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23 COMPANY

24 UNITED STATES DISTRICT COURT  
25 NORTHERN DISTRICT OF CALIFORNIA  
26 SAN FRANCISCO DIVISION

27 UNITED STATES OF AMERICA,  
28  
29 Plaintiff,  
30  
31 v.  
32 PACIFIC GAS AND ELECTRIC COMPANY,  
33  
34 Defendant.

Case No. 14-CR-00175-WHA

**RESPONSE TO FOLLOW-UP  
QUESTIONS RE CPUC REPORT  
ON CAMP FIRE, FURTHER  
QUESTIONS TO BE ANSWERED  
BY PG&E BY DECEMBER 19 AND  
SUPPLEMENTAL QUESTION 6a**

Judge: Hon. William Alsup

1 Defendant Pacific Gas and Electric Company (“PG&E”) respectfully submits this  
2 response to the Court’s December 5, December 6 and December 16, 2019 requests for  
3 information relating to the November 8, 2019 Incident Investigation Report regarding the Camp  
4 Fire issued by the Safety and Enforcement Division (“SED”) of the California Public Utilities  
5 Commission (“CPUC”).

6 For clarity, PG&E uses the term “wear” and its variants throughout this  
7 submission to refer to material loss on a suspension hook or hanger plate resulting from relative  
8 sliding motion between those components. PG&E uses the term “hanger plate” throughout this  
9 submission to refer to any hardware on a transmission structure used to attach a C-hook or other  
10 type of suspension hook to the structure, including tower arms with “working eyes” or “rigging  
11 eyes” through which C-hooks pass. PG&E understands the terms “Incident Tower” and  
12 “Adjacent Tower”, as used in the Court’s December 5 and December 6, 2019 orders, to refer to  
13 Tower :27/222 and Tower :27/221, respectively, on the Caribou-Palermo 115 kV Transmission  
14 Line (the “Caribou-Palermo Line”). The C-hook on Tower :27/222 that broke was suspended  
15 from the left-phase transposition runner arm of the tower before it broke.

16 **Question 1:** On the Incident Tower, did the C-hook thread through the eye on the  
17 original runner arm or the eye on the added hanger plate or both? What was the  
18 point of two eyes?

19 **PG&E Response:**

20 Working eyes are openings on hanger plate surfaces through which insulator  
21 attachment hardware, including C-hooks, are threaded. The two C-hooks of interest on  
22 Tower :27/222 were each suspended from a transposition runner arm, and each attached a  
23 suspension insulator supporting a transposition jumper to the tower. As of November 8, 2018,  
24 each of those C-hooks passed through only the working eyes of the replacement hanger plates  
25 affixed to their respective runner arms. The two C-hooks did not pass through the working eyes  
26 of both the original runner arms and replacement hanger plates at the same time.

1 PG&E believes that the C-hooks supporting the transposition jumper previously  
2 passed through the working eyes of the transposition runner arms. Based on original design  
3 drawings for towers of the type corresponding to the Incident Tower (on which the replacement  
4 hanger plates do not appear), as well as recent photographs showing that the original working  
5 eyes on the left- and right-phase transposition runner arms are worn, PG&E believes that the  
6 replacement hanger plates may have been installed to address wear on the original working eyes  
7 of the left- and right-phase transposition runner arms.

8 **Question 2:** What was the condition of the C-hook on the second parallel runner  
9 arm on the Incident Tower (the one that did not detach during the storm)?

10 **PG&E Response:**

11 PG&E is providing as Exhibit A photographs showing the condition of the  
12 C-hook on the right-phase transposition runner arm on Tower :27/222 at the time the California  
13 Department of Forestry and Fire Protection (“CAL FIRE”) collected it on November 14, 2018.  
14 At that time, PG&E assisted CAL FIRE’s collection of, among other items of evidence, the  
15 C-hook that broke on Tower :27/222, the C-hook on the right-phase transposition runner arm that  
16 did not break, the transposition runner arms and the insulator strings to which the foregoing  
17 C-hooks were attached. CAL FIRE permitted PG&E to take photographs of the November 14,  
18 2018 evidence collection. PG&E previously provided the photographs attached as Exhibit A to  
19 the CPUC, CAL FIRE, the Butte County District Attorney’s office and the California Attorney  
20 General’s office in connection with their investigations related to the Camp Fire.

