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THE STATE OF NEW HAMPSHIRE

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November 14, 2017

Matthew Fossum
Senior Legal Counsel
Eversource Energy
P.O. Box 330
Manchester, NH 03105

Re: DE 17-174, Complaint of Ensconce Data Technologies, LLC against Eversource Energy

Dear Mr. Fossum:

On November 7, 2017, the Commission received a complaint from Ensconce Data Technologies, LLC (EDT) concerning Eversource Energy's (Eversource) cutover of a transformer at 100 Market Street in Portsmouth, New Hampshire. (See attached.)

The Commission is treating this matter as a formal complaint pursuant to RSA 365:1 and 365:2 and N.H.Code Admin Rules Puc 204 and requires that Eversource respond to the complaint on or before November 24, 2017.

Sincerely,

Debra A. Howland
Executive Director

Encl.

cc: Docket File
Electric Division
Consumer Services
Jacob J.B. Marvelley

DE 17-174
Debra

SHAINES & MCEACHERN, PA
Attorneys at Law

COPY

November 6, 2017

NHPUC 7NOV'17PM3:20

New Hampshire Public Utilities Commission *sent via Federal Express*
Consumer Affairs Division
21 South Fruit Street, Suite 10
Concord, NH 03301-2429

Re: Complaint of Ensconce Data Technologies, LLC against Eversource
Eversource File No. G20161994

Dear Sir or Madam:

This office represents Ensconce Data Technologies, Inc. ("EDT"). EDT hereby lodges a complaint against Eversource for its refusal to negotiate in good faith to resolve a dispute arising out of Eversource's negligent cutover of a transformer. This letter explains what happened, EDT's expert review of the issue, and Eversource's refusal to negotiate in good faith. EDT seeks your intervention to require Eversource to negotiate in good faith.

I. Background.

EDT is a technology company that develops and sells bespoke data shredding machines. Each machine costs EDT approximately $50,000.00 to build in a quantity of four units. At its Portsmouth office, EDT maintains an office and operates several of its machines.

EDT is a tenant at 100 Market Street, in Portsmouth. The building's owner is 100 Market Street, LLC. The building is Class A office space with 54,000 square feet of space. Before this issue arose, the building was powered through a transformer contained in the building's basement.

In 2016, Eversource decided to remove the transformer from the basement and run power through a new transformer, to be installed across the street. Eversource's manager-in-charge was Michael Busby, Eversource's Manager of Field Engineering Design. Mr. Busby told 100 Market that it intended to perform the cutover on June 2, 2016 in the early morning. Mr. Busby assured 100 Market that the cutover would simply cause a blackout "like any other power outage." 100 Market asked whether 100 Market needed to take any action before the cutover, and Eversource replied that no such action was necessary, and that 100 Market's personnel did not need to attend the cutover.

On June 2, 2016 at approximately 5:10am, Eversource performed the cutover. Mr. Busby did not attend: his subordinates performed the cutover. Before beginning the work, Eversource

282 Corporate Drive, Suite 2
Portsmouth, New Hampshire 03801
Telephone: 603/436-3110, Fax 603/436-2993

negligently failed to open the building's main circuit breaker, which left the building exposed to the cutover. Opening the main breaker would have protected the building from the cutover. It was a matter of opening one switch.

Eversource's cutover procedure caused single phasing and brownouts.[1] Eversource disconnected the primary side phases from the onsite transformer by removing three live fuses, one-at-a-time, from the transformer. By removing one live phase at a time, Eversource caused a coextensive single-phasing and brownout incident. The equipment that was not connected to the life safety generator experienced a brownout for as long as it took Eversource to remove the remaining fuses.

Eversource connected the offsite transformer by installing one live fuse at a time. This caused a second single-phasing and brownout incident for all equipment except the equipment connected to the life safety generator. The two brownouts were long enough to set 100 Market's three-phase air handler afire, requiring emergency response from the Portsmouth Fire Department. It is, therefore, unsurprising that EDT's single-phase equipment experienced crippling damage from the brownouts they experienced.

Eversource could have—and should have—protected the building by opening the main circuit breaker before performing the work. That way, the building would have been shielded from the power fluctuations caused by the cutover. Eversource broke the first, basic, inviolate rule of performing electrical work: turn off the power before doing the work.

Later that morning, EDT opened its office to find two laptops, one desktop, one server, and four data shredding machines were rendered unusable.

The next week, on June 10, 2016, 100 Market's Chad Gamester and EDT's Dan Casperson spoke with Mr. Busby outside the 100 Market building. Mr. Busby began the conversation, discussing Eversource's work in the area. The conversation turned to the 100 Market building, and Mr. Busby said "that he would of [sic] done things differently," in reference to the cutover. Mr. Busby stated "that he made sure that Paul knew to do it the right way In the future, meaning shut off the Main Breaker first" when performing a cutover. Mr. Busby stated that Eversource's insurance would pay for the damages caused by the cutover. A note by 100 Market's Chad Gamester is annexed hereto as **Exhibit 1**.

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[1] The electrical principles at-issue are discussed by EDT's expert, Lee Consavage, PE, in the reports described below and annexed as **Exhibit 2**, **Exhibit 3**, and **Exhibit 4**.

II. Expert analysis.

100 Market and EDT hired Lee Consavage, a Professional Engineer, to investigate what happened and why. After his thorough investigation, Mr. Consavage determined that:

1. Eversource failed to open the building's main circuit breaker, which exposed the building to power fluctuations (**Exhibit 4**, p. 3);
2. Eversource's cutover procedure caused single-phasing and brownouts (**Exhibit 4**, pp. 6-7); and
3. Surge protectors do nothing to prevent damage caused by brownouts (**Exhibit 4**, pp. 3-5).

