NERC

NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Transmission Availability Data System Automatic Outage Metrics and Data

NPCC – Updated 2008 Report

June 14, 2010

(Replacing prior Report dated 6/30/2009)

to ensure the reliability of the bulk power system

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1 Introduction

Following the publication of the 2008 Report on June 30, 2009 and during preparation of 2009 data, a number of errors were found by several Transmission Owners relating to both 2008 inventory and outage data. As this was the first year of reporting data, the TADS Working Group (TADSWG) carefully evaluated the impact of the changes on the reported metrics and identified improvements to the data collection process. The errors were of sufficient magnitude to warrant a one-time republishing of the 2008 calculated results in this Updated Report. The TADSWG has since implemented several improvements to the data collection and validation process. This will be the only update to the 2008 Report. All numerical metric and summary tables (including diagrams where appropriate) have been updated. There are no other substantive changes to the text. The Updated 2008 Reports may be found on the TADSWG website at the following link; http://www.nerc.com/filez/tadswg.html

1.1 Contributors and Acknowledgements

The North American Electric Reliability Corporation (NERC) gratefully acknowledges the support of the Transmission Availability Data System Task Force (TADSTF), Open Access Technologies International (OATI),) and the 193 reporting Transmission Owners (TOs) in NERC. "Reporting TOs" are TOs that own any TADS facilities, as described in Section 1.3 below, on January 1, 2008.

- TADS Phase I participation is mandatory for all U.S. TOs on the NERC Compliance Registry, and all of the NERC TOs complied.[1]
- Participation is voluntary for Mexican and Canadian TOs on the NERC Compliance Registry, and all non-U.S. TOs in NERC except one voluntarily provided data.

In addition to TOs, TADS Regional Entity coordinators (RECs) in NERC,[2] and NERC TADS administrators supported the effort.

1.2 TADS History

The TADS effort began with the establishment of the TADSTF under the NERC Planning Committee in October 2006. On October 27, 2007, the NERC Board of Trustees approved the collection of TADS Phase I data beginning in calendar year 2008.

[1] For TADS, three U.S. companies in NERC that operate multiple NERC-registered TOs were allowed to submit one TADS set of data for their combined TOs. See *NERC ID Exceptions for TADS Data* posted at NERC ID Exceptions.

[2] The *TADS Data Reporting Instruction Manual* dated November 21, 2008 has the names and contact information for all RECs in Appendix 9. The manual may be downloaded at TADS Manual.

As described below, Phase I includes only Automatic Outage data, and the reader is referred to Appendix 1 for the definition of capitalized Phase I terms. On October 29, 2008, the board approved the collection of Non-Automatic Outage data beginning in calendar year 2010 (Phase II). Two reports describe all aspects of each phase, and these reports were the basis of the board's approvals– one for Phase I and Phase II. They are available for download and review by the reader.[3]

1.3 Scope

This report is based upon Phase I data for the calendar year 2008. Phase I TADS includes Momentary and Sustained Automatic Outages of the following Elements(greater than or equal to 200 kV):

- AC Circuits ≥ 200 kV (Overhead and Underground Circuits). Radial circuits are included;
- DC Circuits with ≥ +/-200 kV DC voltage;
- Transformers with ≥ 200 kV low-side voltage; and
- AC/DC Back-to-Back (BTB) Converters with ≥ 200 kV AC voltage, both sides.

The following basic information is collected:

- Automatic Outage Data:
  - Event ID & Event Type
  - Outage ID code
  - Fault Type
  - Outage Initiation Code
  - Outage Start Time
  - Outage Duration
  - Outage Cause Codes
    - Initiating
    - Sustained
  - Outage Mode
- Element Inventory Summary:
  - Number of Elements
  - For AC and DC Circuits, Circuit Miles
  - For AC and DC Circuits, AC and DC Multi-Circuit Structure Miles.

1.4 TADS Reports – NERC, Regional, and Transmission Owner

This report is the second TADS reporting effort for 2008 data. A NERC-wide report for the first quarter of 2008 was produced and is dated October 30, 2008.[4] It was the first TADS reporting effort, and it was required to exercise the data collection and analysis process prior to completing an entire year of data collection. The objective was to identify potential errors and settle on a report format. NERC staff and RECs did find several systematic data collection errors, and in the time between that report and the March 1, 2009 data submittal cut-off for TOs, NERC staff, working with OATI,

[3] The Phase I report link is Phase I report, and the Phase II report link is Phase II report.
[4] The first quarter 2008 report is posted at TADS 1Q 2008 Report.

improved the automatic data entry error checks in webTADS[5] and asked TOs to correct previously submitted suspect data. That first report only contains NERC-wide metrics and data for the first quarter of 2008.

For calendar year 2008, one NERC-wide report and eight regional reports have been produced, using a common format, and these are posted on the TADSTF page on the NERC Web site. Appendix 1 (definitions) is common to each report and can be separately accessible on the TADSTF Web site page via links in this report.

In addition, each report has an associated Excel workbook that contains non-confidential data from webTADS as well as all of the tables and figures in the report that were developed from that data. Those workbooks are posted on the TADS Web site along with each report.

After NERC has posted the NERC-wide and regional reports for calendar year 2008, each TO which has a secure logon ID will be able to obtain its own metrics for the identical tables and figures contained in this report. NERC will be issuing instructions to all reporting TOs on how this can be accomplished by early July, 2009. Each TO's confidential data and results are only available to that TO and not to the public.This report contains an analysis of the NPCC results and the metrics recommended by the TADSTF, taking into account comments the task force received on the first quarter 2008 report. The purpose of this report is to just state the facts of the first annual 2008 data collection. Moving forward the TADSTF[6] and other NERC groups may separately provide observations, interpretations of the annual results, and suggest further areas for study. Readers of this report should not draw conclusions based on this initial first year data collection for 2008. It will take several years of data to provide interpretations with a high degree of confidence.

1.5 Confidential Data Not Publically Reported

Per the data confidentiality policy,[7] the report does not display performance data associated with a TADS Element in a Voltage Class or for circuits of a particular construction type (Overhead or Underground) if all of the Elements in that Voltage Class and applicable construction type are reported by one TO.[8] In this report, confidential performance data has *not* been displayed for the following Elements, Voltage Classes, and construction types that are reported by one TO in NPCC:

1. AC Circuits – one TO reported all of the 400-599 kV AC Circuit performance data in NPCC. Therefore, no 400-599 kV AC Circuit performance data is displayed in this report.
2. DC Circuits – one TO reported all the 400-499 kV DC Circuit performance data, both Underground and Overhead, in NPCC. Since this Voltage Class contains all

[5] All data was entered via a secure internet link into software called webTADS that was developed by OATI for NERC. It is used to collect and validate data (using basic logic checks). It also computes the data inputs used to produce the report.
[6] The TADSTF will become a working group on July 1, 2009. In NERC subgroup terminology, a "task force" is formed to address a specific issue, and after that issue is addressed, the task force is dissolved. A working group has on-going responsibility over a specific subject area.
[7] See Section 1.5 of the *TADS Data Reporting and Instructions Manual* dated November 11, 2008.
[8] NERC will ask the impacted TOs for permission beginning with the calendar year 2009 report.

of the DC Circuits in NPCC, no DC Circuit performance data is displayed in this report.

3. AC/DC Back-to-Back Converters - two TO's reported all the AC/DC BTB Converters performance data in NPCC, one TO for each Voltage Class. Therefore, no AC/DC BTB Converter performance data is displayed in this report.

Although the performance data above is excluded from this NPCC report, with one exception, it is included in the NERC report since it is combined with data from other regions where TOs have the same type of facilities. The exception is the data for two Underground DC Circuits in the 400-499 kV class. These circuits are the only circuits with these characteristics in NERC.

1.6 Report Organization

Section 2 has summary NPCC metrics and data for each of the reported Elements while Section 3 has more detailed data for these same Elements, with separate subsections devoted to each Element (e.g., Section 3.1 for AC Circuits, Section 3.3 for Transformers, etc.).

1.6.1 Table and Figure Labeling

Table NPCC 1-1 shows the assigned numbering scheme for the tables and figures in this report. The prefix "NPCC" indicates the region covered by the report. The table and figure numbering scheme includes the major report section heading (e.g., Section 1, 2, 3.1, etc.) followed by a "dash" and then followed by a number (e.g., 1, 2, 3, etc.) that reflects the order that the table or figure appear in the report. Any tables or figures that are purposely omitted in this report are highlighted in the Table NPCC 1-1. Tables or figures may be omitted because (i) they have no data because there are no Elements, or (ii) they contain confidential TO data, or (iii) there were no reported outages.

1.6.2 Tables and Figures Data Categories

The task force elected to use a common NERC-wide template for each of the tables and figures displaying performance data. The template only includes data categories (i.e., Voltage Class and construction type) for Elements that are found within NERC. The use of a common NERC-wide template allows for all reports (regional and NERC) to utilize a familiar format while making production easier. Table NERC 1-2 shows the categories included in the NERC template.

Performance data are not shown in Tables NPCC 2-1 and NPCC 2-2. These tables show, respectively, the Inventory of AC equipment and DC equipment within NPCC. The task force felt that a complete snapshot of all TADS categories was needed, including categories with zero inventories in NPCC.

1.6.3 Tables and Figures Data Display Conventions

Some regions do not have any Elements in a Voltage Class, but since those Elements exist elsewhere within NERC, the NERC template has a row or column for them. For example, only one region in NERC has DC Circuits in the 200-299 kV Voltage Class.

That Voltage Class is contained in all DC Circuit tables in the NERC and all regional reports because the template is NERC-wide. However, the task force took these steps to assist the reader in viewing such tables:

1. Appendix 2 contains the metric definitions along with their acronyms. These acronyms are used frequently in tables and figures.
2. If there are no Elements of a particular Voltage Class and applicable construction type in a region, performance data in a table such as the number of Sustained Outages is shown as a "dash" and not a zero. Also, all calculations that would normally use that data are shown as a "dash."
3. If there are Elements in a Voltage Class and applicable construction type, but the performance data displayed for that Element is equal to zero (for example, the number of Sustained Outages is equal to zero), a "0" is shown. In this case, if a computation using that data would result in a division by zero, a "tilde" (~) is shown for the results of that computation. This avoids the Excel "#DIV/0!" display.
4. If there are Elements in a Voltage Class and applicable construction type, but the performance data may not be displayed because it is confidential, all performance data for that Voltage Class and applicable construction type is removed and a "C" is displayed for that data. However, as explained in Section 2-3, Table NPCC 2-3 (Event Types and Outages) generally includes all outage data because it does not reveal any confidential data; however, if it would reveal confidential performance data, that data would have a "C" displayed.
5. In each report subsection devoted to a specific Element (e.g., Section 3.1 for AC Circuits), separate tables display total (a) Element-Initiated Outages and (b) Other than Element-Initiated Outages for Sustained Outages by Voltage Class, and similar tables display the this data for Momentary Outages. These tables also compute metrics on a per Element basis, such as SOF. As described above, confidential performance data for a specific Voltage Class is displayed as a "C." However, since these tables also compute per Element metrics for "All Voltages," the "All Voltages "calculations would be incorrect if confidential performance data in a Voltage Class are excluded while non-confidential associated inventory data are included. Therefore, an "NC" has been displayed in the inventory data to ensure the correctness of the computations.[9]
6. If a cell is not supposed to contain data, a grayed pattern is inserted in that cell. For example, Circuit Miles are not applicable to Transformers.

1.7 Feedback and Comments

Readers may submit comments and feedback to tadscomments@nerc.net at any time. At present, NERC is interested in report content suggestions, such as (i) the way the report is organized (ii) the way data are displayed and (iii) the type of data that should be reported. If changes are requested, please describe the benefits of each suggested change. NERC will use this feedback to develop and improve future reports.

[9] The Excel "SUM" function treats text such as "C" or "NC" as a zero.

