PJM Generator Interconnection #RO7 Pleasantville 2.0 MW Feasibility/Impact Study

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General

Queue #RO7 is for a request to interconnect a 2 MW Capacity Resource at the Atlantic County Utilities Authority Landfill by DCO Energy. The proposed interconnection consists of an additional 1.9 MVA landfill gas-fueled reciprocating engine-generator. The customer's Interconnection Facilities are located on ACUA (Atlantic City Utilities Authority) property at 6700 Delilah Road, Egg Harbor Township, Atlantic County, New Jersey. AC Landfill Energy's schedule for commercial operation is 2^{nd}-3^{rd} Quarter 2007.

Direct Connection Requirements

Telemetry Requirements

Atlantic will require real-time telemetry from the generator output and the Point of Interconnection to be sent to Atlantic's City Electric's Energy Control Center at NCRO in Newark, Delaware. The specific telemetry points that are required are outlined in Delmarva Power's "Technical Considerations Covering Parallel Operations of Customer Owned Generation of One Megawatt or Greater and Interconnected with the Conectiv Power Delivery System." The specific points for the generator are: MW, MVAR, MWH, MVARH, generator bus voltage and generator breaker open/closed status, and for the Point of Interconnection are: MW, MVAR, MWH, MVARH, interconnection bus voltage and amp flow. For this specific project, the customer may send the telemetry data to Atlantic via the existing installation of fiber optic cable. If fiber optic is not possible, or not chosen by the Interconnection Customer, then the Interconnection Customer will be required to send real time telemetry via a leased circuit.

The MWH and MVARH values that are telemetered to Atlantic must originate from the Revenue Quality meter systems described below under "Revenue Metering". The MWH values telemetered to Atlantic must match the MWH sent by the Interconnection Customer to PJM for eMeter.

For this project it is assumed that dual-winding revenue quality Revenue Metering instrument transformers will be supplied and installed per Atlantic specifications. One winding will be used by the Interconnection Customer to send telemetry to Atlantic and the other winding used by Atlantic as the source for its Revenue Quality meter. If this methodology is not used, then bi-directional kyz outputs and analog outputs from the Atlantic Revenue Metering can be used as the source of MWH/MVARH and instantaneous MW/MVAR telemetry data points, respectively, at an additional cost.

Reactive Requirements

Atlantic will require that the Interconnection Customer design its Customer Facility with the ability to maintain a composite power delivery at continuous rated power output at the generator's terminals at a power factor of at least 1.0 unity to 0.90 lagging. As required in "Technical Considerations Covering Parallel Operations of Customer Owned Generation of One Megawatt or Greater and Interconnected with the Conectiv Power Delivery System", Atlantic will require that the Interconnection customer compensate var consumption at the site in a sufficient amount to maintain the previously existing power factor prior to the addition of the new generator as measured at the Point of Interconnection.

Revenue Metering

The Revenue Metering is the accepted measurement of energy out of and into the facility. Atlantic, at Interconnection Customer's cost, will install equipment as needed to provide Revenue Metering (MWH,

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MVARH) to measure the output, for billing purposes, of the new generator as required in Atlantic's "Technical Considerations Covering Parallel Operations of Customer Owned Generation of One Megawatt or Greater and Interconnected with the Conectiv Power Delivery System" and in accordance with PJM Manuals M-01 and M-14D. Interconnection Customer shall provide a phone line dial up connection to facilitate Atlantic's retrieval of Revenue Meter data from its meter. It is being assumed that the existing phone line for the other two generators will be used for this project. For this project it is assumed that the Interconnection Customer will provide and install dual winding metering transformers as described in "Telemetry Requirements" above, per Atlantic specifications. Assuming that one of the dual windings goes to the Interconnection Customer's "Master Meter", which will be the source of MWH and MVARH data for PJM eMeter and Atlantic telemetry, then the Master Meter must be rated as "Revenue Quality" as well.

Interconnection Customer has the option to provide, own, install, operate and maintain the Revenue Metering, instead of Atlantic. In such case, the Revenue Metering must meet Atlantic technical standards, provide for dial-up data access by Atlantic and be subject to audit per the PJM Tariff. The values for hourly megawatt hours sent as e-Meter to PJM by the Interconnection Customer must, within accepted tolerance, match the values measured by the Revenue Metering.

