Economic Value and Justification for Sectionalization

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Sectionalization (Duke Energy)

- **Definition** – The optimum placement of protective devices to minimize customer interruptions (CI, SAIFI) or customer minutes (CMI, SAIDI).
- **Radial Sectionalization** – Optimum placement of line reclosers and fuses in a radial distribution system (uni-directional protection of customers from faults.)
- **DA Sectionalization** – Optimum placement of “self healing” devices (bi-directional protection of customers from faults).

Optimum (adj.)

- Dictionary definition – “Greatest degree attainable under specified conditions.”
- “Greatest degree” – Lowest SAIFI or SAIDI.
- “Specified conditions” – Don’t break the bank!

Radial Sectionalization Project (Duke Energy)

Five year project to improve reliability at Duke Energy by optimizing the location of radial protective devices on all circuits (2001 to 2005)….

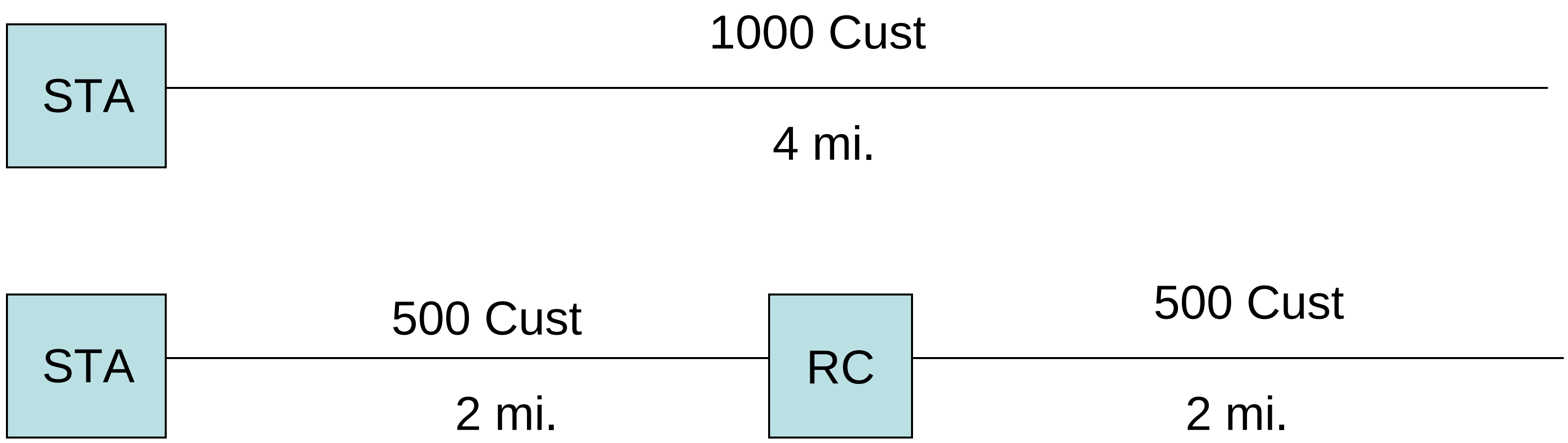
….and not break the bank!

Overview for Original Duke Energy Sectionalization Project

- **Service area:** 22,000 square miles in North Carolina and South Carolina
- **Distribution:** Approximately 69,900 miles – 2,200 feeders
- **Customers:** Approximately 2.3 million customers
- **Employees:** 10,300
- **Generation:** 8 coal-fired stations
  3 nuclear stations
  31 hydroelectric stations
  Numerous combustion turbine units
- **System Capacity:** 19,300 megawatts
- **Transmission:** 12,700 miles

The Value and Justification of Reliability Projects

Reliability Value of Adding a Line Recloser

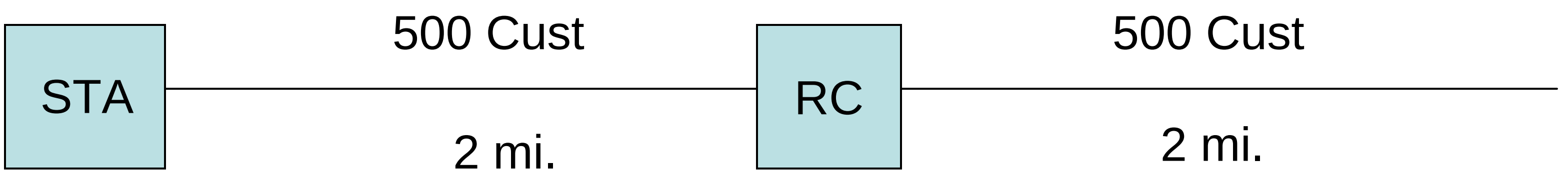


What does reliability value depend on?

