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REPORT

Village of Wellsville

Vossler Road Substation Upgrades

March 17, 2013

O'BRIEN & GERE

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Vossler Road Substation Upgrades

Vossler Road
Wellsville, New York

Prepared for:
Village of Wellsville

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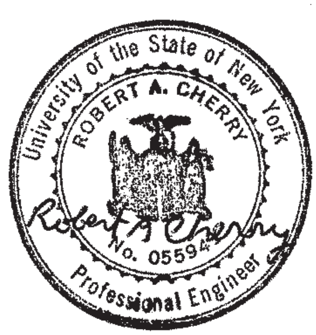

ROBERT A. CHERRY, TECHNICAL DIRECTOR
O'Brien & Gere Engineers, Inc.

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EXECUTIVE SUMMARY

The estimated budgetary cost for the project, as presently defined by the Village, is $2,257,000. This roughly compares to the amount of $2,750,000 for the original project scope. The original project scope is Alternative 2a in the Budgetary Cost chapter and included the following:

- A revised site layout that facilitates construction and maintenance and includes secondary containment for transformer oil
- Two new transformers with mineral oil and automatic load tap changers (LTCs)
- Two new 34.5 kV, vacuum type, circuit breakers
- New indoor metal-clad switchgear with one breaker per vertical section (1-high switchgear)
- A masonry control building.

Costs were developed for various alternatives, including:

- Retaining existing site layout (Alternative 1, $2,630,000)
- Switchgear with two breakers per vertical section (Alternative2b, $2,680,000)
- A factory fabricated E-Building in lieu of a masonry building (Credit of $43,000)
- Voltage regulators in lieu of automatic load tap changers (Additional cost of ($9,000)
- Biodegradable oil in lieu of mineral oil(Additional cost of $50,000)

On February 15, 2013, the Village requested that the project scope be revised to delete the replacement of the south (Dresser-Rand) transformer. A subsequent constructability review indicated that replacement of the following equipment associated with the Dresser-Rand transformer should also be deleted from the project: transformer foundation, oil circuit breaker and voltage regulators. It is anticipated that the existing Dresser-Rand transformer could be reconnected, via underground cables, to supply the new switchgear, since replacement of the existing switchgear is a major goal of this project.

The construction cost estimate breakdown that was submitted with the draft of this report has been modified to include an additional cost column that addresses the village requested changes. These changes are as follows:

- Use of a factory fabricated "e-building" rather than a field constructed masonry building.
- Use of three individual voltage regulators in the new bay, rather than a transformer automatic load tap changer (LTC)
- Deletion of costs associated with the replacement of the Dress-Rand transformer and related work,
- Engineering fees has been changed to more closely reflect the scope of engineering services appropriate for this project.
- A contingency line has been added since only conceptual design has been completed to date and since construction prices may vary substantially with commodity prices and contractor's work loads.

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The estimated project cost, including a 10% contingency, for the project scope and options selected by the Village is about $2,257,000. The following sections of this report describe the project in more detail and provide a solid basis for final design.

BACKGROUND

2.1 GENERAL

The Village of Wellsville electric system includes three substations:

- The Niles Hill (or E. J. Rowe) 115 kV supply substation
- The State Street 4.16 kV distribution substation
- The Vossler Road (or J.L. Moore or Worthington) 4.16 kV distribution substation

This project addresses work at the Vossler Rd. Substation.

2.2 EXISTING SUBSTATION

The existing substation was constructed in 1969 to meet the power requirements of Worthington Corporation and to support general load growth in the franchise area of the Village electric system. The substation has been known by various names, including the Vossler Road Substation, J.L. Moore Substation, and Worthington Substation. The Worthington Corporation facility that was supplied by the substation is now owned by the Dresser-Rand Corporation.

The initial substation included a single power transformer and did not include any voltage regulation. A second transformer was added in 1973 to provide backup capability in the event the original transformer required maintenance or failed. The original transformer did fail and was replaced in 1996. A three-phase regulator to provide voltage regulation on circuits supplying Village electric system loads was installed sometime after 1974. Selected ratings for the existing substation are as follows:

	South Bay	North Bay
Supply Voltage	34.5 kV	34.5 kV
Secondary Voltage	4.16 kV	4.16 kV
Primary Protection-Oil Circuit Breaker		
Manufacturer	Westinghouse	Westinghouse
Approx date of manufacture	1969	1974
Type	345GS1500	345GS1500
Current rating	1200 A	1200 A
Protective Relays	CO Overcurrent & RC Reclosing	CO Overcurrent & RC Reclosing
Transformer		
Manufacturer	Cooper	Westinghouse
Approx date of manufacture	1996	1970
Base Power Rating	5,000 kVA	5,000 kVA
Maximum Power Rating	7,000 kVA	7,000 kVA
Voltage Regulator	None	
Manufacturer	NA	General Electric

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	South Bay	North Bay
Base Power Rating	NA	600 kVA (800 A)
Metal-Clad Switchgear		
Manufacturer	General Electric	General Electric
Approx date of manufacture	1969	1974
Voltage Rating	4.76 kV	4.76 kV
Main/Tie Breaker Current Rating	2000 A	2000 A
Feeder Breaker Current Rating	1200 A	1200 A

Design life for substation equipment is in the order of 30 years. Most substation equipment has now been in service from to 39 to 44 years. Most equipment is presently in serviceable condition, however settlement of the switchgear foundation installed in 1974 has occurred. This has caused serious damage to the equipment and results in both reliability and safety concerns. Protective relaying located in the oil circuit breakers and in the switchgear is obsolete.

2.3 PROJECT DESCRIPTION

2.3.1 General

The primary driving force for the project is to replace the existing metal-clad switchgear. Based on discussions held on August 10, the project is also to upgrade and extend the life of other substation equipment. The project, as originally defined by the Village, is to include replacing 34.5 kV circuit breakers, replacing power transformers, and providing voltage regulation on all buses.

2.3.2 34.5 kV Circuit Breakers

Existing circuit breakers are oil-filled and have substantially exceeded their design lives. The existing oil circuit breakers are obsolete and no longer available. Current 34.5 kV breaker designs use either SF6 gas or vacuum style breakers. Either design eliminates the potential for environmental contamination due to oil spills. The Village has indicated that vacuum type breakers are preferred.

2.3.3 Transformers

The Village had originally indicated that both existing transformers should be replaced as part of the project and that voltage regulation should be provided for the 4.16 kV bus. However, due to budget limitations, the project scope has been reduced to include the replacement of only one 34.5 kV circuit breaker and transformer. The desired rating of each transformer, based on Dresser-Rand load projections and estimated load growth within the Village, is about 8,400 kVA. There are various means of obtaining this rating and detailed transformer ratings will need to be determined during final design. Niagara Transformer Corporation is one of the primary manufacturers of transformers in this size and voltage range. Niagara has indicated that it can supply a transformer rated 8400 kVA, but detailed ratings would not necessarily be the same as the ratings of the transformer at the Village's State St substation. Based on discussions with the Village, the following options for transformers were to be considered.

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- Mineral Oil vs. Biodegradable Fluid (such as Cooper/Cargill FR3) for transformer insulating fluid
- Transformers with integral automatic load tap changers vs. stand-alone voltage regulators, for voltage regulation.
- After review of the draft version of this report, the Village has elected to purchase a transformer containing mineral oil and to purchase stand-alone voltage regulators.

2.3.4 Metal-Clad Switchgear

The Village initially indicated that a masonry building similar to that at its State Street Substation was desired. Based on discussions with Jon Tucker and the Village, it was determined than a factory fabricated switchgear building (sometimes called an E-Building, Pre-engineered Building, Power Center, or Power Control Complex) should also be considered. Old-fashioned sheltered-aisle switchgear is not desired due to maintenance, life, and energy efficiency concerns. After review of the draft version of this report, the Village has elected to proceed with a factory fabricated switchgear building.

Revenue metering for Dresser Rand is located within the existing metal-clad switchgear. The project must address Dresser-Rand revenue metering, but the entire metering installation does not necessarily need to be within the new switchgear or building.

2.4 ENGINEERING AUTHORIZATION

A budgetary cost estimate for the substation upgrades is needed in order to complete a rate study that is presently in progress. The following documents describe the engineering services to be provided in support of this budgetary estimate.

- Purchase Order Acknowledgement dated August 3, 2012
- Purchase Order 0403 dated July 5, 2012
- Village -email of July 17, 2012 regarding project responsibilities
- Jon Tucker's discussion points of August 7, 2012 and meeting on August 10, 2012

The services included developing a conceptual basis of design as well as identifying and evaluating design alternatives that might substantially impact project costs.

PROJECT ALTERNATIVES

3.1 GENERAL

The original substation was designed as small, low cost, substation primarily to supply power to Worthington Corporation. Much has changed since the substation was designed over 40 years ago. There is now a much higher emphasis on power reliability, power quality, maintainability, operational safety, construction safety, and environmental impacts. Two overall conceptual alternatives have been considered to address these changes:

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- Alternative 1: a basic design that attempts to minimize disturbance to the site and reuse as much of the existing foundations as possible.
- Alternative 2: Site layout upgrade to address the increased emphasis on reliability and safety.

These alternatives are discussed in sections 3.2 and 3.3. Sub-alternatives and other design considerations are discussed in the following sections:

3.4 Transformer and Voltage Regulation Alternatives

3.5 Mineral Oil vs. Biodegradable Fluid

3.6 Dresser Rand Metering

3.7 Distribution Feeder Configuration

3.2 ALTERNATIVE 1 - EQUIPMENT REPLACEMENT

This alternative attempts to reuse the existing 34.5 kV structure, 34.5 kV oil circuit breaker foundations, and transformer foundations. It appears that this alternative is feasible, but space is very limited and feasibility cannot be confirmed until final design is substantially complete.