Existing Previous Protection Scheme Enhancements

Modifications have already been made to the Pleasantville Substation, West 12kV Feeder circuit to support the interconnection of the two existing generators. The justification for these modifications was first addressed with the installation of the first generator under PJM Queue #L02. The installation of additional generation capacity farther reinforces the need for these modifications. These modifications include:

1. The addition of a SEL-351 relay to the West 12kV Feeder terminal at Pleasantville Substation.
2. The replacement of two existing hydraulic Automatic Line Reclosers on the West 12kV Feeder with electronic reclosers with type SEL-351R controllers. These two reclosers on located between Pleasantville Substation and the ACUA site.
3. The installation of fiber optic transfer trip communication channels between Pleasantville Substation and the ACUA site and between the two Automatic Line Reclosers and the ACUA site.

The protection schemes have be designed and set so that transfer trip is sent to the existing two ACUA generators when the West 12kV Feeder trips at Pleaantville Substation or when either feeder Automatic Line Recloser operates. Auto reclosing on the West 12kV Feeder breaker at Pleasantville Substation will take place only after confirmation has been received that the ACUA generator breakers are open. Auto reclosing of the two Automatic Line Reclosers will also only take place after confirmation is received that the ACUA generator breakers are open.

In the event of any channel or transfer trip equipment failure, the ACUA generators are tripped and not permitted to re-interconnect until the affected transfer tripping scheme has been restored.

A sketch of the system configuration including the two existing and proposed third ACUA generators is shown below:

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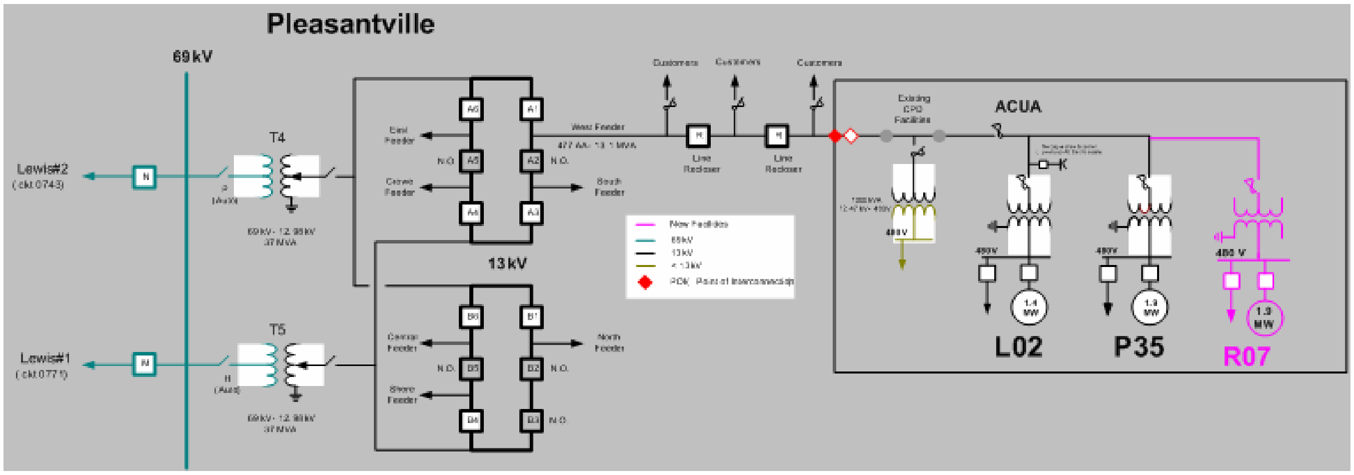

Impact of Third Generator on Short Circuit Duty

Discussion at the 11/6/06 Project Kickoff Meeting noted that the third generator will be identical to the second generator that was installed in Spring 2006. System Protection has assumed that the generator step up transformer will also be identical in characteristics. The new generator data was modeled in the ASPEN Short Circuit Program and faults at various locations on the West 12kV feeder were reviewed. Existing feeder conductor sizes were used. Any feeder re-conductoring will impact the fault current results. A summary of the increase in available fault current is provided below. Data is provided with only the existing two generators on line and with all three generators on line.

Location	Fault	No ACUA Gen.	Existing Two Generators Only		All Three Generators On	
P'ville 69kV Bus	3θ	18755 A.	18923 A.	0.90 % Increase	18973 A.	1.16 % Increase
	1L-G	14377 A.	14440 A.	0.44 % Increase	14457 A.	0.56 % Increase
P'ville #4 12kV Bus	3θ	9644 A.	10449 A.	8.35 % Increase	10775 A.	11.7 % Increase
	1L-G	9862 A.	10522 A.	6.69 % Increase	10722 A.	8.72 % Increase
P/N P2557 ALR	3θ	6257 A.	7293 A.	16.6% Increase	7667 A.	22.5 % Increase
	1L-G	5086 A	5492 A.	7.98 % Increase	5617 A.	10.4 % Increase
P/N P13305 ALR	3θ	4275 A.	5387 A.	26.0 % Increase	5838 A.	36.6 % Increase
	1L-G	3063 A.	3383 A.	10.4 % Increase	3486 A.	13.8 % Increase
P/N P64718 @ ACUA	3θ	3141 A.	4332 A.	37.9 % Increase	4882 A.	55.4 % Increase
	1L-G	2125 A	2412 A.	13.5 % Increase	2508 A.	18.0% Increase

