



June 8, 2001

Dear Task Force Members-

It's time to start thinking about the upcoming summer power meeting in Vancouver. During the last meeting, we had a significant discussion about the inadequacies of the Major Event definition. Multiple proposals were brought to the table and we elected to have a sub group formulate a methodology based on Jim Bouford's work for the WG to consider. Since our meeting there have been numerous inquiries on the Major Event definition from utilities across the US. Also, Cheri took the beginnings of our proposed definition to a NARUC meeting in an attempt to garner feedback from regulators.

There is no basis for the 10% concept and several utilities have raised concerns about listing 10% as part of the standard. Several of you have run your numbers to review the 10% approach. It does not look promising.

A few of us have been busily working to formulate a proposed methodology. Our original intent was to ask a few utilities to provide data to use as test cases for the proposed methodology. A few utilities did just that and one (identified as Utility 2) even has given us permission to openly use its data. Because this idea is snowballing so quickly, and the first round of data looks very promising, we would like to get as many of you to try this approach as possible. We are willing to analyze your data (CONFIDENTIALLY!!) or to have you analyze your data using the approach detailed in this paper. We will discuss the approach at the SPM meeting and it would be good for you to raise concerns, questions, or praises.

The Concept

The goal is to move away from defining Major Events on a weather related basis while developing an approach that monitors system health. Our proposed approach identifies "normal" and "abnormal" reliability occurrences, either days or individual interruptions, using a utility's past interruption history. Normal occurrences are those that occur regularly and are within the utility's normal operating environment and design limits. Abnormal occurrences are those that exceed a utility's design limits or normal operating conditions. Abnormal occurrences are data outliers when the data is presented in graphical form.

**UTILITY 1
1993 - 1999**

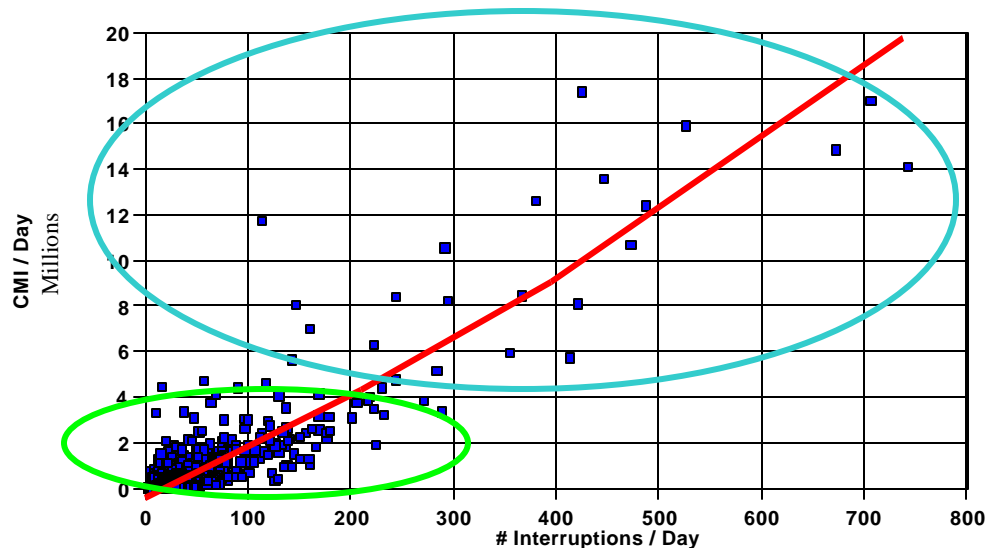


Figure 1. Normal/Abnormal Definition

To illustrate this concept, seven years of one utility's actual data is presented in Figure 1. The data for each and every day during that period is plotted on the graph. The proposed method utilizes Customer Minutes of Interruption (CMI) as the fundamental variable to indicate abnormal conditions as this has been seen, empirically, to produce reasonably consistent results. It is expected that under normal conditions, as the number of interruptions doubles for a day, the total CMI would increase slightly more than double. The red line in the chart illustrates this idea, and, as can be seen, the data tends to follow this concept.

