Switch Mode Battery Chargers for Utilities: Why? How? and Where?

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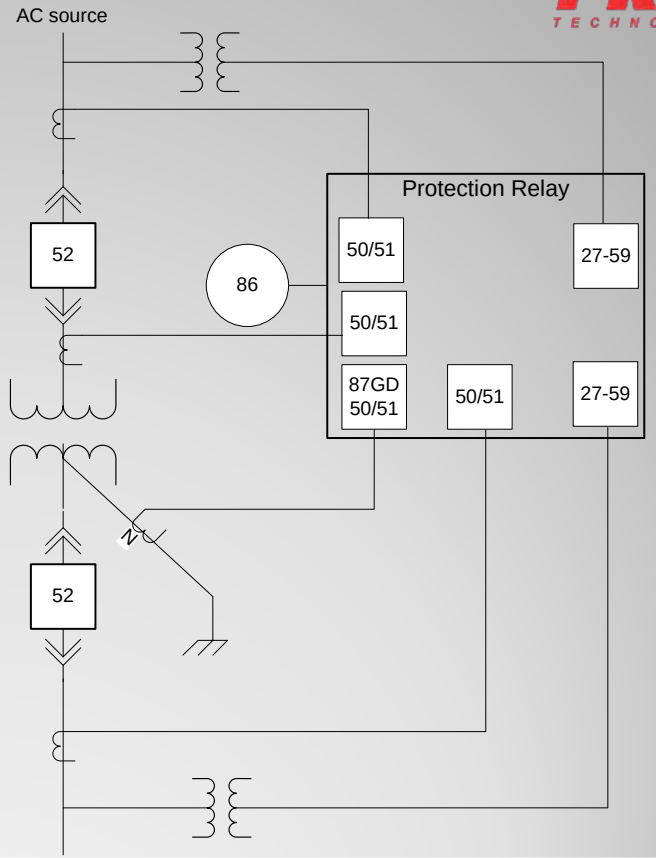
Schedule:

- History
- DC System Review
- SCR Type Battery Chargers
- SMR Type Battery Chargers
- Physical and Environmental Considerations
- Service and Repair Considerations

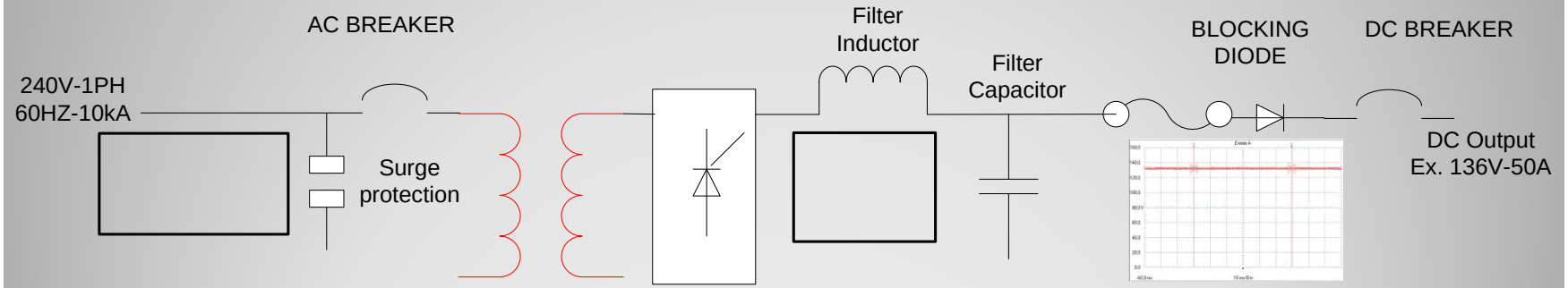
Typical MV switchgear diagram



Common Topologies

- Ferroresonant
- Magnetic Amplifier (Mag-Amp)
- Thyristor (SCR)
- High Frequency switching (Switchmode)