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As expected, the impact of the ACUA generators is most pronounced closer to the ACUA site. The feeder phase fault current near the ACUA site increases by as much as 55.4%. However the fault magnitude is only 4882 Amps and is still well within equipment ratings. The generators have minimal impact on feeder circuit faults near Pleasantville Substation and negligible impact on faults on the Pleasantville 69kV Bus. In summary, no equipment appears to be overstressed due to the addition of the third ACUA generator.

Impact on West 12kV Feeder Terminal Over Current Protection

The addition of the third ACUA generator will increase the contribution via the West 12kV Feeder for a phase fault on the Pleasantville #4 12kV Bus or a close in fault on another feeder. (Ground faults are a lesser concern since the ACUA generators are not a contributor for $3I_0$ ground fault current due to the delta-wye configuration of their step-up transformers. The generators will still contribute I_1 and I_2 currents for 12kV ground faults.)

3θ Fault Pleasantville #4 12kV Bus, All three ACUA Generators On Line
Total: 10775 Amps
Via #4 Transformer: 9466 Amps
Via West 12kV Feeder: 1312 Amps

The existing pickup of the feeder phase IAC53 relays and the phase time over current element of the SEL-351 relay is 6 Amps @ 200/1 or 1200 primary amps. The contribution via the ACUA generators is high enough to cause these relays to pickup. However, the relay operating time would be long as the relay has only 1.09 multiples of pickup. Any 12V bus phase fault or a "close in" phase fault on another feeder would clear before this relay could operate. In summary, no modifications are needed to make these relays directional at this time.

(If it was necessary, the SEL-351 relay could be made directional via a setting change. The pick up of the IAC53 relay could be increased and still provide sufficient sensitivity for all feeder phase faults that require the feeder breaker to trip. The lower pickup directional setting on the SEL-351 relay would provide backup protection for the first downstream recloser.)

The phase instantaneous units on other 12kV feeders off the Pleasantville Sub. #4 12kV Bus should be checked to insure that they do not over reach any circuit reclosers due to the added fault current contribution from the ACUA generators. This should not be a major issue and can be corrected with a minor setting change if necessary.

Phase A-G Fault Pleasantville #4 12kV Bus, All three ACUA Generators On Line
Total: 10722 $3I_0$ Amps
Via #4 Transformer: 10722 $3I_0$ Amps
Via West 12kV Feeder: 0 $3I_0$ Amps, 826 Phase A Amps, 410 Phase B Amps, 418 Phase C Amps
No relays on the West 12kV Feeder terminal will operate for this 1L-G fault.

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The feeder terminal relays must still provide sufficient sensitivity for feeder faults that require the feeder breaker to trip.

<u>3θ Fault at P/N P2760, Worse Case Location, all three ACUA Generators On Line</u>
Total: 4069 Amps
Via ACUA Generators: 698 Amps
Via West 12kV Feeder Terminal: 3371 Amps
3371/1200 = 2.81 Times Relay Pickup
A θ- θ fault at the same location = 2.43 Times Relay Pickup

<u>Phase A-G Fault at P/N P2760, Worse Case Location, all three ACUA Generators On Line</u>
Total: 2678 $3I_0$ Amps
Via ACUA Generators: 0 $3I_0$ Amps, 289 Phase A Amps, 143 Phase B Amps, 147 Phase C Amps
Via West 12kV Feeder Terminal: 2678 $3I_0$ Amps
2678/800 = 3.35 Times Relay Pickup on the Feeder Ground Relays

In conclusion, no modifications or relay settings changes are needed for the West 12kV Feeder terminal. In addition, feeder terminal fault sensitivity is not adversely impacted.

Impact on P/N P-2557 VWE ALR Controller Over Current Protection

The addition of the third ACUA generator will increase the contribution via the P/N P-2557 Automatic Line Recloser for a feeder circuit phase fault on the substation side of the ALR. (Again, ground faults are a lesser concern since the ACUA generators are not a contributor for $3I_0$ ground fault current. The generator I_1 and I_2 current contributions will be considered for a 1L-G fault.)