Mr. Consavage's reports are annexed hereto as **Exhibit 2**, **Exhibit 3** and **Exhibit 4**.

III. Settlement of claims.

Eversource settled with 100 Market Street, LLC, for the damage to its equipment. Eversource has, however, refused to settle with EDT. Eversource, without any technical backup, claimed that it cannot determine how its cutover would have damaged single-phase equipment. EDT responded with a straightforward expert opinion, explaining that cutovers cause brownouts, which damage single-phase equipment. Eversource argued, without any backup, that EDT could have avoided its damages with surge protectors. EDT responded with an expert opinion, explaining that surge protectors protect against over-voltage (surge) events but do not protect against under-voltage (brownout) events. Eversource also demanded that EDT conduct a forensic evaluation of its machines to determine the cause of the damage. Such a costly post-mortem is unnecessary, since causation and damage are apparent. EDT has documented its cost to replace the destroyed data shredders. See **Exhibit 5**.

Most recently, EDT asked Eversource to participate in a phone conference, for Eversource and EDT's expert to discuss causation. Initially, Eversource's adjuster, Stephen Clark, said he would discuss the matter with Eversource's Legal Department. Since then, Mr. Clark informed the undersigned that Michael Busby, the engineer in charge of the team that performed the botched cutover, will decide whether Eversource will speak with EDT.

EDT complains against Eversource because of its refusal to negotiate in good faith. The facts and principles are simple: Eversource left the building connected to mains during a cutover; cutovers cause single-phasing and brownout events; brownouts damage single-phase equipment; and EDT's equipment is inoperable. Eversource has now put Michael Busby, whose team botched the cutover, in charge of deciding whether Eversource should continue settlement negotiations. EDT is stuck in the position of trying to negotiate with the person whose negligent supervision caused the damage. This is unlike most situations, where a third-party insurance company negotiates the claim. Eversource, which self-insures, is attempting to adjust and negotiate a claim it caused. Worse, Eversource, a large and resourceful company, is positioning the employee-wrongdoer to negotiate.

EDT seeks your assistance in bringing this matter to a resolution. The facts are not reasonably in dispute, and the electric principles at-issue speak for themselves. EDT asks the PUC to intervene and require Eversource to resume good faith negotiations.

Thank you for your consideration of this complaint. If you have any questions, or if I can provide further information, please contact me.

Sincerely,

Jacob J.B. Marvelley

JJM/rlm
Enclosures
cc: Martin P. Honigberg, Chairman
Kathryn M. Bailey, Commissioner
Michael S.Giaimo, Commissioner
Ensconce Data Technologies, LLC

Exhibit 1

9:00 AM

On 6/10 Dan Casperson and I were out on the sidewalk and Mike Busby came up to us and started talking about the inprovements in the area. He then started talking about the issue at 100. He said that he would of done thing differently. He also stated that he made sure that Paul knew to do it the right way in the future. Meaning shut off the Main Breaker first. He also stated the Insurance would pay any issues that was caused by the single phasing of the Transformer.

Chad Gamester

[signature]

Exhibit 2

Seacoast Consulting Engineers, LLC
Mechanical, Electrical & Energy Engineers

July 05, 2016

Michael Simchik
100 Market Street
Portsmouth, NH 03801

Re: Eversource Issue - Evaluation of Electrical Equipment

Reference (a): The Impact That Voltage Variations Have on AC Induction Motor Performance. By Austin H. Bonnett, Fellow IEEE, Retiredfrom U.S. Electrical Motors, Emerson Motors Rob Boteler, "QS. Electrical Motors, Emerson Motors. From ACEEE Proceedings, 2001

Reference (b): Motor Protection Against Single-Phasing, Copper-Bussman Bulletin PSP

Dear Mr. Simchik,

A site visit was conducted at the 100 Market Street building in Portsmouth, NH, on June 20, 2016. Purpose of the visit was to evaluate possible damage to electrical equipment resulting from the utility company energizing one phase at a time (known as single-phasing) for the entire building, with the building's main circuit breaker in the "on" position.

For the remainder of this letter, the building at 100 Market Street will be referred to as the 100 Building.

Eversource recently installed a new transformer for the 100 Building, across the street from the 100 Building, at the Hanover Street parking garage. Previously, electricity for the 100 Building was supplied from the utility transformer located in a transformer vault in the basement of the 100 Building. That transformer vault is now used as a tie point to wire the new secondary conductors from the new transformer to the existing secondary conductors wired to the main switchgear in the 100 Building.

On June 2, 2016, power was shut-off to the 100 building at 5:10 am and was off for 20 minutes. The temperature during the power outage was in the low 50°F. During that time the life safety generator for the 100 building energized automatically to provide power to the lighting, fire alarm and elevator circuits. Equipment wire to the generator was not affected by the new transformer providing electricity to the building one phase at a time since they were isolated from this event. None of the air conditioning units were operational during the power outage.

When Eversource energized the new transformer to supply energy to the 100 Building, the main circuit breaker for the 100 Building was left "on". Eversource energized one phase at a time by inserting the fuses into each phase. It took approximately 10 minutes to install the 3 fuses.

When normal power was restored to the building, one phase at a time, the thermostat in the spaces calling for cooling would have tried to start HVAC units serving those spaces, including the roof top air handler unit, the chiller and all the water source heat pumps. Three phase motors protected from phase loss would have shut-off upon sensing lack of all three-phases. Other motors, including pump motors, would have tried to start when two of the phases were energized.

When one-phase of a three-phase motor is energized, and the motor doesn't start, the electrical resistance (impedance) of a stalled motor is considerably less than a rotating motor. This is a result of negative phase sequence components in the voltage. Motors generally have low impedances for negative phase sequence voltage. The distortion in terms of negative phase sequence current will be substantial.

