Transmission Network Performance Report

Fiscal Year 2008

nationalgrid

National Grid US Transmission

Network Performance Summary Report
FY2008

This report has been prepared for National Grid's customers and other interested parties. The intention of this report is to provide its recipients information on National Grid's transmission reliability performance for Fiscal Year 2008 (April 1, 2007 through March 31, 2008). Performance trends over the previous nine years have also been provided.

National Grid USA is a registered public utility holding company headquartered in Westborough, Massachusetts. National Grid USA does not directly own or operate any facilities for the transmission or distribution of electricity; rather, such facilities are owned and/or operated directly by National Grid USA operating subsidiary companies. However, for ease of reference and for the convenience of the reader, the terms "National Grid" or "Company" shall be used in this document to refer to the transmission facilities and assets owned and/or operated by one or more of the subsidiary companies of National Grid USA. This document does not cover the performance of assets operated on Long Island.

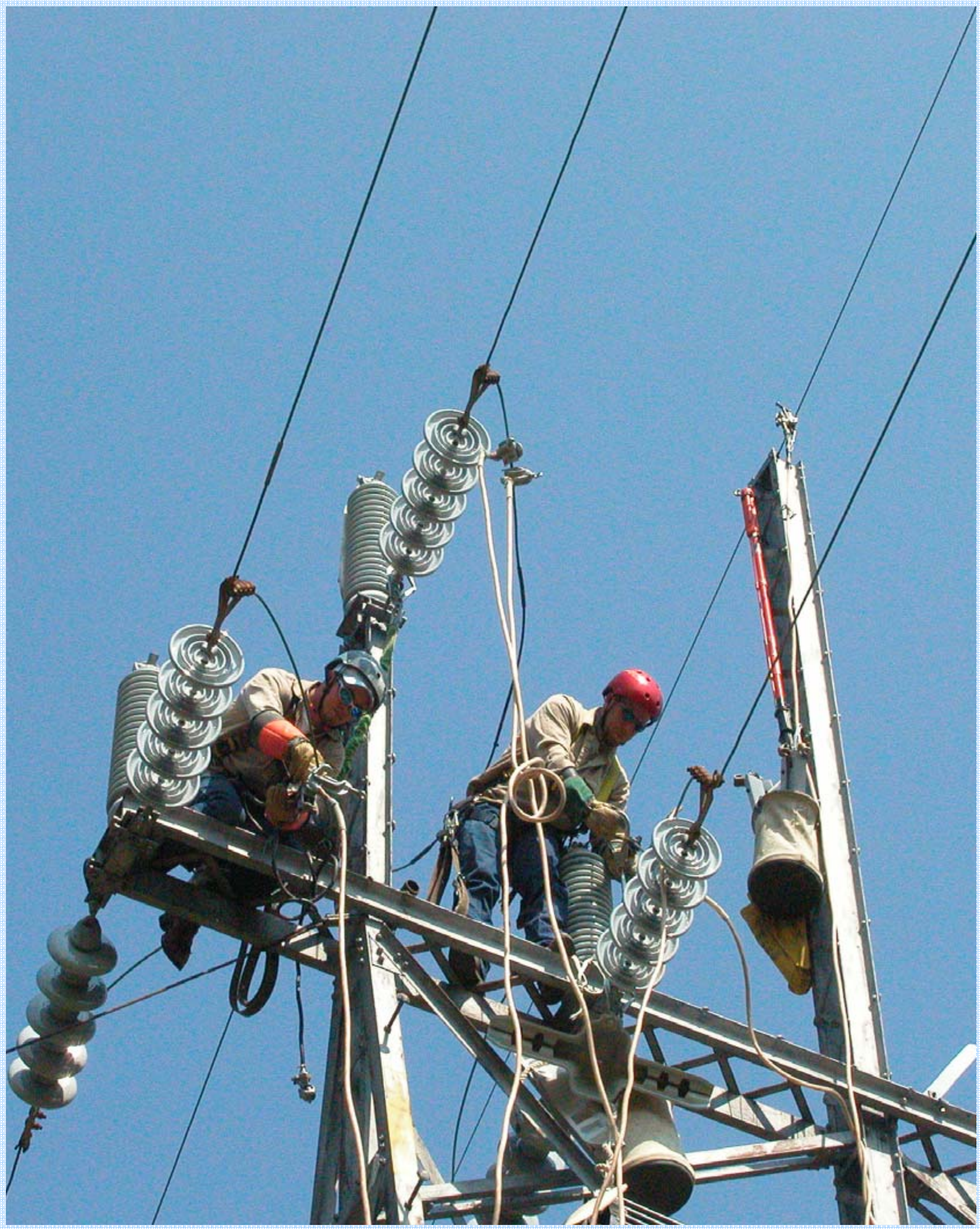
0 Contents

0.1 Table of Contents

0.2 Table of Figures

0.3 Table of Tables

RELIABILITY



1 Reliability

1.1 Introduction

This report is prepared primarily for National Grid's transmission customers, to inform you about the reliability performance of our transmission system over the past year and also compare it to preceding years.

The North American Electric Reliability Council (NERC) defines reliability as "the degree to which the performance of the elements of the system result in power being delivered to customers within accepted standards and in the amount desired". This definition contains the concepts of adequacy and security. Using NERC definitions again, adequacy is "the ability of the system to supply the aggregate power and energy requirements of the consumers at all times" and security is "the ability of the system to withstand sudden disturbances".

Transmission failures cause only a small percentage of power outages, yet these can be significant in their impact on customers. This report provides information on the various metrics that we use to monitor and improve performance of our transmission system. These metrics measure the reliability of the transmission system and consequently, the impact on customers. This edition includes more focus on five-year and long-term performance than in previous years, in an attempt to more clearly indicate performance trends.

If you have any comments or questions about this report,
please contact your Account Manager

1.2 Performance Summary

The overall performance of the system in FY2008 was, for the most part, in-line with the five-year averages for most metrics, but with a significant increase in outages compared to the previous year. This is reflective of a year that was considerably stormier than the previous one. The number of lightning ground strokes in the transmission system's areas of operation (a good indicator of overall storminess) was nearly 48% higher in FY2008 than during FY2007. Two key customer impact metrics Loss of Supply and Losses of Generation were also up compared to the five-year average.

The summary data presented on Table 1-1 below will be examined in greater detail throughout the rest of the report.

