- BEFORE THE PUBLIC SERVICE COMMISSION OF UTAH -

In the Matter of the Formal Complaint of DAMMERON VALLEY WATER WORKS vs. UTAH POWER AND LIGHT	))))	DOCKET NO. 03-035-04 THIRD REPORT AND ORDER

ISSUED: May 18, 2006

SYNOPSIS

Having concluded the evidence does not support the complaint of Dammeron Valley Water Works that its equipment failures and protective equipment faults are the result of substandard power supplied by Utah Power and Light, the Commission dismissed the same.

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By The Commission:

I. PROCEDURAL HISTORY

This matter originates from a customer complaint filed by Dammeron Valley Water Works ("Dammeron Valley") on March 7, 2003, claiming Utah Power and Light ("Utah Power" or "Company") provided inadequate electric service to Dammeron Valley's Well #3 consisting of two water wells, referred to as numbers 3 and 3A. Dammeron Valley claims on five occasions between February and April 2002 this inadequate service caused power surges, burned up surge protectors and damaged equipment, including submersible pump motors. Dammeron Valley initially sought a Commission order requiring Utah Power to install a duplicate, or "looped", feed to its well site, believing such action would alleviate the alleged power quality problems.[1]

Following hearing on August 5, 2003, the Commission issued an order dated October 22, 2003 ("October 2003 Order") finding the surge protection and industry standard single phase protection equipment utilized by Dammeron Valley satisfies Dammeron Valley's obligations under the single-phase protection requirements of Utah Power's tariff. The Commission further found that on at least a few occasions Utah Power's electric supply to Dammeron Valley fell outside the range required by the American National Standards Institute ("ANSI") power quality standard adopted by Commission rule.[2] The Commission ordered

[1] In addition to a looped feed, Dammeron Valley also now seeks approximately $60,000 in reparations for damaged and destroyed equipment, as well as its time and expense in prosecuting this matter the past four years.

[2] As discussed in more detail in Section III of this Order, this standard is essentially maintenance of steady-state supplied voltage between 263 and 291 volts and limiting voltage unbalance to +/- 3%.

further study, including additional monitoring and recording of line voltage, extending through the summer of 2004. The parties were instructed to file reports of their investigation, including proposals for further Commission action, by September 15, 2004.

On December 4, 2003, the Commission received two letters from Dammeron Valley, dated November 28, 2003, and December 4, 2003, stating that on or about September 7, October 10, and November 24, 2003, three more pump motors had been damaged. Dammeron Valley claimed said damage resulted in over $20,000 in repair costs, not including the then-unknown repair costs stemming from the November 24 incident. At a hearing held on December 22, 2003, parties agreed to additional monitoring measures and a technical conference to be held approximately six weeks later to discuss the data collected from said monitoring. This technical conference was held on February 9, 2004, in St. George, Utah.

Beginning in December 2003, parties spoke on the telephone, exchanged numerous emails, and met at the well site to inspect the electrical set-up of Dammeron Valley's well house and equipment. An additional technical conference was held in Salt Lake City on June 24, 2004, to discuss the state of ongoing monitoring operations, the efforts undertaken by Utah Power and Dammeron Valley to upgrade the power supply and installed equipment protection systems at the well site, and additional electrical equipment events at the site.

On September 15, 2004, Utah Power filed its final summary report and recommendations resulting from power quality monitoring operations, as required by the Commission's October 2003 Order. In an email dated September 15, 2004, Dammeron Valley noted it had hired its own consultant to review the data presented by Utah Power and requested a

delay of three months to enable the consultant to finish his work. Therefore, on September 17, 2004, the Commission issued a Procedural Notice giving Dammeron Valley until December 17, 2004, to file its final report detailing the consultant's conclusions.

On January 13, 2005, the Commission issued a Notice of Technical Conference noting that Dammeron Valley had yet to file its final report; setting a technical conference for March 11, 2005; and requiring Dammeron Valley to file its report no later than March 4, 2005. By subsequent notice, this technical conference was rescheduled to March 23, 2005. Dammeron Valley thereafter failed to file its report by the March 4 deadline. At the March 23, 2005, technical conference, parties agreed to allow Dammeron Valley until April 22, 2005, to file said report.

Dammeron Valley subsequently notified the Commission that it had suffered another pump motor failure on March 23, 2005. In contrast to actions taken following previous pump motor failures, Dammeron Valley sent this motor to the manufacturer for failure analysis and asked the Commission grant an indefinite extension for submission of its final report in order to include the manufacturer's failure analysis in that report. Therefore, on April 26, 2005, the Commission issued its Third Procedural Notice extending to May 23, 2005, the Dammeron Valley deadline for filing its report.

By Fourth Procedural Notice issued May 31, 2005, the Commission required Dammeron Valley to submit bi-weekly reports to the Administrative Law Judge beginning June 15, 2005, regarding the status of its analysis and report, including information regarding the

manufacturer's motor failure analysis. Dammeron Valley subsequently filed one such report on July 14, 2005.

On October 27, 2005, Dammeron Valley faxed to the Commission a copy of the manufacturer's failure analysis report, dated July 20, 2005, indicating the failure that had occurred on March 23, 2005, was the result of a manufacturer's defect in the motor. On November 1, 2005, the Commission issued a Notice of Technical and Scheduling Conference setting said conference for November 29, 2005.

On December 1, 2005, pursuant to agreement of the parties, the Commission issued a Notice of Hearing setting an evidentiary hearing for March 7, 2006. Said hearing convened as scheduled before the Administrative Law Judge. Utah Power was represented by David L. Elmont of Stoel Rives. Dennis Hansen, Utah Power power quality engineer; Greg Bean, Utah Power field engineer; and Keith Hegerhorst, independent electrical consultant, testified on behalf of Utah Power. Carol Thorpe represented Dammeron Valley and testified on its behalf, as did Ross Gregerson of Southwest Sales Service and Pumps, and Danny Thorpe. Patricia Schmid, Assistant Attorney General, State of Utah, appeared on behalf of the Division of Public Utilities ("Division")[3].

