BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Application of Pacific Gas and Electric Company for Authority, Among Other Things, to Increase Rates and Charges for Electric and Gas Service Effective on January 1, 2014 (U39M).	Application 12-11-009 (Filed November, 15, 2012)

OPENING TESTIMONY OF DAVID MARCUS ON BEHALF OF THE COALITION OF CALIFORNIA UTILITY EMPLOYEES

May 17, 2013

1011-851cv

SUBJECT INDEX

I. INTRODUCTION

Three years ago, on behalf of CUE, I testified in PG&E's TY 2011 GRC that the job of PG&E is service to customers and that job was not getting done.[1] I cited PG&E's own presentations regarding its inferior electrical service,[2] and presented evidence that PG&E's gas safety efforts were failing to discover or repair tens of thousands of gas leaks.[3] After the San Bruno gas explosion took place, PG&E clearly refocused. It is undertaken an immense program of fixing old gas problems and preventing new ones, with new senior management for its gas efforts. It has increased its focus on repairing critical operating equipment (COE).[4] In 2012 it replaced more aging transmission poles than in any year since 2004.[5] It has produced an updated value of service (VOS) study, which allows it to quantify the economic benefits of improving reliability, and used that study to justify various projects to proactively improve reliability.[6] And it is testing and starting to implement a potentially revolutionary new technology to find more gas leaks (including the most serious ones) faster and potentially more cheaply than it has in the past.[7]

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[1] David Marcus, direct testimony in A.09-12-020, 5/19/10, p. 1.
[2] Ibid., p. 2.
[3] Ibid., p. 2.
[4] Section III of this testimony discusses COE.
[5] Section IV of this testimony addresses replacement of aging facilities, particularly poles.
[6] Section V of this testimony addresses specific PG&E projects to proactively improve reliability.
[7] Section VI of this testimony addresses that new gas leak detection technology, known as Picarro.

However, while improved, PG&E still lags far behind its own goals of several years ago in fixing broken COE, it is still replacing poles and other equipment at rates that equate to cycle times of over a century, or even over a millennium, it is still doing much less to proactively improve reliability than its own economic analyses show is justified, and its gas leak detection proposal seems more focused on reducing costs rather than finding as many leaks as feasible. The testimony below addresses each of these shortcomings in turn, and proposes ways the Commission should require PG&E to do a better job and the funding needed to enable PG&E to do a better job.

II. SUMMARY OF RECOMMENDATIONS

- The Commission should require PG&E to fix an additional 926 COE items per year, resulting in an expense increase of $7.3 million per year.
- The Commission should require PG&E to replace an additional 19,000 poles per year, which would require an additional $218.4 million annual capital investment. It would increase the 2014 PG&E revenue requirement by approximately $19.7 million.
- The Commission should require PG&E to double its proposed breaker replacement rate, which would require an additional $31.5 million in capital costs, or an average of $10.5 million per year. It would increase 2014 revenue requirement by roughly $0.9 million.
- The Commission should require PG&E to double its proposed overhead line replacement rate, which would require an additional $101.1 million in capital costs, or an average of $33.4 million per year. That would increase 2014 revenue requirement by roughly $3.0 million.
- The Commission should require PG&E to double its overhead fuse program which would require an additional capital investment of $3 million per year. That would increase 2014 revenue requirements by roughly $0.3 million.

- The Commission should require PG&E to double its recloser program which would require an additional capital investment of $9.8 million over the GRC period, or an average of $3.3 million per year. That would increase 2014 revenue requirements by roughly $0.3 million.

- The Commission should require PG&E to expand its FLISR program by 50 percent, to 300 circuits per year, which would require an additional capital investment of $36.6 million per year. That would increase 2014 revenue requirements by roughly $3.3 million.

- The Commission should require PG&E to expand its targeted circuit program by 50 percent, to 120 circuits per year, which would require an additional capital investment of $13 million per year. That would increase 2014 revenue requirements by roughly $1.2 million.

- The Commission should require PG&E to expand its underground protection program by 50 percent, to a total of 100 fuses and interrupters, which would require an additional capital investment of $4 million, or an average of $1.3 million per year. That would increase 2014 revenue requirements by roughly $0.1 million.

- The combined effect of the above recommendations would be an increase in PG&E's 2014 revenue requirement of approximately $36 million.[8]

- The Commission should order PG&E to use the Picarro methodology, but to use it in addition to existing leak detection methodology, and also approve PG&E's proposed two-way balancing account.

III. CRITICAL OPERATING EQUIPMENT

A. Nature of the Issue

PG&E has explained to CUE that it:

> has equipment on its electric distribution system that is very important to the operation and functionality of the system. This includes equipment such as fuses, interrupters, line reclosers, sectionalizers, switches and disconnects. This equipment plays

[8] $7.3 million in increased expense (first bullet item). $319.5 million per year in increased capital investment (next 8 bullet items). Assuming the capital investment was spread evenly across the year, the increase in 2014 average rate base would be $319.5 million x ½ = $159.75 million. Assuming an 18 percent fixed charge rate to convert that rate base increase into a revenue requirement increase, the 2014 revenue requirement would be $159.75 million x .18 = $28.755 million. $7.3 million plus $28.8 million = $36.1 million.

a major role in preventing customer interruptions and is critical to restoring power after an outage. Prior to April 2011, when this equipment required maintenance, PG&E referred to it as Equipment Requiring Repair (ERR). Beginning in April 2011, after a benchmark study and internal reviews, this equipment was re-designated as Critical Operating Equipment (COE).[9]

In the last GRC, CUE identified ERR (now COE) as an area of significant problems for PG&E.[10] The average length of time from when an item was added to the ERR list until it was repaired and removed from the ERR list, the "cycle time," was according to PG&E, the "key metric" for diagnosing ERR problems.[11] PG&E's overall average cycle time for ERR had grown from 100 days in 2006-07 to 153 days by the end of 2007 to 560 days by the end of 2009. PG&E's internal ERR Report made clear that ERR problems were unique to PG&E. While SDG&E and SCE both repaired protective devices in under five days,[12] PG&E's ERR problems were attributed to, among other things, repeated budget cuts, giving ERR a lower priority than new business, having no coordinated SCADA repair process, lacking SCADA parts, having no backlog reduction plan, and not doing work on ERR devices if they had not been repaired after a year had elapsed.[13]

The effect of unrepaired ERR/COE is decreased reliability. As CUE told the Commission three years ago, "[u]nfixed ERR means that when a device is needed to assure reliability, it's not operable and thus doesn't do its

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[9] PG&E, response to DR CUE 2-15.
[10] David Marcus, direct testimony in A.09-12-020, 5/19/10, pp. 16-21.
[11] Ibid., p. 16, citing PG&E, "LSS Equipment Requiring Repair," Final Report, 8/8/08, provided as Attachment 1 to PGE's response to CUE DR 1-13 in the TY2011 GRC case (cited below as "ERR Report").
[12] Ibid., p. 17, citing PG&E's ERR Report, p. 10.
[13] Ibid., p. 17, citing PG&E's ERR Report, p. 19.

job. Inoperable fuses increase SAIFI and SAIDI both, inoperable switches increase SAIDI, and so on.[14] PG&E estimates that an ERR backlog of 2,061 devices (the 12/31/07 level) causes 5.7 minutes per year of SAIDI and 0.04 of SAIFI per year if not worked off."[15]

B. COE Appears to be Improving

Given the seriousness of the ERR problems identified in CUE testimony in the TY2011 GRC, and in PG&E's own ERR report, CUE posed a variety of data requests to PG&E regarding the ERR/COE issue. PG&E's replies showed that the number of COE items identified each year has fallen in each of the last two years,[16] that the number of COE items repaired has increased from 2010 to 2012,[17] that the backlog of unrepaired maintenance tags relating to COE is well on its way to being eliminated this year,[18] that cycle times were reduced 37% from 2008 to 2009,[19] and that cycle times have decreased since then for most categories of COE.[20] PG&E is to be commended for its efforts to address its past ERR problems, and the progress it appears to be making.