Table 1-1: FY2008 Performance Summary

Reliability Check	FY2008 vs. FY2007	FY2008 vs. Five-Year Average
total number of disturbances	Up by 29%	*In-line with 5 year average*
number of momentary disturbances	Up by 26%	*In-line with 5 year average*
number of sustained disturbances	Up by 34%	*Worse than 5 year average*
sustained disturbances total duration	Up by 21%	*In-line with 5 year average*
number of loss of supply incidents	Up by 25%	*Worse than 5 year average*
number of loss of generation incidents	Up by 117%	*Worse than 5 year average*

1.3 Selected Performance Statistics

Table 1-2 shows some other selected performance statistics for FY2008. All of these results were very similar to the previous fiscal year and five-year averages. It is notable that over half of the circuits on the system did not experience any disturbances at all during the year.

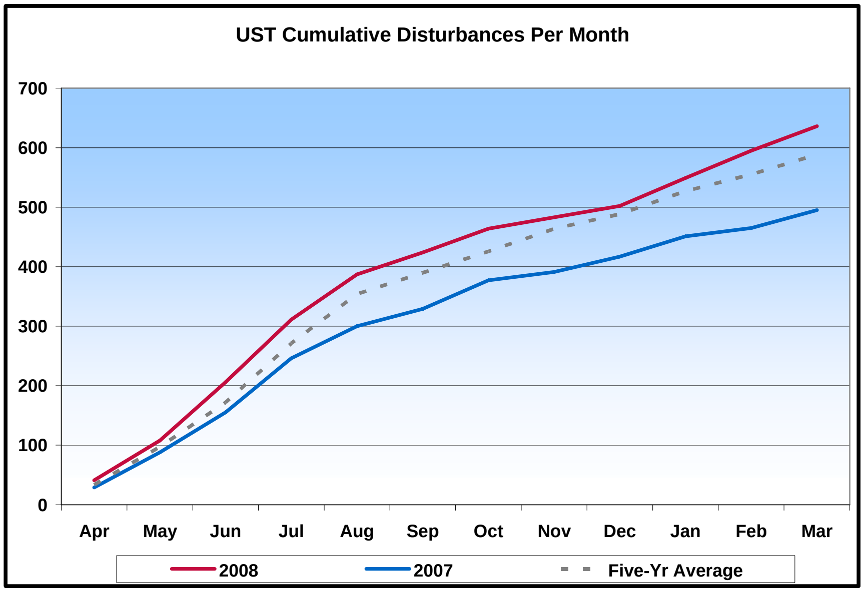
Table 1-2: Selected Performance Statistics FY2008

% of circuits that experienced no disturbances	51%
% of circuits that experienced a single disturbance	23%
% of circuits that experienced 2 disturbances	9%
% of circuits that experienced 3 or more disturbances	17%
Overall ITR	99.963%
Overall Availability	98.6%

1.4 Total Number of Disturbances

Figure 1-1 plots the cumulative system disturbances by month for FY2008, FY2007 and the previous five-year average. The chart shows that FY2008 tracked closer to the five-year average than the previous fiscal year, which was considerably lower. Note the steeper slope June through August. The system experiences over half of the year's disturbances in just these three months.

Figure 1-1: Cumulative Disturbances Per Month- FY2008 & FY2007



The next two charts show the intra-year trends for disturbances for FY2008.

The first chart, Figure 1-2 shows the regional disturbances by week during the year. The New England region is green and New York, blue. The peaking of disturbances through the summer is clearer on this chart. There are also several spikes during weeks when there were exceptional storms.

The worst week of the year occurred in July, when there were a series of severe thunderstorms that worked through both regions of the transmission system. Note also the several storm days in January and early February in New York that caused a high number of disturbances for those weeks.

Figure 1-2: Regional Weekly Number of Outages

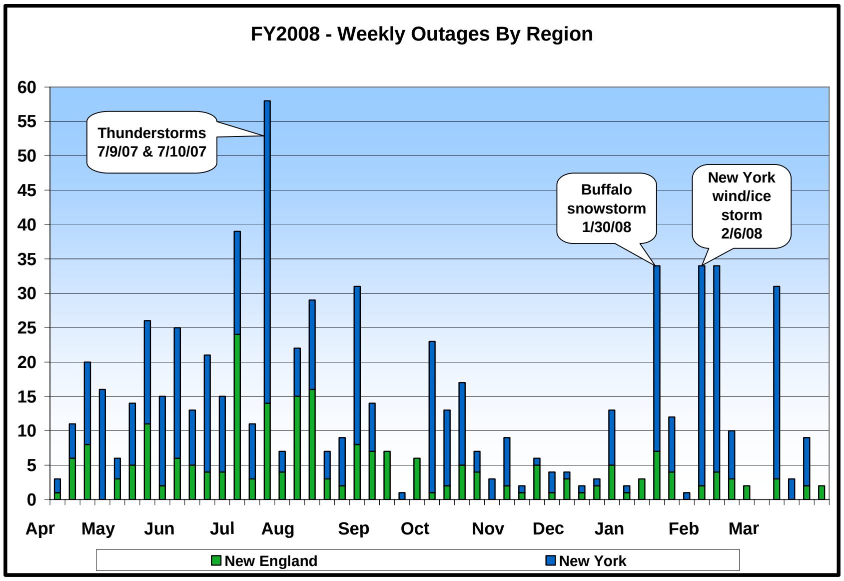
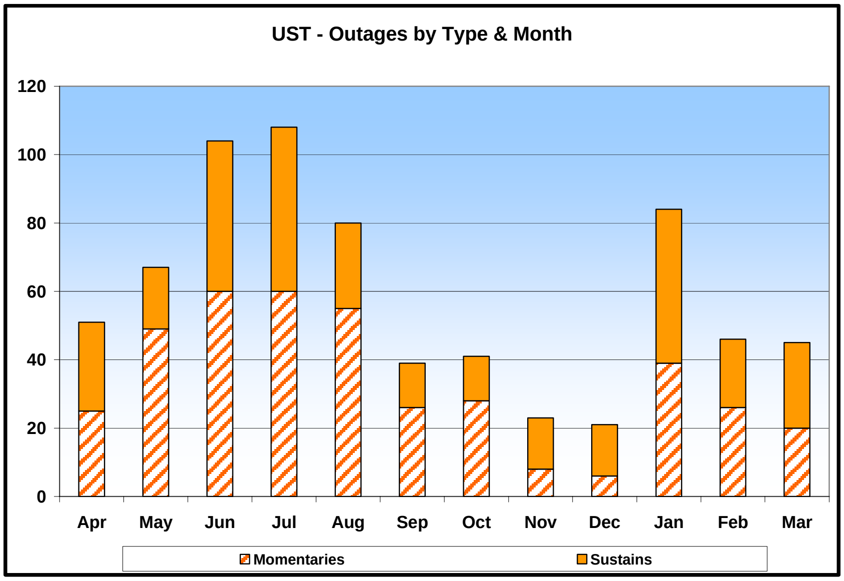


Figure 1-3, a plot of disturbances by type and month, clearly indicates the higher than normal activity in January, which had 50% more disturbances than the five-year average, due to the several storms that month.

