

2019 Operations & Construction Highlights

Board of Directors
December 5, 2019



Accidents & injuries

- **One** employee lost-time injury YTD
 - February 14 – employee reported pain in upper leg and lower back while brushing light snow off UTV trailer; employee returned to work when doctor's note advised. Mitigation: Human Resources & Safety worked with employee & workers compensation adjuster to provide rehabilitation treatment and return to work
- **Zero** at-fault vehicle incidents YTD
- **Four** safety accidents
 - January 25 – contractor hit head after slipping on ice on Pinnacle campus; evaluated at hospital and released same day. Mitigation: increased sanding and salting at Pinnacle, discussed situational awareness, 3 points of contact, and use of ice creepers during safety meetings
 - March 26 – contractor cut head on edge of sheet metal ductwork at Pinnacle campus generator building air intake; first aid provided on-site, stitches given at hospital. Mitigation: sharp edges on ductwork inside generator buildings covered
 - September 30 – employee twisted ankle after stepping into cable trench during wire pulling at Barre substation; first aid administered on site. Mitigation: trench covers installed over openings
 - October 11 – contractor mulcher caught fire in 340 right of way; VELCO System Operator notified and contacted 911 dispatching local first responders. Mitigation: changed equipment and work practice

Third-party reviews

Continue independent safety audits on VELCO and contractor work

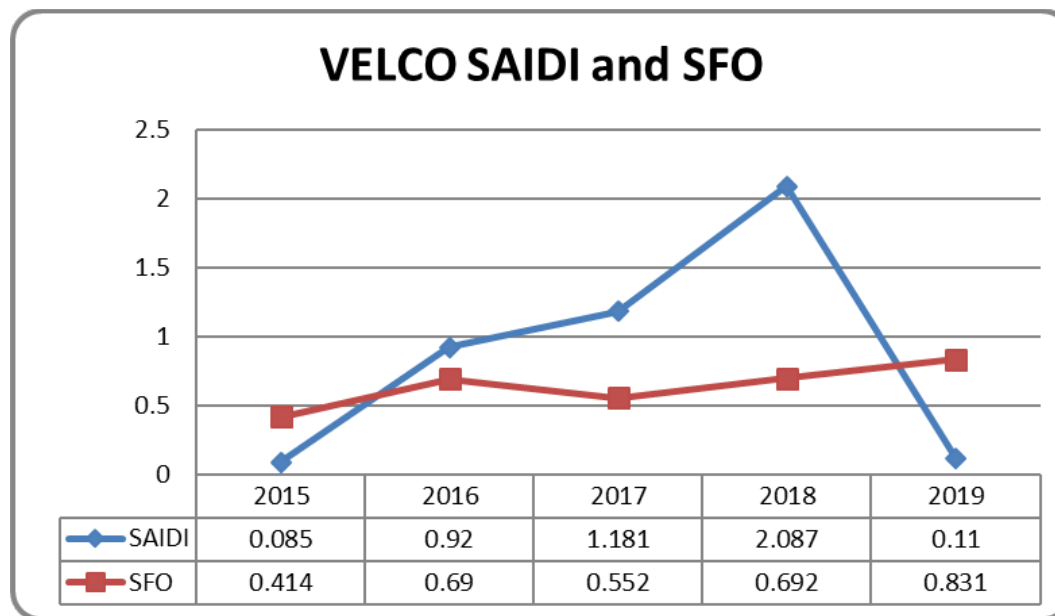
- **Purpose:** ensure continuous improvement by assessing risk, integrating emerging best practices
- 63 audits conducted YTD
- **Follow-up:** audits communicated, reviewed, logged in safety database to track and trend performance
- 64 internal audits conducted YTD

