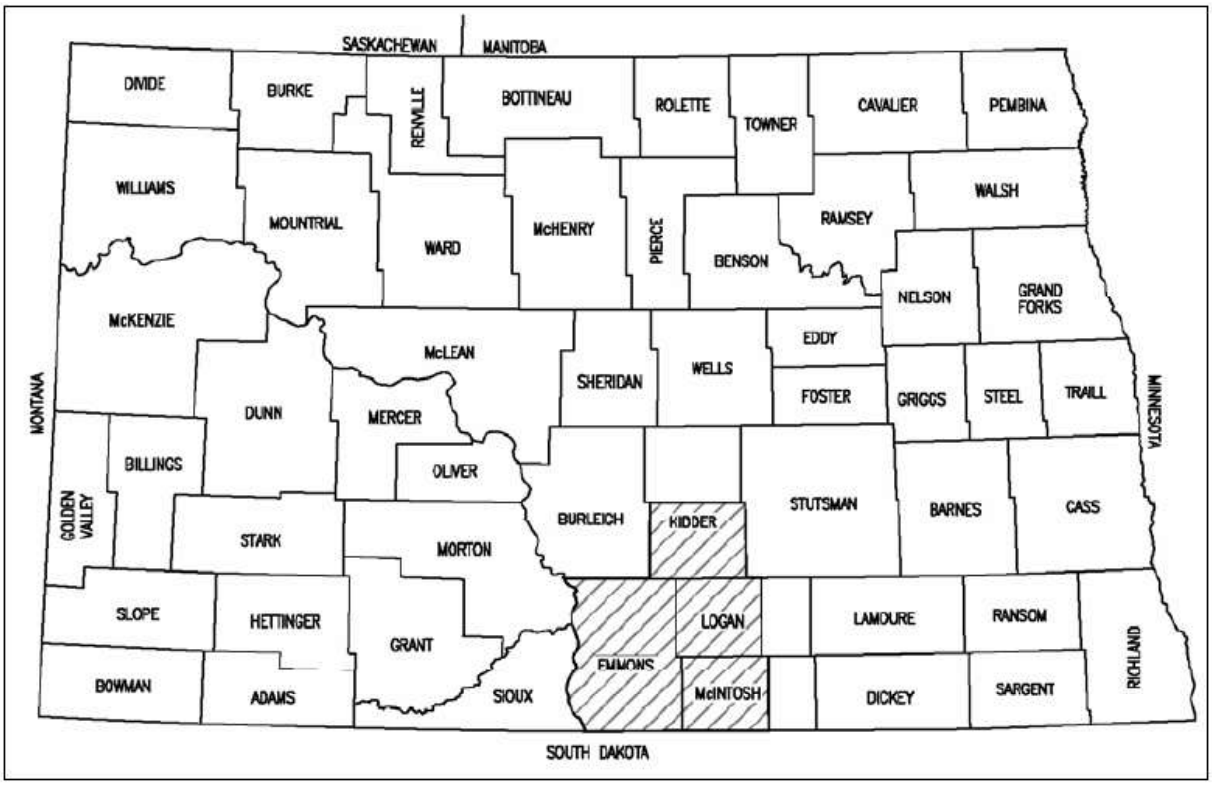


Figure 1: KEM Electric Cooperative Service Area

Project Description

KEM plans to upgrade outdated sectionalizing devices with more reliable devices which have newer technology and are compatible with SCADA. Exhibits of the project locations are in Appendix A. KEM plans to replace 11 old hydraulic reclosers with new Cooper Nova T/S with Form 7 Controllers in 3 distribution substations. The new reclosers will be SCADA capable and will allow KEM to remotely operate the devices, reducing outage times and allowing little to no outage time during planned maintenance. KEM has several Cooper Nova T/S devices installed on their system already and have the training necessary to continue to utilize these devices on their system. Proposed locations for the Cooper Nova T/S are shown in Table 1 below.

Table 1: Cooper Nova T/S with Form 7s

Substation	# Nova T/S w/Controllers	# Meters Impacted	T/R/S	County	State	DAC
Tappen Sub	4	433	T139N R70W S19	Kidder	North Dakota	Yes
Steel Sub	3	469	T139N R73W S7	Kidder	North Dakota	Yes
Hazelton Sub	4	280	T135N R77W S18	Emmons	North Dakota	Partial

In addition to new substation reclosers, KEM plans to replace old single-phase hydraulic reclosers on distribution lines with 35 newer technology S&C TripSavers as part of this project. These allow the Cooperative to retire oil filled reclosers, reduce their annual maintenance costs, reduce mis-operations, better coordinate between devices, reduce outage hours and frequency, and provide data such as fault current and load current to allow for informed decision making. KEM has been installing S&C TripSavers on their system for the last five years with a good track record of reduced outages, reliable operations, and exceptional customer support. Proposed locations of S&C TripSavers are shown in Table 2 below.

Table 2: S&C TripSaver Locations

Substation-Circuit #	# TripSavers	# Meters Impacted	T/R/S	County	State	DAC
Tappen Ckt #4	1	53	T139N R70W 2	Kidder	North Dakota	Yes
Tappen Ckt #4	1	53	T139N R70W 10	Kidder	North Dakota	Yes
Tappen Ckt #4	1	53	T139N R70W 11	Kidder	North Dakota	Yes
Tappen Ckt #4	1	53	T139N R70W 23	Kidder	North Dakota	Yes
Tappen Ckt #1	1	96	T139N R71W 8	Kidder	North Dakota	Yes
Tappen Ckt #1	1	96	T139N R71W 11	Kidder	North Dakota	Yes
Tappen Ckt #1	1	96	T139N R71W 3	Kidder	North Dakota	Yes
Tappen Ckt #1	1	96	T140N R71W 23	Kidder	North Dakota	Yes
Tappen Ckt #1	1	96	T140N R71W 28	Kidder	North Dakota	Yes
Steele Ckt #1	1	67	T140N R73W 17	Kidder	North Dakota	Yes
Steele Ckt #1	1	67	T140N R73W 18	Kidder	North Dakota	Yes

