MISO Generator Interconnection Request
H037
Ironville

Facilities Study Report

May 2011

H037 Ironville
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Description of the Project

FDS (The Developer) has proposed to interconnect a 135 MW co-generation plant to the Ironville 138 kV substation. The 135 MW co-generation facility will be located at the proposed FDS Coke Plant near Ironville substation. Ironville substation would be modified to create a 3 breaker 138kV ring bus. A 138kV transmission line from Ironville to the co-gen site would be designed and constructed by The Developer. The plant will interconnect with the Toledo Edison Company, a FirstEnergy Company (TE), at Ironville Substation. The proposed commercial operation date for the facility is 6/1/2013.

Interconnection Customer's Submitted Milestone Schedule

6/1/2013 - Project Commercial Operation

Direct Connection Facilities

The developer will construct facilities including the 135 MW co-generation, generation step up (GSU) transformer, the high side breakers and the 138 kV transmission line to Ironville Substation. The interconnection point will be located at the point where the customer installed disconnect attaches to the new 138 vK single-circuit steel pole line, as shown in the attached one-line diagram, "Figure 1". Fully rated fault interrupting circuit breakers owned by the developer are required on the high side of the GSU, between the line and the generating station, to protect the developer's facilities.

Project Scope

It is proposed that the H037 project be connected via the Ironville substation. The Ironville substation will be modified to create a 3 breaker 138 kV ring bus. The developer is responsible for constructing all of the facilities on its side of the point of interconnection, which will be located at the point where the customer-owned facilities connects to Ironville Substation, as shown in the attached one-line diagram, "Figure 1".

Description of Facilities Work

Required reinforcements to be constructed by FirstEnergy:

- Ironville Sub - Convert 138kV yard into a 3-position ring bus including new 138kV line terminal. Estimated cost is approximately $1,948,300.
- Replace line relaying on the 138kV Bayshore - Ironville Line. Estimated cost is approximately $244,500.
- Raise the existing 69kV and 138kV lines at Ironville Substation for the new 138kV single-circuit steel pole line, approx. 0.7 miles in length, from the customer's proposed coke facility to Ironville Substation. Estimated cost is approximately $172,500.

Specific detailed protection requirements are provided as Attachment "A".

Total Estimated Costs of Transmission Owner Facilities:

1. Ironville sub conversion	$1,948,300
2. Bayshore – Ironville line relay replacement	$ 244,500
3. Raise existing lines	$ 172,500
4. Engineering Oversight	$ 61,300
Total	$2,426,600

Summary of Proposed Schedule for Completion of Work:

A proposed 16-month construction schedule is estimated to complete construction and the associated activities listed below from the date of a fully executed Generator Interconnection Agreement and project kickoff meeting. A more detailed construction schedule with milestones will be developed for the Generator Interconnection Agreement.

Activity	Start Month	End Month
• Preliminary Engineering	1	2
• Permits & Real Estate	3	10
• Detailed Engineering	3	10
• Equipment Procurement – Delivery	3	10
• Below Grade Construction	7	10
• Above Grade Construction	10	14
• Testing & Commissioning	15	16

Generation Connection Requirements

The proposed interconnection facilities must be designed in accordance with the FirstEnergy "Requirements for Transmission Connected Facilities" located at:

www.firstenergycorp.com/feconnect/

The following is an excerpt taken from the FirstEnergy "Requirements for Transmission Connected Facilities" document.

Design Requirements

The generation owner is responsible for specifying appropriate equipment and facilities such that the parallel generation is compatible with the FirstEnergy Transmission System. The generation owner is also responsible for meeting any applicable federal, state, and local codes.

Design Criteria

Facilities owned and operated by FirstEnergy (FE) Toledo Edison, its operating company, shall comply with the applicable FE technical requirements and standards posted on the MISO website per the MISO Tariff, the MISO transmission and substation design technical requirements, the MISO relay philosophy design standards and the following criteria. Where there are different requirements for the same criterion, the more restrictive shall apply.