Negative phase sequence currents cause heating of the motor and consequently motor failure. The current flowing, in the remaining winding(s), may increase to 600% of the nameplate rating. These current levels are called "Locked Rotor" current. Winding insulation subjected to locked rotor current may fail in as little as 15 to 90 seconds. The winding insulation damage is permanent and cumulative. Motors that are trying to start under full loads will draw the most current, resulting in more obvious damage quickly. Other motors that are more lightly loaded may draw excessive current (greater than the nameplate rating) but not great enough to show signs of motor damage. However the excessive current, which overheats the windings, cause a breakdown of the wiring insulation, which can greatly reduce the life of the motor.

The following estimates the Voltage Unbalance and the Expected Rise in Heat that occurred due to single-phasing. Calculation is based on Phase A and B energized at 277 VAC each and Phase C at 0 VAC:

Step 1: Add together the three phase to phase voltages:
480 + 277 + 277 = 1034 volts

Step 2: Find the "average" voltage.
1034/3 = 345 volts

Step 3: Subtract the "average" voltage from one of the voltages that will indicate the greatest voltage difference. The result is that the greatest voltage difference is 135 volts
480 – 345 = 135 volts
345 – 277 = 68 volts

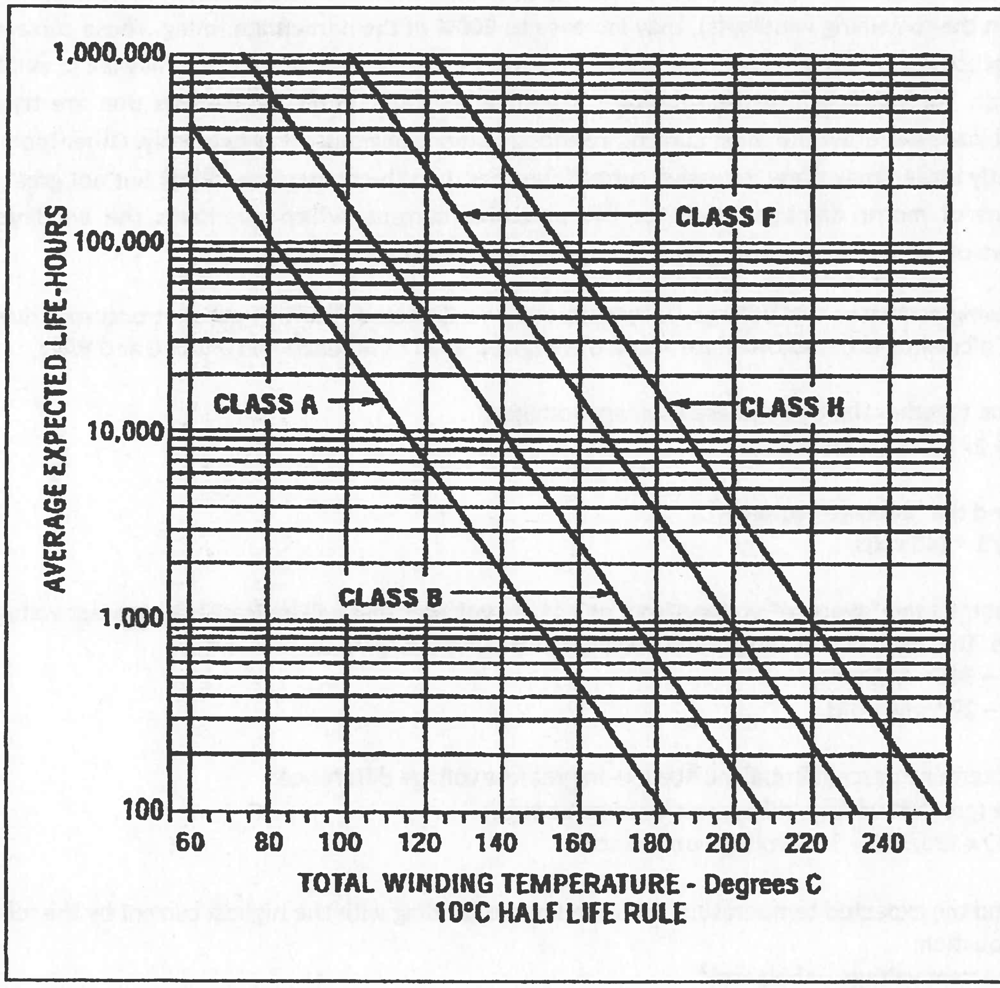
Step 4: Determine percent imbalance based on greatest voltage difference:
100 x (greatest voltage difference/average voltage)
= 100 x 135/345 = 39% voltage unbalance

Step 5: Find the expected temperature rise in the phase winding with the highest current by the following equation:
2 x (percent voltage unbalance)^2
=2 x (39)^2 = 3042% temperature rise.

Therefore, for a motor rated with a 60°C rise, the unbalanced voltage condition in the above example will result in a temperature rise in the phase winding with the highest current of:
60°C x 3042% = 1825°C

Figure 1 below provides the means to estimate the impact voltage unbalance has on motor winding insulation life once a temperature change is determined. The Figure shows that for every 10°C increase in winding temperature, the expected thermal life of the winding is reduce by half.

Figure 1.
Temperature vs. Life Curves for Insulation Systems (Per IEEE 117 & IEEE 101)



As can be seen by Figure 1, a change in temperature of 1825°C is off the chart.

The immediate and obvious damage was to the Renzor air handling unit located on top of the roof of the 100 Building. The operating manual within the unit caught fire due to the excessive current in the winding and complete breakdown of the winding insulation in the unit. The cause of the overheating was likely from the 3-phase, 480 Volt motor trying to start on a single phase input, under full load.

