STATE OF CALIFORNIA GAVIN C. NEWSOM., *Governor*

PUBLIC UTILITIES COMMISSION
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October 16, 2024 SA2024-1232

Mr. Jonathan Moulton
Director of Asset Management
PacifiCorp
825 NE Multnomah St Suite 1700
Portland, OR 97232

SUBJECT: Facilities Audit of PacifiCorp's Klamath Falls Substations

Mr. Moulton:

On behalf of the Electric Safety and Reliability Branch (ESRB) of the California Public Utilities Commission (CPUC), Joe Murphy and Nora Nguyen conducted an audit of PacifiCorp's Klamath Falls Headquarters substation facilities from August 12 to 16, 2024. During the audit, ESRB staff conducted field inspections of PacifiCorp's substation facilities, equipment and reviewed pertinent documents and records.

As a result of the audit, ESRB staff identified violations of General Order (GO) 174. A copy of the audit findings itemizing the violations and observations is enclosed. Please provide a response no later than November 15, 2024, via electronic copy of all corrective actions and preventive measures taken by PacifiCorp to correct the identified violations and prevent the recurrence of such violations.

Please note that ESRB will be posting the audit report and your response to our audit on the CPUC website. If there is any information in your response that you would like us to consider as confidential, we request that in addition to your confidential response, you provide us with a public version (a redacted version of your confidential response) to be posted on our website.

If you have any questions concerning this audit, please contact Joe Murphy at (415) 308-4159 or muj@cpuc.ca.gov.

Sincerely,

Rickey Tse, P.E.
Program and Project Supervisor
Electric Safety and Reliability Branch

Safety and Enforcement Division
California Public Utilities Commission

Enclosure: CPUC Substation Audit Report for PacifiCorp Substation facilities.

Cc: Lee Palmer, Director, Safety and Enforcement Division (SED), CPUC
Nika Kjensli, Program Manager, ESRB, SED, CPUC
Fadi Daye, Program and Project Supervisor, ESRB, SED, CPUC
Yi (Rocky) Yang, Senior Utilities Engineer (Supervisor), ESRB, SED, CPUC
Joe Murphy, Utilities Engineer, ESRB, SED, CPUC
Nora Nguyen, Utilities Engineer, ESRB, SED, CPUC
Eddie Summitt, Director, Power Delivery Asset Maint. and Compliance, PacifiCorp

PACIFICORP, KLAMATH FALL HEADQUARTERS
SUBSTATION AUDIT FINDINGS
AUGUST 12-16, 2024

I. Records Review

During the audit, Electric Safety and Reliability Branch (ESRB) staff reviewed the following records:

- List of all substations/switching stations operated by PacifiCorp's Klamath Falls Headquarters (PacifiCorp).
- Map showing all substations/switching stations operated by PacifiCorp.
- PacifiCorp Substation Inspection and Preventative Maintenance Guidelines
- PacifiCorp Substation Infrared Inspection Guidelines
- PacifiCorp Diagnostic Guidelines for Dissolved Gas-in-oil Concentration Limits (Oil Guidelines)
- PacifiCorp Substation Preventative Maintenance Guidelines
- PacifiCorp Counter Logs
- PacifiCorp Battery System Operation and Maintenance Checks
- List of all PacifiCorp substation inspections conducted from June 2019 through May 2024.
- Last two visual inspection checklists for each PacifiCorp substation.
- List of all open/pending, completed, cancelled, and late work orders and maintenance items from June 2019 through May 2024.
- Equipment lists for each PacifiCorp substation.
- Single-line diagrams for each PacifiCorp substation.
- List of transformer banks that operated beyond nameplate capacity from June 2019 through May 2024.
- Infrared Testing records from June 2019 through May 2024.
- Most recent oil sample test results from June 2019 through May 2024.
- Most recent electric test results from June 2019 through May 2024.

II. Records Violations

ESRB observed the following violations during the record review portion of the audit:

1. **General Order (GO) 174, Rule 12, General** states:

   "These rules are not intended as complete specifications, but embody only minimum requirements that will promote safety and enable adequacy of service.

