

Save Porter Ranch

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September 21, 2016
Councilmember Nury Martinez
Chair, Energy and Environment Committee
Los Angeles City Council
200 N. Spring Street
Los Angeles, CA 90012
Re: Committee Item #2 -LADWP Winter Reliability report motion 15-1380-S7

Dear Chairwoman Martinez

Regarding the above motion:

LADWP is asked to report on winter gas and energy reliability. They already did that in their report as part of The State of California's Aliso Canyon Winter Risk Assessment and Action Plan (ACWRAP). That final State report shows, by the analysis numbers, that there will be adequate gas supplies for Winter 2016-2017.

Bill Powers of Powers Energy, authored San Diego Smart Energy 2020, that city's plan to convert to clean energy. His report, "Critical Review of Aliso Canyon Winter Risk Assessment and Action Plan" (attached) further shows that certain *statements* in the ACWRAP are not backed up by the *numbers* in the same plan. The Powers report is essentially an independent confirmation of the *numbers* in the ACWRAP, refuting the unsubstantiated *statements*. And his further independent confirmation in his report shows that LA will have adequate gas and electricity supplies even with Aliso Canyon remaining shut down.

Now all these energy supply numbers do not exist in a vacuum. Those concerned with energy supplies say that keeping Aliso closed to protect health will potentially (not even guaranteed) cause ***rare*** gas shortages. Then the reverse is also true: re-opening it will sacrifice the health of perhaps thousands of residents, as is REALLY ALREADY HAPPENING! That number is unknown since there is no health study being done nor scheduled. Even though the Los Angeles County Department of Public Health's

CASPER study, March 2016 (short and full versions attached) shows that 62% of households in the Aliso Canyon area surveyed reported still having symptoms weeks after the blowout was allegedly sealed.
NO further health study of any kind has been done or even began. In fact, SoCalGas has indicated that they plan to file in court to remove the required (and previously agreed upon by SoCalGas) AQMD health study. Yet our organization has found via door-to-door surveys, community outreach and social media that many, *many* people are still having the same symptoms. Unfortunately we do not have the recourses at this time to give you statistical numbers.

THAT IS THE CITY'S AND THE COUNTY'S AND THE STATE OF CALIFORNIA'S JOB!
PROTECT PUBLIC HEALTH!

This facility needs to be kept shut down until the source of the health problems is determined.
MORE IMPORTANTLY: the ***cause of the blowout is not even known!*** Returning the facility to the energy grid will greatly reduce reliability since LA would be back to using an already proven unreliable component, ***not even knowing why it failed in the first place.***

In our opinion, LACC needs to authorize a health study. Again, that is the government's job. NOBODY is addressing the health of 1000s of LA residents.

Sincerely,

Matt Pakucko
President and CoFounder
Save Porter Ranch

ALISO CANYON GAS LEAK

Preliminary Casper Results

Data Subject To Change Pending Further Analysis

County of Los Angeles Public Health

Table 1: Households reporting that any member of the household had experienced any of the following health symptoms during the month after the leaking well was sealed that was believed to be caused by or related to the gas leak, weighted to the entire sampling frame, Porter Ranch and Granada Hills, CA, March 2016.

	During the active gas leak			After the leaking well was sealed		
	Number of households (n=210)	Projected number of households (n=7,755)	Weighted % of households (95% CI)	Number of households (n=210)	Projected number of households (n=7,755)	Weighted % of households (95% CI)
Any symptom(s)	170	6,278	81.3 (75.5 – 87.2)	130	4,801	62.5 (56.3 – 68.7)
Eye, nose and/or throat irritation	154	5,687	74.4 (67.6 – 81.2)	124	4,579	59.6 (53.0 – 66.2)
Nosebleed(s)	96	3,545	46.6 (40.0 – 53.2)	64	2,363	30.9 (24.4 – 37.4)
Skin rash/irritated skin	95	3,508	46.1 (38.6 – 53.6)	76	2,807	37.3 (31.0 – 43.5)
Respiratory complaint*	138	5,096	67.0 (60.6 – 73.3)	105	3,878	50.7 (44.1 – 57.4)
Headache/migraine	147	5,429	71.7 (65.1 – 78.3)	108	3,988	51.9 (45.0 – 58.8)
Nausea/vomiting	112	4,136	54.6 (48.4 – 60.9)	83	3,065	40.7 (34.3 – 47.0)
Dizziness/light headedness	119	4,395	59.5 (52.7 – 66.2)	81	2,991	39.9 (33.5 – 46.3)

* Includes symptoms such as shortness of breath/difficulty breathing, chest tightness or heaviness, cough, wheezing, worsening of asthma or worsening of emphysema/chronic obstructive pulmonary disease (known as COPD)

Table 2: Medical care sought by households reporting symptoms in the past month, survey conducted in response to the Aliso Canyon gas leak incident, CA, March 2016

	Number of households (n=130)	Projected number of households (n=4,801)	Weighted % of households (95% CI)
In the past month, did you or any member of your household seek medical care for symptoms related to the gas leak?*			
No	48	1,773	38.4 (30.2 – 46.6)
Yes	77	2,844	61.6 (53.4 – 69.8)
If yes, where did you seek care?†			
Emergency room or hospital	14	517	18.2 (7.5 – 28.9)
Family doctor or urgent care	69	2,548	89.6 (82.3 – 96.9)
Specialist or other type of care	23	849	29.9 (20.1 – 39.7)

* Among households that reported any household member experienced any symptoms in the past month thought to be caused by or related to the gas leak (n=130)

Table 3: Odors and oily residue among households interviewed for survey conducted in response to the Aliso Canyon gas leak incident, CA, March 2016

	Number of households (n=210)	Projected number of households (n=7,755)	Weighted % of households (95% CI)
During the past month, smelled a "gas-like' odor…			
Outdoors at home	52	1,920	26.1 (19.7 – 32.6)
Outdoors in neighborhood	40	1,477	20.1 (14.5 – 25.7)
Inside home	48	1,773	23.5 (18.3 – 28.8)
Oily residue noticed during or after gas leak	73	2,696	39.7 (30.3 – 49.0)

* Among households that reported smelling an odor inside their home (n=48) and reported using methods such as running the central air conditioning system, opening windows and doors, using portable air purifiers, or using fans to try to reduce the odors inside the home (n=38).