At hearing, based on testimony indicating Utah Power's installed power quality recorders had failed to provide data for periods during which Dammeron Valley had experienced equipment problems, the Administrative Law Judge asked Utah Power to provide the Commission any available recorder data for periods close in time to the Dammeron Valley

[3]The Division observed the evidentiary proceedings and interjected questions of the parties at various times, but did not offer any independent testimony or evidence in this matter.

equipment failures. On April 3, 2006, Utah Power provided this information to the Commission and Dammeron Valley via email. On April 5, 2006, the Administrative Law Judge requested parties provide written interpretations of this recorder data to the Commission not later than April 19, 2006. However, on April 17, 2006, Dammeron Valley requested extension of the April 19 deadline to April 25. On April 18, 2006, the Administrative Law Judge granted this request. On April 25, 2006, both Dammeron Valley and Utah Power filed the requested reports. On May 9, 2006, Utah Power filed a Response to Dammeron Valley Water Company's Interpretation of Events challenging Dammeron Valley's claim in its April 25 submission that (1) voltage at the load should be constant, regardless of load changes, and (2) voltage imbalance at the load cannot be caused by load imbalance but must be utility-based.

Finally, because Dammeron Valley was not satisfied with the form and content of Utah Power's response to Dammeron Valley's data requests regarding recent power system upgrades in the Dammeron Valley area, the Administrative Law Judge asked Utah Power to provide copies of work orders or other relevant records for all work done on the Middleton 24 circuit serving Dammeron Valley during the past three years. The Administrative Law Judge instructed Dammeron Valley to make the Commission aware of any information contained in those records that Dammeron Valley believes could impact the Commission's decision in this matter. As of the date of this Order, Dammeron Valley has not contacted the Commission regarding any such information.

II. BACKGROUND

A. Dammeron Valley's Well Site and Initial Complaint

Dammeron Valley operates wells 3 and 3A, using a 40 horsepower ("hp") and 30 hp submersible pump motor, respectively, at its Well #3. This well site has been in existence for some thirty years and receives three-phase, 277/480 volt ("V") service via a mile-long Utah Power tap line connected to Utah Power's Middleton 24 feeder which is in turn supplied by the Middleton substation. The well site sits at the end of the tap line; there are no other electrical customers on this line.

In February 2002, Dammeron Valley first noticed there may be a problem with its electrical supply at Well #3 when a 30 hp motor then used in well 3 failed and was replaced by a 40 hp model. In March 2000, Dammeron Valley had replaced a damaged 30 hp motor in well 3 and had thereafter experienced radio and telemetry problems at the site so the failure of the 30 hp motor in February 2002, just two years after its installation, seemed suspicious. According to Dammeron Valley, the submersible pump motors used at this site typically have a five-year life span.[4] In all, Dammeron Valley claims to have experienced eight motor or cable failures since February 2002, in addition to numerous incidents of equipment shut down and damaged radios and telemetry equipment that did not result in motor failure.[5] Dammeron Valley attributes these problems to substandard power received from Utah Power.

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[4] All pump motors at issue in this docket were produced by the same manufacturer. While Dammeron Valley introduced manufacturer's promotional materials regarding providing various technical data for these motors, the record does not indicate whether all motors referenced in this docket were the same model of motor.

[5] Throughout these proceedings and this Order, the term "failure" has been loosely used to refer to an event where Dammeron Valley had to repair or replace a pump motor or the electrical cable attached to a motor. A time line of events offered into evidence at hearing lists approximately 35 electricity-related events, including failures, at the well site since March 2000.

Ross Gregerson of Southwest Sales, Service, and Pumps installed the equipment and facility wiring at issue in this docket. He testified at hearing that he has worked on hundreds, perhaps thousands, of well installations similar to Dammeron Valley's Well #3, except for the fact that Well #3 is located at the end of the electricity distribution line. He often encounters multiple problems with customers at the end of a line and, when he receives a call from one person at the end of a line concerning their televisions or other equipment, he has come to expect calls from other people at the end of other lines.

Customers at the end of the line have more problems than any other customers he services. For example, the town of Toquerville and Sunset Canyon Ranch are end-of-the-line customers that have experienced frequent problems similar to those at Dammeron Valley. Based on Mr. Gregerson's experience, as well as the comments of Utah Power line men made to Dammeron Valley personnel, Dammeron Valley believes the problems it has experienced have been caused by a voltage unbalance problem–either a sag, surge, or spike–in the Utah Power electrical system serving the well site which may be caused or amplified by the well site's location at the end of the line.[6]

Utah Power, while willing to provide looped facilities at Dammeron Valley's expense continues to argue such a loop may not solve whatever problems Dammeron Valley is experiencing. Utah Power points out that the "end-of-the-line" locations cited by Dammeron Valley are not on the same distribution circuit so if a problem occurred on the line feeding one of them that problem would have no affect on the lines feeding the other two. Utah Power serves

[6] According to Dammeron Valley, Utah Power field personnel told Mr. Gregerson as much, and recommended the Dammeron Valley line be looped to provide more stable power to the well site.

many other pump installations at the end of tap lines but it has not received complaints similar to Dammeron Valley's. Furthermore, Utah Power notes that if siting a pump at the end of a primary voltage distribution line such as the one supplying Dammeron Valley were recognized within the electric utility industry as making the site unusually susceptible to voltage disturbances, then one would expect there to exist an industry standard regarding such siting; there is no such standard.

According to Utah Power, the most common type of problem for facilities at the end of the distribution line is lightning strikes. Utah Power has 27 kV lightning arresters installed on Dammeron Valley's tap line to deal with this problem. These lightning arresters respond instantaneously to the voltage surge caused by a lightning strike by conducting voltage to ground and then restoring the system insulation value to normal after the surge has passed. This equipment would act in the same way to handle any voltage surge on the line, whether or not caused by a lightning strike. Therefore, Utah Power concludes there is no problem caused by the location of Dammeron Valley's well site at the end of the line, nor by the power it supplies to the site.

