ROCKY MOUNTAIN POWER
A DIVISION OF PACIFICORP

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March 28, 2024

VIA ELECTRONIC FILING

Public Service Commission of Utah
Heber M. Wells Building, 4th Floor
160 East 300 South
Salt Lake City, UT 84114

Attention: Gary Widerburg
Commission Administrator

Re: Docket No. 24-035-16
Rocky Mountain Power's Electrical Power Delivery Quality Plan

In accordance with Utah Code §54-25-201 and Public Service Commission of Utah ("Commission") Rule R746-316-3, PacifiCorp d. b. a Rocky Mountain Power ("the Company") hereby submits its Electrical Power Delivery Quality Plan.

All formal correspondence and data requests regarding this filing should be addressed as follows:

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Informal inquiries may be directed to Jana Saba, Manager, State Regulatory Affairs, at (801) 220-2823.

Sincerely,

Joelle Steward
Senior Vice President, Regulation/Customer and Community Solutions

CC: Division of Public Utilities, Office of Consumer Service

CERTIFICATE OF SERVICE

Docket No. 24-035-16

I hereby certify that on March 28, 2024, a true and correct copy of the foregoing was served by electronic mail to the following:

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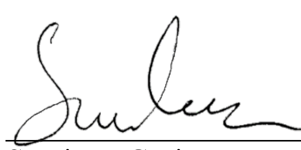

Santiago Gutierrez
Coordinator, Regulatory Operations

ROCKY MOUNTAIN POWER
A DIVISION OF PACIFICORP

UTAH
ELECTRICAL
POWER DELIVERY
QUALITY PLAN

April 1, 2024
Report

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Executive Summary

Rocky Mountain Power's Electrical Power Delivery Quality Plan was created in response to administrative rule R746-316-1 which establishes requirements pertaining to the submission, review, and implementation of Electrical Power Delivery Quality Plan pursuant to Sections 54-25-101, 54-25-102, and 54-25-201 of the Utah code. Sections 54-25-101, 54-25-102, and 54-25-201 of the Utah code are predicated on House Bill 389.

The submitted report complies with the requirement for qualified utilities to submit a biannual electrical power delivery quality plan. It includes a description of the metrics and equipment the Company uses to assess power quality, procedures and standards used to assess generation interconnections and their effects on system performance. It also includes modifications or upgrades the Company may implement to address power delivery quality issues.

1 Metrics for Assessing Power Quality

This section provides a description of the metrics the Company uses to assess Power Quality against applicable Industry Standards.

Power quality standards ensure that the voltage, current, and frequency of electric supply meet established specifications. They address both steady-state power quality (including voltage magnitude, balance, and distortion) and power quality during disturbances (such as voltage fluctuations, sags, and transients)

Voltage regulation and power quality significantly impact the efficiency and reliability of customer equipment. Steady-state voltage that is too high, too low, or unbalanced can lead to inefficiencies and equipment wear. Harmonic distortion in a power system can cause overheating and operational issues. Additionally, power disturbances, like high-speed transients, can shorten sensitive equipment's lifespan, resulting in costly downtime and lost revenue. Certain equipment in a customer's facility may also affect distribution system current and voltage, impacting sensitive devices connected to the same circuit. Even utility equipment is at risk; for instance, a voltage dip caused by a customer starting a motor can disrupt microprocessor-controlled equipment nearby.

Power quality standards enable facilities with sensitive or power-disturbing loads to operate on the company's distribution system without disrupting utility equipment or customer loads. These standards guide design, installation, maintenance, and operation of such facilities, ensuring effective voltage ranges. They play a crucial role in assessing power quality for any electrical distribution system, be it a utility feeder or customer facility circuit.

Adhering to standards ensures acceptable power quality for both providers and users. Cooperation among users, manufacturers, and companies leads to longer equipment life and cost savings. The following table lists published power quality standards to which the Company and its customers must adhere to ensure acceptable power quality.