ALISO CANYON GAS LEAK Community Assessment for Public Health Emergency Response (CASPER)

May 13, 2016

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Table of Contents

SECTION I. Background

The massive release of natural gas from Well SS-25 at the Aliso Canyon Natural Gas storage facility began on October 23, 2015. On February 11, 2016 Southern California Gas (SCG) reported that the flow of gas from the Well SS-25 had been stopped, and on February 18, 2016 the California Department of Oil, Gas, and Geothermal Resources (DOGGR) confirmed that the well was permanently sealed. The Los Angeles County Department of Public Health (DPH) has been actively monitoring and assessing the environmental and health issues related to this incident, including a multi-agency comprehensive air monitoring program for methane, sulfur compounds, benzene, and numerous other chemicals. Throughout the leak, methane levels in the community were elevated, but below those presenting a risk to health and safety.[1] Measured benzene levels in the community fluctuated somewhat, with a maximum short-term reading of 5.6 parts per billion (ppb); however, average outdoor air levels were consistently less than 1 ppb, established by the Office of Environmental and Health Hazard Assessment (OEHHA) as the outdoor air threshold for long-term exposure in the state of California.[2] Sulfur odorants, which are added to natural gas, were consistently below the instrument detection limits of field instruments, but were presumed to be the cause of symptoms experienced by some residents in the community due to their low odor threshold. Symptoms of odorant exposure include nausea, abdominal discomfort, headaches, dizziness, light-headedness, eye discomfort and other mucus membrane irritation, and shortness of breath.[3]

During the 16-week period from October 28, 2015 to February 18, 2016, DPH received approximately 700 complaints of symptoms associated with odors from the gas leak. On November 19, 2015, DPH issued a directive to SCG to provide temporary relocation assistance to any resident affected by odors from the Aliso Canyon site. The purpose of this directive was to provide area residents with a mode of relief from odors and symptoms experienced in their homes. After Well SS-25 was sealed, DPH continued to monitor outdoor air contaminant levels for several weeks to ensure that they returned to expected background levels. DPH also enlisted volunteers within the community to report on the continued presence of odors in the outdoor environment. During this time, many residents attempted to return to their homes, as air quality returned to typical conditions for the area and reports of odors diminished. Health symptoms thought to be caused by outdoor air contaminants or odors were expected to diminish. However, from February 18 to March 20, DPH received 240 additional reports from residents reporting symptoms in one or more members of the household sometimes in the absence of odors, including recurrence of symptoms upon temporary or permanent re-occupation of their homes. Reported symptoms during this period were similar to those that prompted relocation of families before the leak was sealed. Some residents reported the onset of symptoms upon returning to their homes, with subsequent relief of symptoms upon leaving their homes and the area to go to work, school, or a temporary relocation destination.

DPH collaborated with the California Department of Public Health (CDPH) to develop a Community Assessment for Public Health Emergency Response (CASPER) to further investigate the nature of the health complaints within the communities closest to the Aliso Canyon facility. CASPER is an epidemiologic tool developed by the Centers for Disease Control and Prevention (CDC) to obtain rapid household-based information about health status, basic needs, and other relevant information about a particular community after a disaster to enable public health and other authorities to make informed decisions regarding response efforts.[4] On March 10-12, 2016, DPH conducted a CASPER in order to address the following objectives: 1) to assess the frequency and types of reported health symptoms from residents during the active gas leak and after the leaking well was sealed, 2) to determine the scope of reported odors and the appearance of oily residues on surfaces in the community, and 3) to develop recommendations to guide public health response.

SECTION II: Materials and Methods

Sampling

The sampling frame is a predetermined area of interest that captures the entire population from which a CASPER sample is drawn and to which the results would be generalized. The sampling frame for the CASPER encompassed the communities closest to the Aliso Canyon facility which reported the most frequent number of health complaints to DPH. This consisted of the census blocks within a 3-mile radius south of Well SS-25, including the Porter Ranch community north of California State Route 118 and a group of highly populated census blocks of the Granada Hills community (Figure 1). A two-stage cluster design was used to randomly select a representative sample of 210 households to be interviewed from a total of 7,755 housing units (2010 census) in the sampling frame.[5]

Stage 1:

In the first stage, 30 census blocks were randomly selected as clusters from the sampling frame using a custom toolbox for Arc Geographic Information Systems (ArcGIS),[6] with the probability of selection proportional to the number of housing units in each census block; this resulted in higher density census blocks having a higher probability of being selected.

Stage 2:

In the second stage of sampling, trained interviewers used systematic random sampling methods to select seven households within each of the 30 census blocks. The interviewers randomly selected a housing unit as the starting point then used a detailed map of the census block to systematically select every n^{th} housing unit, with n^{th} being the total number of housing units in a particular cluster divided by 7. For example, if there were 70 housing units in the census block, the interviewers would visit every tenth housing unit to survey until they had completed 7 interviews.