General Design Requirements

• System phasing (counter clockwise)	1-2-3
• System frequency:	60 hertz
• Elevation, AMSL:	2254 feet
• Isokeraunic level:	40
• Maximum ambient temperature:	40 degrees C
• Minimum ambient temperature:	-40 degrees C
• Maximum conductor operating temperature:	Per MISO Documentation
• Wind Loading (round shapes):	Per ASCE 7-98, per Fig. 6-1 depending on location
• Ice loading – Substations (no wind):	25 mm
• Seismic zone:	Per ASCE 7-98, per Fig. 9.4.1.1(a) and (b). Equipment qualification per IEEE 693-97

Voltage and Current Ratings

- Nominal phase-to-phase: 138 kV
- Maximum phase-to-phase: 145 kV
- Basic impulse level (BIL): 650 kV
- Maximum continuous current carrying capacity: 2000 A
- Design fault current: 40 kA
- Single Contingency (breaker failure) clearing time: 35 cycles

Clearances and Spacing

- Recommended rigid bus center-to-center phase spacing: 96”
- Minimum phase-to-phase, metal-to-metal distance: 63”
- Recommended phase-to-ground: 52.5”
- Minimum phase-to-ground: 50”
- Minimum vertical clearance from live parts to grade: 12’-2”
- Minimum horizontal clearance from live parts: 6’-8”
- Minimum conductor clearance above roads in switchyard: 25’
- Minimum bottom of insulator to top of foundation: 8’-6”

Transmission Lines – New/Upgraded

1. Raise Existing 69kV and 138kV Lines

Raise the existing 69kV and 138kV lines at Ironville Substation for the new 138kV single-circuit steel pole line, approx. 0.7 miles in length, from the customer's proposed coke facility to Ironville Substation.

The estimated cost for this work is $172,500 and could be completed as noted in the “Summary of Proposed Schedule for Completion of Work” on page 3 of this Facility Study Report.

Substations – New/Upgraded

1. Ironville Substation

Add two 138kV breakers and convert 138kV yard to a 3 position ring bus. Replace existing line relaying for the 138kV Ironville - Bayshore line. Add provisions for new 138kV line terminal connection to the proposed FDS Coke Plant.

The estimated cost for this work is $1,948,300 and could be completed as noted in the “Summary of Proposed Schedule for Completion of Work” on page 3 of this Facility Study Report.

2. Bayshore

Replace line relaying on the 138kV Bayshore - Ironville Line.

The estimated cost for this work is $244,500 and could be completed as noted in the "Summary of Proposed Schedule for Completion of Work" on page 3 of this Facility Study Report.

Metering and Communications

The Developer shall install, own, operate, test and maintain the necessary revenue metering equipment. Please refer to Attachment "B", "FirstEnergy Revenue Metering Requirements for Generation Owners", for details. The Developer shall also provide Toledo Edison with dial-up communication to the revenue meter.

The Developer will be responsible for designing, furnishing and installing a SCADA RTU in their generation substation and obtaining the telecommunication circuits from the RTU to the Toledo Edison Data Center.

These requirements are in addition to any metering required by MISO.

Environmental, Real Estate and Permitting

The following are possible environmental, real estate and permitting issues:

- The transmission line tap may require stormwater control plans with the Ohio EPA and/or county conservation district and associated application permit filings. Included in these procedures is the applicable threatened and endangered species evaluation.
- If the developer owns the project property, in fee title, Toledo Edison will require a permanent easement for the transmission line tap to the generation substation.
- If the developer leases the project property, then the developer will be required to obtain a permanent easement for the transmission line tap to the substation for Toledo Edison.
- All property rights must be surveyed and metes and bounds descriptions prepared for incorporation into Toledo Edison's document forms, for transfer of title.
- Environmental and Real Estate notification durations vary, some up to 6 months or longer.

Summary of Results

The facilities work is described in the above project details and on the attachments.

