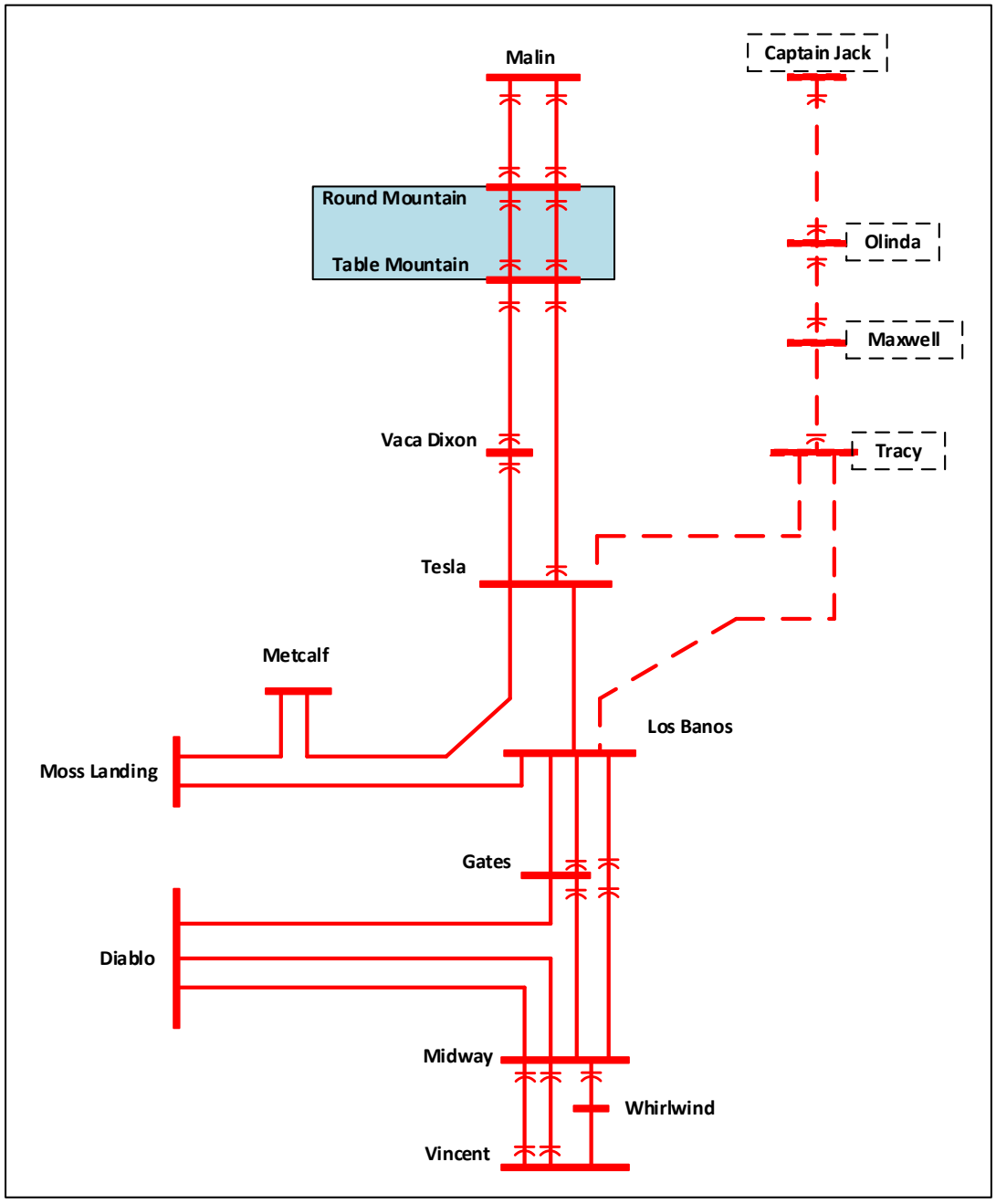
Round Mountain 500 kV Area Dynamic Reactive Support Description and Functional Specifications for Competitive Solicitation

Revision 1

1. Description

In the 2018-2019 Transmission Plan, the ISO has identified a reliability-driven need for a +/- 500 Mvar dynamic reactive power support connecting in vicinity of the Round Mountain 500 kV substation as depicted below.

Figure 1: Round Mountain 500 kV Area Dynamic Reactive Support



Two alternatives for the dynamic reactive power support in the vicinity of the Round Mountain 500 kV substation are included in the functional specification, with only one of the alternatives to be selected through the competitive procurement process. The evaluation of the bids submitted on either of the alternatives will include in the evaluation cost of the non-competitively bid facilities identified to be constructed by the incumbent participating transmission owner, Pacific Gas & Electric, to interconnect the proposed dynamic reactive power support facilities submitted by the Project Sponsor as a part of the competitive procurement process.