Substation-Circuit #	# TripSavers	# Meters Impacted	T/R/S	County	State	DAC
Steele Ckt #1	1	67	T140N R73W 30	Kidder	North Dakota	Yes
Steele Ckt #1	1	67	T140N R74W 21	Kidder	North Dakota	Yes
Steele Ckt #4	2	121	T139N R73W 1	Kidder	North Dakota	Yes
Steele Ckt #4	1	121	T139N R72W 8	Kidder	North Dakota	Yes
Steele Ckt #3	1	219	T139N R73W 10	Kidder	North Dakota	Yes
Steele Ckt #3	1	219	T139N R73W 15	Kidder	North Dakota	Yes
Steele Ckt #3	1	219	T138N R73W 4	Kidder	North Dakota	Yes
Steele Ckt #3	1	219	T138N R73W 28	Kidder	North Dakota	Yes
Steele Ckt #3	1	219	T137N R73W 5	Kidder	North Dakota	Yes
Steele Ckt #3	1	219	T137N R74W 10	Kidder	North Dakota	Yes
Steele Ckt #3	1	219	T137N R74W 3	Kidder	North Dakota	Yes
Steele Ckt #3	1	219	T139N R73W 1	Kidder	North Dakota	Yes
Steele Ckt #2	2	62	T139N R74W 4	Kidder	North Dakota	Yes
Steele Ckt #2	1	62	T139N R74W 15	Kidder	North Dakota	Yes
Steele Ckt #2	1	62	T138N R74W 3	Kidder	North Dakota	Yes
Steele Ckt #2	1	62	T139N R74W 29	Kidder	North Dakota	Yes
Hazelton Ckt #3	1	128	T136N R76W 30	Emmons	North Dakota	Partial
Hazelton Ckt #3	2	128	T136N R75W 19	Emmons	North Dakota	Partial
Hazelton Ckt #3	1	128	T135N R77W 6	Emmons	North Dakota	Partial
Hazelton Ckt #3	1	128	T134N R76W 6	Emmons	North Dakota	Partial
Hazelton Ckt #3	1	128	T134N R77W 13	Emmons	North Dakota	Partial

The S&C TripSavers are a good option for single-phase lines but are not as economical for three-phase lines as other devices on the market. KEM has chosen Siemen's Compact Modular Reclosure (CRM) to replace 9 hydraulic reclosures in 3 locations on multi-phase distribution lines. Again, this will reduce annual maintenance costs, reduce mis-operations, better coordinate between devices, reduce outage hours, reduce outage frequency, and provide data such as fault current and load current for informed decision making. The Siemen CRMs are also SCADA capable and will be tied into KEM's SCADA network in the future to reduce or eliminate outages during planned switching scenarios. KEM has not used these particular devices yet, however the local sales rep will provide training before, during, and after installation for the best success possible. In addition to training, KEM has part ownership of Maintenance Solutions Cooperative and Innovative Energy Alliance Cooperative, which supports the day to day technical and engineering needs of the cooperative. Proposed locations of Siemen's CRMs are listed in Table 3 on the following page.

Table 3: Siemen CRM Locations

Substation-Circuit #	# CRMs	# Controllers	# Meters Impacted	T/R/S	County	State	DAC
Steele Ckt #3	3	1	219	T137N R74W 34	Kidder	North Dakota	Yes
Hazelton Ckt #3	3	1	128	T135N R77W 13	Emmons	North Dakota	Partial
Hazelton Ckt #3	3	1	128	T135N R77W 24	Emmons	North Dakota	Partial

Standards of Success

Objective 1: Reduce the magnitude and duration of grid outages caused by major disruptive storm and non-storm events.

This project will meet Objective 1 by improving coordination between sectionalizing devices therefore reducing the miles of line and number of meters that are out of power during storm and non-storm events. The mechanisms in the older devices start to wear out over time and no longer operate as precisely as they once did, therefore causing multiple devices to sometimes operate during a fault or causing some devices to not operate at all. If a device that should have operated does not operate at all, it causes the upstream device to operate leaving more meters out of power. Mis-operation of devices makes it harder for line workers to find the fault location, causing the outage duration to be longer. Replacing these older devices with new and more modern devices will reduce the number of meters impacted by interruptions and decrease the longevity of the outage. We have found a reduction of 80-90% in KEM's SAIDI numbers on substation areas converted from oil filled hydraulic style reclosers to TripSavers.

The substation NovaT/S with Form 7 Controllers will be SCADA operable, which will reduce outage times. Instead of having to drive to the substation to manually close the reclosers, there are many instances where the reclosers can be closed remotely with SCADA, reducing outages times dramatically. It is estimated this project will decrease the average duration of outages per member (SAIDI) by at least 50%, and more likely by up to 80%.

Objective 2: Reduce the frequency and impacts of grid outages caused by major disruptive storms and non-storm events.

This project will meet Objective 2 similarly to how it meets Objective 1. The mechanisms in the older devices start to wear out over time and no longer operate as precisely as they once did, therefore causing multiple devices to sometimes operate during a fault or causing some devices to not operate at all. If a device that should have operated does not operate at all, it causes the upstream device to operate leaving more meters out of power. When this happens, meters are out of power that would have never been out of power had the devices all worked as they should have. In addition, the upgraded Nova T/S, TripSavers, and CRMs collect and record fault information that can be used to make informed decisions. The fault information can be

analyzed to determine what is causing the interruptions allowing potential repairs to be made to reduce the frequency of interruptions. We have found a 20-30% reduction in outage frequency on substation areas that have already been converted from oil filled hydraulic reclosers to TripSavers.

The substation Nova T/S with Form 7 Controllers will be SCADA operable. This will help to reduce the frequency of outages as operators can remotely control the devices for preplanned switching scenarios instead of line crews driving to each substation to perform switching. KEM operates with a lean crew and generally would leave line out of power for planned maintenance due to staffing, whereas with SCADA they can perform more remote switching leaving more members with power during planned maintenance. It is estimated that this project will reduce the frequency of outages by at least 15-20%.

Objective 3: Implement grid modernization projects to develop energy solutions to provide lower-cost energy access to disadvantages or underserved communities.

Replacing older oil filled hydraulic sectionalizing devices with Cooper Nova T/S, S&C TripSavers, and Siemen CRMs, will allow for better coordination between devices, resulting in fewer outages, shorter outages, less overtime hours, less truck rolls, and less maintenance costs for the cooperative. Reduced costs for the cooperative positively impacts membership power costs. Reduced frequency and magnitude of power outages positively impacts area businesses and agricultural operations as well. This project will positively impact 209 commercial meters with improved service reliability and increased up-time allowing for increased business opportunities in Disadvantaged Communities across KEM's service area.

KEM's last work plan budgeted for the beginning of a SCADA program and continued TripSaver installations. This grant will allow more members to be positively impacted at a faster rate without raising KEM's rates to do so. In addition to remote operation and improved coordination between devices, the loading information provided by the devices will allow KEM to monitor loading and operate the system more efficiently to allow for increased loading due to EVs as well as possible two-way power flow due to increases in solar generation and other distributed generation.

This project is expected to positively impact all of KEM's 902 meters in Kidder County, which is classified as a Disadvantaged Community according to the Justice40 Initiative, as well as 280 meters in Emmons County which is considered partially Disadvantaged by the Justice40 Initiative.