Interviews

DPH and CDPH provided interviewers with a five-hour training on March 10, 2016 on the purpose for the CASPER, household selection and tracking methods, administration of the survey, and safety and referral information. Interviewers were comprised of DPH staff, primarily public health nurses and health educators, paired in teams of two. Interviewers attempted to conduct seven interviews in each of the 30 selected census blocks, with instructions to make three attempts at each selected household before replacement. At each of the selected households, interviewers obtained verbal consent and respondents were eligible to participate if they were at least 18 years of age and resided in the selected household (Appendix A). The English-language based questionnaire and verbal consent were translated into Spanish, Korean and Mandarin and an interviewer fluent in the appropriate language conducted the interview upon request. Interviews were conducted over two and a half days from March 10–12, 2016.

Additionally, interviewers provided households with a resource list of state and local agencies as well as contact information for SCG services (e.g. cleaning of oily residue) and used confidential referral forms if they encountered urgent physical or mental health needs and forwarded them to DPH for immediate follow up (Appendix A).

Household Survey

The questionnaire developed by DPH is provided in Appendix B. It was designed to collect information over the following domains: 1) household size, demographics and relocation status, 2) health symptoms believed to be related to the leak (both during the leak and after the well was sealed), 3) healthcare sought after the well was sealed, 4) odors and oily residue, 5) methods to improve indoor air quality, 6) activities of relocated households upon returning home, and 7) households' greatest need.

Statistical Methods

Data were entered into EpiInfo 7 (CDC, Atlanta, Georgia; http://wwwn.cdc.gov/epiinfo/) and analyzed using SAS 9.4 (SAS Institute Inc., Cary, North Carolina). A weighted cluster analysis was conducted using weights calculated from the total number of housing units in the sampling frame divided by the total number of clusters selected and the total number of housing units interviewed within each cluster. Responses from the households that participated in the survey (n=210) were weighted to produce projected population estimates that were generalizable to the entire sampling frame of 7,755 households. Unweighted frequencies of responses, along with the projected population estimates based on weighted analyses, plus weighted percentages and corresponding 95% confidence intervals are presented for responses given by 10 or more households.

Additionally, we conducted stratified analyses on unweighted frequencies to compare 1) age demographics and relocation status (ever/never), 2) prevalence of reported health symptoms and observations of odors and/or oily residue, 3) prevalence of reported health symptoms, medical care sought, odors, and usage of air cleaning devices inside the home by relocation status of households, and 4) prevalence of reported health symptoms or odors and usage of air cleaning devices inside the home as well as device usage combined with weather-proofing materials. Chi-square tests were used to compare age demographics and relocation status and the Cochran-Armitage test was used to evaluate a possible trend in the prevalence of symptoms and observations of odors and/or oily residue. All tests of significance were 2-sided, with the level of significance set at $p<0.05$, assuming n-1 degrees of freedom. Univariate logistic regression was also used to examine the associations between prevalence of reported health symptoms and observations of odors or oily residue. The odds ratios (OR) and corresponding 95% confidence intervals (95% CI) are presented based on unweighted frequencies.

Lastly, we examined the distance of households to Well SS-25 by comparing sampled households located within 2 miles from Well SS-25 (group 1, n=63) to sampled households located 2 to 3 miles from Well SS-25 (group 2, n=147). Univariate logistic regression was used to assess the relationship between household location (group 1 vs. group 2) and reported health symptoms, relocation status, odors, or oily residue. The OR and corresponding 95% CI are based on unweighted frequencies within each location group.

The contact rate was calculated by dividing the number of completed interviews by the total number of sampled households. The cooperation rate was calculated by dividing the total number of completed interviews by the total number of households where contact was made. The completion rate was calculated by dividing the number of completed interviews by the goal of 210 total interviews.

SECTION III. Results

Interview teams were successful at conducting 7 interviews in each sampled census block and completed a total of 210 interviews, yielding a 100.0% completion rate (Table 1). Interviews were completed in 45.6% of the 461 households that were approached and in 73.4% of households with an eligible participant answering the door. Nearly all interviews were conducted in English (98.6%), with two interviews conducted in Korean and another conducted in Mandarin.

Household Size, Demographics and Relocation Status

The sizes of households interviewed ranged from one to eight with the majority (54.8%) having two to three persons (Table 2). The proportion of households having at least one member under 5 years old was 11.0% and 45.2% of households had at least one member 65 years or older. Most households (83.3%) resided in single family detached homes.

Nearly half (45.7%) of the responding households had at least one member who had chosen to be temporarily relocated in response to the gas leak. Among households that had been relocated, 53.2% reported that every member of the household had returned back home by the time of interview. Another 14.9% of relocated households reported that some, but not all members of the household had returned back home by the time of the interview and 31.9% reported that no member of the household had returned back home by the time of the interview. “Returned back home” was defined as living in the home and excluded those that routinely visited their homes without staying for an extended period of time.

Comparing age demographics of households that had been relocated to those that had not relocated, a significantly higher proportion of relocated households had at least one member under 5 years old ($p=0.047$), 18 to 39 years old ($p=0.002$), and/or 40 to 64 years old ($p=0.002$), and a significantly lower proportion of relocated households had at least one member 65 years or older ($p=0.019$) (data not shown).

Health Symptoms

During the active gas leak, 81.3% of sampled households reported having at least one member of the household experience any health symptoms that were believed to be related to the gas leak; over half of households reported eye/nose/throat irritation, headache/migraine, respiratory complaint (includes shortness of breath/difficulty breathing, chest tightness/ heaviness, cough, wheezing, and worsening of asthma or chronic obstructive pulmonary disease), stress, dizziness/light headiness, and nausea/vomiting (Table 3). In the month after the gas leak was sealed, 62.5% of sampled households reported having at least one member of the household experience any health symptoms believed to be related to the gas leak; over half of households reported eye/nose/throat irritation, headache/migraine, and respiratory complaint although the frequencies were lower than during the active gas leak.