The normal reliability operating conditions for this utility are grouped in the lower left corner of the graph, within the green oval. Nearly 99% of all the days fall into this region. The abnormal conditions fall within the blue oval. It is obvious, from the paucity of their occurrences, that these are true outliers to the normal operating conditions and should be handled in a separate manner. A change in the operations of a utility, that will impact their customers' reliability, will address the spread of occurrences within the green oval. The external factors that cause the magnitude of CMI to be large enough to fall within the blue oval are of the type not affected by utilities modifying their operations. The outliers should be removed from the calculation of a utility's reliability indices and be reported to the regulators as "special events."

It has been suggested that the number of Interruptions per Day also be utilized as a measure to identify abnormal occurrences. As stated above, the CMI would typically increase as a linear relationship with the number of interruptions. If a level of CMI were chosen to identify abnormal occurrences, then, by proxy, the number of interruptions required for abnormality would also be selected. Since external events can only make a utility's reliability worse, there will be occasions where a high level of CMI will exist with a small number of interruptions. If the converse occurs,

where there are a large number of interruptions and a small number of CMI, 1) the impact of that day's interruptions would have a minor impact on the utility's overall reliability results and it would be difficult to justify that day as a true abnormality, and 2) a review of the base data might be warranted as it is unlikely that a doubling of the number of interruptions would not also cause the CMI to increase likewise, especially at the level of interruptions per day that are in the abnormal range.

EXAMPLE :

Figure 2 begins the presentation of an example using one utility's actual data, with the data available in an attached Excel file.