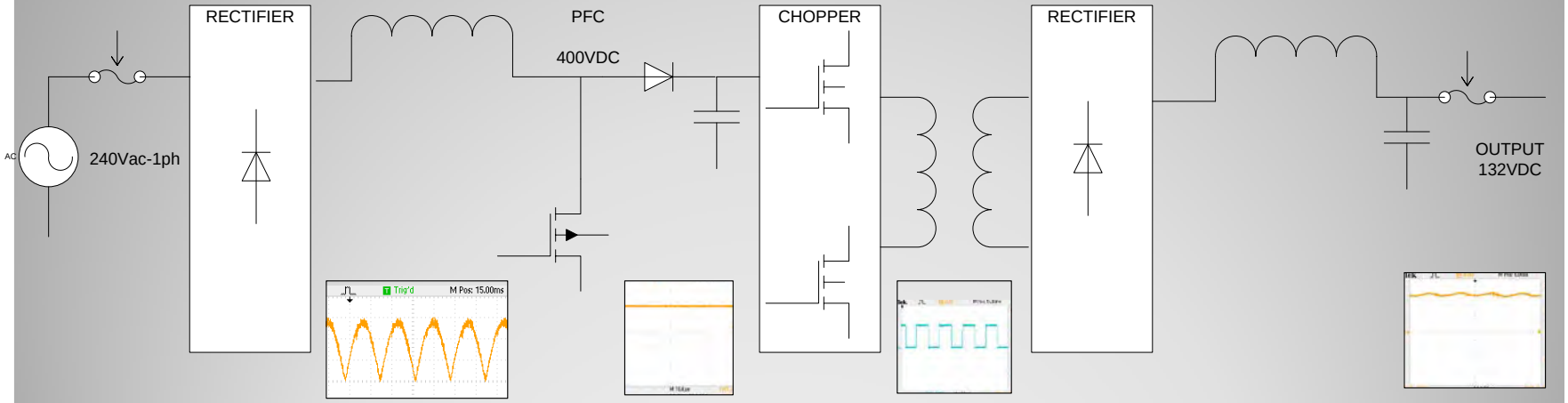
SCR Chargers Electrical Layout



SCR CHARGERS SPECIFICS:

- Single conversion stage
- Low frequency operation: larger components
- Need filters for Power factor and THDi correction

Switchmode Chargers Electrical Layout



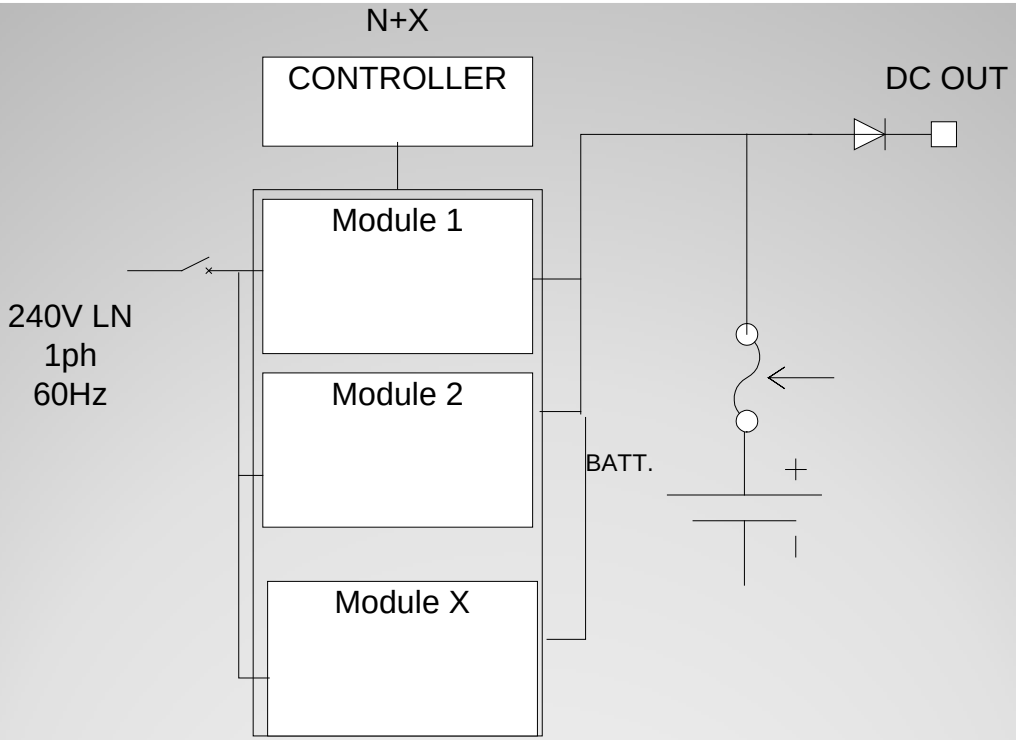
SMR SPECIFICS:

- High frequency -> smaller components
- Compact design -> cooling fans if not: larger footprint
- 4 conversion stages
- 1ph units include PFC and THDi
- 3ph-3wire units: may or may not include PFC and THDi. Complex designs
- 3ph-4wire units: easier to design
- More power -> multiple parallel units
- 19’’ rack design

5kVA transformers: SCR vs SMR

125VDC-30A SCR vs SMR

125VDC-200A 19’’ subrack



REDUNDANT SCHEME N+X

COMPONENTS

SCR

-Larger power -> larger components

SMR

Smaller components -> compact design/PCB mount

PCB mount -> modular designs

Mounting

- SCR: Wall mount or freestanding enclosures

- SMR: 19’’ racks or wall mount enclosures

SCR:

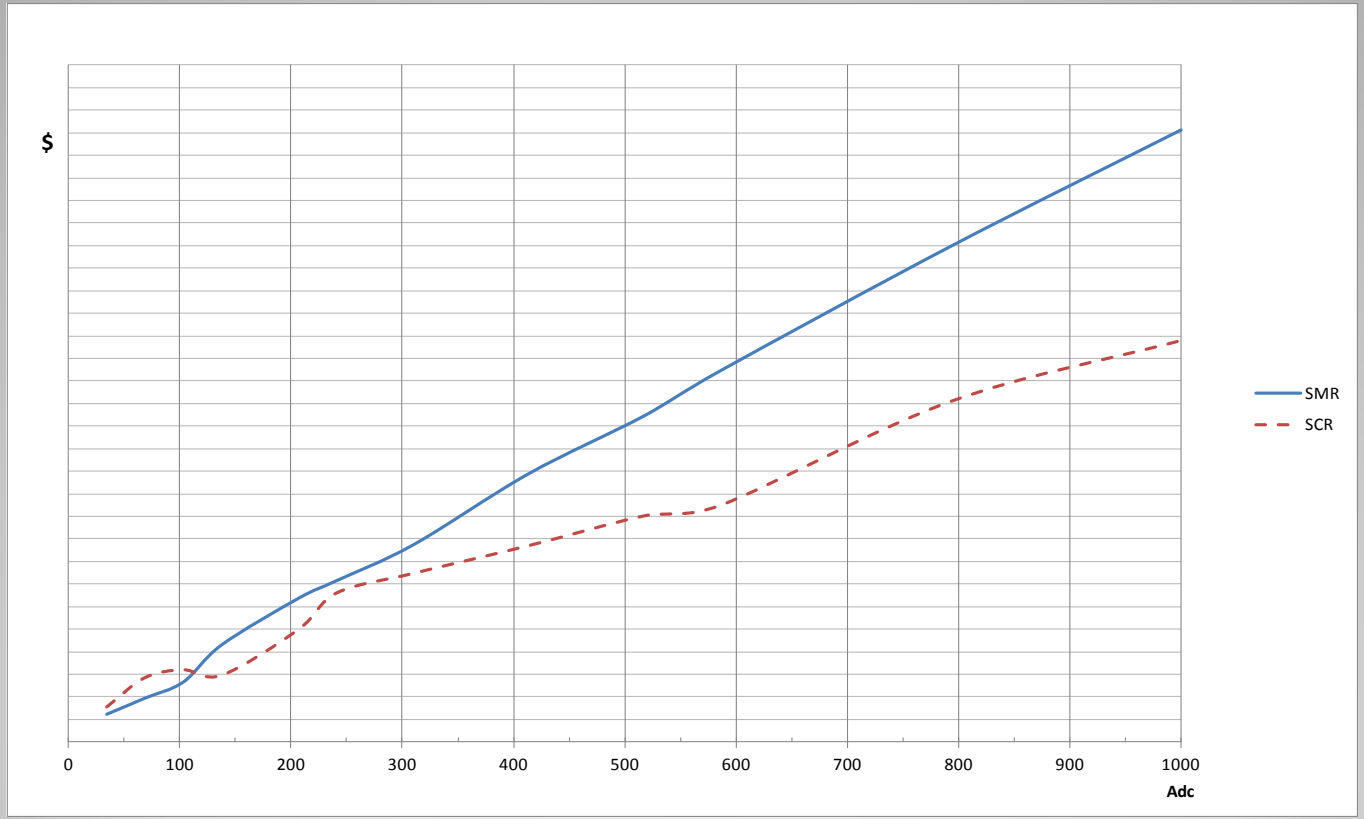
- One component failure: charger is down
- Need of skilled technician
- The failure becomes urgent
- Need of shutting down and disconnecting the charger

