

HPI Principles in Switchyard Design

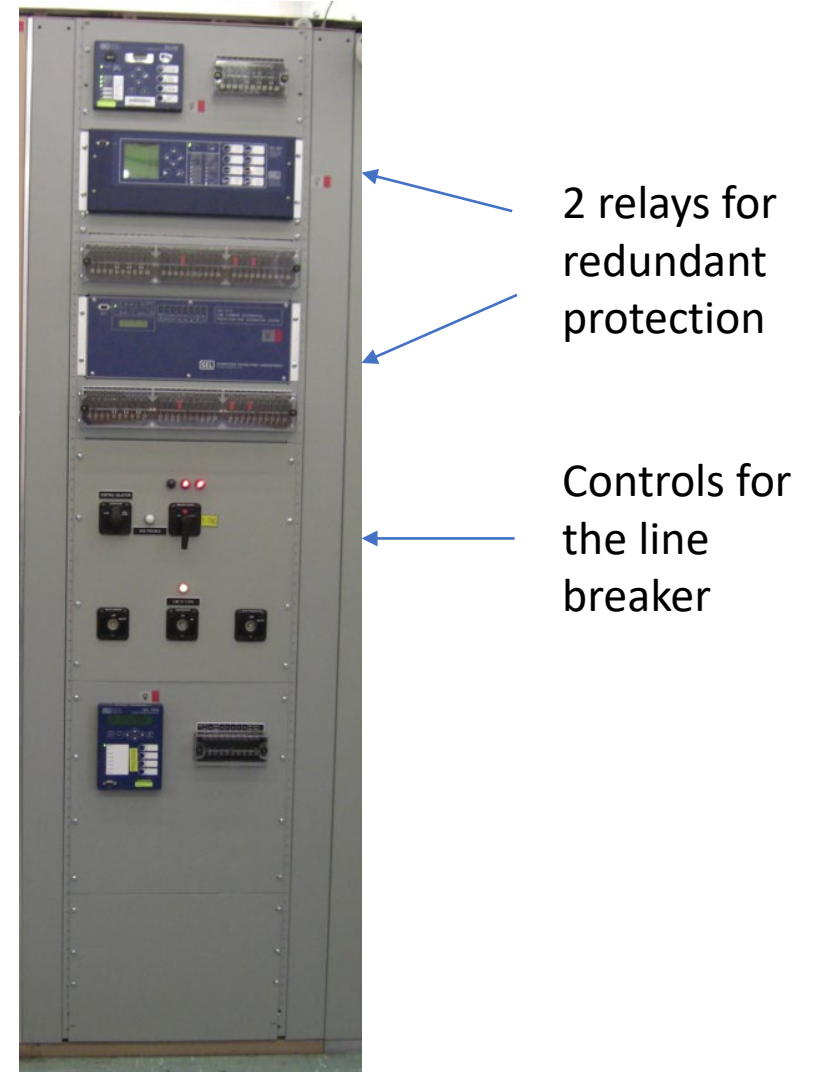
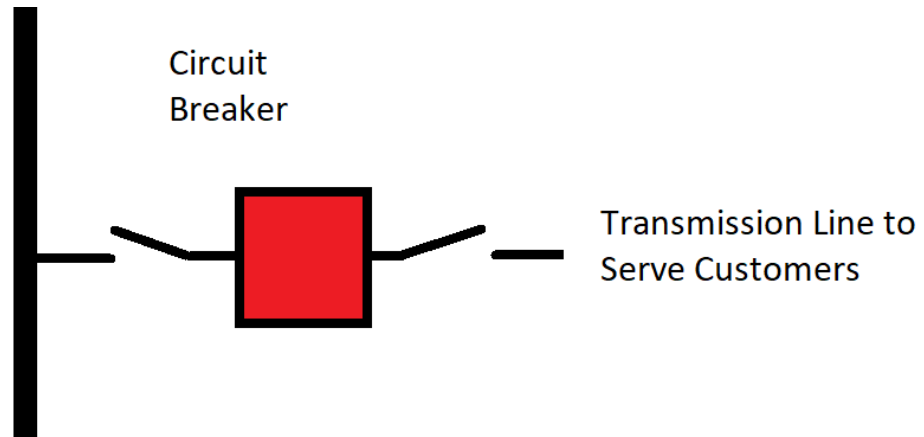
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Transmission is faced with a change:

- For the new station near Malaga, the customer has specified a different switchyard type than what we typically build
- This different type has an increased cost with increased reliability
- The change will impact engineering, wireman, technician, line crews
- HPI conversations started Day 1 of the new switchyard design.