<u>3θ Fault Substation side of P/N P-2557 ALR, All Three ACUA Generators On Line</u>
Total: 7667 Amps
Via West 12kV Feeder Terminal: 6257 Amps
Via ACUA Generators thru ALR: 1412 Amps

The phase and ground trip points of this ALR are set to 750 Amps. The ALR will have 1412/750 = 1.883 times pickup for this fault condition. The ALR is set for a #117 time curve and would have an operating time of 1.74 Seconds. The feeder relays at Pleasantville Substation would have 6257/1200 = 5.214 times pickup for this fault condition. With the existing time lever settings, the relay operating time would be 0.625 Second. Therefore, the upstream feeder breaker terminal relays at Pleasantville Substation will trip first and send transfer trip to the ACUA generators before this ALR at P/N P-2557 has a chance to operate.

<u>Phase A-G Fault Substation side of P/N P-2557 ALR, All Three ACUA Generators On Line</u>
Total: 5617 $3I_0$ Amps
Via West 12kV Feeder Terminal: 5617 $3I_0$ Amps
Via ACUA Generators via ALR: 0 $3I_0$ Amps, 654 Phase A Amps, 325 Phase B Amps, 331 Phase C Amps

The ALR controller will not pickup for this 1L-G fault case.

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Check that the ALR controller still has sufficient sensitivity for feeder circuit faults between the two recloser locations that require this ALR at P/N P-2557 to trip. The "worse case" is a feeder tap line end fault at P/N P3980.

<u>3θ Fault at P/N P3980, Worse Case Location, all three ACUA Generators On Line</u>
Total: 3980 Amps
Via ACUA Generators: 1039 Amps
Via P/N P2557 ALR: 2947 Amps
2947/750 = 3.92 Times Pickup
A θ- θ fault at the same location = 3.40 Times Pickup

<u>Phase A-G Fault at P/N P3980, Worse Case Location, all three ACUA Generators On Line</u>
Total: 2374 $3I_0$ Amps
Via ACUA Generators: 0 $3I_0$ Amps, 391 Phase A Amps, 194 Phase B Amps, 198 Phase C Amps
Via P/N P2557 ALR: 2274 $3I_0$ Amps
2274/750 = 3.03 Times Pickup

In conclusion, no modification or controller setting change are apparently needed at this ALR. In addition, the fault sensitivity of the ALR controller is not adversely impacted.

Impact on P/N P-13305 VWE ALR Controller Over Current Protection

The addition of the third ACUA generator will increase the contribution via the P/N P-13305 Automatic Line Recloser for a feeder circuit fault between the two feeder reclosers. (As before, ground faults are a lesser concern since the ACUA generators are not a contributor for $3I_0$ ground fault current. The generator I_1 and I_2 current contributions will be considered for a 1L-G fault.)

<u>3θ Fault Substation side of P/N P-13305 ALR, All Three ACUA Generators On Line</u>
Total: 5838 Amps
Via West 12kV Feeder Terminal & Upstream P/N P-2557 ALR: 4275 Amps
Via ACUA & P/N P-13305 ALR: 1574 Amps

The phase and ground trip points of this ALR are set to 560 Amps. Therefore, the ALR will have 1574/560 = 2.811 times pickup for this fault condition. This ALR is also set for a #117 time curve and would have an operating time of 0.82 Second. The upstream ALR at P/N P-2557 would have 4275/750 = 5.7 times pickup. With a #117 time curve, this upstream ALR would operate in 0.256 Second. Therefore, the upstream ALR at P/N P-2557 will trip first and send transfer trip to the ACUA generators before this ALR at P/N P-13305 has a chance to operate.

<u>Phase A-G Fault Substation side of P/N P-13305 ALR, All Three ACUA Generators On Line</u>
Total: 3486 $3I_0$ Amps
Via West 12kV Feeder Terminal & Upstream P/N P-2557 ALR: 3486 $3I_0$ Amps
Via ACUA & P/N P-13305 ALR: 0 $3I_0$ Amps, 594 Ph. A Amps, 295 Ph. B Amps, 301 Ph. C Amps

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The ALR will have only 594/560 = 1.06 times pickup for this fault condition. The upstream ALR at P/N P-2557 will have 3486/750 = 4.65 times pickup. It can be concluded that the upstream ALR at P/N P-2557 will trip first and send transfer trip to the ACUA generators before this ALR at P/N P-13305 has a chance to operate.

Check that the ALR controller still has sufficient sensitivity for feeder circuit faults between the recloser location and the ACUA site that requires this ALR at P/N P-13305 to trip. The "worse case" is a feeder line end fault near the ACUA at P/N P64718.