21 Based on the photographs, PG&E believes that, as depicted in the photographs,  
22 the C-hook on the right-phase transposition runner arm had material loss of roughly 30%. Under  
23 the guidelines in PG&E’s Electric Transmission Preventive Maintenance (“ETPM”) Manual in  
24 effect at the time of the Camp Fire, material loss of between 30% and 50% on insulators and  
25 steel structures, including C-hooks, is a condition that should be assigned Priority Code E. Such  
26 conditions must be addressed within 12 months.

1                   **Question 3:** What was the height above ground on the C-hook in question?

2 **PG&E Response:**

3                   Using the area directly beneath the C-hook as a reference point, the C-hook on  
4 Tower :27/222 that broke on November 8, 2018 was, before it broke, approximately 47 feet  
5 above the ground. PG&E notes that the Incident Tower is located on a steep incline. The  
6 distance from the C-hook to the ground therefore varies (in some cases substantially) depending  
7 on the precise location used as the reference point for any measurement from the C-hook to the  
8 ground.

9                   **Question 4:** How closely did any drone inspect the C-hook in question prior to  
10 the Camp Fire? Are the images available? If so, provide the ones that show the  
11 C-hook in question.

12 **PG&E Response:**

13                   PG&E did not inspect the Incident Tower by drone before the Camp Fire. PG&E  
14 first used camera-equipped drones to inspect the Caribou-Palermo 115 kV Transmission Line  
15 and other lines in high fire-threat areas in connection with its Wildfire Safety Inspection Program  
16 (“WSIP”). That program was implemented after the Camp Fire. Prior to the Camp Fire,  
17 PG&E’s routine inspection and patrol records for 115 kV lines typically did not include  
18 photographs of the specific tower components observed by the inspector, except where an  
19 abnormality was identified.

20                   The most recent photographs of Tower :27/222 of which PG&E is aware were  
21 taken during a 2017 helicopter flight over the Caribou-Palermo Line in connection with PG&E’s  
22 Transmission Coating Maintenance Program, and are attached to this submission as Exhibit B.

1           **Question 5:** Prior to the Camp Fire, did PG&E keep records from which PG&E  
 2           could determine how long the C-hooks and/or hanger plates in question had been  
 3           in place? Explain this history.

4           **PG&E Response:**

5           Prior to the Camp Fire, PG&E did not specifically track the length of time that  
 6           individual C-hooks and hanger plates on its overhead power lines had been in place, but  
 7           maintained records that enabled it to identify the installation date of components on transmission  
 8           lines, including C-hooks and hanger plates, in certain circumstances described below. Such  
 9           records include historical design drawings, manufacturer catalogs and work orders (also called  
 10          “Line Corrective” or “LC” notifications) relating to the installation or replacement of insulators  
 11          and insulator attachment hardware, including C-hooks and hanger plates.<sup>1</sup>

12          For various reasons, PG&E’s records may not in every instance allow PG&E to  
 13          determine how long any particular C-hook or hanger plate has been in place. For example, work  
 14          orders relating to the replacement of attachment hardware that occurred several decades ago may  
 15          be archived in hard copy or no longer be available, consistent with applicable record retention  
 16          periods. *See* CPUC General Order 95, Section I, Rule 18(A)(1) (requiring that “corrective  
 17          action” records “be preserved by the company for at least ten (10) years and . . . be made  
 18          available to Commission staff upon 30 days notice”); 18 C.F.R. §§ 125.1-125.3 (regulations  
 19          promulgated by the Federal Energy Regulatory Commission (“FERC”) prescribing a five-year  
 20          retention period for “maintenance work orders and job orders” for transmission and distribution  
 21          facilities owned by public utilities subject to FERC’s jurisdiction). In addition, PG&E’s  
 22          transmission system is composed of hundreds of lines, some of which (including the Caribou-  
 23          Palermo Line) PG&E acquired nearly a century ago. Many of those lines were acquired from  
 24          companies that did not keep records of when their towers were installed and, as a result, PG&E

25 \_\_\_\_\_  
 26          <sup>1</sup> PG&E began keeping transmission line work orders in electronic form in approximately  
 27          2000-2001. Work orders generated before that time, to the extent they have been retained, are  
 28          generally archived in hard copy with an offsite vendor.