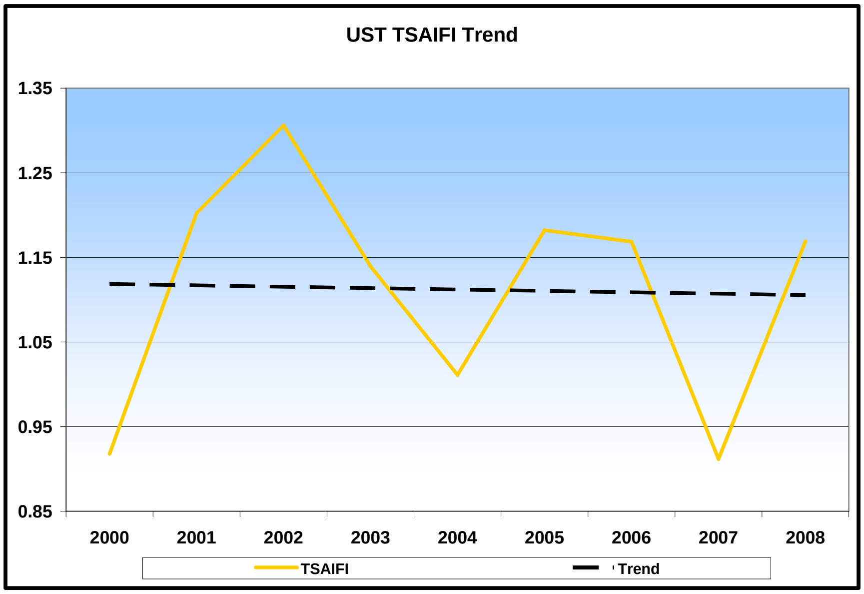
Figure 1-3: UST - Outages by Type & Month



The metric used to track the total disturbances rate is TSAIFI (the total number of disturbances per circuit-year). The FY2008 result for this metric was 1.17, indicating there was, on average, slightly more than one disturbance per circuit over the year. The actual break-down of disturbances for the year was 374 momentaries and 262 sustained.

Figure 1-4 below plots the results for this metric for the past nine years. There long-term trend of disturbances is slightly lowering, though there is a large amount of variability from year to year.

Figure 1-4: Long-Term Trend of TSAIFI



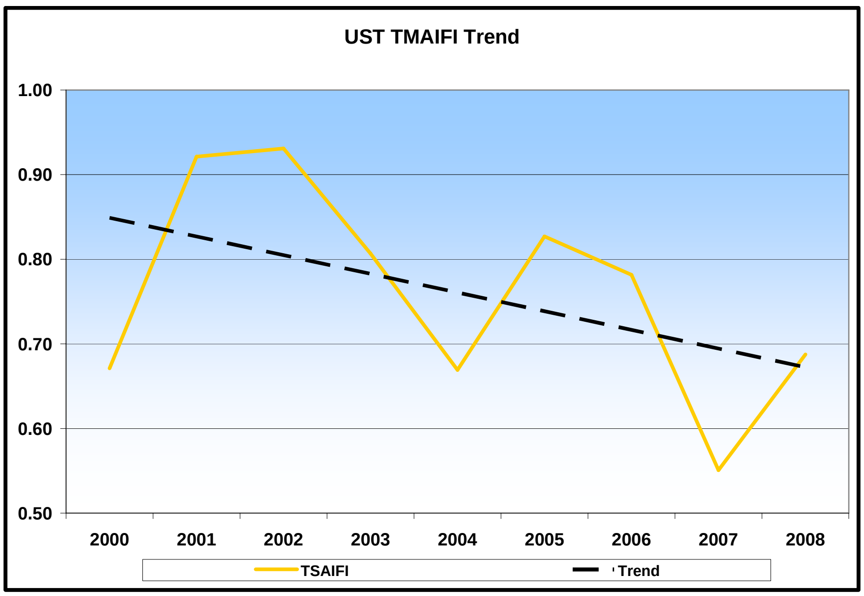
The year-to-year variability in the total disturbance rate reflects differences in the regional weather patterns, particularly thunderstorms, from year to year. The weather, in general, and storms in particular have a very pronounced influence on the number of momentary disturbances, as will be shown in more detail in the discussion in Section 1.5. And since normally about 2/3 of all disturbances each year are momentary in nature, the trend in total disturbances is driven by the trend in momentary disturbances.

1.5 Momentary Disturbances

This section discusses the most prevalent type of system disturbance, those that are momentary (a trip and reclose operation where the total outage duration is less than or equal to one minute) in nature. There were 374 momentary disturbances on the system in FY2008, which was slightly fewer than the five-year average of 380, but 26% higher than the previous year's result of 298.

The metric used to track momentary disturbances is TMAIFI (the total number of momentary disturbances per circuit-year). The long-term trend of this metric, shown on Figure 1-5, indicates that this type of disturbance has been trending downward moderately over the past nine years with a large amount of variability year to year.

Figure 1-5: Long-Term Trend of TMAIFI



The variability in the number of momentaries year-to-year is strongly influenced by the weather, particularly the frequency and severity of thunderstorms during the summer stormy season. The break-down of causes of momentary disturbances over the past five years is shown on Figure 1-6 on the following page. Note that the categories of Weather and Lightning make up 36% of the causes of momentaries. But there is a stronger influence than that.

Our research into the largest category of causes of momentaries, those that we were unable to identify a definitive cause for, found that over two-thirds of these "Unknown" momentaries also occurred during storms. These "Unknown" operations may be caused by the severe winds, heavy precipitation, or blowing debris that is encountered during storms. But the transient nature of both storms and momentary system disturbances makes finding the specific causes very difficult. Figure 1-7 shows the trend of lightning exposure to the system, which has been up significantly over the past four years.