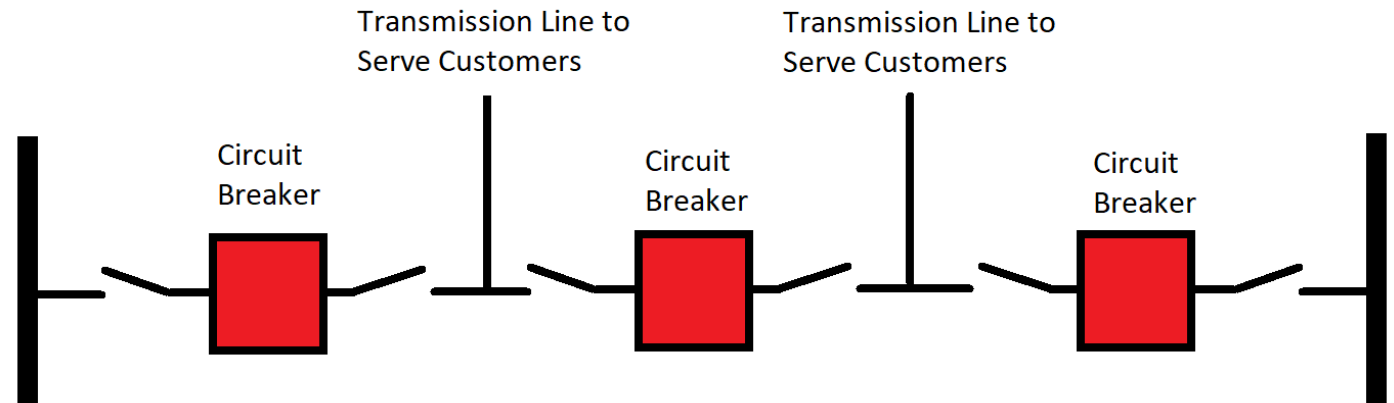
Normal CHPD station and control panel:

- One breaker, one panel:



New station: 'Breaker and a Half'

- 3 breakers, 2 lines: $3 \div 2 = 1.5$ breakers per line -> 'breaker and a half'
- Benefits: Easier switching, easier maintenance, better load service and faster restoration
- Drawbacks: More cost, more complexity, bigger or more relays to handle the more complex protection