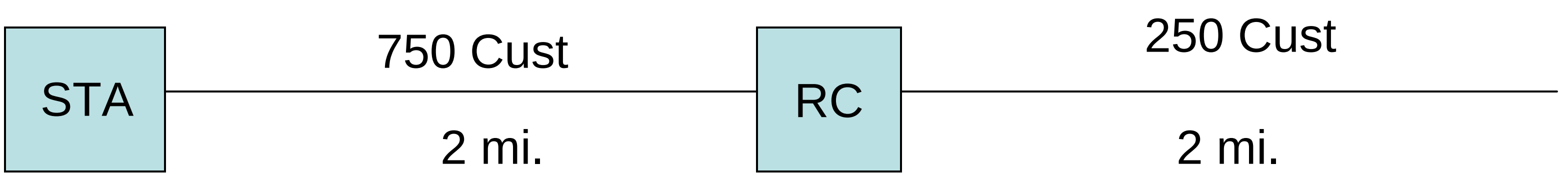
Customers upstream = 500 units

Faults downstream = 2 units

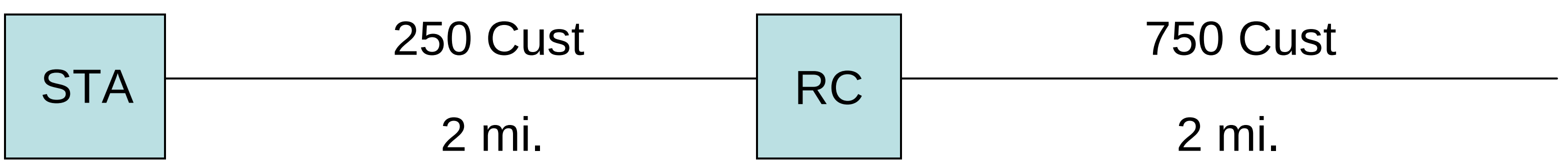
Reliability Value = Customers Upstream x Line Miles Downstream



RV = 1000 Customer-Miles (cm)



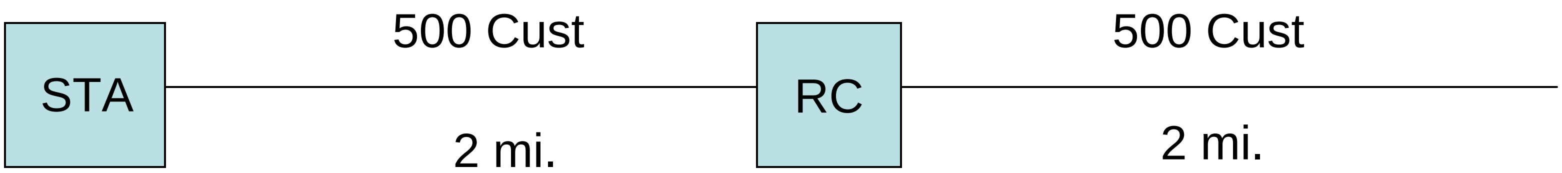
RV = 1500 cm



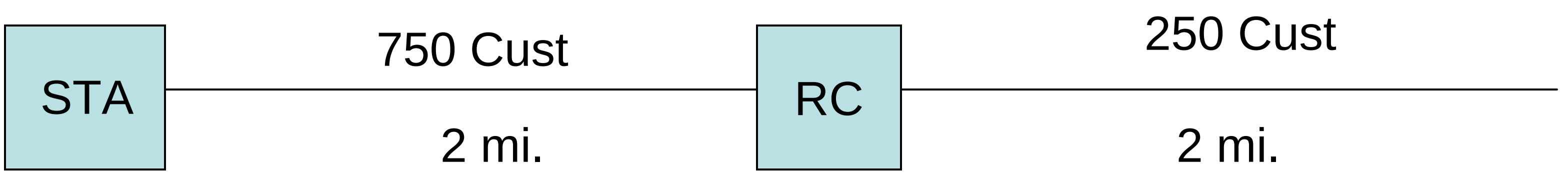
RV = 500 cm

Experienced engineers could identify which reclosers were justified.

