DER Use-Case Capacity Service

FEI WG Meeting #4

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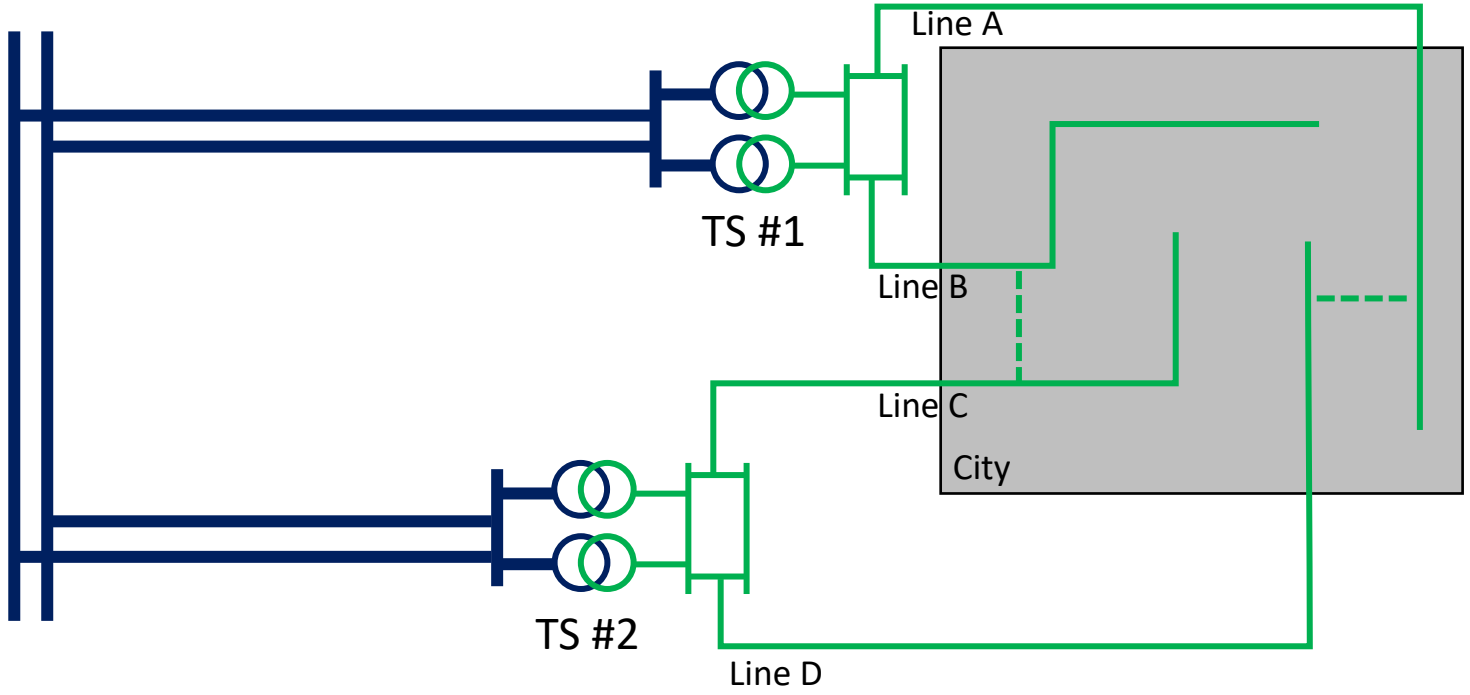
Distribution Need – planning process

- An LDC's planning criteria requires that it design its system to serve all load even when one distribution or transmission element is out of service (N-1)
- This deterministic planning criterion requires the LDC to:
  - Assess how much load its system can serve under each recognized outage
  - Forecast how much load the LDC expects to serve
  - Determine whether there is a need to expand or enhance the system within the planning horizon (e.g., 5 to 10 years)

Distribution Need – example system

- Two transformer stations (TS) serve a city
- The distribution system allows load to be transferred between feeders



Facility	Capability
TS #1	2 x 60 MW transformers
TS #2	2 x 40 MW transformers
Line A	50 MW
Line B	50 MW
Line C	60 MW
Line D	40 MW
Line A-D transfer	10 MW
Line B-C transfer	20 MW