HPI Challenges

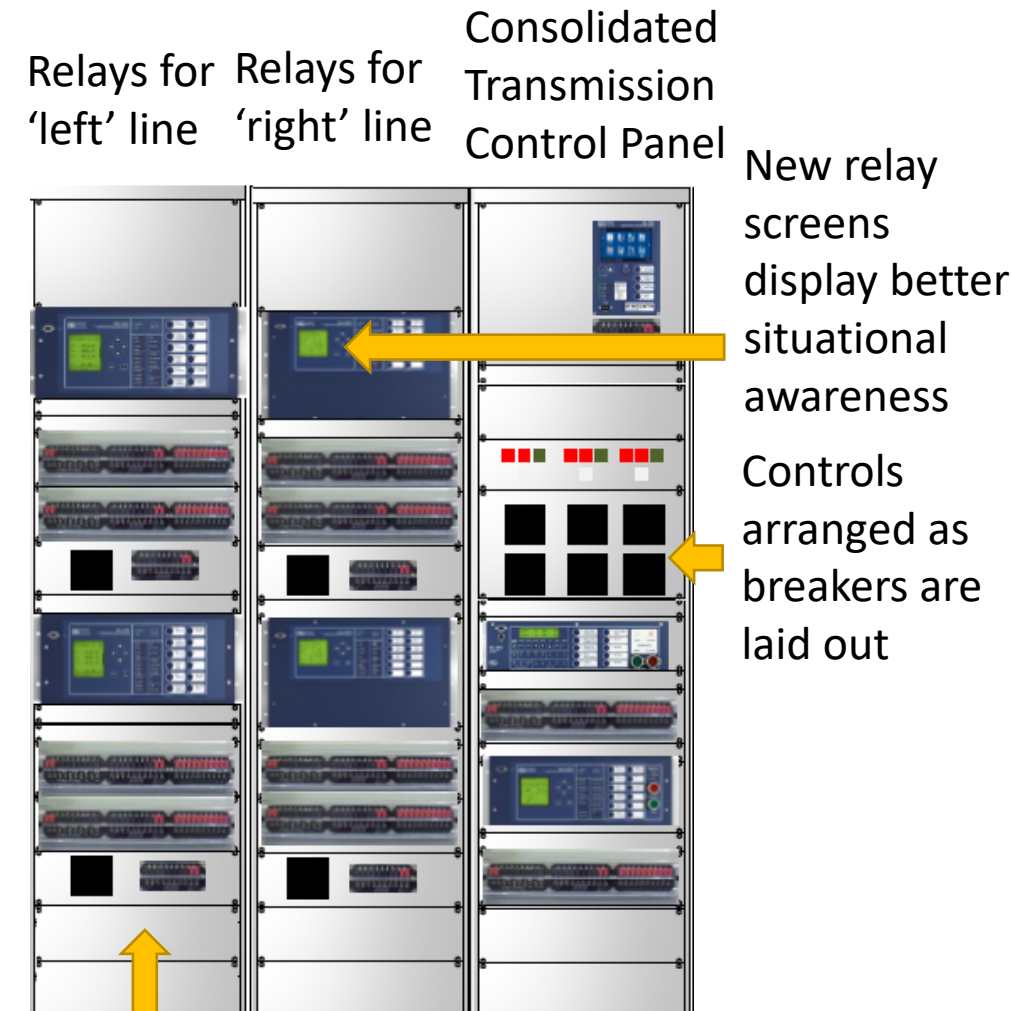
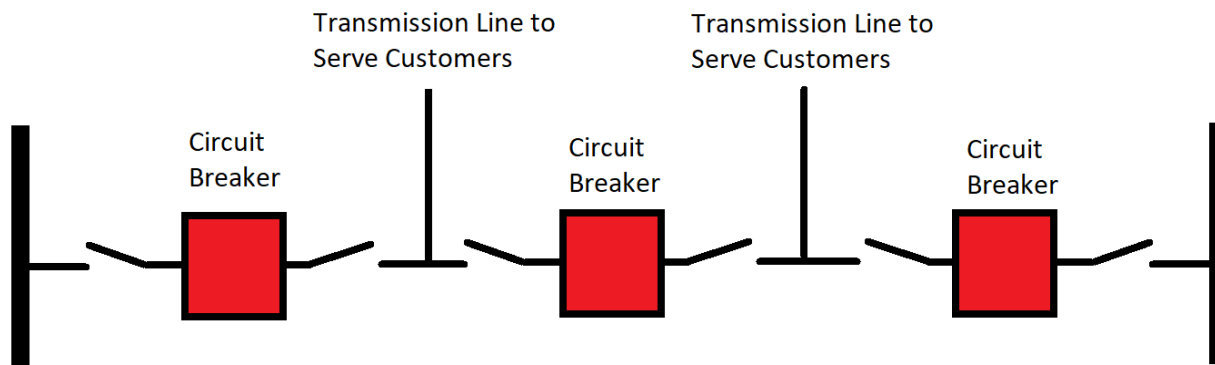
- District crews don't normally work with this type of station
- How can we design a station that is different, yet have it functionally "feel" similar to our existing stations?
- Bigger and more complex protective relays mean less space for other equipment
- How can we maintain a reasonable control house size?

Solution Approach:

Recognize	Recognize 'usual' won't work here
Scope out	Scope out requirements and constraints
Brainstorm	Brainstorm HPI options; external resources
Discuss	Discuss options with design team
Develop	Develop quality proposals
Reach out	Reach out to crews to get their feedback on the new designs (HPI for crews is different than HPI for engineering)

HPI-Embedded Solution

- Intuitive Design, protection and control together
- Based on input from engineering and crafts
- Understandable and clear panel functions
- Compact and concise arrangement for control house size
- Risk of work-related errors is reduced
- Faster restoration, faster troubleshooting



Redundant relays separated vertically (reduce the possibility for side-by-side equipment work errors)

Any Questions?