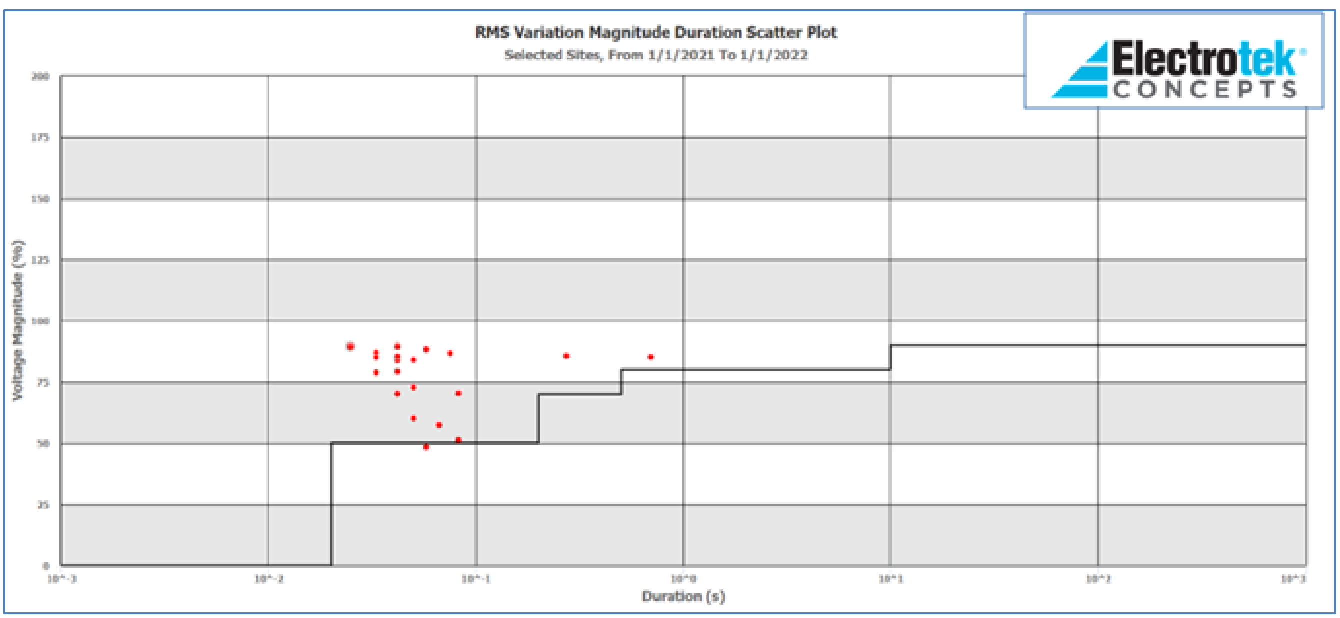
Power Quality Introduction - 1C.1(Table 1) PacifiCorp Engineering Handbook	
Power Quality Standard	**Description**
1C_2_1_PF.pdf (rockymountainpower.net)	Normal voltage levels, overvoltage, undervoltage
1C.3.1 (rockymountainpower.net)	Limits of phase-phase variation in voltages
1C.4.1 (rockymountainpower.net)	Voltage and current waveform distortion
1C.5.1 (rockymountainpower.net)	Repetitive sags and other voltage variations
1C.6.1 (rockymountainpower.net)	Descriptions of brief voltage variations and the disturbance events that cause them

1.1 Voltage Sag

Electrical system faults occur when there is a short-circuit on the electrical system. Faults can cause direct outages to customers if they are located on a line that is faulted. Customers can also be affected indirectly by a fault, as the fault will cause a voltage sag to lines adjacent to or electrically close to the faulted line.

Faults occur when lightning hits the line, power lines slap together from excessive wind, or when a power line falls to the ground, such as when a power pole is hit by a vehicle. They also occur when tree branches contact the power lines, such as during a windstorm; and they occur during a rainstorm when a substantial amount of dust is stirred up, thus compromising the effectiveness of the line insulators. The clearing of these faults is necessary to prevent catastrophic damage to the electrical system and maintain the power quality. The Company implements industry best practices to clear faults quickly and prevent faults from occurring. Because faults are an inevitable occurrence on the system, often beyond the Company's control, the Company encourages customers to develop processes to accommodate for riding through fault-caused voltage sags.

