# IEEE Guide for Electric Power Distribution Reliability Indices

Sponsor

**Transmission and Distribution Subcommittee of the IEEE Power Engineering Society**

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**Abstract:** Useful distribution reliability indices, and factors that affect their calculation, are identified. This guide includes indices that are useful today as well as ones that may be useful in the future. The indices are intended to apply to distribution systems, substations, circuits, and defined regions.
**Keywords:** circuits, distribution reliability indices, distribution systems, electric power, reliability indices

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# Introduction

(This introduction is not part of IEEE Std 1366, 2001Edition, IEEE Guide for Electric Power Distribution Reliability Indices.)

An active committee that saw a need to create indices specifically designed for distribution systems created this guide. Other groups had created indices for transmission and industrial systems, but none were available for distribution. This group will continue working in this area by refining the information contained in this guide.

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Also included is the following nonvoting IEEE-SA Standards Board liaison:

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# IEEE Guide for Electric Power Distribution Reliability Indices

## 1. Overview

### 1.1 Scope

This guide identifies useful distribution reliability indices and factors that affect their calculation. It includes indices that are useful today as well as ones that may be useful in the future. The indices are intended to apply to distribution systems, substations, circuits, and defined regions.

### 1.2 Purpose

The purpose of this guide is twofold. First, it is to present a set of terms and definitions that can be used to foster uniformity in the development of distribution service reliability indices, to identify factors that affect the indices, and to aid in consistent reporting practices among utilities. Secondly, it is to provide guidance for new personnel in the reliability area and to provide tools for internal as well as external comparisons. In the past, other groups have defined reliability indices for transmission, generation, and distribution but some of the definitions already in use are not specific enough to be wholly adopted for distribution. It is recognized that not all utilities will have the data available to calculate all the indices. However, as systems become more sophisticated, the index calculation will become broader and all of these will be able to be calculated.

## 2. References

This guide shall be used in conjunction with the following standards. When the following standards are superseded by an approved revision, the revision shall apply.

IEEE Std 100-1996, IEEE Standard Dictionary of Electrical and Electronics Terms.[1]

IEEE Std 859-1987 (Reaff 1993), IEEE Standard Terms for Reporting and Analyzing Outage Occurrences and Outage States of Electrical Transmission Facilities.

[1]IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA (http://www.standards.ieee.org/).

## 3. Definitions

Definitions are given here to aid the user in understanding the factors that affect index calculation. Many of these definitions were taken directly from IEEE Std 100-1996.[2] If there is a conflict between the definitions in this guide and IEEE Std 100-1996, the definitions in this guide take precedence. Others are given because they have a new interpretation within this guide or have not been defined before.

**3.1 connected load:** The connected transformer kVA, peak load, or metered demand (to be clearly specified when reporting) on the circuit or portion of circuit that is interrupted. When reporting, the report should state whether it is based on an annual peak or on a reporting period peak.

**3.2 customer count:** The number of customers or number of meters. The number of customers is the preferred item to count if the counting system is not already in place.

**3.3 distribution system:** That portion of an electric system that delivers electric energy from transformation points on the transmission system to the customer. *Note:* The distribution system is generally considered to be anything from the distribution substation fence to the customer meter. Often the initial overcurrent protection and voltage regulator are within the substation fence.

**3.4 duration interruption:** The period (measured in seconds, or minutes, or hours, or days) from the initiation of an interruption to a customer or other facility until service has been restored to that customer or facility. An interruption may require step-restoration tracking to provide reliable index calculation. It may be desirable to record the duration of each interruption.

**3.5 forced interruption:** An interruption caused by a forced outage.

**3.6 interrupting device:** A device capable of being reclosed whose purpose is to interrupt faults and restore service or disconnect loads. These devices can be manual, automatic, or motor-operated. Examples may include transmission breakers, feeder breakers, line reclosers, and motor-operated switches.

**3.7 interrupting device event:** The operation associated with the interrupting device for cases where a reclosing device operates but does not lockout and where a switch is opened only temporarily.

**3.8 interrupting device operation:** The operation associated with a reclosing device for cases where the switch opens and closes once but does not lockout.

**3.9 interruption:** The loss of service to one or more customers. *Note:* It is the result of one or more component outages, depending on system configuration. *See:* **outage.**

**3.10 interruptions caused by events outside of distribution:** For most utilities, this type of interruption is a small percentage of the total interruptions. It will be defined here to account for the cases where outside influences are a major occurrence. Three categories that may be helpful to monitor are: transmission, generation, and substations.

**3.11 lockout:** The final operation of a recloser or circuit breaker in an attempt to clear a persistent fault. The overcurrent protective device locks open their contacts under these conditions.

**3.12 loss of service:** The loss of electrical power, a complete loss of voltage, to one or more customers or meters. This does not include any of the power quality issues (sags, swells, impulses, or harmonics).

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[2]Information on references can be found in Clause 2.