Households that reported having at least one member who experienced health symptoms believed to be related to the gas leak were also asked if those specific symptoms improved when they were away from home or away from the local area (e.g. at work, school, or relocated housing). Over three-quarters of sampled households reported that symptoms of eye, nose or throat irritation, headache/migraine, respiratory complaint, dizziness/light headedness, nausea/vomiting, nosebleeds, and fever got better when they were away from home or the local area both during the gas leak and after the leak was sealed (Table 4). Fewer households reported that stress related to the gas leak was reduced or got better when they were away (70.1% during gas leak and 63.5% after well was sealed), and participants often commented during interviews that the situation itself or factors relating to relocation were stressful.

More relocated households reported experiencing health symptoms believed to be related to the gas leak than households that had not relocated both during the leak and after the well was sealed. During the gas leak, nearly all relocated households reported experiencing health symptoms (99.0%) compared to 65.8% of households that had not relocated (data not shown). After the well was sealed, 79.2% of relocated households reported health symptoms while 47.4% of households that had not relocated reported health symptoms.

Households closer to Well SS-25 reported greater frequencies of any health symptoms as well as specific health symptoms both during the gas leak and after the well was sealed (Table 5). During the active gas leak, sampled households less than 2 miles from the well were 2.7 times more likely to report having at least one member of the household experience health symptoms believed to be related to the gas leak compared to households 2 to 3 miles from the well (OR = 2.7, 95% CI: 1.1, 6.8). In the month after the gas leak was sealed, sampled households less than 2 miles from the well were 1.4 times more likely to report health symptoms than households 2 to 3 miles from the well, but this was not statistically significant (OR = 1.4, 95% CI: 0.7, 2.6).

We considered the possibility that households closer to the well may be more likely to have relocated and not returned home compared to households further away; and we evaluated whether this resulted in a difference in symptoms reported after the well was sealed. More households less than 2 miles from the well had relocated compared to households 2 to 3 miles from the well (58.7% and 40.1%, respectively), yet a similar proportion of households had not returned home from each distance group (32.4% and 31.0%, respectively, data not shown). Nearly all households that had relocated and not returned home (n=30) reported experiencing symptoms after the well was sealed regardless of distance to the well (data not shown).

Healthcare Sought After the Well Was Sealed

Among surveyed households that reported symptoms experienced in the past month related to the gas leak (n=130), 60.8% of households sought medical care for their symptoms (Table 6). Households that sought care were most likely to do so at their family doctor or urgent care center (89.9%), followed by a specialist or other type of care (29.1%), and emergency room or hospital (17.7%). Among households that did not seek care for their symptoms experienced in the past month (n=48), the most common reason indicated by 52.1% of households was that their symptoms were “not bad enough” (data not shown).

Although more relocated households reported experiencing symptoms after the well was sealed compared to households that had not relocated, a similar proportion of households sought medical care for the symptoms experienced regardless of relocation status (61.8% and 59.3%, respectively, data not shown).

Odors and Oily Residue

During the month after the well was sealed, 40.5% of sampled households reported smelling “gas-like” odors: 25.9% inside their home, 43.5% outside their home or in the neighborhood, and 30.6% both inside and outside (Table 7). Households that reported smelling “gas-like” odors specified all times of day when they recalled smelling odors in the past month; no specific time of day received greater frequency to be noteworthy and this was true for odors smelled inside homes as well as outside (data not shown).

More than three-quarters of households (78.8%) that reported smelling “gas-like” odors in the past month experienced health symptoms compared to 50.0% of households that did not smell odors, and this difference was statistically significant (Table 8). Households that reported smelling “gas-like” odors in the past month were 3.7 times more likely to report experiencing symptoms during the same time frame

compared to households that did not smell odors (OR = 3.7, 95% CI: 2.0, 7.1). Compared to households that did not smell odors, more households that smelled odors in the past month also reported every kind of symptom.

Households closest to the well (less than 2 miles) were no more likely to report smelling "gas-like" odors than households further away from the well (2 to 3 miles) (OR = 0.9, 95% CI: 0.7, 1.2) (Table 9). A similar proportion of households reported smelling odors both inside and outside among homes closer and further away (30.4% and 30.6%, respectively). Fewer households less than 2 miles from the well reported smelling odors outside than households 2 to 3 miles from the well (34.8% and 46.8%, respectively). Compared to households less than 2 miles from the well, households 2 to 3 miles from the well were more likely to report smelling odors both outside their homes (26.5% and 20.6%, respectively) and outside in the neighborhood (21.1% and 14.3%, respectively, data not shown).

We considered the possibility that households closer to the well may be more likely to have relocated and not returned home compared to households further away; and we evaluated whether this resulted in a difference in odors reported after the well was sealed. Among households that had relocated and had not returned home (n=30), a similar proportion of households reported smelling odors regardless of distance to the well (data not shown).

One-third of households (34.8%) reported ever noticing the appearance of oily residue on surfaces outdoors at their home or in the neighborhood during the active gas leak or after the well was sealed, while another 12.4% reported that they didn't know if they ever noticed the appearance of oily residue (Table 7). Households closer to the well (less than 2 miles) were 1.9 times more likely to notice oily residue than households further away (2 to 3 miles from the well) and this was statistically significant (OR = 1.9, 95% CI: 1.4, 2.7) (Table 9). Households that noticed oily residue were 9.2 times more likely to report health symptoms during the gas leak (OR = 9.2, 95% CI: 2.7, 31.3) and 3.9 times more likely to report health symptoms after the well was sealed (OR = 3.9, 95% CI: 2.0, 7.8), and these findings were statistically significant (data not shown).