The other noticeable occurrence was to the heat pumps located on the 5th floor, in the ceiling. Some of the 50 heat pumps tripped off and had to be manually reset. Not all heat pumps tripped off however, which may indicate there was excessive current in the windings but not enough to trip the unit off-line. However there may have been a sufficient amount of overcurrent to damage the wiring insulation (reducing the life of the motor) but not enough to trip the unit off line.

Other equipment that did not trip off-line but may have winding insulation damage include:

Basement:

Packaged Pumping System, Canaviis Corp, Model DJ-150-33 (480VAC, 3-phase)

Water Pump Motors – Shut down automatically by overload protection

Heat Pump (cover off, wiring exposed)

Well Pump motor, 3/4 hp, 1150 rpm

1st – 4th Floors: Split system AC unit in the spaces (480 VAC, 3-phase)

5th Floor: 50 Heat Pumps, McQuay (480 VAC, 3-phase)

Roof: Chiller, Evapco (480VAC, 3-phase)

<u>Conclusion:</u>

Due to the fire in the air handling unit as a result of energizing the 100 building one phase at a time, it is not unreasonable to expect winding insulation damage occurred to other three-phase motors that were trying to start, reducing their useful life. The heat pumps on the 5th floor that were tripped were obviously trying to start. It is not known how hot and for how long the units became before tripping. As noted above, every 10^0C rise in winding temperature will shorten a motor's life by half. To determine if any damage occurred, recommend performing insulation resistance testing on all motors that may have been affected by single-phasing, in accordance with manufacturer's instructions.

Please let me know if you have any questions.

Sincerely,

Lee D. Consavage

Lee Consavage, PE

Exhibit 3

Exhibit 3

Seacoast Consulting Engineers, LLC
Mechanical, Electrical & Energy Engineers

August 25, 2016

Michael Simchik
100 Market Street
Portsmouth, NH 03801

Re: Eversource Issue - Evaluation of Damage to Electronic Equipment

Reference (a): IEEE Standard C62.41.1-2002 IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits (Chapter 7)

Reference (b) Interference Technology, Distinguishing between Surge- and Temporary Overvoltage-Related Failures of Metal Oxide Varistors in End-Use Equipment Designs. Authors : Philip F. Keebler, Kermit O. Phipps and Doni Nastasi, 11/22/2006

Dear Mr. Simchik,

A site visit was conducted at the 100 Market Street building in Portsmouth, NH, on June 20, 2016. Purpose of the visit was to evaluate possible damage to electrical equipment resulting from the utility company energizing one phase at a time (known as single-phasing) for the entire building, with the building's main circuit breaker in the "on" position. My first evaluation, which primarily investigated damage to motors, was summarized in a letter to you dated July 5, 2016. This letter evaluates damage to electronic equipment due to the same occurrence.

For the remainder of this letter, the building at 100 Market Street will be referred to as the 100 Building.

Eversource recently installed a new transformer for the 100 Building, across the street from the 100 Building, at the Hanover Street parking garage. Previously, electricity for the 100 Building was supplied from the utility transformer located in a transformer vault in the basement of the 100 Building. That transformer vault is now used as a tie point to wire the new secondary conductors from the new transformer to the existing secondary conductors wired to the main switchgear in the 100 Building.

On June 2, 2016, power was shut-off to the 100 building at 5:10 am and was off for 20 minutes. During that time the life safety generator for the 100 building energized automatically to provide power to the lighting, fire alarm and elevator circuits. Equipment wired to the generator was not affected by the new transformer switchover.

When Eversource energized the new transformer to supply energy to the 100 Building, the main circuit breaker for the 100 Building was left "on". Eversource energized one phase at a time by inserting the fuses into each phase.

When tenants were allowed to enter the building after given the all-clear by the fire department, who were called to extinguish the fire in the air handling unit (see my Letter dated July 5, 2016), it was noted that several electronic systems were severely damaged and not functioning as a direct result of the occurrence earlier that morning.

It is common for overvoltages to occur after a power outage. Eversource's website has a webpage titled:

Power Outages Do Happen And When They Do, Eversource Works Diligently To Safely And Quickly Restore Our Customers' Power: *Voltage irregularities can occur for any number of reasons during or after a storm, especially if there has been damage on or near your home. The safest thing to do is to unplug any sensitive electrical devices (TV, VCR, stereo, microwave, computer, answering machine, garage door opener, etc.).*

Voltage irregularities result from natural and man-made sources, and are typically identified as surges (overvoltage) or sags (undervoltage). For this evaluation my focus is the source and type of overvoltage that may have occurred on June 2nd since that appears to be the cause of damage to the electronic equipment.

Reference (a), paragraph 1.1 includes a Duration of Event graph that identifies the potential damage to equipment based on the type of voltage irregularly. Surges are shown on the left side of the graph as high magnitude but short duration surges that usually do not damage electronic equipment. Temporary Overvoltages (TOVs) are shown on the right side of the graph as being lower magnitude voltage surges but of longer duration that does damage equipment. The Duration of Event graph is included as Figure 1 of this letter and shown below.

Reference (a), Para 7.2.4 provides a list of causes for TOV's, including a single phase fault and loss of a live conductor in a three phase system. The situation that occurred on June 2nd, by Eversource energizing one phase at a time, simulates loss of a live conductor by having less than 3 phases energized. The following is excerpted from Reference (a), Para 7.2.4:

7.2.4 TOVs Due To The Loss Of A Live Conductor

> In three-phase systems, loss of any conductor can give rise to various conditions, such as unbalance, faults, and TOVs, which can indirectly result in transients. For example, loss of a neutral conductor in an unbalanced star-connected supply can result in a TOV where two phases attain the phase-to-phase voltage with respect to ground. This can cause a fault and possible transients associated with initiation or clearing of the fault. In that case, it is generally considered that the permanent stress voltage is the line-to-line voltage.