<u>3θ Fault at P/N P64718, Worse Case Location, all three ACUA Generators On Line</u>
Total: 4882 Amps
Via ACUA Generators: 1792 Amps
Via P/N P13305 ALR: 3141 Amps
3141/560 = 5.61 Times Pickup
A θ- θ fault at the same location = 4.86 Times Pickup

<u>Phase A-G Fault at P/N 64718, Worse Case Location, all three ACUA Generators On Line</u>
Total: 2508 $3I_0$ Amps
Via ACUA Generators: 0 $3I_0$ Amps, 580 Phase A Amps, 290 Phase B Amps, 297 Phase C Amps
Via P/N P13305 ALR: 2508 $3I_0$ Amps
2508/560 = 3.03 Times Pickup

In conclusion, no modification or controller setting change are apparently needed at this ALR. In addition, the fault sensitivity of the ALR controller is not adversely impacted.

Impact on Existing Transfer Tripping Scheme

The protection enhancements already made as part of the first and second generator installations can be utilized to provide the necessary interconnection protection for the new third 1.9 MW generator. The 5.2 MW net total generation at ACUA increases the likelihood that the generation could be isolated with other ACE load on the West 12kV Feeder without a sufficient degradation in voltage or frequency to locally detect isolation. Consequently, the need for the transfer tripping schemes becomes still greater with the third generator. The required transfer tripping schemes are already in service.

Impact on Detecting Pleasantville 69kV Source Outage

A contingency outage of both 69kV source lines to Pleasantville Substation can occur. One line could be out for a forced outage or planned maintenance. The second line could then trip. Transfer trip will not be sent to ACUA for this condition. However, this occurrence would isolate all the Pleasantville Substation load with the ACUA generation. IEEE 1547, *IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems,* requires that the isolated load be at least 3 times the generation capacity to insure isolation detection and tripping via the generator local voltage and frequency relays. Based on the net generation capacity of 5.2 MW, the isolated load would have to be at least 15.6 MW. The total Pleasantville Substation 12kV load for 2007 is 60.0 MVA or 54 MW @ 0.9

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PF. System Operations normally estimates minimum load at approximately 40% of peak. Therefore, the minimum estimated load at Pleasantville Substation is 0.4(54) = 21.6 MW. In conclusion, the 3 to 1 ratio required by IEEE 1547 is satisfied and the local voltage and frequency relaying at the ACUA site should still be adequate to detect this condition.

Proposed Voltage & Frequency Set Points

No specific voltage and frequency data has been supplied for this third generator. However, it was commented at the Queue RO7 Kickoff Meeting on 11/6/06 that this third generator will be identical to the second generator installed in the spring of 2006. Setting Information for the second generator is supplied below. However, the customer should confirm and provide documentation that the proposed third generator will have the same set points.

The proposed set points were compared to the requirements of IEEE 1547, *IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems.* The operating time indicated below is the total time to achieve generator isolation, i.e. relay time plus breaker time.

Voltage Trips

IEEE 1547 Requirements	Proposed Interconnected Generator Settings
Trip in 0.16 Sec. for V < 50%	Trip in 0.16 Sec. for V < 50%
Trip in 2.0 Sec. For V between 50-88%	Trip in 2.0 Sec. for V < 88%
Trip in 1.0 Sec. for V between 110-120%	Trip in 1.0 Sec. for V >110%
Trip in 0.16 Sec. for V ≥ 120%	Trip in 0.16 Sec. for V > 120%

The proposed voltage trip points fully meet the requirements of IEEE 1547.

.Frequency Trips

IEEE 1547 Requirements	Proposed Interconnected Generator Settings
Trip in 0.16 Sec. for F < 57.0 Hz.	Trip in 1.0 Second for F < 57.5 Hz.
Trip in 0.16-300 Sec. for F between 57.0-59.8 Hz.	Trip in 1.0 Second for F < 57.5 Hz.
Trip in 0.16 Sec. for F > 60.5 Hz.	Trip in 0.16 Sec. for F > 60.5 Hz.

The proposed over frequency set point fully meets the requirements of IEEE 1547. The single under frequency trip point and time is within the IEEE 1547 required range. However, there is no high speed under frequency trip for frequency less than 57.0 Hz. This deficiency needs to be corrected by the addition of a high speed low frequency trip.