Table NPCC 1-1
TADS Report Tables and Figure Guide – NPCC Report

Tables omitted because they have no data, contain confidential TO data, or have no reported outages are shaded as follows:

Section No. and Name	Table Title	Table No.	Figure No.
1. Introduction	TADS Report Tables and Figures Guide	NPCC 1-1	
	Categories Displayed in Report Tables and Figures with Performance Data	NPCC 1-2	
2. Summary NPCC Metrics and Data	Inventory of AC Transmission Equipment	NPCC 2-1	
	Inventory of DC Transmission Equipment	NPCC 2-2	
	AC Circuit Outage Frequency by Outage Initiation Code		NPCC 2-1
	AC Circuit Outage Duration by Outage Initiation Code		NPCC 2-2
	DC Circuit Outage Frequency by Outage Initiation Code		NPCC 2-3
	DC Circuit Outage Duration by Outage Initiation Code		NPCC 2-4
	Transformer Outage Frequency by Outage Initiation Code		NPCC 2-5
	Transformer Outage Duration by Outage Initiation Code		NPCC 2-6
	AC/DC BTB Converter Outage Frequency by Outage Initiation Code		NPCC 2-7
	AC/DC BTB Converter Outage Duration by Outage Initiation Code		NPCC 2-8
	Event Types and Outages	NPCC 2-3	
3.1 AC Circuit Metrics and Data	AC Circuit Sustained Outage – Element-Initiated Only	NPCC 3.1-1	
	AC Circuit Sustained Outage Metrics – Other than "Element-Initiated"	NPCC 3.1-2	
	AC Circuit Sustained Outages by Cause Code	NPCC 3.1-3	
	AC Circuit Sustained Outages – Other Attributes	NPCC 3.1-4	
	AC Circuit Momentary Outage Metrics – Element-Initiated Only	NPCC 3.1-5	
	AC Circuit Momentary Outage Metrics – Other than "Element-Initiated"	NPCC 3.1-6	
	AC Circuit Momentary Outages by Cause Code	NPCC 3.1-7	
	AC Circuit Momentary Outages – Other Attributes	NPCC 3.1-8	
	AC Circuit Metrics 1-16 per Appendix 2	NPCC 3.1-9	
3.2 DC Circuit Metrics and Data	DC Circuit Sustained Outage Metrics and Data – Element-Initiated Only	NPCC 3.2-1	
	DC Circuit Sustained Outage Metrics – Other than "Element-Initiated"	NPCC 3.2-2	
	DC Circuit Sustained Outages by Cause Code	NPCC 3.2-3	
	DC Circuit Sustained Outages – Other Attributes	NPCC 3.2-4	
	DC Circuit Momentary Outage Metrics – Element-Initiated Only	NPCC 3.2-5	
	DC Circuit Momentary Outage Metrics – Other than "Element-Initiated"	NPCC 3.2-6	
	DC Circuit Momentary Outages by Cause Code	NPCC 3.2-7	
	DC Circuit Momentary Outages – Other Attributes	NPCC 3.2-8	
	DC Circuit Metrics 1-16 per Appendix 2	NPCC 3.2-9	

Table NPCC 1-1 (cont'd)

3.3 Transformer Metrics and Data	Transformer Sustained Outage Metrics – Element-Initiated Only	NPCC 3.3-1	
	Transformer Sustained Outage Metrics – Other than "Element-Initiated"	NPCC 3.3-2	
	Transformer Sustained Outages by Cause Code	NPCC 3.3-3	
	Transformer Sustained Outages – Other Attributes	NPCC 3.3-4	
	Transformer Momentary Outage Metrics – Element-Initiated Only	NPCC 3.3-5	
	Transformer Momentary Outage Metrics – Other than "Element-Initiated"	NPCC 3.3-6	
	Transformer Momentary Outages by Cause Code	NPCC 3.3-7	
	Transformer Momentary Outages – Other Attributes	NPCC 3.3-8	
	Transformer Metrics 1-10 per Appendix 2	NPCC 3.3-9	
3.4 AC/DC BTB Converter Metrics and Data	AC/DC BTB Converter Sustained Outage Metrics – Element-Initiated Only	NPCC 3.4-1	
	AC/DC BTB Converter Sustained Outage Metrics – Other than "Element-Initiated"	NPCC 3.4-2	
	AC/DC BTB Converter Sustained Outages by Cause Code	NPCC 3.4-3	
	AC/DC BTB Converter Sustained Outages – Other Attributes	NPCC 3.4-4	
	AC/DC BTB Converter Momentary Outage Metrics – Element-Initiated Only	NPCC 3.4-5	
	AC/DC BTB Converter Momentary Outage Metrics – Other than "Element-Initiated"	NPCC 3.4-6	
	AC/DC BTB Converter Momentary Outages by Cause Code	NPCC 3.4-7	
	AC/DC BTB Converter Momentary Outages – Other Attributes	NPCC 3.4-8	
	AC/DC BTB Converter Metrics 1-10 per Appendix 2	NPCC 3.4-9	

Tables omitted because they have no data, contain confidential TO data, or have no reported outages are shaded as follows:

Table NERC 1-2
Categories Displayed in Report Tables and Figures with Performance Data Based upon the NERC Inventory[10]

No categories of this type exist within NERC

Category	Voltage Class	Construction type (Overhead or Underground)	
AC Circuit	200-299 kV	OH	UG
	300-399 kV	OH	UG
	400-599 kV	OH	UG
	600-799 kV	OH	UG
AC Multi-Circuit Structure Miles	200-299 kV		
	300-399 kV		
	400-599 kV		
	600-799 kV		
	Mixed Voltages		
DC Circuit	200-299 kV	OH	UG
	300-399 kV	OH	UG
	400-499 kV	OH	UG
	500-599 kV	OH	UG
	600-799 kV	OH	UG
DC Multi-Circuit Structure Miles	200-299 kV		
	300-399 kV		
	400-499 kV		
	500-599 kV		
	600-799 kV		
	Mixed Voltages		
Transformers	200-299 kV		
	300-399 kV		
	400-599 kV		
	600-799 kV		
AC/DC BTB Converters	200-299 kV		
	300-399 kV		
	400-599 kV		
	600-799 kV		

[10] For performance tables and figures, only the categories above are shown. As noted in Section 1.6.2, Tables 2-1 and 2-2 have inventory data for all the Voltage Classes.

2 NPCC Metrics and Data Summary

This section reports overall Element inventory data as well as two measures of Element performance - outage frequency for both Sustained and Momentary Outage Frequency (SOF and MOF) and Sustained Outage Duration Time (SODT) – on a per Element basis. The number of Elements shown in the inventory data was used to compute the "per Element" frequency and duration metrics. The figures showing frequency and duration metrics have a different scale for each Element. The scale was dictated by the Element's data. Finally, the report provides the number and percentage of Events for each Event Type.

2.1 Element Inventory Data

The inventory data, summarized in two tables, NPCC 2-1 and NPCC 2-2 shows the average Element inventory for calendar year 2008 for AC transmission equipment and DC transmission equipment respectively. All Voltage Classes available for collection are included in these tables. Because TADS uses an equivalent (or average) inventory, the number of reported Elements will generally not be a whole number. As an example, an AC Circuit that is added in the middle of a reporting period will be shown as 0.5 of an AC Circuit in the inventory. This accurately reflects the exposure of Elements to outages.

2.2 Element Outage Frequency and Duration Metrics

Two figures for each TADS Element (AC Circuits, DC Circuits, Transformers, and AC/DC Back-to-Back Converters) are shown in this section.

- The first figure shows the Sustained Outage and Momentary Outage Frequency (SOF and MOF) by Outage Initiation Code.
- The second figure shows the Sustained Outage Duration Time per Element (SODT) by Outage Initiation Code.

Table NPCC 2-1
Inventory of AC Transmission Equipment

	200-299 kV		300-399 kV		400-599 kV		600-799 kV		Mixed Voltages		All Voltages	
Name	Equiv. No. Elements	Circuit Miles	Equiv. No. Elements	Circuit Miles	Equiv. No. Elements	Circuit Miles	Equiv. No. Elements	Circuit Miles	Equiv. No. Elements	Circuit Miles	Equiv. No. Elements	Circuit Miles
AC Circuit - All	362.1	12716	356.0	6674	32	2295	79	7251			829.1	28937
Overhead	358.1	12696	299	6267	32	2295	79	7251			768.1	28509
Underground	4.0	20	57	408	0	0	0	0			61	428
AC Multi-Circuit Structure Miles*		3279		2395		633		0		64		6371
Transformer	0		27		42		65				134	

* The data shown for AC Multi-Circuit Structure Miles is Multi-Circuit Structure Miles, not Circuit Miles.

Table NPCC 2-2
Inventory of DC Transmission Equipment

	200-299 kV		300-399 kV		400-499 kV		500-599 kV		600-799 kV		All Voltages	
Name	Equiv. No. Elements	Circuit Miles	Equiv. No. Elements	Circuit Miles	Equiv. No. Elements	Circuit Miles	Equiv. No. Elements	Circuit Miles	Equiv. No. Elements	Circuit Miles	Equiv. No. Elements	Circuit Miles
DC Circuit - All	0	0	0	0	4	935	0	0	0	0	4	935
Overhead	0	0	0	0	2	932	0	0	0	0	2	932
Underground	0	0	0	0	2	3	0	0	0	0	2	3
DC Multi-Circuit Structure Miles*		0		0		466		0		0		466

Name	200-299 kV		300-399 kV		400-599 kV				600-799 kV		All Voltages	
AC/DC BTB Converters**	2		1		0				0		3	

* The data shown for DC Multi-Circuit Structure Miles is Multi-Circuit Structure Miles, not Circuit Miles.

** AC/DC BTB Converter Voltage Classes are the highest AC Voltage Class of the two AC voltages on either side of the converter.