   Substations shall be designed, constructed and maintained for their intended use, regard being given to the conditions under which they are to be operated, to promote the safety of workers and the public and enable adequacy of service.

   Design, construction and maintenance should be performed in accordance with accepted good practices for the given local conditions known at the time by those responsible."

   a) PacifiCorp Infrared Scanning of In-Service Equipment, Asset Management Procedure No. 346 (Proc. 346) lists conditions and measurements to be recorded during IR inspections.
      i. Section 4 states, "As the primary source of heat is the flow of current (loading), it is critical to record the amperes or kVA loading while inspecting."[1]
         1. No provision for recording equipment loading is provided on PacifiCorp's SF-SINF Infrared Inspection Form (Inspection Form).[2]
         2. No record of equipment loading was listed in PacifiCorp's Infrared Testing Results.[3]

   b) PacifiCorp's Proc. 346 lists conditions and measurements to be recorded during IR inspections.
      i. Section 4 states, "While scanning can be conducted at lesser loading levels (<100% peak) and other ambient conditions (>15 deg. C), an engineering analysis may be required to properly interpret the data collected and estimate maximum potential temperature levels."[4]
         1. No provision for recording ambient conditions is provided on the Infrared Inspection Form.[5]
         2. No record of ambient conditions was listed in PacifiCorp's Infrared Testing Results.[6]

[1] Preaudit data request responses: CPUC Pre-Audit Data Request, #4-Procedures,#4e Station Infrared Testing, Procedure 346 - Substation Infrared Testing
[2] Preaudit data request responses: CPUC Pre-Audit Data Request, #4-Procedures,#4e Station Infrared Testing, SF-SINF Infrared Inspection Form
[3] Preaudit data request responses: CPUC Pre-Audit Data Request, #11a Infrared Testing Results, all substations.
[4] Preaudit data request responses: CPUC Pre-Audit Data Request, #4-Procedures,#4e Station Infrared Testing, Procedure 346 - Substation Infrared Testing
[5] Preaudit data request responses: CPUC Pre-Audit Data Request, #4-Procedures,#4e Station Infrared Testing, SF-SINF Infrared Inspection Form
[6] Preaudit data request responses: CPUC Pre-Audit Data Request, #11a Infrared Testing Results, all substations.

c) PacifiCorp Proc. 346 lists conditions and measurements to be recorded during IR inspections.

i. Section 5 states, "The measured temperature of the equipment or connection scanned, the rise above ambient temperature of the equipment or connection scanned, and the relative difference between system components carrying the same current are all critical to understanding the system condition and recommended corrective actions."[7]

1. The "Results" column on Inspection Form called entries of A: Acceptable, C: corrected, U: unacceptable, NA: not applicable.[8]
   a) The available entries are not defined in Section 5 (noted above).
   b) The available entries do not align with the callouts in Inspection Procedure.[9]
      i. The Inspection Procedure states, "temperature rise <XX> degrees Celsius or greater shall be reported immediately." But does not specify inspector notation or actions.

d) PacifiCorp's Infrared Testing Results for the Cedarville, Perez, Tulelake, and Tunnel substations show an inconsistent use of "NA" entries from one inspection to the next without comments or explanation. [10]

i. Cedarville:
   1. Surge arrester: 2019: A, 2021: A, 2023: NA
   2. Transformer cooling: 2019: NA, 2021: A, 2023: NA

ii. Perez:
   1. Capacitor banks: 2019: NA, 2021: A, 2023: NA
   2. Load Tap Changer: 2019: NA, 2021: A, 2023: A

iii. Tulelake
   1. Control Room: 2020: NA, 2022: A

iv. Tunnel
   1. Capacitor Bank: 2019: NA, 2021: A, 2023: NA

During the audit, PacifiCorp indicated that consistency in "NA" notation and comments are part of ongoing inspector training.

e) PacifiCorp's Substation Inspection Expectations and Guidelines, Section 14, states in part, " 3. If the circuit breaker counter has increased, check the relay targets and station logbook to determine how many circuit breaker operations are switching operations versus fault operations, and update the counter and fault operations on the