An estimated cost summary in 2011 dollars and excluding taxes or effects from Contribution In Aid of Construction is:

Ironville sub conversion	
Engineering	$ 332,700
Material & Equipment	$ 539,300
Construction & Testing	$ 717,500
Tax Gross Up	$ 358,800
Total	$1,948,300

Bayshore – Ironville line relay replacement	
Engineering	$ 70,200
Material & Equipment	$ 45,500
Construction & Testing	$ 83,800
Tax Gross Up	$ 45,000
Total	$ 244,500

Raise existing lines	
Engineering	$ 25,400
Material & Equipment	$ 23,600
Construction & Testing	$ 91,700
Tax Gross Up	$ 31,800
Total	$ 172,500

Engineering Oversight of the Interconnection Customer relay installation	
Engineering	$ 20,000
Material & Equipment	$ 0
Construction & Testing	$ 30,000
Tax Gross Up	$ 11,300
Total	$ 61,300

Assumptions/Qualifiers

The accomplishment of the work on the FE system to support the estimated costs and proposed schedule is dependent on the following:

- Obtaining the necessary transmission line outages. Transmission line outages are typically not granted from June to September and are discouraged during extreme winter conditions.
- No equipment delivery, environmental or regulatory delays.
- No permitting or real estate delays.
- No extreme weather.
- No force majeure.

Information Required for the Facilities Study

The following table summarizes the total estimated costs according to FERC criteria. The estimated costs are in 2011 dollars and do not include taxes or effects from Contribution In Aid of Construction.

Network Facilities	
Direct Charges Labor	$ 1,223,000
Direct Charges Material	$ 538,700
Indirect Charges Labor	$ 148,300
Indirect Charges Material	$ 69,700
Tax Gross Up	$ 446,900
Total	$ 2,426,600

ATTACHMENTS

H037 Detailed Protection Requirements

System Protection for H037

1. Short Circuit Data

Impedances are given on a 100 MVA, 138 kV base. The faults provided are bolted, symmetrical values for the present, normal FE system conditions for the preferred supply. Future increases in fault currents are possible and it is the customer's responsibility to upgrade their equipment and/or protective equipment coordination when necessary.

Existing Ironville 138 kV bus:
Z1 = 0.295 + j2.102%
Z0 = 0.241 + j1.005%
Three Phase = 19,707 A
Single-Line-to-Ground = 23,792 A

Projected Ironville 138 kV bus, considering new line, GSU, and 135 MW generator:
Z1 = 0.261 + j1.968%
Z0 = 0.218 + j0.954%
Three Phase = 21,078 A
Single-Line-to-Ground = 25,452 A

2. General Connection Requirements

All proposed generation interconnection points and load-serving delivery points must comply with the technical requirements detailed in FE's "Requirements for Transmission Connected Facilities" document.

3. Drawings

See three drawings attached for Ironville, Bayshore, and new H037 substation protective relay diagrams.

4. General Protection Summary

A three-exit ring bus will be constructed at Ironville on the 138 kV system, involving the addition of two new breakers. A new substation will be built near the new H037 generator, consisting of one breaker each for the generator GSU and the cranking/station power transformer. A new 138kV line will be constructed from Ironville to the new H037 substation with a new motor-operated air break switch installed near the Ironville substation. The Bayshore - Ironville 138 kV line protection will be upgraded at both termini. Line protection for both lines will consist of a primary line differential scheme (87L), a second primary directional comparison blocking scheme (DCB), and a backup combination step-distance (21)/directional ground overcurrent (67N) scheme. The Ironville 138/69 kV transformer protection is presently adequate and will be expanded to include a new shared breaker in its zone of protection. H037 Transformer protection specifications are included, with actual implementation by the customer and final review and approval by FirstEnergy engineers. Optical fiber will connect Bayshore to Ironville to the H037 substation to be used for protective line relaying and other communication.

FirstEnergy will complete detailed relay coordination studies to identify off-site relay setting changes required due to this generation interconnection. This may result in additional individual relay replacements being required. These relay replacements will be done at the cost of the developer.