B. Power Quality Monitoring and Investigation

1. The Power Quality Monitoring Regime[7]

[7]Noting that in several instances the power quality recorders apparently failed near the time when Dammeron Valley experienced electrical events, the Administrative Law Judge asked parties whether the recorder failures might have been caused by the same voltage or current events that apparently caused Dammeron Valley's equipment to fail. Utah Power responded that surges, transients, or other disturbances would not have caused the recorders to fail or record inaccurate data because those types of voltage or current events are precisely what the monitors are designed to capture. Utah Power blames at least a portion of its recorder failures on an observed problem with the grounding of the neutral in Dammeron Valley's 120 volt system used to power the recorders. Utah Power notes Dammeron Valley's telemetry equipment is also powered by this 120 volt system and points to Dammeron Valley's own log of events indicating several instances of circuit board and telemetry equipment failure. However, Dammeron Valley challenges this assertion, noting that some of those failures occurred at the firehouse where Dammeron Valley has an office, not at the well site, so those events can not be attributed to the 120 volt supply at the well site.

As required by the Commission's October 2003 Order, the parties undertook extensive power quality monitoring using multiple monitors at several locations during three distinct periods between December 2003 and August 2004. In addition to these monitoring periods, Utah Power operated recorders at the well site at various times between March and July 2004. Utah Power provided data corresponding to some of these other dates post-hearing at the request of the Administrative Law Judge.

a. December 2003 – January 2004

From December 19, 2003, to January 29, 2004, Utah Power employed a Metrosonics SL-8 phase-neutral recorder at the Dammeron Valley service meter, an RPM phase-phase recorder inside the well house, a Metrosonics PA-9 PQ recorder at the transformer on the pole at the end of the tap line serving Dammeron Valley, and an SL-8 monitor at Feller Stone Company.[8] However, the RPM monitor in the well house recorded no data from December 19-29 while the PA-9 recorder at the transformer was not operational at all during this entire period.

According to Utah Power's monitoring report for this period, the data from the power quality recorders discloses a number of electrical events of interest. At approximately 9:00 a.m. on December 19, 2003, the RPM recorder in the well house recorded four aborted motor starts. The data disclose no cause for these aborted starts.[9] On December 29, 2003, the

[8] Feller Stone is the closest three-phase customer to the well site. Both Dammeron Valley and Feller Stone are fed power from Utah Power's Middleton 24 feeder; Feller Stone is located near the Dammeron Valley tap point off of this feeder. Utah Power monitored power quality at Feller Stone in order to determine whether any voltage events upstream from Dammeron Valley might be the cause of the problems observed at Dammeron Valley. The SL-8 monitor at Feller Stone operated from January 21-29, 2004.

[9] Dammeron Valley believes these frequent starts and stops occurred while a motor saver was installed, prior to installation of the current ABB soft start fault protection system. Dammeron Valley also testified it subsequently made system changes to limit the number of pump motor starts per hour.

RPM monitor captured a fifty percent voltage sag lasting just under twelve seconds on both the A-B and B-C voltages. Approximately one second after this twelve-second event, the voltage sagged again on the A-B and B-C voltages, this time lasting just 0.2 seconds. The data indicate no corresponding current surge so Utah Power believes these events were caused either by an upstream voltage sag or by some kind of local voltage shift at the well site. Utah Power believes had these events been caused by an upstream voltage sag they would have also been captured on the SL-8 recorder at the service meter. However, the SL-8 data show no voltage sags of the magnitude shown by the RPM recorder. On January 8, 2004, the SL-8 recorder at the service meter noted the pattern of normal motor starts changed to rapid current fluctuations occurring about every 1.3 minutes. Recorded voltage remained normal during this period. Utah Power believes this rapid load cycling could be due to some kind of pump control problem.

From this monitoring, Utah Power concluded some kind of intermittent loose connection or corroded breaker contact on the B-phase circuit somewhere between the RPM monitor and the service meter caused the observed A-B and B-C voltage sags while an intermittent open caused by an insecure ground on the 120/240 volt split-phase circuit is one possible explanation for the radio and uninterruptible power supply ("UPS") failures noted by Dammeron Valley. Because the Feller Stone monitor detected no voltage quality problems concurrent with those recorded at the Dammeron Valley well site, Utah Power concluded the electrical problems at Dammeron Valley were local in origin. According to Dammeron Valley, no motors failed during this period, but Dammeron Valley did suffer other equipment damage and protective equipment tripping on December 29, 2003 and January 8, 2004.

b. May 4-18, 2004

During this second monitoring period, Utah Power monitored power quality at Dammeron Valley and Feller Stone, again using an RPM recorder in the well house, an SL-8 recorder at the service meter, a PA-9 recorder at the pole, and another SL-8 recorder at Feller Stone. All recorders operated during the entire monitoring period. According to Utah Power, one system fault is apparent from the recorder data gathered during this period. This fault occurred on the Middleton feeder during a windstorm on May 10, 2004, and lasted for about 6 cycles. The data for this event disclose a voltage sag to 28% of normal on C phase and a corresponding voltage surge to 115% of normal on phase A. Aside from this event, Utah Power notes no power system voltage events during this period.

However, beginning on May 8, 2004, several pump motor starts were recorded with corresponding current surges, some of which were larger than expected. Utah Power also notes the small pump motor appears to have operated almost continuously from May 4 to May 11, raising questions about pump settings that may contribute to shortening of pump life. In addition, Utah Power noted several B phase current spikes of approximately 8,000 Amps recorded by the PA-9 monitor. Having compared these spikes to data gathered from other recorders at the same time, Utah Power concluded these spikes did not actually occur but instead represent bad data possibly caused by windstorm damage to the recorder. According to Dammeron Valley, no pump motor failures or other apparent electrical events occurred during this period.

c. June 28 – August 31, 2004

Monitoring during this period took place at the Dammeron Valley service meter from July 6 to August 31 and at Feller Stone from June 28 through August 31, using an SL-8 recorder at each location. According to Utah Power, this monitoring disclosed only normal voltages and confirmed the problems experienced by Dammeron Valley had effectively been solved by correction of previously identified grounding and wiring problems at the well house. According to Dammeron Valley, no equipment failures occurred during this period, but the soft start protective equipment registered faults and tripped on June 14, 16, and 17, and July 5, 9, 10, and 12, 2004.

