Power swing blocking (PSB) function (68) distinguish power swings from faults.

Out of step tripping (OOST) function (78) distinguish between stable and unstable power swings.
Power Swing Detection Methods

- Blinder Schemes

\[ \Delta T \rightarrow \text{Load Point} \]

- Inner Blinder
- Outer Blinder
Concentric Characteristic Schemes

- Outer power swing detection
- Inner power swing detection
- Stable power swing
- Unstable

SEL-421, SEL-321, SEL-311
Impact of System Impedances on PSB

Case I

Case II
Nonconventional Power Swing Detection Methods

1. Continuous Impedance Calculation

A power swing is declared when all three conditions are true: continuity, monotony, smoothness.
2. Continuous Calculation of Incremental Current

If $\Delta i_k > 5\%$ of $I_n$
and $\Delta i_{k+1} > 5\%$ of $I_n$
and $\Delta i_{k+2} > 5\%$ of $I_n$

$\Rightarrow$ declare a power swing
3. Swing-center-voltage (SCV) method

\[ SCV_1(t) = \sqrt{2} E_1 \sin \left( \omega t + \frac{\theta}{2} \right) \cdot \cos \left( \frac{\theta}{2} \right) \]

(i.e. if \( E_1 = |E_s| = |E_R| \))
SCV method

\[ SCV_i = V_{iS} \cos \phi \]

Assuming \( E_{iS} = E_{iR} = E_i \), then \( SCV_i \approx E_i \cos \left( \frac{\theta}{2} \right) \)

\[
\frac{d(SCV_i)}{dt} \approx -\frac{E_i}{2} \sin \left( \frac{\theta}{2} \right) \frac{d\theta}{dt}
\]

**SCV slope detector**, **swing signature detector**, **Dependable PSB detector**
Out of step tripping (78)

Trip-on-the-way-out (TOWO)

Trip-on-the-way-in (TOWI)

slip