 

**3.13 major event:** A catastrophic event that exceeds design limits of the electric power system and that is characterized by the following (as defined by the utility):

a) Extensive damage to the electric power system;
b) More than a specified percentage of customers simultaneously out of service;
c) Service restoration times longer than specified.

Some examples are extreme weather, such as a one in five year event, or earthquakes.

**3.14 momentary event interruption:** An interruption of duration limited to the period required to restore service by an interrupting device. *Note:* Such switching operations must be completed in a specified time not to exceed 5 min. This definition includes all reclosing operations that occur within 5 min of the first interruption. For example, if a recloser or breaker operates two, three, or four times and then holds, the event shall be considered one momentary interruption event.

**3.15 momentary interruption:** Single operation of an interrupting device that results in a voltage zero. For example, two breaker or recloser operations equals two momentary interruptions.

**3.16 outage (electric power systems):** The state of a component when it is not available to perform its intended function due to some event directly associated with that component. *Notes:* 1. An outage may or may not cause an interruption of service to customers, depending on system configuration. 2. This definition derives from transmission and distribution applications and does not apply to generation outages.

**3.17 reporting period:** A period assumed to be one year unless otherwise stated.

**3.18 scheduled interruption (electric power systems):** A loss of electric power that results when a component is deliberately taken out of service at a selected time, usually for the purposes of construction, preventative maintenance, or repair. *Notes:* 1. This derives from transmission and distribution applications and does not apply to generation interruptions. 2. The key test to determine if an interruption should be classified as a forced or scheduled interruption is as follows. If it is possible to defer the interruption when such deferment is desirable, the interruption is a scheduled interruption; otherwise, the interruption is a forced interruption. Deferring an interruption may be desirable, for example, to prevent overload of facilities or interruption of service to customers.

**3.19 step restoration:** The restoration of service to blocks of customers in an area until the entire area or feeder is restored.

**3.20 sustained interruption:** Any interruption not classified as a momentary event. Any interruption longer than 5 min.

**3.21 total number of customers served:** The total number of customers served on the last day of the reporting period. If a different customer total is used, it must be clearly defined within the report.

# 4. Reliability indices

## 4.1 Basic factors

The following basic factors specify the data needed to calculate the indices:

| | |
|---|---|
| i | An interruption event; |
| $r_i$ | Restoration time for each interruption event; |
| E | Event; |
| $T$ | Total; |
| $ID_i$ | Number of interrupting device operations; |

| | |
|---|---|
| $ID_E$ | Interrupting device events during reporting period; |
| $N_i$ | Number of interrupted customers for each interruption event during reporting period; |
| $N_T$ | Total number of customers served for the area being indexed; |
| $L_i$ | Connected kVA load interrupted for each interruption event; |
| $L_T$ | Total connected kVA load served; |
| $CN_{(k>n)}$ | Total number of customers who have experienced more than *n* sustained interruptions during the reporting period; |
| $CN$ | Total number of customers who have experienced a sustained interruption during the reporting period; |
| $CNT_{(k>n)}$ | Total number of customers who have experienced more than *n* sustained interruptions and momentary interruption events during the reporting period; |
| $k$ | Number of interruptions experienced by an individual customer in the reporting period. |

## 4.2 Sustained interruption indices

### 4.2.1 SAIFI

*System average interruption frequency index (sustained interruptions).* This index is designed to give information about the average frequency of sustained interruptions per customer over a predefined area. In words, the definition is:

$$\text{SAIFI} = \frac{\text{Total number of customer interruptions}}{\text{Total number of customers served}} \tag{1}$$

To calculate the index, use the following equation:

$$\text{SAIFI} = \frac{\Sigma N_i}{N_T} \tag{2}$$

### 4.2.2 SAIDI

*System average interruption duration index.* This index is commonly referred to as customer minutes of interruption or customer hours, and is designed to provide information about the average time the customers are interrupted. In words, the definition is:

$$\text{SAIDI} = \frac{\Sigma\ \text{Customer interruption durations}}{\text{Total number of customers served}} \tag{3}$$

To calculate the index, use the following equation:

$$\text{SAIDI} = \frac{\Sigma r_i N_i}{N_T} \tag{4}$$

### 4.2.3 CAIDI

*Customer average interruption duration index.* CAIDI represents the average time required to restore service to the average customer per sustained interruption. In words, the definition is:

$$\text{CAIDI} = \frac{\Sigma\ \text{Customer interruption durations}}{\text{Total number of customer interruptions}} \tag{5}$$

To calculate the index, use the following equation:

$$\text{CAIDI} = \frac{\Sigma r_i N_i}{\Sigma N_i} = \frac{\text{SAIDI}}{\text{SAIFI}} \tag{6}$$

### 4.2.4 CTAIDI

*Customer total average interruption duration index.* For customers who actually experienced an interruption, this index represents the total average time in the reporting period they were without power. This index is a hybrid of CAIDI and is calculated the same except that customers with multiple interruptions are counted only once. In words, the definition is:

$$\text{CTAIDI} = \frac{\Sigma \text{ Customer interruption durations}}{\text{Total number of customers interrupted}} (\text{Duration}) \tag{7}$$

To calculate the index, use the following equation:

$$\text{CTAIDI} = \frac{\Sigma r_i N_i}{CN} \tag{8}$$

NOTE—In tallying total number of customers interrupted, each individual customer should only be counted once regardless of the number of times interrupted during the reporting period. This applies to CTAIDI and CAIFI.