The Company advises customers to implement voltage sag ride-through protocols to prevent equipment interruptions. Strengthening control and low voltage systems can enhance site ride-through capability. Instead of CBEMA or ITIC, the Company recommends using the SEMI-F47 guideline. In SEMI-F47 plots, events below the line will likely cause customer equipment to trip offline. It is recommended that customers strive to have processes ride through events above the line.



1.2 Steady State Voltage

The regulation of the voltage magnitude on the transmission network is defined in the voltage range table below. Steady state transmission network voltage should operate within the baseline permissible voltage ranges as noted.

Voltage classification - 1B.1 (2. Definitions) PacifiCorp Engineering Handbook		
Voltage Range	**Network Classification**	**Subclassification**
230 kV & Above	Transmission	Extra High Voltage (EHV)
46 – 161 kV	Sub transmission	High Voltage (HV)
1 – 34.5 kV	Distribution	Medium Voltage (MV)
Less than 1kV	Service	Low Voltage (LV)

Permissible voltage range for the transmission network. 1.B.3 (3.2 Voltage Ranges) PacifiCorp Engineering Handbook				
Operating Mode	**Normal Operation**		**Outage Conditions[2]**	
System Configuration	**Looped**	**Radial**	**Looped**	**Radial**
Max Voltage	1.06[1]	1.06[1]	1.10	1.10
Min Voltage	0.95	0.90	0.90	0.85

Voltage for Generators Interconnecting with the Company System

All non-company-owned generation entities that interconnect with the Company system, such as Qualifying Facilities (QFs) and Independent Power Producers (IPPs), must include language in their contract that defines the voltage profile requirements to be held under specific system conditions. Generators causing voltages outside of permissible ranges will be required to mitigate their operation to comply with standard voltage ranges as identified in Company business practices, Western Electricity Coordinating Council (WECC) and North American Electric Reliability Corporation (NERC) standards.

1) In some situations, voltages may go as high as 1.08 pu at non-load buses, contingent upon equipment rating review.
2) Voltages immediately after a system emergency may fall outside these ranges before system adjustments occur to bring the voltage level up to, or above the minimum acceptable level, or down to, or below the maximum acceptable level.

1.3 Light Flicker

Repetitive voltage fluctuations alter the quality of lighting as perceived by customers. Repetitive voltage fluctuations are addressed by IEEE 1453. PacifiCorp's policy that flicker events caused by fluctuating voltage under any load on its power system shall not exceed the Pst or Plt (flicker in the short term and flicker in the long term respectively) values shown in the Flicker Compatibility table below. Specific tools for planning of a large fluctuating loads are found in IEEE 1453.1. Individual compatibility problems between existing low voltage and medium voltage customers are resolved at the Pst = 1.0 level, and future medium voltage installations are more conservatively planned for the Pst = 0.9 level.

Flicker Compatibility and Planning Levels. 1C.5.1 (4.1.4 Specific Flicker Limits) PacifiCorp Engineering Handbook			
	Compatibility Levels	Planning Levels	
Voltage Level	LV & MV	MV	HV & EHV
Pst	1.0	0.9	0.8
Plt	0.8	0.7	0.6

IEEE methodology permits the limits to be exceeded between 1% and 5% of the time over a one-week measurement period. If the times-of-day of exceedance were objectionable, such as during the evenings when many people had lights turned on in their homes, then the 1% limit is held. If the fluctuating load could commit to nighttime exceedance, then the Pst limit can permit a 5% exceedance. If the large flickering loads cannot ensure nocturnal operation, then the 1% exceedance limit is enforced.

1.4 Harmonics

Voltage and Current Distortion

Harmonic distortion is commonly produced by customer equipment injecting electrical noise into the power system. This will degrade PacifiCorp's service to other customers. Maintaining electrical noise within tolerable limits will allow PacifiCorp to provide quality electrical service to all its customers. The customer shall take necessary action, at the customer's sole expense, for the customer's facility to stay within these limits.