If applicants are providing proposals to be evaluated for both alternatives, a separate application for each alternative shall be submitted. The CAISO will not evaluate multiple alternatives as part of a single application.

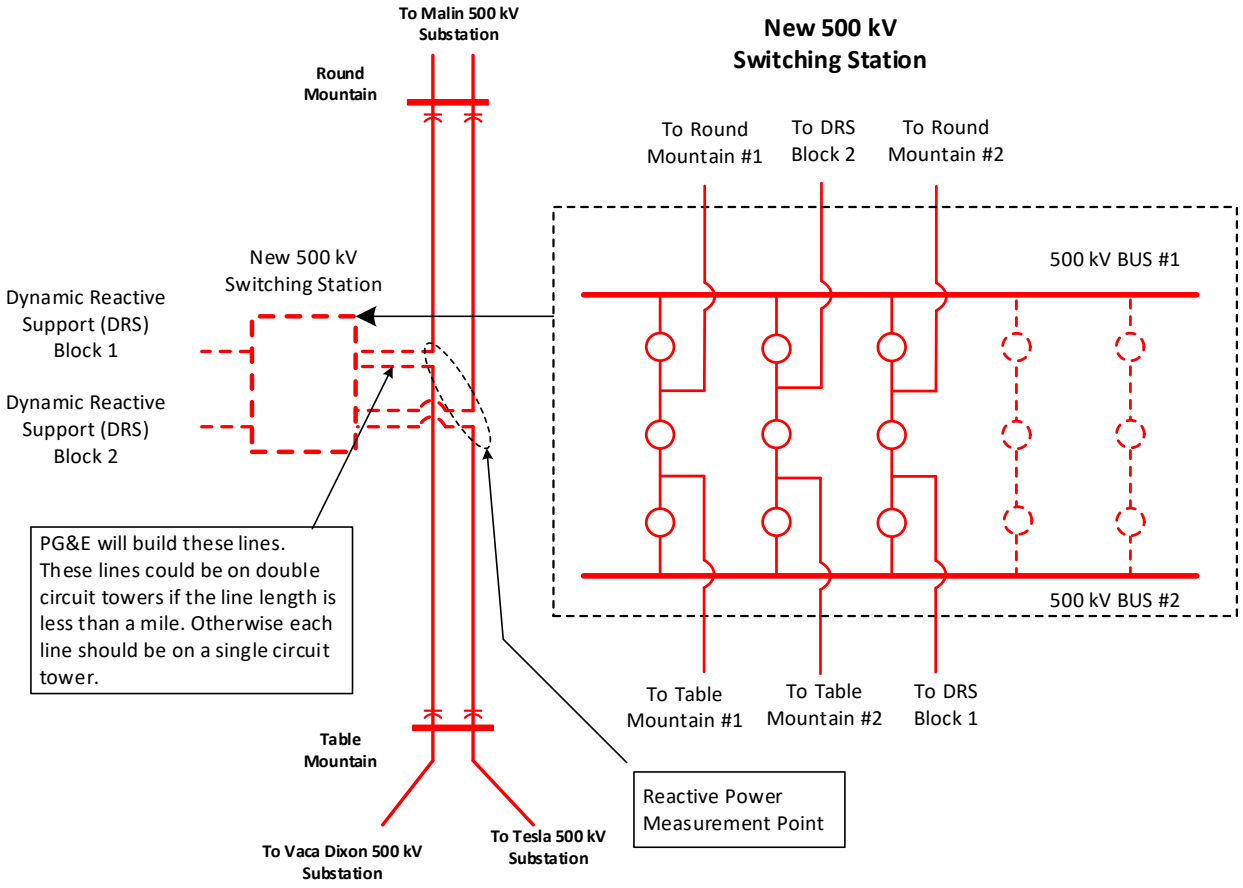
The reactive power support is required to provide continuous dynamic reactive power output over the complete range of the capability (unless the facility experienced a planned or forced outage). It can be one of the following types of devices: SVC (Static VAR Compensator) with Thyristor Switched Capacitors (TSC), STATCOM (Static Synchronous Compensator), or Synchronous Condenser. An appropriately sized and configured inverter associated with a battery storage project could also provide the reactive support. Voltage support requirements would take precedence over any other operation of the battery storage facility. Subsynchronous Resonance (SSR) studies are required to be completed and any identified mitigation shall be implemented as part of this project.