### 4.2.5 CAIFI

*Customer average interruption frequency index.* This index gives the average frequency of sustained interruptions for those customers experiencing sustained interruptions. The customer is counted once regardless of the number of times interrupted for this calculation. In words, the definition is:

$$\text{CAIFI} = \frac{\text{Total number of customer interruptions}}{\text{Total number of customers interrupted}} \tag{9}$$

To calculate the index, use the following equation:

$$\text{CAIFI} = \frac{\Sigma N_i}{CN} \tag{10}$$

### 4.2.6 ASAI

*Average service availability index.* This index represents the fraction of time (often in percentage) that a customer has power provided during one year or the defined reporting period. In words, the definition is:

$$\text{ASAI} = \frac{\text{Customer hours service availability}}{\text{Customer hours service demand}} \tag{11}$$

To calculate the index, use the following equation:

$$\text{ASAI} = \frac{N_T \times (\text{No. of hours/year}) - \Sigma r_i N_i}{N_T \times (\text{No. of hours/year})} \tag{12}$$

There are 8760 hours in a regular year, 8784 in a leap year.

### 4.2.7 ASIFI

*Average system interruption frequency index.* This index was specifically designed to calculate reliability based on load rather than number of customers. It is an important index for areas that serve predominantly industrial/commercial customers. It is also used by utilities that do not have elaborate customer tracking systems. Similar to SAIFI, it gives information on the system average frequency of interruption. In words, the definition is:

$$\text{ASIFI} = \frac{\text{Connected kVA interrupted}}{\text{Total connected kVA served}}(\text{Average no. of interruptions}) \tag{13}$$

To calculate the index, use the following equation:

$$\text{ASIFI} = \frac{\Sigma L_{\text{i}}}{L_{\text{T}}} \tag{14}$$

### 4.2.8 ASIDI

*Average system interruption duration index.* This index was designed with the same philosophy as ASIFI, but it provides information on system average duration of interruptions. In words, the definition is:

$$\text{ASIDI} = \frac{\text{Connected kVA duration interrupted}}{\text{Total connected kVA served}} \tag{15}$$

To calculate the index, use the following equation:

$$\text{ASIDI} = \frac{\Sigma r_{\text{i}} L_{\text{i}}}{L_{\text{T}}} \tag{16}$$

### 4.2.9 $\text{CEMI}_n$

*Customers experiencing multiple interruptions.* This index is designed to track the number *n* of sustained interruptions to a specific customer. Its purpose is to help identify customer trouble that cannot be seen by using averages. In words, the definition is:

$$\text{CEMI}_n = \frac{\text{Total number of customers that experienced more than } n \text{ sustained interruptions}}{\text{Total number of customers served}} \tag{17}$$

To calculate the index, use the following equation:

$$\text{CEMI}_n = \frac{CN_{k>n}}{N_{\text{T}}} \tag{18}$$

## 4.3 Other indices (momentary)

### 4.3.1 MAIFI

*Momentary average interruption frequency index.* This index is very similar to SAIFI, but it tracks the average frequency of momentary interruptions. In words, the definition is:

$$\text{MAIFI} = \frac{\text{Total number of customer momentary interruptions}}{\text{Total number of customers served}} \tag{19}$$

To calculate the index, use the following equation:

$$\text{MAIFI} = \frac{\Sigma ID_{\text{i}} N_{\text{i}}}{N_{\text{T}}} \tag{20}$$

### 4.3.2 $\text{MAIFI}_{\text{E}}$

*Momentary average interruption event frequency index.* This index is very similar to SAIFI, but it tracks the average frequency of momentary interruption events. In words, the definition is:

$$\text{MAIFI}_{\text{E}} = \frac{\text{Total number of customer momentary interruption events}}{\text{Total number of customers served}} \tag{21}$$

To calculate the index, use the following equation:

$$\text{MAIFI}_{\text{E}} = \frac{\Sigma \text{ID}_{\text{E}} N_{\text{i}}}{N_{\text{T}}} \tag{22}$$

NOTE—Here, $N_{\text{i}}$ is the number of customers experiencing momentary interruptions events. This index does not include the events immediately preceding a lockout.

### 4.3.3 $\text{CEMSMI}_{\text{n}}$

*Customers experiencing multiple sustained interruptions and momentary interruptions events.* This index is designed to track the number *n* of both sustained interruptions and momentary interruption events to a set of specific customers. Its purpose is to help identify customer trouble that cannot be seen by using averages. In words, the definition is:

$$\text{CEMSMI}_{n} = \frac{\text{Total number of customers that experienced more than } n \text{ interruptions}}{\text{Total number of customers served}} \tag{23}$$

To calculate the index, use the following equation:

$$\text{CEMSMI}_{n} = \frac{CNT_{k > n}}{N_{\text{T}}} \tag{24}$$

NOTE—This index accounts for both momentary interruption events and sustained interruptions.