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[14] Ibid., p. 17, citing PG&E's ERR Report, p. 17.
[15] Ibid., pp. 17-18, citing PG&E's ERR Report, p. 17. 5.7 minutes of SAIDI is more than 5 percent of PG&E's total SAIDI in 2011, and 0.04 of SAIFI is more than 4 percent of PG&E's total SAIFI in 2011. PG&E, Ex. PGE-4, pp. 15-6 and 15-7. The SAIDI and SAIFI amounts are each about 2/3 of PG&E's average annual improvement from 2007-11 (8.7 minutes per year of SAIDI, 0.06 per year of SAIFI). Ibid.
[16] PG&E, response to DR CUE 2-15.
[17] PG&E, response to DR CUE 2-16.
[18] PG&E, response to DR CUE 2-23.
[19] PG&E, response to DR CUE 2-24.
[20] PG&E, responses to DRs CUE 2-17 and 2-24.

C. The Reported Improvement is Not as Dramatic as PG&E Makes it Out to be

PG&E shows that its backlog of "outstanding maintenance tags" has been reduced from 2,321 at the end of 2008 to 81 at the end of 2012, and is expected to be zero by the end of 2013.[21] This might be read as saying that PG&E has reduced the number of unfixed COE items to near zero. But that can't possibly be the case, since PG&E shows that it still has cycle times in 2012 of over 120 days for each of the subcategories of COE,[22] which implies a backlog of well over 1,000 items as of the end of 2012.[23] The reduction to zero that PG&E reports in its data response is apparently the reduction in the backlog of items that were listed as ERR at the end of 2008; and while it is certainly good that everything on the ERR list in 2008 is now fixed, the fact that some of those items took from 2008 to 2013 to get fixed is not adequate.

Similarly, PG&E indicates at one point that it has reduced the cycle time for four of the subcategories of COE by 33 percent from 2009 to 2012.[24] But the biggest component of that alleged improvement is a reduction in the cycle time for the "switch" category from 793 days in 2009 to 239 days in 2012.[25] It turns out that between 2009 and 2012, PG&E changed the

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[21] PG&E, response to DR CUE 2-23.
[22] Fuses, per PG&E, responses to DRs CUE 2-24; Cutouts, per PG&E, responses to DR CUE 2-17; boosters/regulators, capacitors, conductors, interrupters, reclosers/sectionalizers, and switches, per both DR CUE 2-17 and DR CUE 2-24.
[23] 3451 COE items identified in 2012, per DR CUE 2-15; 2012 cycle times of 127 days or more for all categories of COE items (see previous footnote); 3451 x 127/366 = 1197+ items in backlog.
[24] PG&E, response to DR CUE 2-24, both in the text and in the boldfaced bottom line of the associated table.
[25] PG&E, response to DR CUE 2-24.

definition of the "switch" category to include disconnects along with switches.[26] In 2009, the cycle time for disconnect repairs was only 35 days,[27] so by excluding them from the 2009 definition of the "switch" category, the improvement from 2009 to 2012 was overstated, probably by a lot. Similarly, PG&E changed the definition of the "recloser" category from 2009 to 2012, adding in sectionalizers (which, on their own, had a 2009 cycle period of just 21 days).[28] Again, the definition change means that the reported improvement from 2009 to 2012 (the second largest improvement PG&E reported[29]) was in large part due to the definitional change, and not to an actual decrease in cycle times.

The potentially inaccurate effects of comparing categories whose definitions have changed over time can be avoided by looking 2010-12 data along with the 2009-12 data for categories whose definitions have not changed. There, PG&E shows major improvement in the cycle time for conductor COE, from 268 days to 127 days, and smaller improvements for four other categories. However, two categories have gotten slightly worse and interrupter cycle times have gotten dramatically worse-from 30 days in 2009 to 191 days in 2010 and 262 days in 2012.[30] The overall change still appears to be in the direction of improvement, but not nearly by 33 percent.

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[26] Ibid.
[27] Ibid.
[28] Ibid.
[29] Ibid.
[30] PG&E, responses to DRs CUE 2-17 and 2-24.

Finally, a comparison of the year-by-year difference between COE items identified and COE items repaired shows that, while more items were fixed than found in 2012, the opposite was true in 2010 and 2011.[31] Over the three year period, 13,462 items were identified, but only 10,685 were fixed.[32] This implies that the COE backlog actually increased by 2,777 items over the three-year period.[33] And since PG&E does not plan to fix any more items that it finds over the TY2014 GRC cycle,[34] that backlog will not be reduced.

D. Still Plenty of Room for Improvement

PG&E acknowledges that the goal it identified in 2008 in its ERR Report was a 30-day cycle time, while 2012 cycle times still ranged from 127 to 262 days for the various COE subcategories.[35] It acknowledges that it does not forecast cycle times,[36] despite the ERR Report calling them the "key metric" for diagnosing ERR problems.[37] It acknowledges that it has no formal performance targets for COE,[38] despite the ERR Report calling for incorporating an ERR metric into PG&E's STIP (short-term incentive program).[39] Its plans for 2013-16 include repairing no more COE items than are identified,[40] meaning its backlog of unrepaired items will not shrink from

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[31] PG&E, responses to DRs CUE 2-15 and 2-16.
[32] Ibid.
[33] 13,462 – 10,685 = 2,777.
[34] PG&E, response to DR CUE 3-13a.
[35] PG&E, response to CUE DR 2-24.
[36] PG&E, response to DR CUE 3-13a.
[37] David Marcus, direct testimony in A.09-12-020, 5/19/10, p. 16, citing the ERR Report, p. 8.
[38] PG&E, response to DR CUE 3-13b.
[39] David Marcus, direct testimony in A.09-12-020, 5/19/10, p. 18, citing the ERR Report, p. 26.
[40] PG&E, response to DR CUE 3-13a.

its size at the end of 2012. PG&E's COE performance still has plenty of room for improvement.

At a minimum, the Commission should direct PG&E to eliminate the increase in the COE backlog of 2,777 items which occurred over the 2010-12 period, and provide the funding to do so. Across the 2014-16 GRC cycle, that would require fixing an additional 926 COE items per year.[41] PG&E estimates an expense cost of $33.328 million per year for the 4,234 COE items it currently plans to fix each year in 2014-16.[42] Fixing an additional 926 items per year would increase that expense by $7.289 million.[43] It would reduce the average cycle time for COE items by 80 days per year,[44] bringing PG&E closer to its proposed goals from the 2008 ERR Report.[45]

IV. REPLACING AGING FACILITIES – NOT KEEPING UP WITH FACILITY LIVES AS SHOWN IN DEPRECIATION ANALYSES

In Ex. PG&E-2, PG&E provides estimates of the average service lives for various categories of facilities, while in Ex. PG&E-4, PG&E identifies its plans to replace various aging electrical system components. CUE has identified three areas in which there are large discrepancies between what PG&E's depreciation data implies regarding retirement rates, and what

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[41] 2777 / 3 = 926.

[42] 4,234 COE items per year in 2014-16 per PG&E, response to DR CUE 3-13a. The 4,234 figure is the sum of COE numbers found in the Ex. PGE-4 Workpapers, at pp. WP5-10:5, WP 5-12:3, WP 5-25:3, and WP 5-27:3. The associated dollar costs, which sum to $33.328 million, are found in the Ex. PGE-4 Workpapers at pp. WP 5-10:25, WP 5-12:11, WP 5-25:15, and WP 5-27:11.

[43] $33.328 million x 926/4234 = $7.289 million.

[44] ((926 items extra fixed /year) / (4234 items found/year)) x 365 days/year = 79.8 days.

[45] The 2008 ERR report called for cycle times of 5 days for protective devices and 30 days for "priority one" devices. David Marcus, direct testimony in A.09-12-020, 5/19/10, p. 18, citing the ERR Report, pp. 5 and 14.

PG&E's actual proposals are for retiring and replacing aging facilities. The data suggests that, at least for those three areas (and possibly others that CUE has not reviewed), PG&E's GRC proposals would make its aging infrastructure problems worse, not better.

A. Poles

According to PG&E, distribution poles (FERC account 364) have an average service life of 42 years, and the current stock of distribution poles, towers, and fixtures had an average remaining life of 31.12 years as of December 31, 2011.[46] Accordingly, PG&E has requested $181 million per year to cover the depreciation costs of those pre-2012 poles over their estimated average remaining life of 31+ years.

