Southern States *RLSwitcher*®
for Tertiary Reactor Switching

Performance from a new perspective.

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Why are Shunt/Tertiary Reactors Used?

- **Shunt Reactors** are used on long transmission lines and cables to regulate the reactive power balance of the system and to control the voltage rise as a result of the lines capacitance.

- **Shunt Reactors** are normally switched off for times of heavy load and are switched on to the lines at periods of low load.

- **Shunt Reactors** are also utilized to manage voltage levels at points where Distributed Generation is attached to a transmission line.

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Considerations when Switching Reactors

- Shunt Reactor switching is a difficult duty

- Currents typically less than 300 A, in Transmission
  & 2kA at Distribution. Easy to interrupt but..

- The interruption may occur when the gap is **NOT** adequate to withstand the fast recovery voltage which will lead to a **"Reignition"**.

- CIGRE Breaker Reliability Study – Reactor Switching Breakers have
  --- **10 times the Failure Rate** of normal breakers

- Reignitions cause high Turn to Turn voltage in Reactor Windings.
  Reactor Failures are predominantly from "Current Chopping" and "Reignitions". (IEEE Transformer Committee, 2007)

Where are Reactors Applied?

Reactors are typically applied at the end of lightly loaded lines or on the tertiary of a power transformer.

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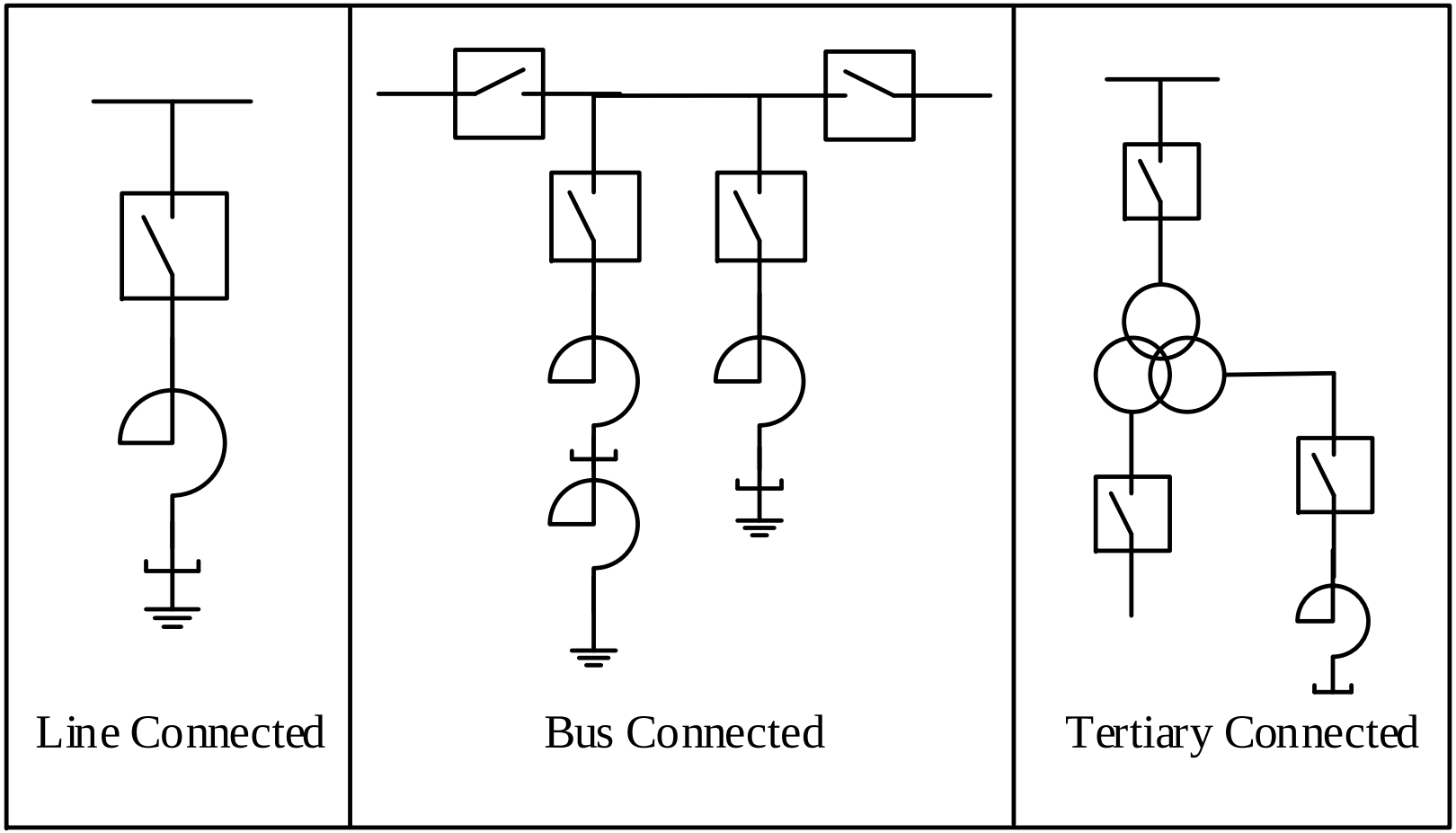
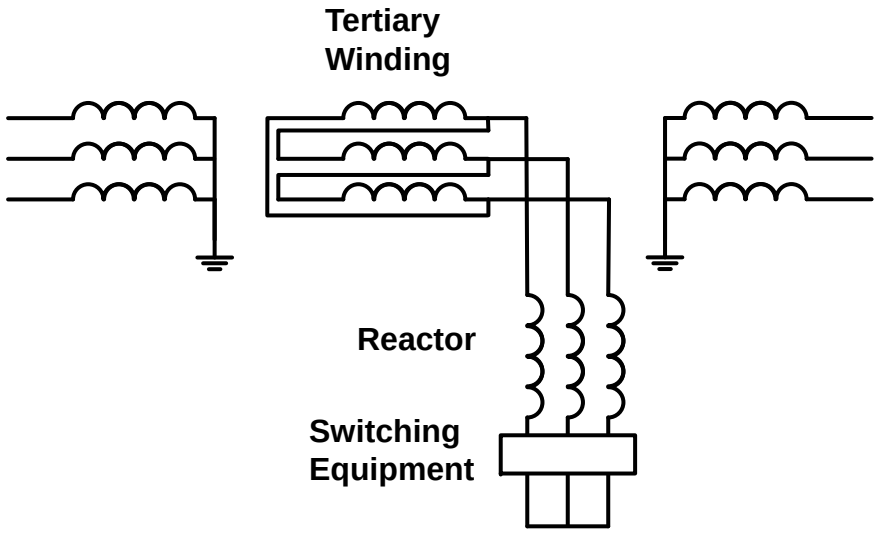
Arrangements where Reactors Used

