

Field Experience with a Series Compensation Device

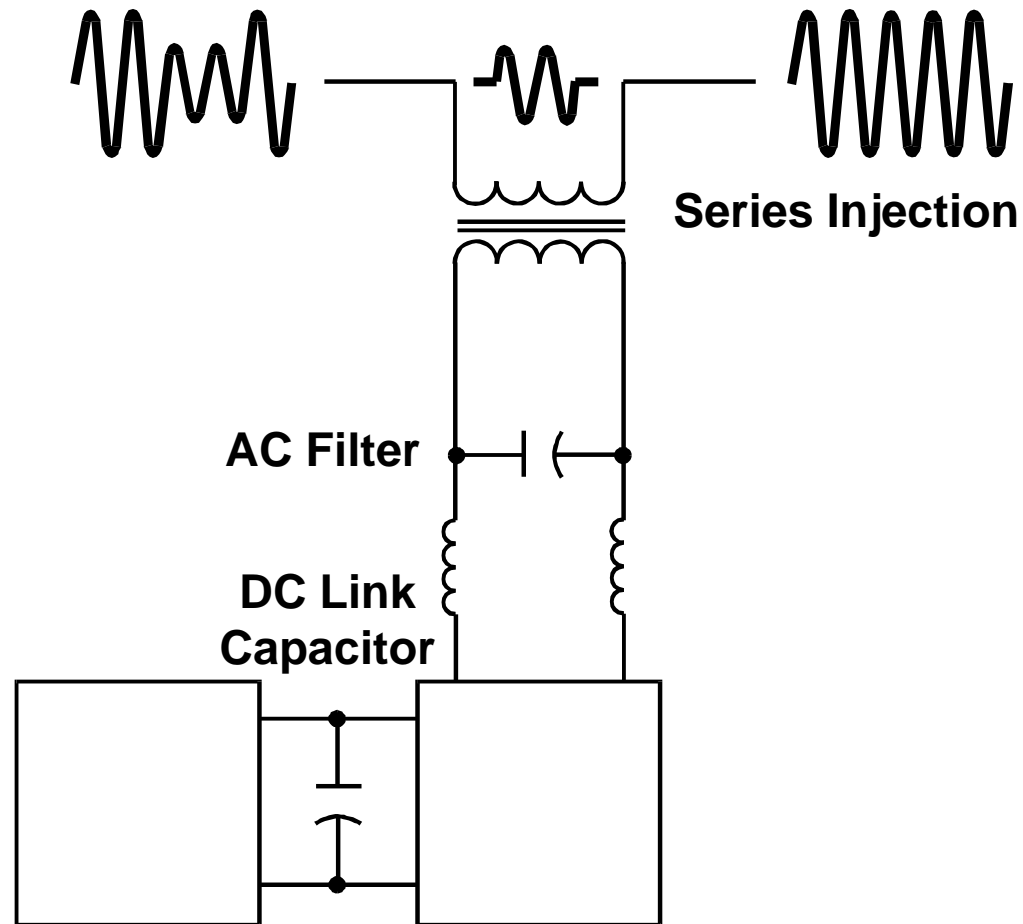
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The Series Compensation Device (SCD)



The Dynamic Voltage Restorer (DVR)

- Westinghouse/EPRI/Duke Power tailored-collaboration
- 50% Rated voltage injection
- Capacitor energy storage
- Installed to protect sensitive textile customer

The World's First DVR installed August 26, 1997



Initial Start-up

- Initial charging of capacitors caused equipment alarms
 - no downtime for customer
 - adjustment solved problem
- Westinghouse personnel on-site
 - DVR only left on during business hours

Reliability Concerns

A Utility's Perspective

- Level of Protection
- Lag-time on replacement parts
- Re-start Time
- Bypass Operation
- Economics

Improving Re-start Time

- Train local personnel
 - Could respond within the day
- Auto-restart
 - Instant
 - Checks for safe conditions
- Remote-restart
 - Hasn't been necessary

