DER Selection for Microgrid Applications

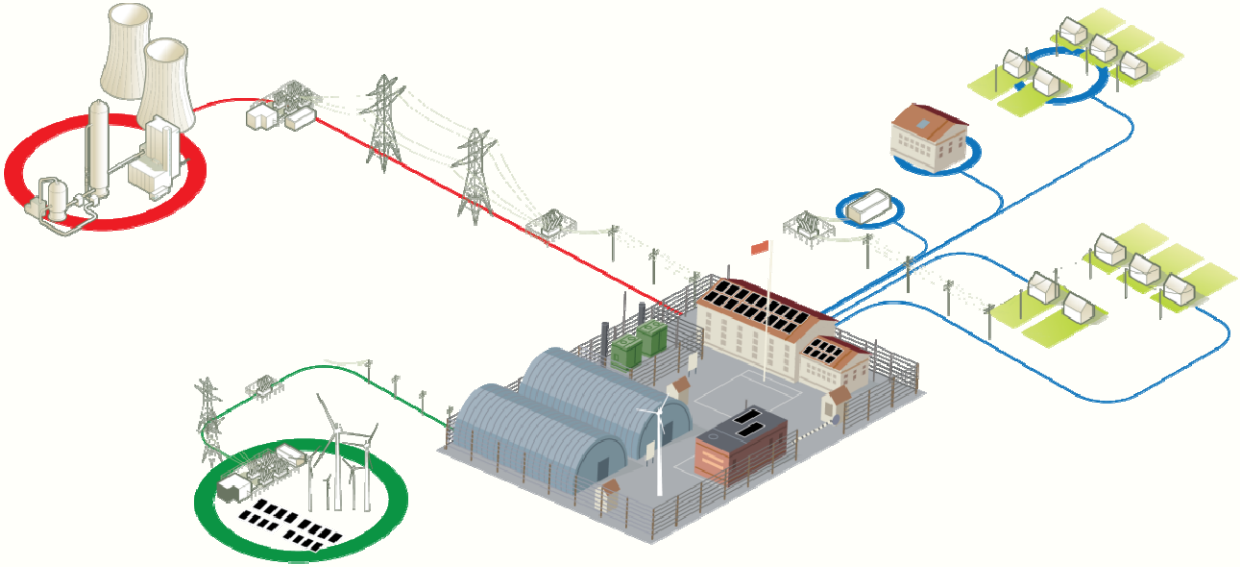
By: Michael Higginson

Summary

Microgrid systems include local generation. Often, this generation is from distributed energy resources (DERs). When selecting DERs for microgrid applications, several factors need to be considered. This presentation will discuss many technical considerations and challenges of DER selection based on real-world microgrid experience. Some of these challenges include the resource power and energy delivery capabilities, steady-state performance, response to system events such as load swings and faults, paralleling limitations, and power system grounding. In summary, this presentation will discuss challenges that must be considered when selecting DERs for integration in microgrid systems.

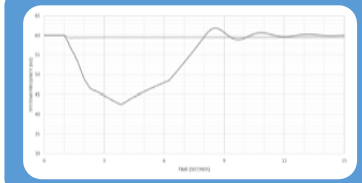
Distributed Energy Resources + Microgrids

- DERs and Loads
- Operate grid-tied or islanded



Microgrid DER Selection: Key Points

Active power and energy considerations



Response to system events

Paralleling and interconnection challenges

Generator:
Active Power & Energy Considerations

Power Output

- Minimum output
- Maximum output

Energy

- Fuel availability

ISO 8528	Load	Hrs/yr	Variable
Emergency Standby Power	70%	200	Yes
Prime Rated Power	70%	8760	Yes
Limited-Time Prime Power	100%	500	No
Continuous Operating Power	100%	8760	No