At the same time, PG&E is not replacing its pre-2012 poles on anything like a 31 year cycle, or even a 42-year cycle. While PG&E has about 2.2 million poles,[47] it has removed an average of just 21,540 poles per year over the last decade, and only 19,090 per year over the last five years.[48] At those rates, it would take over a century to remove all of the existing poles.[49]

Because of this slow pace of pole removal and replacement, the average age of PG&E's stock of poles has been growing steadily for the last decade. In 2003, the average PG&E pole was 32.75 years old.[50] That average has

[46] Ex. PGE-2, p. 11-4.
[47] PG&E, response to DR CUE 2-4, showing a 2012 count of 2,199,408 poles.
[48] PG&E, attachment 2 to response to DR CUE 5-3.
[49] 2.2 million poles/21540 poles per year = 102 years; 2.2 million poles / 19,090 poles per year = 115 years.
[50] PG&E, response to DR CUE 2-4. Note that PG&E's average pole age data contradict its data from the last GRC.

increased every year since, and today the average pole is 39.26 years old.[51] Whereas PG&E had about 150,000 poles over 60 years old in 2007 and over 260,000 poles over 60 years old in 2011, by the start of the Test Year 2014 it will have some 344,000 poles over 60 years old.[52] Moreover, during the GRC period of 2014-16, more than 120,000 existing poles will reach the age of 60 years.[53]

If PG&E truly believed that its average remaining pole life is 31.12 years, and it simplistically assumed that therefore half of its poles will reach the end of their lives in the next 31.12 years, it would have to replace over 35,000 poles per year.[54] If PG&E were simply trying to keep the number of poles over 60 years old on its system from growing, it would have to replace over 40,000 poles per year.[55]

But if PG&E were to align its pole replacement policies with its depreciation rates, it should be replacing over 100,000 poles in 2014. The reason is that PG&E claims to know, and incorporates in its depreciation rates, not just the average service life of its poles, but also their retirement pattern. Using what are known as Iowa curves, PG&E has estimated that its

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[51] Ibid.
[52] Data on poles over 60 in 2007 and 2011 from Marcus rebuttal testimony in PG&E's TY2011 GRC, p. 9. 2014 data from attachment 1 to PG&E's response to DR CUE 5-3, summing all poles with an install date of 1953 or earlier.
[53] PG&E, Attachment 1 to response to DR CUE 5-3, sum of pole counts for poles installed in 1954-56 is 120,829 poles.
[54] 2.2 million poles with an average remaining life of 31.12 years. Assuming a symmetrical distribution of life expectancies, half of them, or 1.1 million, will reach their life expectancy in the next 31.12 years. Replacing them on a straight-line basis would require replacing 1.1 million/31.12 = 35,347 per year.
[55] 120,829 poles reaching age 60 in 2014-16, per Attachment 1 to PG&E's response to DR CUE 5-3. 120,829 poles/3 years = 40,276 poles per year.

distribution poles will have an R1.5 pattern of retirements, in which retirements start out slowly, but then accelerate as poles reach and pass their average service life, which in this case is 42 years.[56] Applying R1.5 curve data and a 42 year average service life, it is possible to estimate the expected number of retirements of each vintage of PG&E poles. Thus, the 42R1.5 retirement curve implies that every pole should be retired by age 84, which means all 2,688 of PG&E's pre-1929 poles should be retired by 2014. Applying a 42R1.5 retirement curve to each vintage of PG&E poles, and summing across all the vintages, the calculated number of poles that should be retired in 2014 would be just over 100,000.[57]

How do these estimates of required pole replacements – from 35,000 to 100,000 poles per year, compare to PG&E's actual plans? The answer is unclear. When asked how many poles PG&E has budgeted to replace in each of the years 2013-16, PG&E's answer was limited to its Pole Replacement Program,[58] which expects to replace only 5,760 poles per year during the GRC period of 2014-16.[59] When re-asked for the total number of poles expected to be replaced through all of its programs, PG&E again referenced just the Pole

[56] Ex. PG&E-2, p. 11-4. DRA accepts PG&E's Iowa curve and average service life proposal. Ex. DRA-19, p. 5.

[57] See Marcus workpaper 1, showing 101,647 expected pole retirements in 2014, based on PG&E data regarding pole vintage and using a 42R1.5 Iowa curve to estimate annual retirements for each age cohort of poles.

[58] PG&E, response to DR CUE 2-2b.

[59] Ex. PGE-4, p. 7-6, Table 7-1. DRA has accepted PG&E's proposed pole replacement rate, while proposing to cut the number of annual pole inspections that would be funded through rates. Ex. DRA-5, pp. 35-41.

Replacement Program.[60] When asked for the number of expected future distribution pole replacement for ***each*** of its programs that replaces poles, PG&E asserted that it "does not forecast the number of distribution pole replacements for any of its programs under which poles are replaced except the Pole Replacement Program."[61] So the one program that is explicitly designed to find and replace poles that are at the end of their lives, the Pole Replacement Program is expected to replace only 5,760 poles per year, which corresponds to a pole replacement cycle of over 380 years.[62] PG&E has rejected the validity of the 380-year figure, but only by pointing to its historical overall pole replacement rate of fewer than 19,000 poles per year in the last 6 years.[63] That would be a replacement cycle of 116 years.[64]

How should the Commission respond to PG&E's multi-year practice of replacing too few poles,[65] which has led to an ever-increasing average pole age and an ever-increasing number of poles over the age of 60? In the last PG&E GRC, CUE said that PG&E should be doing all of its planned pole replacements, should be working off its backlog of poles identified as needing replacement, and should be replacing 28,000 poles per year if it was to

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[60] PG&E, response to DR CUE 3-2b.

[61] PG&E, response to DR CUE 3-2a. See also PG&E's response to DR CUE 3-4b, reiterating that PG&E does not forecast its pole count or average pole age, and PG&E's response to DR CUE 3-1a, where PG&E says it does not have historical data either for how many poles it has actually replaced under each of its various programs.

[62] 2.2 million poles / 5760 poles per year = 381.9 years.

[63] PG&E, response to DR CUE 2-2d, citing 113,833 pole removals in the 6 years from 2007-12, or 18,972 per year.

[64] 2.2 million poles / 18,972 poles per year = 115.96 years.

65 We note that this problem is not unique to PG&E. Southern California Edison and SDG&E also replace too few poles to ensure they are replaced before the end of their useful lives. Underfunding this activity is typical in Commission decisions in electric utility GRCs.

achieve an 80-year replacement cycle.[66] PG&E did indeed do all of its planned replacements, it is indeed working off its backlog, and it even managed to remove 28,000 poles in one year of the GRC cycle (2012). Yet overall, PG&E's pole removal rate over the last three years (19,140 poles per year) has barely budged from the rate over the last 6 years (18,943 poles per year), and is down from the average of the last decade (21,540 poles per year).[67]

This time we urge the Commission to order PG&E to double its rate of pole replacement from the 19,000 poles per year that has characterized the last two GRC cycles and authorize funding to do so. Replacing an additional 19,000 poles per year would increase the 2014 PG&E revenue requirement by approximately $19.7 million.[68] Any Commission order to increase the pole replacement rate should be subject to a one-way balancing account to make sure that ratepayers will not pay for pole replacements that do not occur. That would be an increase of 10,000 poles per year from what PG&E actually

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66 David Marcus, direct testimony in A.09-12-020, 5/19/10, pp. 8-11.

67 Pole removal data is from Attachment 2 to PG&E's response to DR CUE 5-3, showing pole removals from all programs combined.

68 PG&E projects a capital cost of $11,493 per pole to replace 5,760 poles per year in 2014-16. Ex. PGE-4 Workpapers, p. WP 7-5. Replacing an additional 19,000 poles per year, if costs were proportional, would require an additional $11,493 x 19,000 = $218.367 million annual capital investment. The associated revenue requirement, amortized over PG&E's 42-year average service life, would of course be much less. Assuming a $218.367 million capital investment spread evenly across the year, the increase in 2014 average rate base would be $218.367 million x ½ = $109.184 million. Assuming an 18 percent fixed charge rate to convert that rate base increase into a revenue requirement increase, the 2014 revenue requirement would be $109.184 million x .18 = $19.653 million.

did in 2012,[69] a manageable increase.[70] It will still be far fewer replacements than would be expected based on PG&E's claimed average pole service life of 42 years,[71] and it would still not be enough to slow the increase in poles over the age of 60 (even if every single one of the 2014-16 replacements were of a pole over 60, which won't actually happen),[72] but it would be a start. It would not stop the aging of PG&E's fleet of poles – that would require 56,000 pole replacements per year[73] – but it would slow it down.[74] Increasing the rate of pole replacements now will buy time for PG&E to deal with pole aging in the future, and will improve reliability as the number of over-aged poles at risk for failure in major storms is decreased.

