Microgrid Protection Challenges

An Intro

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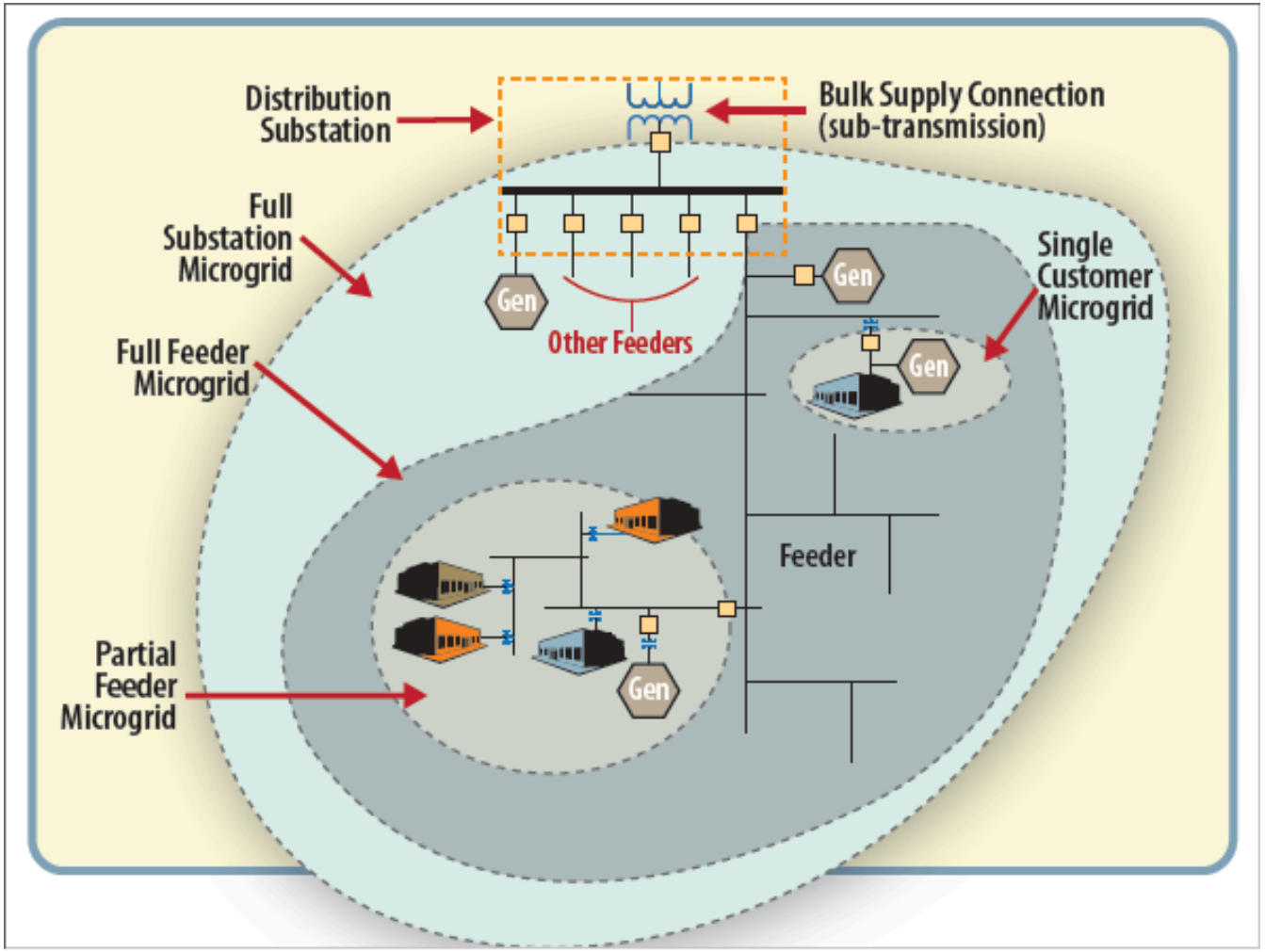
Overview

- Examine Challenges With Traditional Microgrid Topologies
- Present a Topology That Improves Microgrid Performance Through Specific Design Choices