Figure 1-6: Causes of Momentary Disturbances

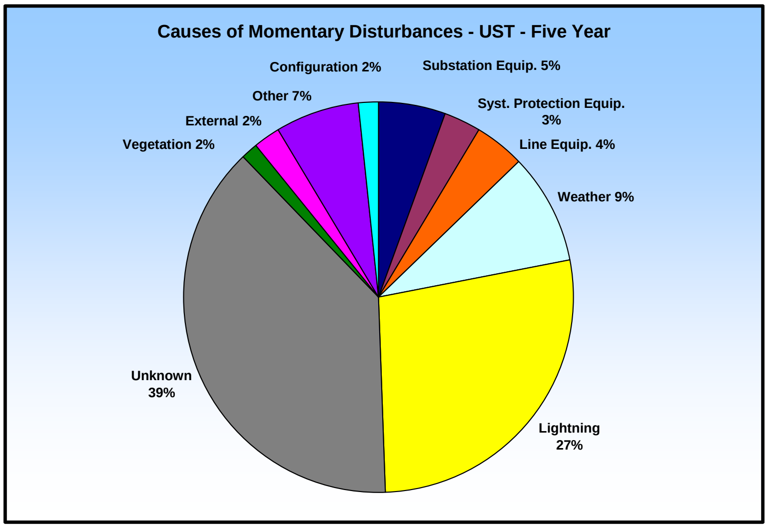
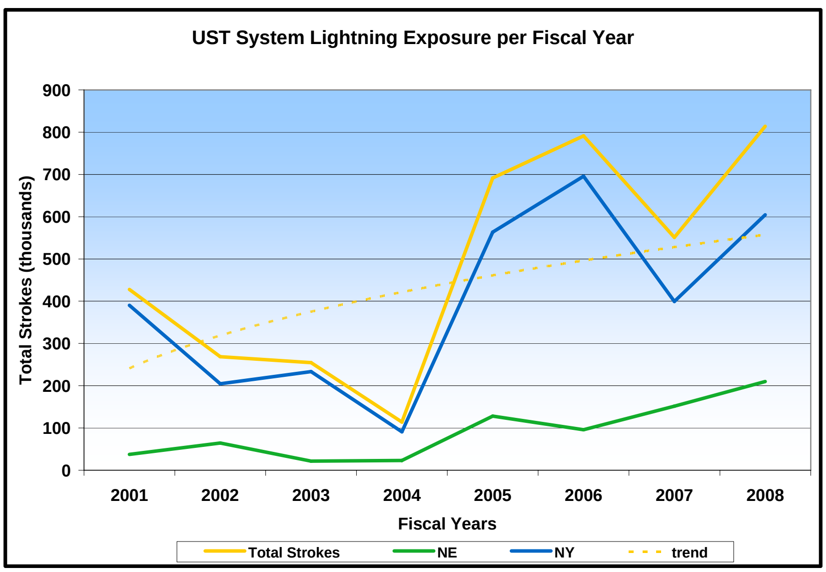


Figure 1-7: Trend of UST Lighting Exposure

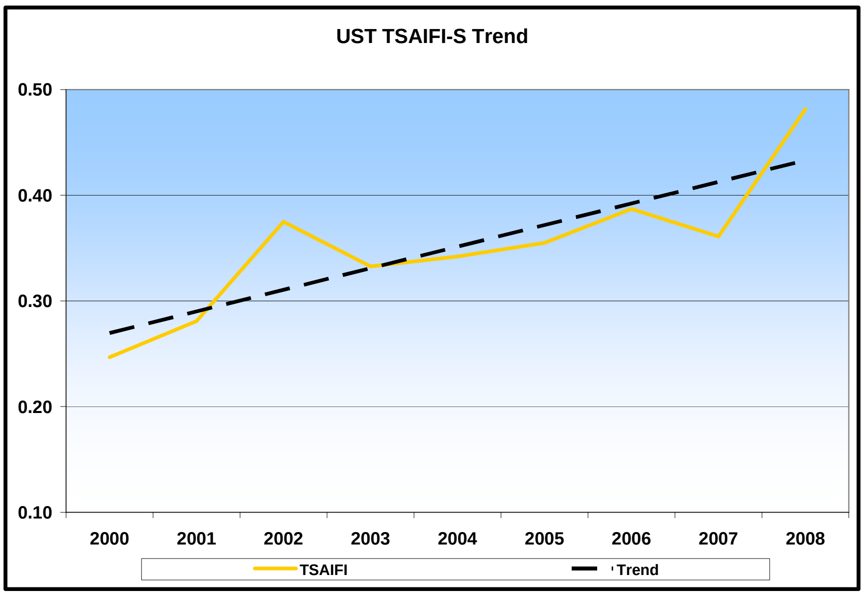


1.6 Sustained Disturbances

There were 262 sustained (> 1 minute in duration) disturbances on the system in FY2008, which was higher than the previous year's result and 26% higher than the five-year average.

The metric used to track sustained disturbances is TSAIFI-S (the total number of sustained disturbances per circuit-year). The long-term trend of this metric, shown on Figure 1-8, indicates that this type of disturbance has been trending upward over the past nine years. There are a number of initiatives the company is undertaking to counteract this trend. These programs are outlined in Section 3.

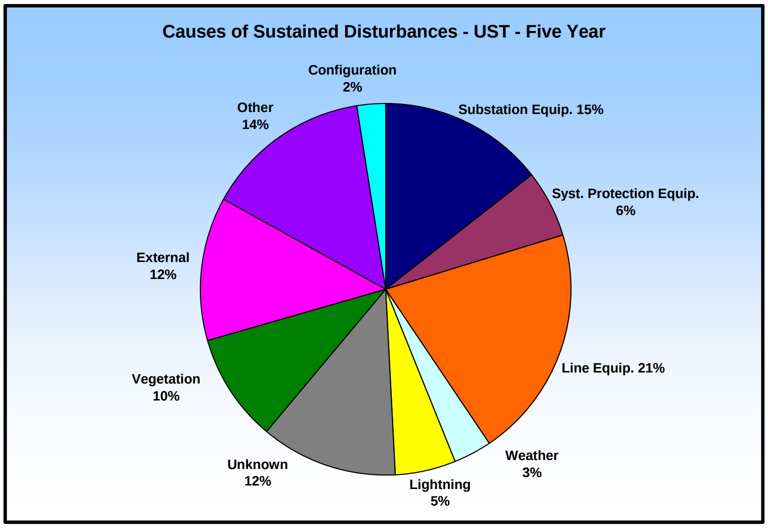
Figure 1-8: Long-Term Trend of TSAIFI-S



The break-down of sustained outage causes over the past five years, on Figure 1-9 on the following page, does not show any one category to be driving these events. A comparison of one-year and year-to-year trends also does not reveal any one outage category as a driver.

The three equipment problem categories (Substation Equipment, System Protection Equipment & Line Equipment) make up about 42% of the sustained outage causes, which is to be expected.