5. Substation Protection Requirements

Each "Line Protection Bundle" referenced below will consist of the following new equipment:

(1) SEL-311L Line Differential unit (87L, backup 21/67N) with fiber optic option
(1) SEL-321 Line Protection (Mirrored Bits DCB, backup 21/67N)
(1) SEL-2815 EIA-232 to Fiber Optic Converter for the SEL-321

This equipment provides all protective functions required for the protection of a transmission line in the FirstEnergy system. The line breakers will be included in the line's zone of protection, meaning that bus-side CTs on line breakers will be used to provide current inputs for these relays. Note that CTs, secondary PT windings, and the trip coil connected to the primary SEL-311L shall be unique from those used with the backup SEL-321 for full redundancy except where noted.

Each "Breaker Failure Protection Bundle" referenced below will consist of the following new equipment:

(1) SEL-501 Overcurrent unit for breaker failure protection (FT)
(1) Lock-out relay (86)

The SEL-501 shall be connected to the same CTs on the protected breaker as the SEL-321 listed in the Line Protection Bundle.

5.1 Bayshore

Bayshore-Ironville 138 kV line relaying at Bayshore will be replaced. The existing breaker B13253, CTs on the bus side of B13253, and existing B-phase line CCVT are to be used with the new relays. The single-phase line CCVT will be used only for synchronization check functionality. The three-phase potential source for the relays will be the existing bus PTs.

New relaying equipment will consist of the following:

(1) Line Protection Bundle
(1) Breaker Failure Protection Bundle

5.2 Ironville

A 138kV three-exit ring bus will be constructed. The existing breaker B13208 will be used, as currently placed, between the existing transformer and line at Ironville. The two new breakers will be 3000A, 40 kA, 145 kV power circuit breakers with SCADA monitoring/indication and control. The breaker added between the existing transformer and the new line to H037 is labeled here "A". The breaker added between the existing line and the new line to H037 is labeled here "B". Each new breaker bushing will be fitted with two CTs. The ratio for both of A's CTs on the new-line side must be 1200/5. The ratio for one CT on the new-line side of B must be 1200/5. These specified ratios are to match existing ratios of CTs on B13208. One new set of three CTs on the transformer side bushing of B13208 will be added. All new CTs shall be of class C800, having a thermal factor of 2.0 or higher. A motor-operated air break switch (MOAB) with SCADA indication and control will be installed on the line to H037 near Ironville.

Two new sets of CCVTs, one for each line exit, will be required for relaying and telemetering purposes. Each set should be rated for continuous phase-phase voltage of 145 kV and have two 115/67 volt secondary windings that have at least a 0.3Z 1200 VA burden accuracy. Secondary windings shall be wye-connected to provide 67 V (L-N) for input to relays.

The existing 138/69 kV transformer protection at Ironville is adequate. Two connections to the new CTs on breaker A will be made to include these in this transformer protection scheme. Bayshore-Ironville 138 kV line relaying at Ironville will be replaced.

New relaying equipment will consist of the following:

(2) Line Protection Bundles
(2) Breaker Failure Protection Bundles
(2) Sets of dual-secondary CCVTs (6 single phase units total)
CTs as specified on the two new breakers

5.3 H037 Substation

It is a little unclear what bus configuration will be used at this new station, if there will be any bus at all. Since this will be a radial feed from Ironville, a line terminal at the H037 substation with no bus is recommended. This saves the expense of a bus protection scheme and another breaker. Breaker "C" and "D" represent the transformer breakers. One transformer provides cranking/station power; the other is a GSU. Each breaker will have a minimum of two CTs (minimum class C800, minimum thermal factor 2.0) on each transformer-side bushing for line protection. One new set of CCVTs for the line will be required at H037 substation for relaying and telemetering purposes. Each CCVT should be rated for continuous phase-phase voltage of 145 kV and have two 115/67 volt secondary windings that have at least a 0.3Z 1200 VA burden accuracy. Secondary windings shall be wye-connected to provide 67 V (L-N) for input to relays.

New relaying equipment specified by FirstEnergy at this facility will consist of the following:

(1) Line Protection Bundle
(2) Breaker Failure Protection Bundles
(1) Set of dual-secondary CCVTs (3 single phase units)
CTs as specified on the two new breakers

The relaying system shall have a reliable source of power independent from the AC system or immune to ac system disturbance or loss (for example - dc battery and charger) to assure proper operation of the protection scheme.