Battery Energy Storage System: Active Power & Energy Considerations

Power Output

- Inverter and battery limited

Energy

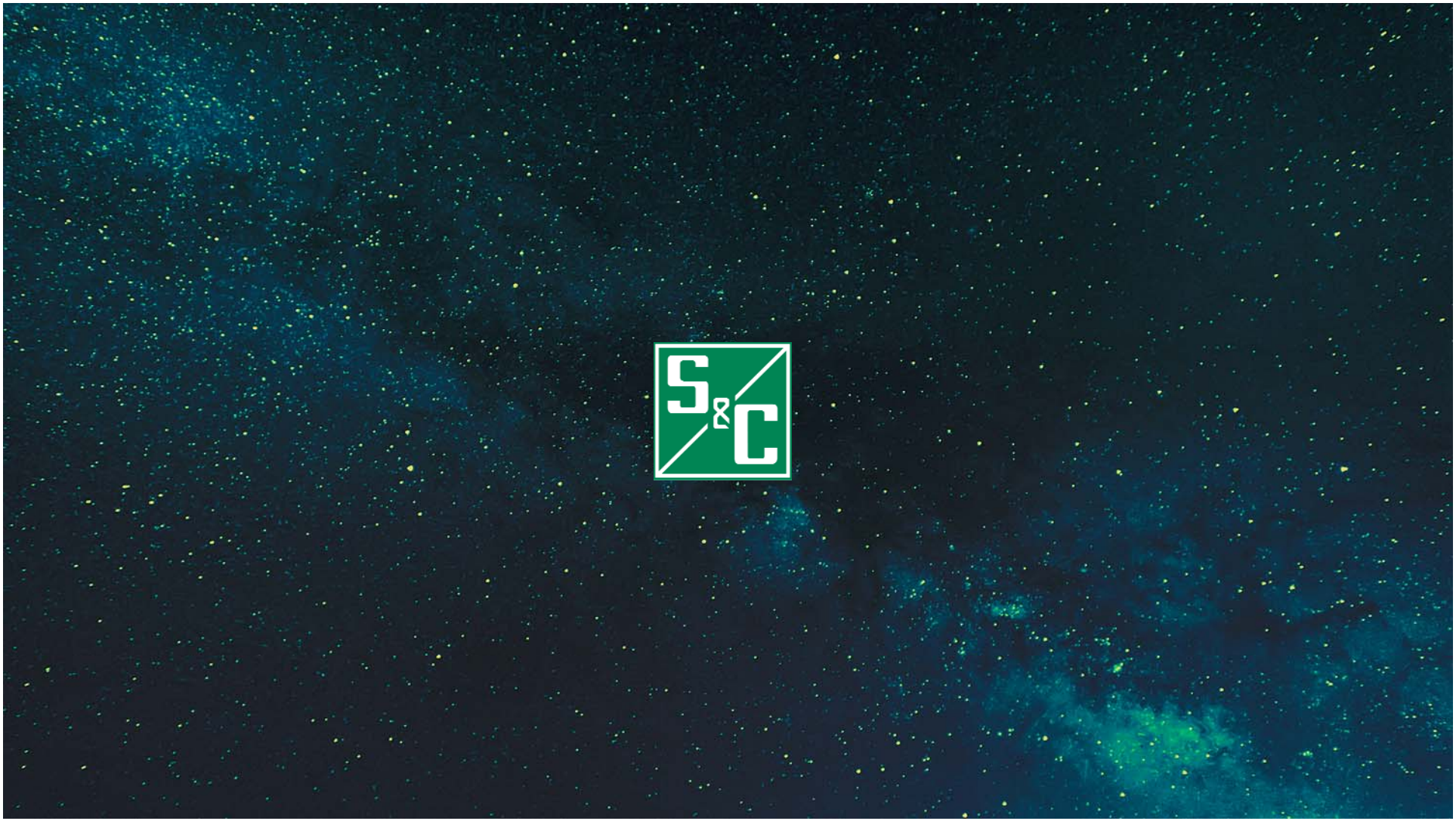
- Battery limited
- Charge cycles

Renewable Generation:
Active Power & Energy Considerations

Power Output

- Intermittency
- Timing

Energy



Response to System Events: Faults

Protection Impacts

- Fault current level
  - Traditional devices
  - CT selection
- Directionality

Grid-Tied Fault Current (kA)	Islanded Max Fault Current (kA)	Islanded Min Fault Current (kA)	Max Load Current (kA)
5.0	0.5	0.02	0.05