# 5. Application of the indices

Utilities typically store data about interruptions in large computer databases. Some databases are better organized than others for polling reliability data. This clause provides a sample skeleton database and the methodology for calculating indices based on the information in this partial database. Be aware that this is a bare bones system that shows only the data necessary to illustrate index calculation.

## 5.1 Example one

Table 1 shows an excerpt from one utility's customer information system (CIS) database for feeder 7075, which serves 2000 customers for a total load of 4 MW. In this example, Circuit 7075 constitutes the "system" for which the indices are calculated. More typically the "system" combines all circuits together in a region or for a whole company.

## 5.2 Calculation of the indices

The equations and definitions given in Clause 4 should be used to calculate the annual indices. In the example below, the indices are calculated by the equations given in 4.2 and 4.3 and the data given in Table 1 and Table 2.

$$\text{SAIFI} = \frac{200 + 600 + 25 + 90 + 700 + 1500 + 100}{2000} = = 1.6075 \tag{25}$$

$$\text{SAIDI} = \frac{(8.17 \times 200) + (71.3 \times 600) + (30.3 \times 25) + (267.2 \times 90) + (120 \times 700) + (10 \times 1500) + (40 \times 100)}{2000} = 86.11 \text{ min} \tag{26}$$

$$\text{CAIDI} = \frac{\text{SAIDI}}{\text{SAIFI}} = \frac{86.110}{1.6075} = 53.567 \text{ min} \tag{27}$$

To calculate CTAIDI and CAIFI, some flags need to be set in the database. The total number of customers affected (*CN*) for this example can be no more than 2000. Since only a small portion of the customer information table is shown it is impossible to know *CN*. It is likely that not all of the 2000 customers on this feeder experienced an interruption during the year. An arbitrary flag of 1800 will be assumed for *CN* since the interruption on 9/3 shows that at least 1500 customers have been interrupted during the year.

$$\text{CTAIDI} = \tag{28}$$

$$\frac{(8.17 \times 200) + (71.3 \times 600) + (30.3 \times 25) + (267.2 \times 90) + (120 \times 700) + (10 \times 1500) + (40 \times 100)}{1800} = 95.677 \text{ min}$$

$$\text{CAIFI} = \frac{200 + 600 + 25 + 90 + 700 + 1500 + 100}{1800} = 1.786 \tag{29}$$

$$\text{ASAI} = \tag{30}$$

$$\frac{8760 \times 2000 - (8.17 \times 200 + 600 \times 71.3 + 30.3 \times 25 + 267.2 \times 90 + 120 \times 700 + 10 \times 700 + 10.1500 + 40 \times 100)/60}{8760 \times 200} = 0.999836$$

$$\text{ASIFI} = \frac{800 + 1800 + 75 + 500 + 2100 + 3000 + 200}{4000} = = 2.119 \tag{31}$$

 

$$\text{ASIDI} = \frac{(800 \times 8.17) + (1800 \times 71.3) + (75 \times 30.3) + (500 \times 267.2) + (2100 \times 700) + (10 \times 3000) + (200 \times 40)}{4000} = 444.693 \quad (32)$$

As with CTAIDI, the indices—CAIFI, $CEMI_n$, and $CEMSMI_n$,—require detailed interruption information for each customer. The database should be searched for all customers who have experienced more than *n* interruptions that last longer than 5 min. Assume *n* is chosen to be 5. In Table 2, customer Willis, J. experienced seven interruptions in one year and it is plausible that other customers also experienced more than five interruptions, both momentary and sustained.

**Table 1—Outage data for 1994**

| Date | Time | Time on | Circuit | Event code | No. of customers | Load (kVA) | Interrupt type |
|---|---|---|---|---|---|---|---|
| 3/17 | 12:12:20 | 12:20:30 | 7075 | 107 | 200 | 800 | Sustained |
| 4/15 | 18:23:56 | 18:24:26 | 7075 | 256 | 400 | 1600 | Momentary |
| 5/5 | 00:23:10 | 01:34:29 | 7075 | 435 | 600 | 1800 | Sustained |
| 6/12 | 23:17:00 | 23:47:14 | 7075 | 567 | 25 | 75 | Sustained |
| 7/6 | 09:30:10 | 09:31:10 | 7075 | 567 | 2000 | 4000 | Momentary |
| 8/20 | 15:45:39 | 20:12:50 | 7075 | 832 | 90 | 500 | Sustained |
| 8/31 | 08:20:00 | 10:20:00 | 7075 | 1003 | 700 | 2100 | Sustained |
| 9/3 | 17:10:00 | 17:20:00 | 7075 | 1100 | 1500 | 3000 | Sustained |
| 10/27 | 10:15:00 | 10:55:00 | 7075 | 1356 | 100 | 200 | Sustained |