1.1. Alternative 1 – 500 kV Interconnection to Round Mountain-Table Mountain 500 kV Lines

In Alternative 1, the Project Sponsor will develop a new 500 kV breaker and a half switching station with 3 bays and 6 positions to be looped into the 500 kV transmission lines from Round Mountain substation to approximately half way (40% to 60% of the distance) between Round Mountain to Table Mountain 500 kV substations to interconnect the dynamic reactive power support. The property shall have space for expansion to a total of 5 bays and 10 positions in the future. The new 500 kV switching station shall meet CIP standards, which require 500 kV substations have a physical wall at the perimeter. The incumbent participating transmission owner, PG&E, will build the loop in tie lines to connect the new switching station to the existing Round Mountain to Table Mountain 500 kV lines. The schematic diagram in Figure 2 provides a high level arrangement of the new switching station and how the dynamic reactive devices will be interconnected. The cost estimate for PG&E's scope of work depends on the distance of the new switching station from the existing 500 kV lines. The cost estimate for double circuit 500 kV line and single circuit 500 kV line is around $4M and $2.5M per mile, respectively. These are typical costs and may vary significantly based on the terrain and potential construction challenges.

In Alternative 1, the Project Sponsor will own and operate the dynamic reactive power support devices as well as the new substation. PG&E will continue to own and operate the looped in Round Mountain to Table Mountain 500 kV transmission lines. The reactive device is to be installed in a minimum of two equally sized blocks independently connected to the 500 kV bus to accommodate maintenance and contingencies of the reactive device. These blocks are to be completely independent of each other and have their own dedicated connections to the bus. There will be no single point of failure between them. The blocks will not share a 500 kV breaker and the associated step up transformers shall be separated by a blast wall.

Figure 2: High level schematic diagram for Alternative 1



1.2. Alternative 2 – 230 kV Interconnection at Round Mountain and Table Mountain Substations

In Alternative 2, one +250/-250 Mvar block of the dynamic reactive power support will be connected to the Round Mountain 230 kV substation and another +250/-250 Mvar block of the dynamic reactive power support will be connected to the Table Mountain 230 kV substation. The Project Sponsor will develop both of the dynamic reactive devices and connect them to the 230 kV bus at the respective substations. The incumbent participating transmission owner, PG&E, will install second 500/230 kV transformers in both Round Mountain and Table Mountain substations and will extend the 230 kV bus to facilitate the interconnection of the dynamic reactive device. The following schematic diagram (Figure 3) provides a high level connections in the area. The cost estimate for PG&E's scope of work is $91M and $43M for Round Mountain and Table Mountain, respectively.