d. Additional Monitoring Data Provided Post-Hearing

Utah Power also provided recorder data for twelve dates–March 1-5, 7-9, and 16; April 11-12; and July 20, 2004–not otherwise included in the monitoring data discussed above.[10] According to Utah Power, the data generally show Utah Power supplied voltage within ANSI limits. However, Utah Power notes several instances of current pulses caused by motor starts and subsequent current unbalance. On March 1, 2004, the unbalance measured between the A and C phases reached 5% while phase voltages remained balanced. Though Utah Power does not consider this unbalance to be extreme, it argues the unbalance demonstrates that, for Dammeron Valley's particular well house load, unbalanced current is not necessarily an

[10] In response to concerns voiced by Dammeron Valley that it had not received requested power quality recorder data for periods when it claimed equipment failures or shutdowns had occurred, the Administrative Law Judge at hearing instructed Dammeron Valley to provide Utah Power a more precise list of dates for which it still sought said data. Utah Power was instructed to provide any data it possessed for those dates. The Administrative Law Judge thereafter sought written testimony from the parties regarding their interpretation of this data and informed parties he intended to admit the data and interpretive testimony into evidence for Commission use in reaching its decision in this matter. Neither party objected.

indication of unbalanced supplied voltage. This pattern of unbalanced current but balanced voltage repeats several times within the additional data supplied by Utah Power.

Utah Power also points out that on April 12, 2004, an event occurred that appears to have resulted in the failure of a pump motor cable on April 13, 2004. At 10:25 a.m., following normal current and voltage operation, B-phase current increased while B-phase voltage decreased. At the same time A and C phase currents and voltages all increased. Utah Power claims such an event can be caused by a problem known as "neutral shift", in which a short circuit exists somewhere on B phase between the recorder and the motor neutral with the neutral ungrounded or poorly grounded. Once the neutral shifts, the voltage-to-neutral across the remaining two phases will increase. Utah Power notes the voltage imbalance caused by a neutral shift can cause intermittent, and eventually permanent, motor failure.

Dammeron Valley interprets this data differently, claiming voltage imbalance is not caused by current fluctuation but that current imbalance is caused by voltage imbalance. According to Dammeron Valley, Utah Power is wrong to claim that the pump motors caused a current problem which in turn caused a voltage imbalance. Dammeron Valley believes the additional recorder data supplied by Utah Power shows huge voltage imbalances that could have caused the observed current problems.

2. October 10, 2003

Only twice, on October 10, 2003,[11] and on April 12, 2004 as discussed above, did Utah Power's power quality monitoring capture data for any period when Dammeron Valley's pump motors or associated equipment actually failed. On October 10, 2003, the Utah Power monitor at the service meter registered a series of 11% voltage unbalances over a period of approximately thirty minutes. Utah Power admits this unbalance lasted long enough to be considered a steady-state event[12], but finds no other evidence that Utah Power supplied unbalanced voltage during this period. Instead, Utah Power argues the data obtained from the SL-8 recorder shows the voltage unbalance was preceded by a current increase which was in turn caused by some change in the Well #3 pump motors.

Utah Power notes the first event of consequence on October 10 was that Dammeron Valley's equipment began to draw more current. While this increased current appears in the SL-8 data, it is not initially accompanied by a corresponding voltage change so the rise in current must have been caused by something within the Dammeron Valley facility. As explained by Utah Power, if there is a constant voltage source, as indicated by the recorder data, increased current could only be caused by a decrease in the resistance or impedance of the load. Load impedance would change if a motor winding started to fail, or if resistance on the meter

[11] In response to Dammeron Valley's initial complaints, Utah Power had placed an SL-8 monitor at the Dammeron Valley service meter. However, as was the case with all SL-8 data obtained at the service meter throughout the complaint period, Utah Power was only able to fit two current probes from the SL-8 monitor into the Dammeron Valley meter cabinet. We therefore have no data for the B phase current for this event or subsequent monitoring periods.

[12] At hearing in March 2006, Utah Power testified a steady-state condition is one typically lasting "at least several seconds and usually minutes and hours." At hearing in August 2003, Utah Power indicated "steady-state" refers to a condition lasting more than one minute. Generally speaking, steady-state conditions are those normally present on the power system. As discussed below, the voltage standards applicable to Utah Power in this docket concern only steady-state conditions.

side of the system decreased. Therefore, since the voltage appears to stay constant longer than the current, the cause of this event appears to be current-related at the load rather than a voltage problem on Utah Power's system.

Dammeron Valley does not challenge Utah Power's reasoning but, given the noted data gaps and periods when the power quality recorders were inoperable, it does question the accuracy of the recorder data on which Utah Power's conclusions are based.[13] Dammeron Valley argues its equipment constitutes a fixed load that has not varied for twenty years so there could be no change in the load unless a mechanical problem developed in one of the pump motors. Dammeron Valley believes the data do not support the conclusion that the increased current was due to a pump motor failure since the power readings fluctuated between relatively normal and well out of balance levels over the recorded period. If a pump motor had failed, there would be no power fluctuations; likewise, if a motor winding went to ground it would stay at ground and no voltage or current fluctuations would be observed. Since the power quality recorder data show voltage fluctuating in and out of balance, Dammeron Valley concludes the recorder data does not indicate motor failure and cannot be relied upon.