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Interconnection Fault Protection

No specific drawings for this third generator have been supplied. Based on the statement that this third generator is identical to the second generator, it can be assumed that the generator interconnection protection will also be the same. Again, the customer should supply specific drawings and other material for the proposed third generator. Based on the second generator data, generator over current 51V and 51N protection is provided along with unbalance 46 and reverse power 32 protection. An over voltage 59N element supplied via 12kV open delta PTs is also provided to detect a ground on the 12kV system. The protection schemes appear to be adequate however the set points are not provided to fully evaluate their operation. System Protection will review specific drawings and set points when they are available to insure adequate coordination with utility protection systems.

Transfer Trip Scheme Operation

No specific information has been received regarding the interfacing of the new proposed generator with the existing transfer trip schemes. However, it is assumed that operation will be identical to the first two generators. The operating requirements are described on the next page.

1. All three ACUA generators must immediately trip if transfer trip is received from the West 12kV Feeder Terminal at Pleasantville Substation or from either of the two feeder Automatic Line Reclosers.
2. A failure of any of the transfer trip channels or transfer trip equipment must trip all three ACUA generators.
3. The generators cannot interconnect with the Atlantic Electric System unless the incoming 12kV feeder circuit is at normal voltage and frequency and all three transfer tripping schemes are operational.
4. The joint open status of all three generator breakers must be sent via the transfer trip schemes to the West 12kV Feeder terminal at Pleasantville Substation and to the two feeder Automatic Line Reclosers to control auto reclosing.

Summary

1. The additional fault current supplied by the addition of a third 1.9 MW generator will not overstress any Atlantic City Electric equipment.
2. No design or trip settings changes are needed on the West 12kV Feeder Terminal at Pleasantville Substation.
3. No trip setting changes are needed on the controllers associated with the two West 12kV Feeder Automatic Line Reclosers.
4. The proposed voltage set points (assuming they are identical to the earlier 1.9 MW generator) fully comply with IEEE 1547. The frequency set points also comply with the exception that no high speed under frequency trip is provided for frequency less than 57.0 Hz. A high speed low frequency trip needs to be added.

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5. The existing transfer tripping schemes between Pleasantville Substation and the ACUA site and between the two feeder Automatic Line Recloser locations at the ACUA site will provide the necessary anti-islanding protection for the all three generators.
6. The third generator must be interfaced with the transfer tripping schemes and operate in a mode identical to the two existing generators.
7. The ACUA needs to provide drawings and protective relay set points for review and approval.

Network Impacts

Normal System
No problems identified.

Single Contingency
No problems identified.

Stability Analysis
Not required because of size and interconnection location of generation.

Short Circuit Analysis
A short circuit study was performed and no problems were found.

Network Reinforcement Requirements
None required.

Scope of Work for ACE and Cost Estimate

I. Metering Scope:
The existing 12kV primary metering cluster mount installed with #P35 at the ACUA's POI, is of sufficient size to accommodate an additional 1.9MW of generation. ACE's metering technicians will install the secondary conductors for the metering instrument transformers, installed and owned by the customer, at the new 1.9 MW generator, and install an ACE owned metering device, with test switch.

ACE will supply the metering enclosure, secondary control cable, test switch, meter, and ACP call diverter. DCO's contractors will supply and run all conduits, and the needed cable to link the existing phone line from the existing generator cabinet (Generator #1 meter cabinet), to the new cabinet. This will allow ACE to interrogate all three generator meters remotely via a single (existing) phone line.

Direct (Internal or ACE)
    Labor - $3,520.00
    Material - $1,852.00

Indirect (External or Contractor)
    Labor - N/A
    Material - N/A

Metering Total Cost: $5372.00

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II. Outside Plant Communications Scope:
Assumptions:
1) ACE's existing fiber optic termination equipment located in the control enclosure of Generators #1 and #2 will not be moved or changed in any way. The fiber which was installed at the time Generator #2 was installed is adequate to accommodate the addition of a third generator.
2)ACUA will install RS-485 cable between the new Generator meter and the previously installed Hoffman Enclosure.

Scope:
ACE Communications Technicians will terminate and test the RS-485 cable between the Generator meter points. ACE Technicians will reprogram the existing RTU to accommodate the new Generator path and additional data points. Additional testing may be required between the ACUA site and the reclosers and metering point.

ACE will allow ACUA to utilize a fiber path at their site for monitoring purposes. This will require ACE Communications Technicians to purchase and install 2 small fiber optic termination boxes, 2 single mode fiber modems (TCF-90), RS-232 cables an misc. fiber jumpers and connectors. ACUA will provide a compatible multimode fiber optic/RS-232 modem and a fiber path to our termination enclosure.