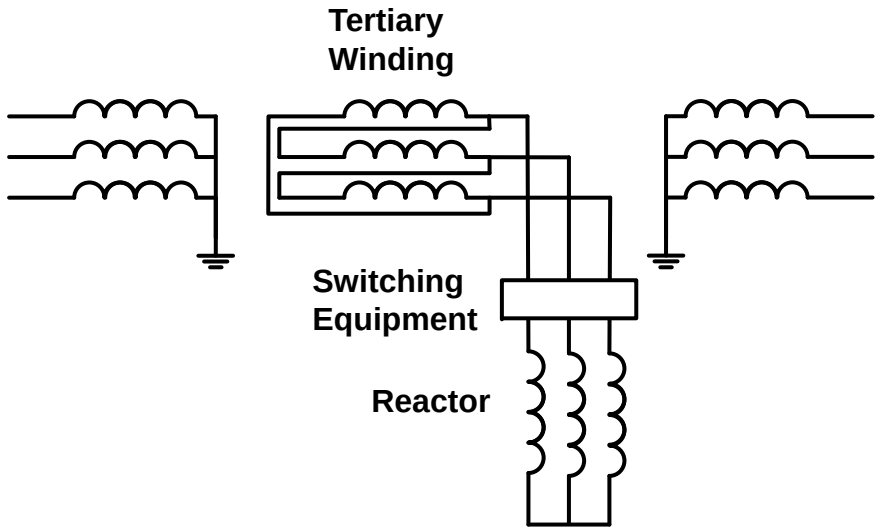


One Lines for Tertiary Reactors

Switched on Neutral Side



Switched on Supply Side



Types of Reactors Used on Transformer Tertiary's

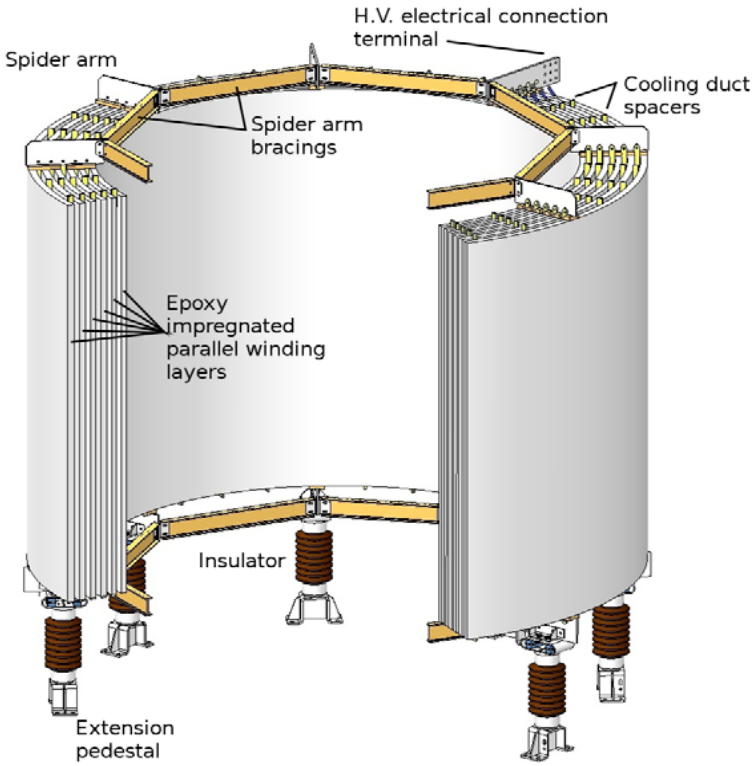


Figure 4 Device under te

Air Core

Iron Core

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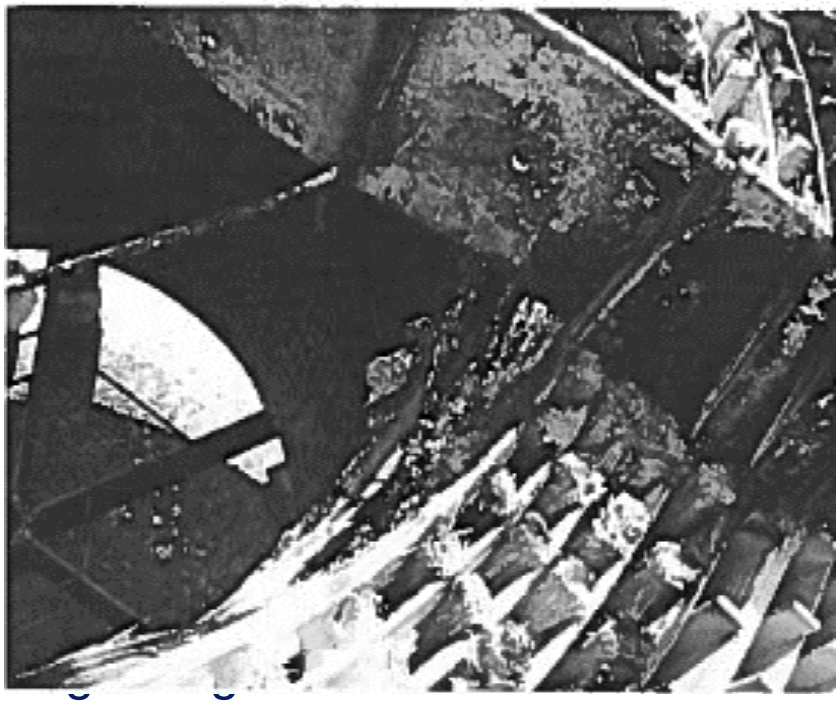
Lightning is Slow
- Compared to Reignitions