[7] Preaudit data request responses: CPUC Pre-Audit Data Request, #4-Procedures,#4e Station Infrared Testing, Procedure 346 - Substation Infrared Testing
[8] Preaudit data request responses: CPUC Pre-Audit Data Request, #4-Procedures,#4e Station Infrared Testing, SF-SINF Infrared Inspection Form
[9] Preaudit data request responses: CPUC Pre-Audit Data Request, #4-Procedures,#4e Station Infrared Testing, SP-SINF Infrared Inspection Procedure
[10] Preaudit data request responses: CPUC Pre-Audit Data Request, #11a Infrared Testing Results, Cedarville, Perez, Tulelake, and Tunnel substations.

circuit breaker/relay card."[11] Incorrect entries with missed fault counts were recorded at (see Figure 1 a, b, c):

i. Alturas Substation, Feeder 2L22
ii. Clear Lake Substation, Feeder 5L66
iii. Newell Substation, Transmission Circuit Breaker 3L25

Figures 1 a, b, c. Counter card entry errors for Alturas, Clear Lake, and Newell Substations

ESRB notes that the Relay Operations cards at each site were corrected in the field.

f) PacifiCorp's Counter PMs from Policy 001-PP lists maintenance fault operations for various equipment types.[12] Incorrect equipment fault operation records were found for the substations: [13]

i. Alturas, CKB 2L22. See Figure 2.
ii. Newell, CKB2720 3L25. See Figure 3.

Inspecti	Reported By	Inspection Question	Form Name	Reported Date	Asset Description
45	P20924	Fault Counter (pole 1)	Substation Breaker Gas (Major)	5/7/2024	ALTURAS CKB 2L22
45	P20924	Fault Counter (pole 2)	Substation Breaker Gas (Major)	5/7/2024	ALTURAS CKB 2L22
45	P20924	Operations Counter (breaker) (pole 3)	Substation Breaker Gas (Major)	5/7/2024	ALTURAS CKB 2L22
418	P20924	Fault Counter (pole 3)	Substation Breaker Gas (Major)	5/7/2024	ALTURAS CKB 2L22
418	P20924	Operations Counter (breaker) (pole 1)	Substation Breaker Gas (Major)	5/7/2024	ALTURAS CKB 2L22
428	P20924	Operations Counter (breaker) (pole 2)	Substation Breaker Gas (Major)	5/7/2024	ALTURAS CKB 2L22

Figure 2 Alturas breaker record. Note error in Operations Counter (pole 3) and Fault Counter (pole 3)

Inspection Numeric Result	Reported By	Inspection Question	Reported Date	Asset Description
1	P20924	Fault Counter (pole 2)	5/14/2024	NEWELL CKB2720 3L25
106	P20924	Fault Counter (pole 1)	5/14/2024	NEWELL CKB2720 3L25
106	P20924	Fault Counter (pole 3)	5/14/2024	NEWELL CKB2720 3L25
106	P20924	Operations Counter (breaker) (pole 2)	5/14/2024	NEWELL CKB2720 3L25
142	P20924	Operations Counter (breaker) (pole 1)	5/14/2024	NEWELL CKB2720 3L25
142	P20924	Operations Counter (breaker) (pole 3)	5/14/2024	NEWELL CKB2720 3L25

Figure 3 Newell breaker record. Note Fault Counters (poles 1 and 3)

[11] Preaudit data request responses: CPUC Pre-Audit Data Request, #12 Training Records, Inspector Training Guidelines, p. 5.
[12] Preaudit data request responses: CPUC Pre-Audit Data Request, #4 Procedures, #4h Counter Results, Counter PMs from Policy 001-PP, Apparatus Tab
[13] Preaudit data request responses: CPUC Pre-Audit Data Request, #5 Substation Inspections, Substation Inspection Result Report

ESRB acknowledges that PacifiCorp is initiating the use of Maximo data entry tool. Per PacifiCorp, Maximo will scan data entries for errors and flag values such as non-sequential counter readings.[14]

2. **GO 174, Rule 33.1 Records** states:

> *"Electronic or hard copy records of completed Inspections shall include, at a minimum:*
> - *Inspector name or identification*
> - *Inspection date*
> - *Brief description of identified discrepancies*
> - *Condition rating (where applicable)*
> - *Scheduled date of corrective action (where applicable)."*

Neither PacifiCorp's Substation Open nor Completed Work Order records include the Condition Rating (Priority) or a Scheduled date of corrective action from work orders initiated from inspections.[15] GO 174, Rule 33.1 specifically requires condition ratings and scheduled dates of corrective action to be recorded for non-conformances generated from inspections but PacifiCorp's list of Preventative Maintenance (PM), Corrective Maintenance, and Capital work orders do not identify the source of the work order.[16] PacifiCorp must make entries for all required records in accordance with GO 174, Rule 33.1.

Due to the lack of condition ratings and scheduled dates of corrective action, ESRB is unable to assess the timeliness of PacifiCorp's response to non-conformances. ESRB reviewed PacifiCorp's 585 Work Orders and found 69 work orders either closed after one year or pending/still open for more than 1 year. Additionally, ESRB noted 21 entries with errors which did not allow analysis of compliance.[17] See Table 1.

Table 1: Work Orders, Closed or Still Open after One Year

Category	Entries	Closed after more than one year	Pending, open for more than one year*	Entry errors**
PM	462	4	12	13
CM	59	12	4	4
Capital	64	19	18	4
Total	**585**	**35**	**34**	**21**

* As of May 31, 2024, record close date for the audit.
**Errors such as completion date before entry date, entry after current date, etc.

[14] PacifiCorp follow up to a request for clarification, email dated 10 Sept 2024.
[15] Preaudit data request responses: CPUC Pre-Audit Data Request, #6 – List of Maintenance Items, CM_PM_CAP Order List
[16] Ibid.
[17] Ibid.

Examples of work orders, either completed after one year, or still open after one year are shown in Table 2.

Table 2: Examples of Work Orders, Closed or Still Open after One Year

Category	Order Number	Description	Order Call Date	Order Close Date	Days Elapsed[#]
PM	105558	Relay Maintenance	7/12/2019	Open	1,785
PM	780619	CKB Inspect and Op	1/2/2019	7/10/2020	555
CM	301054	5L78 PCM Trblshoot	7/15/2022	Open	685
CM	984045	5L68 blown arrestor	9/1/2016	2/4/2020	1,251
Capital	10075083	T-3520 Bank #1 LTC Controller	5/24/2021	Open	1,103
Capital	10071442	Replace 3L25 bushings	2/4/2020	2/26/2024	1,483

[#] For open work orders, as of May 31, 2024, record close date for the audit.

3. **GO 174, Rule 30.1 General** states:

> *"Each Operator shall establish, update as needed, and follow an Inspection Program. At a minimum, this Program shall specify for each piece of equipment and system listed in Rule 32.1*
> - *Inspector activities*
> - *Frequency of Inspections*
> - *Record keeping and retention "*

PacifiCorp's Policy 001-PP and other procedures[18] do not list a record retention period. PacifiCorp must establish and publish a record retention period for its inspection program. Note that GO 174, Rule 33.2 requires records of completed inspections to be retained for not less than five years.

4. **GO 174, Rule 30.2 General** states:

> *"Inspections shall be performed by persons who, by reason of training, experience and instruction, are qualified to perform the task."*

PacifiCorp requires journeyman level electrician and on the job training with more senior staff to provide inspectors with background to perform their required duties. PacifiCorp does not maintain a required continuing education or tracking of training to staff. ESRB noted at least two areas where a lack of uniform and traceable training has caused PacifiCorp to have diverging practices:

- Infrared inspection comments

[18] Preaudit data request responses: CPUC Pre-Audit Data Request, #4 – Procedures, #4c – Latest Sub Inspection Documents.

- Use and placement of warning tags (e.g. Do Not Operate or gate tags) as enhanced fire risk setting alerts.

PacifiCorp must establish training programs that assure uniformity in the inspection process.