**Table 2—Extracted customers who were interrupted**

| Name | Circuit no. | Date | Event code | Duration (min) |
|---|---|---|---|---|
| Willis, J. | 7075 | 3/17/94 | 107 | 8.17 |
| Williams, J. | 7075 | 4/15/94 | 256 | 0.5 |
| Willis, J. | 7075 | 4/15/94 | 256 | 0.5 |
| Wilson, D. | 7075 | 5/5/94 | 435 | 71.3 |
| Willis, J. | 7075 | 6/12/94 | 567 | 30.3 |
| Willis, J. | 7075 | 8/20/94 | 832 | 267.2 |
| Wilson, D. | 7075 | 8/20/94 | 832 | 267.2 |
| Yattaw, S. | 7075 | 8/20/94 | 832 | 267.2 |
| Willis, J. | 7075 | 8/31/94 | 1003 | 120 |
| Willis, J. | 7075 | 9/3/94 | 10 | 10 |
| Willis, J. | 7075 | 10/27/94 | 1356 | 40 |

For this example, assume arbitrary values of 350 for $CN_{(k > n)}$ and 750 for $CNT_{(k > n)}$. The number of interrupting device operations is given in Table 3. Assume that the number of customers downstream of the recloser equals 750. These numbers would be known in a real system.

**Table 3—Interrupting device operations**

| Device | Date | Time | No. of operations | No. of operations to lockout |
|---|---|---|---|---|
| Brk 7075 | 4/15 | 18:23:56 | 2 | 3 |
| Recl 7075 | 7/6 | 09:30:10 | 3 | 4 |
| Brk 7075 | 8/2 | 2:29:02 | 1 | 3 |
| Brk 7075 | 8/2 | 2:30:50 | 2 | 3 |
| Recl 7075A | 8/2 | 3:25:40 | 2 | 4 |
| Recl 7075 | 8/25 | 08:00:00 | 2 | 4 |
| Brk 7075 | 9/2 | 04:06:53 | 2 | 3 |
| Recl 7075 | 9/5 | 11:53:22 | 3 | 4 |
| Brk 7075 | 9/8 | 5:25:10 | 1 | 3 |
| Recl 7075 | 10/2 | 7:15:19 | 1 | 4 |
| Recl 7075 | 11/12 | 00:00:05 | 1 | 4 |

$$\mathrm{CEMI}_5 = \frac{350}{2000} = 0.175 \tag{33}$$

$$\mathrm{MAIFI} = \frac{8 \times 2000 + 12 \times 750}{2000} = 12.5 \tag{34}$$

$$\mathrm{MAIFI}_E = \frac{5 \times 2000 + 6 \times 750}{2000} = 7.25 \tag{35}$$

$$\mathrm{CEMSMI}_5 = \frac{750}{2000} = 0.375 \tag{36}$$

Using the example above should help define the methodology and approach to obtaining data from the customer information system and calculating the indices.

 

### 5.3 Example two

To better illustrate the concepts of momentary interruption, and sustained interruption, and the associated indices, consider the following figure.

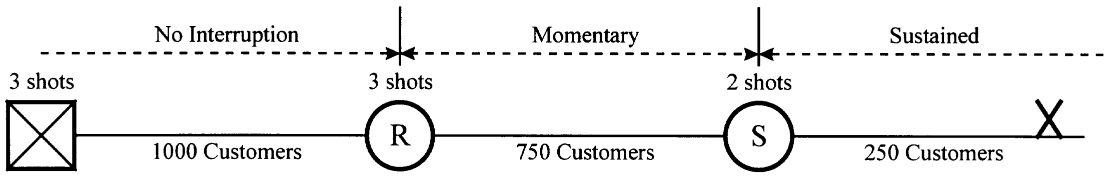


**Figure 1—Sample system 2**

For this scenario, 750 customers would experience a momentary interruption and 250 customers would experience a sustained interruption. Calculations for SAIFI, MAIFI, and $MAIFI_E$ are shown below.

$$SAIFI = \frac{250}{2000} = 0.125 \tag{37}$$

$$MAIFI = \frac{2 \times 750}{2000} = 0.75 \tag{38}$$

$$MAIFI_E = \frac{1 \times 750}{2000} = 0.375 \tag{39}$$

## 6. Factors that affect the calculation of reliability indices

### 6.1 Rationale behind choosing the indices

Reliability indices are concerned with both duration and frequency of interruption. They also need to consider overall system conditions as well as specific customer conditions. Averages give a general trend of conditions for the utility, but using averages will lead to loss of some information, such as time, until the last customer is returned to service. As more utilities improve their data tracking capabilities, the tracking of actual interruption numbers rather than averages will become more prevalent.

### 6.2 Calculation of subsets of reliability data for analysis purposes

Reliability data can be useful even if some well-defined subset of the data is excluded. Some examples of things that may be omitted are: major events, scheduled interruptions, and interruptions caused by other portions of the electrical system. If the numbers in these categories are not included, it should be clearly noted within the reporting document.