1 is not always able to ascertain the length of time any particular C-hook or hanger plate had been  
2 in place at the time PG&E acquired those lines.

3 **Question 6:** Prior to the Camp Fire, had PG&E ever previously noticed *any* worn  
4 C-hooks and/or hanger plates on *any* of its transmission lines? Explain this  
5 history. Had worn C-hooks been preserved (as evidence or for any other  
6 purpose)?

7 **PG&E Response:**

8 There are hundreds of thousands of C-hooks and hanger plates across PG&E's  
9 system. Prior to the Camp Fire, reports of wear on C-hooks and hanger plates were infrequent.  
10 C-hooks and other types of suspension hooks are common hardware on transmission structures  
11 and occasionally are used on distribution structures. In PG&E's service territory, there are in  
12 excess of 50,000 steel transmission structures, most of which have multiple suspension hooks of  
13 some type supporting insulators and other equipment. There are also suspension hooks on many  
14 of the nearly 100,000 non-steel transmission structures and on a proportion of the more than two  
15 million distribution poles in PG&E's service territory.

16 At the request of government entities investigating the Camp Fire, PG&E has  
17 performed extensive searches of its data repositories for records potentially relating to worn,  
18 failed or otherwise defective hardware used to attach insulator strings to transmission structures,  
19 including C-hooks and hanger plates.<sup>2</sup> PG&E did not apply any date restrictions to its searches.

20 \_\_\_\_\_  
21 <sup>2</sup> Specifically, PG&E searched (1) Line Corrective and Electric Line maintenance  
22 notifications stored in its Systems, Applications and Products database of inspection and  
23 maintenance records for transmission lines; (2) reports on material testing performed by PG&E's  
24 Applied Technology Services ("ATS") department and predecessor groups; (3) PG&E's database  
25 of issues reported through its Corrective Action Program; (4) Material Problem Reports  
26 documenting potential issues with equipment; (5) reports of outages and incidents on  
27 transmission lines recorded in PG&E's Event Reporting Engine; (6) Electric Incident Reports  
28 submitted to the CPUC; (7) outage information stored in PG&E's Transmission Operation  
Tracking and Logging database; (8) outage reports submitted to the California Independent  
System Operator; and (9) the electronically stored information of certain PG&E personnel  
involved in PG&E's transmission inspection and maintenance program.

1 PG&E’s search of those repositories yielded records identifying wear on only a limited number  
2 of C-hooks and hanger plates out of the hundreds of thousands of such components in service on  
3 PG&E transmission lines.<sup>3</sup>

4           Specifically, PG&E records prior to the Camp Fire identified the following  
5 instances of worn C-hooks or hanger plates:

- 6           • In 1987, PG&E tested the strength of two suspension hooks and their attaching  
7           plates removed from the Oleum-G 115 kV Transmission Line. The hooks and  
8           attaching plates showed signs of wear and were taken out of service for testing.  
9           This testing is discussed further below in PG&E’s response to Question 6a.
- 10          • As a result of an aerial patrol in September 2000, PG&E noted “mild rust and  
11          wear” on C-hooks and hanger plates on Tower 44/174 on the Pittsburg-San Mateo  
12          230 kV Transmission Line. PG&E records indicate that the equipment was  
13          replaced by June 2003 and was monitored prior to replacement.
- 14          • In August 2002, PG&E generated a work order noting potentially worn C-hooks  
15          on approximately 30 towers along the Las Positas-Newark 230 kV Transmission  
16          Line. According to PG&E records, PG&E personnel recommended the entire line  
17          be monitored. PG&E records indicate that C-hooks “at several locations” along  
18          the line were reassessed in December 2007 and determined not to require  
19          corrective action.
- 20          • Between August 2002 and August 2005, PG&E identified rust and some wear  
21          (material loss of approximately 25%) on C-hooks and hanger plates on certain  
22          structures on the Jefferson-Hillsdale 60 kV Transmission Line. PG&E records  
23          indicate that, in response to these findings, PG&E personnel conducted detailed  
24          climbing inspections of multiple structures along the approximately 15-mile line  
25          to assess the prevalence of the condition along that line. PG&E records further  
26          indicate that, following those inspections, PG&E replaced insulators and  
27          attachment hardware (including C-hooks) on approximately 30 structures along  
28          that line.