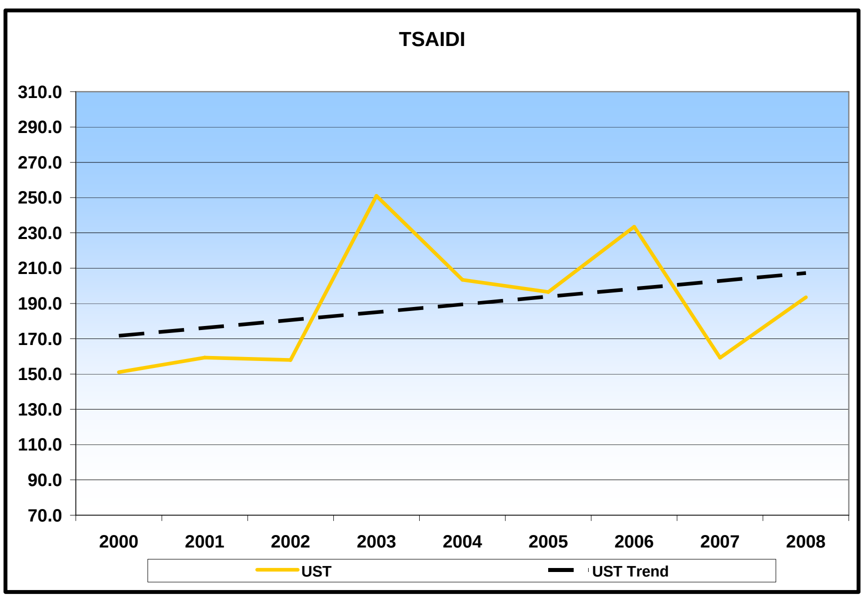
Figure 1-9: Causes of Sustained Disturbances



1.7 Disturbance Total Duration

The duration trend of sustained disturbances is tracked by the TSAIDI metric, which is the total outage duration (in minutes) per circuit-year. This trend generally follows the trend in sustained outage rate, with the exception of a single year when there were some very-long duration outages due to the need to replace some 230 kV circuit breakers following a fault.

Figure 1-10: Long-Term Trend of TSAIDI



1.8 System Availability

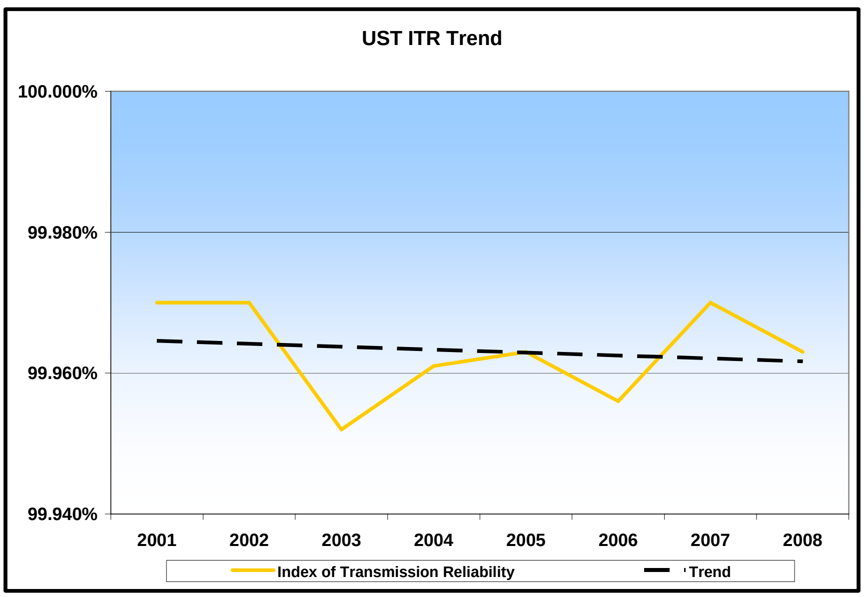
This section examines the percentage of the time that system circuits were available for the transmission of electricity. The first section deals with the availability of circuits after disturbances are accounted for, and the second section looks at the total availability of system circuits when considering both automatic and planned outages.

1.8.1 Unplanned Unavailability (ITR)

The UST metric that has been used for measuring availability after unplanned outages are accounted for is the Index of Transmission Reliability (ITR). It is the percentage of the specified time period that the system was available for the transmission of electricity after the total duration of unplanned outages is accounted for.

The ITR metric finished FY2008 at the five-year average of 99.963%, slightly below last year's result of 99.970%. The long-term trend of this metric, on Figure 1-10, shows very little change over the past eight years that this metric has been in use.

Figure 1-11: UST ITR Trend



1.8.2 Total Availability

Total availability takes both unplanned and planned outage durations into account. But of the two, the overwhelming majority of the outage duration is due to planned outages. Availability last year was higher than the previous year, and at about the five-year average.

Table 1-3: UST & Regional System Availability

Region	FY2008	FY2007	5 Year Average	Change vs. FY2007	Change vs. 5 Yr Average
UST	98.6%	98.1%	98.5%	26%	7%
NE	98.5%	98.1%	98.5%	18%	3%
NY	98.7%	98.2%	98.5%	31%	13%

CUSTOMERS

2 Customers

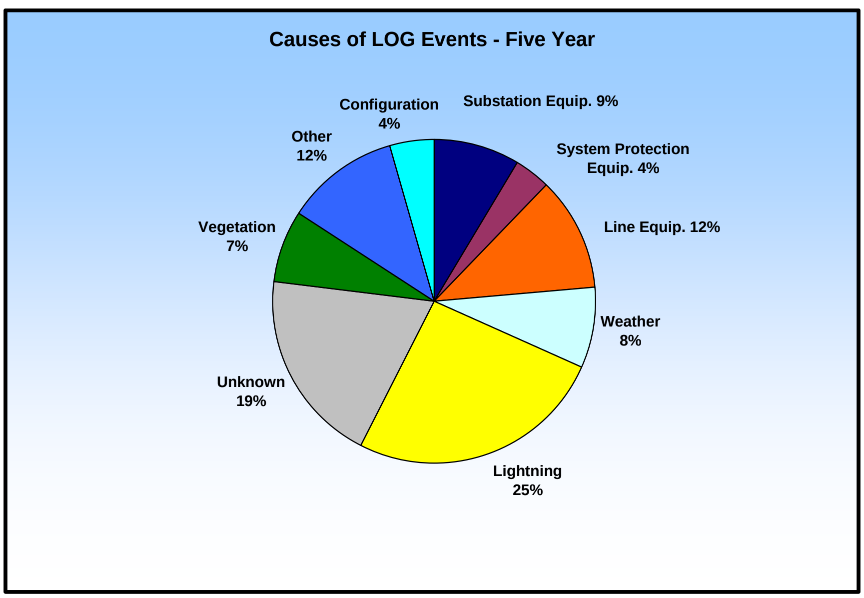
This section focuses on the impact of transmission performance on our customers. There are primarily two metrics that are used to track the impact of transmission system disturbances on customers. They are Loss of Generation (LOG), and Loss of Supply (LOS).