Also shown in circles on the H037 relay diagram are required protective functions for the transformers. These required protective functions include a transformer differential scheme (87T), some type of second overlapping overall differential scheme that includes transformer leads (marked as 87OA), transformer high-side lead backup directional overcurrent and impedance protection (TH 67N, 21), transformer low-side lead backup differential (TL 87), and backup time overcurrent ground protection on the grounded-wye transformer winding ground connection (51G).

5.4 Relay Selection, Settings, and Commissioning

FE will furnish 138 kV line protective device settings for all new line relays and breaker failure relays. FE review and approval is required for customer H037 transformer protective relay

selections, settings, and schematics. Upon completion of the installation, FE personnel will verify settings of all transformer, 138 kV line, and breaker failure protective devices and witness functional testing. FE personnel will verify the voltage transformer connections associated with the Ironville line relays and functionally test the line relaying.

6. Operational Metering/Indication

A new customer-owned and maintained SCADA Remote Terminal Unit (RTU) is required at the H037 substation to provide communication to the regional FE System Control Center (SCC) in Wadsworth, OH. The RTU is to provide FE with position indication of both transformer breakers and instantaneous bi-directional MW, MVAR, AMP and voltage for the new line connected to the station. Metered quantities may be measured using customer provided relay accuracy class instrument transformers and meters with a RS 485 output using DNP 3.0 Protocol (examples: Satec, Bitronics, etc.). Customer will be responsible for RTU external communication to the SCC.

FirstEnergy Revenue Metering Requirements for Generation Facilities Connected 69 kV and Higher

This document addresses the revenue metering requirements for new generation-only facilities connected to FirstEnergy (FE) system voltages 69 kV and higher. This document is not intended for existing retail or wholesale load facilities where behind-the-meter generation is being installed.

The Interconnection Customer (IC) shall install, own, operate, test, and maintain the necessary revenue metering equipment. This includes current transformers, voltage transformers, mounting structures, wiring, meters, communication circuits, and associated devices. The metering equipment must meet the specifications listed in the FE and PJM connection documents.

The revenue metering equipment shall be located at the generation facility on the high voltage side of the generator step-up transformers or facility main step-up transformer and/or station service power transformers. Power flows to and from the facility shall be compensated to the Point of Interconnection.

FE will provide revenue metering equipment for a station service power supply at a generation facility if the supply is from the local FE distribution system.

The revenue metering equipment shall be capable of collecting and storing bidirectional billing data. The billing data shall be stored in intervals specified by FE, typically fifteen minutes or thirty minutes. The IC must provide FE with remote access to the billing data in the revenue meter via a dedicated voice-grade analog telephone circuit. The IC shall provide FE with contact information for the person or persons responsible for meter programming and metering equipment maintenance.

The IC shall consult with FE regarding the revenue metering system design and provide the following information:

- Facility one line and revenue metering installation drawings (schematics, wiring diagrams, etc.)
- Estimated power flows to and from the facility at all revenue metering points
- Current transformer and voltage transformer specifications, including manufacturer, type, nameplate drawings, and certified accuracy test reports
- Revenue meter specifications including manufacturer, type, model number, and accuracy
- Revenue meter program information including but not limited to billing data recorder channel assignments, recorder pulse weights (Ke), and read-only password for access to interval data by the FE billing data collection system (MV-90)
- Revenue meter telephone number
- Revenue meter loss compensation data (if applicable)

The IC shall provide FE with prior notification of any modifications at the facility that will affect the revenue meter measurements, including substation reconfigurations and meter program changes.

The revenue metering system at each location shall be tested for accuracy by the IC once every two years. The IC shall give reasonable notice to FE of the time when the testing is scheduled so that FE may have representatives present. FE and PJM shall have the right to audit the revenue metering equipment and/or related documents. The IC shall be given a reasonable period of time to comply with any requests associated with an audit.