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<sup>3</sup> PG&E’s search also yielded records relating to conditions on C-hooks and hanger plates other than wear, such as rust, corrosion and fatigue cracking. Those records are not described in this response unless it appeared from the record that wear on the C-hook or hanger plate was also observed.



- 1 • In January 2004, PG&E conducted testing on a ball-hook that had failed. The  
2 analysis concluded that “the hook failure was the result of a single overload event  
3 that produced excessive stresses in the hook body and caused it to fracture” and  
4 noted “[e]vidence of normal wear, with no significant section loss”, on the ball-  
5 hook.
- 6 • In August 2004, PG&E generated a work order to replace worn working eyes on  
7 crossarms on four towers on the Pittsburg-Martinez #1 115 kV Transmission  
8 Line. PG&E records indicate that the working eye plates were replaced in  
9 September 2004.
- 10 • In December 2004, PG&E generated a work order to address worn C-hooks on a  
11 structure on the Jefferson-Martin 230 kV Transmission Line. The entire structure  
12 was replaced in May 2006.
- 13 • In August 2011, PG&E generated a work order for the replacement of a C-hook  
14 on a transmission tower on the Brighton-Bellota 230 kV Transmission Line that  
15 was not in its proper position, possibly due to wear or faulty installation. PG&E  
16 records indicate that the C-hook was replaced by December 2011.
- 17 • In August 2011, PG&E generated a work order noting that C-hooks on a tower on  
18 the Martin-Millbrae #1 115 kV Transmission Line were “rusty and worn”. In  
19 September 2012, the condition was identified for monitoring during the next  
20 routine inspection.
- 21 • In September 2015, PG&E generated a work order noting that a crew had  
22 identified “worn out suspension eye plates” on a structure along the Humboldt-  
23 Bridgeville 115 kV Transmission Line. That same work order notes that the  
24 suspension plates were replaced.
- 25 • In May 2016, PG&E generated a work order identifying for replacement “worn  
26 through ‘C’ hooks and eye nuts” on two structures along the Cordelia Interim  
27 Pumps Tap 60 kV Transmission Line. PG&E records indicate that the work was  
28 completed in May 2017.
- In March 2018, PG&E’s Applied Technology Services department examined and  
reported on “severe wear” observed on six hanger plates that PG&E personnel  
removed from a double-circuit tower that supported the Parkway-Moraga and  
Bahia-Moraga 230 kV Transmission Lines. Based on the ATS report’s  
recommendation, PG&E inspected multiple other adjacent towers to determine  
whether the hanger plates on those towers also showed signs of wear. PG&E  
records indicate that those inspections did not identify any conditions requiring  
repair.



1 PG&E records identified two failures of C-hooks in the field in the 10 years  
2 before the Camp Fire, not including the C-hook on the Incident Tower that broke. Neither  
3 failure appears to have resulted from wear on the hook or plate.<sup>4</sup>

4 PG&E has been storing the worn hanger plates removed from the tower  
5 supporting the Parkway-Moraga and Bahia-Moraga 230 kV Transmission Lines, noted above,  
6 since before the Camp Fire. In addition, to comply with a March 2019 evidence preservation  
7 request, PG&E has also collected and stored as evidence C-hooks and hanger plates removed  
8 from multiple transmission lines (including the Caribou-Palermo Line) as a result of WSIP  
9 inspections or other maintenance work.

10 Since the Camp Fire, PG&E has conducted climbing and drone inspections of the  
11 approximately 50,000 transmission structures in Tier 2 and Tier 3 High Fire-Threat District areas  
12 under its WSIP. These inspections identified over 50,000 conditions on transmission lines,  
13 including conditions relating to wear or other damage to C-hooks and hanger plates. All of the  
14 highest-priority conditions identified as a result of those inspections have been repaired or made  
15 safe.

16 **Question 6a:** With respect to the extent to which PG&E had been aware of the  
17 C-hook problem, please respond specifically to the attached news story stating  
18 PG&E was so aware as early as 1987.