Note: Tx lines ignored in this example

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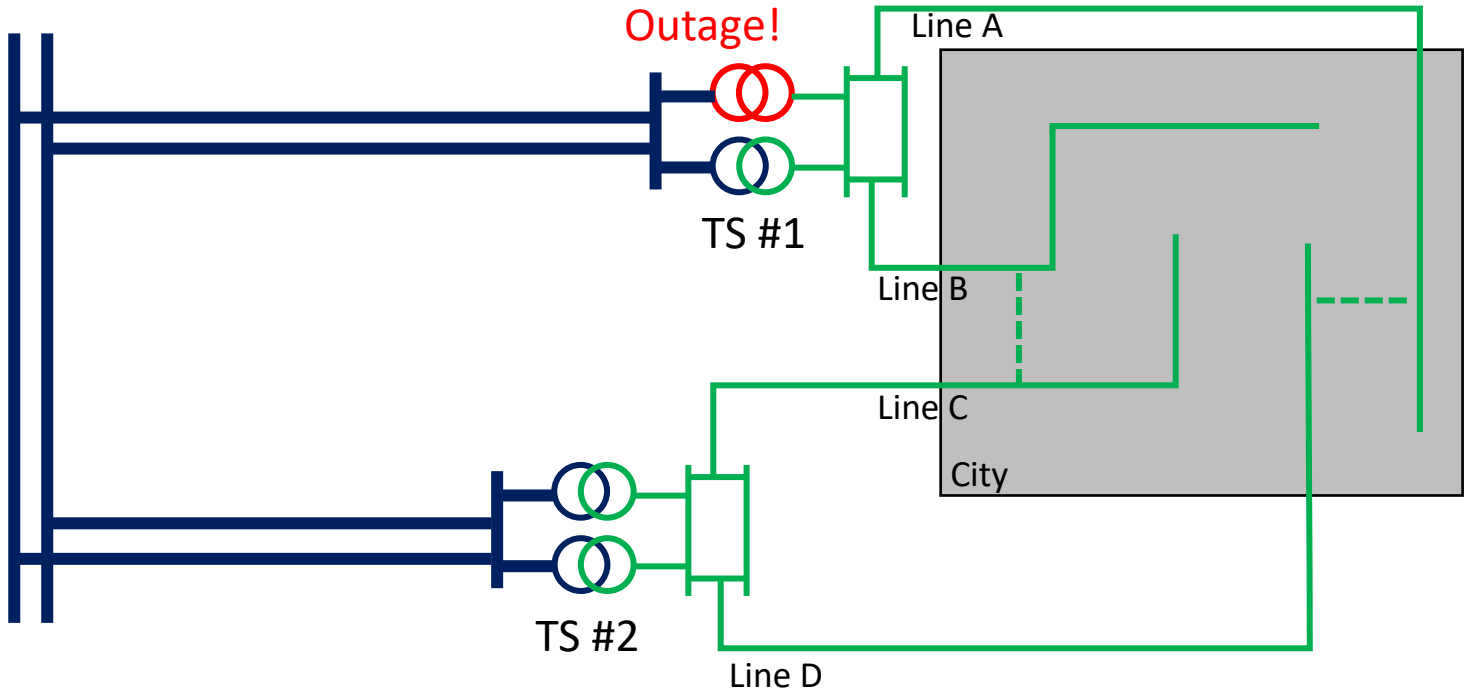
Distribution Need – worst outage