In the month after the well was sealed, the percentage of households that reported symptoms believed to be related to the leak was 42.9% among households reporting no odors or oily residue, 58.8% among households reporting odors only, 60.6% among households reporting oily residue only, and 94.7% among households reporting both odors and oily residue (Table 10). Excluding households that did not know if they observed odors and/or oily residue, a statistically significant trend was found between odors/oily residue and increased reporting of symptoms ($p_{trend}<0.001$).

Methods to Improve Indoor Air Quality

Households were asked whether they ever used an in-duct air cleaning device that is built into or attached to their home's central heating/ventilation/air conditioning system or portable air purifiers to try to improve the indoor air quality of their homes. One quarter of sampled households (24.3%) used in-duct air cleaning devices, another fifth of households (21.4%) used portable air purifiers, another quarter (28.6%) used both kinds of devices, and the remainder did not use either kind of device (23.3%) (Table 11). The majority of households (97.3%) that used in-duct air cleaning devices had them newly installed by SCG. Those that used portable air purifiers had on average two purifiers per household (range: one to five), with the majority (89.4%) receiving at least one from SCG. Another 31.7% of households newly purchased at least one portable air purifier since the gas leak began and 19.0% owned at least one portable air purifier prior to the gas leak (data not shown).

The majority of households (66.0%) reported regular use of either in-duct air cleaning devices or portable air purifiers in the month after the well was sealed: 44.5% of households used them daily and 21.5% of households used them 1 to 6 days per week (Table 11). Only 30.6% of households did not use the devices or did not have them. We considered the possibility that relocated households that had not returned home (n=30) may differ from occupied homes in terms of having in-duct air cleaning devices installed or using portable air purifiers; but only three households that had not returned home reported that they did not use either kind of device (data not shown).

During the month after the well was sealed, 73.6% of households that used air cleaning devices daily reported health symptoms, 62.2% of households that used air cleaning devices 1 to 6 days per week reported symptoms, and 45.3% of households that did not use air cleaning devices reported symptoms. Use of air cleaning devices did not appear to affect the proportion of households smelling any “gas-like” odors or any “gas-like” odors inside the home (data not shown). In addition, individually examining the use of either in-duct air cleaning devices or portable air purifiers did not change the proportions of households experiencing any symptoms or reporting any odors presented for both devices assessed together (data not shown).

Although regular use of air cleaning devices may not have affected the reporting of any odors, use of these devices may have reduced the frequency of smelling odors inside the home. Among households that reported smelling “gas-like” odors inside their home and reporting that they used methods to air out their home (such as running the central air conditioning system, opening windows and doors, using portable air purifiers, or using fans), two-thirds (68.4%) reported that those methods helped to reduce the odors while the remaining third (31.6%) reported that using those methods did not reduce the odors or they did not know if they reduced the odors (Table 7).

SCG provided weather-proofing materials to 42.8% of households to seal gaps that allow air to enter the home. Having weather-proofing materials provided by SCG in addition to use of either air cleaning device did not affect the percentages of households experiencing symptoms or reporting odors in the month after the well was sealed (data not shown).

Activities of Relocated Households Upon Returning Home

Households that temporarily relocated in response to the gas leak (n=96) were asked whether they aired out their home for at least two hours or cleaned their homes in preparation to moving back or after returning home from relocation (Table 12). Half of relocated households (48.9%) had both aired out and cleaned their home, while another 14.9% had only aired out their home and another 13.8% had only cleaned their home. Almost one fifth of relocated households (18.1%) had not aired out or cleaned their home, but the majority (64.7%) of these seventeen relocated households reported that no one had returned home yet.

Among households that had their home cleaned in preparation to moving back or after returning home (n=59), the majority (62.7%) did not have any member experience any health symptoms; however, one fifth of households (22.0%) reported that at least one member of the household experienced health symptoms while their home was being cleaned or later that same day and another 9 households did not know if anyone had experienced symptoms.

In preparation to moving back or after returning home, more than one third of relocated households (36.6%) reported running all of their faucets in their home for at least 60 seconds and two-thirds (66.7%) reported flushing all of their toilets in their home at least once.

Households' Greatest Need

When asked about the household's greatest current need, 25.7% indicated no need, but others reported home and property cleaning (13.3%), solutions to the decline in property values (11.0%), assurance that the gas leak and similar incidents will not happen again (9.5%), testing for pollutants inside homes (9.0%), follow-up for health risk in the future (7.6%), recovery from current health symptoms (6.2%), air purifiers or weather stripping from Southern California Gas Company (5.7%), honest information about the gas leak (4.8%), clean air (4.3%), reimbursement for relocation expenses (3.8%), the return to "normal life" after relocation, particular for local schools (3.3%), and safe water in swimming pools and for drinking (2.9%) (Table 13).

SECTION IV. Discussion

Key Findings

1. **Symptom reporting:**
    - **Before leak was sealed: 81%**
    - **After leak was sealed: 63%**
2. **The majority of households (61%) sought medical care for symptoms experienced after the well was sealed, primarily from family doctors and urgent care centers.**
3. **Residents commonly report alleviation of symptoms upon leaving their homes, both before and after the leak was sealed.**
4. **After the leak was sealed, 41% of households reported smelling "gas-like" odors.**
5. **Among households that reported both odors and oily residue, 95% experienced symptoms after the leak was sealed.**
6. **64% of relocated households reported airing out their home upon returning home. Only half of relocated households (49%) reported both airing out and cleaning their home upon returning home.**

