

Study 34b – Proposed Transformer Operation Study Plan

Study Plan for Use of Phase-shifting Transformers at Case Springs

Prepared by Nevada Hydro

To limit non-project power through the LEAPS interconnection transmission lines, Nevada Hydro proposes to install phase shifting transformers. When operating the project to pump water back to Decker Canyon from Lake Elsinore, or vice versa, both the Case Springs Substation and Alberhill Substation ends of the Transmission line must be closed for the phase shifting transformers to ensure non-project power does not flow from Case Springs to Alberhill (or from Alberhill to Case Springs). To accomplish this operation, Nevada Hydro will need to demonstrate through this study how the phase shifting transformers are operated in a manner to accomplish the above stated objectives. The study should provide details regarding the proposed operation of the phase shifting transformers and includes comments on the detailed operations plan from the two transmission owners to which the Leaps Project interconnects, San Diego Gas and Electric and Southern California Edison, and the California Independent System Operator (CAISO).

Description of the Case Springs Phase-shifting Transformers

Nevada Hydro is planning to install three phase-shifting transformers at the new Case Springs Substation. These will be operated at a nominal voltage of 230 kV and will each have 33 phase angle positions. This will provide a change of angular position of up to +/- 32 degrees. This would be a change of 2 degrees in angular position for each step of the transformers. Each of the three phase shifters would have a capacity rating of 500 MVA. It should be noted that the angular range of the phase shifters is considerably greater than the system angular difference between the Palo Verde 500 kV bus and the most negative angle of the San Diego 69 kV system under peak demand conditions in the 2021 WECC Summer Heavy load flow base case.

The retirement of the San Onofre Nuclear Generating Station (SONGS) has changed the expected operations of the Case Springs Phase shifters in a positive way from the pattern seen in Nevada Hydro's June 2007 study of phase shifter angular positions. This positive change is that under normal conditions the center point of angular position of the phase shifters is essentially at a zero position (no shift), as compared to the approximately -15 degrees needed with SONGS operating. Thus, the full +/-32 degree shift is available to manage flow requirements without any base angular offset.

Description of the LEAPS Project with Associated Transmission Ties

Please see the LEAPS Area Transmission diagram, below.

System Conditions to be Used in Study

The system conditions to be used in the study will be selected to provide the widest changes in system performance that are available for the first few years of expected service by LEAPS. Those conditions are the WECC 2021 Spring Light Load Case and the 2022 Summer Heavy Load Case. These will have wide diversity in time of day, flow directions, and transmission loading conditions.

Study of the Case Springs Phase-shifter Operations under Normal System Operations

The LEAPS generation will seek to operate under a schedule planned to optimize the use of the water availability. To some extent, this schedule can be foreseen now, but will require detailed refinement as it begins operation. The scheduled time of operation of the Project, in either a generating or pumping (load) mode and from which direction (via the tie to Case Springs or the tie to Alberhill), will provide the system operators with the information needed to operate the Case Springs phase shifting transformers such that through-flow from SCE's Alberhill Substation to SDGE's Case Springs Substation, net of power from or to the LEAPS Project, is minimized. This operator-directed flow management of the two LEAPS tie lines will be done entirely through the Case Springs phase shifting transformers.

This study will review and extend as necessary the required operation of the Case Springs phase shifters to give minimum net through-flow. Tests will be conducted using system normal transmission conditions and changes in generation at various locations. The objective is to test the effects of east-west power delivery changes through a variety of load and generation scenarios that would impact the operation of the Case Springs phase shifters.

Generation Scenarios to study (with LEAPS either pumping or generating)

High internal generation in SDGE and low SDGE purchase from Palo Verde area
High internal generation in SDGE and pumping at LEAPS
High Generation in SCE's LA Basin and low generation in SDGE
Low Load and generation in SDGE and high generation in Arizona (Pump LEAPS)
High Columbia Basin delivered south and low SCE Generation