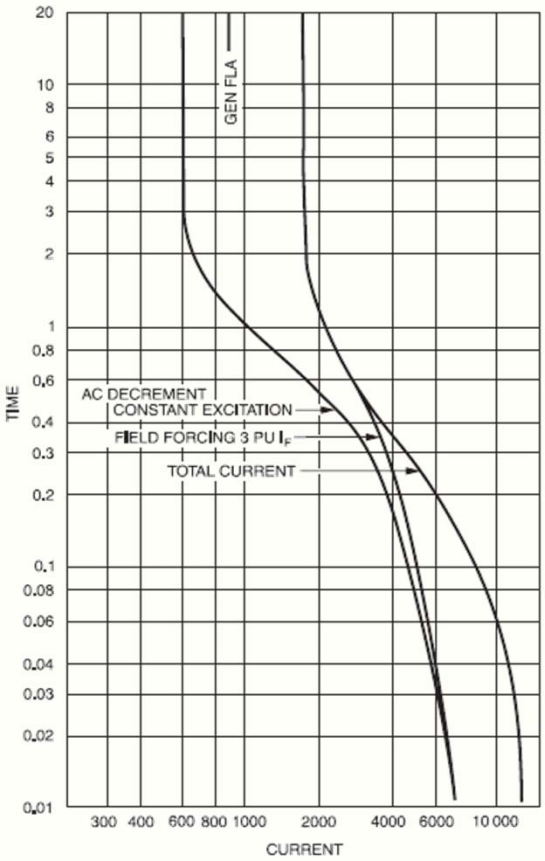
Response to System Events: Faults

Generators

- Decrement curves
- Frequency

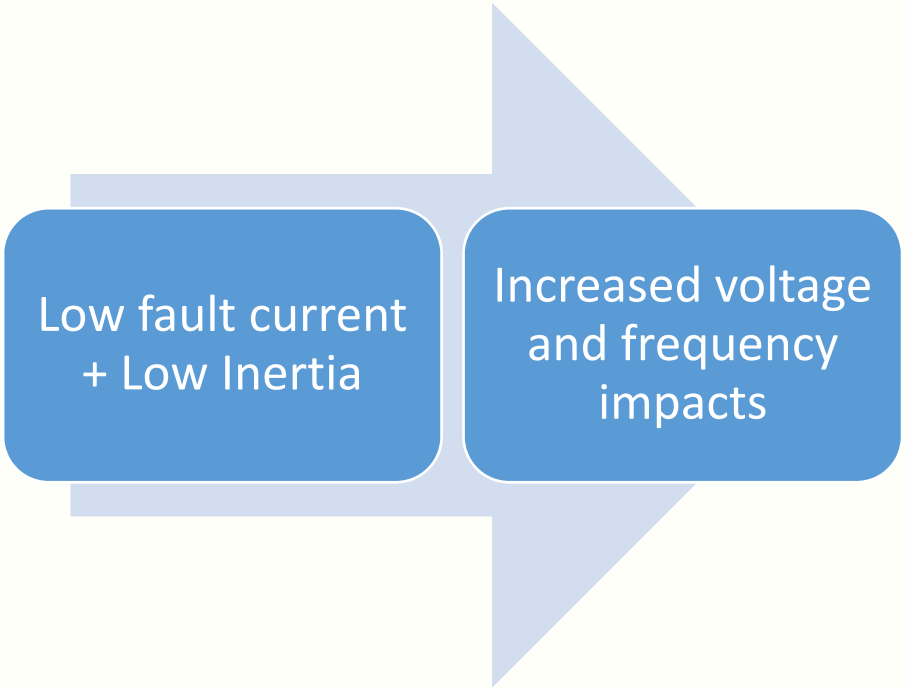
Inverters

- Limited current output
- Ride-through



Response to System Events: Load and Generation Mismatch

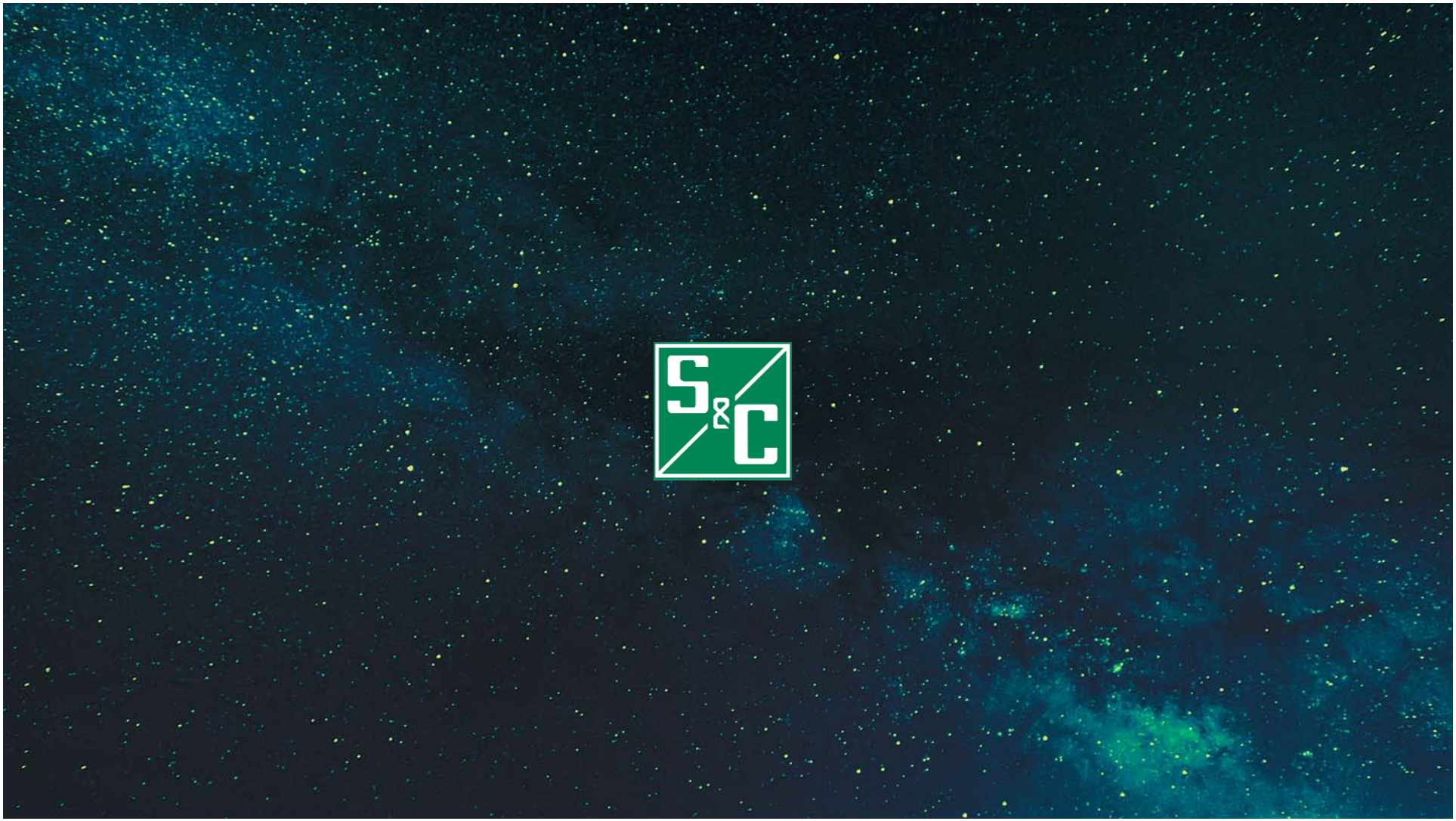
- Loss of generation
- Black start
- Load acceptance



Response to System Events: Load and Generation Mismatch

- Loss of generation