- For simplicity, focus on TS #1



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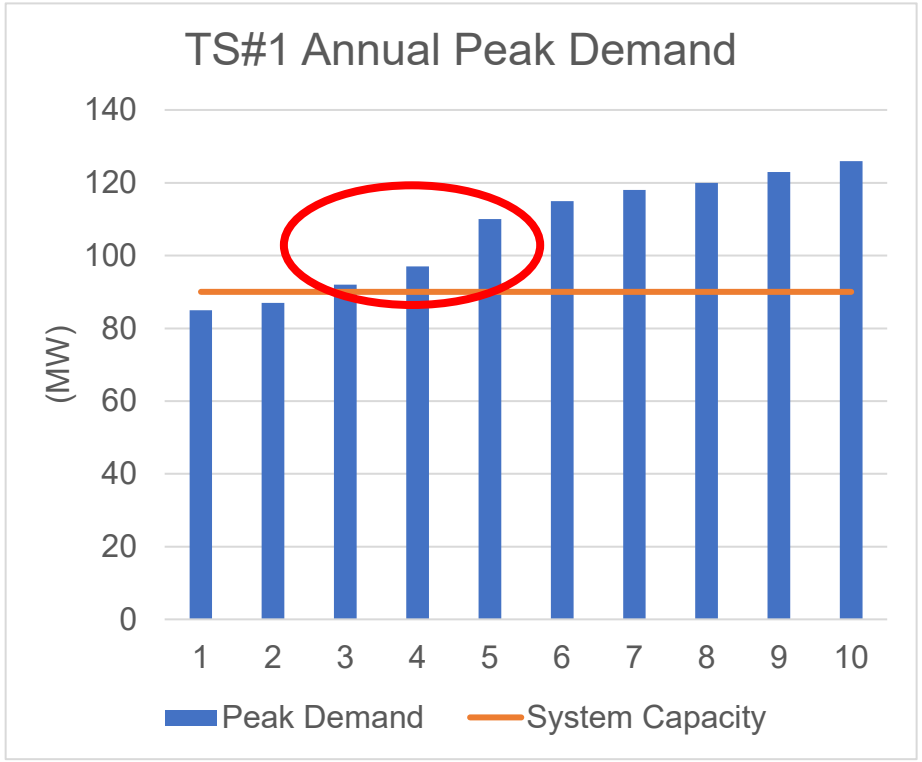
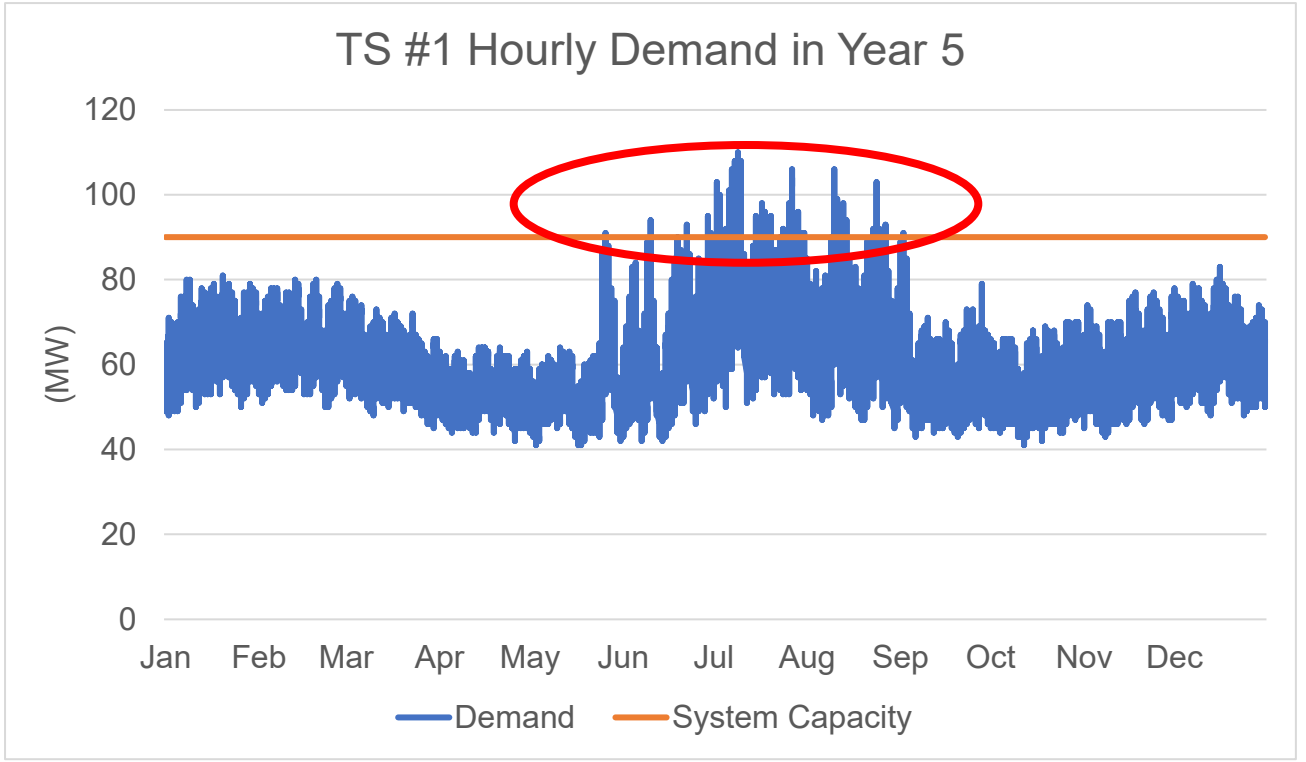
- There are two transformers at TS #1, each with a capacity of 60 MW
- There is also the capability to transfer 10 MW of load from Line A to Line D and 20 MW of load from Line B to Line C
  - This adds another 30 MW of capacity to TS #1
- The worst contingency is an outage to one of the transformers at TS #1 because this removes the most capacity from the system
- The system can serve 90 MW of load on Lines A and B following an outage to a transformer at TS #1
  - 60 MW on the remaining transformer plus
  - 30 MW of transfers to other dx lines