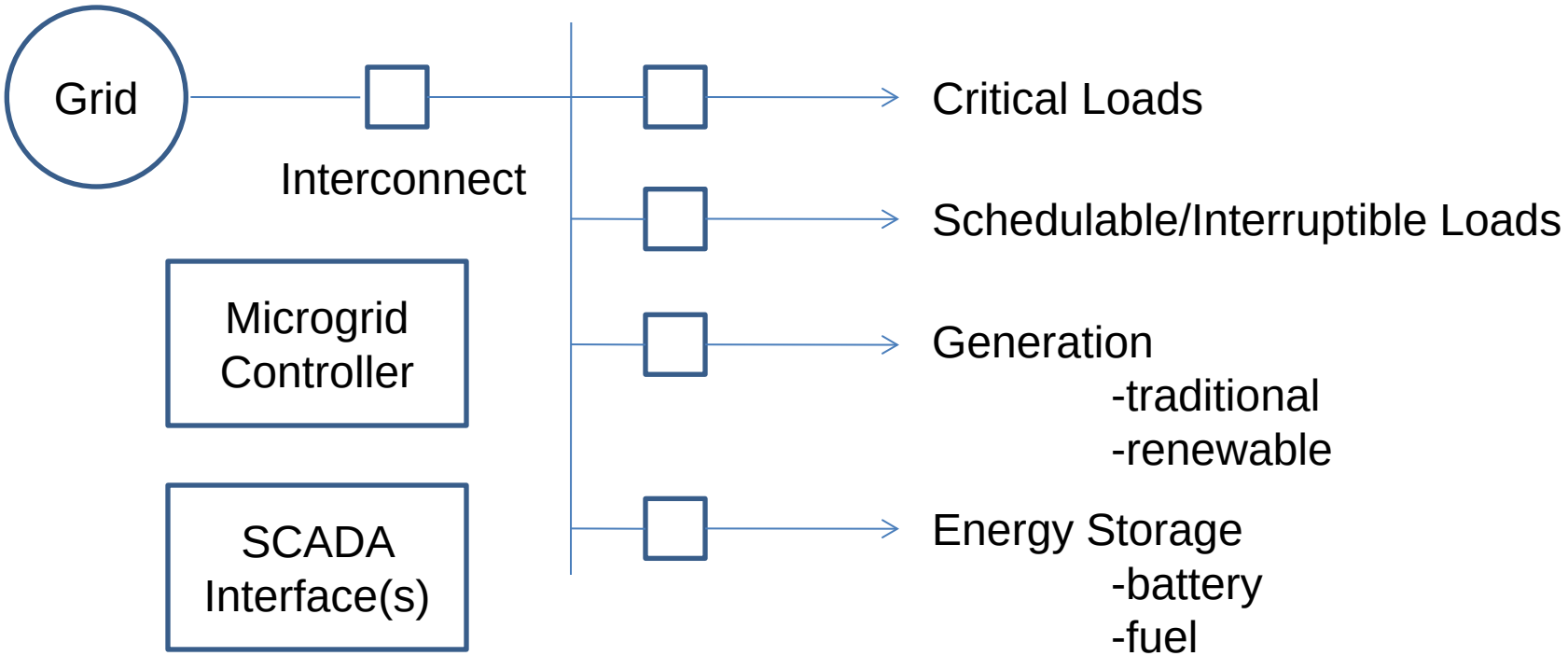
EPRI's Microgrid Concept



Practical Matters

- Defined geographically and electrically
- Point(s) of interconnect that permit islanding and paralleling
- Controllable sources and loads
- Economic or social rationale for the investment

What's in the Microgrid?

