STATE OF MAINE
PUBLIC UTILITIES COMMISSION

Docket No. 2002-464

May 8, 2003

MAINE PUBLIC UTILITIES COMMISSION

POWER QUALITY
TASK FORCE REPORT

Inquiry into the Development of Power Quality Criteria for Use in T&D Utility Alternative Rate Plans (ARPs)

I. SUMMARY

On August 20, 2002, the Commission initiated this inquiry to gather information on the development of a suitable power quality criteria for use in transmission and distribution (T&D) utility Alternative Rate Plans (ARPs). Pursuant to the Commission's notice, a Power Quality Task Force (PQTF) comprised of representatives from Bangor Hydro-Electric Company (BHE), Central Maine Power Company (CMP), Maine Public Service Company (MPS), the Office of the Public Advocate (OPA) and the Commission Staff was convened. The PQTF has met periodically and has exchanged information and ideas on the development of an ARP power quality metric.

At this time, the Joint Task Force does not recommend that a MAIFI or $MAIFI_E$ metric be established. Rather, we recommend that each utility collect data using the utility's currently available technology regarding recloser operations for a two-year period. The data will be used to determine if MAIFI, $MAIFI_E$, or some other metric should be adopted to assess the quality of power provided by CMP, BHE and MPS.

The data will also be used to determine if a correlation exists between customer satisfaction and momentary interruptions. Based on the information collected, a metric may be incorporated into BHE's ARP during the plans' mid period review, and into CMP's next ARP. MPS does not currently have an ARP. However, if such a plan is established, the information collected will be used to assess whether a momentary outage metric should be included.

II. BACKGROUND

With customers' increased use of electronic equipment such as VCRs, digital clocks, computers, etc., the quality of power provided to customers has become more important in recent years. Momentary power interruptions[1] are therefore becoming more of a focus of consumer's perception of reliable electric service. While sometimes the impact of momentary interruptions is more of a nuisance than a serious problem, frequent occurrences of this nature can damage equipment, erode public confidence, and increase the likelihood of complaints to the utilities and to the Commission. Equally important, power quality problems have an adverse effect on the state's efforts to attract

[1] The IEEE definition of a "momentary power interruption" is "a single operation of an interrupting device that results in a voltage of zero. For example, two breaker or recloser operations equal two momentary interruptions." Momentary interruptions are the result of the operation of protective devices installed on transmission and distribution systems that can produce multiple momentary interruptions in the attempt to permit a single fault to clear itself, thus avoiding a sustained interruption.

high-tech industries that are very sensitive to such interruptions, as well as on the increasingly computer-dependent operations of other commercial enterprises in Maine.

In CMP's ARP 2000 case,[2] Commission Staff proposed to adopt MAIFI[3] or $MAIFI_E$[4] as a service quality metric to evaluate power quality. CMP's first alternative rate plan[5] already contained measures that monitored its performance with regards to sustained power interruptions,[6] CAIDI and SAIFI.[7] The Commission Staff believed that

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[2] Central Maine Power Co., Request for Approval of an Alternative Rate Plan, Docket No. 99-666.

[3] Momentary Average Interruption Frequency Index (MAIFI) is a measure of the number of momentary interruptions on an electric utility system. These events may occur as a precursor to a sustained interruption (which is captured in the other indices) or may be isolated events that are resolved by the automatic operation of resoling devices or other protection devices on the system. MAIFI is calculated by dividing the total number of customer momentary interruptions by the total number of customers served.

[4] Momentary Average Interruption Event Frequency Index ($MAIFI_E$) is a measure of the number of momentary customer interruption events that are experienced by customers where multiple momentaries are associated with a single event. This data is a superset of the MAIFI data and could be produced as a result of the data processing necessary to process the MAIFI data, with some extra effort. Its usefulness would be in determining the proper performance of automatic devices on the system.

[5] Central Maine Power Co., Request for Approval of an Alternative Rate Plan, Docket No. 92-345.

[6] IEEE defines a "sustained interruption" as any interruption that is not classified as a momentary event. More specifically, any interruption that lasts longer than 5 minutes.