Distribution need – load forecast

- The load forecast shows that TS #1 will exceed the system's capability in 3 to 5 years due to new loads being connected





Distribution need - characteristics

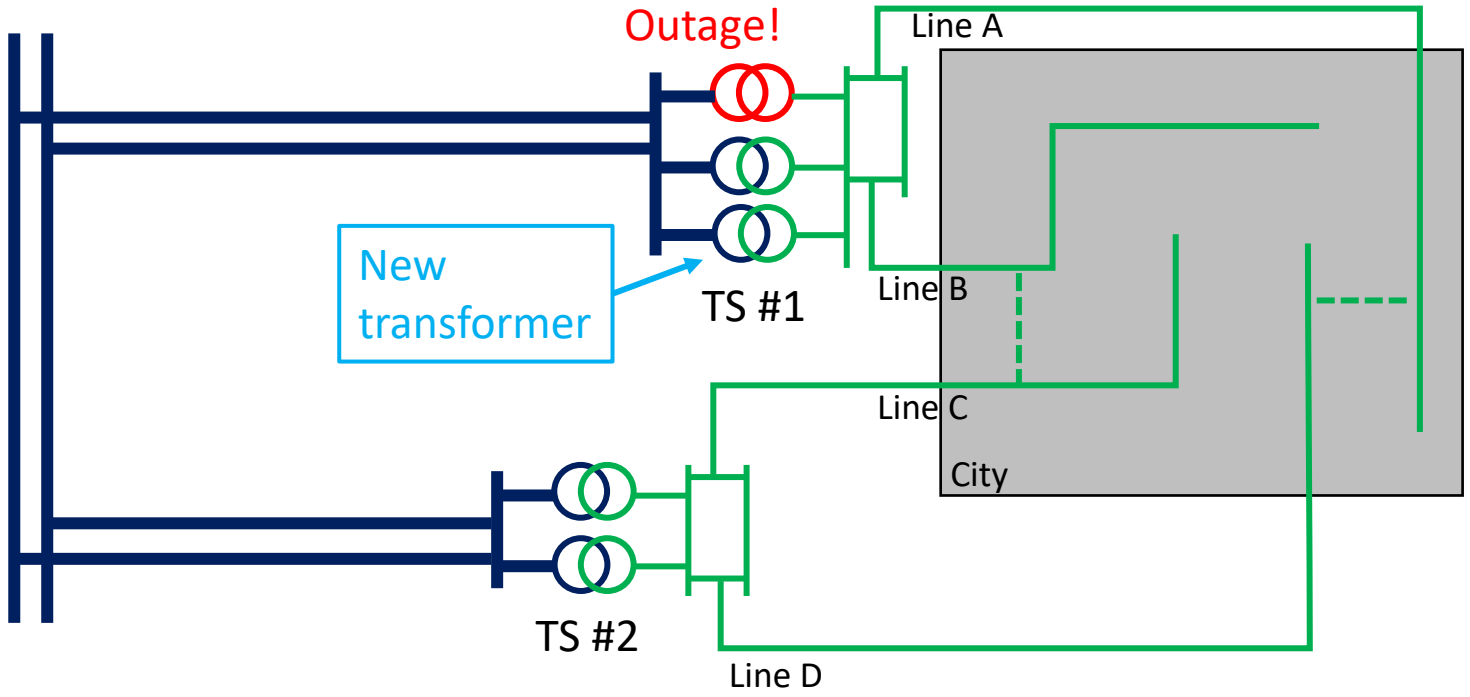
- Capacity needed: 2 MW (Year 3), 7 MW (Year 4), 20 MW (Year 5)
- System conditions: whenever load exceeds system capability
- Need seasonality: May to September
- Need days: Monday to Friday
- Need hours: Hour 10 to 22
- Delivery Duration: 4 hours for instantaneous supply, 12 hours for non-instantaneous