Figure NPCC 2-1
AC Circuit Outage Frequency by Outage Initiation Code

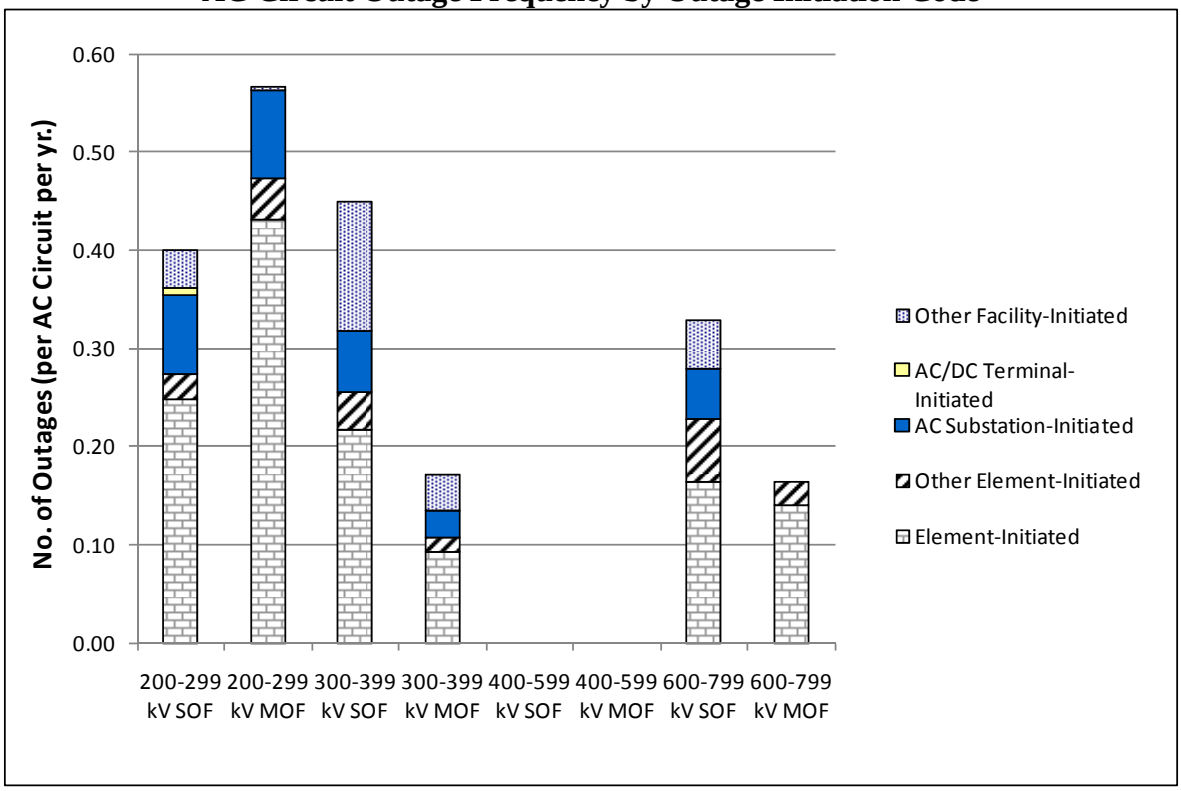

Figure NPCC 2-2
AC Circuit Outage Duration by Outage Initiation Code

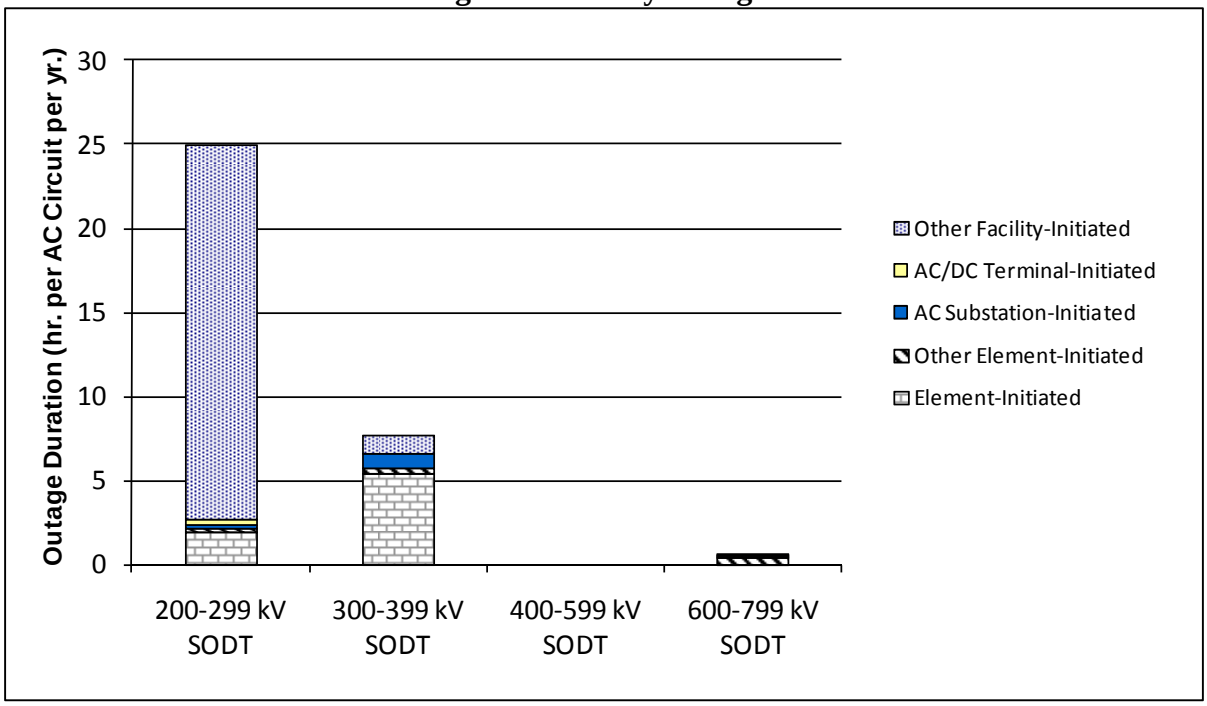

Figure NPCC 2-3
DC Circuit Outage Frequency by Outage Initiation Code

This space intentionally left blank.
This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

Figure NPCC 2-4
DC Circuit Outage Duration by Outage Initiation Code

This space intentionally left blank.
This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

Figure NPCC 2-5
Transformer Outage Frequency by Outage Initiation Code

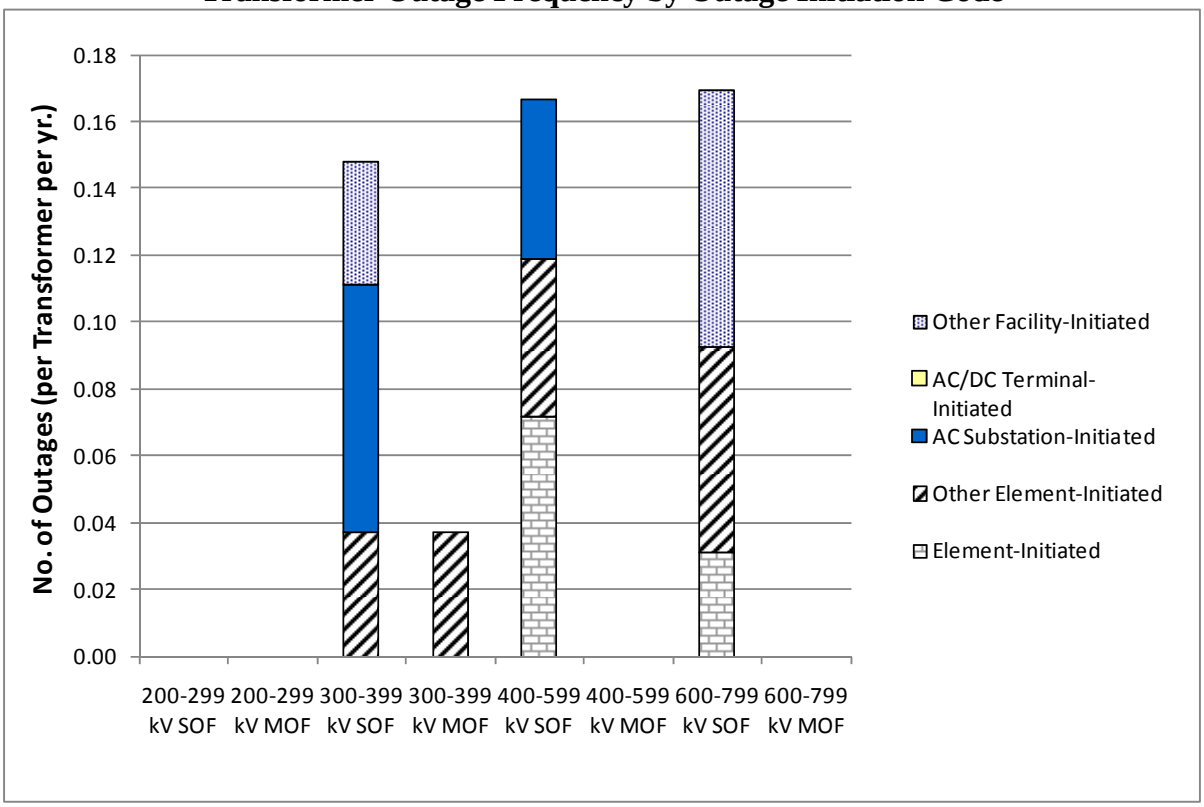

Figure NPCC 2-6
Transformer Outage Duration by Outage Initiation

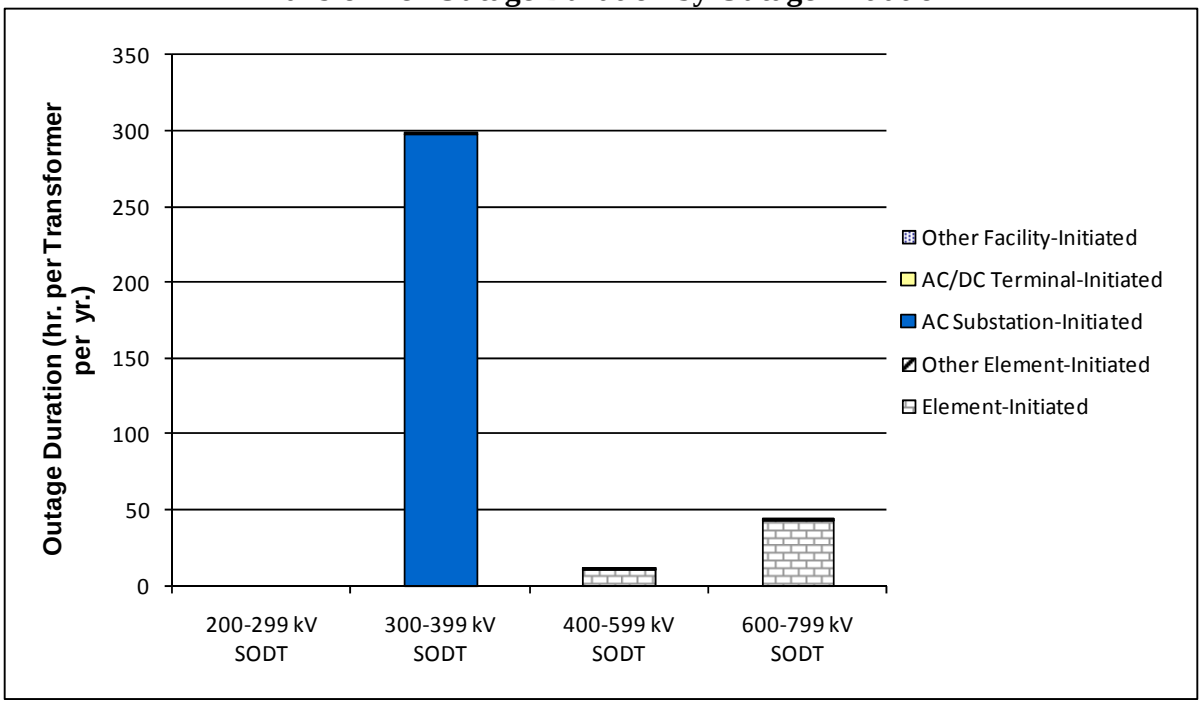

Figure NPCC 2-7
AC/DC BTB Converter Outage Frequency by Outage Initiation Code

This space intentionally left blank.
This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

Figure NPCC 2-8
AC/DC BTB Converter Outage Duration by Outage Initiation Code

This space intentionally left blank.
This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

2.3 Event Types

Event Type data, shown in Table NPCC 2-3 below, provides the number and percentage of Events by Event Type as well as the number of outages associated with each Event. See the Event Type 10, 20, 30, 40, and 50 descriptions below.

Each Element outage, Sustained and Momentary, is assigned an Event Type. An Event may contain any number of Sustained and/or Momentary Outages and may include an outage from any type of Element; i.e. AC Circuit, DC Circuit, Transformer, or AC/DC BTB Converter. However, as defined, Event Types 10 and 20 involve only one Element outage, with Event Type 10 involving only an AC Circuit or a Transformer, and Event Type 20 involving a DC Circuit. Event Types 30 and 40 involve two AC Circuit and DC Circuit outages, respectively. Event Type 50 includes all other single or multiple outages not included elsewhere.

The Event Type data below has none of the confidential data exclusions described in Section 1.5. There are two reasons that the exclusions were not applied. First, no TO-specific performance data can be discerned. Second, because Event Types data are intended to include outages of more than one Element, it was not possible to delete confidential TO data without distorting the Event Type data.

Table NPCC 2-3
Event Types and Outages

	Events		Outages	
Event Type	# Events	%	# Outages	%
10	424	72.2%	424	66.0%
20	C	C	C	C
30	27	4.6%	54	8.4%
40	C	C	C	C
50	136	23.2%	164	25.6%
TOTAL	587	100.0%	642	100.0%

Event Type	Description
10	Automatic Outage of an AC Circuit or Transformer with Normal Clearing.
20	Automatic Outage of a DC Circuit with Normal Clearing.
30	Automatic Outage of two ADJACENT AC Circuits on common structures with Normal Clearing.
40	Automatic Outage of two ADJACENT DC Circuits on the common structures with Normal Clearing.
50	Other

3 NPCC Metrics and Data Details

3.1 AC Circuit Metrics and Data

AC Circuit metrics are displayed in three sections: Section 3.1.1 addresses Sustained Outages and Section 3.1.2 addresses Momentary Outages. In all cases, the metrics displayed in these two sections include *all* AC Circuits (Overhead and Underground). Additionally, Section 3.1.3 has AC Circuit metrics that are differentiated into Overhead and Underground categories. Data and metrics are displayed for the four AC Voltage Classes in the NERC template plus the total of all Voltages Classes.

3.1.1 AC Circuit Sustained Outages

3.1.1.1 AC Circuit Sustained Outage Initiation Code Metrics

The Outage Initiation Code describes where an outage was initiated.

- Table NPCC 3.1-1 shows metrics for AC Circuit Sustained Outages that were "Element-Initiated," which means the outages were initiated on or within the Element (AC Circuit in this case) being reported. Since these types of failures are directly linked to circuit exposure measured in Circuit Miles, this table provides a frequency calculation on a per 100 Circuit Miles (CM) basis.
- Table NPCC 3.1-2 shows the metrics for AC Circuit Sustained Outages that were initiated by all other Outage Initiation Codes *except* those that were Element-Initiated. These included outages that were initiated on or within an AC Substation, an AC/DC Terminal, another TADS Element (Other-Element Initiated), or by Other Facilities.