Direct (Internal or ACE)
- Labor – $5,120 (5 Days)
- Material - $2,000

Indirect (External or contractor)
- Labor – N/A
- Material – N/A
Outside Plant Communications Total estimate = $ 7,120

III.Relaying, ALR and Communications Scope:

Scope:
- Troubleman service to externally tie customer load on West 12kv feeder to prevent customer outages while functional testing is conducted. Untie customer loads and restore feeder to normal configuration after testing is complete.
- Automatic Line personnel will be required to bypass the reclosers to allow functional testing and verify trip signals received at the ALR devices and perform any setting changes to ensure transfer trip schemes initiate and operate as designed.
- Relay Dept - development of setting and test plan for complete end to end functional testing of brkrs, reclosers and associated devices included in the transfer trip scheme. Implement necessary setting changes required for the SEL2505's for the extra contacts and anticipated coordination/tuning of settings to ensure transfer trip schemes initiate and operate as designed.

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Verification of loss of transfer trip scheme communication link/path trips both generators. Verify recloser and generator brkr status open/close received when brkrs are tripped.

- Communications – ensure that fiber optic signal paths are correctly reaching each device with proper signal strength and ensure proper trip signal reached at various devices. Ensure equipment status indication received at proper address locations.
- Estimate provides for an additional day of relay crew time to allow for unexpected relaying and or communication/coordination issues that typically arise when performing functional trip testing.

Cost Estimate for Resetting/Reprogramming and Functional Testing
Relaying, ALR and Communications Equipment

Department	Crew Size	Duration	Total Man days	Cost
Overhead Line Troubleman (Tie external loads to allow testing)	1	1/2	1/2	$508
Automatic Line Equipt (Bypass Reclosers and functional testing)	2	3	6	$6528
Communications (reprogram comm. Ports and assist functional testing)	1	5	5	$5440
Relay Crew (SEL2505 setting changes and end to end functional testing)	2	3	6	$6528
Relay Crew (Extra day for testing problems should they arise)	2	1	2	$2176
Overhead Line Troubleman (Untie external loads after testing complete)	1	1/2	1/2	$508
Totals			18 man days	$21,688

Direct (Internal or ACE)
Labor - $21,688
Material - 0

Indirect (External or Contractor)
Labor - N/A
Material - N/A

Relaying, ALR and Communications Total estimate = $21,688

Worst case estimate based on experience and issues that arose during initial ACUA Generator installation functional testing in winter 2005, and experience with installation of 2nd generator in 2006. Keep in mind problems on generator side or delays do tho their equipment not functioning could increase this cost estimate significantly.

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IV. Project Management costs
Scope:
Coordinate all internal groups working on this project as well as with the customer to insure
Direct (Internal or ACE)
  Labor - $ 13,800 (120 hrs)
  Material - 0

Indirect (External or Contractor)
  Labor - N/A
  Material - N/A

Project Management Total Cost: $ 13,800

V. System Protection
Scope:
Review and adjust final relay settings. Program equipment for additional communication channels to the ACUA site.

Direct (Internal or ACE)
  Labor - $ 1,840 (16 hrs)
  Material - 0

Indirect (External or Contractor)
  Labor - N/A
  Material - N/A

System Protection Total Cost: $ 1,840

VI. System Operations
Scope:
This would include EMS display work, database work to accomodate additional monitored points for the new generator, verification of accuracy and scaling constants, meeting participation, inclusion of any new data into our PI system.

Direct (Internal or ACE)
  Labor - $ 1,610 (14 hrs)
  Material - 0

Indirect (External or Contractor)
  Labor - N/A
  Material - N/A

System Operations Total Cost: $ 1,610

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VII. Interconnection Arrangements
Scope:
Perform interconnection technical issue review and resolution. Review installation approach and initial output to insure compliance with agreement.

Direct (Internal or ACE)
 Labor - $ 4,600 (40 hrs)
 Material - 0

Indirect (External or Contractor)
 Labor - N/A
 Material - N/A

Interconnection Agreements Total Cost: $ 4,600

VIII. System Planning
Scope:
Review initial plans and coordinate the Feasibility/impact study. Incorporate the capacity resource into overall system plans.

Direct (Internal or ACE)
 Labor - $ 3,450 (30 hrs)
 Material - 0

Indirect (External or Contractor)
 Labor - N/A
 Material - N/A

System Planning Total Cost: $ 3,450

IX. Distribution Engineering
Scope:
No changes are necessary to any protective equipment. Distribution will need time to write switching instructions, etc.