Figure 3*:* High level schematic diagram for Alternative 2

Figure 3.a: Round Mountain 230 kV Substation

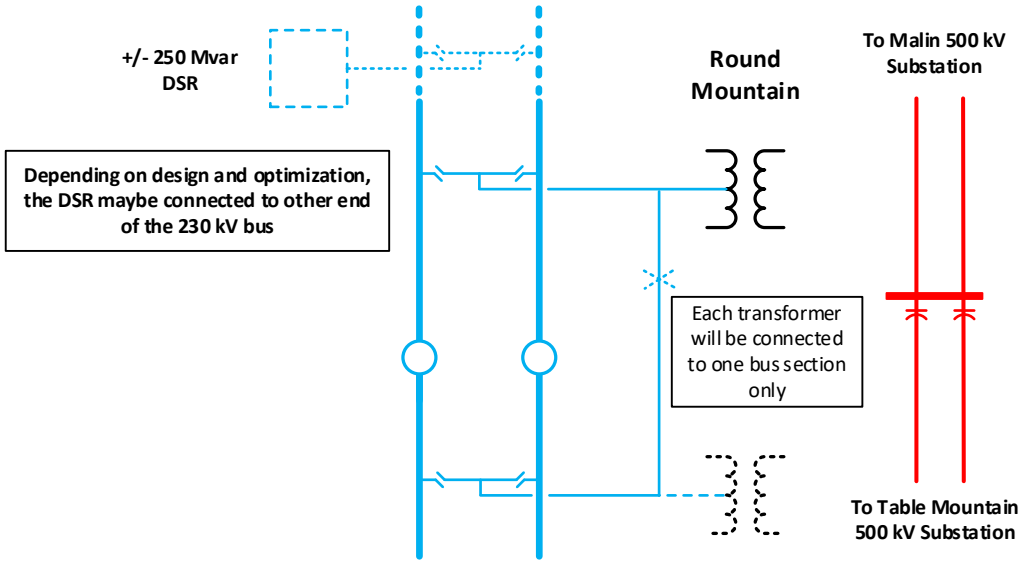
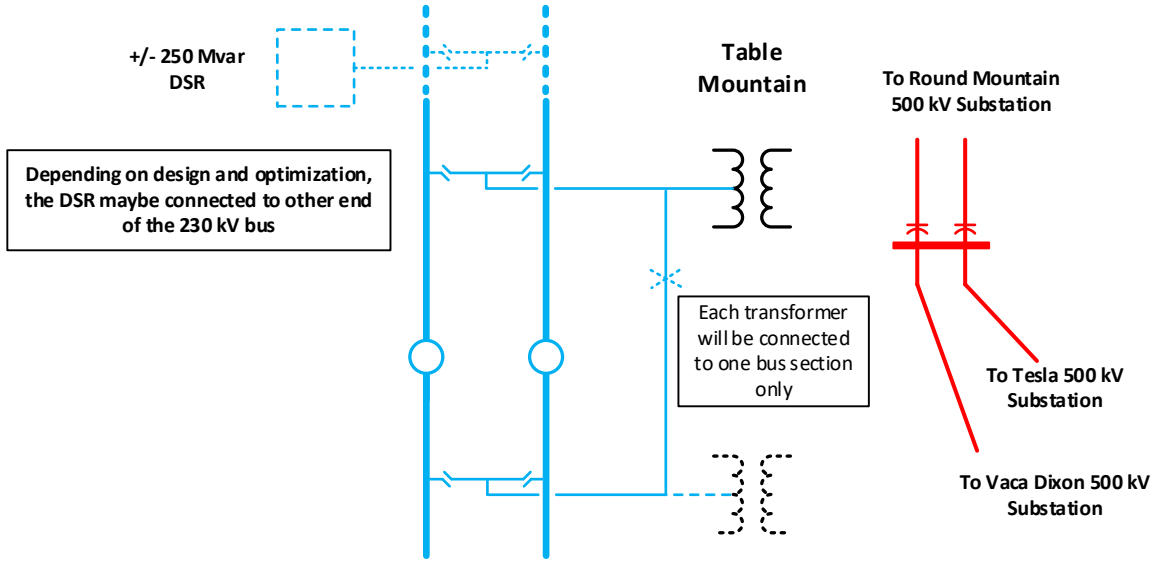


Figure 3.b: Table Mountain 230 kV Substation



2. Functional Specifications

Dynamic Reactive Power Support Functional Specification

2.1. Alternative 1

Point of Interconnection: The new switching station along the Round Mountain – Table 500 kV lines.

Loop-in tie lines: PG&E will be responsible to build the loop-in tie lines connecting the new switching station to the existing Round Mountain to Table Mountain 500 kV lines. If the tie lines are less than one mile they could be on double circuit towers. If the tie lines are one mile or longer, the circuits shall be on single circuit towers.

Rated Real Power Output: 0 MW

Rated Mvar: +500/-500 Mvar. The entire inductive (absorption) range should be continuously available when the voltage is in the 500 kV – 550 kV range and the entire capacitive (injection) range should be available when the voltage is in the 473 kV – 540 kV range. The reactive power will be measured at the end of the tie lines connecting the new switching station to the existing Round Mountain to Table Mountain 500 kV lines (see Figure 2 above).

Response time: The time required for the output to go from 10% of the final value to 90% of the final value shall be less than 100 ms.

Nominal Terminal Voltage: 500 kV (typically the bus voltage is at 530 kV)

Latest in Service Date: June 1, 2024

Inverter Ride Through Capability: NERC PRC-024 requirements and NERC industry recommendation on momentary cessation.

Availability and Reliability requirements: Proposed dynamic reactive power support solutions shall be designed for high availability. All proposals shall provide a calculation identifying the designed annual availability of the dynamic reactive support device proposed.

2.2. Alternative 2

Point of Interconnections: One at Round Mountain 230 kV bus and one at Table Mountain 230 kV bus

Rated Real Power Output: 0 MW

Rated Mvar for each dynamic reactive device: +250/-250 Mvar. The entire inductive (absorption) range should be continuously available when the 500 kV bus voltage is in the 500 kV – 550 kV range and the entire capacitive (injection) range should be available when the 500 kV bus voltage is in the 473 kV – 540 kV range. The reactive power will be measured on the 500 kV side.

Response time: The time required for the output to go from 10% of the final value to 90% of the final value shall be less than 100 ms.

Nominal Terminal Voltage: 230 kV (typically the bus voltage is at 235 kV)

Latest in Service Date: June 1, 2024

Inverter Ride Through Capability: NERC PRC-024 requirements and NERC industry recommendation on momentary cessation.

Availability and Reliability requirements: Proposed dynamic reactive power support solutions shall be designed for high availability. All proposals shall provide a calculation identifying the designed annual availability of the dynamic reactive support device proposed.