B. Distribution Breakers in Substations

In Ex. PGE-4, PG&E declares that it "has approximately 4500 distribution circuit breakers in its substations" and their age is the number

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[69] Proposed 2014-16 pole removals of 2 x 19,000 poles per year = 38,000 poles per year. Actual pole removals in 2012 were 27,999 poles. PG&E, attachment 2 to response to DR CUE 5-3. Increase of 38,000 – 27,999 = 10,001 poles per year.

[70] The number of poles removed in 2012 was an increase of more than 12,000 poles from the year before. PG&E, attachment 2 to response to DR CUE 5-3. CUE's proposal would require a smaller 2012-14 increase in the number of pole removals than actually occurred in 2011-12.

[71] 101,647 poles in 2014. See Marcus workpaper 1.

[72] PG&E has over 120,000 poles that will reach age 60 during 2014-16. Replacing 38000 poles per year for three years would mean 114,000 replacements, not enough to keep up.

[73] Simple algebra shows that to maintain the average age of its poles constant at its 2012 level of 39.26 years (per PGE response to DR CUE 2-4), PG&E must replace a 1/39.26 of its poles each year. With a 2012 pole count of 2,199,408 poles (ibid.), that corresponds to 2,199,408/39.26 = 56,022 poles per year.

[74] In 2012, when PG&E removed 27,999 poles, the most since 2004, its average pole age went up 0.45 years. With no replacements, the average pole age would increase 1 year each year, so the 2012 replacements reduced the fleet aging rate by about .02 years per 1000 poles removed. (1-.45)/27.999 = .0196. Replacing an additional 10,000 poles per year above that level would reduce the annual aging of the pole fleet to approximately .25 years (.45 – 10*.0196 = .254). The average pole would still be over 40 years old by the end of the GRC cycle in 2016 (39.26 +4*.254 = 40.28).

one prioritization criterion for replacing them prior to failure.[75] In Ex. PGE-2, PG&E estimates the average service life for distribution station equipment as 42 years, with an average remaining life for the 12/31/2011 stock of station equipment of 31.5 years.[76] Over the four year period 2013-16, PG&E plans to proactively replace 130 of those 4,500 breakers,[77] or less than 3 percent of them.[78] At PG&E's planned peak replacement rate of 40 breakers per year, it would still take over 112 years to replace the current stock of distribution breakers.[79]

As with poles, PG&E has a substantial mismatch between the useful life of equipment as reflected in depreciation rates – a stock of assets with 31.5 years of life left – and what it is planning to actually do, which is to replace its stock of breakers over a 112 year cycle.

PG&E should be required to align its replacement rate with its depreciation rate. If the average existing breaker has 31.5 years of life left, and if the distribution of remaining breaker life is symmetrical, then half of all existing breakers will reach the end of their lives over the next 31.5 years. That means that the average breaker replacement rate should be 71 per year,[80] not PG&E's planned average of 35 breakers per year in 2014-16. The Commission should order PG&E to double its planned breaker replacement

[75] Ex. PGE-4, p. 13-10.
[76] Ex. PGE-2, p. 11-4.
[77] Ex. PGE-4, p. 13-11.
[78] 130/4500 = .0289 = 2.89%.
[79] (4500-130)/40 = 109.25 years after 2016, or 112.25 years from 1/1/2014.
[80] 4500 existing breakers, with half to be retired over 31.5 years implies 4500/2/31.5 = 71.4 retirements per year.

rate, and authorize funding to do so. PG&E projects a capital cost of $31.5 million for 105 breakers in 2014-16.[81] Doubling the breaker replacement rate, assuming costs are proportional, would require an additional $31.5 million in capital costs, or an average of $10.5 million per year. That would increase 2014 revenue requirement by roughly $0.9 million.[82]

C. Overhead Conductor

In Ex. PGE-4, PG&E declares that it "has over 113,500 miles of overhead conductor" subject to annealing and other types of deterioration.[83] In Ex. PGE-2, PG&E estimates the average service life for overhead distribution conductor and devices (FERC Account 365) as 42 years, with an average remaining life for the 12/31/2011 stock of 30.53 years.[84] Over the GRC period 2014-16, PG&E plans to proactively replace 62 miles per year of "deteriorated and annealed conductor," which will not only prevent outages due to conductor failure but also "mitigate the public and system safety implications associated with "wire down" events."[85] The planned replacements will total less than 1/6 of one percent of the total overhead distribution wire on PG&E's system.[86] At PG&E's planned replacement rate

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[81] Ex. PGE-4, p. 13-11.
[82] Assuming the increased spending was spread evenly across the year, the increase in average 2014 rate base would be $10.5 million x ½ = $5.25 million. Assuming an 18% fixed charge rate to convert that rate base increase into a revenue requirement increase, the 2014 revenue requirement would be $5.25 million x .18 = $0.945 million.
[83] Ex. PGE-4, p. 15-16.
[84] Ex. PGE-2, p. 11-4.
[85] Ex. PGE-4, p. 15-12.
[86] (3 x 62)/113500 = .00164 = 0.164%.

of 62 miles per year, it would take over 1,800 years to replace the current stock of overhead distribution conductor.[87]

As with poles, PG&E has a substantial mismatch between the useful life of equipment as reflected in depreciation rates – a stock of assets with 30.5 years of life left – and what it is planning to actually do, which is to replace its stock of distribution conductor over an 1,800+ year cycle.[88]

As a practical matter, PG&E cannot be required to align its overhead conductor replacement rate with its overhead conductor depreciation rate. If the average overhead distribution conductor has 30.53 years of life left, and if the distribution of remaining overhead conductor life is symmetrical, then half of all existing overhead conductor will reach the end of its life over the next 30.53 years. That means that the average overhead conductor replacement rate should be 1,859 miles per year,[89] not PG&E's planned average of 62 miles per year in 2014-16.

What the Commission can do is order PG&E to double its planned overhead conductor replacement rate, and authorize funding to do so. PG&E projects a capital cost of $101.1 million for 62 miles of overhead line replacement in 2014-16.[90] Doubling the overhead line replacement rate, assuming costs are proportional, would require an additional $101.1 million

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[87] 113500/62 = 1831 years.

[88] DRA's proposal would cut PG&E's rate in half, to 31 miles per year, despite acknowledging and not disputing the B/C ratio of 2.0 that PG&E has calculated. Ex. DRA-7, pp. 52-53. DRA's proposal would double the replacement cycle length for overhead conductor to 3662 years (1831 years, per previous footnote, times 2).

[89] 113,500 miles of existing overhead conductor, with half to be retired over 30.53 years, implies 113500/2/30.53 = 1859 miles of retirements per year.

[90]. Ex. PGE-4, p. 15-17.

in capital costs, or an average of $33.4 million per year. That would increase 2014 revenue requirements by roughly $3.0 million.[91]

PG&E has demonstrated that the planned replacement rate will, by reducing outages, have a benefit/cost ratio of 2.0.[92] Doubling the replacement rate will increase the reliability benefits of the program by some amount, even if it does not increase them proportionately. Thus the resulting benefit/cost ratio will still be greater than one,[93] and PG&E will be a bit farther along towards its eventual need to replace its entire existing stock of overhead conductor.

V. PROACTIVELY IMPROVING RELIABILITY

More than ten years ago, CUE testified in PG&E's TY2003 GRC that PG&E's reliability was lower than that of other California and non-California utilities.[94] Four years ago, PG&E came before the Commission with testimony acknowledging that its reliability is lower than that of other California and non-California utilities.[95] The Commission has since approved the Cornerstone project to improve PG&E's reliability.[96] Now, in this GRC, the Commission once again faces the question of how much of PG&E's

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[91] Assuming the increased spending was spread evenly across the year, the increase in average 2014 rate base would be $33.4 million x ½ = $16.7 million. Assuming an 18% fixed charge rate to convert that rate base increase into a revenue requirement increase, the 2014 revenue requirement would be $16.7 million x .18 = $3.006 million.

[92] Ex. PGE-4, p. 15-17.

[93] With a benefit/cost ratio of two for PG&E's proposed program, doubling the cost while increasing the benefit by any amount at all will result in a new benefit cost ratio greater than 1.

[94] A.02-11-017, Ex. 500, 5/2/03, section IV.