Direct (Internal or ACE)
 Labor - $ 1,380 (12 hrs)
 Material - 0

Indirect (External or Contractor)
 Labor - N/A
 Material - N/A

Distribution Engineering Total Cost: $ 1,380

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Project Total:
Direct (Internal or ACE)
Labor – 57,008
Material – $ 3,852

Indirect (External or Contractor)
Labor – N/A
Material - N/A

Total: $ 60,860

Total With 18% Overheads (ESAG) and 15% Contingency

Direct (Internal or ACE)
Labor - $ 77,360
Material – $ 5,227

Indirect (External or Contractor)
Labor – N/a
Material - N/A

Project Total: $ 82,587

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ATTACHMENT #1

Interconnection Customer Facilities One Line Diagram

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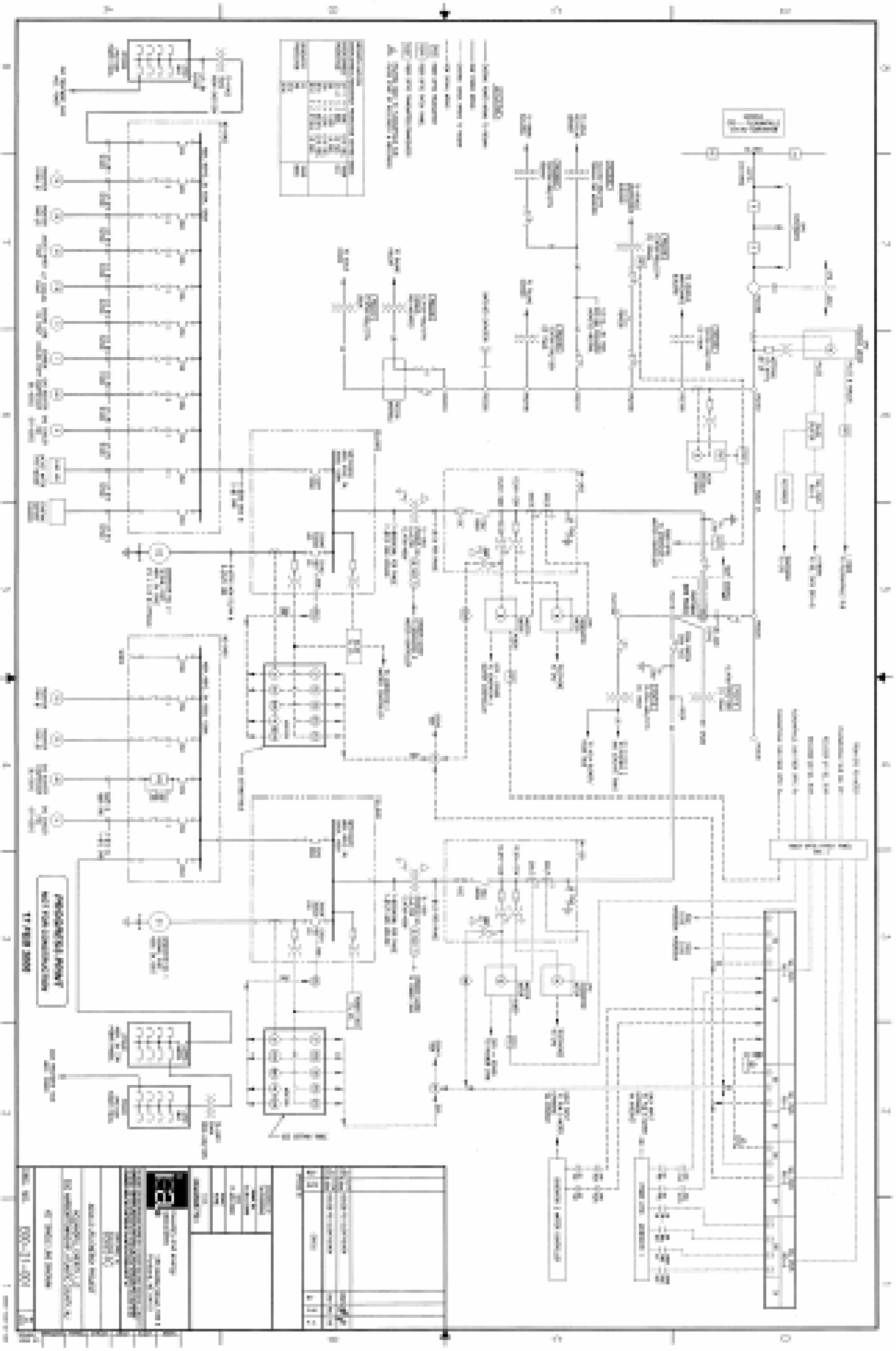

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