Reference (b) provides a good summary for defining the types of overvoltages and how they affect electronic equipment. In fact Reference (b) was written to provide general information about design protocol when designing protective circuits for electronic equipment to withstand voltage irregularities such as TOVs. Reference (b) is provided for general background information about how TOVs affect electronic equipment.

Figure 1.
Simplified Relationships Among Voltage, Duration, Rate Of Change & Effects On Equipment

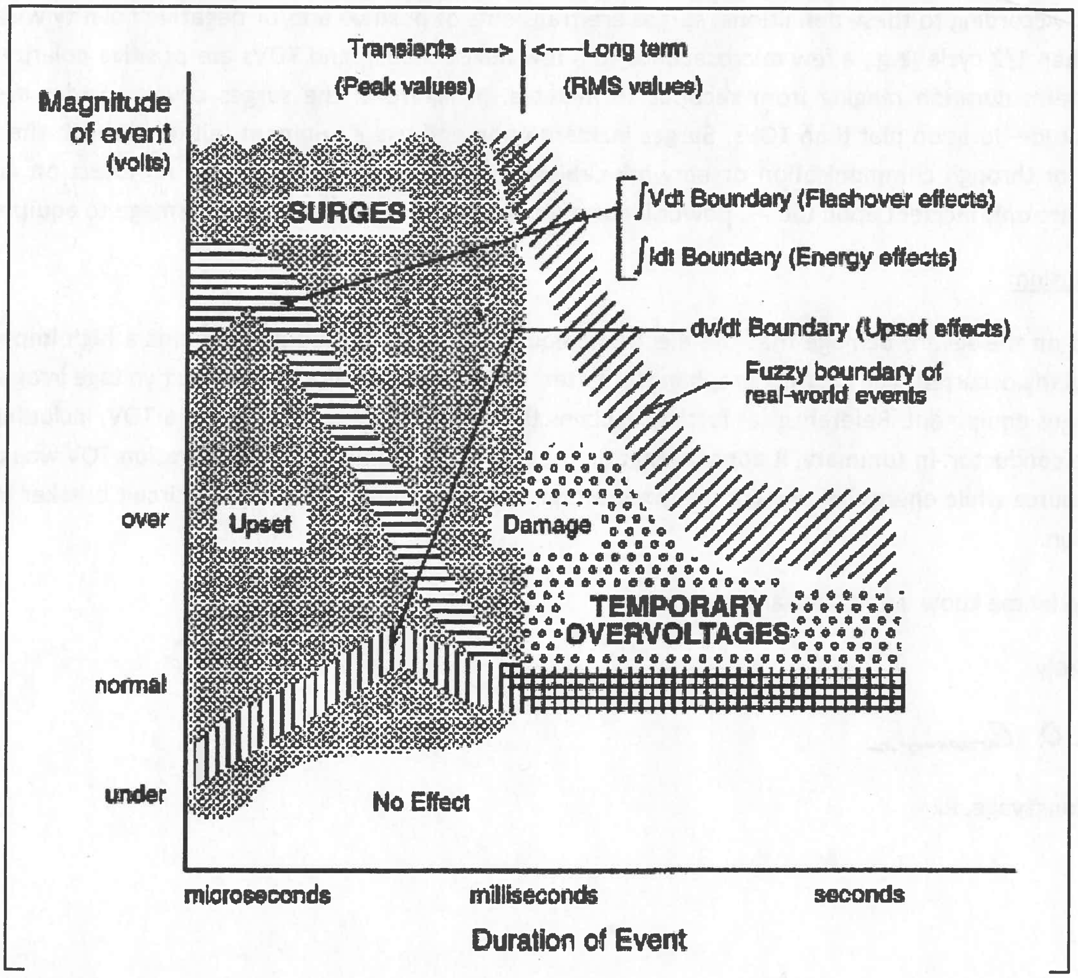


Figure 1 Notes:

1. The graph shows the relative position of effects and the order of magnitude of the amplitude and duration. Do not attempt to read numerical values from this graph.
2. The scope of the guide is shown by the two dot-pattern areas. The fine pattern relates to surges, the prime scope of this guide. The coarse pattern relates to TOVs, the secondary scope of this guide. For surges, the upper limit for the duration is one half-cycle of the applicable power frequency. Swells. overvoltage events longer in duration than a surge, but lasting only a few seconds are considered to be a subset of TOVs.
3. The values or positions of the boundaries between .no effect and .upset and between .upset and damage vary with the withstand characteristics of the equipment exposed to the surges.
4. The boundary between .upset and damage in the microsecond range is shown as the integral of *Vdt* to reflect the upturn in the volt-time characteristic of sparkover. Equipment responses that do not involve a sparkover are more likely to be influenced by the simple magnitude of voltage *V*.
5. This figure shows only one measure of surge severity emphasizing voltage and time relationships. Other possible measures include current peak and duration, rise time, and energy transfer.

Figure 1 above, which was excerpted from Reference (a), defines surges and TOVs graphically on a magnitude-duration plot with respect to the duration of an event (in milliseconds) and the magnitude of an event (in volts). According to these definitions, surges are transients of positive and/or negative polarity with duration less than 1/2 cycle (e.g., a few microseconds to a few milliseconds), and TOVs are positive polarity events of long term duration ranging from seconds to minutes. In Figure 1, the surges cover a wider area on the magnitude-duration plot than TOVs. Surges incident upon end-use equipment (either through the AC power input or through communication or network cables) can damage, upset, or have no effect on equipment. TOVs are only incident upon the AC power input of equipment and typically cause damage to equipment.