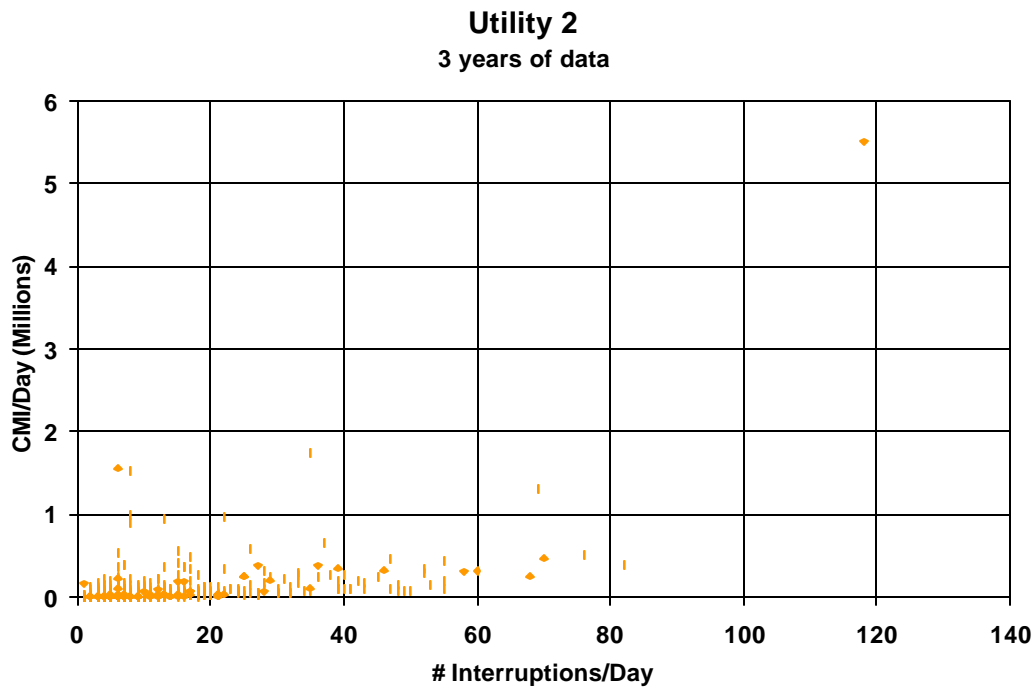


Figure 2. Example CMI/Day

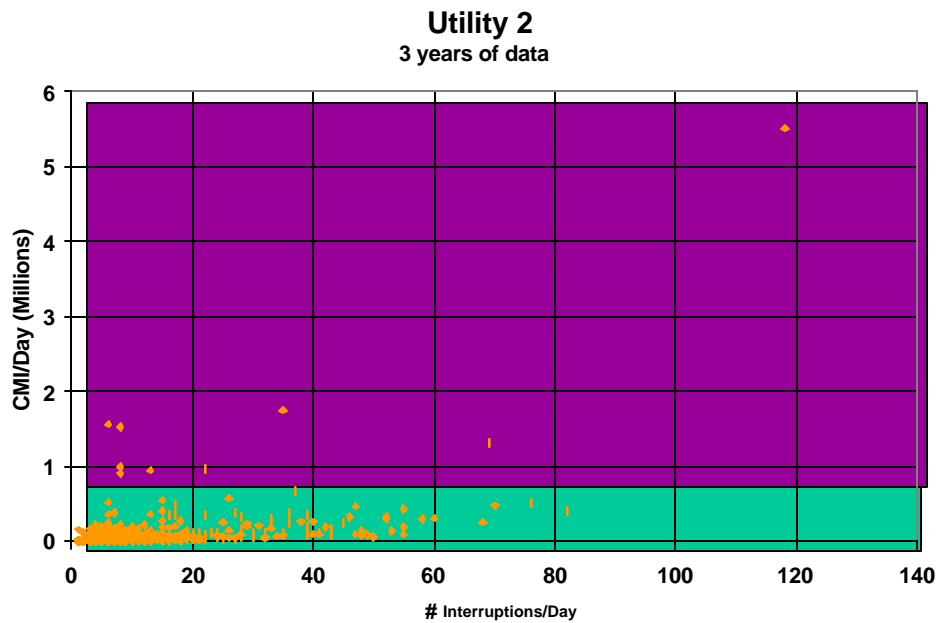


Figure 3. Normal/Abnormal Boundaries

Figure 3 clearly illustrates normal (green area) and abnormal operating (purple area) events. The selection of the “Normal/Abnormal Boundary” is discussed in the section entitled Data Analysis. When a period of three or more years is considered, system health can be determined by assessing changes in the pattern of dots in the normal region. The regulators, from the data presented in the descriptive reports, should address significant changes in the pattern of dots in the abnormal region.

Ideally, a utility will have historical data for a 5, or more, year period. Tests have shown, however, that using a one-year period is sufficient to start using the methodology, as seen in Figure 4. Utilities with only a one-year test period should build upon that as more years of data are accumulated. As has been seen with the available data from a number of companies, the actual boundary between the ranges should require only minor adjustments once three years of data are on hand. The “boundary” chosen in Figure 3, with only one year of data, can be compared to the boundary chosen in Figure 2, when three years of data are available.

Utility 2
One Year of Data

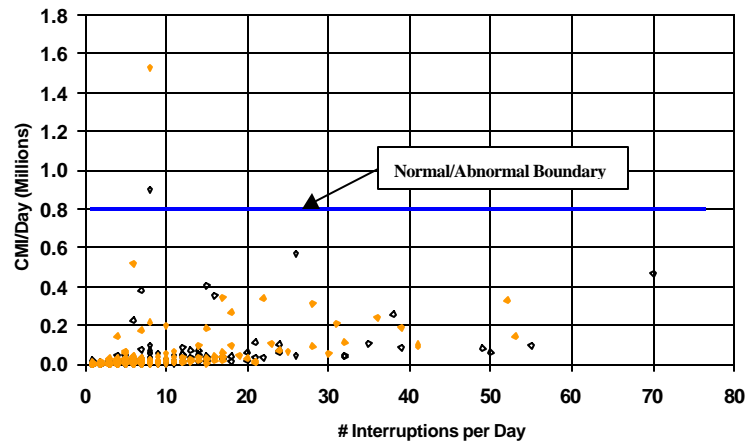


Figure 4. A Single Year of Data

The WG is proposing that utilities will generate reports detailing significant aspects of all occurrences that are designated as abnormal. We are hopeful that regulators will not penalize utilities for occurrences that were 1) outside the utilities' control, and 2) handled in an efficient and effective manner. Regulators however, will likely closely scrutinize occurrences affecting large numbers of customers for long periods of time, such as a substation equipment failure event, and utilities should be prepared to respond adequately to try to avoid any possible consequences.

Data Analysis

To determine normal and abnormal occurrences, one must plot historical data as described in this document. Once the abnormal occurrences are determined, they should be moved to a separate file or tagged as "abnormal". Indices could then be generated for normal, abnormal, and total occurrences.

