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IEEE Standard Terms for Reporting and Analyzing Outage Occurrences and Outage States of Electrical Transmission Facilities

IEEE Power and Energy Society

Sponsored by the
Analytical Methods for Power Systems Committee

IEEE
3 Park Avenue
New York, NY 10016-5997
USA

IEEE Std 859™-2018
(Revision of IEEE Std 859-1987)

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Abstract: Terminology and indices for reporting and analyzing outage occurrences of transmission facilities are defined in this standard. Outage definitions and indices are given for two general types of facilities: units and components. Units are functional facilities that transfer power between designated points, while components are specific pieces of equipment. Outage definitions are given both for describing the outage history of a particular facility and for describing groups of individual outage occurrences that are related in some way.

Keywords: data, electricity transmission, exposure, failure, IEEE 859™, maintenance, outage, power systems, reliability, weather

The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

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Participants

At the time this IEEE standard was completed, the Update of IEEE Standard 859: "Standard Terms for Reporting and Analyzing Outage Occurrences and Outage States of Electrical Transmission Facilities" Working Group had the following membership:

Chris Dent, *Chair*

Murty Bhavaraju	Donna Pratt	Simon Tindemans
Mark Lauby	Zhouyan Ren	Kaigui Xie
Wenyuan Li	Alex Schneider	
Milorad Papic	David Till	

The following members of the individual balloting committee voted on this standard. Ballots may have voted for approval, disapproval, or abstention.

Ali Al Awazi	Laszlo Kadar	James Reilly
Murty Bhavaraju	Peter Kelly	Charles Rogers
William Bloethe	Jim Kulchisky	Alex Schneider
Gustavo Brunello	Mikhail Lagoda	Hyeong Sim
Demetrio Bucaneg Jr.	Wenyuan Li	Gary Smullin
Kristine Buchholz	John McDaniel	Gary Stoedter
William Byrd	Michael Newman	K. Stump
Paul Cardinal	Gearold O. H. Eidhin	John Vergis
Michael Chirico	Lorraine Padden	Daniel Ward
Neal Dowling	Bansi Patel	Val Werner
Donald Dunn	Stephen Pell	Tamatha Womack
Michael Garrels	Howard Penrose	Jonathan Woodworth
Randall Groves	Christopher Petrola	
Werner Hoelzl	Lakshman Raut	

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Thomas Koshy	Paul Nikolich	Philip Winston
Hung Ling	Ron Petersen	Howard Wolfman
Dong Liu	Annette Reilly	Jingyi Zhou

*Member Emeritus

Introduction

This introduction is not part of IEEE Std 859-2018, IEEE Standard Terms for Reporting and Analyzing Outage Occurrences and Outage States of Electrical Transmission Facilities.

Foreword to 2018 revision

This new edition of IEEE Std 859 is a revision of IEEE Std 859-1987, which has since been reaffirmed twice with no alterations to the 1987 text. The Review Working Group began by consulting members of the user community and wider power system reliability community on the need for revisions. The clear consensus from this was that the 1987 content remains relevant and that there is no need for significant changes in content—a number of useful suggestions for clarification of the existing text did, however, emerge, and in particular there was general agreement that clarification of the terms **component, subcomponent** and **unit** in Clause 3 would be helpful to new users of the standard.

Where clarifications were deemed beneficial, the Working Group decided to proceed as far as possible by adding additional explanatory notes rather than changing the main text of the standard. Indeed, the only changes to the main text are the addition of "Maintenance outage" as a second major type of scheduled outage in 2.3, and the addition of "Adverse weather forced outage rate" in 7.1.1. A full list of changes from the 1987 edition is included in Annex A.

The primary purpose of this standard is to define summary statistics of historic data, for reporting and analyzing outage occurrences, and to facilitate exchange of data between utilities (see Clause 2). The original Foreword to the 1987 edition states that "The indices defined here are intended to serve as estimates for parameters of models which are used in transmission system reliability evaluation," and a similar statement is made in Clause 2. Users are reminded that if indices from Clause 5 of this standard are used as inputs to predictive models, it is necessary to ensure that (a) the transmission elements and the environment in which their performance was observed are similar to the system whose performance is to be predicted; (b) the period of observation over which the input data was collected is a sufficient multiple of the mean time to outage to achieve a reasonable confidence interval for the indices to be used in the predictive models, and (c) that adequate consideration of common mode and dependent events has been given to avoid the fallacy of assuming that all transmission outages are independent.