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# Annex A

(normative)

## Survey of reliability index usage

The Working Group on System Design has conducted two surveys on distribution reliability index usage. The first one was completed in 1990 and the second was completed in 1995. The purpose of the surveys was to determine index usage. In 1990, 100 U.S. utilities were surveyed, 49 of which responded. In 1995, 209 utilities were surveyed, 64 of which responded. Both surveys showed that the most commonly used indices are SAIFI, SAIDI, CAIDI, and ASAI. Figure A.1 shows the percentage of companies using specific indices in 1990. Figure A.2 shows the same information for 1995. Figures A.3 through A.7 show data on the most commonly used indices given by quartiles where Q1 is the top quartile.

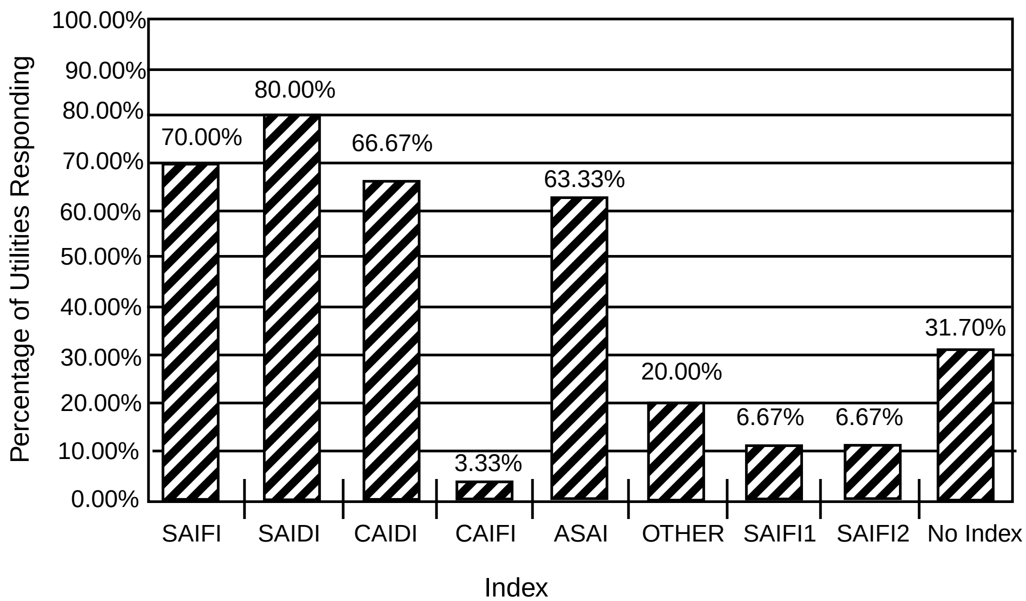


**Figure A.1—Percentage of companies using a given index reporting in 1990 (49 out of 100 utilities responding)**

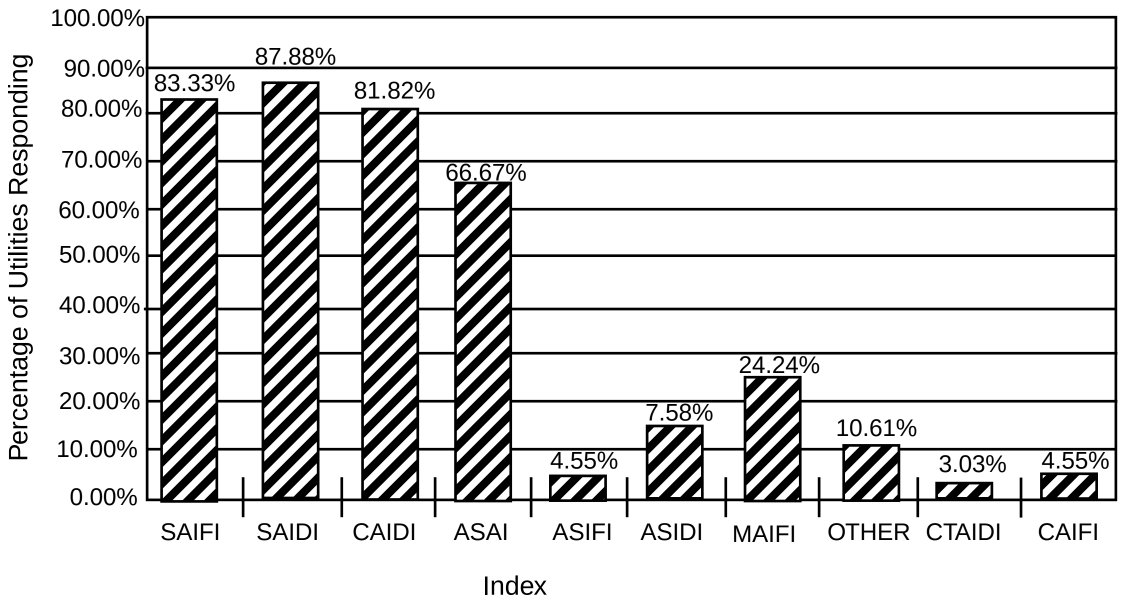