Bypass Operation

- Don't want to create more problems for customer
- For protection of both system and SCD
- DVR bypass is virtually transparent to customer

Bypass Circuitry



Monitoring

- Necessary to monitor at input and output
 - Synchronously
- Vital to tracking performance
 - Ensuring optimum design
- Data is essential
 - Tracking benefits / payback time
 - Characterizing customer susceptibility

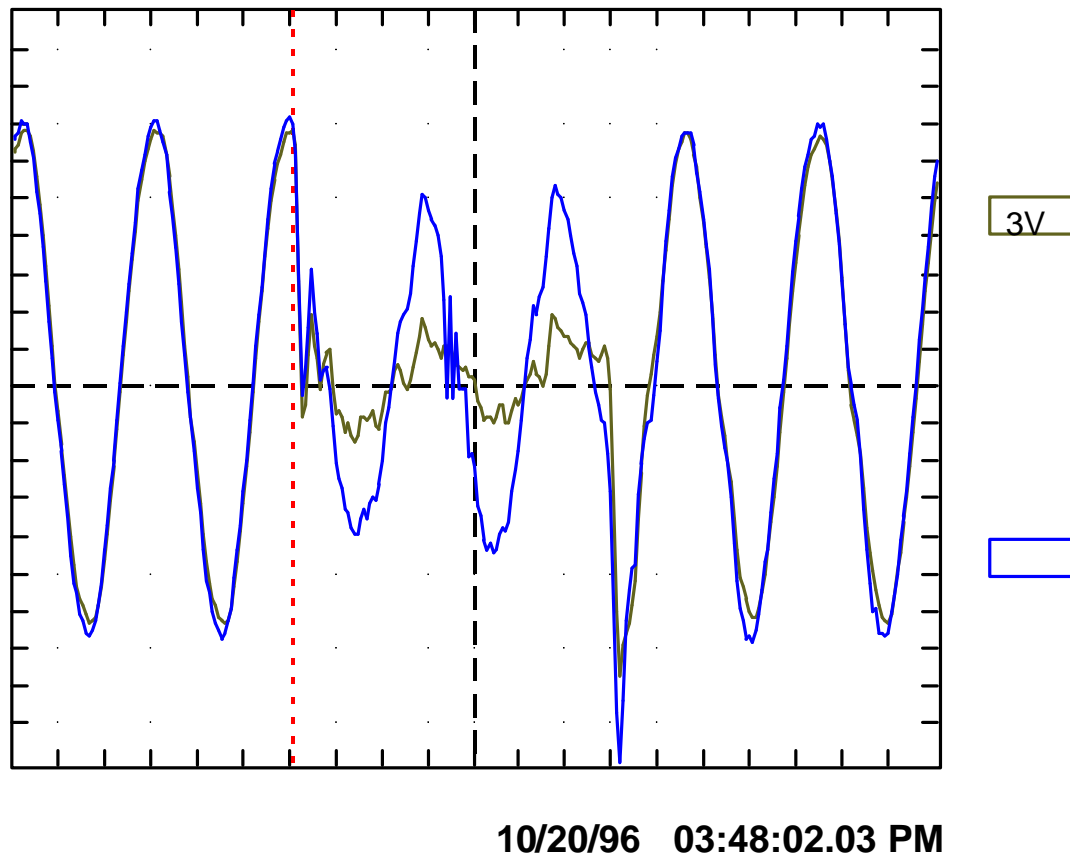
Performance

- Designed for 50% injection
 - Optimal design for customer needs
- Low lightning and storm activity for 1997
- DVR has been totally transparent to customer
- Availability nearing 100%

Performance (cont)

- On-line to correct for over 35 sag events
- Estimated 10 compensations were ‘saves’
- Design and injection capability extremely optimal
- Compensated for first sag 2 weeks after installation
- First ‘save’ within 2 months

First Save



Conclusions

- Lessons learned:
 - Customer equipment characterization essential
 - Monitoring is essential
 - Pre-installation testing is essential
 - Bypass operation is important element
- Duke DVR is a benefit to the customer
- Series compensation technology is successful