The Working Group wishes to thank the following for making valuable comments, which have contributed to the review process, without taking a formal role in the process: R.N. Allan, D. Gorinevsky, J. Schaller, M.C.M. Troffaes, and members of the GARPUR project and the NERC TADS Working Group.

Foreword to 1987 edition

Data on outage occurrences of transmission facilities have been collected for many years. Initially, reporting was generally limited to reporting frequency of outage occurrence on transmission lines. Total outage frequency was classified into several general cause categories, but there were no formal definitions for the events and statistics reported beyond those contained in the data forms and instructions. Early efforts did not generally collect data on outage duration, except to class outages as temporary or permanent according to type of restoration used.

In the 1960s, methods were first proposed for calculating reliability of transmission and distribution "systems" (networks) in terms of the reliability of their individual "components." This led to the need for more formal definitions of terms to foster uniformity and standardization of language among engineers engaged in reporting, analyzing, and predicting outages of transmission and distribution facilities and interruptions to customers. This resulted in development of IEEE Std 346-1973, IEEE Standard Definitions in Power Operations Terminology Including Terms for Reporting and Analyzing Outages of Electrical Transmission

and Distribution Facilities and Interruptions to Customer Service. More recent developments have shown the need to include definitions for a broader scope of outage events. For example, two general categories of facilities (reportable entities) must be recognized to support presently available models. In one type of model, a transmission system is partitioned functionally into "units," which represent the capability to transfer power between specified points. In the second type of model, a system is partitioned physically into "components?

Another recent development is the increasing recognition of the importance of "related outage occurrences" in which outage occurrences of two or more facilities are related in some way due to the physical construction of equipment (such as common structure), the electrical interconnection of equipment (common bus, for example), or exposure to a common environment (storms). Achieving clear and unambiguous definitions for related outage occurrences is important for reporting outage occurrences at the transmission unit level. At the component level, an important consideration is the recognition of several modes of failure, particularly for switching, protection, and automatic reclosing equipment.

No attempt is made here to standardize procedures for the collection of outage data. What is attempted is to specify certain common terms and indices to provide a basis of information exchange. The task force has attempted to keep the list of terms and indices as brief as possible. The indices defined here are intended to serve as estimates for parameters of models which are used in transmission system reliability evaluation. The indices may also be used directly to guide system operation or in assessment of equipment performance. No attempt is made to recommend acceptable equipment reliability levels.

This is a revision of IEEE Std 346-1973. However, terms related to distribution system facilities and interruptions were eliminated from the scope of this document. This document was prepared by the Transmission and Distribution Outage and Interruption Definitions Task Force. This task force was formed by the PROSD (Performance Records for Optimizing System Design) Working Group, which is under the guidance of the Power System Engineering Committee.

Contents

IEEE Standard Terms for Reporting and Analyzing Outage Occurrences and Outage States of Electrical Transmission Facilities

1. Scope

This standard defines terminology and indices for reporting and analyzing outage occurrences of transmission facilities. Outage definitions and indices are given for two general types of facilities: units and components. Units are functional facilities that transfer power between designated points, while components are specific pieces of equipment.

Outage definitions are given both for describing the outage history of a particular facility and for describing groups of individual outage occurrences that are related in some way.

2. Purpose

This standard is intended to aid the electric power industry in reporting and analyzing outage occurrences of transmission facilities. Use of systematic, precise definitions is essential for meaningful exchange of data. It is expected that specific instructions for reporting outages will be developed by the industry based on these definitions. The outage definitions and indices are intended for use in system planning models, operations and maintenance planning, and system design. The definitions and indices may not be sufficiently detailed to cover the information required for equipment design.

3. Equipment classifications

3.1 Component

A device which performs a major operating function and which is regarded as an entity for purposes of recording and analyzing data on outage occurrences.

NOTE 1—Some examples of components are line sections, transformers, ac/dc converters, series capacitors or reactors, shunt capacitors or reactors, circuit breakers, line protection systems, and bus sections.

NOTE 2—Sometimes it is necessary to subdivide a line section into segments to allow proper calculation of failure rates and exposure data. For example, if a line section is composed of an overhead line segment and an underground line segment, failure, and exposure data for each line segment may be recorded separately.