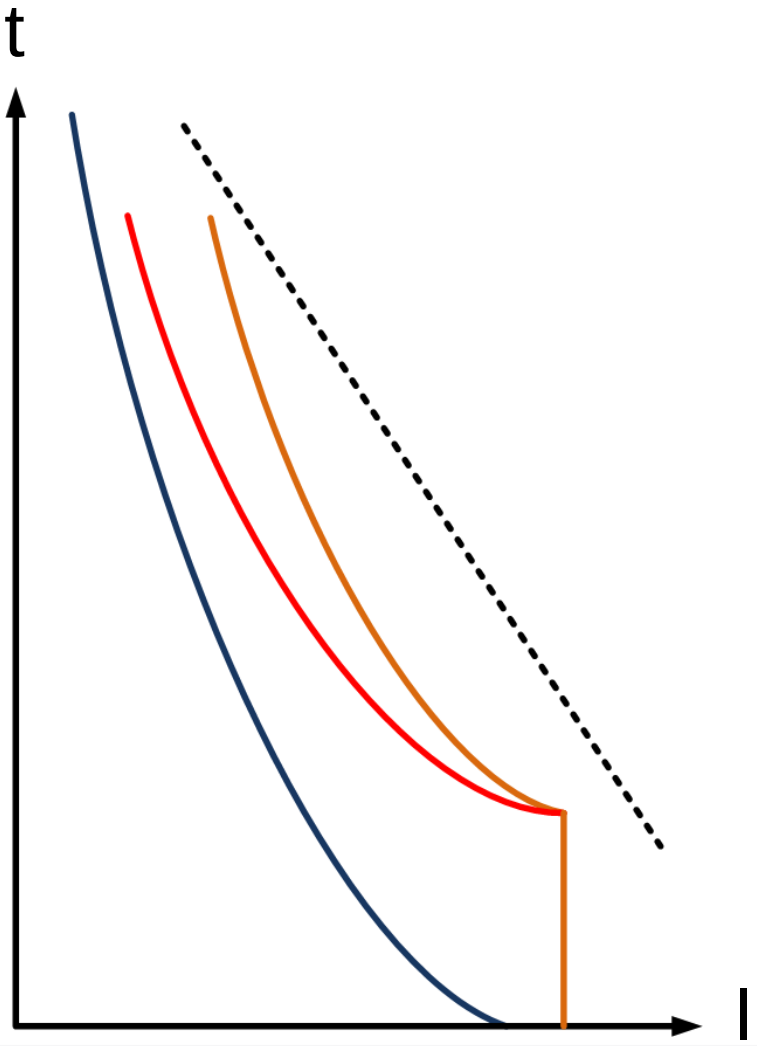


Typical Microgrid Topology

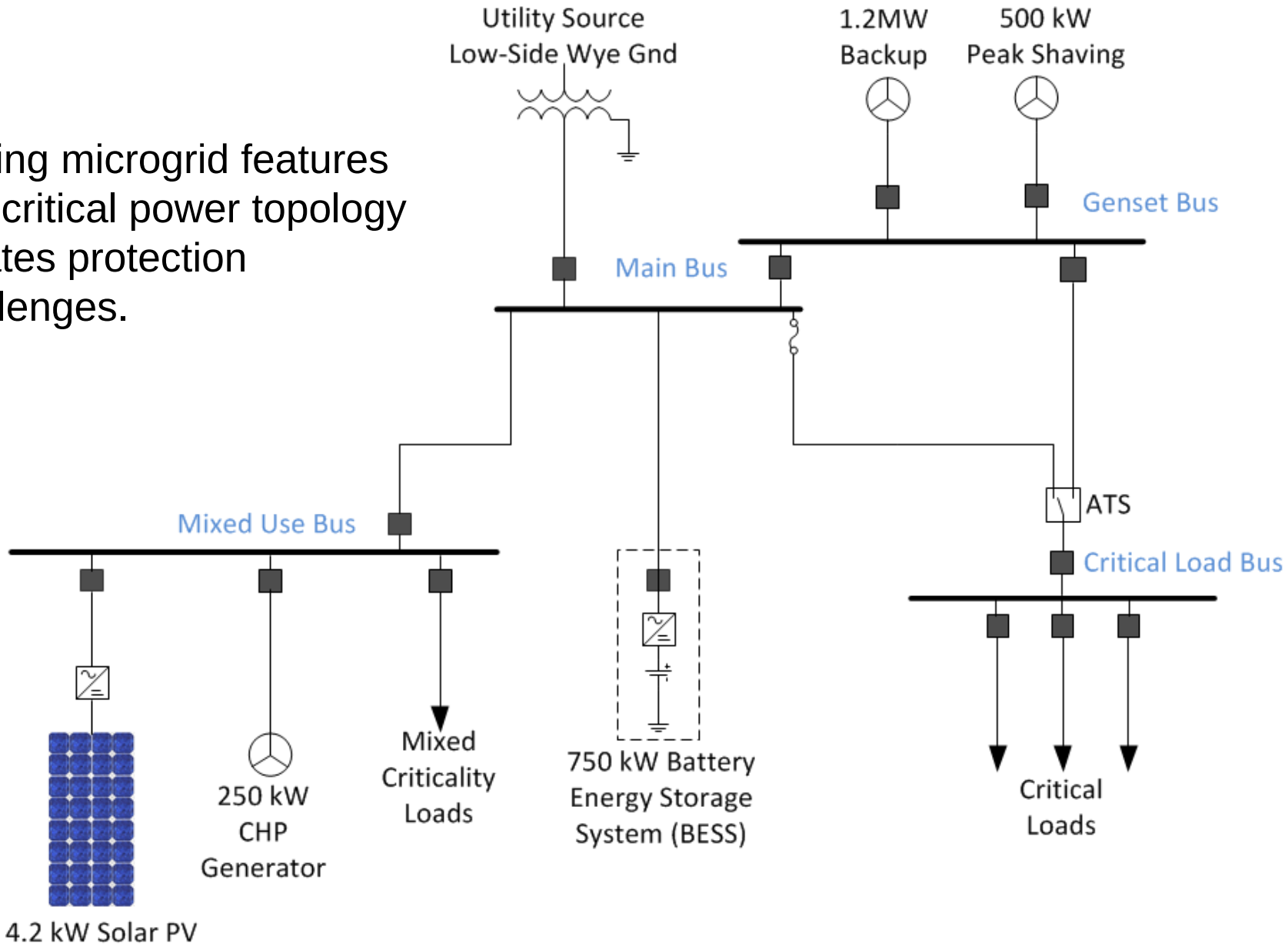
- Based on existing critical power layout
- Traditional time-overcurrent protection
- Ground-source difficulties