Considerations regarding this alternative include:

- Space between the 34.5 kV structure, 34.5 kV circuit breakers, and each 34.5 kV transformer is extremely limited. There is a reasonably high probability that the present surge arrester support steel on the existing 34.5 kV structure will need to be raised to permit full access to the controls and mechanism on a modern vacuum breaker. This work is easily done while de-energized, but presents a challenge if outages must be of short duration or are prohibited altogether. See Figure E1 and photos below.

- Space between the north and south transformers is very limited. The existing Cooper transformer appears to use an inexpensive and less reliable rectangular winding design that results in a relatively small tank size. It appears that a more reliable circular core transformer may fit in the available space, but there may not be sufficient space for a circular core transformer with an automatic load tap changer. Alternative 1 might require the use of stand-alone voltage regulators, if there is not sufficient space for transformers with automatic load tap changers
- Even if new transformers will fit in the available space, transformers will be very close to one another. A catastrophic transformer failure would almost assuredly damage the adjacent transformer. Construction will be difficult due to need to work close to energized equipment.

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- Secondary containment for transformer oil would be difficult to provide. Secondary containment is recommended, but not presently required, for new transformer installations. Lack of space prohibits use of most common containment designs. A drip-pan type design with drainage to a buried tank might be feasible, but is not a preferred design.
- Design and construction will be complicated by the outage, coordination, and safety issues related to work in close proximity to existing energized equipment.

3.3 ALTERNATIVE 2 - EQUIPMENT REPLACEMENT & SITE UPGRADE

This alternative creates a new north bay between the existing north transformer and the existing control building. See Figures E2 and E3. The new north bay and new switchgear may be constructed and energized without requiring an outage to either of the existing transformers. All existing feeders would be transferred to the new transformer and switchgear before upgrading existing equipment.

The existing north transformer, voltage regulator, and metal-clad switchgear would be de-energized , but remain in place, while the new south bay is being constructed. This will provide emergency backup throughout most of the construction period. The existing north transformer, voltage regulator, and existing switchgear would be permanently de-energized and removed once the new south transformer is placed on its pad.

Potential site layouts are shown in Figures E2 and E3. A new 34.5 kV tap pole and a new 34.5 kV dead-end steel structure will be required. There is just sufficient space between the existing meter building and existing structure to construct a structure with standard recommended electrical clearances for 34.5 kV conductors. However, removing the existing meter building would allow a slightly wider structure. This would allow greater electrical clearances and decrease the possibility of bird or rodent initiated faults.

Alternative 2 allows for secondary containment for transformer oil and for voltage regulator oil, if regulators are used. Either one or two sumps with manually controlled electric pumps would be provided to remove accumulated rain water. Costs for a concrete style, stone-filled, secondary containment system are included in the cost estimates. However, containment is not presently an absolute DEC or EPA requirement.

Alternative 2 provides additional space between the substation fence and Vossler Road. This will allow for additional landscaping and/or an architectural fence or visual barrier.

Alternative 2 allows for two different control building orientations. Either orientation is technically feasible and similar in cost, so orientation is mainly a matter of Village preference and possibly local zoning laws. Both orientations appear to require the relocation of the existing 34.5 kV line. The Village has indicated that it prefers the East-West orientation shown in figure E-3.

3.4 TRANSFORMER AND VOLTAGE REGULATION ALTERNATIVES

3.4.1 Alternatives Considered

- Transformers with integral automatic load tap changers
- Transformers with separately mounted voltage regulators
- Transformers with mineral oil

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- Transformers with biodegradable fluid

3.4.2 Automatic Load Tap Changers vs. Voltage Regulators

Voltage regulation may be provided by either automatic load tap changers (LTCs) integral to transformers or by voltage regulators mounted separately from the transformer. O'Brien & Gere has been unable to find a manufacturer willing to quote a price for a three-phase voltage regulator of the required size and voltage. Conceptual design and pricing was therefore based on three single-phase regulators with a steel structure for supporting cables and by-pass switches.

75% or more of modern installations use automatic load tap changers for the following reasons:

- Installation simplicity: A transformer with an automatic load tap changer is one device. A voltage regulator installation requires three regulators, five foundations (one per regulator plus two for the structure), additional oil containment, 3 regulator controllers, a cable riser structure, and a by-pass switch structure.
- Design and construction complexity: an installation using transformers with automatic load tap changers is much easier to design and install
- Aesthetics and real estate: A transformer with an automatic load tap changer takes up less space and is more aesthetically pleasing than an installation using regulators
- Reliability: An installation using voltage regulators has more connections and is prone to faults caused by weather or animals. But see advantages of voltage regulators below.
- Safety: Voltage regulator installations have exposed energized components that are within 6 feet of the regulator base. Special bases are required to meet Safety Code clearance requirements.
- Costs: Initial capital cost of voltage regulator installations is usually higher and on-going maintenance costs are higher. Jon Tucker has advised that voltage regulators have required an unexpected amount of maintenance. The project cost estimate shows a capital cost premium of about $8,500 for a voltage regulator installation. Operational, maintenance and design costs may result in a differential owning cost that is $30,000 to $50,000 higher for the voltage regulators.

Installations using voltage regulators have two major advantages over transformers with automatic load tap changers:

- Regulation is provided on a per-phase basis.
- Automatic load tap changer failures are the most common cause of transformer failures. A power transformer without an automatic load tap changer is more reliable. A failure of a voltage regulator does not necessarily result in a loss of load. Since the Village's 34.5 kV system is a regulated system, voltage regulator by-pass switches may be used to by-pass a failed regulator.

5 kV Voltage Regulators

Transformer with Automatic Load Tap Changer

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3.5 MINERAL OIL VS. BIODEGRADABLE FLUID

Transformer main tanks may be filled with either mineral oil or a biodegradable fluid. In either case, the oil or fluid provides both insulation and cooling. Mineral oil has been used in transformers since the reign of Thomas Edison and George Westinghouse. Biodegradable fluids were first placed in commercial use in 1996. Biodegradable fluids are now common in distribution pole-top and pad-mounted transformers. Biodegradable fluids were developed by Cooper Power. Cooper designates its biodegradable fluid as FR3. In 2012, ABB announced the availability of BioTemp: its version of a biodegradable fluid.

Advantages of biodegradable fluid, compared to mineral oil, generally include the following:

- Resistance to fire (FM non-flammable listing, high flash point and high fire point)
- Lower smoke production in event of fire
- Biodegradable, food grade, renewable
- Non-toxic
- Recyclable
- Improved insulation capabilities
- Longer life expectancy of paper insulation

Disadvantages of biodegradable fluid include:

- Higher transformer operating temperature (or larger radiators)
- Not suitable for use where fluid is exposed to air (due to degradation from oxygen)
- Not suitable for applications involving contact movement (due to higher viscosity)
- No present basis for interpreting the meaning of the gas ratios obtained from dissolved gas tests
- Cost: FR3 cost $5.00 to $8.00 more per gallon. It is expected that transformers for this project would contain 2,500 to 3,500 gallons each.

No manufacturer provided estimating prices showing comparative prices for mineral oil and FR3 filled transformers. Comparative prices in the cost estimate are based on 3,100 gallons at $8.00/gallon. Transformer cost should be equivalent, if it is assumed that the longer insulation life resulting from use of a biodegradable fluid off-sets the higher temperature resulting from use of a biodegradable fluid.

3.6 DRESSER RAND SERVICE

3.6.1 Existing Service

Dresser Rand is currently supplied by two overhead circuits that are dedicated to Dresser Rand. Both circuits are connected to bus A (the south/west bus), which is supplied from a Cooper 3Phase transformer rated 5000/5600 kVA, OA/FA, 55 degrees C and 6250/7000 kVA, OA/FA, 65 degrees C. There is no voltage regulation at 4160 volts, although a small capacitor bank is connected the north/east circuit near the Dresser Rand property line. Both circuits are supported by common poles and crossarms. Total length of the overhead line is about 1100 feet. It appears that loads are located at multiple points along the line.

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3.6.2 Existing Revenue Metering

Revenue metering for Dresser Rand is provided by instrument transformers and meters located at the Vossler Rd Substation. Details for the current metering installation were not field verified for this initial investigation, but, based on O'Brien & Gere's documentation from 1973, meters are supplied from outdoor Westinghouse PTOM 2400/4160Y voltage transformers and switchgear mounted General Electric JCS-H, 600/5 current transformers.

Accuracy data for the existing General Electric JCS-H current transformers cannot be located. The last character of General Electric's style number (H) generally refers to the CT voltage class. Switchgear bushing mounted current transformers are generally rated 600 volts. If it is assumed that accuracy classification of the exiting CTs is the same as a modern 600 volt GE JCS-0 CT, then the existing CTs have a rated metering accuracy classification of 0.3 for burdens of B-0.1, B-0.2, and B-0.5. It is likely that the burden (resistance of wiring, meters, and electromechanical relays) on existing CTs exceeds B-0.5. Therefore, the existing CTs, with present loads, probably do not provide an ANSI 0.3 (0.3%) metering accuracy.