**Figure A.2—Percentage of companies using indices reporting in 1995**

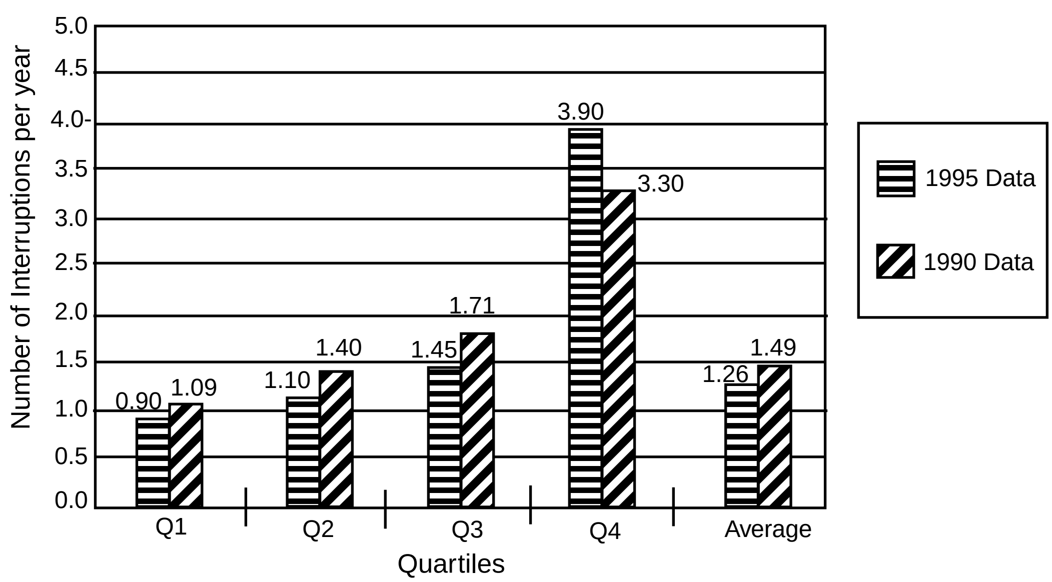


**Figure A.3—SAIFI—1990 and 1995 survey results**

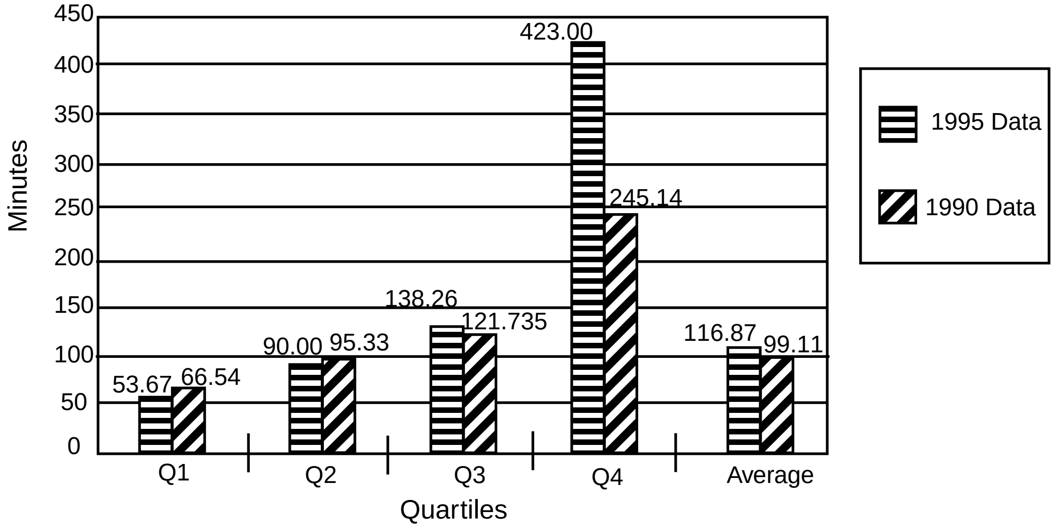


**Figure A.4—SAIDI—1990 and 1995 survey results**

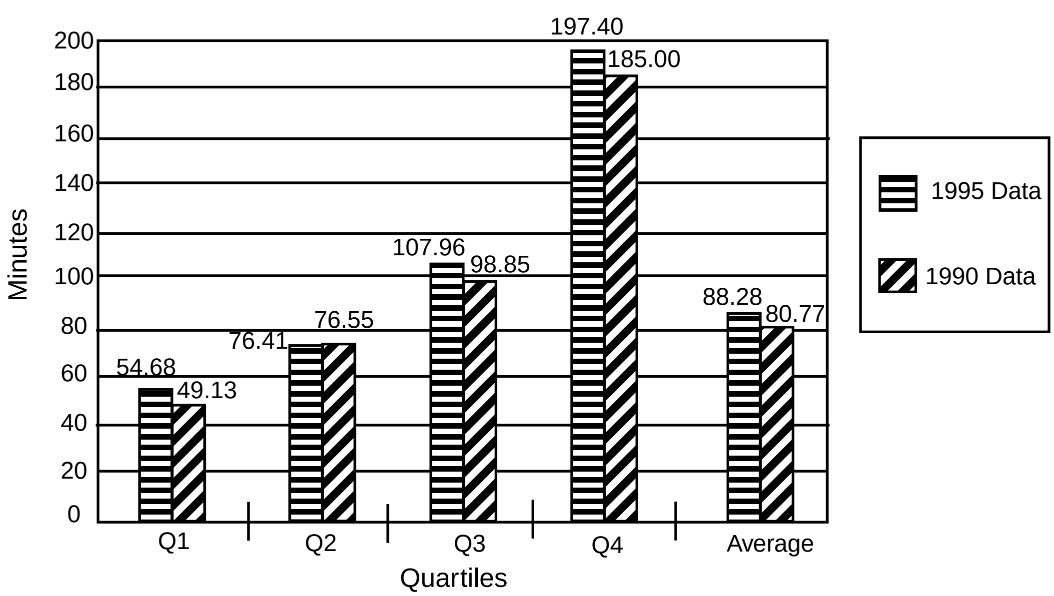


**Figure A.5—CAIDI—1990 and 1995 survey results**

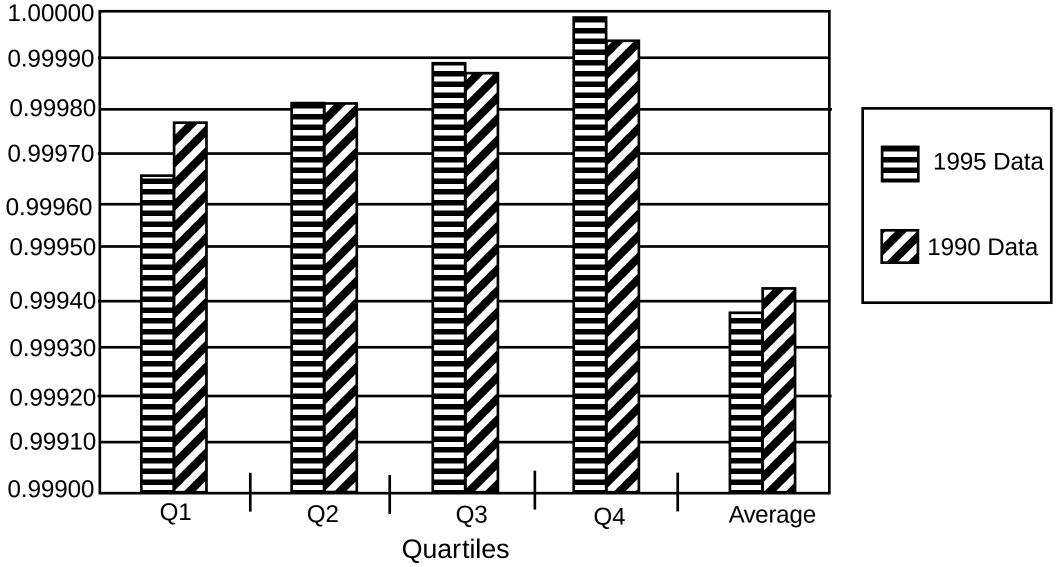


**Figure A.6—ASAI—1990 and 1995 survey results**

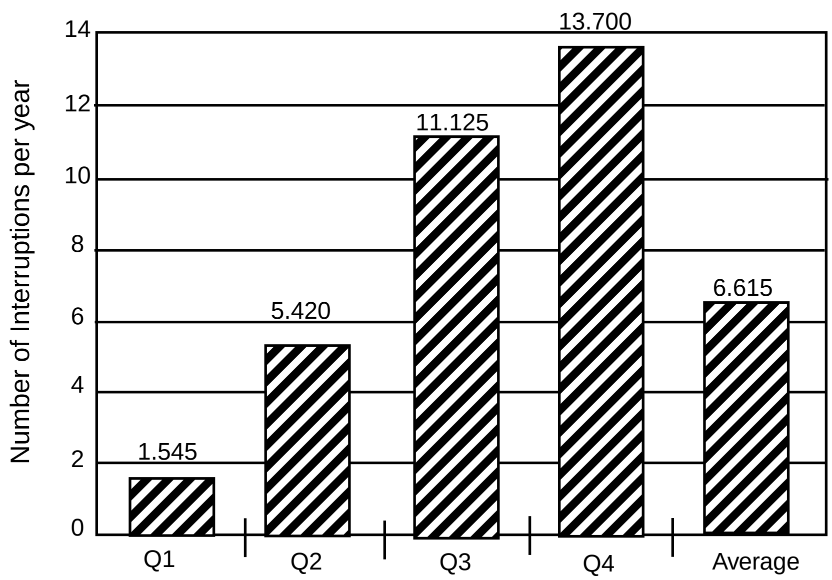


**Figure A.7—MAIFI—1995 survey results (1990 data not available)**