

# Service Quality Regulation and Performance Monitoring in Ohio

Measuring Commercial Quality Between  
Distribution and Supply



National  
Association of  
Regulatory  
Utility  
Commissioners

**Ohio**

**Public Utilities  
Commission**

# Commercial Quality Distribution

- (1) What is to be measured?
- (2) What are the indicators?

- MEASUREMENT = the reliability of each distribution system
- INDICATORS = Service reliability indices to be matched against performance targets.

# “Reliability” is defined by

## 1. Adequacy

The ability of an electric system to supply the aggregate electrical demand and energy requirements of the customers at all times.

## 2. Security

The ability of the electric system to withstand sudden disturbances such as electric disruptions or unanticipated loss of system elements

In the USA, three measurements are used to determine how well a distribution system is performing

1. **CAIDI** (customer interruptions)
2. **SAIDI** (system interruptions) and
3. **SAIFI** (the frequency of system interruptions)

The measurement of how well a system is performing provides an indicator of “reliability.”

# CAIDI

- CAIDI (measurement) - The customer average interruption duration index, represents the average interruption duration or average time to restore service per interrupted customer.
- CAIDI (percentage indicator) is expressed by:  
$$\text{Sum of customer interruption durations} \div \text{number of interruptions}$$

# SAIDI

- “SAIDI” (measurement) is the system average interruption duration index, represents the average time each customer is interrupted.
- SAIDI (percentage indicator) is expressed by:  
Sum of customer interruption durations ÷ number of customers

# SAIFI

- “SAIFI” (measurement) is the system average interruption frequency index, represents the average number of interruptions per customer.
- SAIFI (percentage indicator) is expressed by:  
Sum of customer interruptions ÷ number of customers

## Momentary outages can act as precursors to larger reliability problems

- “MAIFI” (measurement) represents the average number of momentary interruptions per customer
- For example, if a recloser or circuit breaker operates, the operation shall be considered one momentary interruption.



# Momentary outages (cont'd)

MAIFI ( percentage indicator) is expressed by:  
$$\text{customer momentary interruptions} \div \text{number of customers}$$

Including the following details in a report will prove helpful in correcting the onset of greater problems:

1. Each circuit lockout that occurred during the reporting period should be noted with an explanation of the cause and duration
2. The total number of outages experienced during the reporting period with an explanation of the cause
3. Total out-of-service minutes for the reporting period by outage cause
4. Identification of any major factors or events that specifically caused the circuit to be reported

# How To Use Measurements and Indicators

- Each distribution system operator should determine system performance targets to create the basis for a service reliability indicator
- Performance targets (starting with the next succeeding calendar year) can be revised as patterns of performance of the system become more recognizable
- Performance targets should reflect historical system performance, system design, service area geography, and other relevant factors

# Recognition of system performance aids in targeting maintenance and system improvements

- Annual performance levels for each service reliability indicator during a major weather event such as a storm should be recorded and reported for future use
- Performance data during a “major storm”, or other uncontrollable interruption of service can be used by the operator to develop an emergency plan
- If the annual performance level is worse than the target for any indicator, the operator can develop an action plan to improve performance to a level that meets or exceeds the target level for each missed reliability indicator

# Measurements for performance of generators

- Generator performance is also important to maintaining adequate and reliable capacity resources.
- Generator performance, particularly for deregulated capacity resources in a competitive market can assure reliability and optimized return on investment in these assets.
- The generator that avoids unexpected (“forced”) outages of equipment will find that regular maintenance and repairs pay off in the long run
- Outages to accommodate regular maintenance schedules are not considered “forced” outages and therefore do not contribute to the calculation of a forced outage rate.

## Two Types of “forced outage rates” have been used in the USA

- **Equivalent forced outage rate or EFOR** =  $\text{Equivalent Forced Outage Hours} / (\text{Period Hours} - \text{Equivalent Scheduled Outage Hours})$
- **Equivalent Demand Forced Outage Rate or EFORd** = approximations to estimate when a resource is needed and the EFORd equation includes additional information on each unit such as average forced outage duration. This more accurate equation, based on actual availability of generating units, is favored by RTOs/ISOs for the deregulated wholesale markets in the USA .

## Variations on the use of these indicators

- **EFOR** - Defined by the NERC GADS Data Reporting Instructions Appendix F. This value may be calculated on any basis including hourly, daily, weekly, monthly, quarterly, and annually as well as time periods based on these periods such as 12-month rolling averages, last 5 years, etc. In addition, the EFOR may be calculated for peak periods.
- **EFORd (PJM)** - Defined by the PJM Interconnection. As required by the PJM Interconnection, the EFORd can be calculated on a monthly, quarterly and annual basis as well as time periods based on these periods such as 12-month rolling averages, last 5 years, etc. Also utilized by New York ISO and ISO-New England. And under development by MISO.

- The value of these individual performance indicators for distribution and generation is the improvement that can result in the overall performance and reliability of any electrical system.
- If “points” were awarded to the best performing distribution systems and individual generators as they meet customer requirements, the customers, the asset owners and the system operators would indeed, all be

**“WINNERS!”**