Utah Power points out there is no evidence that the recorder was not working properly on October 10, and that the basic sequence shown by the recorder data is an appropriate steady-state voltage, a rise in the current, a subsequent voltage unbalance, and eventual motor

[13] Dammeron Valley points to the failure of the PA-9 recorder during the December 2003 monitoring period and blown fuses on Utah Power's SL-8 monitor at Feller Stone in April 2004. Dammeron Valley also cites these blown fuses as further evidence of problems occurring in Utah Power's system, questioning what sort of voltage would blow fuses in a piece of monitoring equipment manufactured to withstand and record voltage irregularities. Utah Power notes that the fuses on the Feller Stone monitor could have blown for reasons other than extreme voltage surge on the system. Utah Power blames the 120V power supplied by Dammeron Valley for its recorder failures, but Dammeron Valley notes these recorders also malfunctioned on Utah Power's pole, located on the Utah Power side of the service meter, and at Feller Stone.

failure. Utah Power believes a neutral shift occurred similar to the one indicated by the April 12, 2004, data. A fault in the motor caused it to go to ground, resulting in a short circuit in the motor's winding and the subsequent voltage increase seen by the recorder. Utah Power believes the data simply show the motor beginning to fail and progressing to complete failure. Each Utah Power witness testified if there had been problems with the power supplied by Utah Power, those problems would not have first manifested at the recorder as a current increase. Dammeron Valley provided no alternative to this testimony, except to challenge the accuracy of the recorder data itself.

3. Other Investigatory Measures

Utah Power also introduced evidence of its efforts, in addition to Commission-ordered monitoring, to identify potential causes for the problems experienced by Dammeron Valley. This investigation included the aforementioned monitoring at Feller Stone, as well as analysis of records relating to three hydro plants connected to the Middleton circuit, and analysis of Middleton Substation Supervisory Control and Data Acquisition ("SCADA") data. Utah Power claims no monitored steady-state voltages from Feller Stone fell outside of the applicable ANSI standard, save one brief instance caused by the loss of generation at the Palo Verde nuclear plant on June 14, 2004, which caused the motor on pump 3A to trip but did not damage the motor. Analysis of the hydro plant records revealed no correlation between events at the plants and at Dammeron Valley, nor did the Middleton SCADA data show any deviation from ANSI standards corresponding to events at Dammeron Valley.

C. Wiring and Grounding Issues at Well #3

Utah Power alleges many of the problems experienced by Dammeron Valley may have been the result of wiring and grounding deficiencies noted by Utah Power and its independent expert during a site visit to Well #3 in December 2003. These problems included loose or non-workman-like wiring connections, insufficient site grounding, and possibly inadequate circuit breakers. According to Utah Power, loose connections caused by system heating and cooling can lead to voltage disturbances in the system. Other causes of voltage disturbances are improper grounding and motor starts. Following the December 2003 site inspection, Utah Power's independent consultant sent Dammeron Valley a list of recommendations to improve the well site electrical system. These recommendations included additional grounding and installation of separate circuit breakers for each well.

Utah Power also observed that the grounding rod for the well site was only driven about two-thirds of the way into the ground. Though this grounding method may have been considered sufficient years ago, it satisfies none of the grounding methods approved in the current National Electric Code. The Company also points to testimony from the August 2003 hearing indicating that during initial inspection at the well site the door to the well house had been broken off its hinges and was laying by the side of the doorway. In addition, during the December 2003 site visit, the UPS system showed a definite fault, indicating the neutral was not grounded on the 120 volt system. Utah Power does not suggest any of these observed conditions caused motor failures, but believes they could reasonably lead one to question the condition of Dammeron Valley's equipment and installation practices.

The parties agree that by the end of March 2004 Dammeron Valley had addressed each of Utah Power's wiring and grounding concerns at Well #3, including installing a new breaker panel, ninety feet of new grounding around the site, and tightening loose wire connections. Dammeron Valley made these changes in order to try to identify the source of its power problems, but does not concede that Well #3 had any wiring or grounding deficiencies causing its electrical problems. While admitting the wire connections observed in the well house in December 2003 could have been completed in a more workmanlike manner, Dammeron Valley argues its facility was nonetheless properly grounded and wired and notes Utah Power's inspection disclosed no incorrect electrical connections. Dammeron Valley also notes Utah Power would not have installed a meter at the well house approximately fifteen years ago if Utah Power had not approved of the well site's grounding at that time. Furthermore, Dammeron Valley points out that when the grounding rods at the new Well #4 just 400 feet from Well #3 proved difficult to drive completely into the ground, Utah Power personnel simply cut off the exposed portion of the rods and said "we're good to go."

D. Events after March 2004

Despite the remedial action undertaken at Well #3, Dammeron Valley experienced two more equipment failures, on April 13, 2004, and on March 23, 2005, respectively, and numerous protective equipment faults. The April 2004 failure was a burnt cable that failed before any motor failure could occur.[14] The motor damaged in March 2005 was

[14] According to Dammeron Valley, voltage surges and spikes tend to cause problems in insulation systems which break down at the weakest point. This is generally seen in the motors themselves but sometimes it occurs instead in the cable feeding the motor.

returned to the manufacturer for failure analysis which disclosed the problem to be a failed lead seal, a manufacturer's defect. Of the four claimed motor failures since February 2002, the motor that failed in March 2005 is the only one that was returned to the manufacturer for analysis.

Utah Power points to this manufacturer's defect as support for its position that its power quality is not the cause of Dammeron Valley's equipment problems. Dammeron Valley, on the other hand, notes the manufacturer's report finds no fault with the installation or sizing of the motor and therefore confirms the correctness of the motor installation. In addition, Dammeron Valley believes the lead seal failure could have been caused by a phase unbalance and the resulting excess heat in the motor. Thus, the fact that the manufacturer accepted the failure as a manufacturer's defect does not prove that the failure was not caused by a voltage unbalance on Utah Power's system.

Although it has suffered no motor failures since March 2005, Dammeron Valley argues the numerous soft-start protection equipment faults since that time are evidence that its power problem continues. Dammeron Valley says the phase unbalance parameters on its soft start protective equipment should be set at one to three percent. However, because of frequent tripping, the parameters were increased to five percent in February 2004. When the soft start trips continued, even on Well #4 when it became operational, Dammeron Valley had to increase the phase unbalance parameter to ten percent, a level which Dammeron Valley believes is too high to provide adequate equipment protection, in order to significantly reduce the number of soft start trips.