Voltage Harmonic Distortion Limits

It is the Company's responsibility to provide quality voltage to all its customers. Customers keeping their current distortion within limits of 1C.4.1 in the PacifiCorp engineering handbook and corresponding IEEE 519 guidelines will allow the Company to provide this service. This service is defined as voltage having distortion levels within the limits of the Voltage Total Harmonic Distortion (VTHD) limits table below. During start-ups, shutdowns, or unusual non-steady state conditions these limits may be exceeded up to 50%.

Voltage THD limits. 1C.4.1		
Bus Voltage at PCC	**Individual Harmonic Voltage Distortion (%)**	**Total Voltage Distortion THD (%)**
1.0 ≤ 69kV	3.0	5.0
69 kV < V_{rms} ≤ 161 kV	1.5	2.5
V_{rms} > 161 kV	1.0	1.5

Current Total Demand Distortion Limits

Current distortion occurs when customer equipment draws current from the utility in a nonlinear or choppy manner. It always produces harmonics in the load current waveform and can produce significant harmonics in the voltage waveform at the point of common coupling and elsewhere.

Determination of current total demand distortion (CTDD) requires the collection of site's load current I_L and the I_{SC} to determine the I_{SC}/I_L ratio. A higher ratio permits a greater Total Demand Distortion (TDD) value. Determination of compliance to the IEEE 519 standard is completed on a case-by-case basis if VTHD is found in an area is found to be out of compliance. If compliance of a site needs to be determined, the statistical analysis of 1C.4.1 Section 8 is used to determine acceptable exceedances and enforcement.

- Measured over a period of 24 hours, 99th percentile very short time (3 sec.) harmonic currents should be less than 2.0 times the values given in 1C.4.1 in the PacifiCorp engineering handbook.
- Measured over a period of 7 days, 99th percentile short time (10 min.) harmonic currents should be less than 1.5 times the values given in 1C.4.1 Section 8

Measured over a period of 7 days, 95th percentile short time (10 min.) harmonic currents should be less than the values given in Section 8

1.5 Voltage Balance

The Company's baseline for voltage imbalance is found in Appendix D of ANSI Std. C84.1, Voltage Ratings for Electrical Power Systems and Equipment. The electric supply systems are designed and operated to a maximum voltage imbalance of three percent when measured at the electric utility revenue meter while unloaded.

2 Equipment for Assessing Power Quality

Summary description of the equipment the qualified utility uses to assess Power Quality.

2.1 Monitor/Meter Types and Accuracy

ION 8650 B meter
- ANSI Class 0.1 and IEC 62053-22 Class 0.2 S metering

GE KV2C meter
- ANSI C12.20 Class 0.2%

Nexus 1252 monitor
- ANSI C-12 and IEC 687

Nexus 1500 monitor
- ANSI C12.20 Class 0.2 and IEC 62053-22

Shark 250 monitor
- ANSI C12.20 0.1 CL and IEC 62053-22 0.2S

SEL 735 monitor
- ANSI C12.20-2015 Class 0.1 and IEC 62053-22

Revolution monitor
- Voltage 0.33% with 1MHz sample rate
- Current 1.0% with 250kHz sample rate (clamp on CT)

3 Procedures and Standards for Assessing Utility-Scale Interconnections

This section is a description of the procedures and standards the qualified utility will use to assess an interconnection request to decrease the risk that the interconnected utility-scale generation facility will adversely affect electrical power delivery quality to customers.

3.1 Policy 139

PacifiCorp's Policy 139 addresses the technical requirements for generation facilities, transmission facilities, and end-user facilities that are interconnected with PacifiCorp's transmission system. This policy seeks to ensure that adverse impacts on reliability and power quality of the transmission system are avoided. Technical studies described in this policy will determine whether PacifiCorp will be required to modify its transmission system to interconnect the requested facilities. PacifiCorp's requirements specified in this policy are designed to protect PacifiCorp facilities and maintain grid reliability and power quality standards pursuant to applicable reliability criteria and industry power quality standards.