Turn to Turn Voltages Lead to Failures

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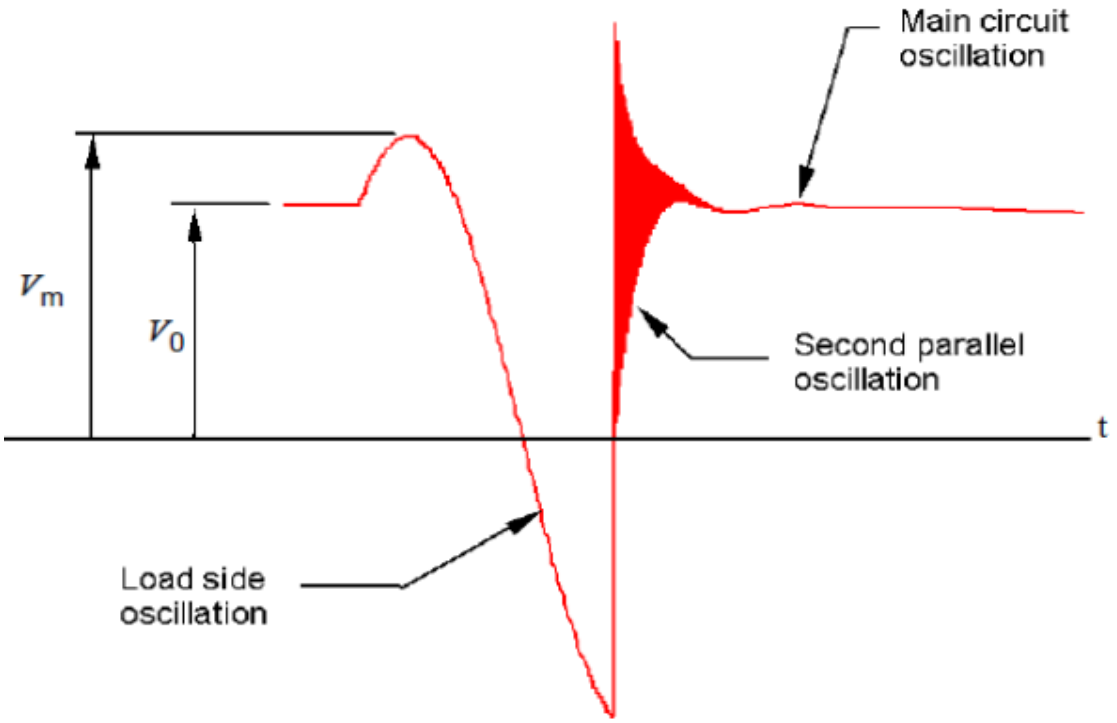
Current Chopping Produces High Voltage to Ground Reignitions Causing High Turn to Turn Voltages