III. Field Inspection

During the field inspection, ESRB inspected the following 9 substations:

Substation	City
Macdoel Substation	Macdoel
Dorris Substation	Dorris
Alturas Substation	Alturas
Cedarville Substation	Cedarville
Perez Substation	Perez[19]
Clear Lake Substation	Clear Lake
Newell Substation	Newell[20]
Tulelake Substation	Tulelake
Tunnel Substation	Tulelake

[19] See station sign location error noted by station name below.
[20] Ibid.

IV. Field Inspection – Violations List

ESRB observed the following violations of GO 174, Rule 12 during the field inspection:

GO 174, Rule 12, General states in part:

"…Substations shall be designed, constructed and maintained for their intended use, regard being given to the conditions under which they are to be operated, to promote the safety of workers and the public and enable adequacy of service.

Design, construction, and maintenance should be performed in accordance with accepted good practices for the given local conditions known at the time by those responsible."

1. Macdoel Substation

1.1. Touch potential between down guy and fence. Down guys are within 5 feet of station perimeter fence. No evidence that exterior structures are attached to the station ground grid. [21] [22]

[21] PacifiCorp's Engineering Handbook 6B.6 section 4.2.1 calls for the peripheral ground conductors to be installed four feet outside the fence, parallel with the fence. The down anchors noted here are within touch potential and outside the peripheral ground.

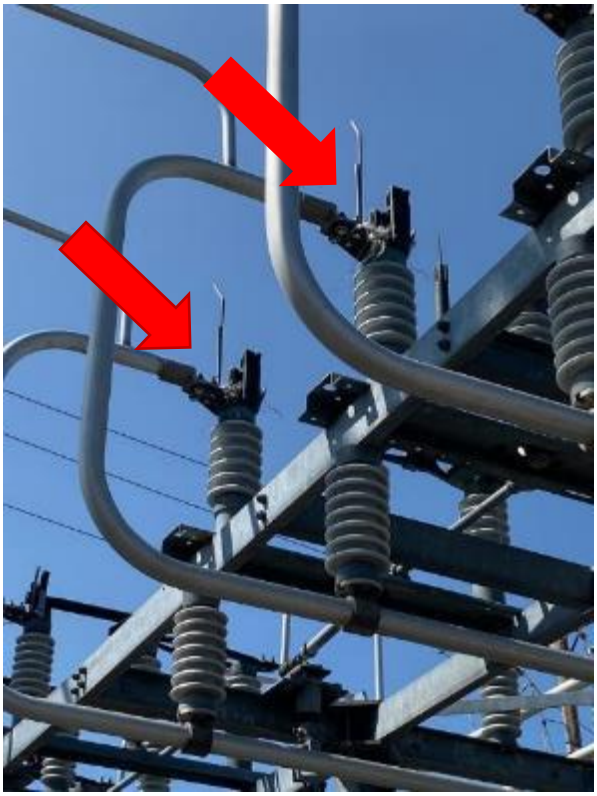
[22] Station drawings PD-19353_pg1, et al supplied by PacifiCorp in response to post audit questions. Received by ESRB on 6 Sept 2024. Station drawings supplied to ESRB do not show a connection between the down guy anchor external to the station fence and the ground plan of the stations.

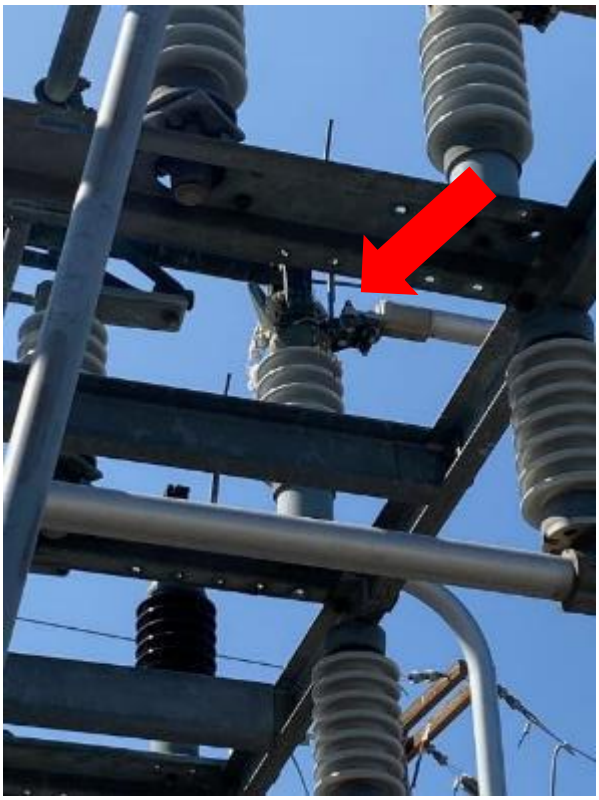
1.2. Station fence has an unattached ground wire.