Health & safety

- Good catch/near miss program
 - 20 good catches and 2 near misses YTD
 - VELCO encourages employees to report “learning opportunities” including: work practices needing improvement, efficiencies gained through different practices, and hazards when performing similar work
 - Information entered in database, broadcast to frontline supervisors and managers, and discussed during Field Safety Meetings to promote learning culture
 - Working group developing Learning Opportunity process improvements. This process will capture good catches and other learning opportunities that will be shared with the organization, distribution utilities, and North American Transmission Forum (NATF)
- Training program enhancement
 - Safety training week January 7-11, 2019 provided designated time for all employees to attend safety trainings
 - All required safety training was scheduled for this week and proved to be an effective way to complete trainings
 - January 13-17, 2020 is next safety training week

System Performance 2019

VELCO System Average Interruption Duration Index (SAIDI) and Sustained Forced Outage (SFO) five-year KPI performance



- SFO: a forced transmission line outage equal to or greater than five minutes in duration
- SAIDI: measures sustained distribution customer outages caused by transmission lasting longer than five minutes

System Performance 2019

Customers impact YTD (*SAIDI KPI = Distinguished*)

- January 20 - temporary fault and breakers failed to reclose on 1400 (Newport to HQ-Stanstead) 120kV (8,111 VEC customers out for 5 minutes)

Transmission reliability YTD (*SFO KPI = Distinguished*)

- January 20 - temporary fault on 1400 (Newport to HQ-Stanstead) 120kV circuit and Newport breakers failed to reclose
- March 20 - outage taken on K42 (St. Albans Tap to Highgate) circuit to repair a severely checked/cracked crossarm
- August 17 - temporary fault on F206 (Granite to NGrid-Comerford) 230kV circuit and National Grid breakers in New Hampshire failed to reclose
- October 11 - outage taken on 340 (Coolidge to Vernon) 345kV circuit due to a contractor equipment fire in right-of-way
- October 28 - outage taken on K31 (Ascutney to Coolidge) 115kV circuit due to a danger tree cut by a landowner
- November 15 - outage taken on PV-20 (Sand Bar) tie-line terminal with New York Power Authority to repair failed load tap-changer motor and transmission

System Performance 2019

Energy Management System (EMS) and Operations 2019 projects

- VELCO SCADA/EMS version upgrade
 - Successful cutover to newer version of Open Systems International, Inc. (OSII) on January 29
- VELCO Operations Training Simulator (OTS) – a game-changer
 - OTS was recommended by NATF and ISO-NE as a lesson learned from 2017 North American GridEx IV exercise
 - SCADA/EMS version update was a pre-requisite for OTS implementation
 - First used in Cycle 3 Operations NERC accredited training in October
 - Used again, with great success, as part of North American GridEx V simulation in November
 - Supports ongoing NERC coursework for certified VELCO staff
 - Will expose new System Operators to events that otherwise may take years to experience

System Performance 2019

EMS and Operations 2019 projects and initiatives

- Quality Data Systems (QTS) Upgrade
 - Database for all aspects of training for NERC certified staff
 - Electronic record keeping for maintaining training records, including testing and course evaluations, as recommended by NATF
 - Improved functionality for existing Operator Training
 - Achieved a near-paperless process for the training program
- Development of operating staff
 - Training for NERC-certified Operator averages 12 months
 - New Operator qualified in Q3, backfilling a 2018 retirement
 - Operator transitioned into Outage Coordinator position to support a retirement
 - Two Operators currently in training, one backfilling for the transition of an Operator to the Outage Coordinator vacancy and the second supporting the transition of an Operator to another department
 - Succession planning for several more changes on the horizon

System Performance 2019

EMS and Operations 2019 projects and initiatives

- October Master/Local Control Center Operations Audit (ISO-NE and NE Control Center Managers)
 - Received a compliant rating with no findings
 - Received twelve recommendations for existing operating procedures that would: add and modify Operator situational awareness/monitoring tools and displays; and update or modify specific processes for Operators
 - Best practices for use of electronic (paperless) tools will provide significant reduction in trainers' administrative work load, and for VELCO Geomagnetic Induced Current monitoring tools/program and associated Geomagnetic Disturbance response procedure
- VELCO Emergency Response Plan and GridEx exercise
 - Performed two-day North America-wide GridEx exercise with ISO-NE and neighboring entities in November
 - Several Vermont distribution utilities observed
 - Many observations and lessons-learned for program improvements