Mechanics of the Approach

Attached is an example spreadsheet that illustrates the concepts used to produce the proposed charts. The data is actual and has been provided by one of our members for our use. Within the spreadsheet there are many tabs, described as follows:

1. Original Data – Contains 3 years of interruption history
2. U2_98 – on a per day basis, it contains events, CI (000s), and CMI (millions) for 1998 only
3. U2_99 – on a per day basis, it contains events, CI (000s), and CMI (millions) for 1999 only
4. U2_00 – on a per day basis, it contains events, CI (000s), and CMI (millions) for 2000 only
5. U2_98_00 – on a per day basis, it contains events, CI (000s), and CMI (millions) for 1998 – 2000
6. U2_3 yr CMI – Plots three years of CMI data per DAY (as shown in Figure 2)
7. U2_3 yr CI – Data for three years of CI data per DAY (not used herein)
8. U2_1 yr CMI – Plots one year of CMI data per DAY (as shown in Figure 4).
9. CI_CMI – Contains every line of interruption data* from original data. This sheet only shows CI and CMI. It restates CI and CMI by placing the data in bins.

- 10. Output – Contains the results from the macro.
 - 11. 3d_U2 – Contains the data for the 3D plot of single events.
 - 12. Indices – Normal and Abnormal index values.
- *One line of interruption data is equivalent to one event.

To start the process, interruption data (provided in our example on the Original Data Sheet) is summarized by **day** to form tables for each year (Sheets U2_98, U2_99, U2_00, U2_98-00). This can be done using pivot tables or sumif statements within Excel. Alternatively, it can be done using a summary query in Access. (Other software packages that perform these spreadsheet functions could also be utilized.) After the data is summarized by date, X-Y scatter plots can be made (U2_3 yr CMI, and U2_1 yr CMI, for example). The plots, using the sample data, have been presented as Figure 2 and Figure 4.

It is critical that **ALL** data is included in the development of the charts (i.e., that means NO exclusions!). The charts will identify interruptions and days to be excluded. Two charts are required:

- # of Interruptions versus CMI per Interruption versus # of Customers per Interruption,
- Customer Minutes Interrupted (“CMI”) per Day versus # of Interruptions per Day.

The first chart, a three-dimensional plot of the data, will identify individual interruptions of such magnitude that they require special attention by the utility and the regulators. Outliers, the interruptions to be excluded and individually reported to the regulators, should be identified by use of either a “number of customers per interruption,” or, a “CMI per interruption” criterion.

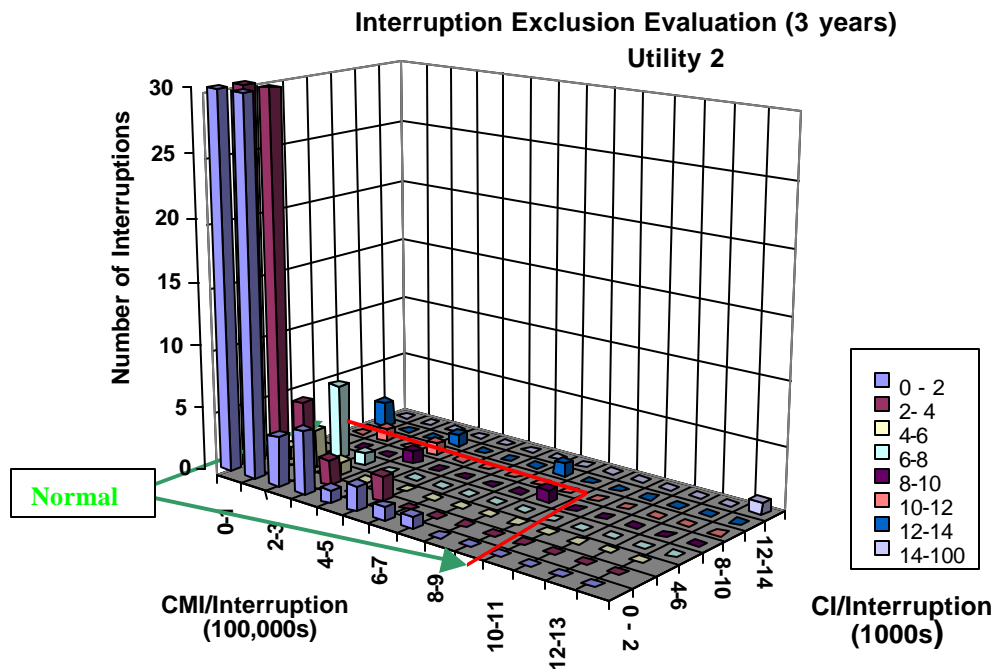


Figure 5. 3D Single Interruption Plot

With only a few years of data, it is best to be conservative in choosing the criteria for identifying the interruptions to be excluded. What may seem to be outliers may become absorbed in the

normal spread of interruptions with additional years of data. In the example, any **interruption** with more than 1,000,000 CMI, or affecting more than 10,000 Customers would be identified as an abnormal interruption.