All of the improvements will take place either within existing substation yards or at existing pole locations. No new ground will be disturbed. Existing oil tank filled reclosers will be

recycled. This eliminates the possibility of ground contamination from any possible oil leaks from the old oil filled tanks. Due to no new ground being disturbed, work being done on existing poles and within existing substations, CFR1970.53 (d)(10) applies and no environmental report should be needed.

It is estimated that KEM will utilize 2-3 contract individuals (temporary) to install the Cooper Nova T/Ss, 2 engineers (mostly temporary), and 4 line workers (existing) to plan for and program the devices. The contractors and engineers will be needed for maintenance and troubleshooting for the life of the devices but are not expected to be retained full-time.

Project Timeline

KEM plans to order all devices after grant approval and will replace the substation devices with the 11 Cooper Novas within 12 months of receiving the devices. The Cooperative will replace old line reclosers with TripSavers and CRMs within 18 months of receiving the devices. It is expected there will be a roughly 12-month lead time on all equipment.

Project Budget

The total project cost is estimated to be $835,000. That total is made up of $550,000 to replace substation devices with 11 Cooper Novas and Form 7 Controllers, $210,000 to replace distribution line devices with 35 S&C TripSavers, and $75,000 to replace distribution line reclosers with 9 CRMs with 3 Siemen Controllers. This includes cooperative or contract labor to install new devices and retire existing devices. It also includes engineering services to plan for optimal device placement, device settings, and programming of the new protective devices.