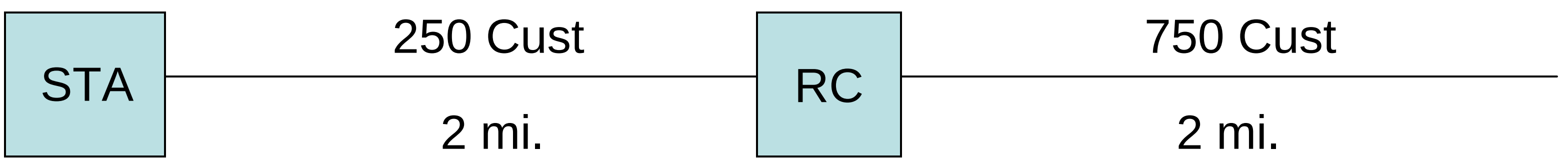
Reliability Budget = Customers Upstream x Line Miles Downstream x $10



Reliability Budget = $10,000 (cust x miles x $10)

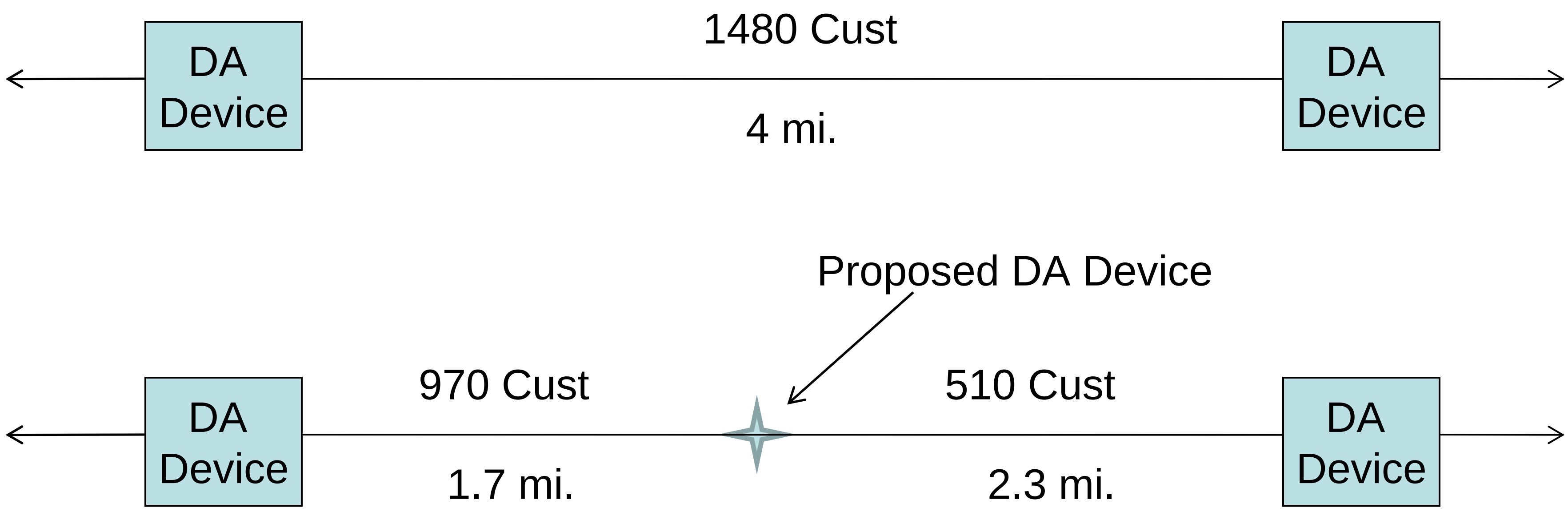


Reliability Budget = $15,000 (cust x miles x $10)



Reliability Budget = $5,000 (cust x miles x $10)

DA SECTIONALIZATION



RV = cust upstream X miles downstream + cust downstream X miles upstream

RV = 970 x 2.3 + 510 X 1.7 = 2,231 + 867 = 3,098 cm

Reliability Budget = 3,098 x $10 = $30,980

General form of Reliability Value Equation

Reliability Value = Customers Protected x Miles (faults) they are protected from x $10

Reliability Value = Cust x miles x ($10)

Reliability Value = Cust x miles x (0.2 faults per mile x value of preventing customer interruption)

…so Value of Preventing Customer Interruption = $50

…i.e. the unit cost justified to prevent one customer interruption per year.