1.3. Transformer 3520 has an oil leak.[23]

[23] PacifiCorp notes that work orders were opened and closed for cleaning the leak, but not to repair the leak.

1.4. Switch 4L4 phases A and B have bird nests. Switch 4L5 phase B has a bird nest.





1.5. Station batteries have no provision for containing spilled electrolytes, and the metal battery rack is not grounded.[24]

[24] National Electric Safety Code (NESC 2017), Part 1 Section 14, Item 143. Racks, states in part, "Racks made of metal shall be grounded."

ESRB notes that Berkshire Hathaway Energy (BHE, parent company of PacifiCorp) has no requirement for secondary containment for batteries. [25] National Electric Safety Code calls for provisions to contain spilled electrolytes. [26] Containing electrolytes be accomplished by secondary containment, dams, absorbent materials, or spill pillows.

Additionally, BHE's Substation Equipment—Flooded Lead-Acid Stationary Batteries EBU-BT-S01 states, "Racks shall have holes or brackets suitable for fastening the rack unit to the wall and ground surfaces. The battery rack shall have provisions for grounding".[27] PacifiCorp states that the rack was installed prior to the issuance of EBU-BT-S01 (Dec 2020) and believes the grounding requirement should be grandfathered.[28] As the NESC requirement for battery rack grounding predates the BHE document, prior revisions of the Flooded Lead-Acid Stationary Batteries rack standard should require grounding of the battery rack. No installation date of the battery rack was provided.

1.6. Station has abandoned ground rod causing a tripping hazard 1 foot outside fence perimeter. The rod may also be a touch potential hazard.

1.7.12/20 kV Transformer placed on temporary timbers and not secured onto a foundation.

[25] PacifiCorp response to CPUC follow up requests, email dated 22 August 2024.
[26] NESC 2017, Part 1 Section 14, Item 144. Floors in battery areas.
[27] Substation Equipment—Flooded Lead-Acid Stationary Batteries EBU-BT-S01, Section 4.11 Rev Dec 2020.
[28] PacifiCorp response to CPUC follow up requests, email dated 22 August 2024.

2. Dorris Substation

2.1. Counter on 5L64 does not properly index, resulting in unclear readings.

3. Alturas Substation

3.1 Station batteries have no provision for containing spilled electrolytes, and the metal battery rack is not grounded.[29]

[29] See battery rack notes at Macdoel station.

3.2 Station has an abandoned down guy anchor, an unmarked trip hazard.

3.3 Station has a greater than 4-inch gap under the security fence.

3.4 Touch potential between down guy and fence. Down guys are within 4 feet of station perimeter fence. No evidence that exterior structures are attached to the station ground grid. [30]

3.5 Station has debris and unmarked tripping hazards within the yard. Secondary service lines on ground.

[30] PacifiCorp station drawings PD-19353_pg1, see notes for Macdoel station.

3.6 115/69 kV Transformer Phase A temperature gauges are inaccurate: fluid temperature is higher than winding temperature.

3.7 Transformer 2954 Phase B is leaking.

ESRB acknowledges that PacifiCorp has an open work order (#10071240, created 31 Jan 2020) to replace the transformer bank.

3.8 Capacitor bank 238 has a bird nest.

3.9 Regulator 368117 has a broken position indicator. Issue was marked by an information tag in 2015.

3.10 Unrestrained 69kV conductors, formerly attached to equipment.

4. Cedarville Substation

4.1. “Do Not Operate” tag was improperly used to indicate fire mode enabled.[31]

[31] See also Record Review Findings, Section 4

4.2. Station has a bird nest on framing near the station transformer.

5. Perez Substation

5.1. Station sign incorrectly states location as Newell, OR.[32]

[32] Station is in California rather than Oregon; Newell is 17 miles north of this station. Latitude and longitude are approximately correct.