- Black start
- Load acceptance

Scenario	Voltage Drop	Frequency Drop
Generators Only	40.5%	19.1%
Generators + BESS	24.5%	6.0%

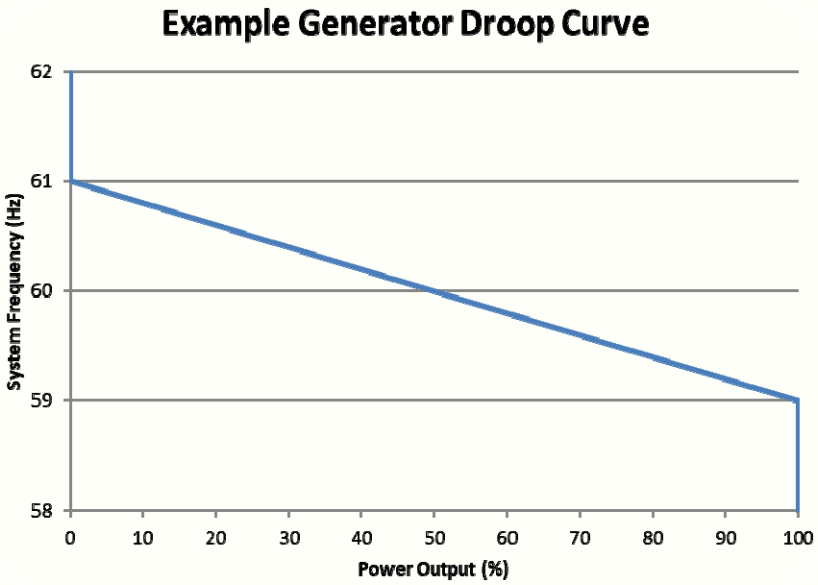


Paralleling and Interconnection Challenges: Grounding + Unbalance

- System grounding while islanded + grid-tied
  - Grounding transformers impact fault current while grid-tied
- Many system loads are unbalanced
  - Generator rotor ripple
  - Inverter DC bus ripple