[95] A.08-05-023, 3/17/09 Updated CIP testimony, Chapter 2.

[96] D.10-06-048.

reliability deficit should be eliminated, and when it is appropriate to spend money to improve reliability.

At one time, PG&E rejected the idea that improving reliability was desirable at all, without regard to cost, arguing that the Commission did not want it to spend any money to improve reliability above 1996-98 levels.[97] PG&E evolved past that idea with its Cornerstone application in 2008,[98] but without any quantification of the dollar value of specific reliability improvements. In the Cornerstone decision, the Commission called on PG&E to provide some actual data on the economic value of reliability to customers for use in this GRC,[99] and PG&E responded appropriately by producing a Value of Service (VOS) study in 2012.[100]

A. PG&E's VOS Study Allows Reliability Benefits to be Compared to Their Costs

The PG&E VOS study analyzes, for various customer classes and for various types and durations of outages, the economic costs associated with those outages. Of course, that means it also shows the economic values associated with avoiding those outages in the first place. By providing data to convert outage frequency and duration into dollar terms, the VOS study allows proposed expenditures to improve reliability to be evaluated on a

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[97] A.02-11-017, Ex. 500, 5/2/03, section IX.
[98] A.08-05-023.
[99] D. 10-06-048, as cited in Ex. PGE-4, p. 15-13:5-9.
[100] Freeman, Sullivan & Co., *Pacific Gas & Electric Company's 2012 Value of Service Study*, 5/17/2012, provided as a workpaper in PG&E's GRC filing. See Ex. PGE-4 workpapers, pp. 15-20 to 15-103. Cited below as "VOS" or "VOS study" or "PG&E's VOS study."

benefit/cost basis.[101] Particular measures can have their reliability benefits estimated in terms of the level of avoided outages or avoided outage hours, and those benefits can then be converted into dollar terms using the data in the VOS study. PG&E is to be congratulated for having not just produced the VOS study (pursuant to Commission order), but for having used it to analyze the cost effectiveness of various proactive reliability improvements it is proposing in this GRC cycle.

B. VOS Analyses Show Various PG&E Proposals are Worth Doing

PG&E has applied the VOS study to a variety of measures it is proposing for this GRC to show that they would not only improve reliability, but that the dollar benefits of that improvement would outweigh the cost of the proposed measure. For example, PG&E proposes to expand its programs involving fuses and reclosers, FLISR, underground protection, and improvements to its worst-performing circuits, and in each case shows that its proposals would have benefit/cost (B/C) ratios above four.[102] DRA generally accepts PG&E's proposals.[103] The real question is whether PG&E should be doing even more.

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[101] That is precisely the use the Commission contemplated. See D.10-06-048, p. 2, as cited in Ex. PGE-4, p. 15-13, fn. 10: saying that a VOS study will "help [PG&E] and the Commission decide to what extent, if any, electric distribution reliability should be improved to satisfy [PG&E] customers' needs."
[102] Ex. PGE-4, pp. 15-20 to 15-24.
[103] Ex. DRA-7, pp. 56-58, accepting PG&E's proposals for fuses and reclosers, underground protection, and worst-performing circuits, and half of PG&E's proposal with regard to FLISR.

C. Benefit/Cost Ratios Greater Than One Show PG&E Should Be Doing More

With perfect information, expanding a proactive reliability program produces declining marginal returns. The most effective measures, with the highest B/C ratios, will be taken first, and each successive measure will produce less benefit and thus a lower B/C ratio. At the point when the B/C ratio drops below one, it will no longer make economic sense to spend money on that particular reliability-improving measure.[104] In economists' jargon, the total benefit of a program divided by its total cost is its average B/C ratio, while the benefit of the last unit of the program divided by the cost of that last unit is its marginal cost. With perfect information, marginal cost falls below average cost. So stopping program expansion when the marginal B/C ratio reaches one means that the average B/C ratio will still be above one.

In the real world, perfect information does not exist. Last year's worst-performing circuits may not be next year's worst-performing circuits. It may make more sense to add fuses on a geographic basis rather than trying to calculate exactly where new fuse installations would have the highest B/C ratio. Thus the marginal B/C ratio may not be known, and will not necessarily be lower than the average B/C ratio.

In this case, PG&E does not know the marginal B/C ratios associated with potential expansions of the various programs for which it has provided

[104] DRA claims it makes sense to stop even sooner, when the B/C ratio is above one, sometimes well above it. See Ex. DRA-7, pp. 57-58, among other places.

average B/C ratios.[105] However, it is reasonable to expect that the marginal B/C ratio will not be hugely lower than the average B/C ratio, particularly since PG&E will not be implementing any of these programs in perfect order of declining marginal benefit.

1. Fuses

PG&E proposes to spend $3 million per year in 2014-16 to install 700 overhead fuses, with a calculated B/C ratio of 21.0.[106] That means that the reduction in outages due to those 700 fuses will save customers from outage-related costs of some $189 million.[107] In an expanded fuse program, even if each incremental fuse was only 1/10 as valuable in terms of improved reliability as the average of the fuses PG&E is proposing to install, the marginal B/C ratio for those additional fuses would still be greater than two. It seems very unlikely that PG&E has identified 700 fuses whose installation would have an average B/C ratio of 21, but that the 701st fuse would have a B/C ratio less than one.

The Commission should order PG&E to double its overhead fuse program by identifying additional locations for fuses that would have an incremental B/C ratio well above one. And the Commission should also authorize the necessary funding for an expanded program. Doubling PG&E's

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[105] PG&E, response to CUE data request 4-1.
[106] Ex. PG&E-4, p. 15-23.
[107] Cost of $3 million/year x 3 years x B/C ratio of 21 = benefit of $189 million. Note that PG&E's workpapers show a present value (PV) benefit based on the VOS study of $161.1 million (Ex. PGE-4 Workpapers, p. 15-15), which suggests a B/C ratio of $161.1/$9 = 17.9, rather than 21.0.

requested $3 million per year program would require an additional capital investment of $3 million per year. That would increase 2014 revenue requirements by roughly $0.3 million.[108]

Given the B/C ratio of 21 for the proposed program, the downside risk of an expanded program is small. Even if PG&E doubled its program and the additional fuses produced no incremental benefits at all, the overall program B/C ratio would still be 10.5.[109]

2. Reclosers

PG&E proposes to spend $9.8 million in 2014-16 to install 244 new line reclosers, with a calculated B/C ratio of 37.2.[110] That means that the reduction in outages due to those 244 reclosers will save customers from outage-related costs of some $364 million.[111] In an expanded recloser program, even if each incremental recloser was only 1/10 as valuable in terms of improved reliability as the average of the reclosers PG&E is proposing to install, the marginal B/C ratio for those additional reclosers would still be greater than three. It seems very unlikely that PG&E has identified 244

[108] Assuming the increased spending was spread evenly across the year, the increase in average 2014 rate base would be $3 million x ½ = $1.5 million. Assuming an 18% fixed charge rate to convert that rate base increase into a revenue requirement increase, the 2014 revenue requirement would be $1.5 million x .18 = $0.270 million.
[109] $189 million benefit / doubled cost of $18 million = 10.5. If the benefit were only $161.1 million (Ex. PGE-4 workpapers, p. 15-15), the B/C ratio would still be 8.9.
[110] Ex. PG&E-4, pp. 15-23, 15-24.
[111] Cost of $9.8 million x B/C ratio of 37.2 = benefit of $364.56 million. Note that PG&E's workpapers show a present value (PV) benefit based on the VOS study of $309.4 million (Ex. PGE-4 Workpapers, p. 15-15), which suggests a B/C ratio of $309.4/$9.8 = 31.6, rather than 37.2.

reclosers whose installation would have an average B/C ratio of 37.2, but that the 245th recloser would have a B/C ratio less than one.

The Commission should order PG&E to double its recloser program by identifying additional locations for reclosers that would have an incremental B/C ratio well above one. And the Commission should also authorize the necessary funding for an expanded program. Doubling a $9.8 million program would require an additional capital investment of $9.8 million over the GRC period, or an average of $3.3 million per year. That would increase 2014 revenue requirements by roughly $0.3 million.[112]

Given the B/C ratio of 37.2 for the proposed program, the downside risk of an expanded program is small. Even if PG&E doubled its program and the additional reclosers produced no incremental benefits at all, the overall program B/C ratio would still be 18.6.[113]

3. FLISR

Fault Location, Isolation, and Service Restoration (FLISR) is an automated technology that "reduces the impact of outages by quickly opening and closing automated switches to reduce what may have been a one-to-two-hour outage, to less than five minutes for most affected customers."[114] PG&E proposes to spend $180 million in 2014-16 to install FLISR on 600 circuits,

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[112] Assuming the increased spending was spread evenly across the year, the increase in average 2014 rate base would be $9.8 million x 1/3 x ½ = $1.633 million. Assuming an 18% fixed charge rate to convert that rate base increase into a revenue requirement increase, the 2014 revenue requirement would be $1.633 x .18 = $0.294 million.