Table NPCC 3.1-1
AC Circuit Sustained Outage Metrics - Element-Initiated Only

Voltage Class	Circuit Miles	No. of Circuits	No. of Outages	Total Outage Time (hr)	Frequency (SCOF) (per 100 CM per yr)	Frequency (SOF) (per circuit per yr)	MTTR or Mean Outage Duration (hr)
200-299 kV	12716	362.1	90	670.1	0.7078	0.2486	7.4
300-399 kV	6674	356.0	77	1929.3	1.1537	0.2163	25.1
400-599 kV	2295	32.0	0	0.0	0.0000	0.0000	~
600-799 kV	7251	79.0	13	4.0	0.1793	0.1646	0.3
All Voltages	28937	829.1	180	2603.4	0.6220	0.2171	14.5

Table NPCC 3.1-2
AC Circuit Sustained Outage Metrics - Other than "Element-Initiated"

Voltage Class	No. of Circuits	No. of Outages	Total Outage Time (hr)	Frequency (SOF) (per circuit per yr)	MTTR or Mean Outage Duration (hr)
200-299 kV	362.1	55	8374.5	0.1519	152.3
300-399 kV	356.0	83	794.8	0.2331	9.6
400-599 kV	32.0	0	0.0	0.0000	~
600-799 kV	79.0	13	38.4	0.1646	3.0
All Voltages	829.1	151	9207.7	0.1821	61.0

3.1.1.2 AC Circuit Sustained Outage Cause Code Data

For Sustained Outages, TADS requests two Cause Codes – an Initiating Cause Code that describes the initiating cause and a Sustained Cause Code that describes the cause that contributes to the longest duration. For 2008, TADS asked TOs to provide both if they are available, but if not, to supply one or the other. TADS has a Cause Code (Unavailable) that TOs can use if they do not have one of these two Cause Codes available. Table NPCC 3.1-3 shows the two Outage Cause Codes (Initiating and Sustained) plus the number of outage hours associated with each Cause Code.

Table NPCC 3.1-3 (p. 1 of 3)
AC Circuit Sustained Outages by Cause Code

Outage Cause Code	200-299 kV						300-399 kV					
	No. Init.	Init. %	No. Sust.	Sust. %	No. Hrs.	Hours %	No. Init.	Init. %	No. Sust.	Sust. %	No. Hrs.	Hours %
Weather, excluding lightning	7	4.8%	5	3.4%	18.9	0.2%	23	14.4%	17	10.6%	120.5	4.4%
Lightning	30	20.7%	25	17.2%	6.4	0.1%	34	21.3%	23	14.4%	43.9	1.6%
Environmental	0	0.0%	0	0.0%	0.0	0.0%	0	0.0%	0	0.0%	0.0	0.0%
Contamination	0	0.0%	0	0.0%	0.0	0.0%	0	0.0%	0	0.0%	0.0	0.0%
Foreign Interference	2	1.4%	2	1.4%	7.7	0.1%	1	0.6%	1	0.6%	79.0	2.9%
Fire	1	0.7%	0	0.0%	0.0	0.0%	3	1.9%	2	1.3%	7.2	0.3%
Vandalism, Terrorism, or Malicious Acts	0	0.0%	0	0.0%	0.0	0.0%	0	0.0%	0	0.0%	0.0	0.0%
Failed AC Substation Equipment	9	6.2%	13	9.0%	8210.8	90.8%	12	7.5%	13	8.1%	299.4	11.0%
Failed AC/DC Terminal Equipment	0	0.0%	0	0.0%	0.0	0.0%	0	0.0%	0	0.0%	0.0	0.0%
Failed Protection System Equipment	20	13.8%	22	15.2%	38.1	0.4%	26	16.3%	24	15.0%	198.7	7.3%
Failed AC Circuit Equipment	9	6.2%	13	9.0%	484.3	5.4%	10	6.3%	14	8.8%	324.5	11.9%
Failed DC Circuit Equipment	0	0.0%	0	0.0%	0.0	0.0%	0	0.0%	0	0.0%	0.0	0.0%
Vegetation	9	6.2%	9	6.2%	121.0	1.3%	2	1.3%	2	1.3%	16.5	0.6%
Power System Condition	26	17.9%	27	18.6%	38.8	0.4%	5	3.1%	11	6.9%	9.1	0.3%
Human Error	19	13.1%	18	12.4%	59.4	0.7%	14	8.8%	15	9.4%	1353.5	49.7%
Unknown	10	6.9%	9	6.2%	35.1	0.4%	10	6.3%	6	3.8%	12.0	0.4%
Other	3	2.1%	2	1.4%	24.2	0.3%	20	12.5%	32	20.0%	260.0	9.5%
Unavailable	0	0.0%	0	0.0%	0.0	0.0%	0	0.0%	0	0.0%	0.0	0.0%
TOTAL	145	100.0%	145	100.0%	9044.6	100.0%	160	100.0%	160	100.0%	2724.1	100.0%

Table NPCC 3.1-3 (p. 2 of 3)
AC Circuit Sustained Outages by Cause Code

Outage Cause Code	400-599 kV						600-799 kV					
	No. Init.	Init. %	No. Sust.	Sust. %	No. Hrs.	Hours %	No. Init.	Init. %	No. Sust.	Sust. %	No. Hrs.	Hours %
Weather, excluding lightning	0	~	0	~	0.0	~	8	30.8%	8	30.8%	1.9	4.6%
Lightning	0	~	0	~	0.0	~	6	23.1%	6	23.1%	4.1	9.7%
Environmental	0	~	0	~	0.0	~	0	0.0%	0	0.0%	0.0	0.0%
Contamination	0	~	0	~	0.0	~	0	0.0%	0	0.0%	0.0	0.0%
Foreign Interference	0	~	0	~	0.0	~	0	0.0%	0	0.0%	0.0	0.0%
Fire	0	~	0	~	0.0	~	0	0.0%	0	0.0%	0.0	0.0%
Vandalism, Terrorism, or Malicious Acts	0	~	0	~	0.0	~	0	0.0%	0	0.0%	0.0	0.0%
Failed AC Substation Equipment	0	~	0	~	0.0	~	3	11.5%	4	15.4%	26.1	61.6%
Failed AC/DC Terminal Equipment	0	~	0	~	0.0	~	0	0.0%	0	0.0%	0.0	0.0%
Failed Protection System Equipment	0	~	0	~	0.0	~	4	15.4%	4	15.4%	5.5	12.9%
Failed AC Circuit Equipment	0	~	0	~	0.0	~	0	0.0%	0	0.0%	0.0	0.0%
Failed DC Circuit Equipment	0	~	0	~	0.0	~	0	0.0%	0	0.0%	0.0	0.0%
Vegetation	0	~	0	~	0.0	~	0	0.0%	0	0.0%	0.0	0.0%
Power System Condition	0	~	0	~	0.0	~	0	0.0%	0	0.0%	0.0	0.0%
Human Error	0	~	0	~	0.0	~	4	15.4%	4	15.4%	4.8	11.3%
Unknown	0	~	0	~	0.0	~	1	3.8%	0	0.0%	0.0	0.0%
Other	0	~	0	~	0.0	~	0	0.0%	0	0.0%	0.0	0.0%
Unavailable	0	~	0	~	0.0	~	0	0.0%	0	0.0%	0.0	0.0%
TOTAL	0	~	0	~	0.0	~	26	100.0%	26	100.0%	42.4	100.0%

Table NPCC 3.1-3 (p. 3 of 3)
AC Circuit Sustained Outages by Cause Code

Outage Cause Code	All Voltages					
	No. Init.	Init. %	No. Sust.	Sust. %	No. Hrs.	Hours %
Weather, excluding lightning	38	11.5%	30	9.1%	141.4	1.2%
Lightning	70	21.1%	54	16.3%	54.4	0.5%
Environmental	0	0.0%	0	0.0%	0.0	0.0%
Contamination	0	0.0%	0	0.0%	0.0	0.0%
Foreign Interference	3	0.9%	3	0.9%	86.7	0.7%
Fire	4	1.2%	2	0.6%	7.2	0.1%
Vandalism, Terrorism, or Malicious Acts	0	0.0%	0	0.0%	0.0	0.0%
Failed AC Substation Equipment	24	7.3%	30	9.1%	8536.3	72.3%
Failed AC/DC Terminal Equipment	0	0.0%	0	0.0%	0.0	0.0%
Failed Protection System Equipment	50	15.1%	50	15.1%	242.2	2.1%
Failed AC Circuit Equipment	19	5.7%	27	8.2%	808.7	6.8%
Failed DC Circuit Equipment	0	0.0%	0	0.0%	0.0	0.0%
Vegetation	11	3.3%	11	3.3%	137.6	1.2%
Power System Condition	31	9.4%	38	11.5%	47.9	0.4%
Human Error	37	11.2%	37	11.2%	1417.7	12.0%
Unknown	21	6.3%	15	4.5%	47.0	0.4%
Other	23	6.9%	34	10.3%	284.2	2.4%
Unavailable	0	0.0%	0	0.0%	0.0	0.0%
TOTAL	331	100.0%	331	100.0%	11811.1	100.0%

3.1.1.3 Other AC Circuit Sustained Outage Data

Table NPCC 3.1-4 shows other AC Circuit Sustained Outage attributes by Fault Type, Outage Initiation Code, Outage Mode Code, and Event Type, and Outage Duration Interval.

Table NPCC 3.1-4 (p. 1 of 3)
AC Circuit - Other Sustained Outage Attributes

Fault Type	200-299 kV				300-399 kV				400-599 kV				600-799 kV			
	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %
No fault	83	57.2%	546.3	6.0%	82	51.3%	627.0	23.0%	0	~	0.0	~	10	38.5%	12.4	29.2%
P-P fault	2	1.4%	1.3	0.0%	11	6.9%	50.1	1.8%	0	~	0.0	~	7	26.9%	1.9	4.4%
Single P-G fault	50	34.5%	8391.4	92.8%	49	30.6%	419.7	15.4%	0	~	0.0	~	8	30.8%	28.0	66.1%
P-P-G, 3 P, or 3P-G fault	4	2.8%	2.4	0.0%	10	6.3%	1531.4	56.2%	0	~	0.0	~	1	3.8%	0.1	0.2%
Unknown fault type	6	4.1%	103.2	1.1%	8	5.0%	96.0	3.5%	0	~	0.0	~	0	0.0%	0.0	0.0%
TOTAL	145	100.0%	9044.6	100.0%	160	100.0%	2724.1	100.0%	0	~	0	~	26	100.0%	42.4	100.0%

Outage Initiation Code	200-299 kV				300-399 kV				400-599 kV				600-799 kV			
	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %
Element-Initiated	90	62.1%	670.1	7.4%	77	48.1%	1929.3	70.8%	0	~	0.0	~	10	38.5%	12.4	29.2%
Other Element-Initiated	9	6.2%	104.0	1.2%	14	8.8%	90.9	3.3%	0	~	0.0	~	7	26.9%	1.9	4.4%
AC Substation-Initiated	29	20.0%	64.8	0.7%	22	13.8%	335.4	12.3%	0	~	0.0	~	8	30.8%	28.0	66.1%
AC/DC Terminal-Initiated	3	2.1%	116.3	1.3%	0	0.0%	0.0	0.0%	0	~	0.0	~	1	3.8%	0.1	0.2%
Other Facility-Initiated	14	9.7%	8089.4	89.4%	47	29.4%	368.6	13.5%	0	~	0.0	~	0	0.0%	0.0	0.0%
TOTAL	145	100.0%	9044.6	100.0%	160	100.0%	2724.1	100.0%	0	~	0	~	26	100.0%	42.4	100.0%

Outage Mode Code	200-299 kV				300-399 kV				400-599 kV				600-799 kV			
	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %
Single Mode	80	55.2%	8725.0	96.5%	91	56.9%	1929.3	70.8%	0	~	0.0	~	13	50.0%	4.0	9.4%
Dependent Mode Initiating	11	7.6%	11.7	0.1%	10	6.3%	90.9	3.3%	0	~	0.0	~	5	19.2%	27.5	64.7%
Dependent Mode	31	21.4%	131.8	1.5%	32	20.0%	335.4	12.3%	0	~	0.0	~	4	15.4%	8.3	19.5%
Common Mode	21	14.5%	169.4	1.9%	25	15.6%	0.0	0.0%	0	~	0.0	~	0	0.0%	0.0	0.0%
Common Mode Initiating	2	1.4%	6.9	0.1%	2	1.3%	368.6	13.5%	0	~	0.0	~	4	15.4%	2.7	6.4%
TOTAL	145	100.0%	9044.6	100.0%	160	100.0%	2724.1	100.0%	0	~	0	~	26	100.0%	42.4	100.0%

Table NPCC 3.1-4 (p. 2 of 3)