Household Size, Demographics and Relocation Status

Interview teams successfully completed the goal of 210 interviews in the sampling area. The household sizes and the ages of residing persons were similar to the 2010 Census demographic data for the Porter Ranch community (zip code 91326) and part of the Granada Hills community (zip code 91344).[7] Only three CASPER interviews were conducted in Asian languages and may underrepresent this demographic group, assuming that the number of households speaking Asian languages at home and speaking English "less than very well" were similar to the Census Bureau's 2014 American Community Survey data (8.6% in Porter Ranch and 4.6% in part of Granada Hills).[8]

According to the Southern California Gas Company, 4,547 households in Porter Ranch and 149 households in Granada Hills (all located in zip code 91344) were relocated as a result of the gas leak, representing 55.0% of the population within 3 miles of Well SS-25. Although 45.7% of households interviewed for the CASPER had been relocated as a result of the gas leak and interviews were able to be completed for 30 households where no one had yet returned home from relocation, the findings presented here slightly underrepresent the relocated population. More relocated households had at least one member under 5 years old compared to households that had not relocated, while more households that had not relocated had at least one member 65 years or older.

Health Symptoms and Healthcare Sought After the Well Was Sealed

Several weeks after sealing Well SS-25, the majority (62.5%) of households in the communities closest to the well had at least one household member experiencing health symptoms, representing an estimated 4,801 households in the entire sampling frame. These findings indicate only a modest improvement from 81.3% of sampled households reporting any symptoms during the 16-week-long gas leak. The proportion of each reported symptom declined somewhat after the well was sealed, as compared to during the active gas leak; however, a large proportion still experienced symptoms after outdoor air levels for methane and other chemicals returned to background.[9] The majority of households (60.8%) sought medical care for symptoms experienced after the well was sealed. This represents an estimated 2,917 households in the sampling frame seeking medical care, primarily from family doctors and urgent care centers.

The actual number of households experiencing symptoms may be greater than what is estimated in this report since relocated households were more likely to experience symptoms than households that did not relocate (79.2% and 47.4%, respectively) but were less likely to be at home to be interviewed. Although the relocated households were more likely to experience symptoms, it is uncertain whether their symptoms were more severe than households that did not relocate, as they had a similar proportion that sought medical care.

Continued symptoms after Well SS-25 was sealed may have several origins. Some residents may have ongoing exposures to pollutants from the oil field; some residents may have symptoms originating from or amplified by stress and/or social influences; some residents may have symptoms unrelated to exposure to pollutants; and some residents may exhibit a combination of any or all of these possibilities. This investigation could not be designed to determine the relative contribution of each of these possible etiologies.

Although the leak from Well SS-25 was sealed, there may be other smaller, less detectable emissions from other areas of the field or from the soil surrounding the oil leak. Thus, there may be fugitive emissions or other as yet unidentified pollutants representing ongoing exposures from the gas field that require further study.

Many of the symptoms reported by community members were non-specific and can be prevalent among the general population; therefore, they are challenging to interpret. The frequencies of reported symptoms seem to be higher than what would be expected in the general population. For example, headache was the most common symptom reported both during and after the gas leak. Headache is also the most prevalent neurological symptom and among the most frequent symptom seen in general medical practice, with an overall prevalence of 38% during any given year.[10] Although there are limitations to this comparison because we asked households (not individuals) specifically about symptoms that were believed to be related to the gas leak in the time frame of one month after the well was sealed, the proportion of interviewed households reporting headache in the past month (51.9%) appears higher than what would be found in the general population.

There were similar proportions of symptoms reported during the Aliso Canyon gas leak and another household-based investigation conducted in response to a storage tank leak of tert-butyl mercaptan near a community in Alabama. In both investigations, headache was the most commonly reported symptom.[11] Nearly all of the symptoms were reported at similar frequencies, with a few notable exceptions; households near Aliso Canyon were much more likely to report dizziness, eye irritation, and nausea/vomiting than households in the Alabama community. The percentages were greater even though the Aliso Canyon investigation included households further from the source (up to 3 miles compared to less than 2 miles) and specifically asked about symptoms believed to be related to the gas leak as opposed to those linked to

any other known cause. Households near Aliso Canyon continued to report symptoms after the well was sealed and the reported mercaptan odors had very greatly decreased (see odor discussion, below), supporting the need to further investigate the ongoing symptoms and indoor environments.

Higher prevalence of symptom reporting is expected in a community that has experienced environmental exposure because of increased stress, recall bias and heightened environmental worry. Households may be more likely to recall symptoms and exposure details due to this highly publicized gas-leak incident, leading to overestimation of symptoms and exposures to odors or oily residue. Both during and after the gas leak, 16.0% and 12.9% of households, respectively, attributed a fever to the gas leak, even though fever is not known to be related to such an exposure. It is also possible, however, that there could be continued exposure to materials emitted during the gas leak or other emissions from the facility. Anecdotal evidence from symptom reporting to DPH suggests that many households are reporting symptom onset after spending time inside their homes after the gas leak. In contrast, during the gas leak it was reported that symptoms were worse while outdoors. This supports the need for indoor environmental testing to determine if there is exposure related to the gas leak happening inside homes and to address the widespread concerns about such exposures.

Odors and Oily Residue

Although the gas leak has stopped, residual natural gas will continue to off gas from the ground in the weeks and months following the permanent sealing of Well SS-25.[9] "Gas-like" odors were reported by 40.5% of sampled households during the month after the well was sealed and 30.6% of those households reported smelling odors both inside their home and outside their home or in the neighborhood. The reported odor findings are supported by complaints to the South Coast Air Quality Management District (SCAQMD), including 20 odor complaints from Porter Ranch residents and 6 reports from Granada Hills (zip code 91344) in the two weeks after the gas leak was sealed. No particular times of day for reported odors were noteworthy, and temporal correlations would not be expected if the potential sources of these odors were "flights" of off gassing as opposed to specific activities at the field occurring at cyclical times. In addition, it may be difficult for the interviewed member of the household to recall specific times of day without having kept odor diaries, nor to be able to report odor observations for all members of the household.