NERC Compliance year in review

- **ISO-NE Transmission Operations Audit** – *Received compliant rating*
- **Northeast Power Coordinating Council Physical (NPCC) Security Assessment of proposed New Havens Operations Facility Project** - *“the site chosen is a good choice, far enough away from the Primary Control Center and in an area that can be well protected”*
- **Critical Infrastructure Protection (CIP) Mock Audit**
 - No systemic compliance issues identified, well positioned to demonstrate compliance to NPCC
 - VELCO’s culture of compliance and security is strong
 - Areas of improvement:
 - Documentation and process detail
 - Challenge long-standing assumptions
 - Continue pursuing internal control efforts to drive maturity and consistency
 - Expansion of automation tools
 - Ensure subject matter experts (SMEs) are familiar with VELCO procedural documentation
 - Preparation for SMEs
 - Develop additional SMEs to reduce reliance on single individuals in key areas



2019 field crew highlights

Line crew

- Replaced 61 structures and 12 crossarms in Transmission Line Refurbishment (TLR) program YTD
- Installed longer center post insulators on K41/K46 for storm hardening
- Replaced structures utilizing live-line bare hand techniques

Substation and technician crew

- Restored St. Johnsbury voltage transformer failure and subsequent failures
- Supported Barre temporary substation commissioned using new mobile switching substation
- Supported Barre Substation construction and commissioning

- Replaced failed Bennington T1 transformer
- Replaced Essex X10 transformer
- Green jacket animal protection installed at East Ave and Queen City
- Installed circuit switcher at Ascutney SVC
- Dissolved gas analysis monitors installed on select transformers
- Replaced oil-filled breaker at Cold River substation
- Replaced tap changer motor on the Sandbar Phase Shifting Transformer (PST)

Maintenance

- Completed all high-priority line maintenance identified during routine inspections – replaced condemned poles identified by Osmose Utilities Services, Inc.
- All NPCC-driven system protection work at required substations complete
- Five dissolved-gas monitors on system-critical transformers to be commissioned by year end, allowing for remote oil analysis at St. Johnsbury, Essex X10, Tafts Corners, and Queen City
- GE JVT Super Bute voltage transformers replaced at East Fairfax and Blissville
- Queen City 13.8kV voltage transformer scheduled to be replaced by year end