[113] $364 million benefit / doubled cost of $19.6 million = 18.57. If the benefit were only $309.4 million (Ex. PGE-4 workpapers, p. 15-15), the B/C ratio would still be 15.8.

[114] Ex. PGE-4, p. 1-10.

with a calculated B/C ratio of 31.2, although the actual B/C ratio may be as low as 21.8.[115] That means that the reduction in outages on those 600 circuits will save customers from outage-related costs of at least $4.78 billion over the life of the FLISR installations.[116] In an expanded FLISR program, even if each incremental circuit using FLISR was only 1/10 as valuable in terms of improved reliability as the average of the circuits on which PG&E is proposing to install FLISR, the marginal B/C ratio for the additional FLISR would still be greater than two. It seems very unlikely that PG&E has identified 600 circuits where FLISR installation would have an average B/C ratio of 21.8-31.2, but that the 601st circuit would have a FLISR B/C ratio less than one.

The Commission should order PG&E to expand its FLISR program by 50 percent, to 300 circuits per year, by identifying additional circuits where FLISR would have an incremental B/C ratio well above one. And the Commission should also authorize the necessary funding for an expanded FLISR program. Increasing a $60 million per year program by 50 percent

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[115] Ex. PG&E-4, pp. 15-20, 15-21. Note that PG&E's workpapers show a present value (PV) benefit based on the VOS study of $4783.2 million (Ex. PGE-4 Workpapers, p. 15-15), which suggests a B/C ratio of $4783.2/$180 = 26.6, rather than 31.2. Also, PG&E's B/C ratio calculations include associated recloser benefits but not the recloser costs, which increase FLISR costs by 22%, from $300,000 per circuit to $366,000 per circuit (Ex. PG&E-4 Workpapers, pp. 15-9 and 15-105). So the net B/C ratio could be as low as 26.6/1.22 = 21.8.

[116] Cost of $180 million x B/C ratio of 31.2 = benefit of $5616 million. PG&E-calculated PV of reliability benefits is $4.7832 billion (Ex. PG&E-4 Workpapers, p. 15-15).

would require an additional capital investment of $30 million per year. That would increase 2014 revenue requirements by roughly $2.7 million.[117]

Given the B/C ratio of 21.8 to 31.2 for the proposed program, the downside risk of an expanded program is small. If PG&E increased its FLISR program by 50 percent, to 300 circuits per year, and the additional FLISR circuits produced no incremental benefits at all, the overall program B/C ratio would still be over 17.[118]

Increasing the FLISR program by 50% would not only increase FLISR capital costs by $30 million per year, it would also increase recloser costs by $6.6 million,[119] With an associated increase in 2014 revenue requirements of about $0.6 million.[120] To the extent the Commission orders an expanded FLISR program, it should also authorize the required increase in recloser purchases.[121]

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[117] Assuming the increased spending was spread evenly across the year, the increase in average 2014 rate base would be $30 million x ½ = $15 million. Assuming an 18% fixed charge rate to convert that rate base increase into a revenue requirement increase, the 2014 revenue requirement would be $15 million x .18 = $2.700 million.

[118] $5616 million benefit / increased cost of $180 million x 1.5 = 5616/270 = 20.8. If the benefit were only $4783.2 million (Ex. PGE-4 workpapers, p. 15-15), the B/C ratio would still be 17.7.

[119] Ex. PGE-4 workpapers, pp. 15-9 and 15-105, showing that FLISR costs of $300,000 per circuit do not include associated reclosers, and p. 15-8, showing 3 reclosers per FLISR circuit, at a cost of $22,000 each, for a recloser cost of 3 x 100 x $22,000 = $6.6 million for an additional 100 FLISR circuits per year.

[120] Assuming the increased spending was spread evenly across the year, the increase in average 2014 rate base would be $6.6 million x ½ = $3.3 million. Assuming an 18% fixed charge rate to convert that rate base increase into a revenue requirement increase, the 2014 revenue requirement would be $3.3 million x .18 = $0.594 million.

[121] DRA has already acknowledged the linkage between the FLISR program and recloser purchase costs, when it calls for cuts in the FLISR program to trigger cuts in the associated recloser purchases. Ex. DRA-7, pp. 52-53. The same relationship applies in the other direction.

DRA also wants PG&E to change the size of its FLISR program by 50 percent (100 circuits per year), but DRA wants the change to be a contraction rather than an expansion.[122] DRA acknowledges, and does not dispute, the 31.2 B/C ratio that PG&E calculated using the Commission-ordered 2012 VOS study.[123] DRA provides no basis for its desire to cut such a highly cost-effective program other than a claim that "judgment must be exercised" and that "in DRA's judgment" cutting the FLISR proposal in half would be consistent with the FLISR installation rates approved in the Cornerstone case.[124] But the decision in this case must be based on the record in this case, not what the Commission did in Cornerstone. With a B/C ratio of 21.8 to 31.2, capital investments in FLISR will pay for themselves very quickly, possibly even during this GRC cycle. Unless the Commission proposes to simply ignore VOS data, after ordering it in the Cornerstone case, it should increase funding for projects with very high B/C ratios (like FLISR), not cut them in half as DRA proposes.

4. Targeted Circuit Improvements

PG&E proposes to spend $26 million per year in 2014-16 to target improvements for 80 of its 400 worst-performing circuits each year, with a calculated B/C ratio of 7.1.[125] That means that the reduction in outages due to those 80 targeted circuits per year will save customers from outage-related

[122] Ex. DRA-7, pp. 57-58.
[123] Ibid.
[124] Ibid.
[125] Ex. PG&E-4, pp. 15-21, 15-22.

costs of some $364 million.[126] In an expanded targeted circuit program, even if each incremental targeted circuit investment was only ½ as valuable in terms of improved reliability as the average of the targeted circuits PG&E is proposing to install, the marginal B/C ratio for those incremental targeted circuits would still be greater than two. It seems very unlikely that PG&E can identify 240 circuits which can be improved with an average B/C ratio of 7.1, but that the 241st targeted circuit would have a B/C ratio less than one.

The Commission should order PG&E to expand its targeted circuit program by 50 percent, to 120 circuits per year, by identifying additional circuits where targeting would have an incremental B/C ratio well above one. An expanded program would still not address all of the 400 worst-performing circuits over the three year GRC cycle. The Commission should also authorize the necessary funding for an expanded targeted circuit program. Increasing a $26 million per year program by 50 percent would require an additional capital investment of $13 million per year. That would increase 2014 revenue requirements by roughly $1.2 million.[127]

Given the B/C ratio of 7.1 for the proposed program, the downside risk of an expanded program is small. If PG&E increased its targeted circuit program by 50 percent, to 120 circuits per year, and the additional targeted

[126] Cost of $26 million/year x 3 years x B/C ratio of 7.1 = benefit of $553.8 million. Note that PG&E's workpapers show a present value (PV) benefit based on the VOS study of $469.8 million (Ex. PGE-4 Workpapers, p. 15-15), which suggests a B/C ratio of $469.8/$78 = 6.0, rather than 7.1.

[127] Assuming the increased spending was spread evenly across the year, the increase in average 2014 rate base would be $13 million x ½ = $6.5 million. Assuming an 18% fixed charge rate to convert that rate base increase into a revenue requirement increase, the 2014 revenue requirement would be $6.5 million x .18 = $1.170 million.

circuits produced no incremental benefits at all, the overall program B/C ratio would still be over four.[128]

5. Underground Protection

PG&E proposes to spend $8 million per in 2014-16 to install 67 underground fuses and 67 interrupters, with a calculated B/C ratio of 4.6.[129] That means that the reduction in outages due to those underground fuses will save customers from outage-related costs of some $36.8 million.[130] In an expanded underground protection program, even if each incremental underground fuse and interrupter was only ½ as valuable in terms of improved reliability as the average of the underground fuses and interrupters PG&E is proposing to install, the marginal B/C ratio for those additional underground fuses and interrupters would still be greater than two. It seems very unlikely that PG&E can identify 67 underground fuses and interrupters with an average B/C ratio of 4.6, but the 68th would have a B/C ratio less than one.