Conclusion:

Based on the severe damage that the electronic equipment experienced it is obvious a high impact voltage irregularly occurred. The Figure 1 graph in this letter identifies a TOV as a high impact voltage irregularity that damages equipment. Reference (a) further explains the conditions that may create a TOV, including loss of a phase conductor. In summary, it appears that on the morning of. June 2nd a long duration TOV was created by Eversource while energizing one conductor at a time with the 100 Building's main circuit breaker in the "on" position.

Please let me know if you have any questions.

Sincerely,

Lee D. Consavage

Lee Consavage, PE

Exhibit 4

Seacoast Consulting Engineers, LLC
Mechanical, Electrical & Energy Engineers

April 17, 2017

Michael Simchik
100 Market Street
Portsmouth, NH 03801

Re: Eversource Issue - Evaluation of Damage to Electronic Equipment

Reference (a): IEEE Standard 242-2001 (Buff Book), IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

(b) Aurora Energy, Protecting your electrical appliances, Surge Diverters, https://www.auroraenergy.com.au/help-and-advice/safety/safety-at-home/protecting-your-electrical-appliances

(c) Open Phase Conditions in Transformers Analysis and Protection Algorithm. Presented at 2013 66th Annual Conference for Protective Relay Engineers by Amir Norouzi. http://www.cce.umn.edu/documents/cpe-conferences/mipsycon-papers/2013/openphaseconditionsintransformersanalysisandprotectionalgorithm.pdf

(d) Voltage sags and what to do about them .Jack Smith, Senior Editor, Plant Engineering magazine, 08/08/2002. http://www.csemag.com/home/single-article/voltage-sags-and-what-to-do-about-them/0499ada0dfbb1d6747ee2bf3adacd2ee.html

(e) Voltage Dips And Sensitivity Of Consumers In Low Voltage Networks, Günther Brauner, Christian Hennerbichler, Vienna University of Technology, 2001 http://www.cired.net/publications/cired2001/2_31.pdf

(f) Fluid Power Design Data Sheet 30 - Finding the Cause of Solenoid Coil Burn-Out. http://www.womackmachine.com/engineering-toolbox/design-data-sheets/finding-the-cause-of-solenoid-coil-burn-out.aspx

Dear Mr. Simchik,

A site visit was conducted at the 100 Market Street building in Portsmouth, NH, on June 20, 2016. Purpose of the visit was to evaluate possible damage to electrical equipment resulting from the utility company energizing one phase at a time (known as single-phasing) for the entire building, with the building's main circuit breaker in the "on" position. My first evaluation, which primarily investigated damage to 3-phase motors, was summarized in a letter dated July 5, 2016.

The purpose of today's letter is to summarize damage to single-phase equipment that occurred during the same single-phasing event that damaged 3-phase motors.

For the remainder of this letter, the building at 100 Market Street will be referred to as the 100 Building.

In May 2016, Eversource installed a new utility transformer for the 100 Building. The new transformer is located across the street from the 100 Building, at the Hanover Street parking garage. Previously electricity for the 100Building was supplied from the utility transformer located in the transformer vault in the basement of the 100Building. The transformer vault is now used as a tie point to wire the new secondary conductors from the new transformer to the existing secondary conductors which are then wired to the main switchgear in the 100Building.

On the morning of June 2, 2016, during the swap over from the old utility transformer to the new utility transformer, Eversource caused a single-phasing event to occur in the 100 Building. The result was that various types of equipment located in the 100 Building were damaged beyond repair, including the heating and ventilation roof-top unit (which caught fire), EDT electronic equipment (which caused the room to have a faint burnt smell), the solenoid in the fire alarm master box and the elevator controller.

According to reference (a), paragraph 14.2, one of the primary requirements of electric utility companies is to protect the consumer from single-phasing events as stated below:

> ***14.2 Service requirements***
>
> ***Consideration of the design, operation, and protection of service lines between a consumer and utility power supplier should be based on deep mutual understanding of each other's needs, limitations, and problems. The electric power supply for an industrial or commercial power system should meet the following basic requirements listed below:***
>
> ***a) Accommodate normal peak power demand and provide ability to start large motors without excessive voltage sag.***
>
> ***b) Maintain deviations from normal frequency and normal voltage within acceptable tolerances.***
>
> ***c) Maintain consistent phase rotation in a multiphase system.***
>
> ***d) Maintain voltage-wave distortion, harmonics, and voltage surges within acceptable tolerances.***
>
> ***e) Maintain three-phase supply during normal conditions to avoid voltage unbalance and single-phasing.***

The most effective method used by utility companies to prevent single-phasing events from occurring when swapping-over transformers is to open the main circuit breaker in the consumer's main switchboard. This was not the case during the transformer swap-over on June 2. The main circuit breaker was left in the closed position which resulted in several pieces of equipment suffering severe damage. Surge protection devices are ineffective in preventing damage from single-phasing events.

According to Reference (c), Section III-B2 (Open Phase Conditions in Transformers with Ungrounded Primary) (Page 7);

> ***What is common among all such transformers with ungrounded primary winding is that upon loss of a single phase there will be substantial voltage unbalance on both primary and secondary side of the transformer. As discussed in III-A2 only half of the phase-phase voltage will appear on two of the primary coils.***

The result is that equipment wired to the affected phases will experience a 50% drop in voltage during the voltage sag.

Voltage sag, as defined by IEEE, is a reduction in voltage for a short time. The voltage reduction magnitude is between 10% and 90% of the normal root mean square (RMS) voltage at 60 Hz. The duration of a voltage sag event, by definition, is less than 1 minute and more than 8 milliseconds, or a half cycle of 60-Hz electrical power.