Maintenance work

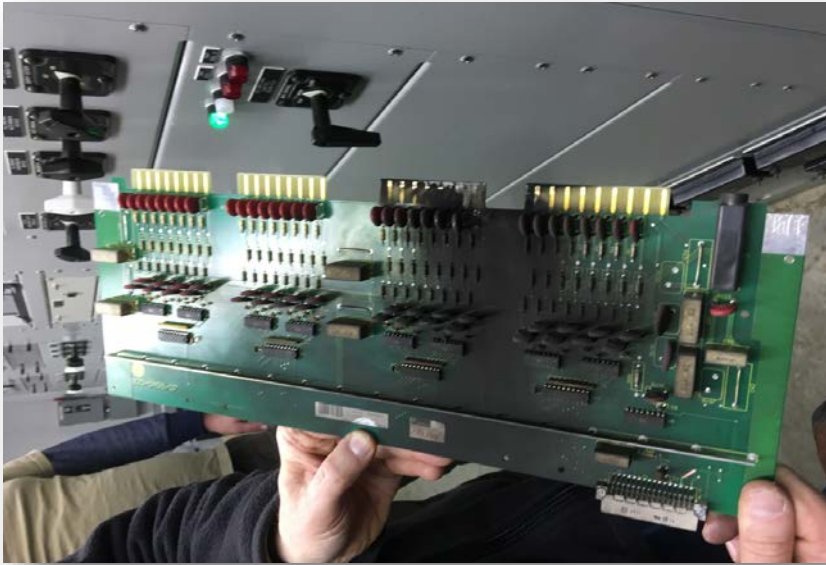
Barre Substation



Essex X10 Foundation Replacement



St. Johnsbury voltage transformer failure



Right of Way Management

- Managed vegetation on ~2,500 right-of-way acres; removed >2,400 danger trees, including preemptively removing 900 ash trees due to Emerald Ash Borer (EAB)
- Re-accredited by Right-of-Way Stewardship Council, one of eight utilities nationally
- Developing strategies with distribution utilities to respond to EAB
- Zero vegetation-caused outages
- Supported line access road construction
- Developed mat tracking app resulting in:
 - Reduced mat transportation costs
 - Enhanced asset management strategy for mats



Capital project program overview

Financial/schedule performance

- Placed capital assets > \$65M in service to improve transmission network reliability

Capital project program improvements

- Leveraged projects to develop project management talent across the company
- Continue to integrate products and services efforts into company project management processes
 - Executed several billable engagements delivering value to Vermont
 - Improved project, contracting, billing, and change order processes to encourage innovation

Significant project accomplishments

Line work

- Replaced 231 inadequate transmission structures and 12 cross arms (VELCO line crew replaced 61 structures)
- Built 16 miles of access roads and installed 8 miles of matting as part of TLR program
- Developed methodology to track costs associated with TLR program on a per line basis in accordance with changes to ISO-NE's transmission cost allocation requirements
- Continued to study K42 alternatives to accommodate future grid interconnections



Controlled retirement of Structure 23 on K35 line

Significant project accomplishments

- Commissioned temporary substation to support construction of the Barre and Berlin substation refurbishment projects
- Completed refurbishment of Barre substation
- Continued working with distribution utilities regarding scope and schedule for upcoming Substation Condition Assessment Projects (SCAPs)
- Identified scopes of work and schedules for Sandbar, Florence, and Irasburg projects
- Filed § 248 petitions for Berlin and Sandbar projects



New control building and trench at Barre substation



Temporary substation adjacent to Barre substation

Significant project accomplishments

Other capital work

- Commissioned Pinnacle Ridge Data Center and transitioned servers without service interruption
- Pinnacle Ridge Data Center recognized as example of best practices in the industry
- Performed major refurbishments at Pinnacle Ridge Campus
- Reached agreement with LS Cable and New York Power Authority for prior claims and costs associated with remedial efforts to correct portions of PV20 project
- Completed green jacket installation at select facilities to protect against animal caused outages



Server cabinets in Pinnacle Ridge Data Center



Example of articulated, concrete mats proposed for PV20 project

Significant project accomplishments

Other capital work

- Worked with internal and external stakeholders to develop a sustainable, energy efficient, and cost effective backup control and secondary data center design that meets both VELCO's need to provide secure and reliable service in the event of a natural disaster or terrorist attack and the town of New Haven's desire to maintain the rural environment of the area
- Filed § 248 petition for New Haven Operations Facility