19 **PG&E Response:**

20 The NBC Bay Area article titled “PG&E Alerted to Risk of Worn Hooks Back in  
21 1987”, dated December 12, 2019 and attached to the Court’s December 16, 2019 order, refers to  
22 and quotes from a PG&E Department of Engineering Research report titled “Evaluation of J-  
23

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24 <sup>4</sup> One of the failures, on the Pittsburg-Tesla 230 kV Transmission Line, appears to have  
25 resulted from “side loading stress” leading to a fracture near the base of the hook (*i.e.*, near the  
26 ball of the hook, not where the hook and hanger plate touch). The other failure, on the Bellota-  
27 Cottle 230 kV Transmission Line, appears to have resulted from the separation of the C-hook  
28 from the insulator string due to wear on the insulator string socket that held the ball of the  
C-hook, as opposed to wear on the hook or hanger plate.

1 Hooks and Eyes from 115 kV Oleum G-Line”, dated February 9, 1987. Attached as Exhibit C is  
2 a full copy of that report.

3 As explained in the report, PG&E’s Department of Engineering Research, a  
4 predecessor of PG&E’s Applied Technology Services department, performed tests on two  
5 suspension hooks (described as “J-hooks” in the report) and attaching plates removed from  
6 PG&E’s 115 kV Oleum-G Transmission Line (the “Oleum-G Line”). The report noted that  
7 “[b]oth of the J-Hooks and their attaching plates had grooves worn in them and there was a  
8 concern that they may not be able to hold the weight of insulator strings that are suspended from  
9 them.” The objective of the report “was to establish the tension required to fail the hook or the  
10 attaching plate”. The hooks had an ultimate strength rating of 30,000 pounds. The testing  
11 resulted in the failure of the two worn hooks at 11,500 pounds, the failure of the eye on one of  
12 the attaching plates at 19,600 pounds, and the failure of an additional hook that “had no visible  
13 grooves or scratching in the surface as the two samples in the original test did” at 6,900 pounds.  
14 In other words, the two hooks with wear exhibited greater strength than the unworn hook. The  
15 report recommended “that a test be done on some random samples of different manufacturers’  
16 hooks from PG&E stores to check their strength against their specifications.” PG&E has  
17 searched for records relating to any such strength testing during the late 1980s but has not  
18 located any such records that have been retained.

19 The testing proposed in the 1987 report does not appear to have been prompted by  
20 wear on the hooks or hanger plates. As reflected in the report, the proposal for testing a number  
21 of randomly chosen hooks from PG&E’s stores appears to have been prompted by the failure of  
22 the hook without visible wear at 6,900 pounds (more than three-quarters below its strength rating  
23 of 30,000 pounds).

24 PG&E denies the conclusions drawn in the NBC Bay Area article, including that  
25 PG&E “was aware of a big problem and did nothing to solve that problem” or that it “knew there  
26 was a problem for 30 years”. As can be seen from PG&E’s response to Question 6 above, the  
27 occasions on which PG&E records noted wear on C-hooks or working eyes were limited in the  
28

1 context of the overall number of such components in PG&E's system, and PG&E followed up on  
2 identified issues. Moreover, the article ignores PG&E's inspection and maintenance programs  
3 that existed prior to the Camp Fire and PG&E's investments in its transmission system. PG&E  
4 refers the Court to its prior submissions on those subjects for additional information. (*See*  
5 PG&E's Response to Notice Re California Wildfires, Ex. A, Camp Fire Incident Description and  
6 Factual Summary, dated December 31, 2018 (Dkt. 956-1) at 1-6, 8-15; PG&E's Response to  
7 Order to Show Cause Why PG&E's Conditions of Probation Should Not Be Modified, dated  
8 January 23, 2019 (Dkt. 976) at 42-46; PG&E's Response to Request for Information, dated  
9 July 31, 2019 (Dkt. 1078) at 2-34.)

10 **Question 7:** What was the purpose of the hold-down anchor on the Adjacent  
11 Tower?

12 **PG&E Response:**

13 A hold-down anchor is a type of insulator assembly used when there is a  
14 substantial difference in elevation between two adjacent towers along the same transmission line.  
15 The difference in elevation can result in the insulators at lower elevation being pulled upwards  
16 by the tension of the conductors on the span that they support. The upward pull can impair the  
17 proper functioning of the insulator by causing it to hang improperly. The hold-down anchor  
18 provides downward force to counter the upward pull on the insulator string holding the  
19 conductor. In addition, the hold-down anchor may limit side-to-side movement or sway on the  
20 conductor supported by the suspension insulator that it holds down. Hold-down anchors are not  
21 energized.