Inverse-Time Overcurrent (51)

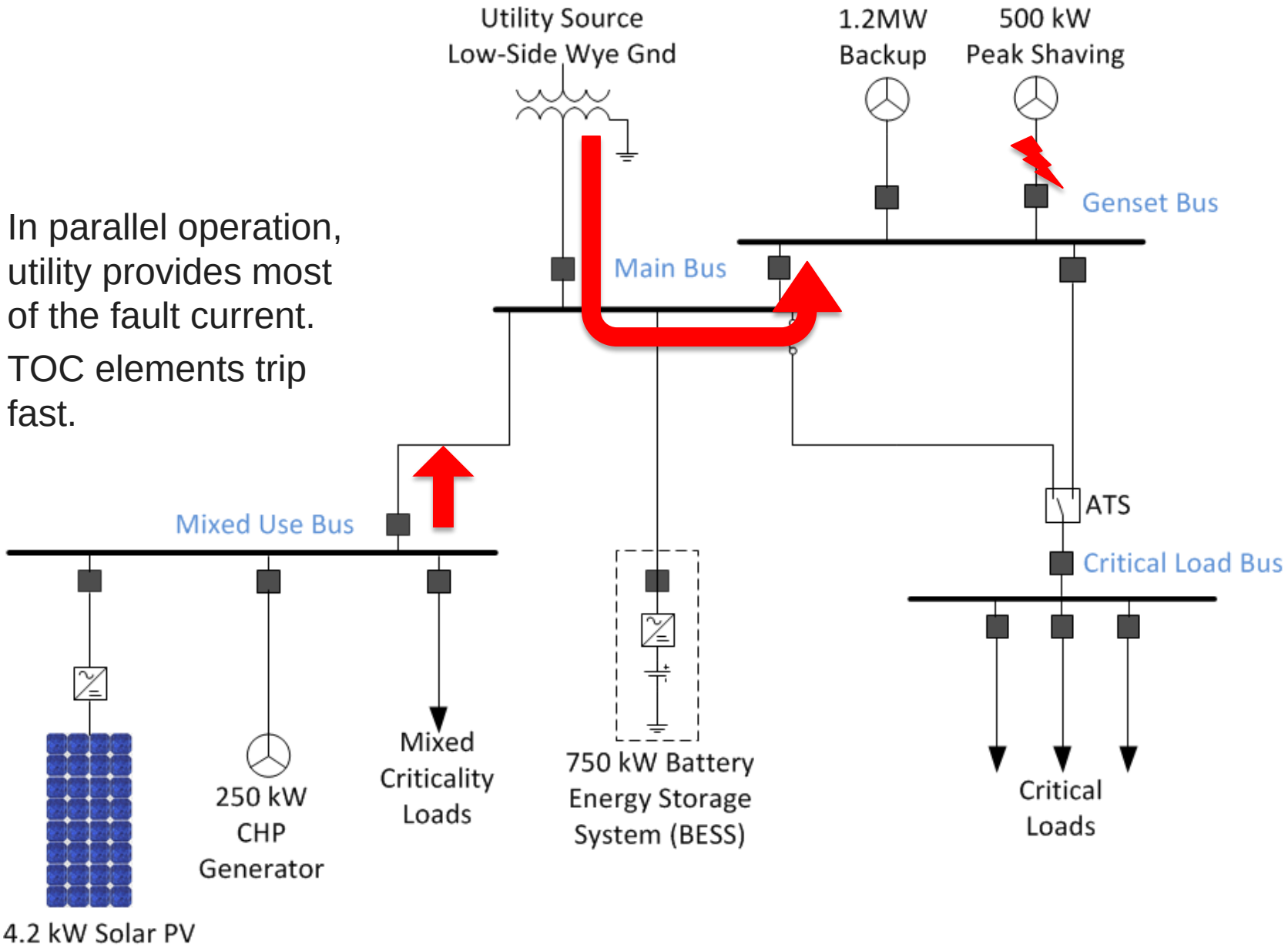
- Overcurrent element trips with variable time, depending on current magnitude and element characteristics
- Larger current = faster trip