3.6.3 Proposed Revenue Metering

For a customer taking primary service, such as Dresser Rand, many utilities would provide revenue metering via a stand-alone pole or pad-mounted metering installation located at the property line. Revenue meters and accessories would typically be located outdoors or within an outdoor cabinet. However, the Village has indicated that meters must be indoors. Options for metering installations that can accommodate indoor meters include:

- Construction of new metering installation at the Dresser Rand property line. The installation would include pole-mounted instrumented transformers and a new walk-in building at the property line to house meters. This would be costly and not particularly aesthetic.
- Installation of pole-mounted instrument transformers at the property line and installation of meters within the Vossler Rd Substation. Meter secondary wiring would have to cross Vossler Road. Crossing public roads with metering wiring is not desirable and the distance would negatively impact metering accuracy.
- Installation of pole-mounted instrument transformers on the substation site. Available space, aesthetics, and distribution switching considerations make this undesirable.
- Installation of pad-mounted instrument transformers at the substation site. This would be costly and the additional 5 kV cable and terminations may adversely impact reliability.
- Installation of instrument transformers within the switchgear. This would be the least expensive option, if the switchgear can readily accommodate transformers of the required accuracy and if the installation can be made flexible enough to accommodate initial and future Dresser Rand services.

Investigation has shown that instrument transformers for revenue metering may be mounted within standard switchgear units. The investigation indicated that:

- Standard switchgear mounted voltage transformers have sufficient accuracy for use in metering circuits. Accuracy is usually an issue only when a substantial number of devices are connected to the same set of VTs, which should not be the case in this project.
- Up to four (per phase) GE/ITI model 780 current transformer will fit on the bushings of standard, modern, metal-clad switchgear. These CTs are dual rated for either metering or

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relay use. Relay accuracy is C200. Metering accuracy is class 0.3 at burdens onB-0.1, B-0.2, B-0.5, B-0.9, and B-1.8.

- Preliminary design requires two CTs per phase for relaying purposes, so sufficient space is available for one set of CTs dedicated to metering on each breaker. There would also be space for one additional set of CTs.
- With the low burdens of modern meters and microprocessor based relays, it may be feasible to use the same CTs for both metering and relaying. This may be investigated further in final design and could result in a minor cost savings.

3.7 FEEDER CONFIGURATION

3.7.1 Dresser Rand Feeders

It is anticipated that two breakers within the metal-clad switchgear will initially be dedicated to Dresser Rand. There is a possibility that Dresser Rand load may exceed the capability of one circuit and that a third circuit may eventually be needed for reliability purposes. This possibility appears to be low and substantial capital expenditures to support a third circuit cannot be justified at this time.

Because Dresser Rand revenue metering will be located within the substation, all circuits that supply, or may supply Dresser Rand will need to be dedicated to Dresser Rand. For consistency and future flexibility, the cost estimate assumes that every switchgear circuit breaker will have a set of CTs dedicated to revenue metering. Future changes in circuit configurations may require reconnection of metering current or voltage circuits, which should be a relatively minor cost.

3.7.2 System Grounding and Back-up Capability

The substation was originally designed to supply Dresser Rand. The south/west part of the substation was designed to meet Dresser Rand's requirements. This included an industrial style, resistance grounded electric service. A substation addition to supply other Village loads was designed shortly after initial substation design was completed. The north/east part of the substation was designed to meet the requirements of other Village loads. This included a utility style, solidly grounded electric supply. Since the Dresser Rand electric service was not solidly grounded, the south/west and north/east parts of the substation had to operate as two separate substations. This meant that the Dresser Rand transformer could not supply Village loads and the Village transformer could not supply Dresser Rand.

The Dresser Rand service was subsequently converted to a solidly grounded system that was compatible with the circuits supplying Village loads. There is no longer an absolute requirement to segregate Dresser Rand from other Village loads.

3.7.3 Bus Connections

Supplying all Village loads from one bus and Dresser Rand from the other bus makes it difficult to perform maintenance on either bus. Outages or reconfiguration of the distribution system are required in order to perform substation maintenance. It would generally be preferable to supply one Village circuit and one Dresser Rand circuit from the south/west bus and the other Village and Dresser Rand circuit from the north/east bus. The desirability of reconfiguring the substation circuits should be confirmed during final design. Among final design considerations:

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- Does Dresser Rand have any large motors, furnaces, or other loads that may cause objectionable flicker to other residential or commercial customers?
- How is load at Dresser Rand allocated between the two feeders? Is paralleling of the two feeders at Dresser Rand possible or permitted?
- Are normal operating voltages on Bus A and bus B similar and acceptable for supplying either Dresser Rand or other Village Loads?
- What is the frequency of faults on Village circuits? A fault on a Village circuit should not result in an outage to Dresser Rand, but momentary voltage dips occur during faults. Such voltage dips are more pronounced at the secondary of the transformer supplying the fault. Dresser Rand may see more momentary voltage dips if it is supplied from the same transformer that supplies other Village loads.
- What are present and future options if voltage regulation for the Dresser-Rand transformer is not installed as part of this project?

3.8 1-HIGH VS. 2-HIGH SWITCHGEAR

Modern metal-clad switchgear with vacuum circuit breakers allows for mounting breakers in a 2-high configuration. Each 36 inch wide vertical section may contain two circuit breakers: one in an upper compartment and one in lower compartment. Switchgear manufactured prior to the mid 1970's could only accommodate one breaker per vertical section.

Advantages of 2-high construction include:

- Less floor space required
- Fewer vertical sections
- Lower cost

Disadvantages of 2-high construction include:

- Limited space for incoming conduits
- Limited space for terminating cable
- Limited space for protective relays
- Special cart required to remove upper breaker
- Inability to use infrared thermal imaging windows in cable termination compartments
- Multiple circuits share the cable termination compartment

The majority of O'Brien & Gere's electric utility clients prefer a 1-high breaker design that has only one breaker per vertical section. The majority of O'Brien & Gere's commercial and industrial clients prefer a 2-high breaker design. Where space and budget permits, O'Brien & Gere believes that the 1-high design is preferable since it may provide higher reliability and greater safety. The cost estimate indicates that 1-high switchgear may increase project costs by about $72,000 as a result of higher equipment and building costs.

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3.9 TRANSFORMER STORAGE YARD

The Village indicated that the project should include space for a storage facility for indoor storage of pole and pad-mounted transformers and other equipment. The site is relatively large and can readily accommodate a reasonable size storage facility. None of the alternatives considered should have any substantial impact on storage yard options. It is anticipated that the storage yard would be to the north or west of the new control building.

BUDGETARY COSTS

Detailed itemized budgetary costs are shown in the construction cost estimate breakdown and metal-clad switchgear cost estimates in the appendices. Costs for metal-clad switchgear, 34.5 kV breakers, transformers, and voltage regulators were based on preliminary quotations solicited from equipment suppliers. Costs are summarized below.

Alternative 1-Replace In-Kind (1-High Swgr, Masonry Bldg, LTC, Mineral Oil)	$2,630,000
Alternative 2a (1-High Swgr, Masonry Bldg, LTC, Mineral Oil)	$2,750,000
Alternative 2b (2-High Swgr, Masonry Bldg, LTC, Mineral Oil)	$2,680,000
Options	
E-Building in lieu of masonry building	($43,000)
Voltage Regulators in lieu of LTCs	$9,000
FR3 in lieu of mineral oil	$50,000

Costs include an allowance for a site topographic survey, geotechnical investigation (boring samples), and engineering. Engineering fees are based on preliminary discussions regarding scope of services appropriate to this project.

See the executive summary for the total cost of options selected by the Village.

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Figure E1
Existing Plan

Figure E2
Proposed Plan
Control Building Oriented
North-South

Figure E3
Proposed Plan
Control Building Oriented
East-West

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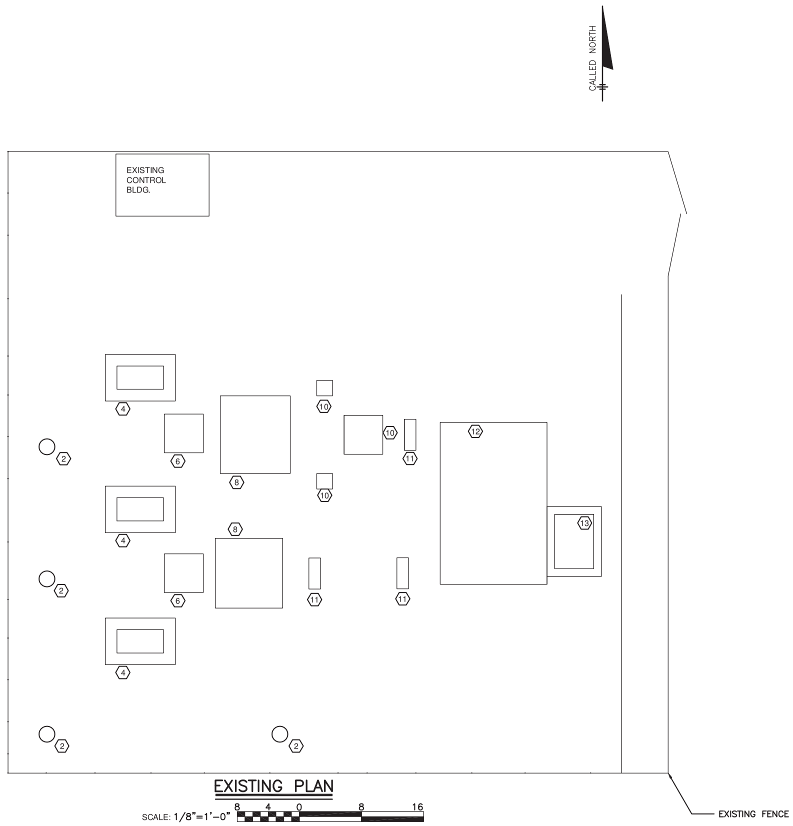