FIGURE 1

FDS Co-Gen Project – H037
Single Line Diagram

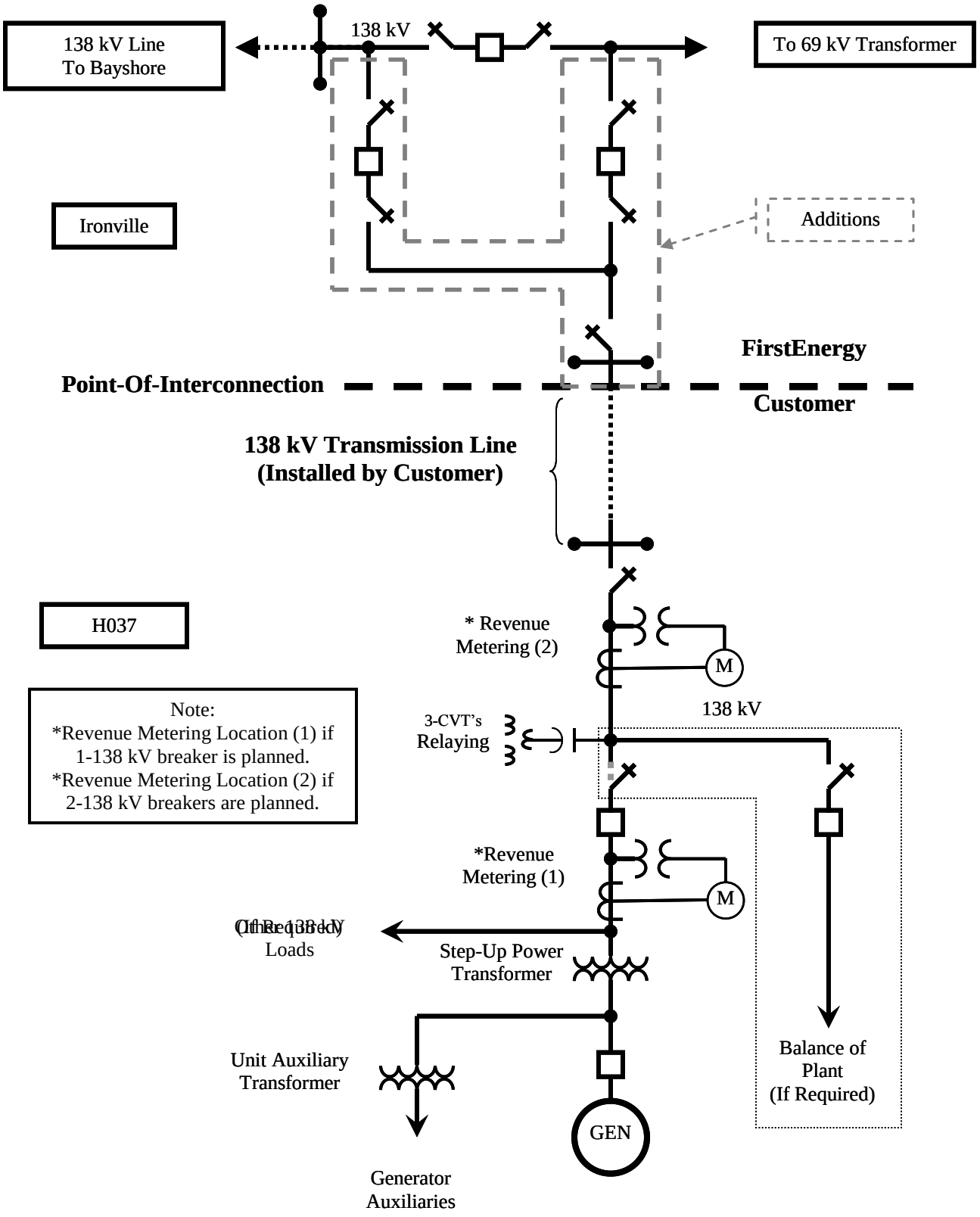

FIGURE 1A

H037 Relay Sketch