Utah Power believes these soft start trips are caused by loading problems in Dammeron Valley's equipment, noting that the current unbalance indicated by the soft start fault codes is not normally caused by power supply. Dammeron Valley argues that any current unbalance recognized by the soft start could have been caused by a voltage unbalance in Utah Power's power supply.[15] Dammeron Valley also points out that if the problem causing the soft start to trip were in the pump motor or cabling, the resultant current surge would be an indication of motor failure. However, Dammeron Valley's repeated soft start trips simply require a system restart; the pump motors work fine after restart, indicating that they did not fail and were not the cause of the soft start trip. Utah Power responds that if Dammeron Valley is seeing current unbalance faults and there is no corresponding unbalance in the delivered voltage, then the system fault can not be due to a Utah Power voltage unbalance.

Utah Power concedes inadequate wiring and insufficient grounding likely were not the cause of any electrical events occurring at the site after March 2004. However, Utah Power believes that some problems experienced after that date may have been caused by problems originating in the system prior to Dammeron Valley correcting its wiring and grounding deficiencies. Such latent conditions may simply have taken some time to manifest themselves in observable motor or other equipment failures.

Dammeron Valley, on the other hand, points to problems at its new Well #4 to refute Utah Power's claims. Well #4 began operation in April 2004 with all new equipment, wiring, and grounding, and is supplied by the same tap line that supplies Well #3. Its wiring and

[15] Dammeron Valley notes a mere 1% voltage unbalance can produce a 6 to 10% current unbalance and that a 2% voltage unbalance can decrease the life of a pump motor by 50%.

grounding were approved by Utah Power prior to commencement of pumping operations. Therefore, if the electrical problems at Well #3 were caused by wiring and grounding deficiencies peculiar to that site, the same problems should not occur at Well #4, but they have occurred. Just as has been the case with Well #3, only after the fault parameters for the soft start equipment at Well #4 were increased to ten percent unbalance did the equipment cease its frequent tripping.

Dammeron Valley also notes that when it was forced to operate the electrical equipment at its well site using a portable generator during fires that burned in the area throughout August 2005 it experienced none of the equipment failures, telemetry problems, or soft start trips that it has experienced when receiving electric service from Utah Power. Finally, Dammeron Valley claims other Utah Power users in the area, such as Feller Stone and Dixie REA, have complained to Dammeron Valley during this period concerning the fluctuating power levels provided by Utah Power.

E. Current Status

Dammeron Valley attributes any perceived power quality improvement since filing its complaint both to upgrades Utah Power must have made to its distribution system over the last several years and to the fact that it has set the parameters on its protective equipment so high that its soft starts simply do not trip as frequently. Dammeron Valley also points out that the commencement of pumping operations at Well #4 in the summer of 2004 resulted in a corresponding decrease in operations at Well #3 so one would expect the number of events at Well #3 to decrease.

Utah Power claims it has done very little in the way of system improvements that would affect Dammeron Valley's power supply. Specifically, Utah Power notes substantial rebuilds of the system feeding the Dammeron area via the Middleton substation were completed by 1999. Its only system modification of note on the Middleton 24 circuit serving Dammeron Valley since 2002 was the installation of voltage regulators on the line in July 2003.[16] Utah Power also notes any event in the power system upstream of Dammeron Valley's mile-long tap line would affect not only Dammeron Valley but also the rest of the Middleton Substation circuit downstream, but that it has not received power quality complaints from other customers.

Utah Power believes everything points to a weak ground producing a weak voltage system localized to Well #3.[17] Each of Utah Power's witnesses testified the problems experienced by Dammeron Valley are more likely caused by site-specific conditions at Well #3 than by substandard power. Dammeron Valley counters that it has performed ground resistance tests and found less than one ohm of resistance, which parties indicate is an acceptable level.[18]

[16] According to Utah Power testimony during the August 2003 hearing, these voltage regulators do not respond to transients; they only operate in response to changes in steady-state conditions.

[17] Utah Power disputes the Commission's finding in its October 2003 Order that voltage on some occasions must have fallen outside the ANSI-approved range. Specifically, Mr. Bean testified he had not intended his testimony at the August 2003 hearing to be construed as agreement with Dammeron Valley that its pump motor failures indicate Utah Power must have provided power outside the ANSI range.

[18] Dammeron Valley's time line of events admitted at hearing appears to contradict this testimony insofar as it indicates a ground test reading of 3 ohms at Well #3 on June 30, 2004. At hearing, parties did not comment on the import of this reading.

III. DISCUSSION, FINDINGS, AND CONCLUSIONS

A. Regulatory Requirements

Commission Rule 746-310-4B(1) states

> Unless otherwise directed by the Commission, the requirements contained in the 1995 edition of the American National Standard for Electrical Power Systems and Equipment–Voltage Ratings (60 Hz), ANSI C84.1-1995 (R2001), incorporated by this reference, shall be the minimum requirements relative to utility voltages.

ANSI C84.1-1995 (the "Standard") requires most service voltages supplied at the service meter to fall within a range ("Range A") of plus or minus five percent. The "occurrence of service voltages outside of these limits should be infrequent." ANSI C84.1-1995, section. 2.4.1. The Standard also recognizes a wider permissible voltage range ("Range B") of plus six to minus eight percent which results from practical design and operating conditions on supply systems. According to the Standard, voltage excursions into Range B are to be limited in extent, frequency, and duration, and corrective measures are to be undertaken when such excursions occur. Beyond the voltages permitted by these ranges, section 2.4.3 of the Standard states

> It should be recognized that because of conditions beyond the control of the supplier or user, or both, there will be infrequent and limited periods when sustained voltages outside Range B limits will occur. Utilization equipment may not operate satisfactorily under these conditions, and protective devices may operate to protect the equipment
>
> When voltages occur outside the limits of Range B, prompt, corrective action shall be taken.

The Standard also provides that the limits contained in Ranges A and B "shall apply to sustained voltage levels and not to momentary voltage excursions that may remit from such causes as

switching operations, motor starting currents, and the like." Finally, Annex D to the Standard states electric supply systems "should be designed and operated to limit the maximum voltage unbalance to 3 percent when measured" at the service meter under no-load conditions.