EXISTING PLAN

SCALE: 1/8"=1'-0"   8 4 0 8 16

- (2) EXISTING 34.5 KV WOOD POLE
- (4) EXISTING 34.5 KV STRUCTURE FOUNDATION
- (6) EXISTING 34.5 KV OIL CIRCUIT BREAKER TO BE DEMOLISHED
- (8) EXISTING TRANSFORMER FOUNDATION TO BE DEMOLISHED
- (10) EXISTING VOLTAGE REGULATOR AND STRUCTURE TO BE DEMOLISHED
- (11) EXISTING BUS SUPPORT TO BE DEMOLISHED
- (12) EXISTING METAL CLAD SWITCH GEAR TO BE DEMOLISHED
- (13) EXISTING MANHOLE TO REMAIN

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CONSTRUCTION
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O'BRIEN & GERE
O'BRIEN & GERE ENGINEERS, INC

VILLAGE OF WELLSVILLE
VOSSLER RD. SUBSATION
WELLSVILLE, NY

ELECTRICAL
EXISTING PLAN

FILE NO. 858.49497-001
DATE JANUARY 2013

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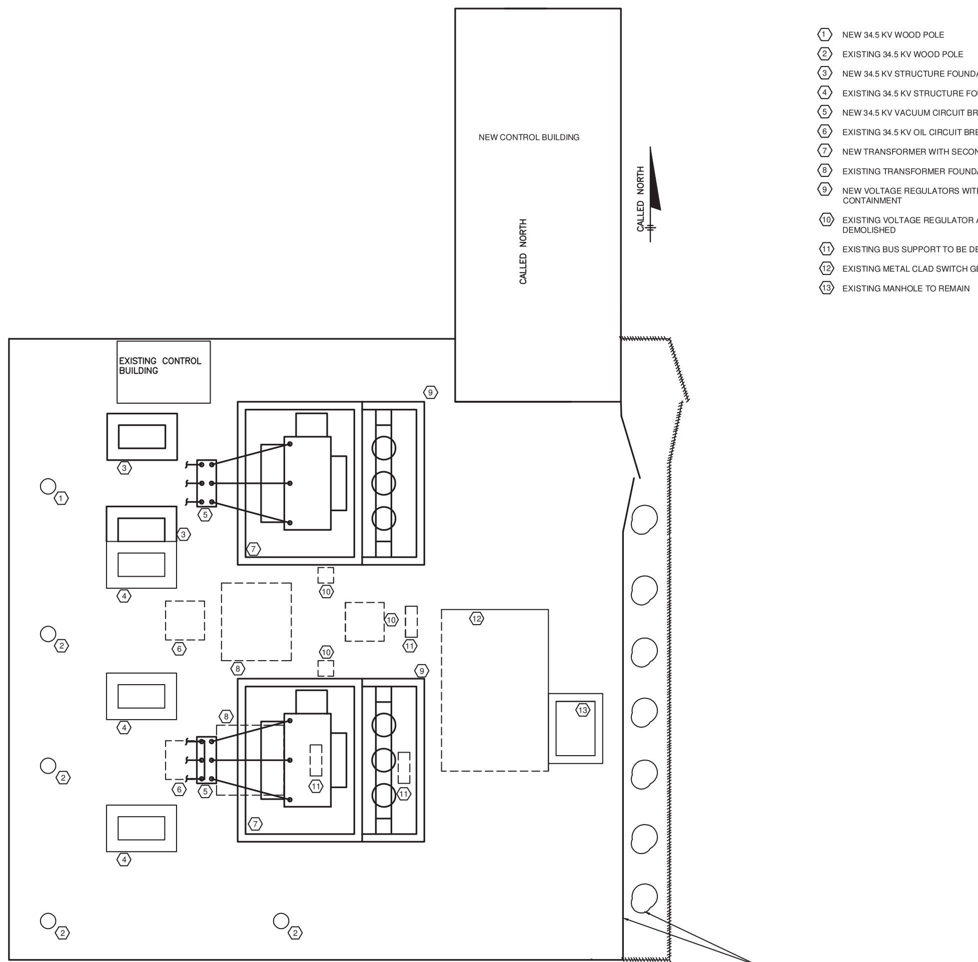

CONTROL BUILDING ORIENTED NORTH–SOUTH

SCALE: 1/8"=1'–0"

1. NEW 34.5 KV WOOD POLE
2. EXISTING 34.5 KV WOOD POLE
3. NEW 34.5 KV STRUCTURE FOUNDATION
4. EXISTING 34.5 KV STRUCTURE FOUNDATION
5. NEW 34.5 KV VACUUM CIRCUIT BREAKER
6. EXISTING 34.5 KV OIL CIRCUIT BREAKER TO BE DEMOLISHED
7. NEW TRANSFORMER WITH SECONDARY CONTAINMENT
8. EXISTING TRANSFORMER FOUNDATION TO BE DEMOLISHED
9. NEW VOLTAGE REGULATORS WITH SECONDARY CONTAINMENT
10. EXISTING VOLTAGE REGULATOR AND STRUCTURE TO BE DEMOLISHED
11. EXISTING BUS SUPPORT TO BE DEMOLISHED
12. EXISTING METAL CLAD SWITCH GEAR TO BE DEMOLISHED
13. EXISTING MANHOLE TO REMAIN

PRELIMINARY
NOT FOR
CONSTRUCTION
DATE: 01/28/13

THIS DRAWING WAS PREPARED AT THE SCALE INDICATED IN THE TITLE BLOCK. INACCURACIES IN THE STATED SCALE MAY BE INTRODUCED WHEN DRAWINGS ARE REPRODUCED BY ANY MEANS. USE THE GRAPHIC SCALE BAR IN THE TITLE BLOCK TO DETERMINE THE ACTUAL SCALE OF THIS DRAWING.

IN CHARGE OF	RAC
DESIGNED BY	RAC
CHECKED BY	RAC
DRAWN BY	WGF

NO.	DATE	REVISION	INT.

O'BRIEN & GERE ENGINEERS, INC
WELLSVILLE, NY

VILLAGE OF WELLSVILLE
VOSSLER RD. SUBSTATION
WELLSVILLE NY

ELECTRICAL
CONTROL BUILDING ORIENTED NORTH-SOUTH

FILE NO. 858.49497-002
DATE JANUARY 2013
E-2

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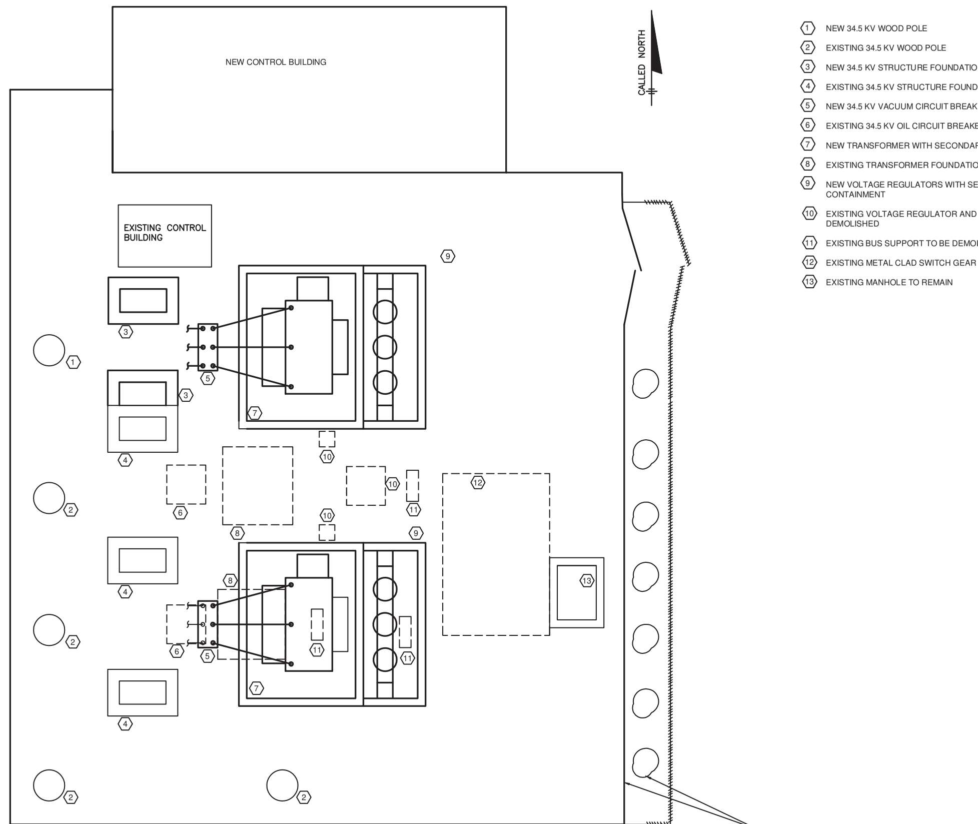
SAVED: 1/28/13 3:59 PM



CONTROL BUILDING ORIENTED EAST–WEST

SCALE: 1/8"=1'-0" 8 4 0 8 16

1. NEW 34.5 KV WOOD POLE
2. EXISTING 34.5 KV WOOD POLE
3. NEW 34.5 KV STRUCTURE FOUNDATION
4. EXISTING 34.5 KV STRUCTURE FOUNDATION
5. NEW 34.5 KV VACUUM CIRCUIT BREAKER
6. EXISTING 34.5 KV OIL CIRCUIT BREAKER TO BE DEMOLISHED
7. NEW TRANSFORMER WITH SECONDARY CONTAINMENT
8. EXISTING TRANSFORMER FOUNDATION TO BE DEMOLISHED
9. NEW VOLTAGE REGULATORS WITH SECONDARY CONTAINMENT
10. EXISTING VOLTAGE REGULATOR AND STRUCTURE TO BE DEMOLISHED
11. EXISTING BUS SUPPORT TO BE DEMOLISHED
12. EXISTING METAL CLAD SWITCH GEAR TO BE DEMOLISHED
13. EXISTING MANHOLE TO REMAIN

PRELIMINARY
NOT FOR
CONSTRUCTION
DATE: 01/28/2013

IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS ACTING UNDER THE DIRECTION OF A LICENSED ENGINEER, TO ALTER THIS DOCUMENT.