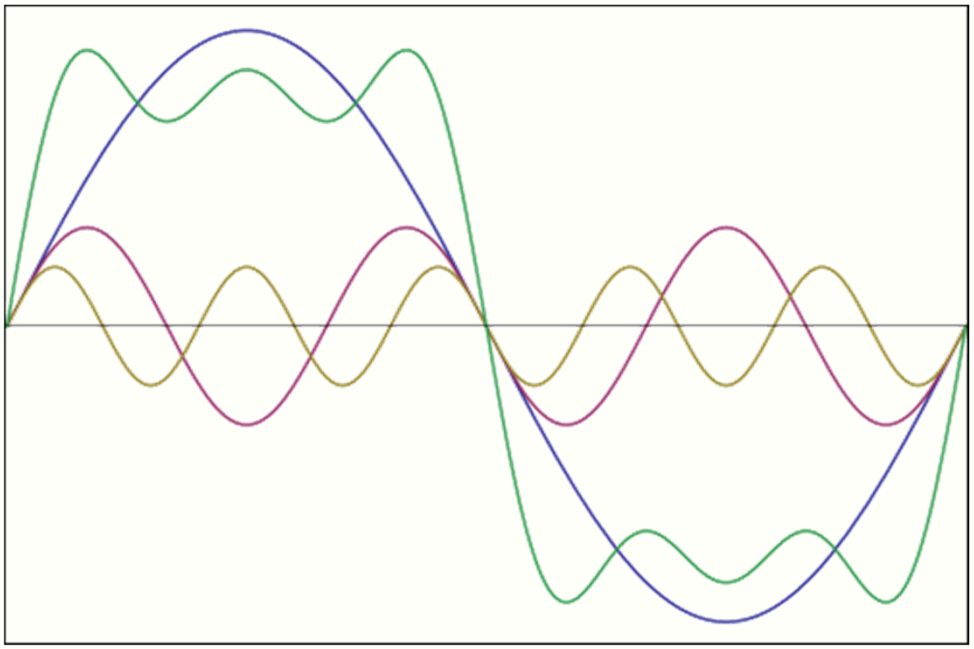
Paralleling and Interconnection Challenges: Load Sharing