Regarding customer equipment protection, Commission Rule 746-310-2(C) states

> Utility's Responsibility–Nothing in these rules shall be construed as placing upon the utility a responsibility for the condition or maintenance of the customer's wiring, appliances, current consuming devices or other equipment, and the utility shall not be held liable for loss or damage resulting from defects in the customer's installation and shall not be held liable for damage to persons or property arising from the use of the service on the premises of the customer.

Utah Power's Electric Service Regulation No. 5, paragraph 5.2(a) likewise provides

> The Customer shall furnish, install, inspect and keep in good and safe condition all electrical wires and lines on the Customer's side of the point of delivery. The Customer shall provide devices to protect his/her equipment from high and low voltage, overload, single phasing, phase reversal or other abnormal conditions.

B. Discussion

For Dammeron Valley's three-phase, 480Y/277 volt service, the ANSI-specified Range A at normal loading for phase to neutral voltage, measured, for instance, by the SL-8 recorder at Dammeron Valley's service meter, is 263 to 291 volts. Range B at the service meter extends from 254 to 293 volts. For unloaded phase to phase voltage, Range A is 456 to 504 volts while Range B extends from 440 to 508 volts. These voltage ranges, along with the Standard's three percent phase imbalance requirement, constitute the standard by which Utah Power's delivered voltage quality is judged in this docket.

As complainant in this matter, Dammeron Valley bears the burden of proving Utah Power has acted in violation of statute, rule, or tariff. To satisfy this burden, Dammeron Valley points to the number of electrical events experienced at Well #3, and later Well #4, since February 2002; the absence of such events when Dammeron Valley employed generator power at these sites during August 2005; Utah Power's inability to identify specific deficiencies in the general electrical setup of Well #3; and the fact that small voltage unbalances can result in large current unbalances capable of causing the damage and equipment shutdown experienced by Dammeron Valley. In addition, Dammeron Valley notes that, despite years of monitoring and investigation, Utah Power can not definitively say that its power supply is not the cause of Dammeron Valley's electrical problems.

Dammeron Valley points out it has made all the wiring and grounding changes Utah Power identified in its site inspections, but it continues to experience electrical problems resulting in equipment shutdown. Furthermore, Dammeron Valley argues the wiring and grounding at the site can not have been the cause of its electrical problems since those problems have occurred intermittently, sometimes happening several days in a row but often occurring months apart. Dammeron Valley feels Utah Power continues to provide sub-standard power, and that its location at the end of the distribution line amplifies this problem. Dammeron Valley also reminds the Commission of its finding in the October 2003 Order that on at least a few occasions the voltage supplied by Utah Power fell outside the range required by the ANSI standard.

Utah Power denies that it has at any time supplied sub-standard voltage to Dammeron Valley's well sites, but argues that even if the voltage supplied to Dammeron Valley

has in some instances temporarily exceeded the voltage ranges specified in ANSI C84.1-1995, that standard applies only to steady-state voltage, not to voltage transients.[19] Utah Power claims its monitoring has disclosed no steady-state voltage irregularities to account for the Dammeron Valley equipment failures. The Company instead points to observed wiring and grounding deficiencies as possible causes of the current unbalance it believes has resulted in equipment failure and shutdown. Utah Power also notes that the only failed pump motor that was analyzed by the manufacturer was found to have had a manufacturer's defect. Utah Power points out it is the customer's responsibility to employ surge protection and other equipment to protect the customer's equipment from any voltage transients on its system. Finally, Utah Power notes that, were the Commission to find Utah Power in violation of any tariff, rule, or statute, the monetary relief available to Dammeron Valley would be limited to rate reparations; claims for monetary damages are not an available remedy before the Commission.

The Division, essentially agreeing with Utah Power, notes the finite jurisdiction of the Commission and the fact that there are limits on the appropriate relief the Commission can award in cases such as this.

C. Findings and Conclusions

Boiling four years of investigation, allegation, technical discussion, and hearings down to a few lines, the facts that confront this Commission are as follows:

[19] As noted by the Standard, there are a variety of sources for such transients. The utility system itself may be the source of transients caused by lightning strikes, capacitor switching, and ground faults (i.e, downed power lines). In limiting its voltage requirements to steady-state conditions, the Standard recognizes that such transients are an unavoidable occurrence in modern utility systems. Transients typically last less than two minutes, and in many cases less than one second.

Dammeron Valley operated pumping equipment at its Well #3 for many years prior to February 2002, apparently without experiencing any unusual or frequent electrical problems at that site. However, since February 2002, Dammeron Valley has suffered an inordinate number of electrical equipment failures and protective equipment tripping. Its pump motors have failed far more frequently than one would expect given the typical five-year life span of such motors. By March 2004, Dammeron Valley had adequately addressed all wiring and grounding concerns identified by Utah Power that may have contributed to the equipment failures at Well #3 prior to that time. Despite this fact, the soft start protective equipment at both Well #3 and Well #4 has continued to trip, indicating some continuing electrical problem. The frequency of these electrical faults declined only after Dammeron Valley increased the parameters on its protection equipment to levels much higher than one might think reasonable in order to adequately protect its pumping equipment. Only when Wells #3 and #4 were supplied by generator power rather than Utah Power in August 2005 did these problems disappear completely from the system.

On the other hand, the only failed pump motor subjected to manufacturer's failure analysis was found to have failed due to manufacturer's defect. While this fact does not lead to the conclusion that all motor and equipment failures were the result of similar defects, it does call into question Dammeron Valley's claim that Utah Power's power quality must be the cause of its electrical problems. Likewise, the only available power quality recorder data directly preceding motor failure discloses a current spike, not a voltage excursion or unbalance, as the precipitating event, an event most likely caused by Dammeron Valley's load, not Utah Power's

supplied voltage. This data is consistent with recorder data from the May 4-18, 2004, monitoring period showing a series of pump motor starts producing current surges not preceded by any voltage event. It is also consistent with Utah Power's explanation of a neutral shift occurring somewhere within the system to cause a current spike on one phase followed by current and phase unbalance across all three phases.