Study of the Case Springs Phase-shifter Operations under Contingency Conditions

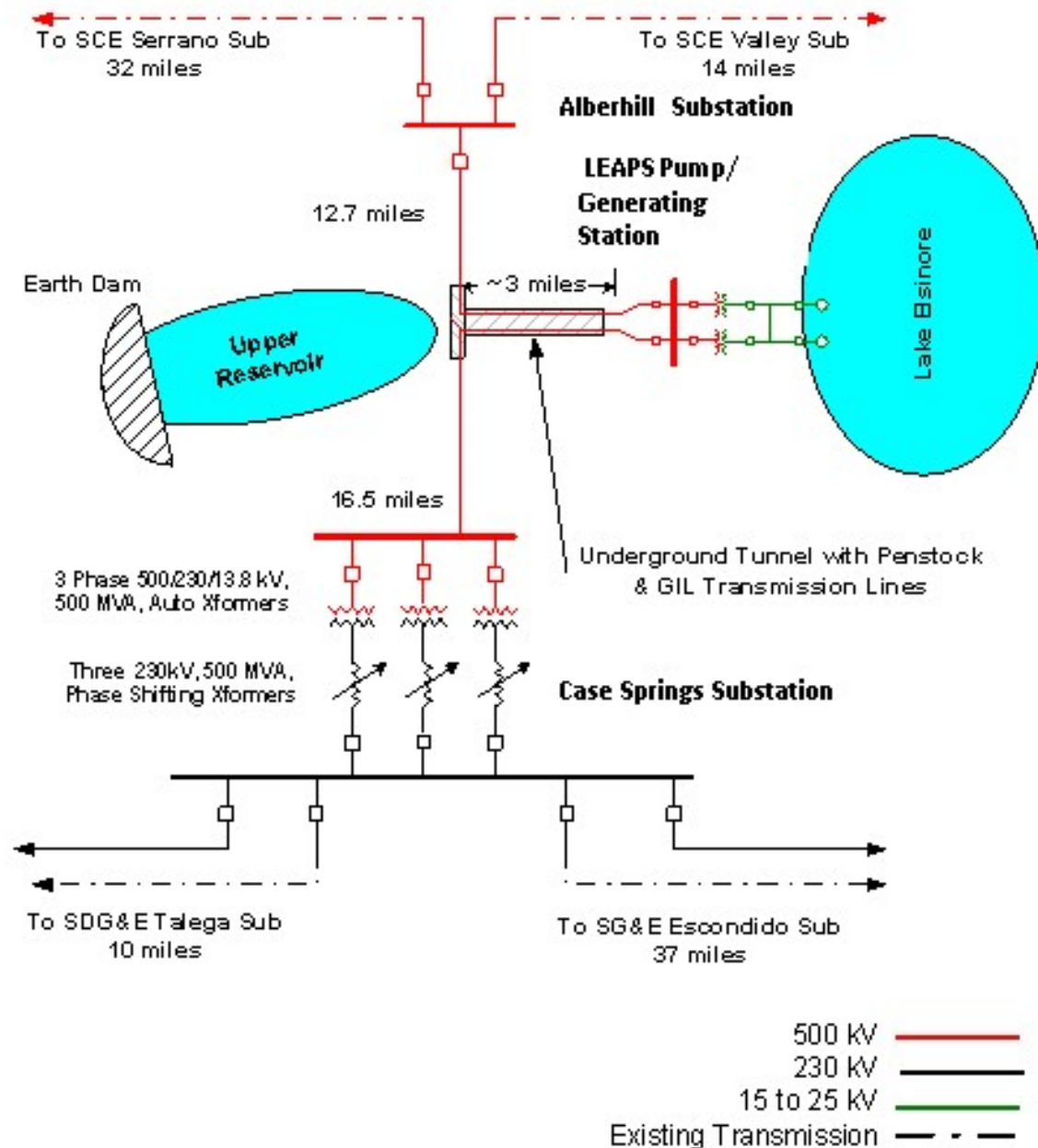
The objective of these tests would be to see what impact on phase shifter operation would occur when critical transmission elements are lost. All tests would be what is known as "N-1" contingency analysis.

Transmission Contingencies to study

one Case Springs phase shifter and associated 500/230 kV transformer,
Alberhill-Serrano 500 kV line,
Alberhill-Devers 500 kV line,
One Case Springs-Talega 230 kV line,
One Case Springs-Escondido 230 kV line,
Imperial Valley-Miguel 500 kV line,
Imperial Valley-Central South (formerly Sycamore) 500 kV line,
Imperial Valley-North Gila 500 kV line,
One SONGS-Talega 230 kV line,
SONGS-Viejo 230 kV line, and
One SONGS-Santiago 230 kV line.

Contingency tests beyond the "N-1" tests would be beyond reasonable design planning for net through-flow on the LEAPS tie lines and may have more serious issues for other reasons.

LEAPS Project One-Line
 Proposed Transformer Optimizations
 3 May 2007



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