10/31/2005, At Red Rock Substation, the switching procedure (TWR 814013) called for the isolation of the Red Rock 345kV bus #2 so that a C-phase lightning arrestor could be installed. The arrestor had failed during an earlier event on 10/4/2005.

During this switching procedure, something caused high voltages on Bus 2 and the A & B phase pot transformers vented significant amounts of oil.

The relay potentials have been placed on the Bus 1 position and the pot paralleling switch has been turned off. The dispatcher has opened two 115kV breakers and two 345kV breakers. Everything appears normal at this point. The next step is to de-energize the 345kV Bus #2 by opening 8P22.
Sequence of Events:
07:15:14  8P22 opened
07:15:40  TR 10 MOD opened

8P22 opened to de-energize the 345kV bus 2.
Va goes to 68%
Vb stays at nominal
Vc goes to 48%
No harmonics present.
What is keeping the Bus 2 B-phase PT at nominal voltage?

Sequence of Events:
07:15:14  8P22 opened
07:15:40  TR 10 MOD opened

TR10 MOD opened.
Va jumps to 131%
Vb stays at nominal
Vc rises to 55%
No harmonics present.
Slow speed record only.

8P22 opened (shown on prev. slide.)
Sequence of Events:
07:15:14  8P22 opened
07:15:40  TR 10 MOD opened
07:16:18  8P22 A MOD opened

Va drops to 127%  
Vb jumps to 128%  
Vc drops to 44%  
Va & Vb have significant harmonics now.

High speed record shows harmonics.
Sequence of Events:
07:15:14  8P22 opened
07:15:40  TR 10 MOD opened
07:16:18  8P22 A MOD opened
07:34:16  Va drops to 50%

What caused Va to drop to 50% of nominal 18 minutes after the last switching occurred? No operator actions are known to have occurred around this time.

Vb is still at 127% with harmonic distortion.

07:42:08  Vb drops to 41%

What caused Vb to drop to 41% of nominal 26 minutes after last switching. No switching was recorded at this time.

All three voltages are at approximately 40%. Smooth waveforms are present.

At the start of this record, Va and Vc contain harmonics.
Sequence of Events:
07:15:14  8P22 opened
07:15:40  TR 10 MOD opened
07:16:18  8P22 A MOD opened
07:34:16  Va drops to 50%
07:42:08  Vb drops to 41%

Next steps? We need to understand what happened here. In talking with the maintenance department, it seems like the two theories that could explain the bus energization are the grading capacitors on the ABB HPL 362A2 breakers or some problem with the pot paralleling scheme is allowing backfeed. More testing, investigation, and possibly ATP study work is needed!!!!

RRK 345kV HPL breakers with external grading capacitors.
RRK 345kV Wire wound potential transformers on Bus 2. A & B phase units blew oil out of their tops.