Architect's rendering of proposed New Haven Operations Facility

System planning accomplishments

- Sheffield Highgate Export Interface (SHEI) accomplishments
 - Helped GMP interpret study results and select preferred solutions
 - Reviewed GMP testimony and provided exhibit describing expected B20 benefits
 - Helped change K42 line rating
 - Performed analysis for ISO-NE updating SHEI limits incorporating Sheldon Springs AVR upgrade
 - Helped ISO-NE determine which 34.5 kV lines matter for SHEI limits
 - Performing long-term SHEI analysis
- Performed Kingdom Community Wind and Jay synchronous condenser model verification studies for GMP
- Helped create Vermont Systems Planning Committee generation constraints subcommittee
- Started load forecast effort for 2021 long-range transmission plan
- Assessed critical clearing times on 345kV system
- Project support for Berlin, Sandbar, Florence, and Irasburg
 - Presented Berlin and Sandbar projects to ISO-NE's Planning Advisory Committee
 - Obtained agreement with ISO-NE on protection improvements at Barre and Berlin
 - Confirmed need and size for Florence capacitor bank
 - Helped Irasburg project manager conclude a temporary substation is not needed
- Reviewed ISO-NE 10-year needs studies
- Reviewed system impact studies for projects that may affect Vermont
 - Six PV plants (15MW to 50MW) in Vermont
 - One 100MW Battery plant and four PV plants (10MW to 20MW) in New Hampshire
 - One PV plant (20MW) and one 900MW DG cluster in Massachusetts

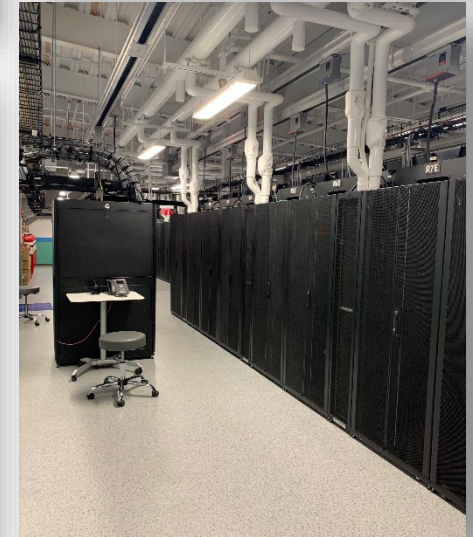
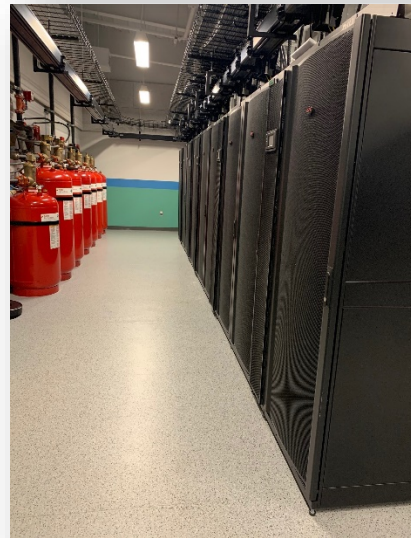
Telecommunications

- Radio
 - Sugarbush and Pico tower and building replacement
 - South Hero tower addition for PV20 microwave protection and radio coverage
 - Microwave links upgraded at five sites
- Fiber
 - Telecommunication headend transitioned into Pinnacle Data Center
 - Leased line eliminated with fiber connection saving \$25,000 annually
 - Implemented network management and analytics
 - Rutland route diversity enhancements for GMP & VELCO Control Centers



Infrastructure & Cybersecurity

- Infrastructure & Application
 - Migration of all Corporate and EMS services to new Data Center
 - EMS application upgrade
 - MS Power BI analytics implementation
 - Implementation of OSIsoft PI community archiver
- Cyber security enhancements
 - Implemented account credential manager providing enhanced remote access control
 - Full disk encryption on all mobile devices



Summary

- 2019 was a productive year
- VELCO line crew completed our first live-line structure replacement
- Internal crews and engineers handled a larger percentage of construction
- Completion of the data center was a major accomplishment
 - First utility to use electromagnetic pulse (EMP) protection technology – many are following VELCO's lead
- First lost time accident (severe back strain) in five years
- First dedicated week of safety and skills training
- All compliance reviews received good marks
- VELCO reliability continues to lead industry nation-wide
- Innovations such as new equipment monitoring and temporary substation at Barre demonstrate our commitment to continuous learning and improvements
- Installation of a Energy Management System simulator will continue to improve Operations