A surge protector (or surge suppressor or surge diverter) is an appliance or device designed to protect electrical devices from voltage spikes. A surge protector attempts to limit the voltage supplied to an electric device by either blocking or shorting to ground any unwanted voltages above a safe threshold. It is design to protect equipment from over-voltage spikes not undervoltage conditions. According to Aurora Energy (reference (b)):

> ***Surge Diverters restrict incoming voltages to predetermined levels, directing the associated fault current to earth. The earth connection of the diverter must be sound and of low resistance to ensure it provides adequate protection. If not properly selected and installed for the magnitude of the surge expected, they may be destroyed by the energy which passes through them when they operate.***
>
> ***These devices minimize the effect of rapid voltage increases above a design threshold voltage but do not provide protection against prolonged voltage decreases or momentary interruptions. These are generally used to protect against lightening striking overhead lines.***

The substantial voltage unbalance is the reason the 3-phase motor in the roof-top heating and ventilation unit caught fire. According to reference (a):

14.3.1.6 Voltage unbalance

Voltage unbalance and loss of a phase (single-phasing) may be caused by events such as large single-phase loads, unequal impedances (e.g., due to untransposed conductors in the supply system), one open fuse, or the failure of one pole to close properly in a circuit breaker or contactor. A single-phase condition is an extreme case of voltage unbalance. The voltage unbalance creates negative-sequence current, which cause an increase in motor losses, heating of generator rotors, and heating of motor windings. Severe negative-sequence conditions can lead to motor failures. In NEMA MG 1-1998, a voltage unbalance of no more than 1% is allowed in order to avoid excessive temperature rise. A voltage unbalance of 3.5% can result in a 20% to 25% increase in motor temperature rise and shorten the motor insulation life by over one half.

Reference (a), Table 14-3 shows the effect of voltage unbalance on motor losses and temperature rise. For example a voltage unbalance of 5% can cause up to 120 degrees C (248 degrees F) temperature rise in motors.

The reason for the damage to the elevator controller circuit boards and power supply is not as obvious, especially since the controller is wired to the life safety panelboard which is wired to the generator. Which means the controller was only subjected to the single-phasing event for the 5-seconds it took for the generator to detect the fault condition, turned-on and then transfer all loads wired to the life-safety panel from the faulty grid power to the generator power within 5-seconds of the detecting the fault condition. All the other equipment wired to the life safety panel, which is mostly lighting, was not damaged.

The EDT electronic equipment, which was not wired to the generator, was also damaged by the single-phasing event.

The one thing that electronic equipment have in common is their DC power supplies. Equipment that have DC power supplies would try to compensate for the voltage drop by discharging the built-in capacitors. The longer the duration of the single-phasing event the greater the damage suffered by the equipment. According to reference (d);

When a sag occurs, the power supply inside electronic devices uses some of its stored energy to compensate for the loss of input voltage. If enough energy is lost due to the sag, then the power supply may lose its ability to maintain an exact DC voltage to all the active components, such as integrated circuits, inside the device — even for a few milliseconds. This is long enough to corrupt data in microprocessor-based electronics and to cause malfunctions of digital equipment.

Research completed at the Vienna University of Technology subjected various types of equipment to voltage sags to determine their point of malfunction. For computer systems, the malfunction occurred within 500 milliseconds (0.5 seconds) for a 50% voltage sag. Reference (e) summarizes the results of the report as follows:

> *In distribution systems power quality is of increasing importance as the low voltage consumers use microelectronic components for control and operation, which are sensitive to voltage dips and power interruptions.*
>
> *Measurements of the immunity of low voltage devices to voltage depressions of different amplitude and duration have shown, that the area of malfunction can be described in many cases by a single point, which represents the minimum voltage needed for continuous operation and the maximum permissible duration of a voltage dip (fig. 1). If the voltage falls below the minimum for steady state operation or exceeds the permissible duration of a voltage dip, a malfunction will occur.*
>
> *It was found, that the allowed duration of a short interruption for personal computers is between 80 ms to 450 ms with an accumulation around a value of about 200 ms.*

In my opinion, the damage to the elevator controller and the EDT equipment occurred within 5 seconds. Therefore by the time the elevator controller was transferred to generator power it is likely it was already damaged. The fact that it was so severely damaged provides justification for my conclusion.

The damage to the solenoid in the master box may also be explained by the resulting voltage sag from the single-phasing event. According to reference (f);

> *Improper match between the electrical source and the coil rating is sometimes a cause for coil burn-out, including voltage too Low. Operating voltage should not be more than 10% below coil rating. Low voltage reduces the mechanical force of the solenoid. It may continue to draw inrush current without being able to pull in.*

Single-phasing events are well-known in the industry as events to be avoided due to the fact that result is often damaged equipment. The most practical solution to avoiding single-phasing events is to open the main circuit breaker serving the building. Shutting off all 3-phases of incoming power simulates a typical power outage. All the equipment damaged on June 2 had experienced several power outages in the past without any noticeable effect.

The following is what I believe to be the sequence of events that led to the damaged equipment at 100 Market Street. This summary is based on my discussions with the building owner and facilities manager:

1. **In May 2016 Eversource installed a new utility transformer for the 100 Market Street building. The new transformer is located across the street at the parking garage.**

2. **Additionally Eversource installed 3 sets of 4-conductors (one conductor for each phase plus a neutral, 12 conductors total) from the secondary side of the new transformer (at the Parking Garage) into the transformer vault in the basement of 100 Market St.**

3. **Eversource wired the primary side of the new utility transformer to primary conductors using fused cut-outs for the overcurrent protection. At that point the fuses have not been installed in the new cut-outs.**

4. **The day before the transformer swap-over, Eversource notified the building owner that power would be cut to the building to allow Eversource to complete the transformer swap-over. Additionally Eversource stated that it was not necessary to notify the tenants of the upcoming power outage since the work would be completed early in the morning, before the tenants arrived. Additionally Eversource stated it would be just like a typical power outage**