PacifiCorp may revise the technical requirements periodically to comply with new requirements from FERC, NERC, state, and other governmental authorities. PacifiCorp may require that all generator, transmission line, and end-user interconnections comply with new regulations by implementing similar procedures and/or upgrades as would be expected on PacifiCorp facilities in a non-discriminatory manner. If the interconnection customer does not comply, PacifiCorp may require an upgrade of the interconnection customer's facilities as necessary to be compliant.

PacifiCorp and/or its consultants conduct all electric system studies and issue reports required by FERC, NERC, RRO, PacifiCorp, and any other regulatory body for authorization and justification of the proposed interconnection to the PacifiCorp electric system. An interconnection study report or a system impact study shall describe the effects of an interconnection on the underlying transmission system.

The customer shall design their facility to meet all current reliability standards and the requirements described in PacifiCorp's Engineering Handbook Section 1B.4, Reliability Criteria for System Planning. The customer shall not cause the PacifiCorp electric system to violate PacifiCorp power quality standards as referenced in section 1 of this report.

3.2 Other Technical Studies

Under infrequent circumstances, other technical studies not described in Policy 139 may be required to ensure adverse effects to the transmission system are not caused by an interconnection or multiple interconnections. This section briefly describes the situation under which these studies may be required, and their general purpose and content.

3.2.1 Voltage Coordination Studies

PacifiCorp performs voltage coordination studies where there are multiple generating resources along with shunt devices that can impact the voltage of the transmission system in the area. These studies are generally conducted when there are multiple resources interconnecting either at the same bus or in a very close electrical proximity of each other.

3.2.2 Sub-synchronous Resonance Study

Sub-synchronous resonance (SSR) is an infrequent issue in the power system but can manifest when synchronous generators are in proximity to the series compensated transmission lines that may cause SSR in generators. SSR can lead to electrical instability at sub-synchronous frequencies and potential equipment failures. Studies are performed when synchronous generators are proposed to be interconnected in proximity to series compensation transmission lines.

3.2.3 Sub-synchronous Torsional Interaction Study

Sub-harmonic currents introduced by large variable frequency drives (VFD) can excite the torsional natural frequencies of the power generation train. This may lead to an unstable resonance effect with growing torsional oscillation, which could reduce plant reliability or damage the rotating equipment. This phenomenon is known as sub-synchronous torsional interaction (SSTI). Sub-synchronous torsional interaction can also occur when generation is near a series compensated transmission line. The need for the sub-synchronous torsional interaction study may be triggered if factors such as interconnecting close to a series compensated transmission line or interconnecting close to a load using VFD are present.

3.2.4 Sub-synchronous Control Interaction Study

Sub-synchronous control interaction (SSCI) is a stability problem caused by the interaction between the control system of a generator and a series-capacitor compensated electrical network. Studies are performed when inverter-based resources are proposed to be interconnected in proximity to series compensation transmission lines.

4 Procedures and Standards to Address Power Service Quality Issues

A description of the procedures and standards the qualified utility will use to address adverse effects to electrical power service quality that are caused by interconnected customer-owned generation systems, including instances where the adverse effects are discovered after the time of interconnection;

4.1 Power Quality Investigations

A database system provides email notifications of voltage sag events on the Company's transmission network below the SEMI-F47 curve. The Company reviews the events captured in the database monthly to identify causes and locations requiring additional investigation.

If a power quality complaint is submitted by a customer, a power quality monitor is set at the customer's point of common coupling for 7 days. The 7-day recording provides the requisite data for evaluations using Company power quality standards.