The Commission should order PG&E to expand its underground protection program by 50 percent, to a total of 100 fuses and interrupters, by identifying additional underground fuses and interrupters which would have an incremental B/C ratio well above one. The Commission should also

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[128] $553.8 million benefit / increased cost of $78 million x 1.5 = 553.8/117 = 4.7. If the benefit were only $469.8 million (Ex. PGE-4 workpapers, p. 15-15), the B/C ratio would still be 469.8/117 = 4.02.

[129] Ex. PG&E-4, p. 15-24. Ex. PGE-4 Workpapers, pp. 15-13 and 15-15.

[130] Cost of $8 million x B/C ratio of 4.6 = benefit of $36.8 million. Note that PG&E's workpapers show a present value (PV) benefit based on the VOS study of $31.0 million (Ex. PGE-4 Workpapers, p. 15-15), which suggests a B/C ratio of $31/$8 = 3.9, rather than 4.6.

authorize the necessary funding for an expanded targeted circuit program. Increasing an $8 million program by 50 percent would require an additional capital investment of $4 million, or an average of $1.3 million per year. That would increase 2014 revenue requirements by roughly $0.1 million.[131]

Given the B/C ratio of 4.6 for the proposed program, the downside risk of an expanded program is small. If PG&E increased its underground protection program by 50 percent, to 100 fuses and 100 interrupters, and the additional underground fuses and interrupters produced no incremental benefits at all, the overall program B/C ratio would still be over 2.5.[132]

VI. PICARRO (EX. PGE-3, CHAPTER 6)

A. Background – How We Got Here

1. CUE Identified the Problem in the Last GRC Cycle – Failure to Adequately Detect and Repair Gas Leaks

"Regarding natural gas service, where detecting gas leaks is a fundamental safety issue, PG&E has discovered that it has been failing to discover or repair tens of thousands of gas leaks."[133] That is what CUE wrote in its expert testimony in PG&E's last GRC.[134] At that time, the number of

[131] Assuming the increased spending was spread evenly across the year, the increase in average 2014 rate base would be $4 million x 1/3 x ½ = $0.667 million. Assuming an 18% fixed charge rate to convert that rate base increase into a revenue requirement increase, the 2014 revenue requirement would be $0.667 million x .18 = $0.120 million.
[132] $36.8 million benefit / increased cost of $8 million x 1.5 = 36.8/12 = 3.1. If the benefit were only $31 million (Ex. PGE-4 workpapers, p. 15-15), the B/C ratio would still be 31/12 = 2.58.
[133] CUE, opening testimony of David Marcus in A.09-12-020, 5/19/10, p. 2.
[134] Ibid.

PG&E Gas T&D field employees had been falling for years, and was down 24 percent from its level in 2004.[135]

Since the San Bruno explosion, PG&E has enormously stepped up its attention to gas safety. It has created a separate Gas Transmission and Distribution organization (in 2011) and has added or is adding more than two thousand new gas workers in the 2012-14 period.[136] It has also worked off, or plans to work off by the end of this year, the enormous backlog of known but unrepaired gas leaks that had built up by 2010. This is noteworthy progress.

2. Picarro is an Attempt to Improve Gas Leak Detection Technology

As part of its efforts to recover from its past history of insufficient leak detection, PG&E has become a leader in implementing a potentially revolutionary new technology. The Picarro technology is a methodology, comprising both new leak detection technology and adaptations to use that technology, which holds out the promise of detecting more leaks than traditional leak detection methods, at a lower cost. PG&E's GRC application proposes to implement Picarro in 2014 in three of PG&E's gas divisions. DRA also proposes a substantial move towards use of the Picarro approach.

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[135] Ibid., p. 15, showing a drop in Gas T&D field service employees from 1572 in 2004 to 1201 in March 2010.

[136] PG&E, response to DR CUE 2-Q10.a., showing Gas T&D staffing increasing from 2534 at 12/31/11 to 4189 at 12/31/12 to a forecasted 4815 by the end of 2014.

B. What Picarro is and How it Works

1. Picarro Proper is a Method That is a Thousand Times More Sensitive to the Amount of Gas in the Air – But Does Not Find the Actual Physical Leak

The Picarro technology relies upon high speed spectroscopy to detect methane in concentrations in the parts per billion range in the time that a moving vehicle travels just a few feet. That is up to a thousand times more sensitive than the traditional methods which involve walking the path of underground gas lines with a detector sensitive to methane in the parts per billion range. However, the Picarro detector by itself does not find any gas leaks. For that several more steps are required.

At the same time that a vehicle with a Picarro detector is being driven through a neighborhood with PG&E gas service, local wind speeds and wind types are also being detected or measured. From that data, a map is generated that shows the area within which any gas found by the detector is estimated to have originated. Using the vehicle-based data, a foot search is then made to detect and rate the actual leaks responsible for the plume of gas located from the vehicle. In addition, the Picarro-generated maps of plume areas are matched against PG&E's maps of gas pipe locations to identify any areas which have gas pipes but were not inside the detection radius of the Picarro detector.[137] Those areas are also searched on foot for leaks.

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[137] For example, if there were a strong wind from north-to-south, the Picarro search radius might not cover gas services located on the north side of a particular street. PG&E tries to mitigate this risk by driving each street twice, preferably at different times of day when wind

2. The "Picarro Methodology" Combines Picarro Detectors with Foot-Based Search and Evaluation, But Still Reduces Overall Leak Detection Costs

Thus the "Picarro methodology" referred to in this testimony is really a combination of several linked actions: vehicle-based detection of leaks, vehicle and software-based mapping of the area(s) from which those leaks could have originated, foot-based search to find specific locations of Picarro-identified leaks, foot-based search of areas that the vehicle-based Picarro search did not cover, and foot-based evaluation and grading of leaks once found. In addition, the Picarro methodology requires increased foot patrols to monitor corrosion, which would otherwise be done as part of the traditional leak detection methods that are entirely foot-based.

Even with its multiple steps, the "Picarro methodology" is still much cheaper than traditional leak detection methodologies that involve entirely foot-based leak detection. The staff time savings from vehicle-based leak detection outweigh the capital costs associated with the Picarro detectors themselves and the unavoided labor costs for the detection and grading of the leaks themselves, as well as the labor costs for covering the small areas not covered by the Picarro detectors.

C. Picarro Methodology Results

PG&E has performed and published two side-by-side comparisons of the Picarro methodology with traditional leak detection methodology. Those

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direction is likely to be different, but there will always be some areas for which the Picarro detector returns no data.

two studies analyzed 16 plats each in PG&E's Sacramento and Diablo divisions, in February through April 2012. In the year since, there have been no published results from PG&E comparing the Picarro methodology to traditional gas leak detection methods.

1. Three Major Results from the 2012 Analyses

The 2012 PG&E studies had three major results, two of them anticipated and the third one very surprising indeed.

a. Picarro is cheaper, at least in labor terms, as a leak detection methodology

First, both studies found that leak detection using Picarro was cheaper. For the Sacramento Division, the total time required for all components of the Picarro methodology was 192 hours, versus 369 hours with the traditional method.[138] The corresponding times for the Diablo division were 252 hours with the Picarro methodology and 343 hours with the traditional methodology.[139] Overall, Picarro reduced time costs by 38 percent.[140] While these savings would be offset in part by its capital costs and operating expenses for vehicles and technology, they are probably enough to make Picarro cheaper overall than traditional methods of leak detection.

b. Picarro methodology finds a lot of leaks the traditional methods do not.