6. Clear Lake Substation

6.1. Station batteries have no provision for containing spilled electrolytes, and the metal battery rack is not grounded.[33]

[33] See battery rack note at Macdoel station.

6.2. Foundation is not appropriately sized for Transformer 33-8306. The footing of the transformer extends beyond the base. Transformer is not secured onto the foundation. The elevated position of the transformer puts this at an increased risk of catastrophic failure in the event the transformer shifts in a seismic event.

6.3. Transformer 33-8306 has a chipped insulator.

6.4. Part of the grounding grid is exposed inside the station. Exposed grounding grid also poses as a potential trip hazard.

7. Newell Substation

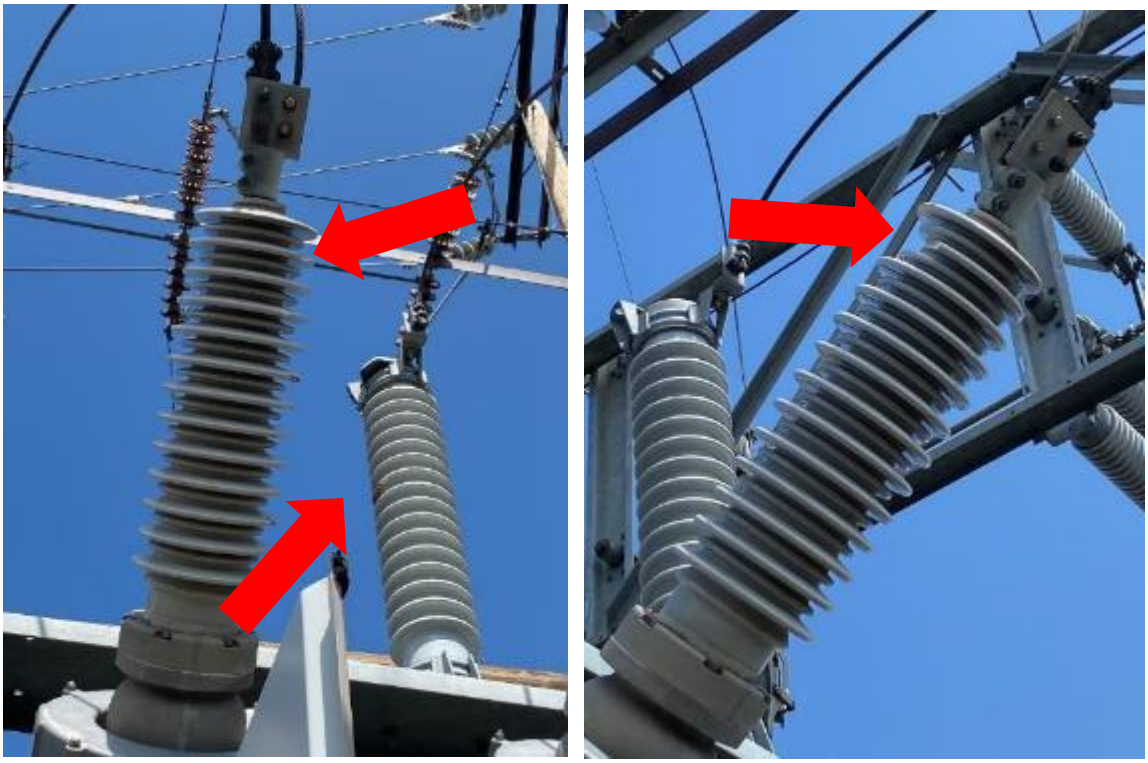
7.1. Station sign incorrectly states location as Newell, OR.[34]

7.2.Unsecured fence surrounding phone pedestal, reducing effective fence height.

[34] Station is in California rather than Oregon; latitude and longitude are approximately correct.