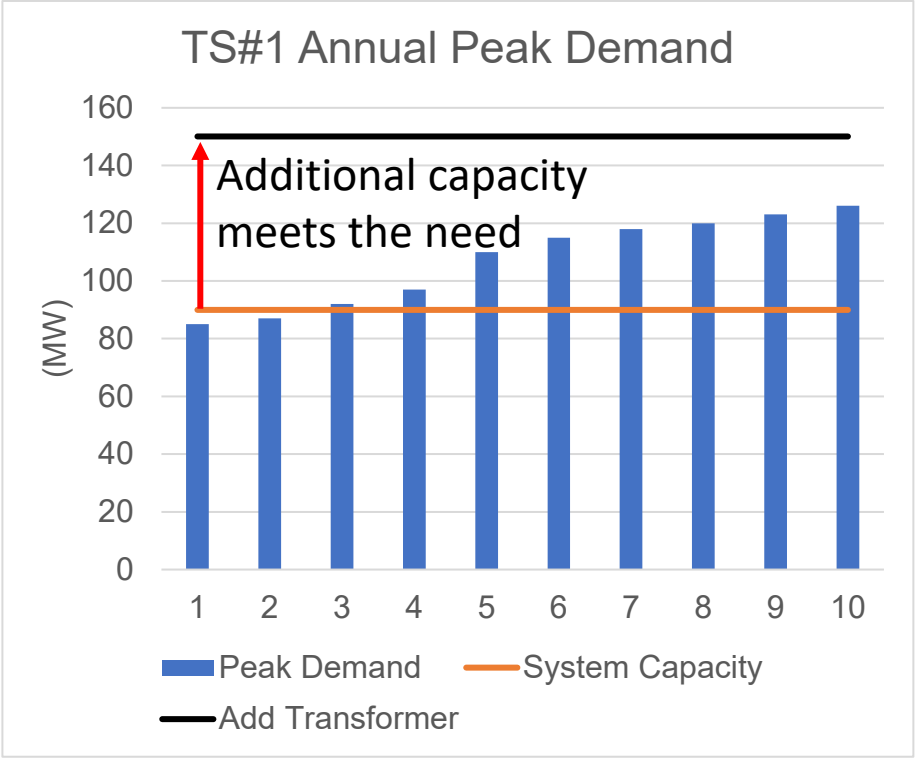
Traditional Solution

- The traditional solutions increase the capability to deliver power to consumers
- These solutions include:
  - A new substation
  - A new transformer at TS #1
  - New or upgraded distribution lines to provide more backup from TS #2
- The traditional solutions can satisfy the need characteristics:
  - Wires have sufficient capacity
  - Wires are available in all hours
  - Wires deliver power instantaneously

How a Traditional Solution Meets the Need

- For example, adding a transformer at TS #1 meets the need by adding more capability to deliver power