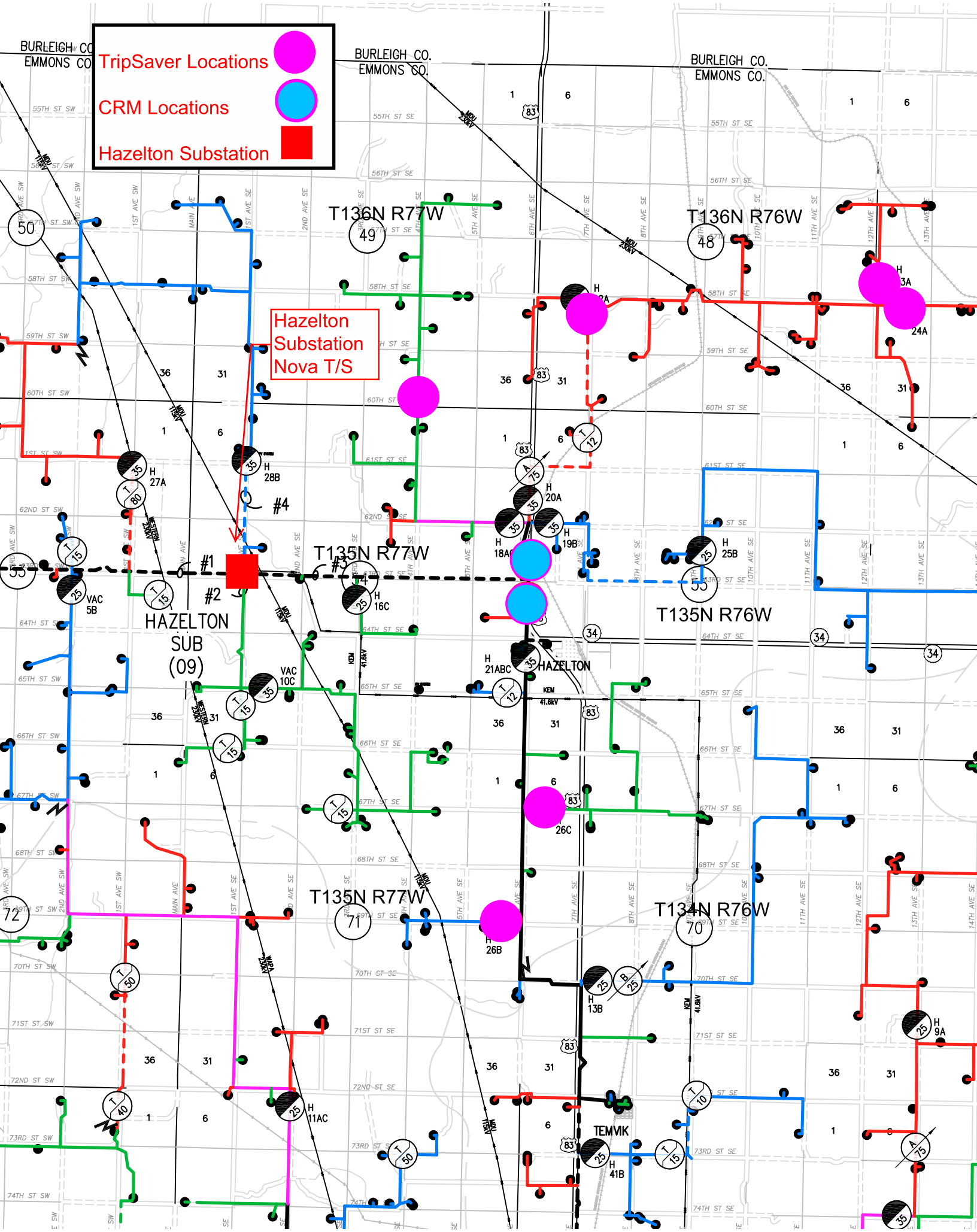
Build American/Buy American

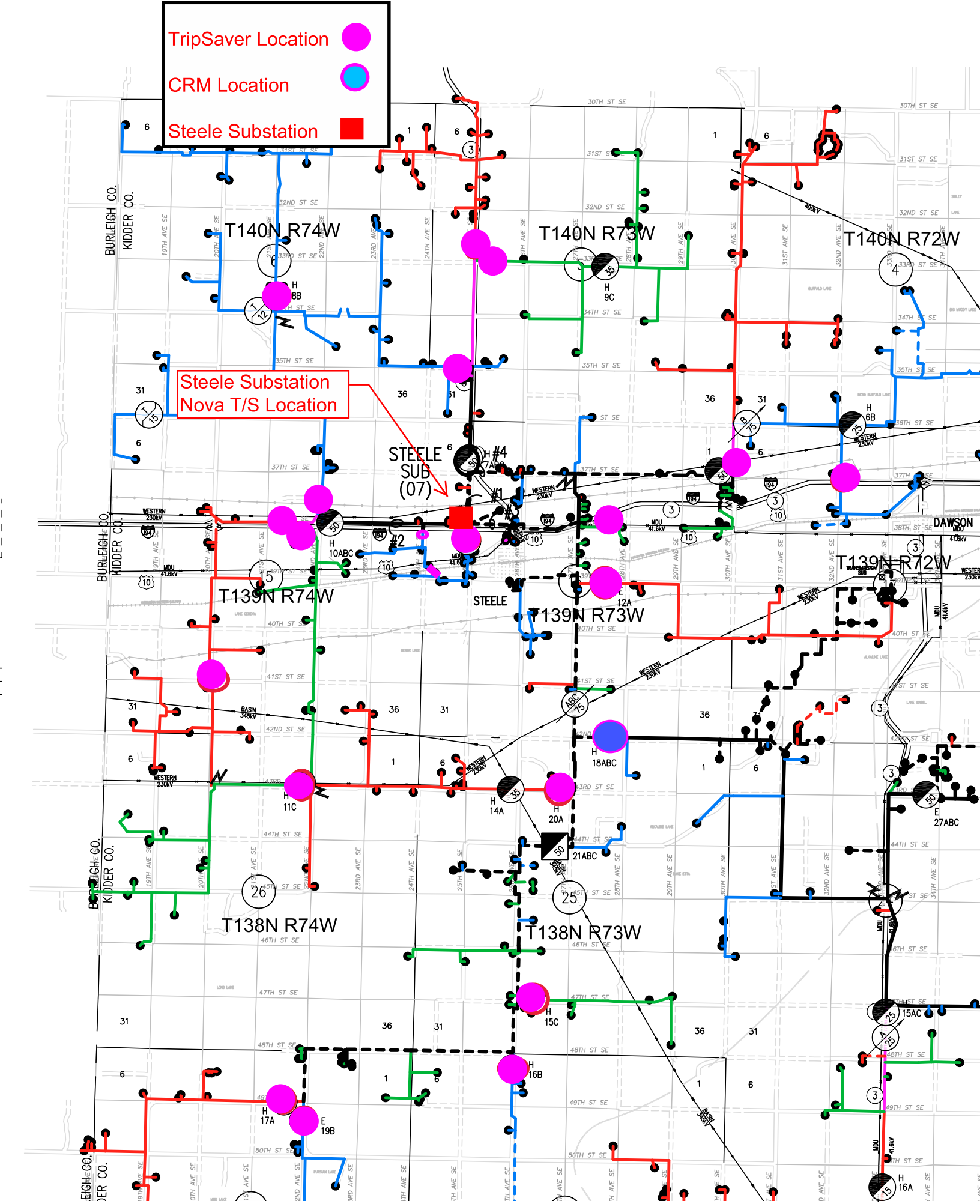
KEM Electric Cooperative is a current RUS borrower and thus follows Build American/Buy American. However, if for whatever reason the manufacturers of the three products are not certified in Buy American, KEM will follow the proper path to apply for waivers or choose a certified Build American/Buy American manufacturer that offers similar devices.

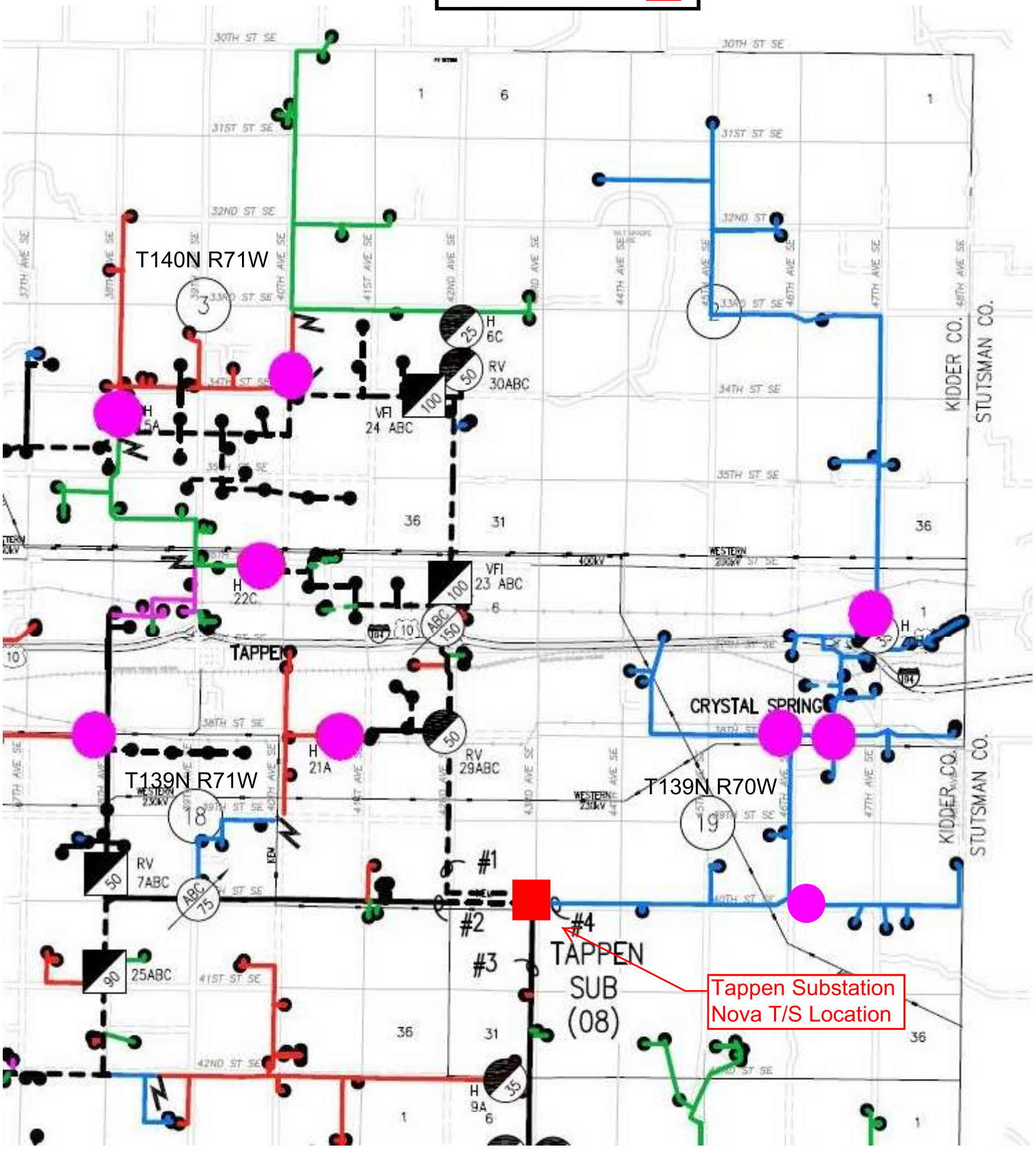
Davis Bacon Act

KEM's line crew are members of the IBEW Union and are paid wages and benefits not less than the prevailing wage in the local area. Union contracts can be furnished if required.

