

Distribution

Reliability Measures

Guideline

November 2018

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1. **Amendment record**

|  |  |  |
| --- | --- | --- |
| Version | Date | Pages |
| 01 | 14 November 2018 | 10 |

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# ****Nature and Authority****

## ****Introduction****

This guideline establishes a set of common definitions of reliability measures that can be used to assess and compare the reliability performance of Distribution Network Service Providers (DNSPs) for all jurisdictions in Australia.

Currently the Australian Energy Regulator (AER) and States regulators define how reliability should be measured, which means it is difficult to compare the reliability performance across Australia. Consequently, the Australian Energy Market Commission (AEMC) implemented a rule change that required us to develop common definitions for distribution reliability measures for application in the National Electricity Market (NEM).

## Authority

Clause 6.28 of the National Electricity Rules (NER) requires the AER to make and publish, in accordance with the distribution consultation procedures, this Distribution Reliability Measures Guideline (the guideline).

## Definitions and interpretation

1. In this guideline the words and phrases have the meaning given to them in:

* in section 3.2
* the glossary, or
* if not defined in the glossary, the NER or the National Energy Retail Rules (NERR).

## Process for revision

We may amend or replace this guideline from time to time in accordance with the distribution consultation procedures.

The AER must review this guideline at least every 5 years.[[1]](#footnote-1)

## Version history and effective date

A version number and an effective date of issue will identify every version of this guideline.

# ****Application of this guideline****

We will apply the definitions of reliability measures specified in this guideline when we issue a Regulatory Information Notice (RIN) under section 28D or Regulatory information Order (RIO) under section 28C of the National Electricity Law (NEL).

We may also make references to this guideline where we consider it appropriate to do so. Other regulatory bodies may make references to this guideline.

# Reliability measures and supporting definitions

The reliability measures contained in this guideline are:

* SAIDI or System Average Interruption Duration Index
* SAIFI or System Average Interruption Frequency Index
* CAIDI or Customer Average Interruption Duration Index
* MAIFI or Momentary Average Interruption Frequency Index
* MAIFIe or Momentary Average Interruption Frequency Index event
* Supply reliability levels experienced by the lowest-reliability customers.

When calculating SAIDI, SAIFI, MAIFI and MAIFIe:

* Exclusions – One or more of the circumstances numbered 1 to 7 below in section 3.3 Exclusions may be excluded from the calculation of these reliability measures.

The MAIFI measure may be used where the current recording facilities do not have the capacity to record momentary interruption events under the MAIFIe method.

Reliability measures should be reported as planned and unplanned supply outages and total outages and on the following basis:

* by feeder type
* overall performance of the entire network.

The tables below provides the definitions of these measures to enable an assessment and comparison of reliability performance of DNSPs.

## Measurements - CAIDI, SAIDI, SAIFI, MAIFI, MAIFIe

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| **CAIDI or Customer Average Interruption Duration Index** in respect of a relevant period, means the total duration of all the Sustained Interruptions (in minutes) divided by the total number of Sustained Interruptions that have occurred during the relevant period, which is equivalent to dividing the SAIDI by the SAIFI measures.  This measure represents the average time to restore supply to customers after a supply interruption event.  This performance measure should be reported on both by feeder type and by distribution network overall basis. |
| **SAIDI or System Average Interruption Duration Index**, means the sum of the durations of all the Sustained Interruptions (in minutes), divided by the Customer Base. Momentary Interruptions (of three minutes or less) are excluded from the calculation of unplanned SAIDI. |
| **SAIFI or System Average Interruption Frequency Index**, means the total number of Sustained Interruptions, divided by the Customer Base. Momentary Interruptions (of three minutes or less) are excluded from the calculation of unplanned SAIFI. |
| **MAIFI or Momentary Average Interruption Frequency Index**, means the total number of Momentary Interruptions, divided by the Customer Base, provided that Momentary Interruptions that occur within the first three minutes of a Sustained Interruption are excluded from the calculation. |
| **MAIFIe or Momentary Average Interruption Frequency Index event**, means the total number of Momentary Interruption Events divided by the Customer Base for the relevant period, provided that Momentary Interruptions that occur within the first three minutes of a Sustained Interruption are excluded from the calculation. |

Notes: When calculating SAIDI, SAIFI, MAIFI and MAIFIe:

- Exclusions – One or more of the circumstances numbered 1 to 7 in Section 3.3 of this section may be excluded from such calculations.

- Interruptions – The Interruptions used to calculate such measurements may be limited to Planned Interruptions or Unplanned Interruptions.

- Feeders – The calculations may be limited to CBD feeders, urban feeders, short rural feeders, long rural feeders or a combination of such feeders.