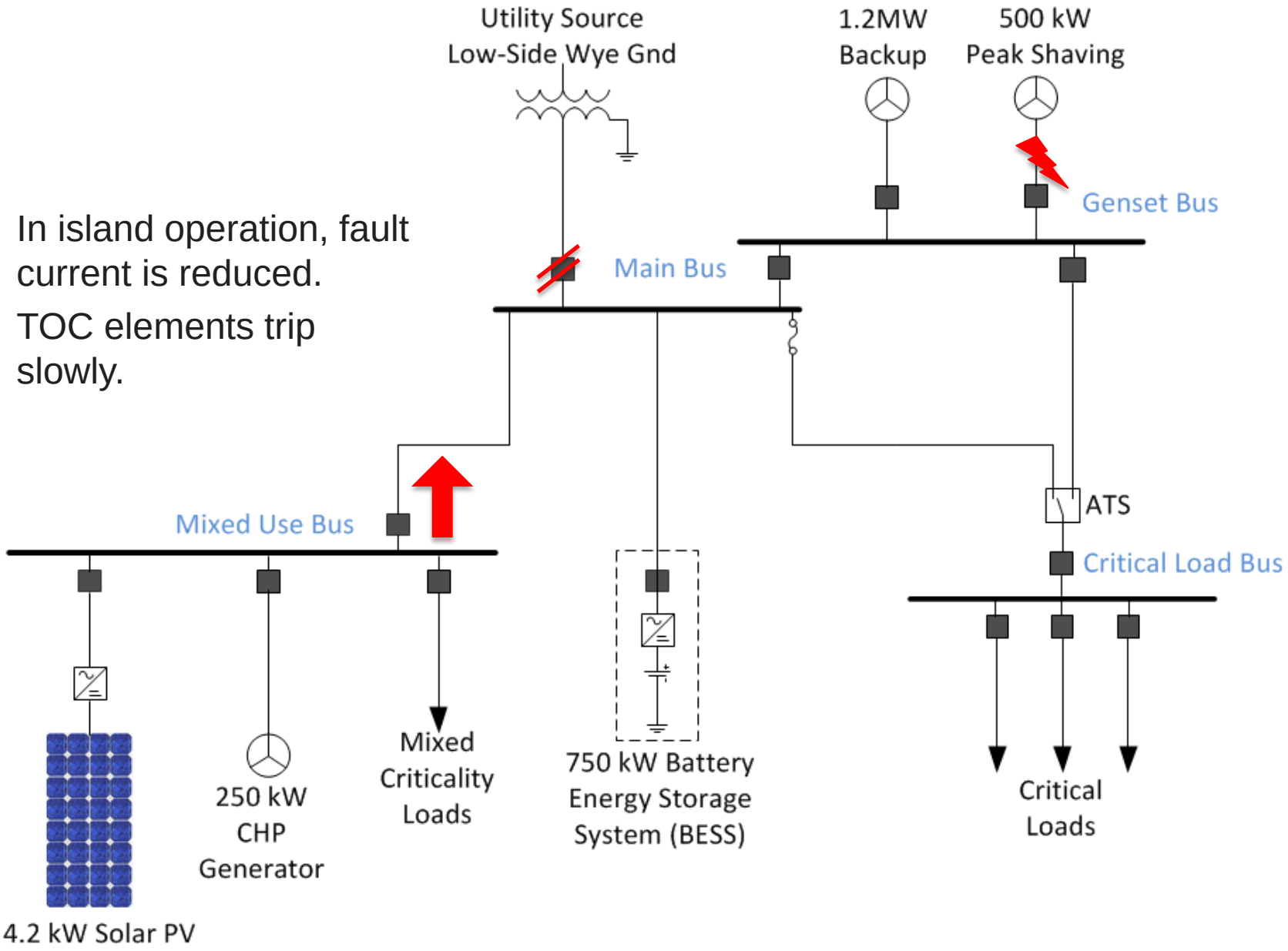
Adding microgrid features to a critical power topology creates protection challenges.