The Value of Reliability

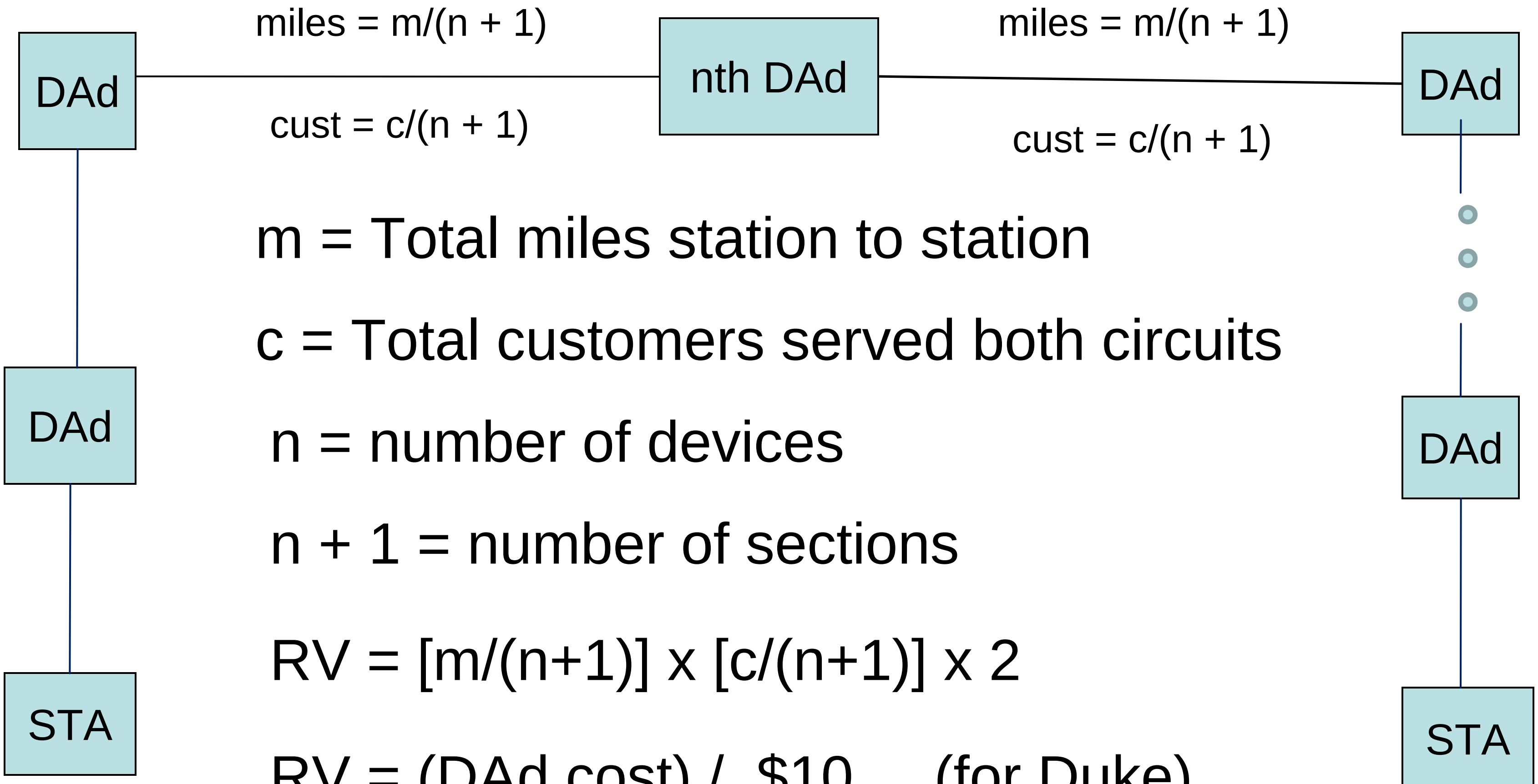
- **NOT** – The value of reliability to customers.
- **INSTEAD** – The value of customer reliability ***to the utility***.
- **SOMETIMES** – The value of customer reliability ***mandated by the utilities commission***.
- **SOMETIMES** – Insurance against regulatory intervention.
- Values generally range from $25 to $200 per CI saved depending on the utility.

Example of how to calculate a utility reliability value.

- Utility will improve SAIFI by 0.05 with Project X.
- Utility customers served = 1,500,000
- Utility will spend $5,000,000 on Project X.
- Therefore, utility is willing to spend the following amount to prevent a customer interruption:

RV = $5,000,000/(0.05 x 1,500,000) = $67

How many DA devices to place?



m = Total miles station to station

c = Total customers served both circuits

n = number of devices

n + 1 = number of sections

RV = [m/(n+1)] x [c/(n+1)] x 2

RV = (DAd cost) / $10 (for Duke)

… where $10 (for Duke) = 0.2 faults per mile per yr X $50 cost to prevent CI per year

Spreadsheet Solution for DA Devices

$30,000 (entry)	- Sample cost of DA device
0.20 (entry)	- Fault rate per mile per year
$50 (entry)	- Will pay to prevent CI/yr
3,000	- Reliability value in Cust-Miles
Total Customer Miles	Number of DA Devices Needed in 2 Circuit Loop
13,500	2
24,000	3
37,500	4
54,000	5
73,500	6
96,000	7

Need Additional Information?

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