AC Circuit - Other Sustained Outage Attributes

Event Type	200-299 kV				300-399 kV				400-599 kV				600-799 kV			
	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %
10	94	64.8%	8799.8	97.3%	78	48.8%	674.5	24.8%	0	~	0.0	~	9	34.6%	8.5	20.0%
30	6	4.1%	60.2	0.7%	23	14.4%	223.0	8.2%	0	~	0.0	~	1	3.8%	0.1	0.1%
50	45	31.0%	184.7	2.0%	59	36.9%	1826.7	67.1%	0	~	0.0	~	16	61.5%	33.9	79.9%
TOTAL	145	100.0%	9044.6	100.0%	160	100.0%	2724.1	100.0%	0	~	0.0	~	26	100.0%	42.4	100.0%

Outage Duration Interval	200-299 kV		300-399 kV		400-599 kV		600-799 kV	
	No. Sust.	%	No. Sust.	%	No. Sust.	%	No. Sust.	%
1-5 Minutes	21	14.5%	24	15.0%	0	~	7	26.9%
6-10 Minutes	24	16.6%	19	11.9%	0	~	1	3.8%
11-30 Minutes	30	20.7%	20	12.5%	0	~	5	19.2%
31-120 Minutes	20	13.8%	36	22.5%	0	~	10	38.5%
121 Minutes to 24 Hours	38	26.2%	45	28.1%	0	~	3	11.5%
> 24 Hours to 48 Hours	5	3.4%	6	3.8%	0	~	0	0.0%
> 48 Hours	7	4.8%	10	6.3%	0	~	0	0.0%
TOTAL	145	100.0%	160	100.0%	0	~	26	100.0%

Table NPCC 3.1-4 (p. 3 of 3)
AC Circuit - Other Sustained Outage Attributes

Fault Type	All Voltages			
	No. Sust.	%	No. Hrs.	Hours %
No fault	175	52.9%	1185.7	10.0%
P-P fault	20	6.0%	53.3	0.5%
Single P-G fault	107	32.3%	8839.1	74.8%
P-P-G, 3 P, or 3P-G fault	15	4.5%	1533.9	13.0%
Unknown fault type	14	4.2%	199.2	1.7%
TOTAL	331	100.0%	11811.1	100.0%

Outage Initiation Code	All Voltages			
	No. Sust.	%	No. Hrs.	Hours %
Element-Initiated	177	53.5%	2611.8	22.1%
Other Element-Initiated	30	9.1%	196.8	1.7%
AC Substation-Initiated	59	17.8%	428.2	3.6%
AC/DC Terminal-Initiated	4	1.2%	116.4	1.0%
Other Facility-Initiated	61	18.4%	8458.0	71.6%
TOTAL	331	100.0%	11811.1	100.0%

Outage Mode Code	All Voltages			
	No. Sust.	%	No. Hrs.	Hours %
Single Mode	184	55.6%	10658.2	90.2%
Dependent Mode Initiating	26	7.9%	130.0	1.1%
Dependent Mode	67	20.2%	475.4	4.0%
Common Mode	46	13.9%	169.4	1.4%
Common Mode Initiating	8	2.4%	378.2	3.2%
TOTAL	331	100.0%	11811.1	100.0%

Event Type	All Voltages			
	No. Sust.	%	No. Hrs.	Hours %
10	181	54.7%	9482.8	80.3%
30	30	9.1%	283.2	2.4%
50	120	36.3%	2045.2	17.3%
TOTAL	331	100.0%	11811.1	100.0%

Outage Duration Interval	All Voltages	
	No. Sust.	%
1-5 Minutes	52	15.7%
6-10 Minutes	44	13.3%
11-30 Minutes	55	16.6%
31-120 Minutes	66	19.9%
121 Minutes to 24 Hours	86	26.0%
> 24 Hours to 48 Hours	11	3.3%
> 48 Hours	17	5.1%
TOTAL	331	100.0%

3.1.2 AC Circuit Momentary Outages

3.1.2.1 AC Circuit Momentary Outage Initiation Code Metrics

The Outage Initiation Code describes where an outage was initiated.

- Table NPCC 3.1-5 shows metrics for AC Circuit Momentary Outages that were "Element-Initiated," which means the outages were initiated on or within the Element (AC Circuit in this case) being reported. Since these types of failures are directly linked to circuit exposure measured in Circuit Miles, this table provides a frequency calculation on a per 100 Circuit Miles (CM) basis.
- Table NPCC 3.1-6 shows the metrics for AC Circuit Momentary Outages that were initiated by all other Outage Initiation Codes *except* those that were Element-Initiated. These included outages that were initiated on or within an AC Substation, an AC/DC Terminal, another TADS Element (Other-Element Initiated), or by Other Facilities.

Table NPCC 3.1-5
AC Circuit Momentary Outage Metrics - Element-Initiated Only

Voltage Class	Circuit Miles	No. of Circuits	No. of Outages	Frequency (MCOF) (per 100 CM per yr)	Frequency (MOF) (per circuit per yr)
200-299 kV	12716	362.1	156	1.2268	0.4308
300-399 kV	6674	356.0	33	0.4944	0.0927
400-599 kV	2295	32.0	0	0.0000	0.0000
600-799 kV	7251	79.0	11	0.1517	0.1392
All Voltages	28937	829.1	200	0.6912	0.2412

Table NPCC 3.1-6
AC Circuit Momentary Outage Metrics - Other than "Element-Initiated"

Voltage Class	No. of Circuits	No. of Outages	Frequency (MOF) (per circuit per yr)
200-299 kV	362.1	49	0.1353
300-399 kV	356.0	28	0.0787
400-599 kV	32.0	0	0.0000
600-799 kV	79.0	2	0.0253
All Voltages	829.1	79	0.0953

3.1.2.2 AC Circuit Momentary Outage Cause Code Data

For Momentary Outages, TADS requests one Cause Code: an Initiating Cause Code. Table NPCC 3.1-7 reports Cause Code data for AC Circuit Momentary Outages.

Table NPCC 3.1-7
AC Circuit Momentary Outages by Cause Code

Outage Cause Code	200-299 kV		300-399 kV		400-599 kV		600-799 kV		All Voltages	
	No. Mom.	%	No. Mom.	%	No. Mom.	%	No. Mom.	%	No. Mom.	%
Weather, excluding lightning	4	2.0%	2	3.3%	0	~	1	7.7%	7	2.5%
Lightning	114	55.6%	17	27.9%	0	~	8	61.5%	139	49.8%
Environmental	0	0.0%	0	0.0%	0	~	0	0.0%	0	0.0%
Contamination	0	0.0%	0	0.0%	0	~	0	0.0%	0	0.0%
Foreign Interference	0	0.0%	0	0.0%	0	~	0	0.0%	0	0.0%
Fire	0	0.0%	2	3.3%	0	~	0	0.0%	2	0.7%
Vandalism, Terrorism, or Malicious Acts	0	0.0%	0	0.0%	0	~	0	0.0%	0	0.0%
Failed AC Substation Equipment	2	1.0%	5	8.2%	0	~	1	7.7%	8	2.9%
Failed AC/DC Terminal Equipment	0	0.0%	0	0.0%	0	~	0	0.0%	0	0.0%
Failed Protection System Equipment	7	3.4%	4	6.6%	0	~	1	7.7%	12	4.3%
Failed AC Circuit Equipment	3	1.5%	0	0.0%	0	~	0	0.0%	3	1.1%
Failed DC Circuit Equipment	0	0.0%	0	0.0%	0	~	0	0.0%	0	0.0%
Vegetation	2	1.0%	0	0.0%	0	~	0	0.0%	2	0.7%
Power System Condition	46	22.4%	1	1.6%	0	~	0	0.0%	47	16.8%
Human Error	4	2.0%	9	14.8%	0	~	0	0.0%	13	4.7%
Unknown	22	10.7%	11	18.0%	0	~	2	15.4%	35	12.5%
Other	1	0.5%	10	16.4%	0	~	0	0.0%	11	3.9%
Unavailable	0	0.0%	0	0.0%	0	~	0	0.0%	0	0.0%
TOTAL	205	100.0%	61	100.0%	0	~	13	100.0%	279	100.0%

3.1.2.3 Other AC Circuit Momentary Outage Data

Table NPCC 3.1-8 shows other AC Circuit Momentary Outage attributes by Fault Type, Outage Initiation Code, Outage Mode Code, and Event Type.

Table NPCC 3.1-8
AC Circuit - Other Momentary Outage Attributes

Fault Type	200-299 kV		300-399 kV		400-599 kV		600-799 kV		All Voltages	
	No. Mom.	%	No. Mom.	%	No. Mom.	%	No. Mom.	%	No. Mom.	%
No fault	106	51.7%	24	39.3%	0	~	1	7.7%	131	47.0%
P-P fault	2	1.0%	1	1.6%	0	~	0	0.0%	3	1.1%
Single P-G fault	81	39.5%	19	31.1%	0	~	12	92.3%	112	40.1%
P-P-G, 3 P, or 3P-G fault	15	7.3%	2	3.3%	0	~	0	0.0%	17	6.1%
Unknown fault type	1	0.5%	15	24.6%	0	~	0	0.0%	16	5.7%
TOTAL	205	100.0%	61	100.0%	0	~	13	100.0%	279	100.0%

Outage Initiation Code	200-299 kV		300-399 kV		400-599 kV		600-799 kV		All Voltages	
	No. Mom.	%	No. Mom.	%	No. Mom.	%	No. Mom.	%	No. Mom.	%
Element-Initiated	156	76.1%	33	54.1%	0	~	11	84.6%	200	71.7%
Other Element-Initiated	15	7.3%	5	8.2%	0	~	2	15.4%	22	7.9%
AC Substation-Initiated	33	16.1%	10	16.4%	0	~	0	0.0%	43	15.4%
AC/DC Terminal-Initiated	0	0.0%	0	0.0%	0	~	0	0.0%	0	0.0%
Other Facility-Initiated	1	0.5%	13	21.3%	0	~	0	0.0%	14	5.0%
TOTAL	205	100.0%	61	100.0%	0	~	13	100.0%	279	100.0%

Outage Mode Code	200-299 kV		300-399 kV		400-599 kV		600-799 kV		All Voltages	
	No. Mom.	%	No. Mom.	%	No. Mom.	%	No. Mom.	%	No. Mom.	%
Single Mode	126	61.5%	51	83.6%	0	~	11	84.6%	188	67.4%
Dependent Mode Initiating	8	3.9%	2	3.3%	0	~	0	0.0%	10	3.6%
Dependent Mode	45	22.0%	3	4.9%	0	~	2	15.4%	50	17.9%
Common Mode	25	12.2%	3	4.9%	0	~	0	0.0%	28	10.0%
Common Mode Initiating	1	0.5%	2	3.3%	0	~	0	0.0%	3	1.1%
TOTAL	205	100.0%	61	100.0%	0	~	13	100.0%	279	100.0%

Event Type	200-299 kV		300-399 kV		400-599 kV		600-799 kV		All Voltages	
	No. Mom.	0	No. Mom.	0	No. Mom.	0	No. Mom.	%	No. Mom.	%
10	182	88.8%	45	73.8%	0	~	10	76.9%	237	84.9%
30	20	9.8%	4	6.6%	0	~	0	0.0%	24	8.6%
50	3	1.5%	12	19.7%	0	~	3	23.1%	18	6.5%
TOTAL	205	100.0%	61	100.0%	0	~	13	100.0%	279	100.0%

3.1.3 Total AC Circuit Metrics

Table NPCC 3.1-9 displays AC Circuit metrics that are defined in Appendix 2.