[7] Customer Average Interruption Duration Index (CAIDI) represents the average time required to restore service to the average customer who experiences an interruption. It is calculated by dividing the sum of customer interruption durations by the total number of customer interruptions. CAIDI considers only sustained interruptions, which last at least five minutes, and does not consider momentary interruptions, which are less than five minutes in length. System Average Interruption

an additional metric was necessary to monitor CMP's performance with regards to momentary interruptions. In the Bench Analysis prepared by the Commission Staff in the ARP 2000 case, Staff recommended that CMP at the outset of the alternative rate plan begin to assemble the necessary data in an electronic database and develop the necessary procedures to make the index available to the Commission. The data would be collected over a two-year period and a base standard would be established from that data. The case was resolved by stipulation however, and neither MAIFI, nor MAIFI$_E$, were actually incorporated into CMP's ARP2000.

In the summer of 2001, Bangor Hydro-Electric (BHE) filed a "Request for Approval of an Alternative Rate Plan," Docket No. 2001-410. As part of that case, Commission Staff recommended the inclusion of MAIFI or MAIFI$_E$ for the same reasons staff recommended the inclusion of one of these two metrics into CMP's ARP II. During case negotiations, BHE expressed concern that the MAIFI standard may not be the most appropriate measure of power quality and that there may be other metrics that would better measure power quality. BHE also stated that if a MAIFI or another similar metric was established, that the Commission should consider implementing the same standard for all distribution utilities. The stipulation settling the BHE ARP case recommended that a "power quality task force," comprised of representatives from BHE, CMP, MPS, the Commission, and the Office of the Public Advocate (OPA), be

Frequency Index (SAIFI) reflects the average number of sustained interruptions experienced by the system's average customer. It is calculated by dividing the number of customer interruptions by the number of customers served. SAIFI, like CAIDI, considers only sustained interruptions and ignores momentary interruptions.

established to evaluate MAIFI and determine if it, or some other metric, is an appropriate measure of power quality and if such measure should be adopted by the three investor-owned utilities. By way of a Notice of Inquiry issued on August 20, 2002, the Commission initiated this docket to provide a vehicle for the Power Quality Task Force to conduct its business. Copies of the Notice were provided to all Parties and interested persons in Docket Nos. 2001-410, 99-666 and 97-596.

III. POWER QUALITY TASK FORCE (PQTF)

Representatives from CMP, BHE, MPS, the OPA, and the Commission met periodically from September, 2002 to January, 2003 to discuss the feasibility of establishing a MAIFI or $MAIFI_E$ metric to evaluate power quality. The PQTF began its discussions by reviewing the objective[8] of the effort and whether MAIFI was a viable option of achieving that objective. Several participants expressed their concern that momentary interruptions are the result of a properly functioning, well designed distribution system and that a service quality metric that encourages fewer momentary interruptions may actually result in more sustained interruptions. Participants further expressed their concern that momentary interruptions are preferred over sustained interruptions and that customers would rather experience a momentary interruption than a sustained interruption.

[8] The objective of the effort was to establish a power quality metric that evaluated the utilities performance with regards to momentary interruptions.

The point was also made that there may be other metrics available that would better represent power characteristics that are important to customers. For example, many industrial customers require "clean power" and a metric that evaluates the continuity of the voltage level may be preferable to a metric that measures only momentary interruptions.[9]

Another concern raised by participants was each utility's ability to measure MAIFI or $MAIFI_E$. The three distribution systems are engineered differently and employ different methods for recording recloser and breaker operations. For example, MPS utilizes a "Sentry System" on its distribution system that allows it to obtain, in real time, the number of recloser operations experienced by its transmission and distribution (T&D) system. The Sentry System involves the installation of a device on each of its T&D system's 150 reclosers that detects operations and transmits the data immediately over telephone lines to the central office. CMP and BHE on the other hand must read recloser and breaker operations manually. BHE reads its 400 ± reclosers and breakers once every month while CMP reads its 1700± reclosers and breakers twice a year. Because both BHE and CMP must take recloser and breaker counts manually, it could be extremely difficult if not impossible for either utility to calculate MAIFI or $MAIFI_E$.

[9] The metric suggested was SARFI (System Average RMS 'Variation' Frequency $Index_{voltage}$). SARFI is an indicator that considers the combination of sustained and momentary interruptions and represents the average number of rms variation measurement events that occur over a specified period per customer.