A Loss of Generation event is defined as a transmission disturbance that results in an on-line generator tripping off-line. LOG events impact system reliability directly through transmission impact and also contingency effects; both which serve to disrupt the wholesale market. A Loss of Supply event is when any transmission or distribution customers' supply of electricity is interrupted due to a sustained transmission disturbance.

2.1 Loss of Generation (LOG)

There were 39 LOG events in FY08 over the whole system. This was up sharply from the previous year and was above the five-year average. An examination of these events over the past five years found that about 60% were the result of momentary disturbances and most of the events (83%) occurred on 115 kV circuits.

Figure 2-1: Causes of LOG Events



The leading cause of LOG events over the past five years has been lightning strikes on the system. Lightning and other storm-related causes make up about 45% of the cause break-down. Note that our analysis of “Unknown” events found that 2/3 of these occurs during storms.

The company has a long-term strategy in place to improve the lightning performance of circuits, which should reverse the rising trend in the number of LOG events

2.2 Losses of Supply (LOS)

There were 74 LOS events in FY08, which was higher than the previous year and 16% above the five-year average. The average number of customers interrupted by each event was 4064 for an average duration of 71 minutes. This compares somewhat favorably to the five-year averages of 5200 customers interrupted for an average duration of 80 minutes. But the averages don’t accurately describe the impact of LOS events.

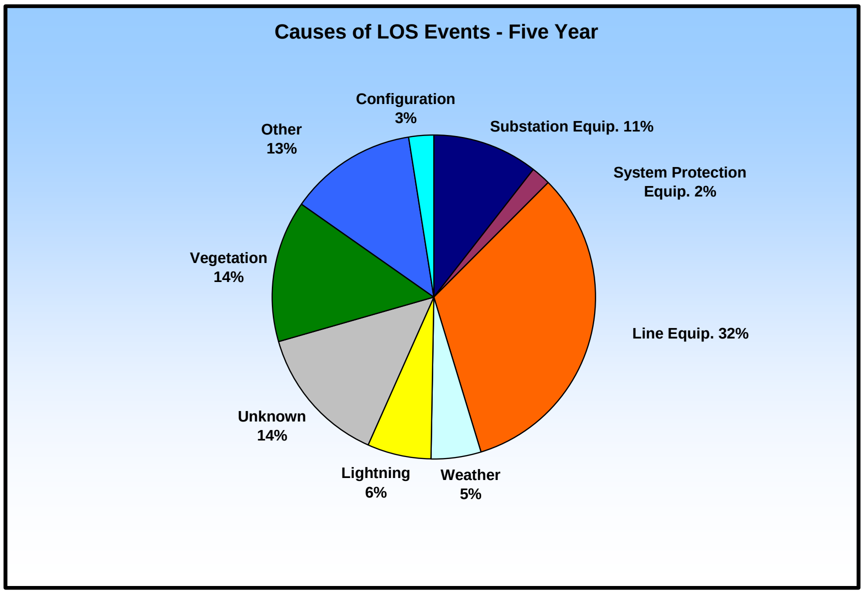
Our analysis of all LOS events over the past nine years (the extent of our data) found that half of the events had a relatively moderate impact; < 1000 customers interrupted for < 30 minutes, while a small number of the most significant events (8%) accounted for most of the Lost Customer Minutes (Number of customers interrupted times the duration, in minutes).

Table 7-3 on the following page lists the most significant customer impact LOS events that occurred in FY2008. These five events account for 75% of the total Lost Customer Minutes for the year.

Table 2-1: Most Significant Customer LOS Events: FY2008

Date	Circuit(s)	Details	Impact
10/20/07	I161 North Chelmsford-Sandy Pond & A153 Tewksbury-Meadowbrook	Several trees were blown down on the I161 line in a severe thunderstorm. The static wire and conductors of I161 broke. The static wire wrapped the A153 conductor, causing it to lockout also, removing both 115 kV sources to several large substations.	Approximately 13,800 customers were interrupted for an average duration of 460 minutes
04/23/07	Boonville-Rome #3 & Boonville-Rome #4	During a wind and ice storm, the conductor broke near Structure 134 and wrapped around the parallel Boonville-Rome #4 circuit, causing lockout there as well.	Approximately 8,900 customers were interrupted for an average duration of 160 minutes
07/30/07	J16 Riverside - Staples	A high-amp lightning strike on the H17 circuit resulted in the Riverside 879 disconnect switch failing on one phase.	Approximately 22,660 customers were interrupted for an average duration of 60 minutes
12/17/07	S145 Tewksbury - Salem Harbor	During construction work on the new Wakefield sub, the contractor's excavator boom contacted the S145 line. The fault also resulted in a lightning arrestor failure at Burtt Avenue substation.	Approximately 17,300 customers were interrupted for an average duration of 67 minutes
07/10/07	Spier - Rotterdam #2	Locked out during severe thunderstorm. An open loop was found at the Ballston substation tap.	Approximately 4,500 customers were interrupted for an average duration of 240 minutes

Figure 2-2: Causes of LOS Events



The leading causes of customer-interrupting outages are those caused by Line Equipment problems and those due to trees coming into contact with lines (mostly during storms).

DEVELOPMENT

3 Development

National Grid wants to provide excellent customer service. To that end, the company will operate, maintain and invest in our transmission networks to meet our obligations and to minimize the risk of supply interruption. This section outlines some of the current activities the company has undertaken to achieve this.

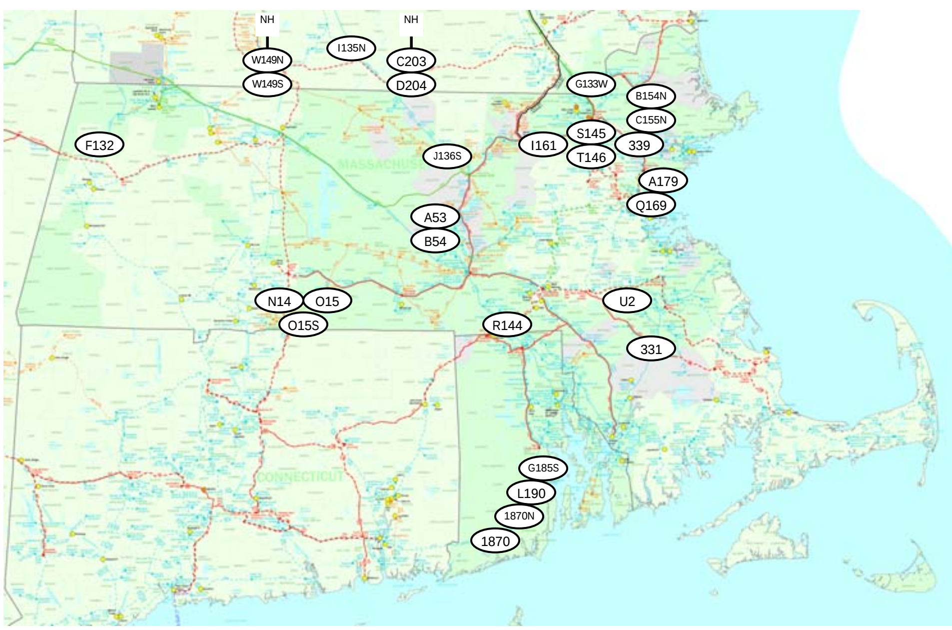
3.1 Transmission Line Rehabilitation Projects

A number of line rehabilitation projects were implemented in FY2008 to improve the transmission equipment condition and reliability performance which enhances service to our customers. This section identifies the circuits where significant projects were undertaken.