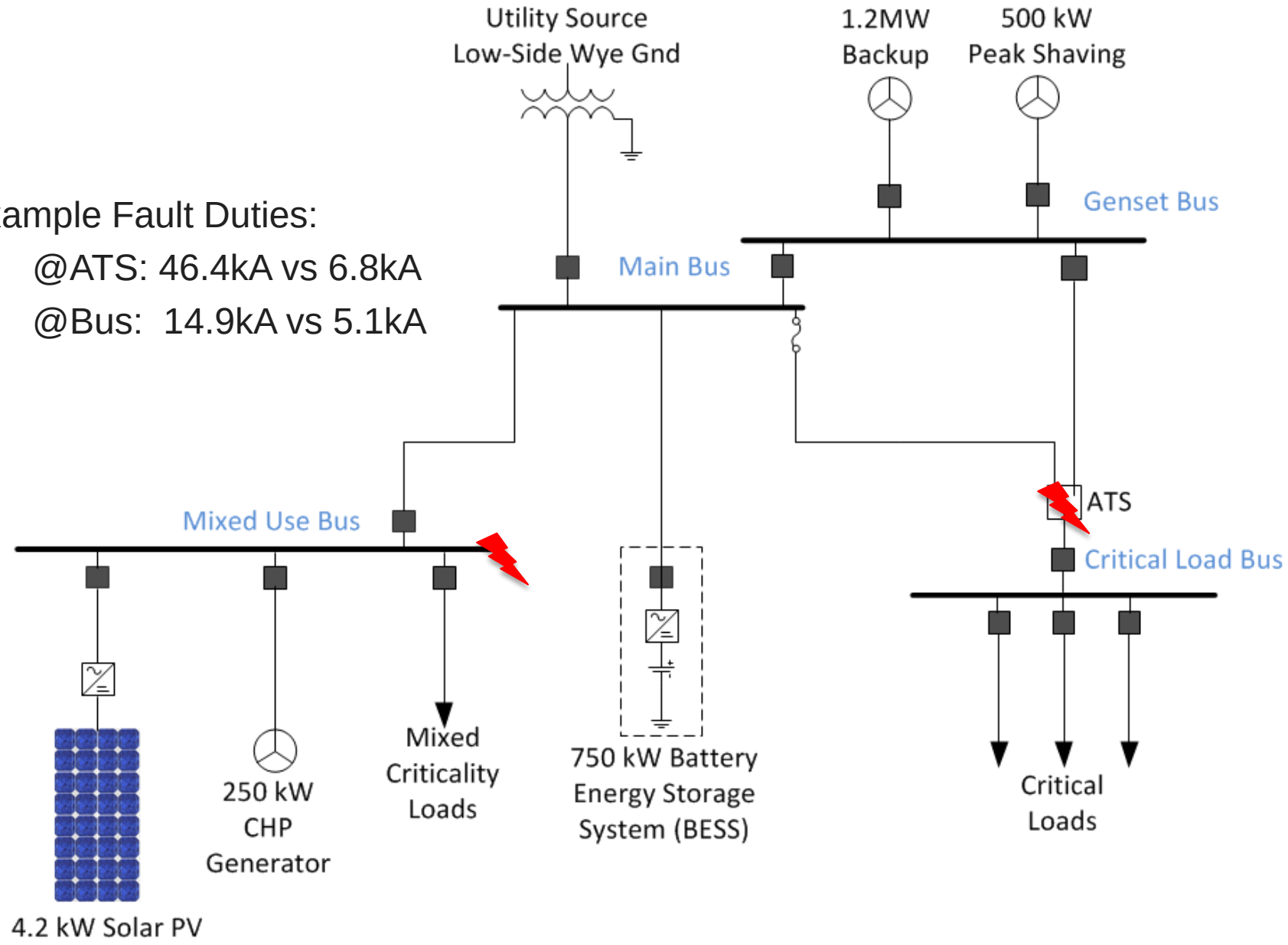
- In parallel operation, utility provides most of the fault current.
- TOC elements trip fast.