22 The Adjacent Tower on the Caribou-Palermo Line, Tower :27/221, was downhill  
23 from Tower :27/222, the tower at which a C-hook broke on November 8, 2018, and was fitted  
24 with three hold-down anchors, one of which disconnected at the turnbuckle, as described in  
25 PG&E's response to Question 8 below. The turnbuckle is a component that can be tightened or  
26 loosened to adjust the amount of downward force being applied to the suspension insulator  
27 above.

1           **Question 8:** Was that hold-down anchor used on the Caribou-Palermo  
2           Transmission Line? If so, was there any support between the C-hook that lost the  
3           anchor and the C-hook that failed?

4           **PG&E Response:**

5           Hold-down anchors were used on Tower :27/221 on the Caribou-Palermo 115 kV  
6           Transmission Line.

7           PG&E’s records indicate that during the most recent routine aerial patrol of the  
8           Caribou-Palermo Line, in September 2018, a new finding was reported for Tower :27/221  
9           because an insulator hold-down anchor’s turnbuckle had become disconnected and required  
10          repair. As noted above, an insulator hold-down anchor is not energized. As a result of the  
11          September 2018 aerial patrol, PG&E generated a notification to repair the insulator hold-down  
12          anchor within 12 months. That notification was open at the time of the Camp Fire in November  
13          2018.

14          The C-hook supporting the hold-down anchor on Tower :27/221 with the  
15          disconnected turnbuckle did not provide support to the C-hook on Tower :27/222 that broke.  
16          The conductor supported by the suspension insulator on Tower :27/221 that was held down by  
17          the hold-down anchor continued toward two “dead-end” insulators on Tower :27/222 and  
18          terminated at a clamp attached to those dead-end insulators. The C-hook on Tower :27/222 that  
19          broke did not support that conductor. Rather, the C-hook on Tower :27/222 that broke supported  
20          a transposition jumper that connected that conductor to a conductor on the other side of the  
21          tower.

22          **Question 9:** In what possible ways did the failure of the hold-down anchor on the  
23          Adjacent Tower contribute to the failure of the C-hook on the Incident Tower?

24          **PG&E Response:**

25          PG&E does not believe that the disconnection of the hold-down anchor at  
26          Tower :27/221 contributed in any non-negligible way to wear on the C-hook that broke on  
27          Tower :27/222 or its connection point. The C-hook on Tower :27/222 that failed did not directly  
28

1 support the conductor supported by the hold-down anchor on Tower :27/221 and was separated  
2 from that conductor by other components.

3 **Question 10:** Generally, what factors exacerbate the gouging of the C-hooks  
4 (like sway, vibration, weight) and to what extent were these factors known by  
5 PG&E before the Camp Fire?

6 **PG&E Response:**

7 A variety of factors can influence the rate of wear on a particular C-hook or  
8 hanger plate, including the degree of tension on the conductor supported by the insulator  
9 assembly; the hardness, thickness and other material properties of the C-hook and hanger plate;  
10 the weight of the load supported by the C-hook; and environmental conditions. Relevant  
11 environmental conditions include elevation, average and maximum wind speeds in the area, the  
12 amount of time the C-hook and hanger plate are subjected to high-wind conditions, and the  
13 proximity of the equipment to coastal areas or other corrosive environments. In connection with  
14 some of the instances identified in response to Question 6 above, PG&E personnel noted that  
15 metal-on-metal rubbing caused or exacerbated by wind conditions could result in wear of  
16 C-hooks and hanger plates.

17 Following the Camp Fire, at the request of the CPUC's Safety and Enforcement  
18 Division, PG&E retained Exponent, Inc. ("Exponent"), an independent third-party scientific and  
19 engineering consulting firm, to conduct a records-based review of the Caribou-Palermo Line.  
20 Exponent's final report has now been made public and discusses the factors that may cause or  
21 exacerbate wear on C-hooks and hanger plates. *See* CPUC Incident Investigation Report,  
22 Nov. 8, 2019, Attachment N, Exponent Report on PG&E Caribou-Palermo Asset Condition  
23 Investigation, Nov. 1, 2019, at 29-61.

1 Dated: December 19, 2019

Respectfully Submitted,

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