Appendix A – Project Exhibits


TripSaver Locations
CRM Locations
Hazelton Substation
Hazelton Substation Nova T/S
BURLEIGH CO.
EMMONS CO.
T136N R77W
T136N R76W
T135N R77W
T135N R76W
T134N R76W
HAZELTON SUB (09)
HAZELTON
TEMVIK
#1
#2
#3
#4
26B
26C

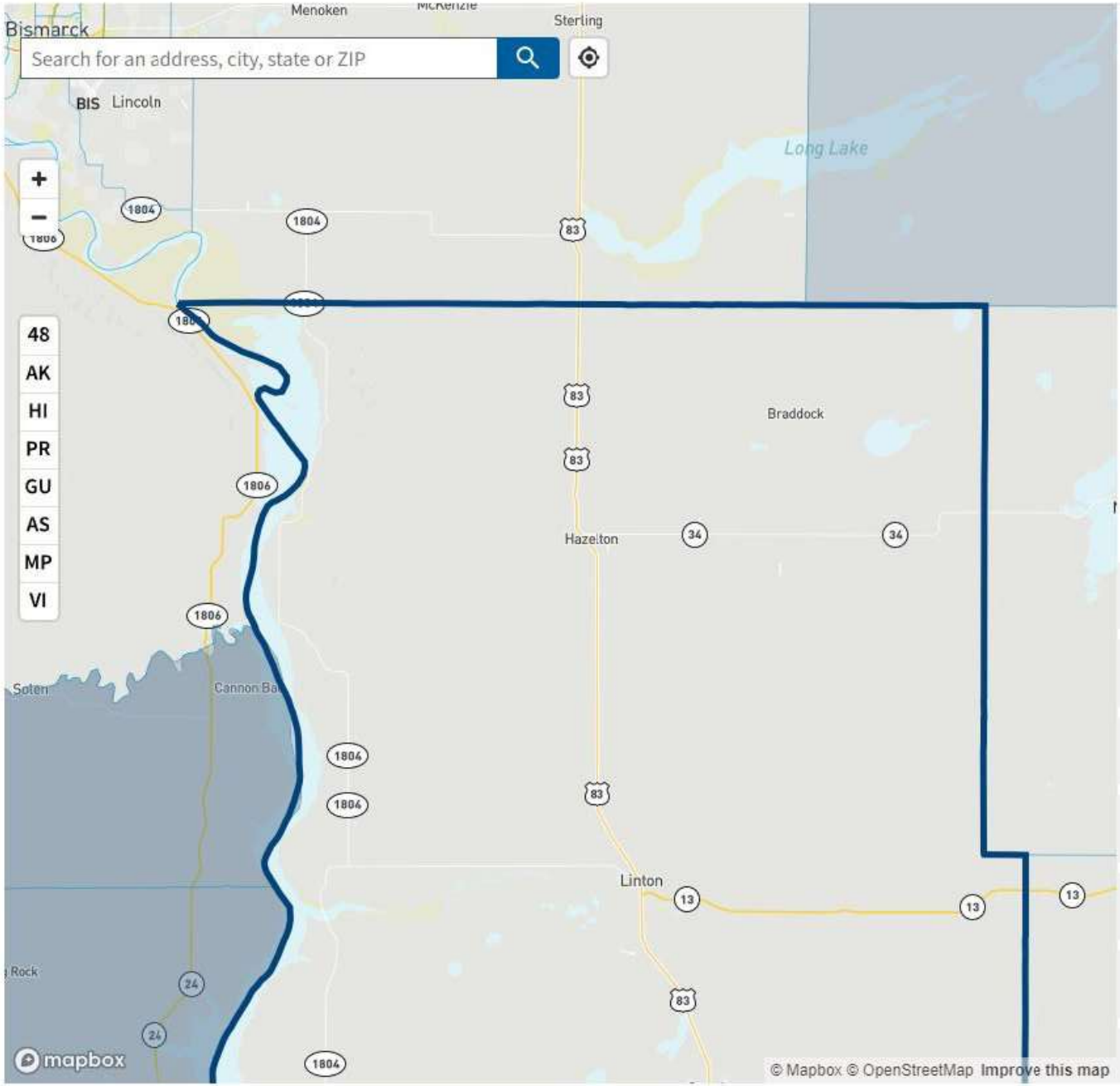

TripSaver Location
CRM Location
Steele Substation
Steele Substation
Nova T/S Location
STEELE
SUB
(07)
STEELE
DAWSON
T140N R74W
T140N R73W
T140N R72W
T139N R74W
T139N R73W
T139N R72W
T138N R74W
T138N R73W
BURLEIGH CO.
KIDDER CO.
WESTERN 230KV
MDU 41.6KV
BASIN 345KV


TripSaver Locations
Tappen Substation
T140N R71W
T139N R71W
T139N R70W
TAPPEN
CRYSTAL SPRING
KIDDER CO.
STUTSMAN CO.
H 6C
RV 30ABC
VFI 24 ABC
H 5A
H 22C
VFI 23 ABC
RV 29ABC
H 21A
RV 7ABC
25ABC
H 9A
#1
#2
#3
#4
TAPPEN SUB (08)
Tappen Substation Nova T/S Location

Appendix B – DAC Exhibit Exports

Zooming in and selecting shows information about each census tract.

and shapefile from the downloads page.



Tract information
Number: 38029966500
County: Emmons County
State: North Dakota
Population: 3,310

Tract demographics
Race / Ethnicity (Show)
Age (Show)

Identified as disadvantaged?