In reviewing the evidence, we can not reasonably conclude that conditions such as wiring or grounding peculiar to Well #3 are the cause of Dammeron Valley's problems. If wiring or grounding were the cause, (1) problems would likely not have suddenly appeared in February 2002 after years of otherwise normal operation, (2) problems should have ceased once Dammeron Valley made the wiring and grounding changes recommended by Utah Power, (3) problems should have continued during August 2005 when the facilities were supplied by generator power, and (4) similar problems should not have occurred at Well #4.

However, as indicated by the recorder data for April 12, 2004, and October 10, 2003, it is possible that some unidentified condition within the motors or elsewhere within the system has caused neutral shifts to occur.[20] Such shifts would explain the fact that a current surge preceded any voltage events on October 10, 2003, and could also account for the recurring current unbalance faults that have caused frequent equipment shutdown at the well sites. Frequent, intermittent current unbalance caused by such shifts also appears capable of gradual

[20] Utah Power has questioned Dammeron Valley's continuing use of submersible motors, noting that in the last ten years many former user of submersibles have switched to line shaft motors due to the higher failure rate of submersibles and their repair expense. However, Dammeron Valley challenges this view, arguing users have moved away from submersibles because sand in the wells causes the submersibles to fail more quickly. Mr. Gregerson claims to have installed thousands of submersible motors and believes they are very dependable.

motor degradation leading to complete motor failure. The evidence supports our conclusion that at least on some occasions neutral shift has occurred and appears to have been the cause of some of the equipment problems experienced by Dammeron Valley.

We also note the recorder data for March 1, 2004, and several other dates demonstrates that, for Dammeron Valley's particular load, unbalanced current is not necessarily an indication of unbalanced supplied voltage. Therefore, it is entirely possible that some of the current surges and faults that have damaged Dammeron Valley's motors and caused its protective equipment to trip so frequently have been caused by a condition peculiar to Dammeron Valley's load rather than by the voltage supplied by Utah Power.

We do not ignore the fact that Dammeron Valley experienced no electrical problems when it operated its equipment off of generator power instead of voltage supplied by Utah Power. Indeed, this fact leads us to conclude that some aspect of the power supplied by Utah Power appears to be a contributing factor in some of the equipment faults experienced by Dammeron Valley. However, this conclusion does not imply that Utah Power must have violated applicable voltage standards.

ANSI 84.1-1995 incorporated by Commission rule recommends no more than a three percent steady-state voltage unbalance. None of the monitoring undertaken in this docket disclosed voltage unbalances outside of this range not preceded by some current event whose likely cause was the Dammeron Valley load. Moreover, scientific studies introduced by Dammeron Valley conclude that even small voltage unbalances can produce proportionately large current unbalances. For instance, a one percent voltage unbalance can produce a current

unbalance of six to ten percent while a two percent unbalance can decrease a motor's life by fifty percent. It is therefore reasonable to conclude that even small voltage unbalances well within the ANSI standard could contribute to the damage and equipment shutdowns experienced by Dammeron Valley. Because these unbalances would not have violated Commission rule, they would not constitute a violation for which the Commission could take action against Utah Power or award reparations to Dammeron Valley.

Likewise, the allowable voltage ranges of ANSI 84.1-1995 apply only to steady-state voltage, not to the transient voltage events that are a routine component of the electrical supply system. In order to prevail in its complaint against Utah Power, Dammeron Valley must provide evidence leading to the reasonable conclusion that Utah Power has supplied steady-state voltage in violation of the Standard. Absent such evidence, we can not conclude that Utah Power's voltage has violated Commission standards.

We are mindful that our October 2003 Order found on some occasions Utah Power must have provided voltage outside of the ANSI-specified ranges. However, said finding does not mean that Utah Power has violated its regulatory obligations. Indeed, the Standard itself recognizes that because of conditions beyond Utah Power's control limited and infrequent voltage excursions outside of Range B will occur. Furthermore, we had no evidence then, and have no evidence now, to support the conclusion that these excursions were anything other than momentary transients rather than steady-state phenomena. Dammeron Valley has argued generally that the thirty-five events it has identified since February 2002 are not infrequent.

We would agree if the evidence supported the contention that Utah Power is responsible for each of these events. However, as discussed above, it does not. Except for the events of October 10, 2003, and April 12, 2004, which we have already concluded were not caused by the voltage supplied by Utah Power, there is no recorder data before us in which the voltage measured by Utah Power departs from the allowable ANSI range. While it is likely that Utah Power, like all electric utilities, at some point provided voltage outside of this range for brief periods, such excursions are permitted under the Standard.

Based on the available evidence, we can not conclude Utah Power has violated any statute, rule, or tariff provision and therefore dismiss the subject complaint. Wherefore, based upon the foregoing information, and for good cause appearing, the Administrative Law Judge enters the following proposed:

IV. ORDER

NOW, THEREFORE, IT IS HEREBY ORDERED, that:

- The complaint filed herein is dismissed.
- Pursuant to *Utah Code Annotated* §§ 63-46b-12 and 54-7-15, agency review or rehearing of this order may be obtained by filing a request for review or rehearing with the Commission within 30 days after the issuance of the order. Responses to a request for agency review or rehearing must be filed within 15 days of the filing of the request for review or rehearing. If the Commission fails to grant a request for review or rehearing within 20 days after the filing of a request for review or rehearing, it is deemed denied. Judicial review of the Commission's final agency action may be obtained by filing a Petition for Review with the Utah

Supreme Court within 30 days after final agency action. Any Petition for Review must comply with the requirements of *Utah Code Annotated* §§ 63-46b-14, 63-46b-16 and the Utah Rules of Appellate Procedure.

Dated at Salt Lake City, Utah, this 18th day of May, 2006.

/s/ Steven F. Goodwill
Administrative Law Judge

Approved and Confirmed this 18th day of May, 2006, as the Report and Order of the Public Service Commission of Utah.

/s/ Ric Campbell, Chairman

/s/ Ted Boyer, Commissioner

/s/ Ron Allen, Commissioner

Attest:

/s/ Julie Orchard
Commission Secretary
G#48941