Table NPCC 3.1-9
AC Circuit Metrics 1-16 per Appendix 2

		Element Outage Frequency (1-3)			Element Outage Duration, Repair Time, and Update Time (4-7)						Element Availability (8-10)		
Voltage Class	OH/UG	TOF	SOF	MOF	SODT	MTTR P(5%) <	MTTR 50/50	MTTR P(5%) >	MdTTR	MTBF	APC %	PCZO %	PCDR %
200-299 kV	Overhead	0.97	0.40	0.57	25.25	62.74	62.79	62.85	0.48	21781.31	99.71	59.02	1.43
300-399 kV	Overhead	0.64	0.43	0.20	3.28	7.53	7.54	7.54	0.80	20195.7	99.96	75.59	3.14
400-599 kV	Overhead	C	C	C	C	C	C	C	C	C	C	C	C
600-799 kV	Overhead	0.49	0.33	0.16	0.54	1.62	1.63	1.64	0.58	26688.2	99.99	70.89	0.00
200-299 kV	Underground	0.25	0.25	0.00	0.55	0.00	2.18	0.00	2.18	35133.82	99.99	75.00	0.00
300-399 kV	Underground	0.53	0.53	0.00	30.61	57.66	58.15	58.65	2.44	16631.5	99.65	75.44	0.00
400-599 kV	Underground	-	-	-	-	-	-	-	-	-	-	-	-

		Circuit Outage Frequency (11-13)						Multiple Circuit Outage Frequency (14-16)			Outage Totals		
		TCOF	TCOF	SCOF	SCOF	MCOF	MCOF						
Voltage Class	OH/UG	All	Elemt. Init.	All	Elemt. Init.	All	Elemt. Init.	TMCOF	SMCOF	MMCOF	Momentary Outages	Sustained Outages	Sustained Outages Hours
200-299 kV	Overhead	2.75	1.94	1.13	0.71	1.61	1.23	0.43	0.15	0.34	205	144	9042.4
300-399 kV	Overhead	3.05	1.71	2.07	1.18	0.97	0.53	0.63	0.54	0.17	61	130	979.6
400-599 kV	Overhead	C	C	C	C	C	C	0.00	0.00	0.00	C	C	C
600-799 kV	Overhead	0.54	0.33	0.36	0.18	0.18	0.15	-	-	-	13	26	42.4
Mixed Voltages	Overhead							0.00	0.00	0.00			
200-299 kV	Underground	4.98	0.00	4.98	0.00	0.00	0.00				0	1	2.2
300-399 kV	Underground	7.36	0.74	7.36	0.74	0.00	0.00				0	30	1744.6
400-599 kV	Underground	-	-	-	-	-	-				-	-	-
										TOTAL	279	331	11811.1

3.2 DC Circuit Metrics and Data

DC Circuit metrics are displayed in three sections: Section 3.2.1 addresses Sustained Outages and Section 3.2.2 addresses Momentary Outages. In all cases, the metrics displayed in these two sections include *all* DC Circuits (Overhead and Underground). Additionally, Section 3.1.3 has DC Circuit metrics that are differentiated into Overhead and Underground categories. Data and metrics are displayed for the three DC Circuit Voltage Classes in the NERC template plus the total of all Voltage Classes.

3.2.1 DC Circuit Sustained Outages

3.2.1.1 DC Circuit Sustained Outage Initiation Code Metrics

The Outage Initiation Code describes where an outage initiated.

- Table NPCC 3.2-1 shows metrics for DC Circuit Sustained Outages that were "Element-Initiated," which means the outages were initiated on or within the Element (DC Circuit in this case) being reported. Since these types of failures are directly linked to circuit exposure measured in Circuit Miles, this table provides a frequency calculation on a per 100 Circuit Miles (CM) basis.
- Table NPCC 3.2-2 shows the metrics for DC Circuit Sustained Outages that were initiated by all other Outage Initiation Codes *except* those that were Element-Initiated. These included outages that were initiated on or within an AC Substation, an AC/DC Terminal, another TADS Element (Other-Element Initiated), or by Other Facilities.

Table NPCC 3.2-1

DC Circuit Sustained Outage Metrics – "Element-Initiated" Only

This space intentionally left blank.
This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

Table NPCC 3.2-2

DC Circuit Sustained Outage Metrics – Other than "Element Initiated"

This space intentionally left blank.
This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

3.2.1.2 DC Circuit Sustained Outage Cause Code Data

For Sustained Outages, TADS requests two Cause Codes – an Initiating Cause Code that describes the initiating cause and a Sustained Cause Code that describes the cause that contributes to the longest duration. For 2008, TADS asked TOs to provide both if they are available, but if not, to supply one or the other. TADS has a Cause Code (Unavailable) that TOs can use if they do not have one of these two Cause Codes available. Table NPCC 3.2-3 shows the two Outage Cause Codes (Initiating and Sustained) plus the number of outage hours associated with each Cause Code.

Table NPCC 3.2-3
DC Circuit Sustained Outages by Cause Code

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This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

3.2.1.3 Other DC Circuit Sustained Outage Data

Table NPCC 3.2-4 shows other DC Circuit Sustained Outage attributes by Fault Type, Outage Initiation Code, Outage Mode Code, and Event Type, and Outage Duration Interval.

Table NPCC 3.2-4
DC Circuit – Other Sustained Outage Attributes

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This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

3.2.2 DC Circuit Momentary Outages

3.2.2.1 DC Circuit Momentary Outage Initiation Code Metrics

The Outage Initiation Code describes where an outage initiated.

- Table NPCC 3.2-5 shows metrics for DC Circuit Momentary Outages that were "Element-Initiated," which means the outages were initiated on or within the Element (DC Circuit in this case) being reported. Since these types of failures are directly linked to circuit exposure measured in Circuit Miles, this table provides a frequency calculation on a per 100 Circuit Miles (CM) basis.
- Table NPCC 3.2-6 shows the metrics for DC Circuit Momentary Outages that were initiated by all other Outage Initiation Codes *except* those that were Element-Initiated. These included outages that were initiated on or within an AC Substation, an AC/DC Terminal, another TADS Element (Other-Element Initiated), or by Other Facilities.

Table NPCC 3.2-5

DC Circuit Momentary Outage Metrics – "Element Initiated" Only

This space intentionally left blank.
This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

Table NPCC 3.2-6

DC Circuit Momentary Outage Metrics – Other than Element Initiated

This space intentionally left blank.
This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

3.2.2.2 DC Circuit Momentary Outage Cause Code Data

For Momentary Outages, TADS requests one Cause Code: an Initiating Cause Code. Table NPCC 3.2-7 reports Cause Code data for DC Circuit Momentary Outages.

Table NPCC 3.2-7
DC Circuit Momentary Outages by Cause Code

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This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

3.2.2.3 Other DC Circuit Momentary Outage Data

Table NPCC 3.2-8 shows other DC Circuit Momentary Outage attributes by Fault Type, Outage Initiation Code, Outage Mode Code, and Event Type.

Table NPCC 3.2-8
DC Circuit – Other Momentary Outage Attributes

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This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

3.2.3 Total DC Circuit Metrics

Table NPCC 3.2-9 displays DC Circuit metrics that are defined in Appendix 2.

Table NPCC 3.2-9

DC Circuit Metrics 1-16 per Appendix 2

This space intentionally left blank.
This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

3.3 Transformer Metrics and Data

Transformer metrics are displayed in three sections: Section 3.3.1 addresses Sustained Outages, Section 3.3.2 addresses Momentary Outages, and Section 3.3.3 has Transformer metrics per the formulas in Appendix 2. Data and metrics are displayed for all four Transformer Voltages Classes in the NERC template plus the total of all Voltage Classes.

3.3.1 Transformer Sustained Outages

3.3.1.1 Transformer Sustained Outage Initiation Code Metrics

The Outage Initiation Code describes where an outage initiated.

- Table NPCC 3.3-1 shows metrics for Transformer Sustained Outages that were "Element-Initiated," which means the outages were initiated on or within the Element (Transformer in this case) being reported.
- Table NPCC 3.3-2 shows the metrics for Transformer Sustained Outages that were initiated by all other Outage Initiation Codes *except* those that were Element-Initiated. These included outages that were initiated on or within an AC Substation, an AC/DC Terminal, another TADS Element (Other-Element Initiated), or by Other Facilities.

Table NPCC 3.3-1
Transformer Sustained Outage Metrics - Element-Initiated Only

Voltage Class	No. of Transformers	No. of Outages	Total Outage Time (hr)	Frequency (SOF) (per transformer per yr)	MTTR or Mean Outage Duration (hr)
200-299 kV	0.0	-	-	-	-
300-399 kV	27.0	0	0.0	0.0000	~
400-599 kV	42.0	3	427.1	0.0714	142.4
600-799 kV	65.0	2	2737.7	0.0308	1368.8
All Voltages	134.0	5	3164.7	0.0373	632.9

Table NPCC 3.3-2
Transformer Sustained Outage Metrics - Other than "Element-Initiated"

Voltage Class	No. of Transformers	No. Outages	Total Outage Time (hr)	Frequency (SOF) (per transformer per yr)	MTTR or Mean Outage Duration (hr)
200-299 kV	0.0	-	-	-	-
300-399 kV	27.0	4	8030.2	0.1481	2007.6
400-599 kV	42.0	4	33.3	0.0952	8.3
600-799 kV	65.0	9	56.5	0.1385	6.3
All Voltages	134.0	17	8120.0	0.1269	477.6

3.3.1.2 Transformer Sustained Outage Cause Code Data

For Sustained Outages, TADS requests two Cause Codes – an Initiating Cause Code that describes the initiating cause and a Sustained Cause Code that describes the cause that contributes to the longest duration. For 2008, TADS asked TOs to provide both if they are available, but if not, to supply one or the other. TADS has a Cause Code (Unavailable) that TOs can use if they do not have one of these two Cause Codes available. Table NPCC 3.3-3 shows the two Outage Cause Codes (Initiating and Sustained) plus the number of outage hours associated with each Cause Code.

Table NPCC 3.3-3 (p. 1 of 2)

Transformer Sustained Outages by Cause Code

Outage Cause Code	200-299kV						300-399kV					
	No. Init.	Init. %	No. Sust.	Sust. %	No. Hrs.	Hours %	No. Init.	Init. %	No. Sust.	Sust. %	No. Hrs.	Hours %
Weather, excluding lightning	-	-	-	-	-	-	0	0.0%	1	25.0%	8027.8	100.0%
Lightning	-	-	-	-	-	-	0	0.0%	0	0.0%	0.0	0.0%
Environmental	-	-	-	-	-	-	0	0.0%	0	0.0%	0.0	0.0%
Contamination	-	-	-	-	-	-	0	0.0%	0	0.0%	0.0	0.0%
Foreign Interference	-	-	-	-	-	-	0	0.0%	0	0.0%	0.0	0.0%
Fire	-	-	-	-	-	-	0	0.0%	0	0.0%	0.0	0.0%
Vandalism, Terrorism, or Malicious Acts	-	-	-	-	-	-	0	0.0%	0	0.0%	0.0	0.0%
Failed AC Substation Equipment	-	-	-	-	-	-	1	25.0%	0	0.0%	0.0	0.0%
Failed AC/DC Terminal Equipment	-	-	-	-	-	-	0	0.0%	0	0.0%	0.0	0.0%
Failed Protection System Equipment	-	-	-	-	-	-	2	50.0%	1	25.0%	0.3	0.0%
Failed AC Circuit Equipment	-	-	-	-	-	-	0	0.0%	0	0.0%	0.0	0.0%
Failed DC Circuit Equipment	-	-	-	-	-	-	0	0.0%	0	0.0%	0.0	0.0%
Vegetation	-	-	-	-	-	-	0	0.0%	0	0.0%	0.0	0.0%
Power System Condition	-	-	-	-	-	-	0	0.0%	0	0.0%	0.0	0.0%
Human Error	-	-	-	-	-	-	1	25.0%	2	50.0%	2.0	0.0%
Unknown	-	-	-	-	-	-	0	0.0%	0	0.0%	0.0	0.0%
Other	-	-	-	-	-	-	0	0.0%	0	0.0%	0.0	0.0%
Unavailable	-	-	-	-	-	-	0	0.0%	0	0.0%	0.0	0.0%
TOTAL	-	-	-	-	-	-	4	100.0%	4	100.0%	8030.2	100.0%

Table NPCC 3.3-3 (p. 2 of 2)
Transformer Sustained Outages by Cause Code

Outage Cause Code	All Voltages					
	No. Init.	Init. %	No. Sust.	Sust. %	No. Hrs.	Hours %
Weather, excluding lightning	0	0.0%	1	4.5%	8027.8	71.1%
Lightning	1	4.5%	0	0.0%	0.0	0.0%
Environmental	0	0.0%	0	0.0%	0.0	0.0%
Contamination	0	0.0%	0	0.0%	0.0	0.0%
Foreign Interference	1	4.5%	1	4.5%	1.8	0.0%
Fire	0	0.0%	0	0.0%	0.0	0.0%
Vandalism, Terrorism, or Malicious Acts	0	0.0%	0	0.0%	0.0	0.0%
Failed AC Substation Equipment	5	22.7%	4	18.2%	3076.3	27.3%
Failed AC/DC Terminal Equipment	0	0.0%	0	0.0%	0.0	0.0%
Failed Protection System Equipment	6	27.3%	5	22.7%	137.0	1.2%
Failed AC Circuit Equipment	0	0.0%	0	0.0%	0.0	0.0%
Failed DC Circuit Equipment	0	0.0%	0	0.0%	0.0	0.0%
Vegetation	0	0.0%	0	0.0%	0.0	0.0%
Power System Condition	4	18.2%	5	22.7%	33.4	0.3%
Human Error	3	13.6%	4	18.2%	2.5	0.0%
Unknown	0	0.0%	0	0.0%	0.0	0.0%
Other	2	9.1%	2	9.1%	5.9	0.1%
Unavailable	0	0.0%	0	0.0%	0.0	0.0%
TOTAL	22	100.0%	22	100.0%	11284.7	100.0%

3.3.1.3 Other Transformer Sustained Outage Data

Table NPCC 3.3-4 shows other Transformer Sustained Outage attributes by Fault Type, Outage Initiation Code, Outage Mode Code, and Event Type, and Outage Duration Interval.