5. **On the morning of the swap-over from the old transformer to the new transformer, Eversource first disabled one of the primary side phases by removing one of the 3 fuses from one of the cut-out switches installed on the primary side of the old transformer. The action resulted in the single-phasing event.**

6. **The main circuit breaker for the 100 Building was left in the closed position, which allowed power to flow from the old transformer to all the equipment in the 100 Building, even though one of the phases was disabled. At this point some of the equipment in the building experienced no effect from the single-phasing event since they were not wired to affected phase. Other equipment experienced a 50% drop in voltage. All 3-phase motors experienced the substantial voltage unbalance. Several of the heat pump units automatically opened their internal circuit breakers to protect the equipment.**

7. **The generator for the 100 Building detected the substantial voltage unbalance, started-up and transferred the life safety equipment from the normal (unbalanced voltage) to the generator within 5 seconds of detecting the voltage unbalance. It was within those 5 seconds that damage most likely occurred to the CLC microprocessor board and the CLC power supply for elevator controller and the EDT equipment**

8. **The additional fuses were removed from the primary side of the transformer resulting in a complete shut-down of power to the 100 Building.**

9. Eversource then entered the 100 Building transformer vault to complete wiring the new secondary conductors from the new transformer to the existing secondary conductors which are then wired to the main switchgear.

10. Once the wiring was completed Eversource then energized the new transformer one phase at a time, once again causing a single-phasing event and resulting voltage sag. Any equipment that were able to withstand the first voltage sag probably were rendered useless with the second event.

Conclusion:

On June 2, 2016, a single phasing event was experienced by electrical and electronic equipment located in the100 Building when the utility company de-energized and then re-energized the building one phase at a time without opening the building's main circuit breaker. Single phasing events can damage electronic equipment within 1 second and therefore is the subject of several Institute of Electrical and Electronic Engineers (IEEE) publications on how to protect against these events. It does not appear these guidelines were followed when Eversource completed the transformer swap-over on June 2, 2016.

Not all equipment in the building was overtly damaged. The explanation could be that some equipment did not experience the single-phasing event since they were not wired to the affected phases. Additionally, equipment wired to uninterruptable power supplies would be protected against voltage sags.

Reference (a) provides guidance to utility companies on how to protect against single phasing events. Shutting off the main circuit breaker to the building would have protected all equipment in the building from the single phasing event.

Please let me know if you have any questions.

Sincerely,

Lee D. Consavage

Lee Consavage, PE

Exhibit 5

CT
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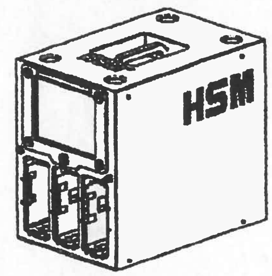
July 14, 2016

CT Proposal # E0515D-18

Mr. Dan Casperson
EDT Ensconce Data Technology
100 Market St – Suite 202
Portsmouth, NH 03801

EDT



Dear Dan:

We are pleased to offer you this budgetary proposal for the following assembly:

Assembly	Quantity	Unit Price	Total Cost	Lead Time
108797 Rev. 1 DS200 HSM	4	$49,500.00	$198,000.00	See Note 3

Notes:

1. The above cost is for budgetary purposes only and is to be confirmed once a full proposal phase is completed.
2. Columbia Tech suspects that obsolete items may be present and Engineering resources will e required to identify proper alternate items. The cost for any Engineering resources required is not included on the above cost and will be quoted separately as required.
3. Lead time of the assembly will be confirmed after a full proposal phase is completed.

Columbia Tech offers a vast array of world class Engineering Services including:

- Documentation Development and Work Instruction Creation services for your products using your choice of (AutoCAD, PRO-E, and Hi-Res Digital Images)
- Comprehensive ECO Management
- Test Equipment Design
- Test Fixture Development

Please contact Alexis at 508-929-4643 to learn more about these turnkey services and our competitive rate structure in this area to support your evolving needs.

Columbia Tech is authorized to purchase materials using standard purchasing practices including, but not limited to, acquisition of material recognizing Economic Order Quantities (EOQ), Minimum Order Quantities (MOQ), Lot Sizes, and manufactures component lead-times. Materials purchased as NCNR (non-cancellable, non-returnable) as a result of custom design or other requirements. EDT recognizes its financial responsibility for materials purchased by Columbia Tech on behalf of EDT and agrees to reconcile Excess and Obsolete monthly.

Please know that all Columbia Tech products are custom made and are non-cancelable/non-returnable. This quotation is valid for 30 days from the quote date and schedule changes require at least 45 days advance notice. Schedules will not be extended more than 30 days past the original requested shipping date without advance written notice. Once written notice is received we will review the status of the specific project and determine with you how to best service the delay. We reserve the right to use Columbia Tech approved vendors for all common materials unless otherwise specified. Due to the day to day volatility in the metals market, all quotes are subject to raw material price and availability review at the time of order. Terms are to be discussed at time of order.

All products are EXW (Incoterms 2010) Columbia Tech. When placing your order, please be certain to specify your freight carrier of choice along with your direct billing account information. If you are interested in obtaining rate information for products to be delivered via Columbia Tech's delivery vehicles, please contact your project manager or Alexis Vallejos at 508-929-4643.

In an effort to improve the control of our printed circuit board assemblies while providing an added benefit to our customers of traceability, Columbia Tech will be implementing a Bar Code Serial Number Tracking Label on all printed circuit boards we assemble.

Thank you for your time and interest in Columbia Tech and the opportunity to quote your requirements. We look forward to working with you.

If you have any questions or comments please feel free to contact me at (508) 929-4643.

Sincerely,

Alexis Vallejos

Vice President, Successful Product Launches

cc: Chris Coghlin, Jim Coghlin, Gerry Burns, Bill Laursen, Scott Nordstrom.