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IEEE Standard Definitions for Use in Reporting Electric Generating Unit Reliability, Availability, and Productivity

Sponsor
**Power Systems Engineering Committee
of the
IEEE Power Engineering Society**

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Foreword

(This Foreword is not a part of ANSI/IEEE Std 762-1987, IEEE Standard Definitions for Use in Reporting Electric Generating Unit Reliability, Availability, and Productivity.)

Measures of generating unit performance have been defined, recorded, and utilized by the electric power industry for over 40 years. Initially, only a few terms, such as *forced outage rate* and *scheduled outage rate*, were needed. The increased focus on generating unit performance in recent years has caused regulatory agencies and the industry to place a greater emphasis on performance measures.

These contemporary constraints have amplified the difficulties that evolved from having generating unit statistics compiled by different organizations to meet their own specific needs. In the past these difficulties have included the interpretation of data within a given system by an outside agency and the correlation of data among the various systems.

The current problems have made clear the need for a standard to overcome these difficulties by providing terminology and indexes for use in existing data systems or in future systems. This standard is directed toward allowing for a meaningful exchange of electric generating unit performance data while attempting to retain as much of existing systems as possible.

No attempt is made here to standardize or to recommend methodologies or procedures for the collection of unit performance data. Furthermore, no attempt is made here to address the special requirements of electric generating units limited by fuel supplies, resources such as water (hydro), or environmental restrictions. It is expected that the methods used will continue to vary from system to system according to individual needs. What is attempted is to specify certain common terms and indexes that must be obtainable from each data base to provide for a basis of information exchange.

The task force has attempted to keep the list of terms and indexes as brief as possible. Performance cannot be measured by a single parameter, and several indexes are required to indicate the ability of a generating unit to produce power when called upon. The use of any single index to measure the performance of a unit or a class of units is misleading. This requirement has necessitated the inclusion of all of the terms and indexes as given here.

Some indexes are based on period hours. By use of such a common base, simple additive relationships between various indexes result, and the use of period hours gives sets of indexes that sum to 100%, as described in Appendix C. Other indexes are not based on period hours. For example, in the statistic forced outage rate (see 7.16), (service hours + forced outage hours) is used as a base because forced outage rate is intended to estimate the probability of forced outage during the times when there is no planned or maintenance outage. For other than base load service, further modifications are needed to estimate this probability correctly. It is the intent of the task force to define sufficient data categories (states, times, capacity levels) so that suitable indexes for all types of units can be calculated.

It should be noted that even the use of all the indexes and terms cannot identify the underlying and sometimes compelling reasons for lost performance.

This standard was prepared by the Power Plant Productivity Definitions Task Force of the Applications of Probability Methods Subcommittee of the Power Systems Engineering Committee, whose members were as follows:

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The task force wishes to dedicate this work to the memory of Veazey M. Cook, a pioneer in the application of generating unit outage data in system planning studies. The format and many of the terms used in this standard can be traced to Veazey Cook's work.

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IEEE Standard Definitions for Use in Reporting Electric Generating Unit Reliability, Availability, and Productivity

1. Purpose

This standard is intended to aid the electric power industry in reporting and evaluating electric generating unit reliability, availability, and productivity. It was developed to overcome present difficulties in the interpretation of electric generating unit performance data from various systems and to facilitate comparisons among different systems. The standard should also make possible the future exchange of meaningful data among systems in North America and throughout the world.

2. Scope

This document standardizes terminology and indexes for reporting electric generating unit reliability, availability, and productivity performance measures. A generating unit includes all equipment up to the high-voltage terminal of the generator step-up transformer.

Reliability in this standard encompasses measures of the ability of generating units to perform their intended function.

Availability measures are concerned with the fraction of time a unit is capable of providing service, and account for outage frequency and duration.

Productivity measures are concerned with the total power produced by a plant with respect to its potential power production. Therefore, productivity measures consider magnitude of outage as well as frequency and duration of outage.

NOTE — This standard was developed for application at the unit level; the definitions are applicable below the unit level in most cases. There are some exceptions, however, such as the definition of *in service*, which applies only at the unit level. Because of these exceptions, care should be taken when using this standard below the unit level.

3. Unit States

A unit state is a particular unit condition that is important for purposes of collecting data on performance.

NOTE — The state definitions are related as shown in Fig 1. The transitions between states are described in Appendix B. The correlation between these definitions and those in use by the industry is shown in Appendix A.

3.1 Active

The state in which a unit is in the population of units being reported on.

NOTE — A unit generally enters the active state on its service date.

3.1.1 Available

The state in which a unit is capable of providing service, whether or not it is actually in service and regardless of the capacity level that can be provided.

3.1.1.1 In Service

The state in which a unit is electrically connected to the system.

3.1.1.2 Reserve Shutdown

The state in which a unit is available but not in service.

NOTE — This is sometimes referred to as economy shutdown.

3.1.2 Unavailable

The state in which a unit is not capable of operation because of operational or equipment failures, external restrictions, testing, work being performed, or some adverse condition. The unavailable state persists until the unit is made available for operation, either by being synchronized to the system (in-service state) or by being placed in the reserve shutdown state.