Households less than 2 miles from the well were no more likely to report "gas-like" odors than households 2 to 3 miles from the well; however, all sampled households were within 3 miles from the well where there were the highest density of odor complaints to the SCAQMD.[12] The prevailing wind direction is northeast for the Aliso Canyon area. The suspected source of these "gas-like" odors are mercaptans which are heavier than air and travel close to the ground from the source.[3] Compared to households that did not smell odors, households that reported odors in the past month were 3.7 times more likely to report symptoms during the same time frame.

Households closer to the well (less than 2 miles) were 1.9 times more likely to notice oily residue than households further away (2 to 3 miles from the well). Compared to households that did not notice oily residue, households that noticed oily residue were 3.9 times more likely to report symptoms after the well was sealed. While this assessment was not designed to evaluate a causal relationship between health effects and exposure to odors or oily residue, nearly all of the households that reported both odors and oily residue (94.7%) reported experiencing symptoms after the well was sealed. A statistically significant trend exists that suggests that smelling odors and observing oily residue increases the reporting of symptoms ($p_{trend}<0.001$).

Methods to Improve Indoor Air Quality

The majority of households (66.0%) reported regular use of either in-duct air cleaning devices or portable air purifiers in the month after the well was sealed: 21.5% of households used them 1 to 6 days per week and 44.5% of households used them daily. During the month after the well was sealed, more households that regularly used devices to improve the indoor air quality in their homes reported experiencing symptoms (62.2 and 73.6%, respectively) compared to households that did not use any air cleaning devices (45.3%). Although this assessment could not determine whether households reporting symptoms were more likely to use air cleaning devices or whether the air cleaning devices themselves increased the reporting of symptoms, residents should be encouraged to check the filters and air cleaners at least monthly and to follow air cleaner manufacturer's maintenance instructions per the California Air Resources Board's recommendation.[13]

Regardless of whether in-duct air cleaning devices or portable air purifiers were used during the month after the well was sealed, regular use of these devices did not appear to affect whether any "gas-like" odors were reported nor did having additional weather-proofing materials provided by SCG. Although this assessment did not determine whether using air cleaning devices or weather proofing materials affected the frequency of symptoms or "gas-like" odors reported, the majority of households (68.4%) reported that using methods such as air cleaning devices to air out their home did help to reduce "gas-like" odors smelled inside their home. Further study is needed to evaluate whether airing out homes also reduces household symptom reporting.

Activities of Relocated Households Upon Returning Home

DPH has been advising residents who are returning home after relocation to air out the inside of their homes if they smell gas odors inside by opening doors and windows or using fans.[14] Only 63.8% of relocated households reported airing out their home, reflecting a need for improved communication to residents. Many community members have expressed concerns and fears regarding opening windows and doors and it is important to address these concerns with very clear guidelines for airing out homes as more relocated households prepare to return home.

Among relocated households that had cleaned in preparation to moving back or after returning home, one-fifth (22.0%) reported that at least one member of the household experienced health symptoms while their home was being cleaned or later that same day. Recommendations for relocated households should also include specific guidelines for cleaning upon returning home such as using high efficiency particulate air (HEPA) filter vacuum cleaners and providing good ventilation while cleaning.

A low percentage of relocated households reported running all faucets (36.6%) and only 66.7% reported flushing all toilets in preparation to moving back or after returning home. Infrequent use of household plumbing when a home is vacant for a while may allow plumbing traps to dry up and sewer gas to enter the home.[15] Since sewer gas can cause symptoms of headache, nausea, and eye, nose and throat irritation,[16] advice to relocated households should include instructions to run all household plumbing upon returning home.

Comments from the Field

Several interview staff reported experiencing health symptoms during the CASPER, including throat irritation and wheezing among interviewers at households closest to the well, and exacerbation of asthma symptoms. Headaches and irritation-type symptoms were also reported among interviewers conducting interviews inside the homes of residents who had not returned home from relocation and had not

ventilated their homes; these symptoms improved shortly after the field teams left the sampled homes. One confidential referral was made to the Los Angeles County Department of Mental Health during recruitment for interviews.

SECTION V: Recommendations

On the basis of the CASPER findings, the following actions are recommended in addition to ongoing air monitoring of emissions from the natural gas storage facility and efforts to ensure the safety of workers and those living in the surrounding communities.

1. Conduct indoor testing of residential homes to determine if materials emitted during the gas leak are present in the home environment. DPH enlisted the assistance of the United States Environmental Protection Agency Indoor Air Quality program to develop an indoor environmental assessment protocol.

2. Study the nature of resurgent symptoms in the communities with the highest number of reported symptoms. DPH interviewed residents at households participating in the indoor environmental testing in order to further investigate the nature of these symptoms.

3. Prepare specific and detailed recommendations for airing out and cleaning homes, as well as any other necessary remediation steps such as changing of air filters based on the results of the indoor environmental study. Include additional advice for relocated households to flush all plumbing pipes upon returning home.

4. Ensure that communication and outreach strategies are culturally and linguistically appropriate for all members of the community. Specific outreach to the Korean speaking community is needed.

5. Encourage community members to report any symptoms experienced after ventilation and any recommended remediation in order to track any new or continued problems that develop.

Tables and Figures

Figure 1. Sampling frame for household survey conducted in response to the Aliso Canyon gas leak, Porter Ranch and Granada Hills, CA, March 2016.