## Definitions

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| **CBD feeder** means a feeder in the CBD area of State or Territory capital that has been determined by the relevant participating jurisdiction as supplying electricity to predominantly commercial, high-rise buildings, supplied by a predominantly underground distribution network containing significant interconnection and redundancy when compared to urban areas. |
| **Customer** means an end user of electricity who purchases electricity supplied through a distribution system to a connection point. |
| **Customer Base** in respect of a relevant period, means:  - the number of Distribution Customers as at the start of the relevant period; plus  - the number of Distribution Customers as at the end of the relevant period,  divided by two. |
| **Distribution Customer** means a connection point between a distribution network and Customer that has been assigned a National Metering Identifier, including energised and de-energised connection points but excluding unmetered connection points without a National Metering Identifier. |
| **Feeder** means a power line, including underground cables, that is part of a distribution network. |
| **IEEE Guide** means the ‘IEEE Guide for Electric Power Distribution Reliability Indices, IEEE Standard 1366-2012’ published by the Institute of Electrical and Electronic Engineers on 31 May 2012. |
| **Interruption[[2]](#footnote-2)** means any loss of electricity supply to Distribution Customers associated with an outage of any part of the network, including outages affecting a single Customer’s premises but excluding disconnections caused by a retailer or a fault in electrical equipment owned by a Customer, provided that:   * the start of an Interruption is taken to be when the Interruption is initially automatically recorded by equipment such as SCADA or, where such equipment does not exist, at the time of the first Customer reports that there has been an outage in the network; and * the end of an Interruption is taken to be when the Interruption is automatically recorded as ending by equipment such as SCADA or, where such equipment does not exist, the time when electricity supply is restored to the affected Distribution Customers.[[3]](#footnote-3) |
| **Long rural feeder** means a feeder that is not a CBD feeder, urban feeder or short rural feeder. |
| **Major Event Day** has a meaning consistent with that given in the IEEE Guide, provided that for the purposes of applying a common distribution reliability measure, the regulator applies a log standard deviation of 2.5, that is, a '2.5 beta'. |
| **Momentary Interruption** means an Interruption to a Distribution Customer’s electricity supply with a duration of 3 minutes or less, provided that the end of each Momentary Interruption is taken to be when electricity supply is restored for any duration. (see Figure 1.2). |
| **Momentary Interruption Event** means one or more Momentary Interruptions that occur within a continued duration of 3 minute or less, provided that the successful restoration of electricity supply after any number of Momentary Interruptions is taken to be the end of the Momentary Interruption Event. (see Figure 1.2) |
| **National electricity legislation** has the meaning given in the National Electricity Law. |
| **Outage** means the loss of ability of a component to deliver electrical power.  Note: for reporting purposes:  • Single premises outage is a network interruption irrespective of whether the outage is caused by the customer’s installation. However, if power is still available at the point of supply, there is no supply interruption.  • HV single phase outage – unless accurate means to determine the exact number of customers affected, report of 67% of all downstream customers for a single-phase HV outage on a three phase network. Report of 100% of customers for all other HV outages, for example; when there is a single HV phase outage on a two phase or single phase HV system.  • LV single phase outage – unless accurate means to determine the exact number of customers affected, report of 33% of all downstream customers for a single phase outage. |
| **Planned Interruption** means an Interruption resulting from a Distribution Network Service Provider’s intentional interruption of electricity supply to a Customer’s premises where the Customer has been provided with prior notification of the Interruption in accordance with all applicable laws, rules and regulations. |
| **Point of Supply** has the same meaning as defined in the relevant jurisdiction's Service and Installation Rules. |
| **SCADA** or **Supervisory Control and Data Acquisition** means a system employed to gather and analyse real-time data in respect of network related infrastructure. |
| **Short rural feeder** means a feeder with a total feeder route length less than 200 km, which is not a CBD feeder or urban feeder. |
| **Sustained Interruption** means an Interruption to a Distribution Customer’s electricity supply at the point of supply that has a duration longer than 3 minutes, provided that the successful restoration of supply to the Distribution Customer is taken to be the end of the Sustained Interruption. |
| **Unplanned Interruption** means an Interruption that is not a Planned Interruption. |
| **Urban feeder** is a feeder which is not a CBD feeder and has a 3-year average maximum demand over the 3 year average feeder route length greater than 0.3 MVA/km. |
| Inadequate level of service customer means a customer experiencing greater than 4 times the Network average for unplanned SAIDI on a three-year rolling average basis compared with a network average customer.  Note DNSPs must report to the AER:   * the average unplanned SAIDI of the inadequate level of service customer * the average unplanned SAIFI of the inadequate level of service customer * the top five feeders or feeder sections with the most inadequate level of service customer * the number of inadequate level of service customer of each of the top five feeders or feeder sections.   Where data are unavailable at feeder or feeder-section level, the DNSP may report on zone substation level. |