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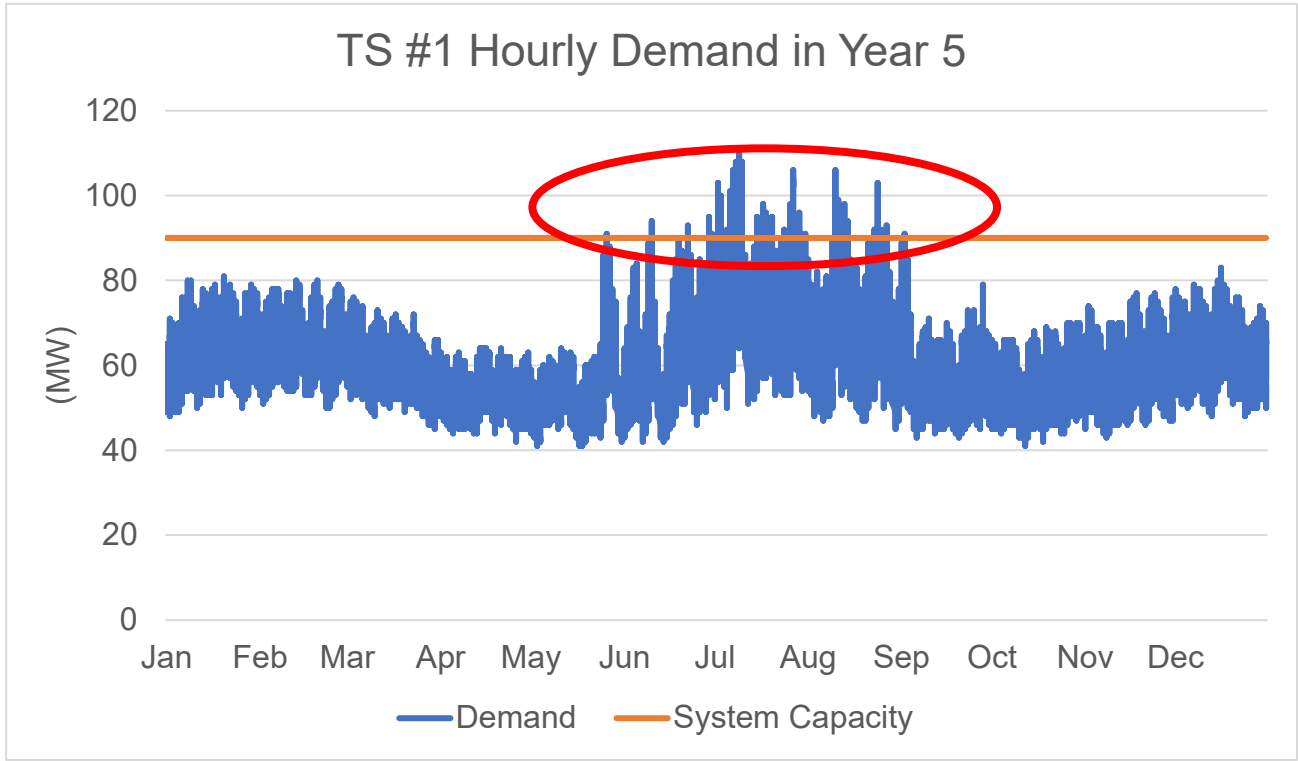
DER Solution

- A DER can meet the need by supplying energy behind the constraining element
- These solutions include:
  - Load-modifying DERs such as demand response and energy efficiency
  - Supply resources such as energy storage, PV solar and gas-fired generators
- The DER solution must be designed appropriately to meet the need characteristics

