Protective Relaying Challenges Faced During the "CONTROL CUBICLE REPLACEMENT" Project

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Company Overview

- CenterPoint Energy is a gas and electric delivery company operating in several states.

- CenterPoint Energy Houston Electric (CEHE) is a structurally unbundled transmission and distribution utility serving Houston, Galveston, Freeport, Baytown, and surrounding communities in the state of Texas. CEHE does not own or operate power plants, nor does CEHE participate in competitive electric energy markets.

- CEHE has a small geographic footprint, but serves approximately 25% of the electric load in the ERCOT region.

CEHE service area

Hurricane Ike, Sept. 2008

Transmission Protection Scheme Relaying Challenges

Substation Water Damage after Ike

Transmission Protection Scheme Relaying Challenges

Control Cubicle Overview - Before

Transmission Protection Scheme Relaying Challenges

Yard Equipment Overview - Before

Transmission Protection Scheme Relaying Challenges

General Substation Configuration

- In total, seventeen panels pertaining to transmission system protection had to be built for the new raised control cubicle.

- Each panel had two to three relays on it with a total of 49 microprocessor relays.

Transmission Protection Scheme Relaying Challenges

138kV Lines

- Three of the 138 kV lines utilize dual-pilot protection schemes.
- The Line current differential (LCD) protection scheme with tapped load (a single distribution power transformer) presents a challenge to the inherent nature of the LCD protection scheme.

Transmission Protection Scheme Relaying Challenges

138kV Lines

- As such, an additional measure has to be taken by introducing additional protection elements.

- Back-up phase and ground distance elements were chosen to supervise the differential element so as to ensure security, i.e., avoidance of tripping for out-of-zone faults which occur on the transformer low voltage system.

Transmission Protection Scheme Relaying Challenges

138kV Lines

- One of the 138 kV lines has a substation with two distribution power transformers that is connected to it.
- This ‘tapped load’ is referred to as a ‘sectionalizing’ substation.

Transmission Protection Scheme Relaying Challenges

138kV Lines

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138kV Lines

Transmission Protection Scheme Relaying Challenges

69kV Lines

Transmission Protection Scheme Relaying Challenges

69kV "Tie-Bus" Panel

Transmission Protection Scheme Relaying Challenges

69kV "Tie-Bus" Panel

- The by-pass switch has both an "a" and "b" contact wired to the relays for added security.
- These two contacts must be in opposite states for the by-pass switch status indication.
- In the relays, all these conditions have to be true, before the relays can switch to that group.

Transmission Protection Scheme Relaying Challenges

Autotransformer Bus Differential Panels

Transmission Protection Scheme Relaying Challenges

Transition from Old to New Control Cubicle

- It can be seen from the example above that nothing about this project was standard.
- Protection for the two autotransformers could not be identical (due to the number of circuit breakers associated with each autotransformer), which added to the design challenge.
- The substation has two distribution power transformers and five 12 kV feeders. It was therefore essential to maintain a substantial portion of it in-service while the replacement project was going on.
- Because only so much work could be accomplished at a time, a challenge arose with regards to transferring the protection schemes from the existing control cubicle to the new control cubicle.
- A lot of temporary cables had to be run between the two cubicles and the protection settings could not be fully implemented at once.

Transmission Protection Scheme Relaying Challenges

Control Cubicle Overview - After

Transmission Protection Scheme Relaying Challenges

Yard Equipment Overview - After

Questions/Comments?