RFL UTILITIES SOLUTIONS

HOW DO I BYPASS POWER LINE CARRIER SIGNALS AROUND A SERIES CAPACITOR WHILE ADDING IT AS A THIRD TERMINAL?

THE SCENARIO

Two utilities are interconnected via a 100+ mile 345 kV transmission line which connects renewable generation in low-population areas with increasing demand in a metropolitan area. For various strategic and technical reasons, the regional operating body has determined that a series compensation capacitor will be installed in the middle of the transmission line, providing more transmission capacity and integrating renewables while utilizing existing transmission infrastructure.

Power Line Carrier (PLC) has long been used as the primary protection communication channel between the existing stations (Station A and Station C). The utilities want to preserve the existing end-to-end protection channel. They also need to add direct transfer trip (DTT) over PLC at the series capacitor site (Station B) to and from each of the remote stations.

Since line traps will be installed on each side of the new station, at first glance it looks like this will require re-keying of the protection functions at the midpoint Station B, from one carrier system to another. Re-keying a signal from the A-B equipment to the B-C equipment will reduce the overall reliability of the system due to the added logic processing and relay operate time (which will increase overall channel delay), and also because of the increased hardware requirement. **See Page 2: Midpoint Station B – Initial Scheme (*simplified*).**

THE SOLUTION

RFL took a step back and re-evaluated options for this application. The outcome: using balanced hybrids to add, drop, and bypass the protection signals into, out of, and around the midpoint Station B. Compared to the re-keying scheme initially envisioned, this circuit has a big advantage – it is entirely passive, with no copper interconnections between the PLC terminal equipment at the midpoint station, no additional active components required by the scheme, and no additional end-to-end channel delay.

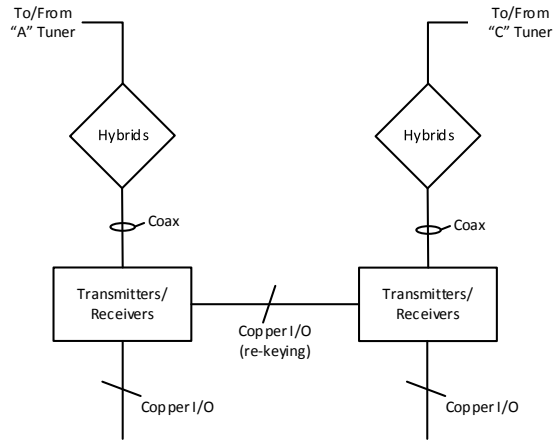
There was some concern about the attenuation caused by the addition of the add/drop/bypass circuit, but the ~6 dB increase in attenuation was deemed to be acceptable when maintenance records reviewed revealed low end-to-end losses for the existing channels. Commissioning proved this out. Overall end-to-end (A-to-C) attenuation from Tx port, through the midpoint station, to Rx port at the remote side was approximately just 22 dB.

THE RESULT

The circuit is not a new one and has been used over the years as a simple bypass circuit around a discontinuity. Using the lessons from the past, RFL helped these utilities preserve existing carrier channels and add new ones, all while isolating the carrier system from the effects of the series capacitor. **See Page 2: Midpoint Station B – Add/Drop/Bypass Scheme (*simplified*).**

HUBBELL

MIDPOINT STATION B – INITIAL SCHEME (SIMPLIFIED)



MIDPOINT STATION B – ADD/DROP/BYPASS SCHEME (SIMPLIFIED)