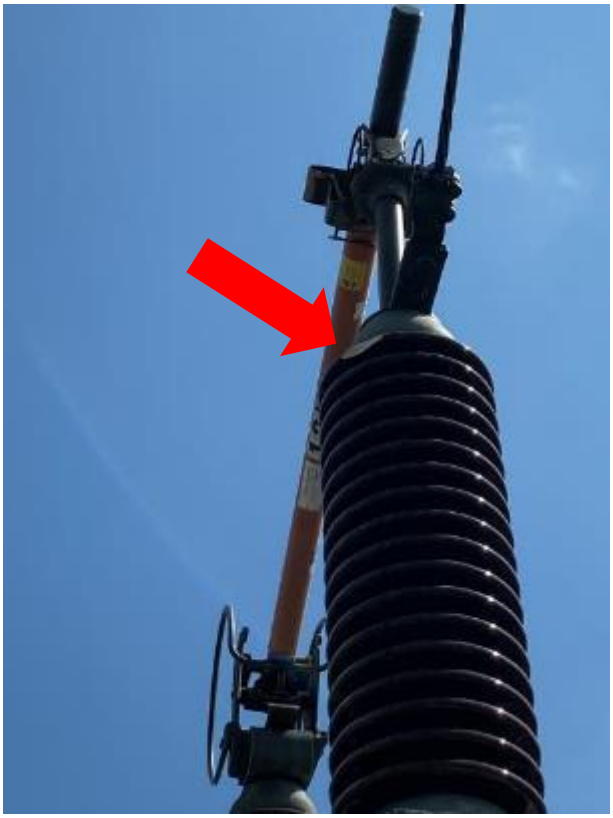
7.3. Station batteries have no provision for containing spilled electrolytes, and the metal battery rack is not grounded.[35]

7.4. Circuit breaker 3L25 has chips on three bushing insulators.



[35] See battery rack note for Macdoel station.

7.5. Transmission fuse 3L26 has a chipped insulator.



7.6. Regulator 1454 is not secured onto the foundation.

7.7. Touch potential between exterior pole reinforcement and fence. No evidence that exterior structures are attached to the station ground grid.

7.8. Circuit breaker 3L68 has a faded counter.

8. Tulelake Substation

8.1. Touch potential between down guy and fence. No evidence that exterior structures are attached to the station ground grid.

8.2. Ground wires on fence distanced approximately 70 feet apart, exceeds PacifiCorp standard for perimeter fence grounding of 50 feet. [36]

[36] PacifiCorp Engineering Handbook 6B.6 section 4.2.3

9. Tunnel Substation

9.1. Ground wires on fence distanced approximately 60-70 feet apart, exceeds PacifiCorp standard for perimeter fence grounding of 50 feet.[37]

[37] Ibid.

9.2. Unknown exposed conductor wire outside fence near interior phone box.

9.3. Regulators 372544 and 370510 have bird nests in the cooling fins.

9.4. Station is missing spare replacement PT fuses. Image below is of fuses in service at station without replacements on hand.

9.5. Grade below fence is eroding, causing a 3-inch gap.

9.6. Station exterior has an exposed ground conductor attached to the fence creating a trip hazard.

V. Field Inspection – Observations List

The area served by the PacifiCorp Klamath Falls HQ substations is in a region of higher than usual seismic activity.[38] ESRB acknowledges that transformers and regulators noted below were installed from c. 1963 to 1985 when common installation practice did not involve securing large pieces of equipment to the foundation.[39] In light of the ongoing risk that seismic events present, ESRB notes the following observations during the field inspection:

1. Perez Substation

1.1. Transformers 2819, 2818, and 2817 are not secured onto foundation.

1.2. Regulator 1212 is not secured onto the foundation.

2. Clear Lake Substation

[38] United State Geological Survey, National Seismic Hazard Maps, 2022.
[39] PacifiCorp Substation General Plans PD-19353, et al.

2.1. Transformer 2970, 3045, 3046 is not secured onto the foundation.



2.2. Regulator 296 is not secured onto the foundation.

3. Tunnel Substation

3.1. Transformers 2784, 2785, and 2786 are not secured onto the foundation.

3.2. Transformers 2942A, 2941B, and 2949C are not secured onto the foundation.