3.1.1 New England Projects

Figure 3-1 shows the major projects undertaken in New England this past fiscal year. The notations on the system map are a relative indication of where the circuit is geographically located and not necessarily the location of the construction. The projects outlined include reconfigurations, installation of new conductors, repair and replacement of structures, and replacement of other equipment.

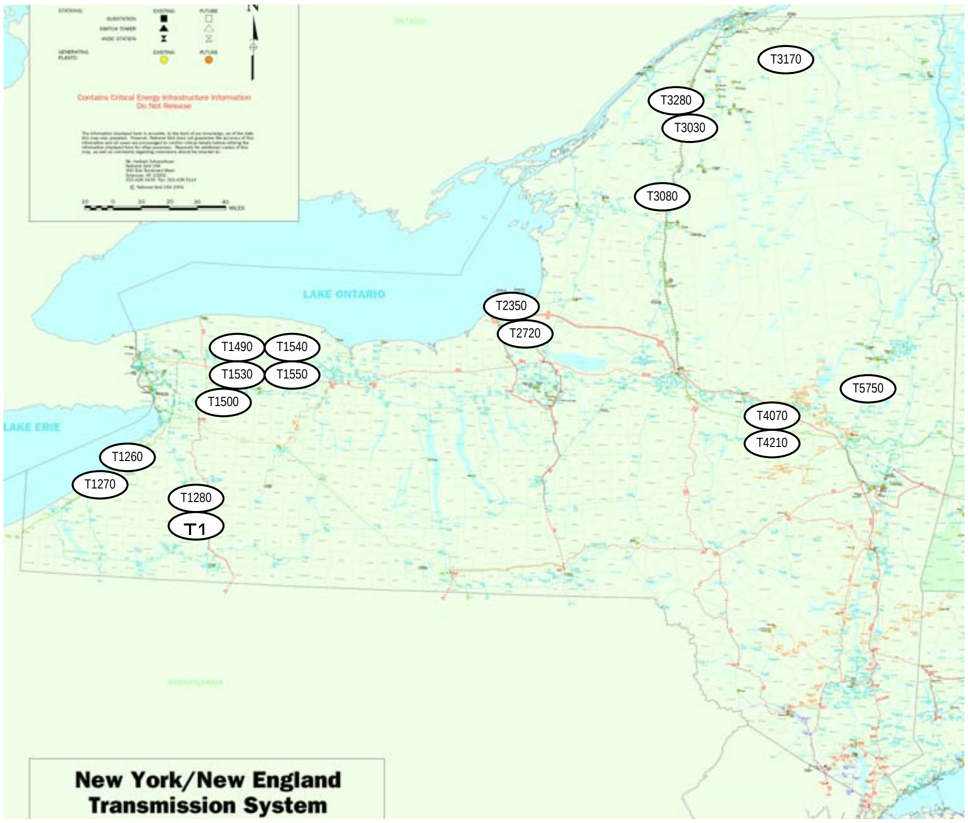
Figure 3-1: New England Projects FY2008



3.1.2 New York Projects

Figure 3-2 shows the bigger projects undertaken in New York this past fiscal year. The projects outlined include reconfigurations, installation of new conductors, repair and replacement of structures, and replacement of other equipment.

Figure 3-2: New York Projects FY2008



3.2 Reliability Improvement Program

This program was initiated several years ago to perform the analyses and develop the strategies necessary to define the investments in the system required to improve the overall reliability. This phase of the program was completed this year, when the comprehensive reviews of the asset condition in both New York and New England were completed. The implementation phase of the program has begun. The plan is the guideline for major increases in capital investment in the system over the next decades.

3.3 PAS 55 Asset Management Certification

Last fiscal year, the company achieved a certification of compliance with PAS 55. This standard, the Publicly Available Specification for the Optimized Management of Physical Infrastructure Assets, sets forth the 'best practice' asset management program that is defined as: systematic and coordinated activities and practices through which an organization optimally manages its assets, and their associated performance, risks and expenditures over their lifecycle for the purpose of achieving its organizational strategic plan.

3.4 Five Year Statement

The *National Grid Five Year Statement, 2008-2012* provides insights into generation development and transmission system loadings and limitations across the New York and New England regions. It also provides information on the impacts of some proposed transmission projects on transmission congestion, and provides indications of where market prices for electricity may be higher or lower than the regional average. This report is available upon request.

FEEDBACK & ADDITIONAL INFORMATION

4 Feedback and Additional Information

4.1 Feedback

As part of our effort to improve both reliability performance and customer satisfaction, we welcome your feedback. We hope that this report has provided both useful and interesting information about our performance and about our continuing efforts to make improvements.

Please contact your Transmission Account Manager to share your views and comments.

If you need additional information on this Report, please contact:

Bill Malee
Manager, Transmission Commercial Services
National Grid
25 Research Drive
Westboro, MA 01582
phone: 508 389 2062
Email: bill.malee@ngrid.us.com

4.2 System Information

The following tables contain the system statistics used for calculation of the various normalized metrics in this report. These counts are for the end of FY2008. Note that these are the data that OPR uses in its performance analysis and are not the official statement of circuits or mileage. The official counts are contained within the Power System Statement.