THIS DRAWING WAS PREPARED AT THE SCALE INDICATED IN THE TITLE BLOCK. INACCURACIES IN THE STATED SCALE MAY BE INTRODUCED WHEN DRAWINGS ARE REPRODUCED BY ANY MEANS. USE THE GRAPHIC SCALE BAR IN THE TITLE BLOCK TO DETERMINE THE ACTUAL SCALE OF THIS DRAWING.

IN CHARGE OF	RAC
DESIGNED BY	RAC
CHECKED BY	CHS
DRAWN BY	WGF

NO.	DATE	REVISION	INT.

O'BRIEN & GERE
O'BRIEN & GERE ENGINEERS, INC

VILLAGE OF WELLSVILLE
VOSSLER RD. SUBSTATION
WELLSVILLE, NY

ELECTRICAL
CONTROL BUILDING ORIENTED EAST-WEST

FILE NO. 858.49497-0043
DATE JANUARY 2013
E-3

I:\WELLSVILLE-V.858\49497.WELLSVILLE-VOSS\DOCS\DWG\CONSTRUCTS\49497 EASTWEST E4.DWG

Received: 03/04/2014

Construction Cost Estimate Breakdown

Metal-Clad Switchgear Cost Estimates

Metal-Clad Switchgear Ratings

One-Line Diagram-Existing

Received: 03/

O'BRIEN & GERE

LINE	ITEM	UNIT	QTY	BARE MATERIALS UNIT COST	BARE MATERIALS TOTAL	BARE LABOR UNIT COST	BARE LABOR TOTAL	DIRECT COSTS UNIT	DIRECT COSTS TOTAL	Line Item Cost TOTAL (WITH O&P)	Total Cost LTC, Masonry Options 1-High Switchgear	Total Cost LTC, Masonry Options 2-High Switchgear	Total Cost LTC, Masonry Options Replace In-Kind (1-high)	Option Comparative Costs Building Options Masonry Control Bldg	Option Comparative Costs Building Options E-Building	Option Comparative Costs Transformer Options Transformer LTC	Option Comparative Costs Transformer Options Voltage Regulators	Total Cost Village Selected Options
CONSTRUCTION COST ESTIMATE BREAKDOWN																		
Village of Wellsville		Location:																
Vossler Substation Upgrades		Wellsville, NY																
858/49497		by:																
January 21, 2013 Rev March 17, 2013		RA Cherry																
	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	
10	**Division 1 - General Requirements**																	
11	Performance bond (1.0%)	LS	1	$0.00	$0	$0.00	$0	$16,000.00	$16,000	$17,600	$25,000	$24,000	$23,000					$18,000
12	Insurance, builder's risk (0.50%)	LS	1	$0.00	$0	$0.00	$0	$8,000.00	$8,000	$8,800	$12,000	$12,000	$11,000					$9,200
13	Insurance, liability (1.5%)	LS	1	$0.00	$0	$0.00	$0	$24,000.00	$24,000	$26,400	$37,000	$36,000	$34,000					$28,000
14	Temporary electric service	EA	1	$1,500.00	$1,500	$1,000.00	$1,000	$0.00	$0	$2,965	$2,965	$2,965	$2,965					$2,965
15	Temporary office trailer	Month	12	$250.00	$3,000	$0.00	$0	$0.00	$0	$3,300	$3,300	$3,300	$3,300					$3,300
16	Temporary power	Month	12	$100.00	$1,200	$0.00	$0	$0.00	$0	$1,320	$1,320	$1,320	$1,320					$1,320
17	Toilet, portable	Month	12	$150.00	$1,800	$0.00	$0	$0.00	$0	$1,980	$1,980	$1,980	$1,980					$1,980
18	**Division 2 - Site Construction**																	
19	Demolition																	
20	Transformer foundation (5 CY Ea *2)	CF	270	$0.00	$0	$14.00	$3,780	$4.00	$1,080	$6,160	$6,160	$6,160	$0					$3,080
21	Voltage regulator pad (1.4 CY Ea)	CF	54	$0.00	$0	$14.00	$756	$4.00	$216	$1,232	$1,232	$1,232	$1,232					$1,232
22	Voltage regulator structure pad (1.9 CY Ea)	CF	54	$0.00	$0	$14.00	$756	$4.00	$216	$1,232	$1,232	$1,232	$1,232					$1,232
23	5 kV bus support (1.4 CY Ea*3)	CF	135	$0.00	$0	$14.00	$1,890	$4.00	$540	$3,080	$3,080	$3,080	$3,080					$3,080
24	Switchgear pad (19.9 CY Ea)	CF	430	$0.00	$0	$14.00	$6,020	$4.00	$1,720	$9,811	$9,811	$9,811	$9,811					$9,811
25	OCB pad (6 CY Ea*2)	CF	324	$0.00	$0	$14.00	$4,536	$4.00	$1,296	$7,392	$7,392	$7,392	$0					$3,696
26	15 kV breaker Pad (4.2 CY)	CF	135	$0.00	$0	$20.00	$2,700	$4.00	$540	$4,146	$4,146	$4,146	$4,146					$4,146
27	Site grading	CY	100	$30.00	$3,000	$12.00	$1,200	$12.00	$1,200	$6,198	$6,198	$6,198	$4,000					$6,198
28	Fence, 7' chain link	LF	300	$35.00	$10,500	$5.00	$1,500	$2.00	$600	$14,183	$14,183	$14,183	$14,183					$14,183
29	Gate, 16 ft	EA	1	$1,000.00	$1,000	$400.00	$400	$200.00	$200	$1,846	$1,846	$1,846	$1,846					$1,846
30	Fence, 7' chain link, storage yard	LF	100	$25.00	$2,500	$4.00	$400	$2.00	$200	$3,496	$3,496	$3,496	$3,496					
31	Gate, 12 ft	EA	1	$800.00	$800	$300.00	$300	$2.00	$200	$1,495	$1,495	$1,495	$1,495					$1,495
32	2" crushed stone, site	CY	145.0	$35	$5,075	$5	$725	$3	$435	$7,015	$7,015	$7,015	$1,000					$7,015
33	2" crushed stone, control bldg perimeter NS	CY	180.0	$35	$6,300	$5	$900	$3	$540	$8,708	$8,708	$8,708	$8,708					
34	2" crushed stone, control bldg perimeter, EW	CY	140.0	$35	$4,900	$5	$700	$3	$420	$6,773								$6,773
35	2" crushed stone, parking	CY	12.0	$35	$420	$5	$60	$3	$36	$581	$581	$581	$581					$581
36	Excavation, backfill, compaction	CY																
37	34 kV structure, 18CY/leg	CY	36.0	$0.00	$0	$10.00	$360	$10.00	$360	$870	$870	$870	$0					$870
38	Vacuum breaker, 0.6 CY/breaker	CY	1.2	$0.00	$0	$10.00	$12	$10.00	$12	$29	$29	$29	$0					$29
39	Transformer, 130CY/transformer	CY	260.0	$0.00	$0	$10.00	$2,600	$10.00	$2,600	$6,280	$6,280	$6,280	$0			$6,280	$6,280	$3,140
40	Voltage regulator, 40CY/regulator	CY	80.0	$0.00	$0	$10.00	$800	$10.00	$800	$1,932	$1,932	$1,932	$0				$1,932	$966
41	Control building, 21'x50'	CY	60.0	$0.00	$0	$10.00	$600	$10.00	$600	$1,449	$1,449	$1,200	$1,449	$1,449	$1,449			$1,449
42	5 kV manholes	CY	70.0	$0.00	$0	$10.00	$700	$10.00	$700	$1,691	$1,691	$1,691	$1,691					$1,691
43	**Division 3 - Concrete, Div 4 - Masonry**																	
44	Equipment & Structures																	
45	34 kV structure, 5.7CY/Leg	CY	12	$200.00	$2,400	$120.00	$1,440	$1.00	$12	$4,547	$4,547	$4,547	$0					$4,547
46	Vacuum Breaker, 1.5 CY/breaker	CY	3	$200.00	$600	$50.00	$150	$1.00	$3	$861	$861	$861	$0					$430
47	Transformer, 45 CY/transformer	CY	90	$200.00	$18,000	$120.00	$10,800	$1.00	$90	$34,105	$34,105	$34,105	$0			$34,105	$34,105	$17,053
48	Voltage regulator,24 CY/set of regulators	CY	48	$200.00	$9,600	$120.00	$5,760	$1.00	$48	$18,190	$0	$0	$0				$18,190	$9,095
49	Control Building		1															
50	Floor, 21'x50'	CY	40	$150.00	$6,000	$50.00	$2,000	$1.00	$40	$9,275	$9,275	$7,400	$9,275	$9,275	$9,275			$9,275
51	Footers, 21' x 50'	CY	60	$150.00	$9,000	$50.00	$3,000	$1.00	$60	$13,912	$13,912	$11,200	$13,912	$13,912				
52	Masonry, 21'x50'x11'H	SF	1600	$20.00	$32,000	$20.00	$32,000	$0.00	$0	$77,293	$77,293	$62,000	$77,293	$77,293				
53	5 kV precast manholes	EA	2	$6,500.00	$13,000	$3,000.00	$6,000	$1,000.00	$2,000	$24,392	$24,392	$24,392	$24,392					$24,392
54	**Division 6 - Wood, Composites**																	
55	Carpentry, trusses, insulation, drywall	SF	1000	$30.00	$30,000	$30.00	$30,000	$0.00	$0	$72,462	$72,462	$58,000	$72,462	$72,462				
56	Doors, hardware	LS	1	$8,000.00	$8,000	$6,000.00	$6,000	$0.00	$0	$16,692	$16,692	$16,692	$16,692	$16,692				
57	Louvers	LS	1	$2,000.00	$2,000	$2,000.00	$2,000	$0.00	$0	$4,831	$4,831	$4,831	$4,831	$4,831				
58	Roofing, siding	SF	1000	$8.00	$8,000	$6.00	$6,000	$0.00	$0	$16,692	$16,692	$14,000	$16,692	$16,692				
59	Painting	SF	1000	$2.00	$2,000	$6.00	$6,000	$0.00	$0	$10,092	$10,092	$10,100	$10,092	$10,092				
60	**Division 13 - Special Construction**																	
61	Fire alarm control panel	EA	1	$1,000.00	$1,000	$500.00	$500	$0.00	$0	$1,758	$1,758	$10,100	$1,758	$1,758	$1,758			$1,758
62	Alarm	EA	1	$250.00	$250	$100.00	$100	$0.00	$0	$407	$407	$10,100	$407	$407	$407			$407
63	Detector	EA	1	$150.00	$150	$100.00	$100	$0.00	$0	$297	$297	$10,100	$297	$297	$297			$297
64	**Division 15 - Mechanical**																	
65	Unit heaters, control building, 10 kW	EA	2	$1,000.00	$2,000	$1,000.00	$2,000	$0.00	$0	$4,831	$4,831	$4,831	$4,831	$4,831				$4,831
66	Wall exhaust fan, 1000 CFM	EA	1	$1,500.00	$1,500	$1,000.00	$1,000	$0.00	$0	$2,965	$2,965	$2,965	$2,965	$2,965				$2,965
67	Packaged terminal air conditioner (6000 BTU)	EA	1	$2,000.00	$2,000	$2,000.00	$2,000	$0.00	$0	$4,831	$4,831	$4,831	$4,831	$4,831				$4,831
68	**Division 16 - Electrical**																	
69	Grounding																	
70	Ground grid, 4/0 copper	LF	1500	$4.25	$6,375	$1.50	$2,250	$0.00	$0	$9,972	$9,972	$9,972	$1,000					$9,972