PARTIALLY

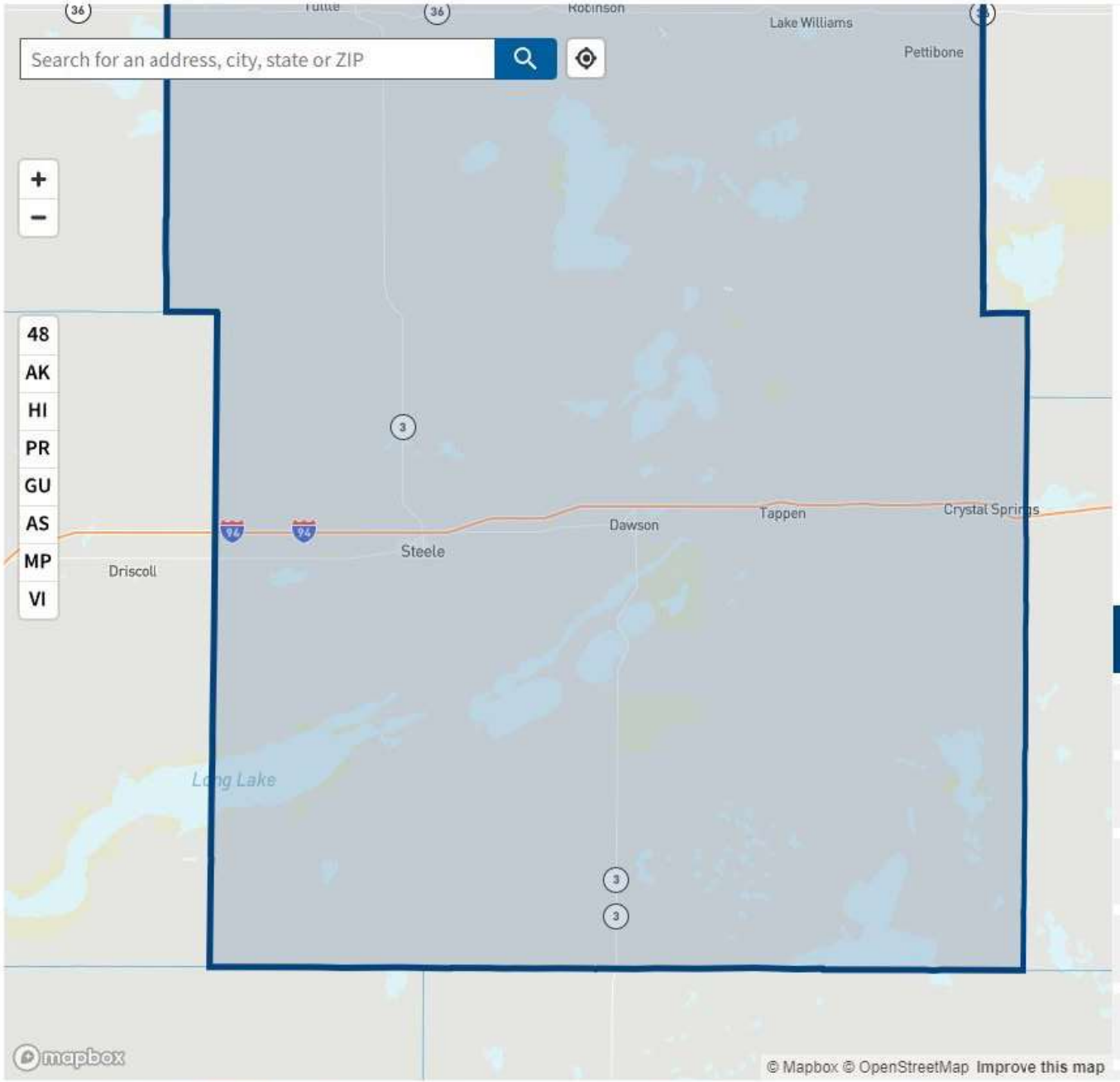
The lands of Federally Recognized Tribes that cover less than 1% of this tract are considered disadvantaged.

Send feedback

- Climate change +
- Energy +
- Health +
- Housing +
- Legacy pollution +
- Transportation +
- Water and +

Zooming in and selecting shows information about each census tract.

and shapefile from the downloads page.



Tract information
Number: 38043966800
County: Kidder County
State: North Dakota
Population: 2,466

Tract demographics
Race / Ethnicity (Show)
Age (Show)

Identified as disadvantaged?

YES

This tract is considered disadvantaged because it meets more than 1 burden threshold **AND** the associated socioeconomic threshold.

Send feedback

Climate change +

Energy +

Health +

Housing +

Legacy pollution +

Transportation +

Appendix C – Project Manager Resume

Trisha Samuelson

Manager of Engineering

1600 E. Interstate Ave, Suite 2
Bismarck, ND 58503
701-989-4551, tsamuelson@iea.coop

Education

University of Mary, Bismarck, ND
Master of Science in Business (MSB), Business, 2019-2021

North Dakota State University, Fargo, ND
Bachelor of Science in Engineering, Engineering, 2004-2006

Bismarck State College, Bismarck, ND
Associate of Science, General, 2002-2004

Training

- Licensed Professional Engineer in ND
- NRECA Supervisor and Management Development Program Certificate

Professional Experience

Innovative Energy Alliance Cooperative (IEA) – Bismarck, ND (2012-current)

Manager of Engineering (2018-current)

Responsible for overseeing IEA's engineering department and ensuring all four IEA member cooperatives are operating and complying with NESC and RUS standards. This includes overseeing construction work plans, line design, substation construction, and maintenance plans and developing annual construction budgets.

Assistance Engineering Manager (2016-2018)

Responsible for performing or overseeing construction work plans and other electrical system studies. In addition, this position is responsible for providing assistance and direction to IEA's engineering department as well as IEA's four-member cooperatives.

System Engineer (2012-2016)

Responsible for performing system studies like construction work plans, long-range plans, sectionalizing studies, and daily operational questions. This position also coordinated with outside consultants for substation and transmission line design and construction.

HDR Engineering, Inc. – Bismarck, ND (2006-2012)

Engineering Supervisor (2009-2012)

Responsible for overseeing electrical system studies, managing workload for the Bismarck, ND engineering planning department, and mentoring three younger electrical engineers. This position worked hand and hand with operations personnel at client rural electric cooperatives as well.

System Engineer (2006-2009)

Responsible for assisting or completing electrical system studies such as construction work plans, long range plans, sectionalizing studies, and motor starting analysis. This position also worked daily with Operations Managers or Line Superintendents at rural electric cooperatives across North Dakota.

Appendix D – Cooper Nova T/S; S&C TripSaver; Siemens Compact Modular Recloser

NOVA-TS
Triple-Single Recloser System

COOPER POWER SERIES

Coordinated, dependable and precise automation

Standardize on the triple-single recloser that provides real benefits and real value. Eaton's Cooper Power series NOVA™-TS triple-single recloser system allows multi-mode configuration for coordinated, dependable and precise automation.

Application versatility, automatic overcurrent protection

The NOVA-TS triple-single recloser system is comprised of the following:

- Three single-phase NOVA-TS reclosers, each with:
  - Manual trip lever
  - Mechanical contact position indicator
- Form 6-TS recloser control
- One compatible, common junction box, which includes:
  - Three interconnecting cables (user-specified length)
  - One receptacle to provide easy access to the Form 6-TS control cable
- Control cable (user-specified length)

The NOVA-TS recloser has three modes of operation:

- **Three-phase trip, three-phase lockout (MODE A)** All three phases simultaneously trip on an overcurrent, reclose and sequence together.
- **Single-phase trip, three-phase lockout (MODE B)** Each individual phase will sense line current and only the phase corresponding to the faulted phase will trip. If any one phase sequences to lockout, the other two phases also lock out, eliminating permanent single-phasing of three-phase loads.
- **Single-phase trip, single-phase lockout (MODE C)** Each individual phase trips and sequences to lockout independently of each other. This is primarily for residential loads and/or where single-phasing of three-phase loads is protected by other means.