Table 4-1: UST Circuit Counts

Voltage	NE	NY	UST
345	26	26	52
230	11	21	32
115	132	288	420
69	40		40
Bulk	37	47	84
Load	172	288	460
System	209	335	544

Table 4-2: UST Circuit-Miles Statistics

Voltage	NE	NY	UST
345	471	683	1,155
230	421	524	945
115	1,620	4,449	6,069
69	537		537
Bulk	893	1,207	2,100
Load	2,156	4,449	6,605
System	3,049	5,656	8,705

4.3 General Definitions

Table 4-3: General Definitions

Term	Definition
Bulk Transmission	A transmission voltage classification used for the purposes of internal performance analysis that is composed of circuits of 230 & 345 kV. Note that this definition is used for convenience in statistical analysis and does not align with the NERC/NPCC definition of Bulk Power System. The inclusion of circuits in the "bulk class" in this report does not suggest or imply that it they should be considered bulk from the NERC/NPCC perspective.
Circuit	An electrical asset that is in place for the purpose of transmitting or delivering electrical energy between two or more terminals. A circuit is composed of a breaker-to-breaker or breaker to load segment of the transmission grid.
Circuit-Mile	The total length of a designated circuit in miles. This would be the sum of all the span lengths (pole, tower, etc.), in a given circuit, including taps.
Circuit-Year	Used in calculation of normalized metrics. The total number of circuits in the class (or system) multiplied by the study time period, in years.
Customer	The ultimate consumer of electricity supplied by the transmission system. A customer can be residential, commercial, industrial, or municipal. Municipal Utilities served by the transmission system are considered one customer each.
Delivery Point	A delivery point is the location where the transmission system delivers electricity to the distribution system. The National Grid defined delivery point is the low-side bushings of the transformer or metering point.

Disturbance	An event which results in the automatic operation (open, open-close, open-close-open) of one or more terminals (circuit breakers, sectionalizing devices) of a transmission circuit. The voltage on the circuit DOES NOT need to drop to zero to be considered a disturbance. Customers may or may not be interrupted by the disturbance.
Fault	A phase-to-phase or phase-to-ground condition on a circuit, which may result in the operation of the protective devices of the circuit. A fault may be transitory and clear before the first re-close of a circuit, or result in a lock-out condition.
Interconnection	An interconnection is a point where transmission service from the transmission provider is transferred to another entity (ex. National Grid to NStar). These are normally closed points of service to generators, non-affiliated utilities, wholesale customers, municipalities, etc.
Interruption	One or more openings of a protective device, resulting in zero voltage or discontinuity, occurring on a single circuit or on adjacent connected facilities.
KPI	Key Performance Indicator. A metric that represents an important facet of transmission system performance.
Line	See Circuit. The two terms are used interchangeably.
Load Transmission	A transmission voltage classification used for the purposes of internal performance analysis that is composed of circuits of 69 and 115 kV in New England and 115 kV only in New York.
Major Event	A catastrophic event occurs, such as a natural disaster (eg. Ice Storm), which results in sustained transmission disturbances where: a. Restoration crews were assigned to related storm duty for greater than 48 hours. b. Extensive damage to the transmission power system c. More than a specified number of customers simultaneously out of service (i.e. in line with the associated Distribution state-related regulatory requirements)
Median	The point at which 50% of systems (or circuits) perform at or above and 50% perform at or below.
Momentary Disturbance	A disturbance with a total duration of less than or equal to 1 minute. Multiple operations of a protective device followed by a successful re-close within the defined momentary duration above would be considered one momentary disturbance.
Operation	The single opening or closing of one or more protective devices.

Outage	Interruption of a transmission circuit, either by a disturbance or planned or unplanned maintenance operation, which causes the circuit to become unavailable for normal power flow.
Outage Duration	The total time a circuit is not available for power flow to an interconnection, delivery point or between two or more terminals. The duration is measured in minutes and is the time difference from when a circuit is interrupted from normal power flow to when it is restored to normal power flow.
Q1 (First Quartile)	The top quartile, the range in which the best-performing 25% of systems (or circuits) perform.
Q2 (Second Quartile)	The range below the First Quartile and above the Median containing the second-tier 25% of systems (or circuits).
Q3 (Third Quartile)	The range below the Median and above the Fourth Quartile containing the third-tier 25% of systems (or circuits).
Q4 (Fourth Quartile)	The bottom quartile, the range in which the worst-performing 25% of systems (or circuits) perform.
Sustained Disturbance	A disturbance with a total duration of greater than 1 minute. Multiple operations of a protective device followed by a lock out or a terminal remaining open for other reasons is considered one sustained disturbance. Note that the definition of "sustained" for all NY-PSC related metrics is > 5 minutes.
Terminal	A point where transmission line conductors terminate and they are connected to one or more sectionalizing devices. The purpose of the terminal is to isolate the given circuit. Typically, a terminal would be in a substation or switch station, where sectionalizing devices are also connected to a station bus or transformer.
Voltage Class	A voltage level used for analysis purposes, by grouping together circuits with a common transmission voltage for transmission performance reporting.

4.4 Reliability Metric Definitions

Table 4-4: Reliability Metric Definitions

Metric	Definition
Availability	Percentage of time the transmission system (or a class or circuit) is available for the transmission of electricity. Calculated by dividing the sum of the total duration of all planned, unplanned, and disturbance outages in a given period by the total hours in the same period. The highest attainable value is 100%.

ITR	The Index of Transmission Reliability: A measure of the unplanned unavailability of the transmission system. Normally calculated as a percentage of the specified time period that the system was available for the transmission of electricity. **ITR = ((Ca-Cu)/Ca)*100 Where Ca** (Circuit Availability) = Total minutes in time period X Total Circuits and **Cu** (Circuit Unavailability) = Total duration, in circuit-minutes, of all unplanned outages in the time period after all sanctioned exclusions are deducted.
LCM	Lost Customer Minutes: A transmission customer impact metric that is the product of the customers interrupted multiplied by their interruption durations, in minutes. Usually multiple feeders are involved with differing interruption durations. In these cases, the LCM is the sum of the products of the same calculation as above for each feeder. Often expressed as MLCM (Millions of LCM)
LOG	Loss of Generation. A transmission customer impact metric that is a count of the events when a disturbance on the transmission system caused an in-service generator to trip offline. The cause of this disturbance can be initiated by either a distribution or transmission event, but not the generator itself.
LOS	Loss of Supply. A transmission customer impact metric that is a count of the events when a sustained disturbance on the transmission system resulted in the interruption of one or more customers for greater than 1 minute.
TCAIDI	Transmission Customer Average Interruption Duration Index: the average duration of interruptions of customers due to transmission disturbances, in minutes. This metric includes Retail, Industrial, Municipal & Foreign Utility customers.
TMAIFI	Transmission Momentary Average Interruption Frequency Index: The total momentary disturbances in a given period divided by the number of circuit-years in the period.
TSAIDI	Transmission System Average Interruption Duration Index. The total duration of all the disturbance outages in a given period divided by the number circuit-years in the period.
TSAIFI	Transmission System Average Interruption Frequency Index. The total number of disturbances (momentary and sustained) in a specified period divided by the number of circuit-years in the period.
TSAIFI-S	Transmission System Average Interruption Frequency Index - Sustained. The total number of sustained disturbances in a specified time period divided by the by the number of circuit-years in the period.

25 Research Drive
Westborough, Massachusetts 01582

www.nationalgridus.com

nationalgrid