Received: 03/

O'BRIEN & GERE

LINE	ITEM (1)	UNIT (2)	QTY (3)	BARE MATERIALS UNIT COST (4)	BARE MATERIALS TOTAL (5)	BARE LABOR UNIT COST (7)	BARE LABOR TOTAL (8)	DIRECT COSTS UNIT (9)	DIRECT COSTS TOTAL (10)	Line Item Cost TOTAL (WITH O&P) (11)	Total Cost LTC, Masonry Options 1-High Switchgear (12)	2-High Switchgear (13)	Replace In-Kind (1-high) (14)	Option Comparative Costs Building Options Masonry Control Bldg (15)	E-Building (16)	Transformer Options Transformer LTC (17)	Voltage Regulators (18)	Total Cost Village Selected Options
	CONSTRUCTION COST ESTIMATE BREAKDOWN																	
	Village of Wellsville	Location: Wellsville, NY																
	Vossler Substation Upgrades																	
	858/49497	by: RA Cherry																
	January 21, 2013 Rev March 17, 2013																	
71	Ground rods, 5/8" x 8'	EA	20	$34.00	$680	$110.00	$2,200	$0.00	$0	$3,642	$3,642	$3,642	$0					$3,642
72	Ground connections, exothermic	EA	40	$10.00	$400	$60.00	$2,400	$0.00	$0	$3,597	$3,597	$3,597	$600					$3,597
73	Ground connections, bolted	EA	40	$15.00	$600	$20.00	$800	$0.00	$0	$1,712	$1,712	$1,712	$200					$1,712
74	5 kV Wire and Conduit																	
75	Conduit, PVC, 6", sch 40	LF	350	$16.00	$5,600	$14.00	$4,900	$0.00	$0	$12,605	$12,605	$12,605	$12,605					$12,605
76	Conductor, 5 kV, 750 kcmil	LF	1200	$16.00	$19,200	$4.00	$4,800	$0.00	$0	$27,434	$27,434	$27,434	$27,434					$27,434
77	Conductor, 600 V, #250	LF	400	$6.00	$2,400	$2.20	$880	$0.00	$0	$3,798	$3,798	$3,798	$3,798					$3,798
78	Conductor terminations, 750 kcmil, 5 kV	EA	24	$150.00	$3,600	$75.00	$1,800	$0.00	$0	$6,328	$6,328	$6,328	$6,328					$6,328
79	Conduit, PVC,5", sch 40	LF	600	$11.00	$6,600	$11.00	$6,600	$0.00	$0	$15,942	$15,942	$15,942	$15,942					$15,942
80	Conductor, 5 kV, 500 kcmil	LF	500	$10.00	$5,000	$4.00	$2,000	$0.00	$0	$8,131	$8,131	$8,131	$8,131					$8,131
81	Conductor, 600 V, #250	LF	1500	$6.00	$9,000	$2.20	$3,300	$0.00	$0	$14,241	$14,241	$14,241	$14,241					$14,241
82	Conductor terminations, 500 kcmil, 5 kV	EA	24	$150.00	$3,600	$75.00	$1,800	$0.00	$0	$6,328	$6,328	$6,328	$6,328					$6,328
83	Outdoor AC & DC Control Wire & Conduit																	
84	Conduit, rigid steel, 0.75"	LF	1300	$3.00	$3,900	$2.50	$3,250	$0.00	$0	$8,565	$8,565	$8,565	$8,565					$8,565
85	Conduit, rigid steel, 1.0"	LF	600	$3.80	$2,280	$4.00	$2,400	$0.00	$0	$5,665	$5,665	$5,665	$5,665					$5,665
86	Conductor, 600 V, #8	LF	15000	$0.40	$6,000	$0.55	$8,250	$0.00	$0	$17,452	$17,452	$17,452	$17,452					$17,452
87	Conductor, 600 V, #10	LF	3000	$0.25	$750	$0.50	$1,500	$0.00	$0	$2,798	$2,798	$2,798	$2,798					$2,798
88	Conductor, 600 V, #12	LF	4500	$0.16	$720	$0.40	$1,800	$0.00	$0	$3,160	$3,160	$3,160	$3,160					$3,160
89	Outdoor AC Distribution																	
90	Conduit, rigid steel, 0.75"	LF	300	$3.00	$900	$2.50	$750	$0.00	$0	$1,977	$1,977	$1,977	$1,977					$1,977
91	Conduit, rigid steel, 1.5"	LF	100	$6.00	$600	$5.00	$500	$0.00	$0	$1,318	$1,318	$1,318	$1,318					$1,318
92	Conductor, 600 V, #1/0	LF	400	$2.50	$1,000	$1.30	$520	$0.00	$0	$1,784	$1,784	$1,784	$1,784					$1,784
93	Conductor, 600 V, #12	LF	900	$6.00	$5,400	$0.40	$360	$0.00	$0	$6,414	$6,414	$6,414	$6,414					$6,414
94	Indoor AC & DC Power Wire & Conduit																	
95	Conduit, rigid steel, 0.75"	LF	500	$3.00	$1,500	$5.25	$2,625	$0.00	$0	$5,103	$5,103	$5,103	$5,103	$5,103	$5,103			$5,103
96	Conductor, 600 V, #12	LF	1500	$0.16	$240	$0.40	$600	$0.00	$0	$1,053	$1,053	$1,053	$1,053	$1,053	$1,053			$1,053
97	Control Building Equipment																	
98	Transfer switch, 240 V, 225 A, manual	EA	1	$4,000.00	$4,000	$400.00	$400	$0.00	$0	$4,926	$4,926	$4,926	$4,926	$4,926	$4,926			$4,926
99	Panelboard, 225A, 240 VAC, 42 ckt	EA	1	$2,000.00	$2,000	$2,000.00	$2,000	$0.00	$0	$4,831	$4,831	$4,831	$4,831	$4,831				$4,831
100	Panelboard, 225A, 125 VDC, 42 ckt	EA	1	$2,000.00	$2,000	$2,000.00	$2,000	$0.00	$0	$4,831	$4,831	$4,831	$4,831	$4,831	$4,831			$4,831
101	Light fixture, 2-lamp, fluorescent, 4 ft	EA	12	$200.00	$2,400	$200.00	$2,400	$0.00	$0	$5,797	$5,797	$5,797	$5,797	$5,797				$5,797
102	Light fixture, Holophane substation	EA	2	$600.00	$1,200	$300.00	$600	$100.00	$200	$2,329	$2,329	$2,329	$2,329					$2,329
103	Light fixture, 70 W HPS, wall mount	EA	2	$200.00	$400	$100.00	$200	$0.00	$0	$703	$703	$703	$703	$703	$703			$703
104	Battery, 125 VDC, C&D 3-DCU-9, 100 AH	EA	1	$10,000.00	$10,000	$1,500.00	$1,500	$0.00	$0	$12,973	$12,973	$12,973	$12,973	$12,973	$12,973			$12,973
105	Battery charger	EA	1	$3,000.00	$3,000	$200.00	$200	$0.00	$0	$3,563	$3,563	$3,563	$3,563	$3,563	$3,563			$3,563
106	Battery accessories (eye wash, containment)	EA	1	$1,500.00	$1,500	$500.00	$500	$0.00	$0	$2,308	$2,308	$2,308	$2,308	$2,308	$2,308			$2,308
107	Transformer Options, 8.4 MVA, 34.5:4.16 kV																	
108	Mineral oil, with load tap changer	EA	2	$400,000.00	$800,000	$20,000.00	$40,000	$2,000.00	$4,000	$937,016	$937,016	$937,016	$937,016			$937,016		
109	FR3, with load tap changer	EA	2	$425,000.00	$850,000	$20,000.00	$40,000	$2,000.00	$4,000	$992,016								
110	Mineral oil, without load tap changer	EA	2	$260,000.00	$520,000	$15,000.00	$30,000	$2,000.00	$4,000	$615,862							$615,862	$307,931
111	FR3, without load tap changer	EA	2	$285,000.00	$570,000	$15,000.00	$30,000	$2,000.00	$4,000	$670,862								
112	Metal-Clad Switchgear Options, 5 kV, 40 kA																	
113	1-high stacked circuit breakers	EA	1	$580,000.00	$580,000	$50,000.00	$50,000	$0.00	$0	$703,770	$703,770		$703,770					$703,770
114	2-high stacked circuit breakers	EA	1	$525,000.00	$525,000	$50,000.00	$50,000	$0.00	$0	$643,270		$643,270						
115	Factory furnished building for 1-high	EA	1	$175,000.00	$175,000		$0	$0.00	$0	$192,500					$192,500			$192,500
116	Factory furnished building for 2-high	EA	1	$95,000.00	$95,000		$0	$0.00	$0	$104,500								
117	Vacuum breaker, 34.5 kV, 600 A	EA	2	$40,000.00	$80,000	$7,000.00	$14,000	$0.00	$0	$106,416	$106,416	$106,416	$106,416					$53,208
118	Voltage regulator, 5 kV, 333 kVA, 1332 A	EA	6	$32,000.00	$192,000	$3,000.00	$18,000	$0.00	$0	$234,877							$234,877	$117,439
119	Substation Structures																	
120	34. 5 kV dead-end structure	LS	1	$20,000.00	$20,000	$8,000.00	$8,000	$3,000.00	$3,000	$35,823	$35,823	$35,823	$8,000					$35,823
121	Voltage regulator structure	EA	2	$20,000.00	$40,000	$10,000.00	$20,000	$2,000.00	$4,000	$74,708							$74,708	$37,354
122	34.5 kV line relocation	LS	1	$8,000.00	$8,000	$6,000.00	$8,000	$3,000.00	$3,000	$22,623	$22,623	$22,623	$22,623					$22,623
123	TOTAL CONSTRUCTION OR OPTION COMPARATIVE COST										$2,489,560	$2,417,623	$2,368,224	$283,875	$241,145	$977,401	$985,954	$1,899,083
124	Survey	LS	1								$3,000	$3,000	$3,000	Difference		Difference		$3,000
125	Geo Technical Investigation	LS	1								$5,000	$5,000	$5,000	$42,730		($8,553)		$5,000
126	Engineering (10%))	LS	1								$250,000	$250,000	$250,000					$130,000
	Contingency (10%)																	$220,000
127	TOTAL PROJECT COST										$2,747,560	$2,675,623	$2,626,224					$2,257,083