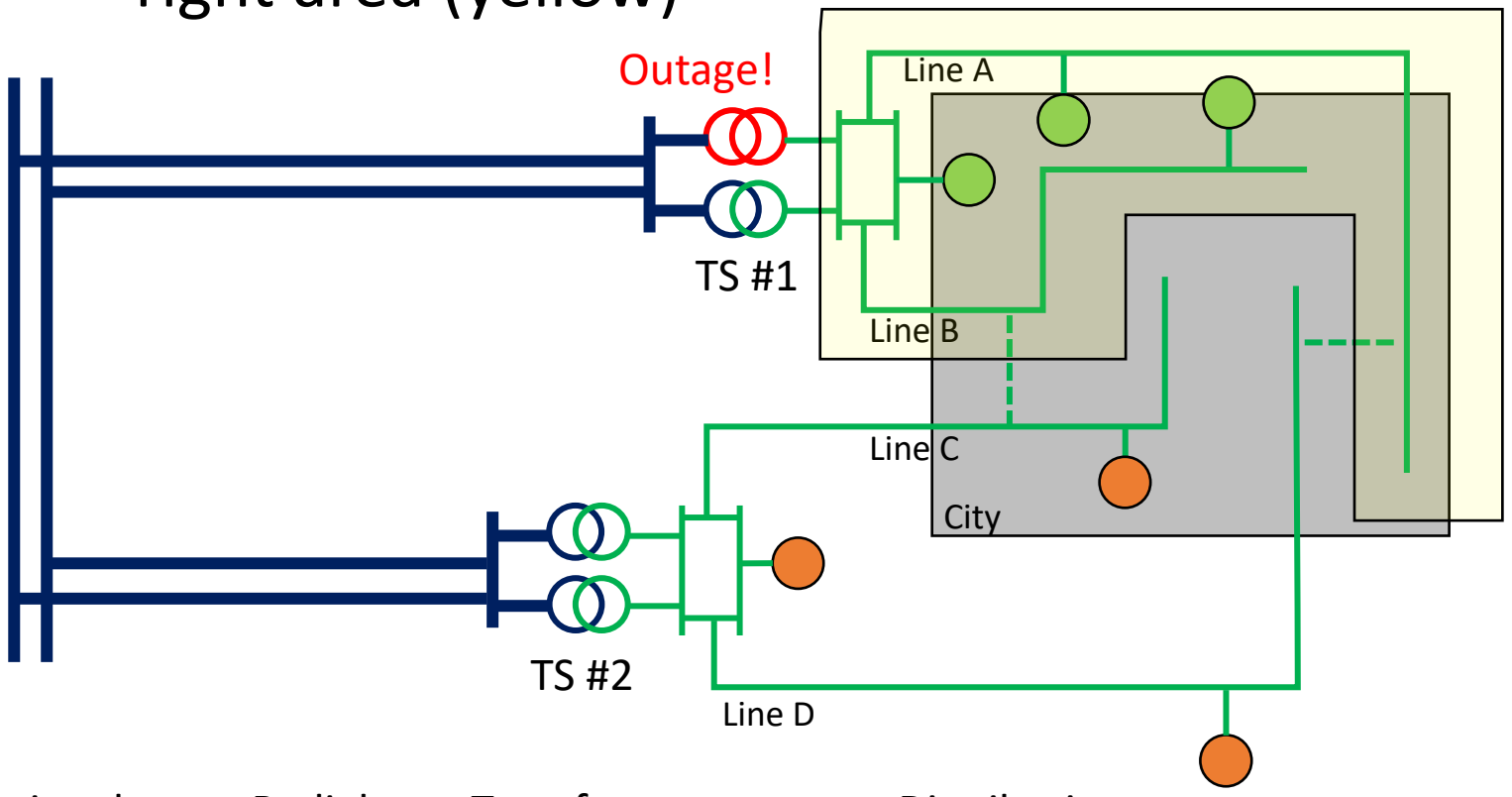
How a DER Solution Meets the Need (1)

- The need to serve load whenever it exceeds the system's capability means that the DER must either:
  - be on whenever load exceeds the system capability (red circle below); or
  - respond within cycles to the outage
- A response within cycles requires a capable resource (storage, DR) and telecommunication to trigger the response
- Slower responding resources will need to be on more frequently



How a DER Solution Meets the Need (2)

- A DER must satisfy the need characteristics and be connected to the right area (yellow)



- A DER would need to be connected to Line A, Line B or at the low voltage side of the transformer station
  - The green circles are locations for DER that can meet the need
- These connection points serve load that cannot be served by TS #1 or the backup from Line C and Line D
- Connection to TS #2 or Line C or Line D doesn't serve load connected to TS #1
  - The orange circles are locations for DER that can't meet the need

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Value of DER solutions

- A DER solution can defer or avoid the need for a traditional solution
- In this example 25 MW of DERs would defer the need by 4 years
- For a $20M transformer station upgrade, a 4 year deferral is worth roughly $6M to ratepayers (8% carrying cost per year)
- DERs would be preferred if they can provide the service for less than $6M