A final concern raised by participants was that the difference in design of each distribution system which makes a uniform benchmark MAIFI or $MAIFI_E$ standard inappropriate. CMP's distribution circuits tend to be longer than BHE's or MPS's and consequently contain a higher number of protective devices. In addition, the three utilities collect data at different points in their systems: the substation level, the circuit level, individual feeder level, etc., making it very difficult to establish a metric consistent between the three utilities. As noted previously, MPS has also adopted a system of real-time reporting of momentary outages. The end result is that MPS can currently calculate MAIFI, as well as $MAIFI_E$; BHE can calculate MAIFI, but it would have to be done manually and would require making certain engineering estimates based on the data collected; and CMP may be able to calculate MAIFI, but it may involve significant resources to calculate the metric consistently with MPS and BHE.

During the process, CMP suggested that customer complaints may be the best indicator of power quality and a metric that evaluates a utility's response to those complaints might be a more effective metric than MAIFI or $MAIFI_E$. CMP further stated that it wants to focus its resources on solving problems important to customers and a metric that evaluates its response to customer complaints is consistent with that objective.

The Advisory Staff responded that, while customer complaints are an indicator of customer satisfaction with utility service, it is not necessarily an indicator of power quality. Rather, it is a measure of the utility's *response to the complaint*, not the quality

of the power provided. Customer complaints are also not necessarily a good indicator of a customer's satisfaction with the quality of his or her power. Some customers who experience momentary interruptions may not "complain" to the utility if they do not have sensitive electronic equipment that is adversely affected by the interruptions or if the customers are "accustomed" to momentary interruptions and therefore accept them as "normal" occurrences for their area. On the other hand, some customers who do have sensitive electronic equipment may be more apt to complain to the utility because of the significant inconvenience the momentary interruptions cause. This does not mean, however, that the interruptions are not important to customers without sensitive electronic equipment. Nevertheless, the PQTF does believe that it would be a useful exercise to collect data regarding customer complaints to help ascertain the importance of momentary interruptions to customers.

During the task force discussions, the Staff noted its belief that tracking momentary outages could provide some insight as to a utility’s tree trimming and maintenance programs and could be an early warning signal of these circuits which might have interruptions at a future date. The PQTF agrees that tracking recloser operations and other data related to momentary outages would also be a useful exercise to test the concerns expressed by Staff.

IV. CONCLUSIONS

Based on discussions during the meetings and data provided by each utility, the PQTF made the following conclusions:

- The value of MAIFI or $MAIFI_E$ as a metric to evaluate power quality is unknown. To assess its value, a comparison should be made between the number of customer complaints filed on momentary outages, the number of recloser operations for the device associated with each of those customers, and also with the number of sustained interruptions on the particular circuit.

- It would be difficult at this time to establish a common standard for MAIFI or $MAIFI_E$ between the three utilities due to the differences in design of the three distribution systems.

- More information is needed to establish a MAIFI or $MAIFI_E$ metric, if one were to be adopted as a measure of power quality in an ARP.

V. RECOMMENDATION

In light of the above conclusions, we do not recommend that a MAIFI or $MAIFI_E$ standard be established at this time. Rather, we recommend that each utility collect data regarding recloser operations for a two-year period. The data will be used to determine if MAIFI, $MAIFI_E$, or some other metric should be adopted to assess the quality of power provided by CMP, BHE and MPS. The data will also be used to

determine if a correlation exists between customer satisfaction and momentary interruptions. If the decision is made to adopt such a metric, the metric could be incorporated into BHE's ARPs during the plan's mid-period review and as part of CMP's next ARP. MPS does not currently have an alternative rate plan, however, if such a plan is established, the metric should be considered for inclusion.

Each utility shall file a report with the Maine Public Utility Commission by March 15th of each year that includes the following information for the previous calendar year:

(a) the total number of recloser operations (including distribution reclosing breakers) by circuit;

(b) the total number of recloser operations (including distribution reclosing breakers) by device identified to each circuit;

(c) the number of recloser operations (including distribution reclosing breakers) per circuit mile by circuit and by distribution system;

(d) the number of customer complaints for momentary interruptions by circuit;

(e) the number of customer complaints for momentary interruptions by device identified to each circuit; and

(f) the number of customer complaints for momentary interruptions per circuit mile.

(g) For MPS the number of momentary events and $MAIFI_E$ as reported by the Company's Sentry system by circuit, by device, and by distribution system.

After the first year's reporting, the report will identify areas where there has been a significant increase in the number of recloser operations or customer complaints, an evaluation of the cause of the increase and an action plan for removing the root causes of any problems identified. BHE and CMP shall incorporate this report into their annual ARP filings. CMP and BHE shall also incorporate the reported information as part of their analysis of the identification of their "ten worst circuits," provided as part of the ARP annual reliability report.

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