3.1.2.1 Planned Outage

The state in which a unit is unavailable due to inspection, testing, nuclear refueling, or overhaul. A planned outage is scheduled well in advance.

3.1.2.1.1 Basic Planned Outage

The planned outage state that is originally scheduled and of a predetermined duration.

3.1.2.1.2 Extended Planned Outage

The planned outage state that is the extension of the basic planned outage beyond its predetermined duration.

NOTE — Extended planned outage applies only when planned work exceeds predetermined duration. The extension, due to a condition discovered during the planned outage that has forced the extension of the planned outage, is to be classified as Class 1 unplanned outage (see 3.1.2.2.2). Startup failure would result in Class 0 unplanned outage (see 3.1.2.2.1).

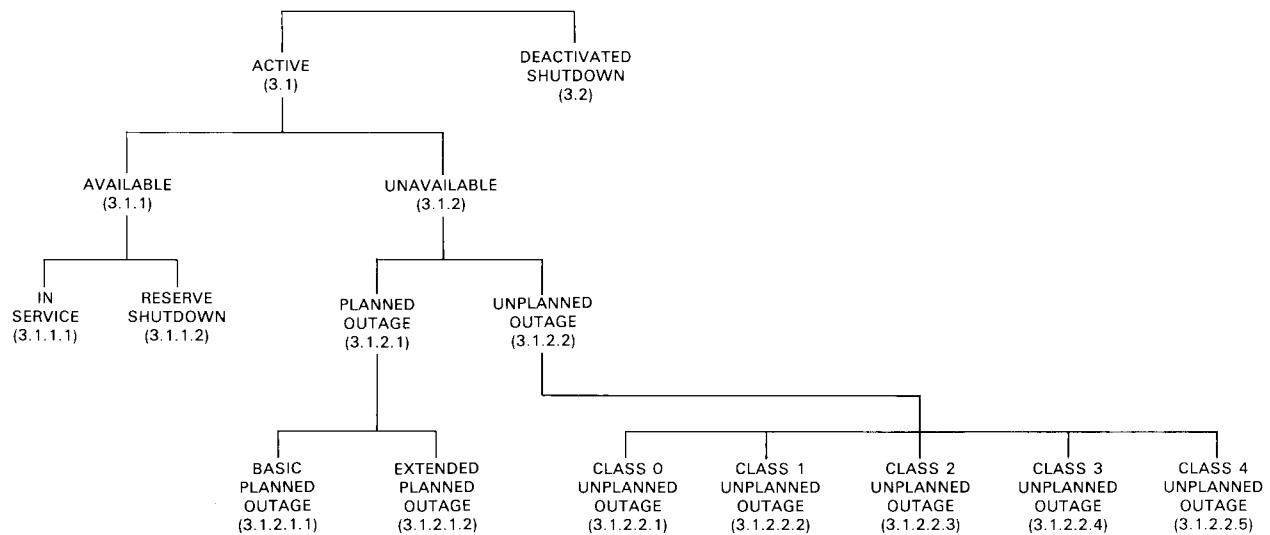


Figure 1—Relation Between Unit States

3.1.2.2 Unplanned Outage

The state in which a unit is unavailable but is not in the planned outage state.

NOTES:

- 1 — When an unplanned outage is initiated, the outage is to be classified according to one of five classes, as defined in 3.1.2.2.1 through 3.1.2.2.5. Unplanned outage Class 0 applies to a start-up failure and Class 1 applies to a condition requiring immediate outage. Also, unplanned outage starts when planned outage ends but is extended due to unplanned work. Classes 2, 3, and 4 apply to outages where some delay is possible in time of removal of the unit from service. The class (2, 3, or 4) of outage is to be determined by the amount of delay that can be exercised in the time of removal of the unit. The class of outage is not made more urgent if the time of removal is advanced due to favorable conditions of system reserves or availability of replacement capacity for the predicted duration of the outage. However, outage starts when the unit is removed from service or is declared unavailable when it is not in service.
- 2 — During the time the unit is in the unplanned outage state, the outage class is determined by the outage class that initiates the state.
- 3 — In some cases, the opportunity exists during unplanned outages to perform some of the repairs or maintenance that would have been performed during the next planned outage. If the additional work extends the outage beyond that required for the unplanned outage, the remaining outage should be reported as a planned outage.
- 4 — Unlike planned outages, unplanned outages do not have a fixed duration that can be estimated each year.

3.1.2.2.1 Class 0 Unplanned Outage (Starting Failure)

An outage that results from the unsuccessful attempt to place the unit in service (see 3.1.3.1).

3.1.2.2.2 Class 1 Unplanned Outage (Immediate)

An outage that requires immediate removal from the existing state.

NOTE — A Class 1 unplanned outage can be initiated from either the in-service or reserve shutdown states. A Class 1 unplanned outage can also be initiated from the planned outage state. See Note in 3.1.2.1.2.