EATON
Powering Business Worldwide

Form 6-TS control operation

One Form 6-TS control for three reclosers, easily configured using ProView™ interface software provides:

- Flexible coordination
- Advanced event recorder/data profiler analysis tools
- Voltage, current and harmonic metering

Additionally, the front panel allows the user to manually open and close any phase independently without menu navigation.

Proven reliability

- Automation to improve substation performance
- Light-weight design well-suited for retrofit or new applications

Enhanced protection with dynamic phase tripping

A configurable option for MODE C operation is available to trip and lockout all three phases in the event of a phase-to-phase or three-phase fault. Normal operations occur per the programmed sequence for a single phase-to-ground fault; however, if a phase-to-phase fault occurs, the control will trip and lock out all three reclosers when any one phase sequences to lockout. This avoids any multiphase energization from one phase.

Internal voltage sensing

Using a high-voltage resistor within each interrupter module with source-side connections, the sensing option and control support a magnitude accuracy of 2% or better and a phase degree accuracy of ±1.5°.

Modernize substation applications

- Cost-effective solution for your protection, metering and communication applications
- Automation features of the Form 6-TS control will improve your substation performance
- Add the remote operation, status and analog metering functions to your automation system through standard industry protocols for real-time system analysis and optimization
- Light weight of recloser system may allow for retrofit of existing structure without the expense of foundations or other structural changes

Effective NOVA-TS recloser application

Multiple fault scenarios were analyzed to provide proper system coordination for both phase and ground faults.

- Phase-to-ground, phase-to-phase and three-phase faults, along with multiple faults on different phases, were studied to verify the correct sequencing of each recloser with proper time-current curves
  - Load-side fuse protection is maintained even if two faults occur on different phases prior to resetting the control
- Should problems occur, utility operators would discover great benefits in repairs made on an individual phase basis
- Replacement of individual phase devices brings lower inventory economics and shorter system restoration and bypass intervals

For Eaton's Cooper Power series Switchgear Support Group, call 1-800-497-5953 or visit: **Eaton.com/cooperpowerseries**

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United States
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Waukesha, WI 53188
Eaton.com/cooperpowerseries

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August 2019

Powering Business Worldwide

A New Way to Think About **Lateral**

Protection

80% of overhead faults are temporary.

Until now, there were only two strategies for protecting lateral lines from faults: fuse blowing, fuse saving, or a mix of two approaches. These strategies hurt your reliability and cost you money.

Fuse Blowing

Any fault—permanent or temporary—causes the lateral fuse to operate, resulting in a costly truck roll to locate the blown fuse, inspect miles of line, and finally replace the fuse.

Fuse Saving

Before the fuse blows, upstream equipment "blinks" the line to determine whether the fault is temporary or permanent. Blinking results in more momentary outages for everyone connected to the main feeder.

	Truck roll required for temporary fault	Truck roll required for permanent fault	Causes momentary or sustained outage for temporary fault
Fuse Blowing	✓	✓	✓
Fuse Saving		✓	✓

The **TripSaver® II Cutout-Mounted Recloser** combines the best of fuse-saving and fuse-blowing strategies without any of the drawbacks. When a temporary fault occurs, the TripSaver II recloser **eliminates momentary outages** for customers on the main feeder by only blinking the affected laterals. This lateral-protection strategy **improves a utility's reliability and bottom line.**

4x

The TripSaver II recloser is so effective, it pays for itself in 4 avoided truck rolls.

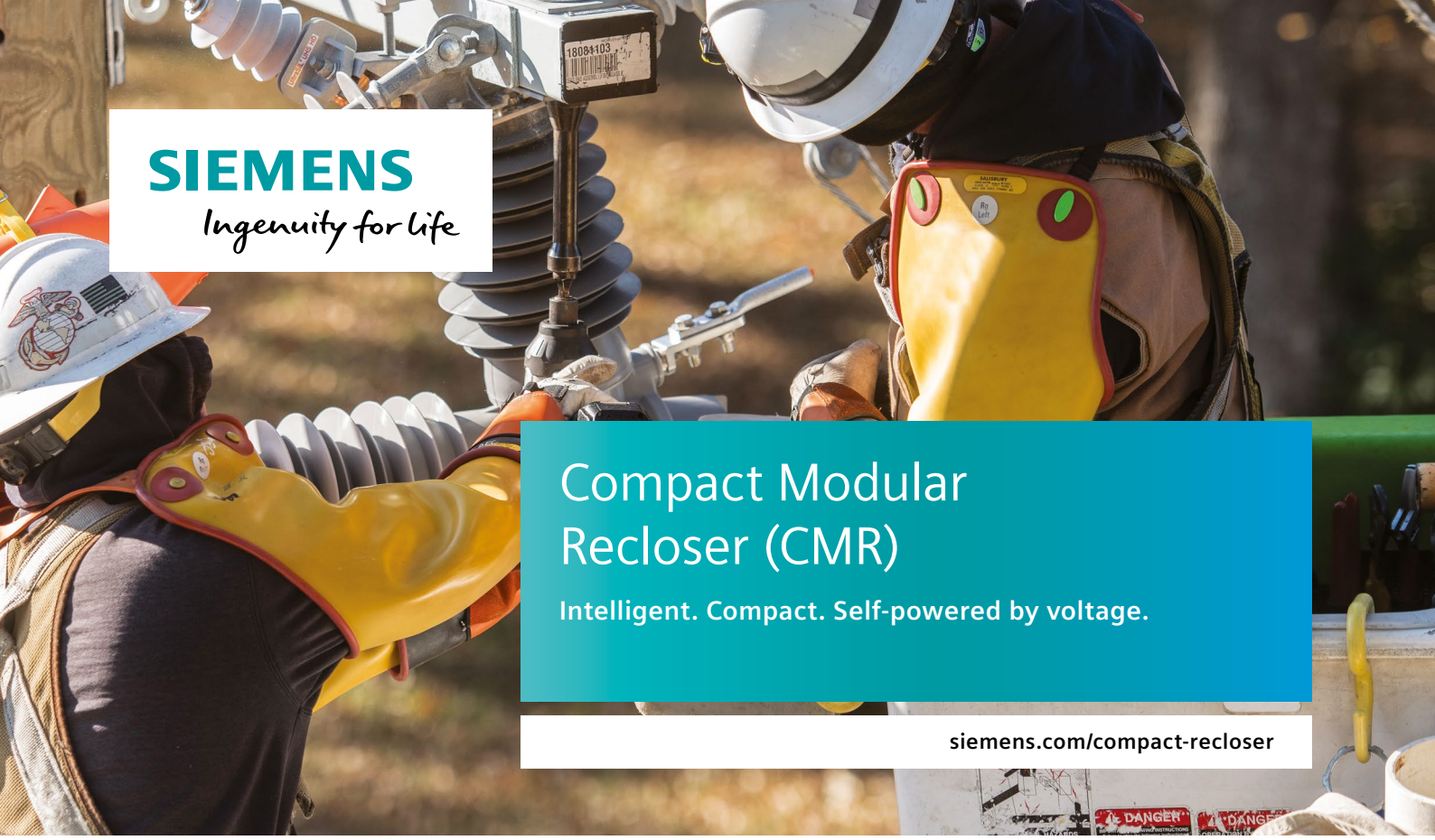
In rural areas with longer lateral lines, utilities can save **$45,000** a year. That is a **90%** rate of return.