Received: 03/04/2014

Equipment Cost Estimate
1-High Metal-Clad Switchgear
Village of Wellsville
Vossler Rd. Substation Upgrades

Item Description	Quantity	Unit Price	Total Price
Breaker Units -1000 MVA (37 kA at 15 kV)			
Base Unit with breaker, 1200A	6	$ 35,121	$ 210,725
Base Unit with breaker, 2000A	3	$ 44,968	$ 134,903
Base Unit with breaker, 3000A	0	$ 56,173	$ -
Base Unit without breaker, 1200A	0	$ 9,541	$ -
Base Unit without breaker, 2000A	0	$ 11,688	$ -
Base Unit without breaker, 3000A	0	$ 15,122	$ -
Breaker, 1200A	0	$ 25,929	$ -
Breaker, 2000A	0	$ 33,284	$ -
Breaker, 3000A	0	$ 41,401	$ -
Empty Unit	10	$ 5,000	$ 50,000
Ground & Test Device, Manual,1200A	0	$ 8,214	$ -
Bus Adders			
Bus Transition Section, 2000A	1	$ 2,823	$ 2,823
Main Bus, 2000A Copper, per vert sect	10	$ 1,106	$ 11,064
Control Power			
Control Power Transf section, 1Ph, 15kVA	0	$ 5,373	$ -
Control Power Transformer section, 1Ph, 25kV	0	$ 6,209	$ -
Control Power Transformer section, 1Ph, 37kV	0	$ 7,063	$ -
Control Power Transformer section, 1Ph, 50kV	0	$ 7,895	$ -
Control Power Transformer section, 3Ph, 15kV	0	$ 9,024	$ -
Control Power Transformer section, 3Ph, 30kV	0	$ 9,873	$ -
Control Power Transformer section, 3Ph, 45kV	0	$ 11,254	$ -
Control Power Transformer section, 3Ph, 75kV	0	$ 13,507	$ -
Miscellaneous			
Test Cabinet, Wall Mtd	1	$ 305	$ 305
Wire Marker Sleeves, per unit	14	$ 341	$ 4,771
Space Heaters for Indoor Equip, per unit	20	$ 177	$ 3,540
Protection/Control			
Current Transformers, EA	78	$ 434	$ 33,829
Current Transformers, Zero Sequence, EA	0	$ 535	$ -
VT Compartment with 3-LG VT	4	$ 6,784	$ 27,137
Surge Arresters, set of 3, 15 kV, Dist Class	0	$ 1,120	$ -
Surge Arresters, set of 3, 15 kV, Int Class	0	$ 1,996	$ -
Surge Arresters, set of 3, 15 kV, Sta Class	8	$ 3,532	$ 28,252
Cable Termination Boots, set of 3	8	$ 252	$ 2,018

Received: 03/04/2014

Equipment Cost Estimate
1-High Metal-Clad Switchgear
Village of Wellsville
Vossler Rd. Substation Upgrades

Item Description	Quantity	Unit Price	Total Price
Test Block, EA	36	$ 212	$ 7,647
Breaker Control Switch with 2 lights	11	$ 407	$ 4,479
Indicating Lamp	13	$ 44	$ 575
Ammeter or Voltmeter Switch	0	$ 239	$ -
Mimic Bus, plastic	0	$ 412	$ -
Ammeter or Voltmeter	0	$ 496	$ -
Overcurrent Relay, Mechanical, EA	0	$ 810	$ -
Lockout Relay	4	$ 602	$ 2,407
Capacitor trip, EA	0	$ 1,137	$ -
Overcurrent Relay, SEL 501	5	$ 2,000	$ 10,000
Bus Differential Relay, SEL 587Z	2	$ 8,000	$ 16,000
Transformer Differential Relay, SEL 587	2	$ 4,000	$ 8,000
Distribution Feeder Relay, SEL 751A	6	$ 2,000	$ 12,000
Multi-function Meter	2	$ 3,500	$ 7,000

Total Estimated Cost $ 577,477

Received: 03/04/2014

Equipment Cost Estimate
2-High Metal-Clad Switchgear
Village of Wellsville
Vossler Rd. Substation Upgrades

Item Description	Quantity	Unit Price	Price
Breaker Units -1000 MVA (37 kA at 15 kV)			
Base Unit with breaker, 1200A	6	$ 35,121	$ 210,725
Base Unit with breaker, 2000A	3	$ 44,968	$ 134,903
Base Unit with breaker, 3000A	0	$ 56,173	$ -
Base Unit without breaker, 1200A	0	$ 9,541	$ -
Base Unit without breaker, 2000A	0	$ 11,688	$ -
Base Unit without breaker, 3000A	0	$ 15,122	$ -
Breaker, 1200A	0	$ 25,929	$ -
Breaker, 2000A	0	$ 33,284	$ -
Breaker, 3000A	0	$ 41,401	$ -
Empty Unit	0	$ 5,000	$ -
Ground & Test Device, Manual,1200A	0	$ 8,214	$ -
Bus Adders			
Bus Transition Section, 2000A	1	$ 2,823	$ 2,823
Main Bus, 2000A Copper, per vert sect	6	$ 1,106	$ 6,638
Control Power			
Control Power Transf section, 1Ph, 15kVA	0	$ 5,373	$ -
Control Power Transformer section, 1Ph, 25kV	0	$ 6,209	$ -
Control Power Transformer section, 1Ph, 37kV	0	$ 7,063	$ -
Control Power Transformer section, 1Ph, 50kV	0	$ 7,895	$ -
Control Power Transformer section, 3Ph, 15kV	0	$ 9,024	$ -
Control Power Transformer section, 3Ph, 30kV	0	$ 9,873	$ -
Control Power Transformer section, 3Ph, 45kV	0	$ 11,254	$ -
Control Power Transformer section, 3Ph, 75kV	0	$ 13,507	$ -
Miscellaneous			
Test Cabinet, Wall Mtd	1	$ 305	$ 305
Wire Marker Sleeves, per unit	12	$ 341	$ 4,089
Space Heaters for Indoor Equip, per unit	12	$ 177	$ 2,124
Protection/Control			
Current Transformers, EA	78	$ 434	$ 33,829
Current Transformers, Zero Sequence, EA	0	$ 535	$ -
VT Compartment with 3-LG VT	4	$ 6,784	$ 27,137
Surge Arresters, set of 3, 15 kV, Dist Class	0	$ 1,120	$ -
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Received: 03/04/2014