The second chart, already seen as Figure 2, will identify days where the Customer Minutes of Interruption that occurred are far greater than the norm. This typically indicates that the resources of the utility, used to restore service to the customers, are overwhelmed. Often, this is caused by a great number of separate interruptions occurring within a short period of time. In the example, the Normal/Abnormal Boundary was placed at 800,000 CMI.

Determining abnormal days/interruptions is done through plot review and good judgement. Some days are abnormal due to the total number of Customer Minutes of Interruption, while certain individual interruptions are so large, from either a CMI or a CI basis, that they are deemed abnormal. A list of days/interruptions identified as Abnormal must be compiled from the chosen criteria. For the example, any **day** with more than 800,000 CMI is abnormal, from Figure 3.

Table 1 shows the nine abnormal days.

Table 1. Abnormal Days

Day	Year	# Events	CI (1000s)	CMI (MILLIONS)
March 11	1999	8	4.97	1.53
March 18	2000	118	175.19	5.51
May 18	1998	22	3.07	0.96
May 27, 98	1998	6	100.24	1.56
June 17	2000	69	7.21	1.31
August 29	2000	35	9.73	1.75
August 31	2000	13	11.59	0.95
October 08	2000	8	11.13	1.00
Dec. 11, 99	1999	8	23.94	0.90

Based upon Figure 5, there were seven abnormal single **interruptions** that exceeded 10,000 customers interrupted and/or 1,000,000 customer minutes of interruption. Table 2 shows the seven abnormal interruptions and uses color-coding to identify the criteria that were exceeded.

Table 2. Abnormal Events

Date	CI	CMI
5/27/98	94,659	1,365,154
7/7/98	13,944	500
12/27/98	10,046	381,748
8/27/99	12,797	383,910
12/11/99	12,000	720,000
12/11/99	11,905	178,575
7/25/00	12,797	76,782

The criteria that define abnormal days/interruptions will be **different** for each utility and will be governed by the local operating characteristics; maintenance, construction, design, operating practices; and weather. If a company has multiple operating areas with differing characteristics and/or major weather patterns, then it would be appropriate to measure reliability for each area separately. When that is done, the identification of abnormal days/interruptions must also be

done for each separate operating area. Each company, along with their regulators, must determine the most appropriate division of their service territory for reliability measurement.

To show the type of impact that the exclusion of abnormal days/interruptions would have on a company's reportable reliability measures, pre- and post-exclusion indices are presented for the example. Reliability indices prior to adjustment are shown in Table 3.

Table 3. Unadjusted Indices

Unadjusted Indices			
Year	SAIFI	SAIDI	CAIDI
1998	1.061	51.848	48.850
1999	0.621	49.663	79.933
2000	1.317	80.774	61.329

Adjusted indices, excluding abnormal days/interruptions, are shown in Table 4. It is important to ensure that double counting of excluded interruptions does not occur by removing them from those days that are also being excluded.

Table 4. Adjusted Indices

Adjusted Indices			
Year	SAIFI	SAIDI	CAIDI
1998	0.638	42.216	66.123
1999	0.483	40.321	83.523
2000	0.561	45.587	81.292

Summary

The decision by the working group to use this methodology will depend upon our findings and discussions at our next meeting. We urge you to generate the plots as described, or, to provide your data to us so that we can prepare them. As previously mentioned, all data provided will be held in the strictest confidence!

Also attached is a copy of the PowerPoint that was presented to NARUC in late February.

Best regards-

Cheri Warren
Chair, WG System Design
Cwarren@rcgroup.com

Jim Bouford
Chair, TF on System Design from a Reliability Perspective
james.bouford@us.ngrid.com