S&C has proven that the TripSaver II recloser can help utility customers save up to **$500,000** per feeder, per year.

Speak with your S&C representative or visit sandc.com/ts2 today.

sandc.com

461-G366
March 14, 2016



SIEMENS
Ingenuity for life

Compact Modular Recloser (CMR)

Intelligent. Compact. Self-powered by voltage.

siemens.com/compact-recloser

Leading the way

For greater flexibility, utilities can choose between pre-configured options as a drop-in alternative to a traditional hydraulic recloser or to self-configure the devices to take advantage of advanced protection, measurement and logging features.

Superior ratings up to 38 kV and unique self-powering via line voltage put the CMR at the forefront of the single-phase auto-recloser market. It presents a quantum leap in technology for cost effectively improving the reliability of overhead medium voltage networks. Featuring a fully insulated housing in a compact design, the lightweight device (<25 kg) permits easy installation and fast commissioning. An intuitive interface, wireless connectivity and SCADA integration capability ensure a high degree of user convenience and flexibility. The comprehensive rating options and practical design of the CMR enable unrestricted deployment onto both urban and rural networks. By eliminating the need for regular maintenance and utilising line voltage as power supply, this new generation of single-phase auto-recloser addresses all common problems of obsolete hydraulic reclosers.

Benefits

- **Elimination of oil filled reclosers**
- **No scheduled maintenance[a]**
- **Fast & easy installation**
- **Highly versatile**
- **Flexible for the future**
- **Fast ROI**
- **Intuitive interface**

Key Features

Fully integrated self-powered system:
- Power supply using line voltage
- Rechargeable battery for back-up power
- Magnetic actuated vacuum interrupter
- Fully insulated design for improved operator safety
- Integrated protection relay and controller
- Flexible mounting options

Intelligent
- Wireless connectivity
- Simple and intuitive configuration tools
- GPS time reference
- SCADA capability (future)
- Voltage and current measurement
- Fault passage indication (FPI)
- Comprehensive event log
- Full range of TCC curves

Reliable and maintenance free

The auto-recloser is suitable for all sites, even those with inconsistent or no line current. Featuring fully configurable protection and four operations in a sequence, the unit is the ideal solution for sectioning faults on long rural distribution lines.

Unlike hydraulic reclosers, which need removal to be serviced and maintained regularly, the CMR switch unit has no need of periodic inspection and maintenance. It is designed to deliver a 25-year uninterrupted service life[a].

Contact us via fusesaver.au@siemens.com to receive more information.

Compact Recloser Ratings

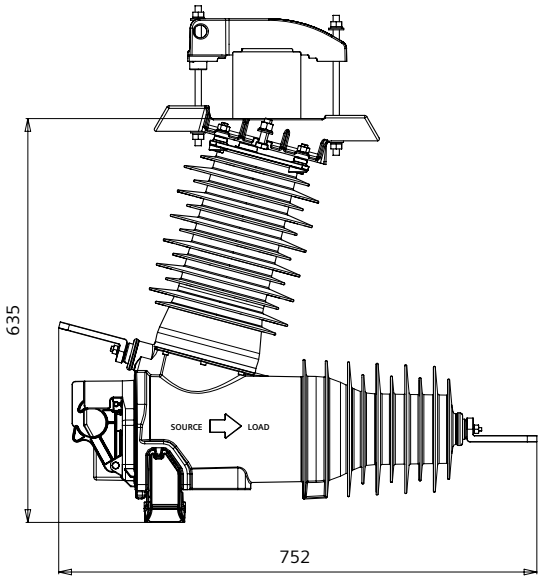
Type tested according to IEC 62271-111 / IEEE C37.60

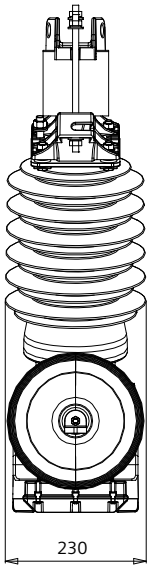
Switch Unit Parameters	Unit	Rating	Rating
Rated voltage	kV	up to 27 kV	38
Rated frequency f_r	Hz	50/60	50/60
Rated continuous current I_r	A	630	630
Rated short-time withstand current I_k	kA	12.5	6.3
Rated peak-withstand current I_p	kA	32.5	16.4
Rated duration of short circuit t_k	s	3	3
Rated symmetrical interrupting current I_{sc}	kA	12.5	6.3
Rated symmetrical fault-making current	kA	12.5	6.3
Rated operating sequence		O – 0.3s – CO – 2s – CO – 2s – CO	O – 0.3s – CO – 2s – CO – 2s – CO
Opening/closing times	ms	<20 ms	<20 ms
Clearing time	ms	<50 ms	<50 ms
Rated line-charging interrupting current	A	5	5
Rated cable-charging interrupting current	A	25	40
Minimum number of operations at rated short-circuit current		70	240
Minimum number of load-break operations at rated current/mechanical operations		10,000	10,000
IP rating		67	67

Ratings Description	Unit	Model[(b)]				
Rated maximum voltage (P-P) U_r	kV	12	17.5	27	27	38
Rated power-frequency withstand – dry U_d	kV	28	50	60	60	70
Rated impulse-withstand voltage U_p	kV	95	110	125	150	170
Minimum system voltage for operation (P-P)	kV	7	10	15.5	15.5	20

Service Environment	Rating
Operating temperature range	–40[(c)] to +55°C
Humidity	0 to 100%
Maximum altitude	4,000m[(d)]
Pollution class	Very Heavy

(a) Excludes routine battery replacements every eight years.
(b) Correct model must be selected for the applicable system voltage (27kV model cannot be used on a 12kV network).
(c) Reclose intervals must be extended at temperatures below –35°C.
(d) De-rating required above 1,000m.





ISO 9001
AS/NZS 4801
OHSAS 18001
ISO 14001
BUREAU VERITAS
Certification

Dimensions are in millimetres