Equipment Cost Estimate
2-High Metal-Clad Switchgear
Village of Wellsville
Vossler Rd. Substation Upgrades

Item Description	Quantity	Unit Price	Price
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Transformer Differential Relay, SEL 587	2	$ 4,000	$ 8,000
Distribution Feeder Relay, SEL 751A	6	$ 2,000	$ 12,000
Multi-function Meter	2	$ 3,500	$ 7,000

Total Estimated Cost $ 520,953

Received: 03/04/2014

MEMORANDUM

TO: File
CC:
FROM: R Cherry
RE: Switchgear Current Ratings
FILE: 858/49497
DATE: Jan 21, 2013

Present and Potential Fault Currents

System Configuration	Bus A	Bus B	Total
Existing, per arc flash study	5,612 A	6,386 A	11,998 A
Existing, infinite 34 kV bus	9,774 A	12,347 A	22,121 A
5000 kVA, Non LTC, infinite 34 kV bus 7.0% Z	9,913 A	9,913 A	19,827 A
5000 kVA LTC, infinite 34 kV bus, 7.5% Z	9,252 A	9,252 A	18,505A
7500 kVA, Non LTC, infinite 34 kV bus 7.0% Z	14,1870 A	14,870 A	29,740 A
7500 kVA LTC, infinite 34 kV bus, 7.5% Z	13,879 A	13,879 A	27,757A

Currently Available metal-clad switchgear short circuit current ratings, 5 and 15 kV class, k=1

Nominal MVA, 5 kV	GE	Eaton
250 MVA	31.5 kA	
350 MVA	40.0 kA	40 kA
	50 .0 kA	50 kA
450 MVA	63.0 kA	63 kA

Based on anticipated transformer size no larger than 7500 kVA and transformers with ANSI standard impedances, a switchgear short circuit current rating of 31.5 kA should be adequate. This short circuit rating would allow temporary or permanent paralleling of the two transformers, without exceeding the switchgear short circuit current rating. However, the minimum short circuit current rating offered by Eaton is 40 kA. Basis of design should be 40 kA.

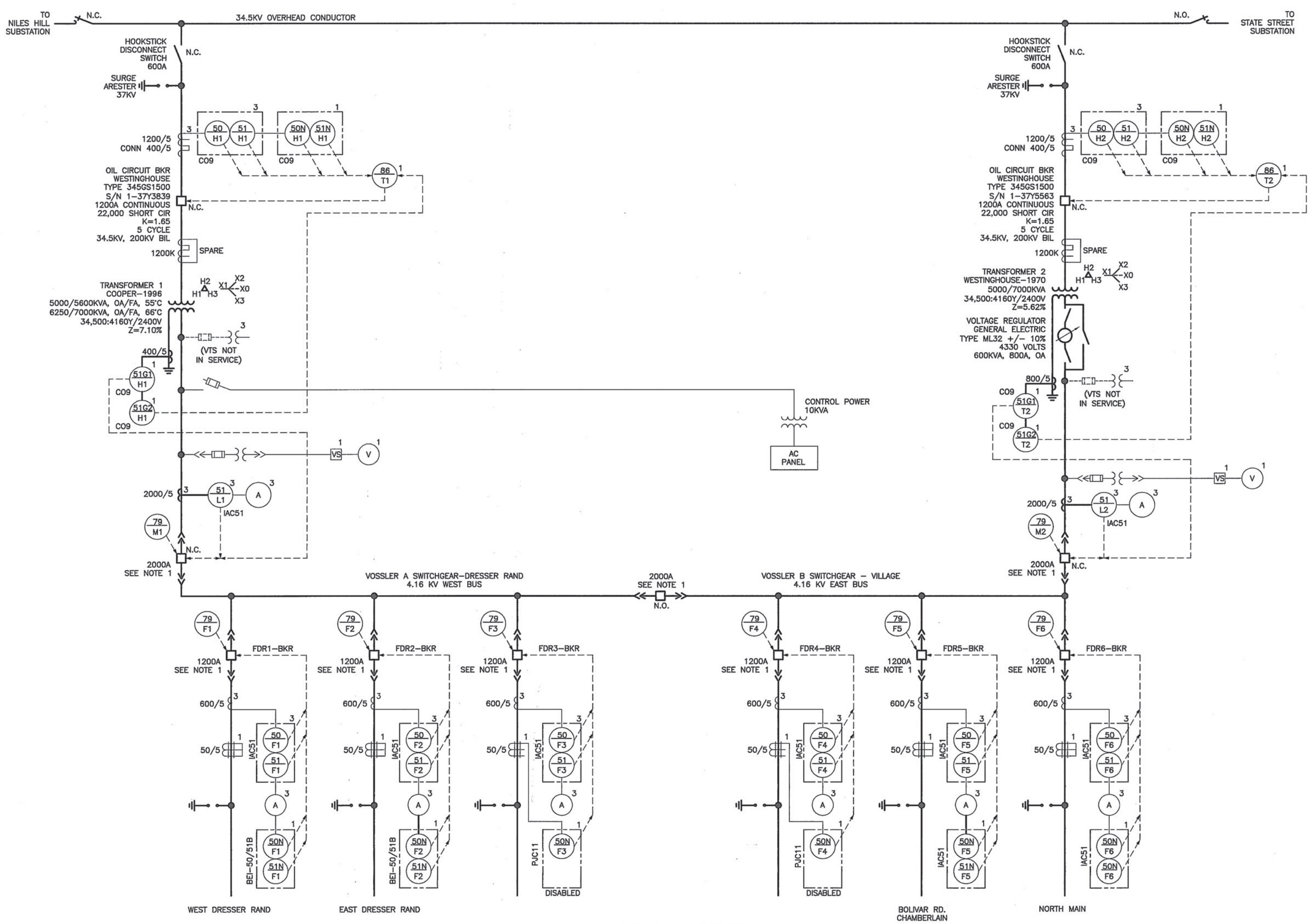
Continuous Current Requirements

Transformer kVA	
5000	694 A
5600	777 A
6250	867 A
7000	971 A
7500	1041 A
8400	1166 A

Currently Available metal-clad switchgear continuous current ratings

1200 A
2000 A
3000 A

Niagara Transformer recommended either a 7500/8400 kVA, or a 6300/8400 kVA transformer. It is unlikely that total bus current would ever exceed the transformer rating 8400 kVA/1166 A. However, good design practice requires that the switchgear continuous rating be at least 20% higher than transformer rated current. Transformers may be operated above their continuous current rating. Switchgear should never be operated its continuous current rating. Basis of design should be 2000A main and tie breakers, 2000 A main bus, and 1200 A feeders.



ONE LINE DIAGRAM

NOT TO SCALE

LEGEND

- A AMMETER
- V VOLTMETER
- VS VOLTMETER SWITCH
- G GROUND
- N NEUTRAL
- H HIGH SIDE
- L LOW SIDE
- M MAIN
- F FEEDER
- T TRANSFORMER
- 50 INSTANTANEOUS OVERCURRENT
- 51 TIME OVERCURRENT
- 79 RECLOSING RELAY
- 86 HAND RESET LOCKOUT RELAY

NOTES:

1. BREAKERS ARE GENERAL ELECTRIC TYPE AMH-4.76-250, RATED 250MVA

RECORD DRAWINGS

To the best of our knowledge, information and belief, these record drawings substantially represent the project as constructed.
O'BRIEN & GERE ENGINEERS, INC.
By: [signature]

IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS ACTING UNDER THE DIRECTION OF A LICENSED ENGINEER, TO ALTER THIS DOCUMENT.

THIS DRAWING WAS PREPARED AT THE SCALE INDICATED IN THE TITLE BLOCK. INACCURACIES IN THE STATED SCALE MAY BE INTRODUCED WHEN DRAWINGS ARE REPRODUCED BY ANY MEANS. USE THE GRAPHIC SCALE BAR IN THE TITLE BLOCK TO DETERMINE THE ACTUAL SCALE OF THIS DRAWING.

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DRAWN BY GDF		

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O'BRIEN & GERE

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VILLAGE OF WELLSVILLE

ELECTRICAL

VOSSLER RD 4.16 KV SUBSTATION ONE LINE DIAGRAM

FILE NO. 858.44459.02F

DATE JULY 2009

E-1

FILENAME: \\SYROES03\ALT\SYRACUSE\WELLSVILLE-V.858\44459.RECORD-1-LINE-D\DOCS\DWG\SHEETS\RECORD DRAWINGS\44459.02F.DWG

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