- Isochronous
  - Load sharing controllers
- Droop
- Baseload

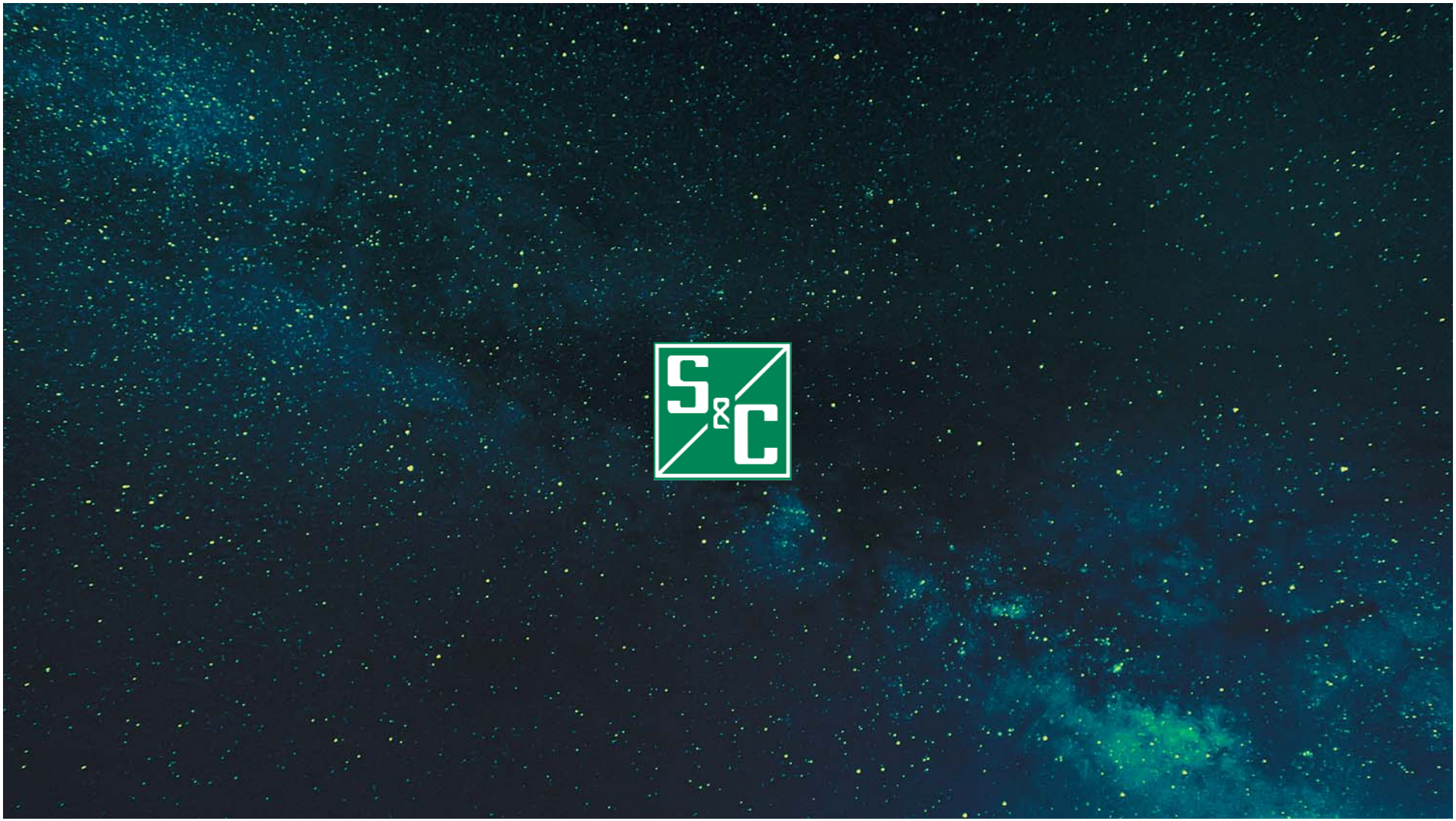


Paralleling and Interconnection Challenges: Harmonics

- Inverter Harmonics
- Generator Pitch



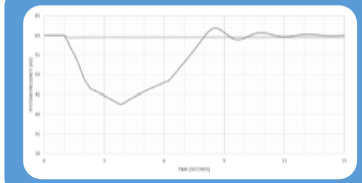
Paralleling and Interconnection Challenges: Synchronization



Microgrid DER Selection: Key Takeaways

Active power and energy considerations

- Capacity and duration of islanding



Response to system events

- Faults or load and generation mismatch

Paralleling and interconnection challenges

- Load sharing, harmonics, synchronization, and grounding

CIGRÉ U.S. National Committee
NEXT GENERATION NETWORK
(USNC NGN)

What is the Next Generation Network (USNC NGN)?

The CIGRÉ U.S. NGN was established for young engineers who have begun to progress their career within the power industry.

- US NGN Membership

  - Any full-time experience of 10 years or less beyond the last degree received in the power field

  - Students (FREE) or professionals (50% Reduction Young member)

