

Major Reliability Events – Self-Defining?

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Abstract—This paper presents a concept of statistical definition of major reliability events. Questions of size and regional scope are raised. Parameters of daily SAIDI and daily outage counts are both suggested as factors in determining major event definitions.

I. INTRODUCTION

Most utility regulating agencies have established rules or guidelines for major events. These are events or situations considered outside of the range of normal situations or contingencies for which utilities could reasonably or economically expect to design facilities to operate without interruptions to service. These events are then excluded from consideration when evaluating the reliability of utility service. An example would be a hurricane or other significant event where it was not reasonable to expect most service to continue uninterrupted. Most of the definitions of major events center around weather events such as hurricanes or tornadoes. Other events are possible (earthquakes, acts of war or terrorism, etc.), but are not specifically defined by the regulatory agency. The reason for excluding these events when evaluating reliability performance is that they can distort the “normal” performance due to the large SAIDI contribution from these major events. This paper proposes that the large SAIDI contribution itself can be used as a factor in a statistical definition of a major event. As such these events are therefore “self defining”..

II. PRESENT MAJOR EVENTS DEFINITION

A. *IEEE Full Use Guide on Electric Power Distribution Indices 1366-2001*

The Working Group on System Design wrote 1366-2001^[7] (“working group”). The present *Major Event* definition defines a major event as one where at least 10% of the customers served experience an interruption in a 24-hour period. A survey of many working group members shows this is an extremely rare event. Major events that are outside the design criteria for a power system that impact an entire service area are required to cause outages of 10% of the customers in a system covering hundreds of square miles. An example of a major event impacting a very large area would be a hurricane.

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Other events such as a tornado are clearly outside the scope of normal design criteria but impact smaller service areas, while still adding very large SAIDI contributions to reliability records due to the severity of the damage and not the size of the area impacted. Other types of events can cause large numbers of outages without severe damage. The focus thus far in the working group has been on daily SAIDI as the parameter defining major events.

B. *Statistical analysis*

A statistical analysis of the daily SAIDI for a typical system results in a lognormal probability distribution as the best fitting distribution. As such, statistics can be used to define the mean, standard deviation and also help to define what constitutes a “statistical outlier” or “major event”. The statistical definition is independent of the type of event. That is the specific cause, be it ice storm, hurricane, earthquake, tornado or other disaster. The issue is the impact on the power system and customers. Several regulatory bodies define major events by type of event. Florida uses a “named tropical storm”, or tornado on the ground – confirmed by the national weather service. These are obvious events in some respects and not so obvious in others. A hurricane has an impact on a very widespread area and results in major SAIDI contributions. Tornadoes cause severe damage in a concentrated area but may not make significant system SAIDI impact due to the small percentage of total system customers affected. Both of these are clearly events, which the power system is not designed to withstand. Another type of event with significant impact is one that causes a very high number of outages with relatively minor specific damage. A severe lightning storm is such an event. There is little permanent damage from this type of event, other than some transformers failed by lightning. Very few spans of wire are downed in such an event. The volume of outages, due to the high flash count, is such that the local field manpower resources are saturated, and help is required from areas outside the impacted region to provide restoration in a reasonable time frame.

C. *Suncoast Storm*

An example of a major event resulting in a high number of outages without severe damage is the Suncoast Storm of 7/15/2000 in Pineals county, Florida. This county is located on the west side of Tampa Bay in Florida and contains a total of 600,000 customers in the most densely populated county in Florida. The storm caused a total of 424 outages, system level SAIDI of 3.7 minutes, and a total of 35,000 customers

interrupted. The local area SAIDI was 7.9 minutes. Crews were dispatched from as far away as Orlando and Ocala to assist with restoration efforts. The thunderstorms produced lightning flash counts of 2.9 times any daily flash count occurring within the previous 10 years. The following charts place this event in perspective relative to prior outage history for the system. Figure 1 shows the regional daily lightning flash counts.

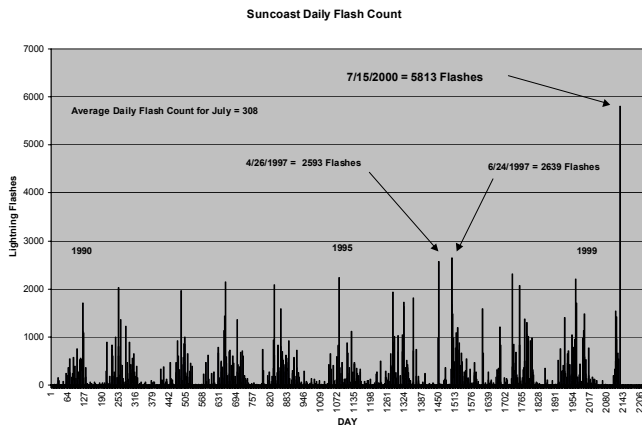


Figure 1. Regional Daily Lightning Flash Counts

Figure 2, shown below, shows the regional daily outage counts for the past 10 years

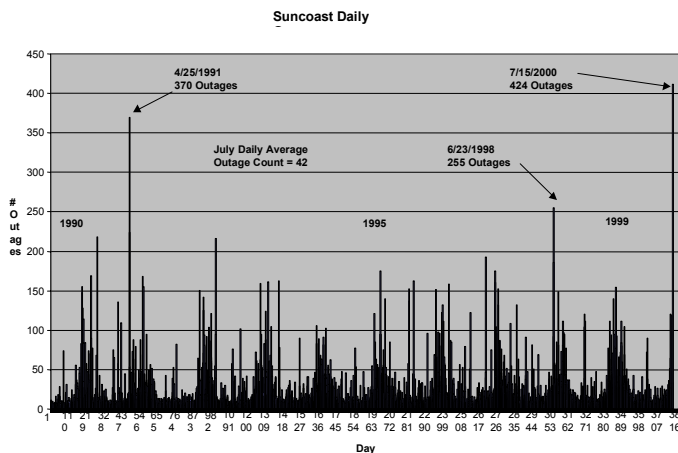


Figure 2. Daily Outages

Figure 3 shows the daily regional SAIDI for the Suncoast Region. The Suncoast Storm resulted in the highest daily SAIDI seen on a regional basis during an 8-year period