## Exclusions

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| Interruptions that result from the following circumstances may be excluded from the calculation of SAIDI, SAIFI, MAIFI and MAIFIe :  1. Load shedding due to a generation shortfall.  2. Automatic load shedding due to the operation of under-frequency relays following the occurrence of a power system under-frequency condition.  3. Load shedding at the direction of AEMO or a System Operator.  4. Load interruptions caused by a failure of the shared transmission network.  5. Load interruptions caused by a failure of transmission connection assets except where the interruptions were due to (a) actions, or inactions, of the Distribution Network Service Provider that are inconsistent with good industry practice; or (b) inadequate planning of transmission network connections points and the Distribution Network Service Provider is responsible for the planning of transmission network connection points.  For example, when a DNSP omits to suppress back-up earth fault (BUEF) protection when undertaking network switching operation that resulted in momentary paralleling of supplies from two different terminal stations, which is inconsistent with the standard practice.  6. Load interruptions caused by the exercise of any obligation, right or discretion imposed upon or provided for under jurisdictional electricity legislation or national electricity legislation applying to a Distribution Network Service Provider.  7. Load interruptions caused or extended by a direction from state or federal emergency services, provided that a fault in, or the operation of, the network did not cause, in whole or part, the event giving rise to the direction.  8. Load interruptions caused or extended by a direction from state or federal emergency services, provided that a fault in, or the operation of, the network did not cause, in whole or part, the event giving rise to the direction.  Interruptions may also be excluded that occur on days where the daily unplanned SAIDI for the DNSP’s distribution network exceeds the major event day boundary, when the event has not been excluded under the seven exclusion clauses described above. |

## Illustration of how to measure supply interruptions

Figure 1.1 shows an example of a sustained interruption, where two unsuccessful attempts are made. In this case, the duration of the interruption is greater than the momentary interruption threshold of 3 minutes.

Figure 1.1 Sustained interruption, unsuccessful auto-reclose

**Supply On**

**t = 0**

**t = 3 min**

SAIDI = 80 minutes

SAIFI = 1

MAIFIe = 0

MAIFI = 0

**t = 80 min**

Supply restored

**Supply Off**

Figure 1.2 demonstrates the difference between MAIFI and MAIFIe. It shows an example of a momentary interruption event, where the affected customers experience two momentary interruptions before the supply is successfully restored. In this case, the duration of the interruption is less than the momentary interruption threshold of 3 minutes.

**t = 3 min**

Figure 1.2 Momentary interruption event

**Supply On**

Supply restored within 3 minutes

**Supply Off**

**t = 0**

= 1 count of MAIFIe

= 2 counts of MAIFI

= 0 count of SAIFI

= 0 minute of SAIDI

# Glossary

1. This guideline uses following definitions and acronyms.

| Shortened form | Extended form |
| --- | --- |
| CAIDI (Customer Average Interruption Duration Index) | has the meaning set out in section 3. |
| distribution consultation procedures | has the meaning set out in the National Electricity Rules. |
| DNSP (distribution network service provider) | has the meaning set out in the National Electricity Rules. |
| interruption | has the meaning set out in section 3. |
| jurisdictional electricity legislation | has the meaning set out in the National Electricity Law. |
| load shedding | has the meaning set out in the National Electricity Rules. |
| MAIFI | has the meaning set out in section 3. |
| major event day | has the meaning set out in section 3. |
| NEL | the National Electricity Law. |
| national electricity legislation | has the meaning set out in the National Electricity Law. |
| national electricity market | has the meaning set out in the National Electricity Law. |
| National Metering Identifier | The NMI (National Metering Identifier) is a unique ten character (plus a one digit checksum) identifier for a metering point. |
| NER | the National Electricity Rules. |
| NERR | the National Energy Retail Rules. |
| network type | the type of network supplying customers being either CBD, urban, short rural or long rural feeders as defined in section 3. |
| system operator | has the meaning set out in the National Electricity Rules. |
| unplanned event | an event that causes an interruption where the customer has not been given the required notice of the interruption or where the customer has not requested the outage. |
| unplanned interruption | an interruption due to an unplanned event. |
| unplanned SAIDI | has the meaning set out in section 3. |
| unplanned SAIFI | has the meaning set out in section 3. |

1. NER clause 6.28(c) [↑](#footnote-ref-1)
2. The definition of interruption under this guideline is modified from that specified in the National Electricity Retail Rules because supply outages due to some upstream events are included in the reliability measures in addition to those interruptions initiated from the distribution networks. [↑](#footnote-ref-2)
3. The number of affected Customers during an Interruption may need to be estimated. [↑](#footnote-ref-3)