  - Become a CIGRÉ US NGN member

  - http://cigre-usnc.org/membership/

  - Provide opportunities for technical and personal development

  - Networking opportunities

  - Collaborate with peers across US and abroad

Ways to get involved

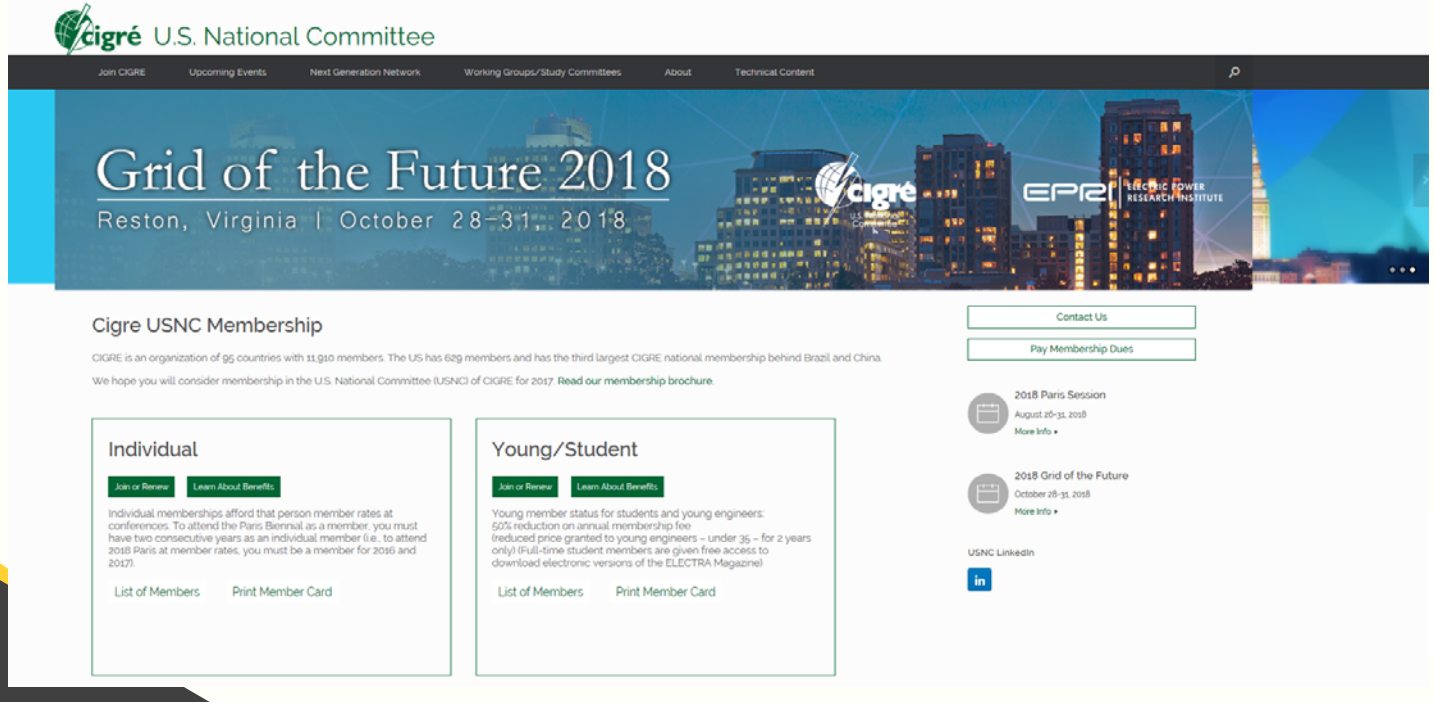
- Participate in webinars and tutorials
- Attend the NGN invited-only events in Grid of the Future Symposium
- Join the NGN Executive Committee
- Expand Technical knowledge through CIGRÉ Working Groups
- Participate in the Paper Competition

CIGRÉ-USNC Next Generation Network (NGN) 2018 Executive Committee

Position	Name	Emails	Company
Chair	Mandy Olson	akolson@burnsmcd.com	Burns & McDonnell
Communications Secretary, newsletter, website	Kyle Thomas	kyle.thomas@dom.com	Dominion
Events Grid of the Future, international colloquium	Chris Mertz	Christopher.G.Mertz@dominionenergy.com	Dominion
International Support	Josh Snodgrass Jack Duncan Jessica Haines	Josh.Snodgrass@powereng.com jack.duncan@mottmac.com JHAINES@firstenergycorp.com	Mott Macdonald First Energy POWER Engineers
Marketing Marketing plan, materials	Yazan Alsmadi	ymalsmadi@aep.com	AEP
Membership University outreach, tracking	Jessica Haines	JHAINES@firstenergycorp.com	Worley Parsons
Mentoring Working group correspondence	Jessica Lau	Jessica.Lau@nrel.gov	NREL
Professional Development Paper competition Webinars	Saeed Kamalinia Jonathan Marmillo	saeed.kamalinia@sandc.com jmarmillo@genscape.com	S&C Electric Company Genscape
Social Media	Nikia Munson	nikia.munson@powereng.com	POWER Engineers
Members-At-Large	Ryan Quint Kojo Sefah Diana Lee	Ryan.Quint@nerc.net ksefah@misoenergy.org deelizlee@gmail.com	NERC MISO

Need more information?
http://cigre-usnc.tamu.edu/ngn/

Questions?
usnc-ngn@cigre.org



sandc.com