Suncoast Daily Regional SAIDI

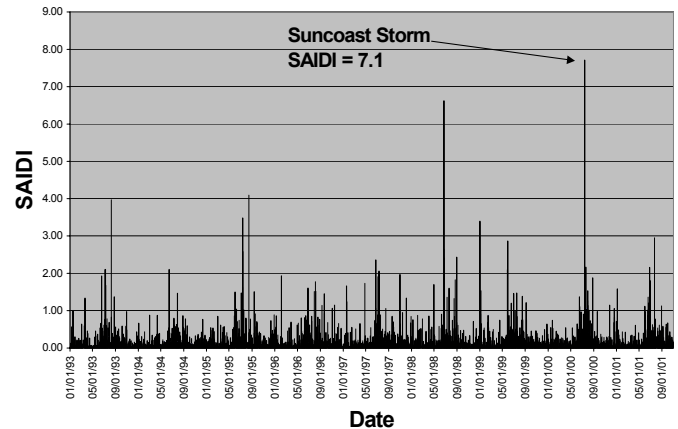


Figure 3. Daily Regional SAIDI for the Suncoast Region

The above charts clearly show this event to be a one in 7-10-year event, with outage frequency and SAIDI impact of major proportions.

III. NEW MAJOR EVENTS DEFINITION

A. Statistical Approach

Analysis of the SAIDI data for most utilities shows that a logNormal probability density function is the best fit for this type of data. A typical Distribution is shown below in Figure 4.

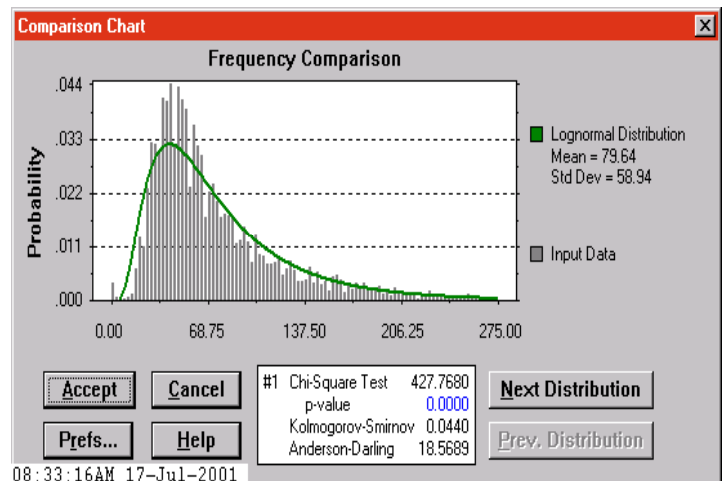


Figure 4. LogNormal Fit of Outage Data

Once the distribution is determined, standard statistical rules for determining “outliers” such as 3 sigma, or others can be used as definitions of Major Events. Another process that helps identify such events is to produce scatter plots of Daily Outage counts vs. Daily SAIDI such as the one shown in Figure 5.

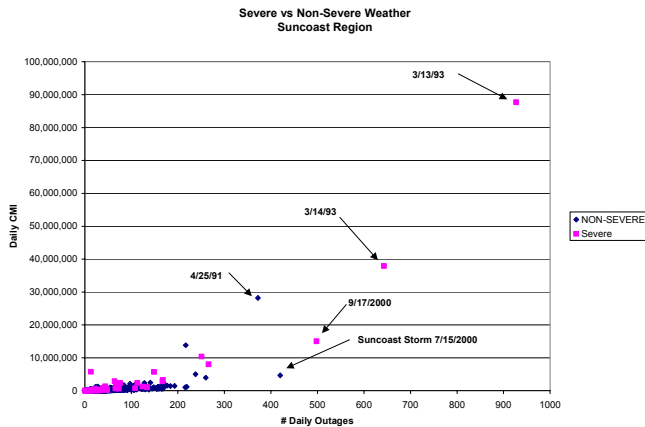


Figure 5. Daily Outage Count vs. Daily SAIDI

This chart shows that there are some events that could be deemed Major based on SAIDI and others based on daily outage count, Such as the Suncoast Storm discussed previously.

B. Regional Definition Issues

The purpose of defining major events is to determine types of events that are unusual and are not within normal design criteria for the utility. Thus some definition of “region” is required. Tornadoes, which cause significant damage to a limited area, will not impact daily SAIDI of a large system, yet they are clearly outside the expected design criteria of the utility. The utility should not be held accountable for service in this type of event, and it is usually acceptable and expected by the ratepayer that service will not be uninterrupted during these events. The increase in mergers and acquisitions of utilities also brings the question for larger areas. Is an event that has large impact to one state and minimal impact to customers in another state truly a major event? Clearly, major events should be defined on a local basis by the impact on local service areas and customers. The statistical methods can still be applied on a local basis to determine normal and major types of events for local customers. When this approach is used major events are then truly “self-defining”.

IV. REFERENCES

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[8] IEEE Full Use Guide for Electric Distribution Reliability Indices, IEEE Standard 1366-2001, March 2001.