- **Reactors Fail Turn to Turn**

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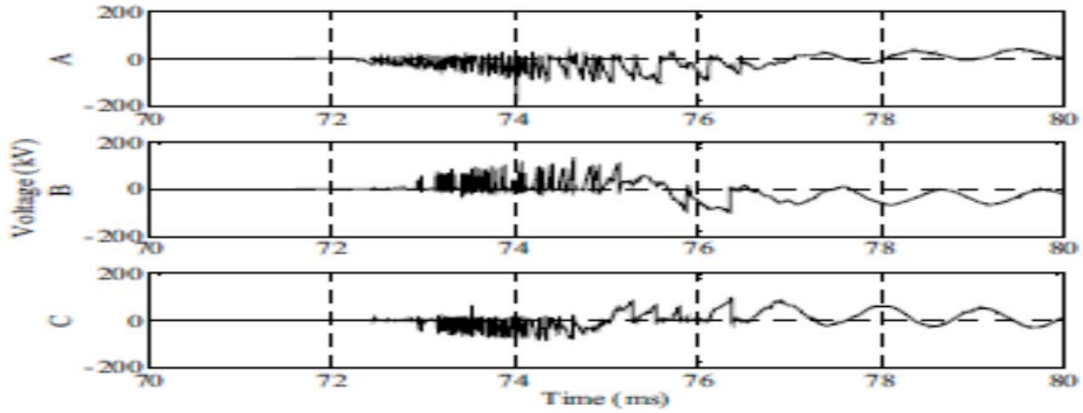
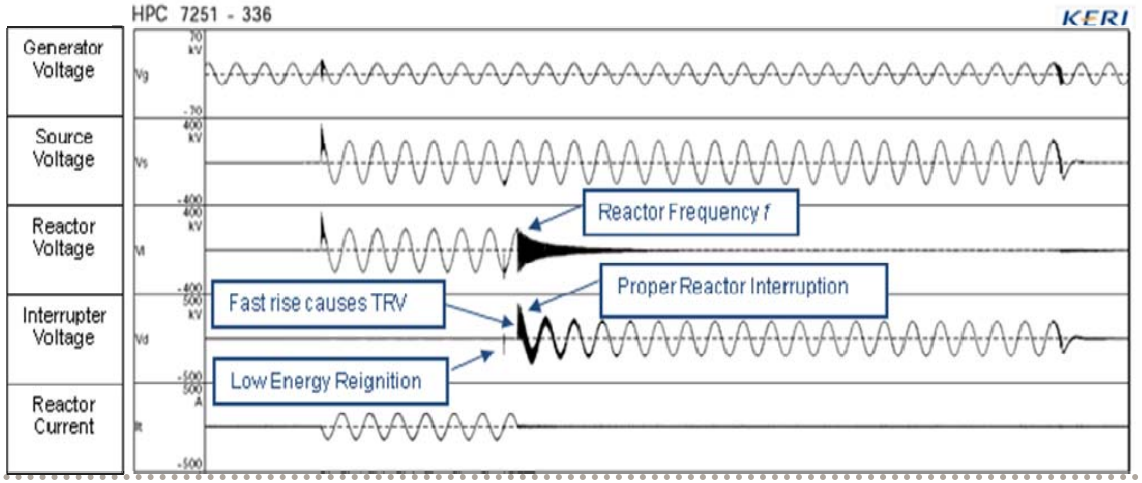
High Frequency Reignitions possible with Vacuum



Low Energy Reignitions & Fewer from New Approach



Performance from a new perspective.

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Technologies used for Switching Reactors

Characteristics of each technology

- Vacuum interrupters can have high chopping currents, high frequency zero interruptions & multiple reignitions
- SF6 Breakers are designed to have high interrupting current
  - Interruption can occur with very small gaps that cause reignitions
  - Not designed to withstand a reignitions without damage.
- RLSwitcher
  - Has low chopping current
  - Has no multiple reignitions
  - Has single gap interrupter
  - Delayed gas flow of interrupter increases contact gap to minimize reignitions

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RLSwitcher®
for Tertiary Reactors

REACTOR SWITCHING RATINGS		
Maximum Voltage Rating (kV)	Minimum Reactor Switching Current (A)	Maximum Reactor Switching Current (A)
15.5	1000	2000
	1000	3000
38	500	1600

ADDITIONAL RATINGS			
Maximum Voltage Rating (kV)	15.5		38
Continuous Current Rating (A)	2000	3000 *	1600
Power Frequency (Hz)	50/60		
Lightning Impulse Withstand (kV)	200		
Short-time Withstand Current (kA/sec)	40 / 2		
Peak Withstand Current (kA)	108		
Short Ciruit Making Current (kA rms / kA peak)	40 / 108		
Creepage Distance (mm)	1842		
Ambient Temperature Operating Range (°C)*	- 40 to + 50		

* At ambient temperatures greater than +40° C to +50° C the 15 kV, 3000 A design has a maximum continuous current rating of 2700 A.

Performance from a new perspective.