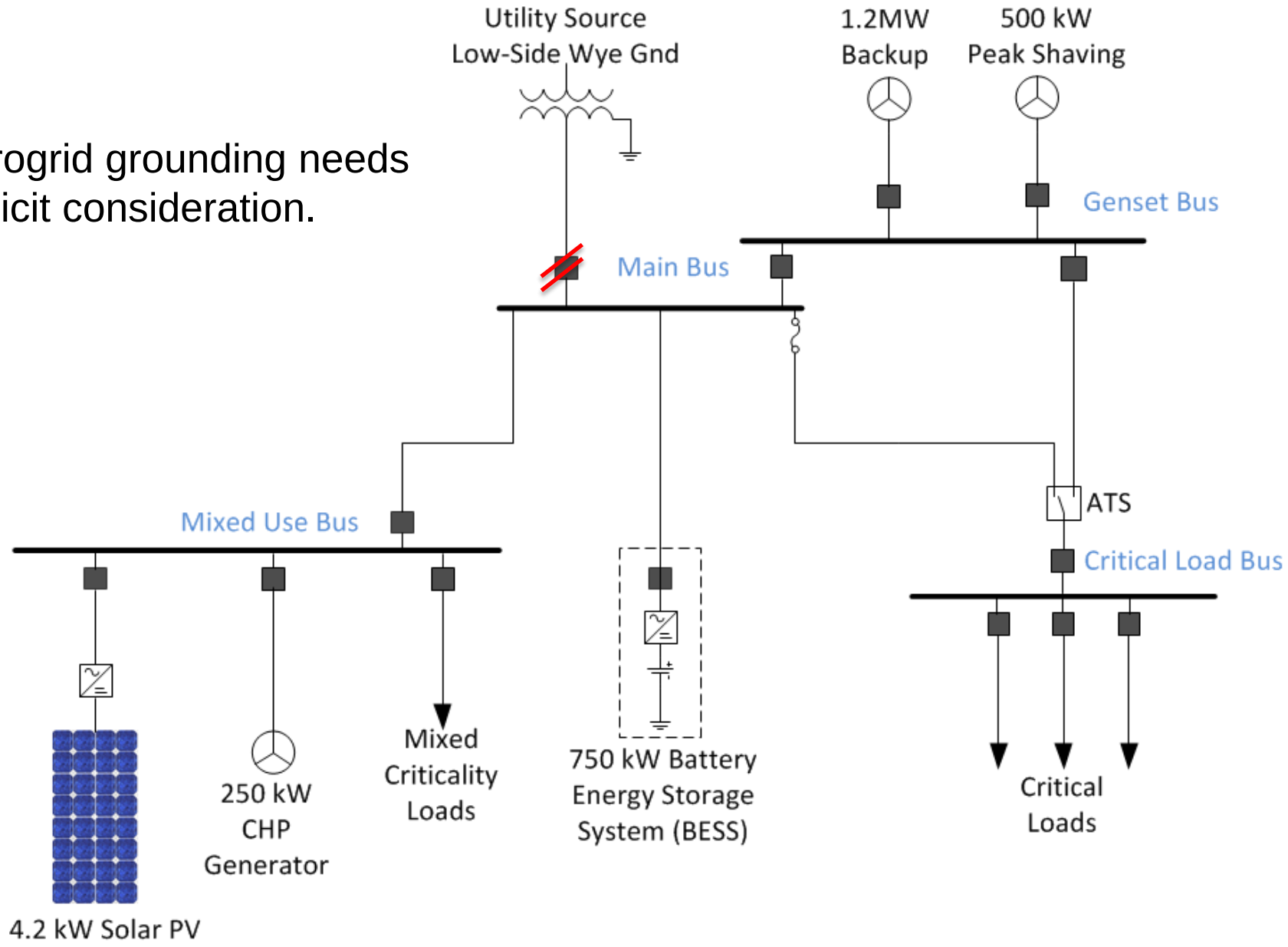
- In island operation, fault current is reduced.
- TOC elements trip slowly.



