Common T&D Reliability Indices

This paper gives formulas used to calculate common reliability indices based on outage history.

Definitions

- \(N_i\) = number of customers interrupted by outage \(i\)
- \(N_T\) = total number of customers in the system
- \(CN\) = total number of customers in the system experiencing 1 or more sustained outages
- \(CN_{(k>n)}\) = total number of customers in the system experiencing more than \(n\) sustained outages
- \(CNT_{(k>n)}\) = total number of customers in the system experiencing more than \(n\) outages
- \(L_i\) = connected kVA of customers interrupted by outage \(i\)
- \(L_{ave}\) = average load of customers interrupted by outage \(i\)
- \(L_T\) = total connected kVA of the system
- \(r_i\) = duration of interruption to customers interrupted by outage \(i\)
- \(T\) = period, usually one year, (8760 hours or 525600 minutes)
- \(ID\) = interrupting device operations
- \(ID_E\) = interruption device events

Sustained Customer Interruption Indices

- System Average Interruption Frequency Index \(SAIFI\) = \((\sum N_i)/N_T\)
- System Average Interruption Duration Index \(SAIDI\) = \((\sum r_i N_i)/N_T\)
- Customer Average Interruption Duration Index \(CAIDI = SAIDI/SAIFI\)
- Customer Total Average Interruption Duration Index \(CTAIDI = \sum r_i N_i/CN\)
- Average Service Availability Index \(ASAI = (N_TT - \sum r_i N_i)/N_TT\)

Momentary Customer Interruption Indices

- Momentary Average Interruption Frequency Index \(MAIFI = (\sum ID_i N_i)/N_T\)
- Momentary Average Interruption Frequency Event Index \(MAIFI_E = (\sum ID_E i N_i)/N_T\)
- Customers Experiencing Multiple Sustained and Momentary Interruptions \(CEMSMI_n = CNT_{(k>n)}/N_T\)

Load and Energy Based Indices

- Average System Interruption Frequency Index \(ASIFI = (\sum L_i)/L_T\)
- Average System Interruption Duration Index \(ASIDI = (\sum r_i L_i)/L_T\)
- Expected Energy Not Supplied \(EENS = \sum L_{ave} r_i\)
- Average Energy Not Supplied \(AENS = (\sum L_{ave} r_i)/N_T\)
- Average Customer Curtailment Index \(ACCI = (\sum L_{ave} r_i)/CN\)

Economic Indices (see power point on cost of customer interruption for more details)

- Sector Customer Damage Function \(SCDF\)
- Composite Customer Damage Function \(CCDF = \sum L_{ave} \times SCDF\)
- Expected Customer Outage Cost \(ECOST = \sum CCDF(r)\)
- Interrupted Energy Assessment Rate \(IEAR = ECOST/EENS\)

Miscellaneous Terms

- Customer Minutes \(CMIN\)
- Customers Experiencing Sustained Outages \(CESO\)
- Customer Experiencing Momentary Outages \(CEMO\)

Generation Adequacy Indices

- Loss of Load Probability \(LOLP\)
- Loss of Load Expectation \(LOLE\)
- Loss of Energy Expectation \(LOEE\)