Pittsburg-LMEC 115kV Overload Scheme

May 1, 2018

Presented by
Pacific Gas & Electric
The Calpine Los Medanos Energy Center (LMEC) is an existing combined-cycle plant interconnected to PG&E’s Pittsburg 115kV Substation in Contra Costa County, California.

LMEC is connected to PG&E’s Pittsburg Substation via two 115kV lines. The two 115kV lines are limited by a 0.9-mile section of underground cable on each line. The UG cables have the following ratings:

- Normal Rating = 1,380 Amps (= 274.9 MVA)
- 5-Day Emergency Rating = 2,300 Amps (= 458.1 MVA)
- 30-minute Emergency Rating = 2,761 Amps (= 549.9 MVA)

Calpine submitted an Interconnection Request to Pacific Gas and Electric (PG&E) to increase the interconnection capacity for LMEC by 72MW, for a total net output of 580MW.

The Pittsburg-LMEC 115kV scheme is designed to address overloads that may result on either Pittsburg – LMEC 115kV #1 or #2 Line, if one of the lines is out of service when the total power on the lines is more than 550MW.
This overload scheme may qualify for exception e of the RAS definition:

* Schemes applied on an Element for non-Fault conditions, such as, but not limited to, generator loss-of-field, transformer top-oil temperature, overvoltage, or overload to protect the Element against damage by removing it from service.

- PG&E requests that the RASRS group determine if the Pittsburg-Los Medanos 115kV scheme meets exception e and is not considered a RAS.

- It is possible to have both cables removed from service.

- Inadverent operation of the scheme could result in tripping the remaining cable.

- Loss of all LMEC generation was studied and no planning violations were found.
Pittsburg – LMEC 115kV Underground Cables

Points of Interconnection

Points of Change in Ownership

Los Medanos Energy Center (LMEC)

CTG2 208 MVA

STG 285 MVA

CTG1 208 MVA
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<tr>
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<th>CB 142</th>
<th>Trip and block reclose</th>
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Similarly, System B trips and blocks reclose of CB 132 and CB 142.
Los Medanos Energy Center (Q963) Vicinity Map
Need for the Pittsburg – LMEC 115kV RAS

• LMEC is connected into PG&E’s Pittsburg Substation via two 115kV lines. The two 115kV lines are limited by a 0.9-mile section of underground cable on each line. The UG cables have these ratings:

  Normal Rating = 1,380 Amps (= 274.9MVA)
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• With the planned retirement of some of the industrial loads supplied with power directly from LMEC, the power plant has more power to export into the PG&E system, and Calpine has requested that PG&E look at the impacts of LMEC “exporting” up to 580MW to Pittsburg Substation.

• The increased loading on the 115kV lines to Pittsburg Substation could result in an overload of an UG cable should either line go out when the total power on the lines is more than 550MW.
Need for the Pittsburg – LMEC 115 kV RAS

• To address this overload issue, Calpine will be installing a scheme to reduce LMEC output if a cable goes out. PG&E will install its own RAS at Pittsburg Substation to detect an overload on either cable and will trip the overloaded cable:
  ▪ The RAS will have redundant A and B schemes.
  ▪ When an overload is detected, the RAS schemes will wait 5 seconds for Calpine’s scheme to activate.
  ▪ If the overload is more than 2,761 Amps, the RAS will trip the breaker on the line that is overloaded (either CB 132 or CB 142).
  ▪ If the overload is more than 2,300 Amps, but less than 2,761 Amps, the RAS will alert PG&E system operators and then will wait 30 minutes for the Calpine scheme to reduce LMEC generation. If the line loading on the cable is not reduced below 2,300 Amps within 30 minutes, the PG&E RAS will trip the line breaker.

• Transient studies were done to see whether the loss of the entire LMEC power plant causes stability issues or significant voltage deviations in the system. The transient stability analysis showed that the transmission system remained stable and met WECC Disturbance-Performance Criteria for all of the simulated outages.
Scheme Design Considerations:

- Two Fully Redundant Systems A & B shall be designed and owned by PG&E with no single point of failure.
- Calpine LMEC terminal will have an additional scheme owned and operated by Calpine on same U/G cable to reduce generation.
- The Pittsburg-Los Medanos 115kV RAS will have intentional 5 second delay as coordination margin to allow the Calpine system to operate first.
- There will be no communication between Pittsburg terminal RAS and Calpine Los Medanos Overload scheme
- No telecom channel is required for the scheme
- The RAS is local Overload detection based only. No outage detection monitoring is required by the scheme.
Scheme Design Considerations:

- Detection is based on Non-directional Overcurrent elements at local terminal only and will operate locally.
- Relay will monitor actual abnormal condition and will activate with no other contingencies. The scheme will ride through the system faulted conditions.
- Scheme does not monitor system voltage or system stability issues.
Pittsburg-LMEC 115kV RAS

LEGENDS:
- **Red**: BREAKER CLOSED
- **Green**: BREAKER OPEN
- **Blue**: U/G CABLE

LMEC 115kV BUS B
- C6
- B6
- A6

TO CTG2

LMEC 115kV BUS A
- C2
- B2
- A2

PITTSBURG PP
115kV BUS SEC D

DEVICES:
- DEV.150/186PLMECRAS-A
- DEV.150/186PLMECRAS-B

BREAKER SYMBOLS:
- CB 132
- CB 142

BUS SYMBOLS:
- BUS 1
- BUS 2

PITTSBURG PP 115kV BUS SEC D

CB 132

CB 142

U/G CABLE
Pittsburg-LMEC 115kV RAS

Scheme Design Considerations:

- Since Pittsburg-Los Medanos #1 and #2 are U/G Cable, CB 132 and CB 142 will not be substituted per PG&E criteria, and there will be no need for a seasonal setting change.

- Two N60 relays shall be utilized (1 relay for System A and 1 relay for System B) on the PG&E Pittsburg SW terminals.

- Pittsburg SW N60 will issue direct tripping to Pittsburg SW CB 132, CB 142, and BFI.
Pittsburg-LMEC 115kV RAS

Scheme Design Considerations:

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Pittsburg-LMEC 115kV RAS

BUS 1

PITTSBURG PP
115kV BUS SEC D

BUS 2

DEV.150/186PLMECRAS-A
GE N60

TRIP CB 132

TRIP CB 142

LMEC 115kV BUS B

TO CTG2

LMEC 115kV BUS A

DEV.150/186PLMECRAS-B
GE N60

TRIP CB 142

TRIP CB 132
Pittsburg-LMEC 115kV RAS

BUS 1

BUS 2

PITTSBURG PP
115kV BUS SEC D

DEV.150/186PLMECRAS-A
GE N60

CB 132
CB 142

LMEC 115kV BUS B

TO CTG2

LMEC 115kV BUS A

DEV.150/186PLMECRAS-B
GE N60
Pittsburg-LMEC 115kV RAS

BUS 1

PITTSBURG PP
115kV BUS SEC D

BUS 2

DEV.150/186PLMECRAS-A
GE N60

TRIP CB 142

LMEC 115kV BUS B

TO CTG2

LMEC 115kV BUS A
Pittsburg-LMEC 115kV RAS

BUS 1

BUS 2

PITTSBURG PP
115kV BUS SEC D

DEV.150/186PLMRCRAS-A
GE N60

CB 132
CB 142

LMEC 115kV BUS B

LMEC 115kV BUS A

TO CTG2
SYSTEM A LOGIC DIAGRAM

Line #1
EXCEED 30 MINUTE RATING (>2761A) DETECTOR: IOC1
EXCEED 8-DAY RATING (>2300A) DETECTOR: IOC2
EXCEED CONTINUOUS RATING (>1800A) DETECTOR: IOC3

NOTE:
CURRENT DETECTORS ARE PHASE IOC ELEMENTS

Line #2
EXCEED 30 MINUTE RATING (>2761A) DETECTOR: IOC1
EXCEED 8-DAY RATING (>2300A) DETECTOR: IOC2
EXCEED CONTINUOUS RATING (>1800A) DETECTOR: IOC3

TRIP CB132
BFI CB132
LATCH 5
OUT9
BLY RCL 132 – Normally Open when RAS Lockout

PUSH BUTTON RESET
SCADA RESET
LOCAL/REMOTE

LATCH 6
OUT10
BLY RCL 142 – Normally Closed, Open when RAS Lockout

TRIP CB142
BFI CB142

CB 132 CUT-OUT
CB 142 CUT-OUT
TIMER 21
TIMER 26
TIMER 22
TIMER 23
Scheme Alarms:

- CB Cut-Out Violation
- Cut-Out / Cut-In Status
- Maintenance Alarm
- Relay Failure
- Overload Detection Alarms
- Trip Alarms
PG&E requests the RASRS group to approve the Pittsburg – LMEC 115kV RAS as a LAPS.
QUESTIONS ?