- Example Fault Duties:
  - @ATS: 46.4kA vs 6.8kA
  - @Bus: 14.9kA vs 5.1kA



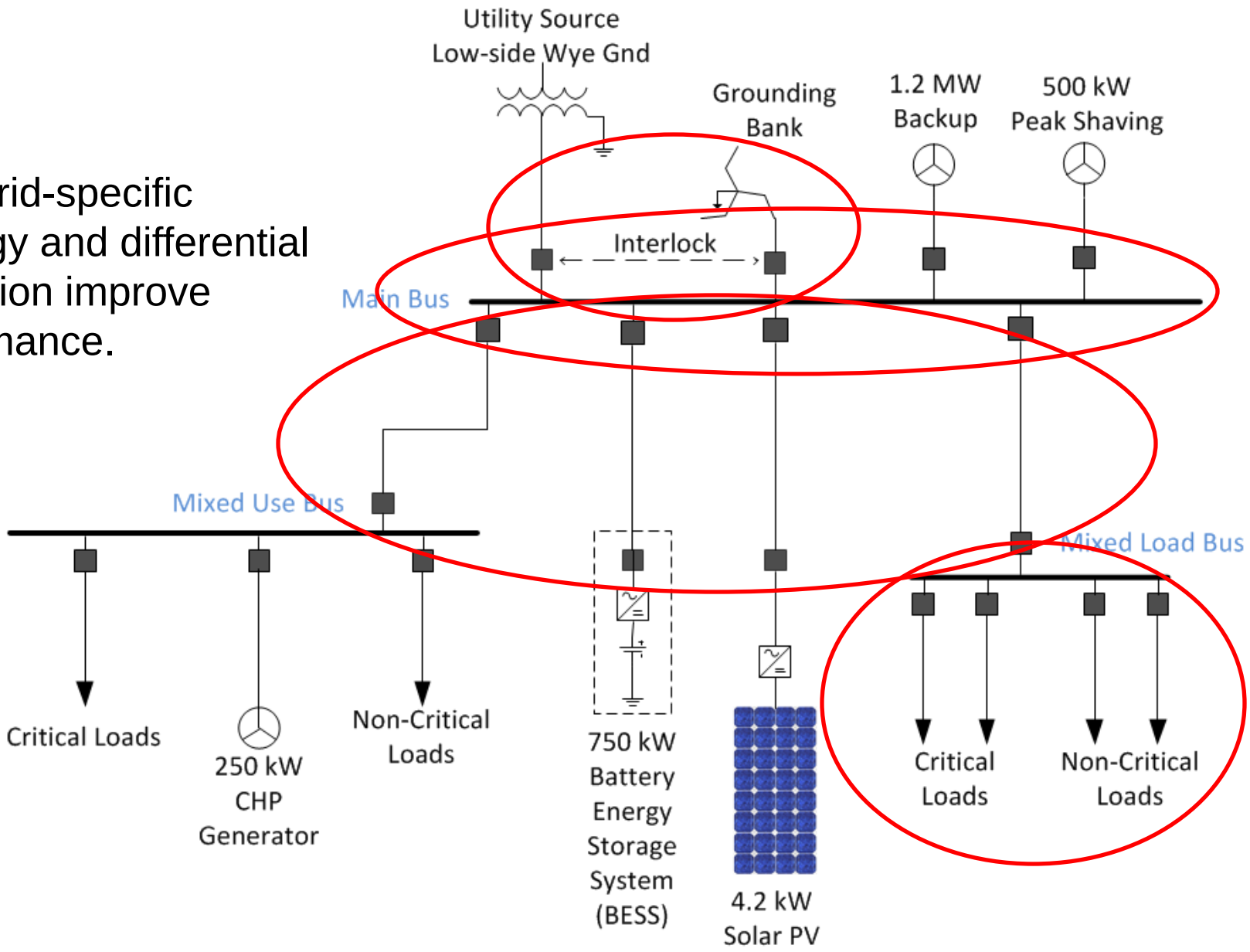
Microgrid grounding needs explicit consideration.



Challenges Summarized

- Large fault current magnitude variations
- TOC trip times increase when islanded
  - reduces microgrid stability
  - may increase arc flash hazard
- Ground source issues
- Alternate relay settings may be required
- Fortunately, solutions exist

Microgrid-specific topology and differential protection improve performance.



Microgrid-Specific Topology Choices

- Use two breakers on express feeders
- Protect feeders and sources with differential elements
- Collect sources on main bus
- Design dependable ground-source
- Group critical and non-critical loads

Dedicated Topology Performs Better

- Clear all faults at differential speed, islanded or paralleled
- Make islanded operation more reliable
- Reduce arc flash hazards

Dedicated Topology Costs Change

- More breakers = more cost
- Protection engineering costs less
  - Simpler coordination, settings
  - Fewer scenarios
- A dependable ground-source is needed during island operation

QUESTIONS?