Service and repair: Factors to consider

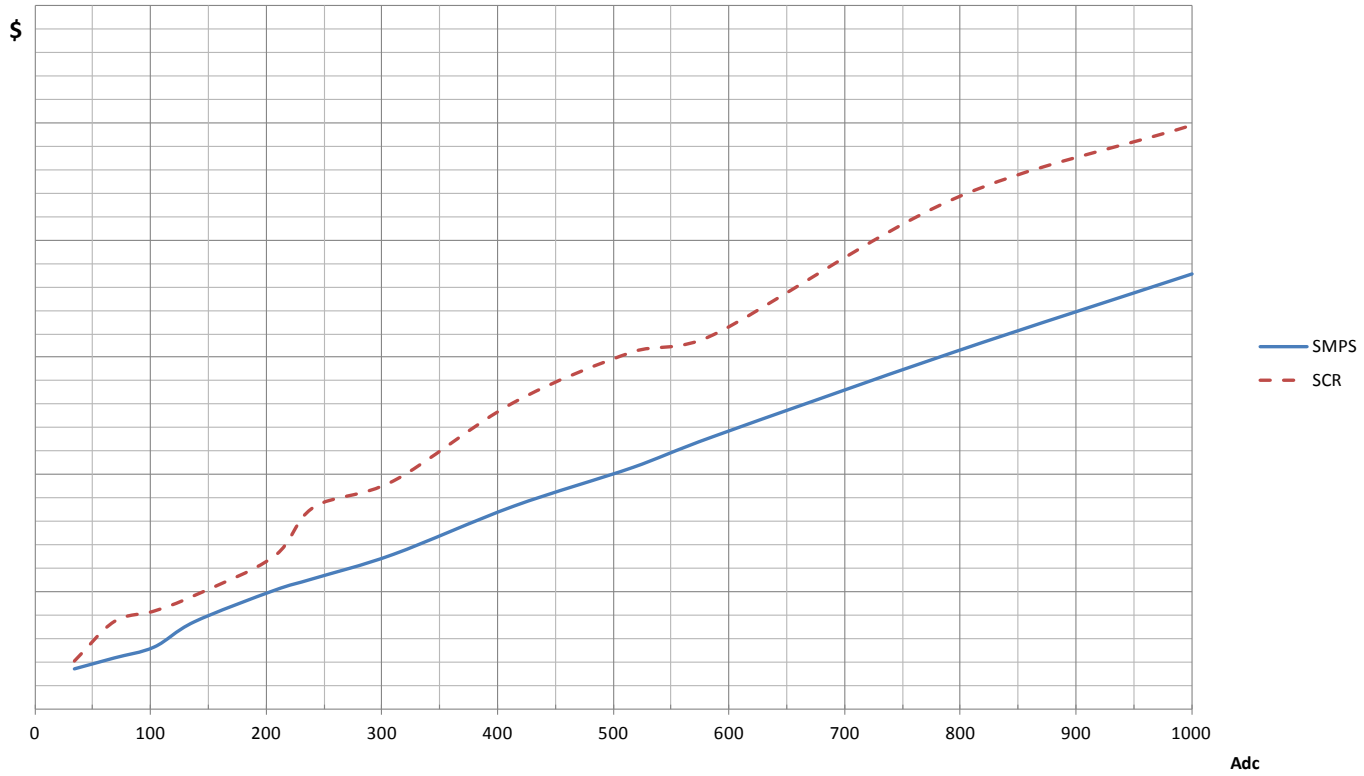
SMR:

- One system is made of multiple parallel units
- One unit failure: reduced power
- If N+1 is implemented: no impact
- Repair can be made by less specialized tech to swap the unit
- No need to shut down the DC system
- Unit can be sent back to manufacturer for repair
- Failure of SMR -> non urgent event

Service and repair: Factors to consider



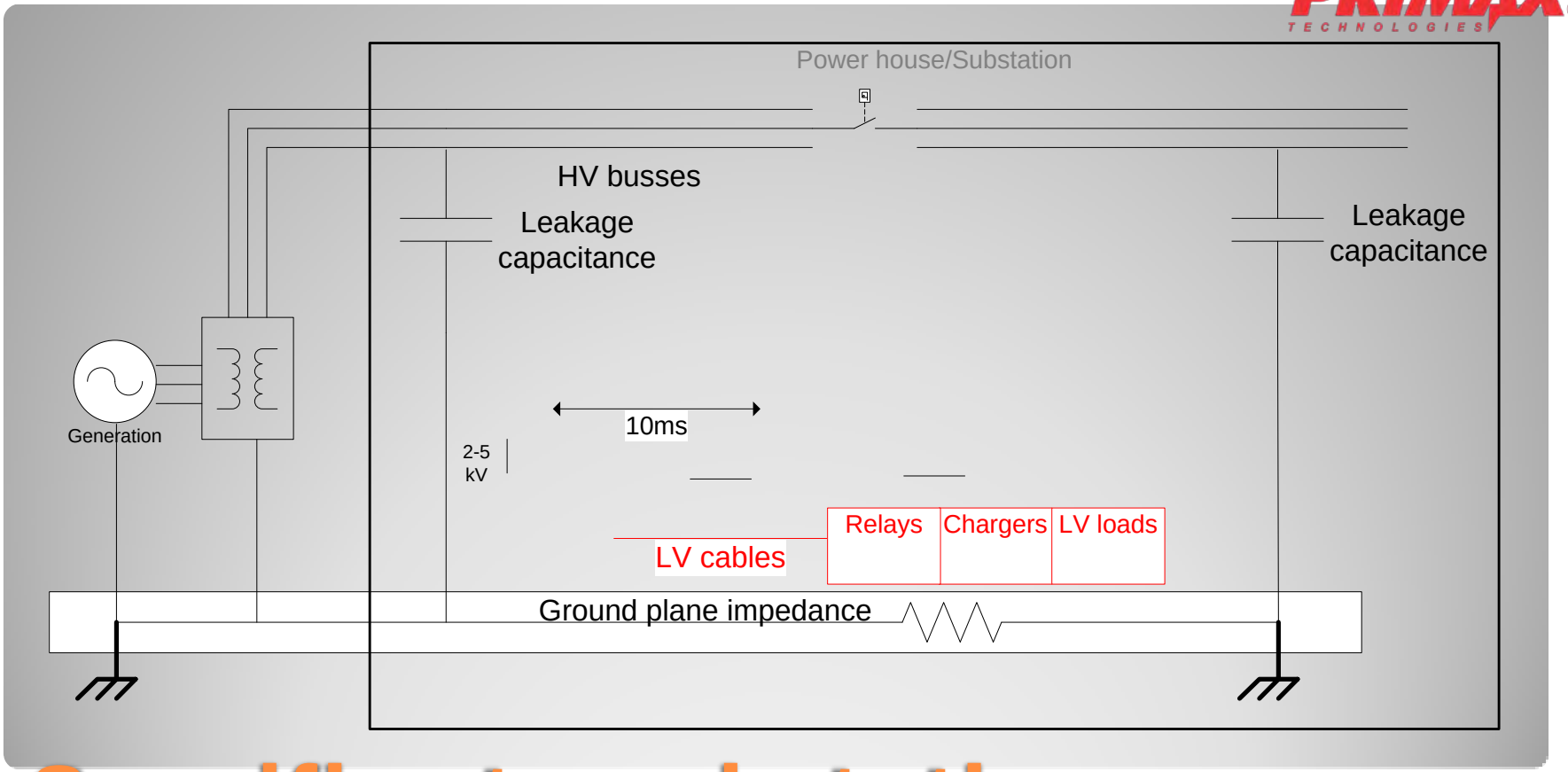
Cost of single SCR vs «N» SMR



Cost redundant SCR vs N+1 SMR

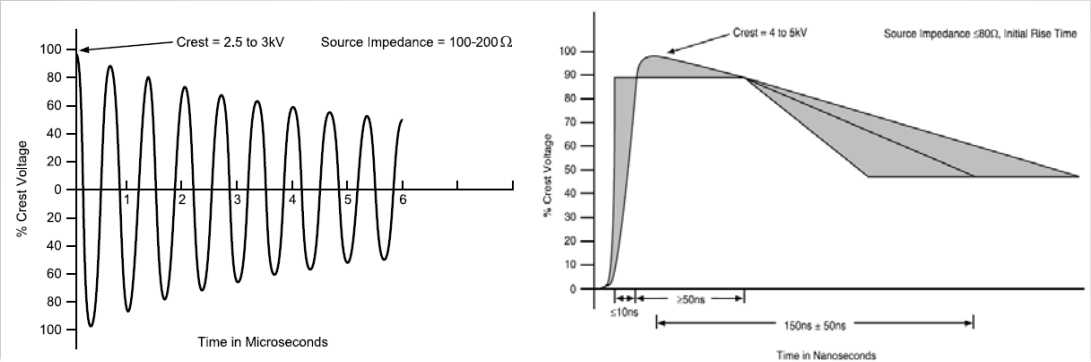
- Low power SCR charger is slightly more expensive than SMR
- High power 3 phase SCR cost become less expensive than SMR
- SCR curve flattens out in larger applications
- SMR curve is quite linear

Comments on Costs



Specifics to substation apps.

- Chargers are installed dirctly under HV and high current busses
- MV Capacitor banks & inductive loads switching
- Transients as high as 5kV occur regularly
- Electrical rooms are not as clean as telecom central offices: more dust and less A/C



Specifics to substation apps.

- Telecom: for over 30 years they are the prevailing option

- Europe and Australia, electrical utilities - over 15 years.

- Some of these utilities exclusively specify SMRs

- Canada: Large utilities started using SMR

SMR Present experience

US and the Canadian industrial markets:

• New gas turbine applications

• Prefab Electrical Houses for industrial applications such as mining, petrochemical and smelting

SMR Present experience

- No simple answer
- Different applications dictate different technologies

What's right for me?

Criterion	SCR	SMR
Scalable	No	Yes
Efficiency	Good	Better
Power management	No	Yes
Input power factor	Relatively poor	Very good
Low ripple	good	better
DC Capacitors aging	Little effect	Some effect
Single point of failure	Yes	No
Serviceability	easy	Very easy
System Reliability	Very good	Very good
Repair time	Good	Better
Phase unbalance & neutral currents	no effect	some effect

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What's right for me?

Criterion	SCR	SMR
Dynamic regulation	Good	Excellent
Transients	Tolerant	Sensitive
Contribution into downstream Fault	Good	limited
Weight	Heavy	light
Size	Large	Small
Heat tolerance	Good	Limited
Dust tolerance	Good	Limited
Natural convection cooling	Yes	Limited
Spare parts	Individual parts	modules

What's right for me?

Can we deploy the SMR on a larger scale for substations and power generation?

Most probably yes.

But not everywhere!

Conclusion

Thank You!