Second, both studies found that the Picarro methodology detected a lot more leaks than the traditional approach. In Sacramento, the Picarro

[138] Sacramento Picarro Leak Detection Report 1 25 2013 FINAL.pdf, Figure 5.0.
[139] Diablo Picarro Leak Detection Report 1 25 2013 FINAL.pdf, Figure 7.0.
[140] (369-192+343-252)/(369+343) = .376.

methodology found 163 leaks while the traditional methodology found only 117.[141] In the Diablo division, the disparity was even larger: Picarro found 339 leaks while the traditional approach found barely half as many, or 189 leaks.[142] Overall, the Picarro approach found 64 percent more leaks than the traditional approach.[143] The Picarro methodology not only found more leaks overall, it found more leaks of every grade,[144] as DRA also acknowledges.[145]

c. The leaks found by traditional methods are largely not found by the Picarro methodology

The third result of the 2012 side-by-side comparisons was the surprising one. While Picarro found a lot of leaks missed by the traditional method, it largely failed to find the leaks found by the traditional on-foot method. In Sacramento, where the traditional method found 117 leaks, Picarro found only 25 of those 117.[146] In the Diablo division, the disparity was even larger. Traditional methods found 189 leaks, only 23 of which were also found by Picarro.[147] Overall, less than 16 percent of the leaks found by the traditional methodology were also found by Picarro.[148] Basically, Picarro did not merely find ***more*** leaks than the traditional approach, it found

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[141] Sacramento Picarro Leak Detection Report 1 25 2013 FINAL.pdf, Figure 3.0. The 163 leaks are net of 75 false alarms, where Picarro sensors detected gas but an on-foot search was unable to find an associated leak. Ibid., pp. 7-8.

[142] Diablo Picarro Leak Detection Report 1 25 2013 FINAL.pdf, Figure 5.0.

[143] (163-117+339-189)/(117+189) = .641. Note that DRA claims that Picarro can only be expected to find 33% more leaks than the traditional approach, contrary to the Diablo and Sacramento data. Ex. DRA-9, pp. 80-81.

[144] Sacramento Picarro Leak Detection Report 1 25 2013 FINAL.pdf, Figure 3.0 and Diablo Picarro Leak Detection Report 1 25 2013 FINAL.pdf, Figure 5.0.

[145] Ex. DRA-9, p. 124.

[146] Sacramento Picarro Leak Detection Report 1 25 2013 FINAL.pdf, Figure 3.0.

[147] Diablo Picarro Leak Detection Report 1 25 2013 FINAL.pdf, Figure 5.0.

[148] (25+23)/(117+189) = .157.

different leaks. Of the total of 760 distinct leaks found by the two approaches, only 48 (6 percent) were found by both.[149]

Because there is little overlap between the leaks found by the Picarro methodology and those found by traditional methodology, the effect of using both is to find far more leaks than either alone would find. While Picarro itself finds 64 percent more leaks than the traditional approach, doing both finds 148 percent more leaks than the traditional method.[150]

2. The Results of the 2012 Analyses Apply to All Relevant Leak Types

One question is whether the disparity between Picarro and traditional leak methods applies to all types of leaks. Perhaps one method is better for minor (Grade 3) leaks, while the other is better for larger, more serious leaks. The data contradict such a hypothesis. Because Grade 1 leaks are required to be fixed immediately, it was not possible to know whether the Grade 1 leaks found by Picarro would also have been found by the traditional method. But for every other grade of leak (2, 2+, 3, and meter set leaks), the same result occurred. For every grade of leak, Picarro found more leaks than the traditional method, but found few of the leaks detected by the traditional methodology. For Grade 2+ leaks, Picarro found 50% of the particular leaks found by the traditional approach.[151] But for Grade 2 it found only 44%,[152]

[149] (25+23)/(306+502-25-23) = .063.
[150] Sacramento Picarro Leak Detection Report 1 25 2013 FINAL.pdf, Figure 3.0, and Diablo Picarro Leak Detection Report 1 25 2013 FINAL.pdf, Figure 5.0, showing 306 leaks found by the traditional method alone, and 760 found by both methods together. (760-306)/306 = 1.484.
[151] Ibid. 1 leak out of 2.
[152] Ibid. 24 leaks out of 55.

and for Grade 3 only 30%.[153] And for meter set leaks, Picarro found only 5% of the leaks that were found by the traditional in-person inspection.[154]

Similarly, the 2012 analyses show that using both leak detection methods finds far more leaks than the traditional method for all grades of leaks. In particular, using both methods finds six times as many Grade 2+ leaks,[155] more than twice as many Grade 2 leaks,[156] more than three times as many Grade 3 leaks,[157] and more than twice as many meter set leaks.[158]

D. Policy Implications for the Picarro Methodology

1. Picarro Should be Used

The fact that the Picarro methodology finds previously unfound leaks, and a lot of them, implies that PG&E's proposal to introduce the Picarro methodology on an increasingly large scale in its service area should be approved.

2. Picarro Should Not Replace Traditional Methods

On the other hand, the fact that existing methods find many leaks that Picarro misses, including Grade 2 and Grade 2+ leaks, implies that PG&E should not be permitted, at this time, to use the Picarro methodology in place of traditional methods. Rather, PG&E should be required, for this GRC cycle, to use Picarro only as a supplement to current methods. In the next GRC, if

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[153] Ibid. 12 leaks out of 40.
[154] Ibid. 11 leaks out of 212.
[155] Ibid. 13 versus 2.
[156] Ibid., 146 versus 55. 146/55 = 2.65.
[157] Ibid. 126 versus 40. 126/40 = 3.15.
[158] Ibid. 462 versus 212. 462/212 = 2.18.

further research results presented then demonstrate that improvements to the Picarro methodology are allowing it to find the leaks that current methodology finds, and not just leaks that the current methodology misses, then Picarro can be used as a replacement methodology.

3. The Cost Implications of Picarro are Currently Uncertain

PG&E's side-by-side studies provided data indicating that Picarro will likely be cheaper than current leak detection methods, when and if it is capable of replacing them rather than supplementing them. But that does not mean that Picarro will cause PG&E's costs to go down. Leak detection is only part of the cost associated with keeping the gas distribution system safe. Leak repair is the other half of the picture. Because Picarro finds so many more leaks than the current methods, it will cause leak repair costs to go up. It will also cause corrosion detection costs to go up as there will no longer be routine foot traffic to all services by PG&E gas employees.

a. Uncertain costs of leak detection

PG&E's two 2012 studies found different ratios of Picarro hours to traditional hours in the two areas studied; the ratios differed by a factor of about 40 percent,[159] suggesting an uncertainty as to Picarro leak detection labor costs of plus or minus 20 percent.

[159] Ibid, Figures 5.0 (Sacramento) and 7.0 (Diablo), showing a Picarro/traditional labor ratio of 52% in one division and 73% in the other. 73/52 = 1.40.

b. Uncertain costs of leak repair

Leak repair costs are generally a function of leak detection levels: the more leaks found, the more it will cost to repair them. The difference between the two areas in terms of number of leaks found was substantial. In Sacramento, the Picarro method found 26 leaks of Grade 1, 2+, or 2 that the traditional method had missed.[160] In the Diablo Division, in the same number of plats, the Picarro method found 83 leaks of Grade 1, 2+ or 2 that the traditional method had missed, or more than three times as many.[161] This suggests that there is still a great deal of uncertainty as to how many leaks requiring repair will be found by a given level of Picarro leak detection efforts.

4. PG&E's Proposed Two-Way Balancing Account Should be Approved

Given the uncertainty about how many incremental leaks the Picarro methodology will find over and above traditional leak detection methods, and given the uncertainty about how much leak repair costs will increase to fix those newly-found leaks, PG&E's proposed two-way balancing account relating to Picarro costs and associated leak repair costs should be approved. To attempt to pick a single number now for the costs of Picarro-based leak detection and the associated repair costs would be a futile exercise. It would give PG&E a financial incentive to not repair leaks, and would reward PG&E if Picarro turns out not to work as well as tests to date suggest it will. A two-

[160] Sacramento Picarro Leak Detection Report 1 25 2013 FINAL.pdf, Figure 3.0.
[161] Diablo Picarro Leak Detection Report 1 25 2013 FINAL.pdf, Figure 5.0.

way balancing account will both cover PG&E costs if Picarro works better than expected (triggering high repair costs), and provide refunds if Picarro works more poorly than expected, or is used less than currently expected.

5. More Research Should be Required Before the Next GRC

PG&E should be required to continue side-by-side analyses of tradition and Picarro methodologies to see if technological improvements to Picarro can increase the overlap between leaks found by the two methodologies. In its next GRC filing, due in about two years, PG&E should be required to report on those continued studies and any policy changes that may be called for in response to them.[162]

[162] DRA has also called for further research on Picarro, with results to be reported in the next GRC. See Ex. DRA-9, p. 76, calling for Picarro to be treated as a "pilot" until the next GRC.