Table NPCC 3.3-4 (p. 1 of 3)

Transformer - Other Sustained Outage Attributes

Fault Type	200-299 kV				300-399 kV				400-599 kV				600-799 kV			
	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %
No fault	-	-	-	-	3	75.0%	2.4	0.0%	6	85.7%	314.9	68.4%	9	81.8%	56.5	2.0%
P-P fault	-	-	-	-	0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
Single P-G fault	-	-	-	-	0	0.0%	0.0	0.0%	1	14.3%	145.5	31.6%	2	18.2%	2737.7	98.0%
P-P-G, 3 P, or 3P-G fault	-	-	-	-	1	25.0%	8027.8	100.0%	0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
Unknown fault type	-	-	-	-	0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
TOTAL	-	-	-	-	4	100.0%	8030.2	100.0%	7	100.0%	460.4	100.0%	11	100.0%	2794.2	100.0%

Outage Initiation Code	200-299 kV				300-399 kV				400-599 kV				600-799 kV			
	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %
Element-Initiated	-	-	-	-	0	0.0%	0.0	0.0%	3	42.9%	427.1	92.8%	2	18.2%	2737.7	98.0%
Other Element-Initiated	-	-	-	-	1	25.0%	2.0	0.0%	2	28.6%	1.2	0.3%	4	36.4%	7.8	0.3%
AC Substation-Initiated	-	-	-	-	2	50.0%	8028.2	100.0%	2	28.6%	32.0	7.0%	0	0.0%	0.0	0.0%
AC/DC Terminal-Initiated	-	-	-	-	0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
Other Facility-Initiated	-	-	-	-	1	25.0%	0.1	0.0%	0	0.0%	0.0	0.0%	5	45.5%	48.7	1.7%
TOTAL	-	-	-	-	4	100.0%	8030.2	100.0%	7	100.0%	460.4	100.0%	11	100.0%	2794.2	100.0%

Outage Mode Code	200-299 kV				300-399 kV				400-599 kV				600-799 kV			
	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %
Single Mode	-	-	-	-	1	25.0%	0.3	0.0%	3	42.9%	427.1	92.8%	5	45.5%	2698.3	96.6%
Dependent Mode Initiating	-	-	-	-	2	50.0%	2.0	0.0%	0	0.0%	0.0	0.0%	3	27.3%	88.2	3.2%
Dependent Mode	-	-	-	-	1	25.0%	8027.8	100.0%	4	57.1%	33.3	7.2%	3	27.3%	7.8	0.3%
Common Mode	-	-	-	-	0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
Common Mode Initiating	-	-	-	-	0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
TOTAL	-	-	-	-	4	100.0%	8030.2	100.0%	7	100.0%	460.4	100.0%	11	100.0%	2794.2	100.0%

Table NPCC 3.3-4 (p. 2 of 3)

Transformer - Other Sustained Outage Attributes

Event Type	200-299 kV				300-399 kV				400-599 kV				600-799 kV			
	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %	No. Sust.	%	No. Hrs.	Hours %
10	-	-	-	-	1	25.0%	8027.8	100.0%	4	57.1%	370.7	80.5%	1	9.1%	2650.0	94.8%
50	-	-	-	-	3	75.0%	2.4	0.0%	3	42.9%	89.7	19.5%	10	90.9%	144.2	5.2%
TOTAL	-	-	-	-	4	100.0%	8030.2	100.0%	7	100.0%	460.4	100.0%	11	100.0%	2794.2	100.0%

Transformer - Sustained Outage Duration Intervals

Outage Duration Interval	200-299 kV		300-399 kV		400-599 kV		600-799 kV	
	No. Sust.	%	No. Sust.	%	No. Sust.	%	No. Sust.	%
1-5 Minutes	-	-	1	25.0%	0	0.0%	1	9.1%
6-10 Minutes	-	-	0	0.0%	0	0.0%	1	9.1%
11-30 Minutes	-	-	1	25.0%	0	0.0%	2	18.2%
31-120 Minutes	-	-	1	25.0%	2	28.6%	2	18.2%
121 Minutes to 24 Hours	-	-	0	0.0%	1	14.3%	2	18.2%
> 24 Hours to 48 Hours	-	-	0	0.0%	1	14.3%	1	9.1%
> 48 Hours	-	-	1	25.0%	3	42.9%	2	18.2%
TOTAL	-	-	4	100.0%	7	100.0%	11	100.0%

Table NPCC 3.3-4 (p. 3 of 3)
Transformer - Other Sustained Outage Attributes

Fault Type	All Voltages			
	No. Sust.	%	No. Hrs.	Hours %
No fault	18	81.8%	373.8	3.3%
P-P fault	0	0.0%	0.0	0.0%
Single P-G fault	3	13.6%	2883.1	25.5%
P-P-G, 3 P, or 3P-G fault	1	4.5%	8027.8	71.1%
Unknown fault type	0	0.0%	0.0	0.0%
TOTAL	22	100.0%	11284.7	100.0%

Outage Initiation Code	All Voltages			
	No. Sust.	%	No. Hrs.	Hours %
Element-Initiated	5	22.7%	3164.7	28.0%
Other Element-Initiated	7	31.8%	11.0	0.1%
AC Substation-Initiated	4	18.2%	8060.2	71.4%
AC/DC Terminal-Initiated	0	0.0%	0.0	0.0%
Other Facility-Initiated	6	27.3%	48.7	0.4%
TOTAL	22	100.0%	11284.7	100.0%

Outage Mode Code	All Voltages			
	No. Sust.	%	No. Hrs.	Hours %
Single Mode	9	40.9%	3125.7	27.7%
Dependent Mode Initiating	5	22.7%	90.2	0.8%
Dependent Mode	8	36.4%	8068.9	71.5%
Common Mode	0	0.0%	0.0	0.0%
Common Mode Initiating	0	0.0%	0.0	0.0%
TOTAL	22	100.0%	11284.7	100.0%

Event Type	All Voltages			
	No. Sust.	%	No. Hrs.	Hours %
10	6	27.3%	11048.5	97.9%
50	16	72.7%	236.2	2.1%
TOTAL	22	100.0%	11284.7	100.0%

Outage Duration Interval	All Voltages	
	No. Sust.	%
1-5 Minutes	2	9.1%
6-10 Minutes	1	4.5%
11-30 Minutes	3	13.6%
31-120 Minutes	5	22.7%
121 Minutes to 24 Hours	3	13.6%
> 24 Hours to 48 Hours	2	9.1%
> 48 Hours	6	27.3%
TOTAL	22	100.0%

3.3.2 Transformer Momentary Outages

3.3.2.1 Transformer Momentary Outage Initiation Code Metrics

The Outage Initiation Code describes where an outage initiated.

- Table NPCC 3.3-5 shows metrics for Transformer Momentary Outages that were "Element-Initiated," which means the outages were initiated on or within the Element (Transformer in this case) being reported.
- Table NPCC 3.3-6 shows the metrics for Transformer Momentary Outages that were initiated by all other Outage Initiation Codes *except* those that were Element-Initiated. These included outages that were initiated on or within an AC Substation, an AC/DC Terminal, another TADS Element (Other-Element Initiated), or by Other Facilities.

Table NPCC 3.3-5
Transformer Momentary Outage Metrics - Element-Initiated Only

Voltage Class	No. of Transformers	No. of Outages	Frequency (MOF) (per transformer per yr)
200-299 kV	0.0	-	-
300-399 kV	27.0	0	0.0000
400-599 kV	42.0	0	0.0000
600-799 kV	65.0	0	0.0000
All Voltages	134.0	0	0.0000

Table NPCC 3.3-6
Transformer Momentary Outage Metrics - Other than "Element-Initiated"

Voltage Class	No. of Transformers	No. of Outages	Frequency (MOF) (per transformer per yr)
200-299 kV	0.0	-	-
300-399 kV	27.0	1	0.0370
400-599 kV	42.0	0	0.0000
600-799 kV	65.0	0	0.0000
All Voltages	134.0	1	0.0075

3.3.2.2 Transformer Momentary Outage Cause Code Data

For Momentary Outages, TADS requests one Cause Code: an Initiating Cause Code. Table NPCC 3.3-7 reports Cause Code data for Transformer Momentary Outages.

Table NPCC 3.3-7
Transformer Momentary Outages by Cause Code

Outage Cause Code	200-299 kV		300-399 kV		400-599 kV		600-799 kV		All Voltages	
	No. Mom.	%	No. Mom.	%	No. Mom.	%	No. Mom.	%	No. Mom.	%
Weather, excluding lightning	-	-	0	0.0%	0	~	0	~	0	0.0%
Lightning	-	-	0	0.0%	0	~	0	~	0	0.0%
Environmental	-	-	0	0.0%	0	~	0	~	0	0.0%
Contamination	-	-	0	0.0%	0	~	0	~	0	0.0%
Foreign Interference	-	-	0	0.0%	0	~	0	~	0	0.0%
Fire	-	-	0	0.0%	0	~	0	~	0	0.0%
Vandalism, Terrorism, or Malicious Acts	-	-	0	0.0%	0	~	0	~	0	0.0%
Failed AC Substation Equipment	-	-	0	0.0%	0	~	0	~	0	0.0%
Failed AC/DC Terminal Equipment	-	-	0	0.0%	0	~	0	~	0	0.0%
Failed Protection System Equipment	-	-	0	0.0%	0	~	0	~	0	0.0%
Failed AC Circuit Equipment	-	-	1	100.0%	0	~	0	~	1	100.0%
Failed DC Circuit Equipment	-	-	0	0.0%	0	~	0	~	0	0.0%
Vegetation	-	-	0	0.0%	0	~	0	~	0	0.0%
Power System Condition	-	-	0	0.0%	0	~	0	~	0	0.0%
Human Error	-	-	0	0.0%	0	~	0	~	0	0.0%
Unknown	-	-	0	0.0%	0	~	0	~	0	0.0%
Other	-	-	0	0.0%	0	~	0	~	0	0.0%
Unavailable	-	-	0	0.0%	0	~	0	~	0	0.0%
TOTAL	-	-	1	100.0%	0	~	0	~	1	100.0%

3.3.2.3 Other Transformer Momentary Outage Data

Table NPCC 3.3-8 shows other Transformer Momentary Outage attributes by Fault Type, Outage Initiation Code, Outage Mode Code, and Event Type.

Table NPCC 3.3-8
Transformer - Other Momentary Outage Attributes

Fault Type	200-299 kV		300-399 kV		400-599 kV		600-799 kV		All Voltages	
	No. Mom.	%	No. Mom.	%	No. Mom.	%	No. Mom.	%	No. Mom.	%
No fault	-	-	1	100.0%	0	~	0	~	1	100.0%
P-P fault	-	-	0	0.0%	0	~	0	~	0	0.0%
Single P-G fault	-	-	0	0.0%	0	~	0	~	0	0.0%
P-P-G, 3 P, or 3P-G fault	-	-	0	0.0%	0	~	0	~	0	0.0%
Unknown fault type	-	-	0	0.0%	0	~	0	~	0	0.0%
TOTAL	-	-	1	100.0%	0	~	0	~	1	100.0%

Outage Initiation Code	200-299 kV		300-399 kV		400-599 kV		600-799 kV		All Voltages	
	No. Mom.	%	No. Mom.	%	No. Mom.	%	No. Mom.	%	No. Mom.	%
Element-Initiated	-	-	0	0.0%	0	~	0	~	0	0.0%
Other Element-Initiated	-	-	1	100.0%	0	~	0	~	1	100.0%
AC Substation-Initiated	-	-	0	0.0%	0	~	0	~	0	0.0%
AC/DC Terminal-Initiated	-	-	0	0.0%	0	~	0	~	0	0.0%
Other Facility-Initiated	-	-	0	0.0%	0	~	0	~	0	0.0%
TOTAL	-	-	1	100.0%	0	~	0	~	1	100.0%

Outage Mode Code	200-299 kV		300-399 kV		400-599 kV		600-799 kV		All Voltages	
	No. Mom.	%	No. Mom.	%	No. Mom.	%	No. Mom.	%	No. Mom.	%
Single Mode	-	-	0	0.0%	0	~	0	~	0	0.0%
Dependent Mode Initiating	-	-	0	0.0%	0	~	0	~	0	0.0%
Dependent Mode	-	-	1	100.0%	0	~	0	~	1	100.0%
Common Mode	-	-	0	0.0%	0	~	0	~	0	0.0%
Common Mode Initiating	-	-	0	0.0%	0	~	0	~	0	0.0%
TOTAL	-	-	1	100.0%	0	~	0	~	1	100.0%

Event Type	200-299 kV		300-399 kV		400-599 kV		600-799 kV		All Voltages	
	No. Mom.	%	No. Mom.	%	No. Mom.	%	No. Mom.	%	No. Mom.	%
10	-	-	0	0.0%	0	~	0	~	0	0.0%
50	-	-	1	100.0%	0	~	0	~	1	100.0%
TOTAL	-	-	1	100.0%	0	~	0	~	1	100.0%

3.3.3 Total Transformer Metrics

Table NPCC 3.3-9 displays Transformer metrics that are defined in Appendix 2.