1) Voltage Deviations – PacifiCorp Engineering Handbook 1C.5.1-4.2
    a. The permitted magnitude of the attached load's ability to deviate from the voltage is identified and reviewed in an assessment.
    b. An assessment is done to ensure that the monitored load is not causing the issue.
2) Voltage Fluctuations and Light Flicker – PacifiCorp Engineering Handbook 1C.5.1-4.1.4
    a. The statistical analysis identified in the standard determines whether the utility is supplying voltage fluctuations that would induce light flicker beyond the acceptable limit.
3) Voltage and Current Harmonics – PacifiCorp Engineering Handbook 1C.4.1 (Table 2 & 3)
    a. Harmonics are recorded to generate daily and weekly IEEE 519 reports.
    b. The assessment is applied to the utility supply and the load's current profile to ensure that the utility is not supplying distorted voltage and that the load is not injecting excessive harmonics.

If corrective action is needed, the owner of the offending equipment is notified that current operations of the equipment are not within Company standards. The operator of the equipment is required to provide a solution. If the offending equipment's impact is not remedied the qualifying utility will engineer and install a solution at the expense of the owner of the offending equipment.

4.2 Other Technical Studies

If an issue is identified where either the cause or the source of the power quality concern is unidentifiable, a special study as reported in section 3 is customized to address the issue. The special study will identify mitigation and the Company will work with customers or internal processes to enact mitigation.

5 Preventive Programs and Proposed Modifications

A description of proposed modifications or upgrades to facilities and preventive programs the qualified utility will implement to address any electrical power delivery quality issues that do not meet the qualified utility's interconnection policy or relevant Industry Standards.

5.1 Power Quality Monitoring Programs

Power quality data from accessible meters is logged into the Company's power quality database. Depending on the type of meter providing the data, additional portable meters may be installed to supplement the available data. The power quality database is queried by power quality engineers regularly for data falling outside of power quality standard parameters. As abnormal conditions are discovered, a power quality investigation is initiated to find and mitigate issues to prevent equipment or system damage.

In addition, phasor measurement units (PMUs) are installed at generation interconnections greater than 75 MVA. The PMUs continually measure and store the generator's voltages and currents for at least 90 days. This provides an additional source for data that can be used in power quality investigations.

5.2 Proposed Modifications or Upgrades to Facilities

As power delivery quality issues are identified, the Company and/or customer can mitigate issues with several solutions. Below is a sampling of solutions that can improve electric power delivery quality, the implementation of which will depend on the parameters of the service quality issues.

5.2.1 Statcom

A Static Synchronous Compensator (STATCOM) is a power electronic device used in electrical systems to control reactive power flow and stabilize voltage. It operates as either a source or sink of reactive AC power, dynamically adjusting to demand. STATCOMs offer grid support during fault conditions or contingency events, and they utilize voltage-source converters to enhance power quality and manage reactive power.

5.2.2 Static Var Compensator

A Static Var Compensator (SVC) is a shunt-connected device used in electrical power systems. Its purpose is to maintain or control bus voltage. The SVC achieves this by exchanging capacitive or inductive current, relying on thyristors to rapidly operate capacitors and inductors to maintain steady voltage during transient voltage events.

5.2.3 Voltage Coordination Controls

Voltage coordination controls refer to strategies and mechanisms used in electrical power systems to manage and regulate voltage levels. There are two main strategies, local control and centralized coordination. Local control focuses on individual components within the system, such as voltage regulators or capacitors, to maintain voltage stability at specific locations. Centralized coordination control decisions are made at a central point based on system-wide information. It ensures coordinated voltage control across multiple devices.

5.2.4 Customer Ride-through Equipment

Voltage ride-through for customer loads focuses on ensuring that electrical equipment and facilities can withstand voltage disturbances without disconnecting. Customer loads, especially sensitive equipment like computers or manufacturing processes, require a certain voltage level to operate correctly. Ride-through capabilities ensure that these loads remain connected during short periods of low voltage, preventing disruptions. Voltage ride-through solutions vary based on load type, criticality, and specific requirements. Examples of specific solutions include uninterruptible power supplies, ultra capacitors, robust voltage settings and intelligent devices that control motor tripping.

5.2.5 Harmonic Filters

Harmonic filtering is used to enhance power quality by reducing the detrimental effects of harmonics in electrical systems. It uses passive or active filters that utilize resistors, inductors, and capacitors to eliminate unwanted harmonic frequencies.