Table NPCC 3.39
Transformer Metrics 1-10 per Appendix 2*

	Element Outage Frequency (1-3)			Element Outage Duration, Repair Time, and Update Time (4-7)						Element Availability (8-10)		
Voltage Class	TOF	SOF	MOF	SODT	MTTR P(5%) <	MTTR MTTR 50/50	MTTR P(5%) >	MdTTR	MTBF	APC %	PCZO %	PCDR %
200-299 kV	-	-	-	-	-	-	-	-	-	-	-	-
300-399 kV	0.19	0.15	0.04	297.41	958.24	2007.55	3056.86	1.16	57284.45	96.50	88.89	0.00
400-599 kV	0.17	0.17	0.00	10.96	61.53	65.76	70.00	29.22	52638.24	99.88	83.33	0.00
600-799 kV	0.17	0.17	0.00	42.99	239.61	254.02	268.42	1.90	51651.44	99.51	98.46	0.00

***Note: Metrics 11-16 only apply to AC Circuits or DC Circuits**

	Outage Totals		
Voltage Class	Momentary Outages	Sustained Outages	Sustained Outages Hours
200-299 kV	-	-	-
300-399 kV	1	4	8030.2
400-599 kV	0	7	460.4
600-799 kV	0	11	2794.2
TOTAL	1	22	11284.7

3.4 AC/DC BTB Converter Metrics and Data

AC/DC BTB Converter metrics are displayed in three sections: Section 3.4.1 addresses Sustained Outages, Section 3.4.2 addresses Momentary Outages, and Section 3.4.3 has AC/DC BTB Converter metrics per the formulas in Appendix 2. Data and metrics are displayed for the two AC/DC BTB Converter Voltages Classes in the NERC template plus the total of all Voltage Classes.

3.4.1 AC/DC BTB Converter Sustained Outages

3.4.1.1 AC/DC BTB Converter Sustained Outage Initiation Code Metrics

The Outage Initiation Code describes where an outage initiated.

- Table NPCC 3.4-1 shows metrics for AC/DC BTB Converter Sustained Outages that were "Element-Initiated," which means the outages were initiated on or within the Element (AC/DC BTB Converter in this case) being reported.
- Table NPCC 3.4-2 shows the metrics for AC/DC BTB Converter Sustained Outages that were initiated by all other Outage Initiation Codes *except* those that were Element-Initiated. These included outages that were initiated on or within an AC Substation, an AC/DC Terminal, another TADS Element (Other-Element Initiated), or by Other Facilities.

Table NPCC 3.4-1
AC/DC BTD Converter Sustained Outage Metrics
"Element Initiated" Only

This space intentionally left blank.
This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

Table NPCC 3.4-2
AC/DC BTD Converter Sustained Outage Metrics
Other than "Element Initiated"

This space intentionally left blank.
This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

3.4.1.2 AC/DC BTB Converter Sustained Outage Cause Code Data

For Sustained Outages, TADS requests two Cause Codes – an Initiating Cause Code that describes the initiating cause and a Sustained Cause Code that describes the cause that contributes to the longest duration. For 2008, TADS asked TOs to provide both if they are available, but if not, to supply one or the other. TADS has a Cause Code (Unavailable) that TOs can use if they do not have one of these two Cause Codes available. Table NPCC 3.4-3 shows the two Outage Cause Codes (Initiating and Sustained) plus the number of outage hours associated with each Cause Code.

Table NPCC 3.4-3

AC/DC BTB Converter Sustained Outages by Cause Code

This space intentionally left blank.
This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

3.4.1.3 Other AC/DC BTB Converter Sustained Outage Data

Table NPCC 3.4-4 shows other AC/DC BTB Converter Sustained Outage attributes by Fault Type, Outage Initiation Code, Outage Mode Code, and Event Type, and Outage Duration Interval.

Table NPCC 3.4-4
AC/DC BTB Converter – Other Sustained Outage Attributes

This space intentionally left blank.
This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

3.4.2 AC/DC BTB Converter Momentary Outages

3.4.2.1 AC/DC BTB Converter Momentary Outage Initiation Code Metrics

The Outage Initiation Code describes where an outage initiated.

- Table NPCC 3.4-5 shows metrics for AC/DC BTB Converter Momentary Outages that were "Element-Initiated," which means the outages were initiated on or within the Element (AC/DC BTB Converter in this case) being reported.
- Table NPCC 3.4-6 shows the metrics for AC/DC BTB Converter Momentary Outages that were initiated by all other Outage Initiation Codes *except* those that were Element-Initiated. These included outages that were initiated on or within an AC Substation, an AC/DC Terminal, another TADS Element (Other-Element Initiated), or by Other Facilities.

Table NPCC 3.4-5

AC/DC BTB Converter Momentary Outage Metrics

"Element Initiated" Only

This space intentionally left blank.
This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

Table NPCC 3.4-6

AC/DC BTB Converter Momentary Outage Metrics

Other than "Element Initiated"

This space intentionally left blank.
This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

3.4.2.2 AC/DC BTB Converter Momentary Outage Cause Code Data

For Momentary Outages, TADS requests one Cause Code: an Initiating Cause Code. Table NPCC 3.4-7 reports Cause Code data for AC/DC BTB Converter Momentary Outages.

Table NPCC 3.4-7
AC/DC BTB Converter Momentary Outages
By Cause Code

This space intentionally left blank.
This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

3.4.2.3 Other AC/DC BTB Converter Momentary Outage Data

Table NPCC 3.4-8 shows other AC/DC BTB Converter Momentary Outage attributes by Fault Type, Outage Initiation Code, Outage Mode Code, and Event Type.

Table NPCC 3.4-8
AC/DC BTB Converter Other Momentary Outage Attributes

This space intentionally left blank.
This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

3.4.3 Total AC/DC BTB Converter Metrics

Table NPCC 3.4-9 on the next page displays AC/DC BTB Converter metrics which are defined in Appendix 2.

Table NPCC 3.4-9
AC/DC BTB Converter Other Momentary Outage Attributes

This space intentionally left blank.
This category of data is not displayed because there is no inventory in the voltage classes or it would reveal confidential Transmission Owner information. See Section 1.5 and Table NPCC 2-2 of this report.

Appendix 1 TADS Definitions

The definitions are a separate document that may be downloaded at http://www.nerc.com/docs/pc/tadstf/Appendix_1_TADS_2008_Reports_(All).pdf.

Appendix 2 Metric Definitions

The metrics definitions are contained on the table below, which is divided into two sections: the first page has metrics 1-10 that apply to *all* Elements. The second page has metrics 11-16 that only apply to AC Circuits or DC Circuits.

- Metric 5: Mean-time-to-repair (MTTR) has the same meaning as mean outage duration. Since this calculation is based upon a limited number of outages, the computed value is an *estimate* of the "true" MTTR for the Element. Using statistical methods, one can estimate the uncertainty in the mean calculation. The tables in the main report provide a range of MTTR values:
  - The value that is calculated straight from the data is labeled "MTTR 50/50."
  - The MTTR labeled "P(5%) >" means the true MTTR has a 5 % chance of being greater than this value, and the MTTR labeled "P(5%)<" means the true MTTR has a 5% chance of being lower than this value

  When a fairly large number of outages are used to calculate the MTTR 50/50 value, the range of uncertainty is fairly low. See the Overhead AC Circuit MTTR values on NPCC 3.1-9. When only a few outages are used, the range is very large, indicating a high degree of uncertainty between the calculated MTTR and the "true" MTTR.
- Metrics 11, 12, and 13: Circuit outage frequency on a per 100 Circuit Mile basis - total circuit outage frequency (TCOF), Sustained (circuit) Outage frequency (SCOF), and Momentary (circuit) Outage frequency (MCOF), are calculated twice – one calculation includes *all* outages while a second calculation only includes Element-Initiated outages. The second calculation more correctly relates outages initiated on the circuit (the Element in this case) to total circuit exposure measured by mileage.

No.	Metric	Formula	Units	Acronym
	Element Outage Frequency			
1	Element Total Automatic Outage Frequency	Total Automatic Outages / Total Elements	No. Automatic Outages per Element per year	TOF
2	Element Sustained Outage Frequency	Total Sustained Outages / Total Elements	No. Sustained Outages per Element per year	SOF
3	Element Momentary Outage Frequency	Total Momentary Outages / Total Elements	No. Momentary Outages per Element per year	MOF
	Element Outage Duration, Repair Time, and Up Time			
4	Element Sustained Outage Duration Time	Total Sustained Outage Hours / Total Elements	No. Sustained Outages hours per Element per year	SODT
5	Element Sustained Outage Mean Time to Repair. Also referred to as Mean Outage Duration	Total Sustained Outage Hours / Total Sustained Element Outages	Average no. of Sustained Outage Hours per outaged Element	MTTR
6	Median Time to Repair Sustained Element Outage Failures	The time when 50% of the Mean Time to Repair minutes are greater than this figure	Median no. of Sustained Outage Hours per outaged Element	MdTTR
7	Mean Time Between Sustained Element Outages (Mean "Up Time"). Also referred to as Mean Time Between Failures.	(Total Element Hours - Total Sustained Outage Hours) / Total Sustained Element Outages	Mean (average) no. of hours of operation of an Element before it fails	MTBF[1]
	Element Availability			
8	Element Availability Percentage	1- (Total Sustained Outage Hours / Total Element Hours) * 100	Percentage	APC[1]
9	Percentage of Elements with Zero Automatic Outages	Total Elements with Zero Automatic Outages / Total Elements	Percentage	PCZO
10	Percent of Element Automatic Outages associated with a Disturbance Report (EOP-004)	Total Automatic Outages associated with a Disturbance Report / Total Automatic Outages	Percentage	PCDR

1 Since Non-Automatic Outage data are not collected, these metrics will be overstated from industry definitions.

	Metric	Formula	Units	Acronym
	Circuit Outage Frequency, per 100 Circuit Miles (Applies to AC and DC Circuits Only)			
11	Circuit Total Outage Frequency, Mileage Adjusted	(Total Circuit Automatic Outages *100) / Total Circuits Miles	No. Automatic Outages per 100 Circuit Miles per year	$TCOF_{100CM}$
12	Circuit Sustained Outage Frequency, Mileage Adjusted	(Total Circuit Sustained Outages *100) / Total Circuit Miles	No. Sustained Outages per 100 Circuit Miles per year	$SCOF_{100CM}$
13	Circuit Momentary Outage Frequency, Mileage Adjusted	(Total Circuit Momentary Outages *100) / Total Circuit Miles	No. Momentary Outages per 100 Circuit Miles per year	$MCOF_{100CM}$
	Multiple Circuit Outage Frequency per 100 Multi-Circuit Structure Miles (For AC Circuits, multi circuit outages are Event Type 30 outages; for DC Circuits, they are Event Type 40 outages.)			
14	Multi Circuit Total Outage Frequency, Mileage Adjusted	(Total Multi-Circuit Automatic Outages *100) / Total Multi-Circuit Structure Miles	No. Automatic Outages per 100 Multi-Circuit Structures Miles per year	$TMCOF_{100SM}$
15	Multi-Circuit Sustained Outage Frequency, Mileage Adjusted	(Total Multi-Circuit Sustained Outages *100) / Total Multi-Circuit Structure Miles	No. Sustained Outages per 100 Multi-Circuit Structure Miles per year	$SMCOF_{100SM}$
16	Multi-Circuit Momentary Outage Frequency, Mileage Adjusted	(Total Multi-Circuit Momentary Outages *100) / Total Multi-Circuit Structure Miles	No. Momentary Outages per 100 Multi-Circuit Structure Mles per year	$MMCOF_{100SM}$

Appendix 3 TADS Task Force Members as of June 30, 2009

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