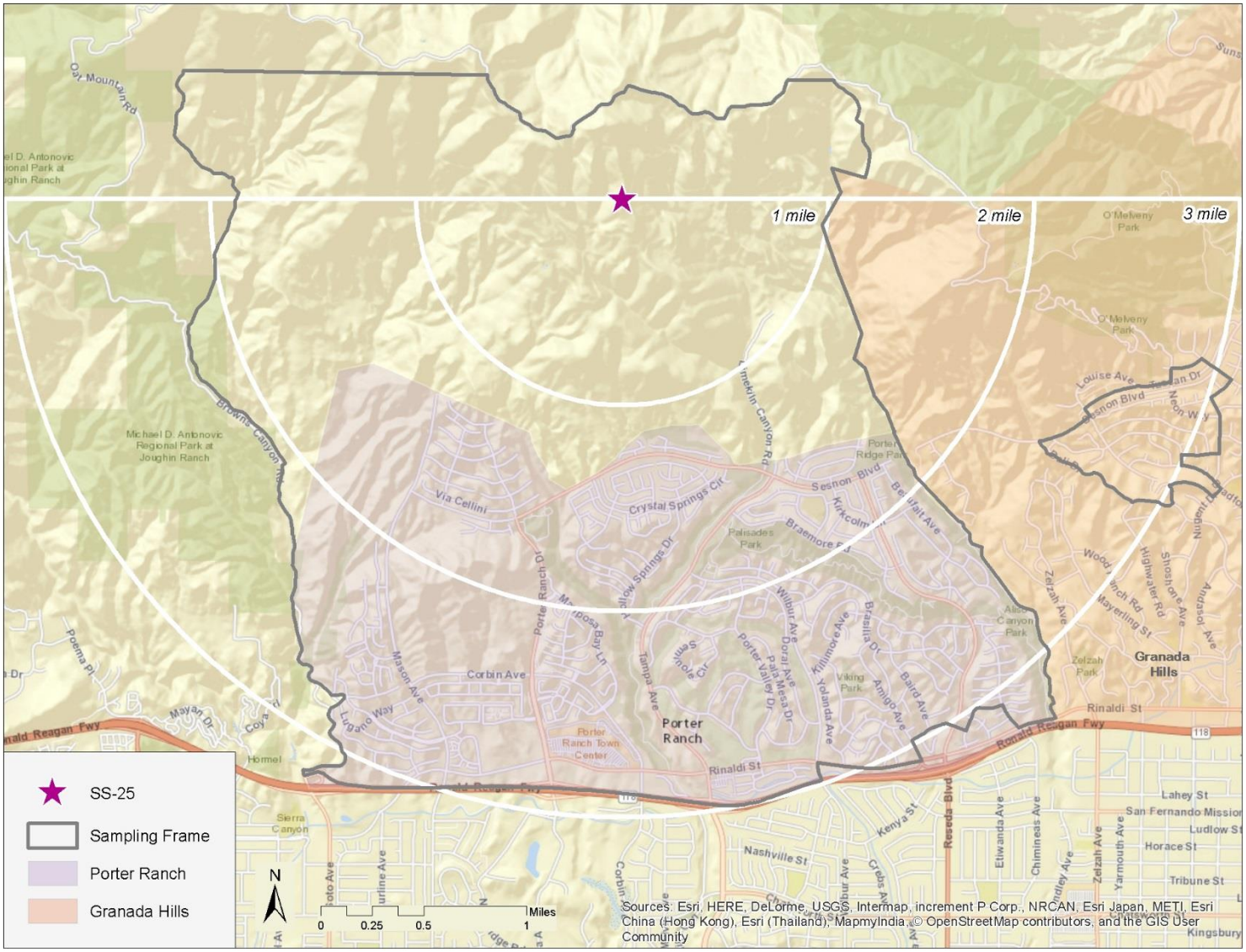

Table 1. Questionnaire response rates for the household survey conducted in response to the Aliso Canyon gas leak, Porter Ranch and Granada Hills, CA, March 2016.

Questionnaire response	Rates	Percent
Completion*	210/210	100.0
Contact†	210/461	45.6
Cooperation‡	210/286	73.4

* Percent of interviews completed in relation to the goal of 210

† Percent of interviews completed in relation to all households where contact was attempted

‡ Percent of interviews completed in relation to all households where an eligible participant answered the door

Table 2. Demographics, housing type and relocation status of households interviewed for survey conducted in response to the Aliso Canyon gas leak, Porter Ranch and Granada Hills, CA, March 2016.

	Number of households (n=210)	Projected number of households (n=7,755)	Weighted % of households (95% CI)
Household size			
1 person	24	886	11.4 (5.9 – 16.9)
2 – 3 persons	115	4,247	54.8 (48.2 – 61.3)
4 or more persons	71	2,622	33.8 (26.6 – 41.0)
Ages of persons in household			
0 – 5 years	23	849	11.0 (7.6 – 14.3)
6 – 17 years	54	1,994	25.7 (19.1 – 32.2)
18 – 39 years	85	3,139	40.5 (34.2 – 46.8)
40 – 64 years	127	4,690	60.5 (52.5 – 68.5)
65 years and older	95	3,508	45.2 (36.8 – 53.7)
Type of housing			
Single family detached home	175	6,463	83.3 (6.1 – 70.8)
Attached home	12	443	5.7 (0.0 – 12.8)
Multi-unit apartment or condo	23	849	11.0 (0.3 – 21.6)
At least one household member relocated in response to the gas leak	96	3,545	45.7 (37.3 – 54.2)
Among those that relocated, has everyone returned back home?*			
Yes, everyone	50	1,846	53.2 (40.9 – 65.5)
Yes, some	14	517	14.9 (5.5 – 24.3)
No, no one	30	1,108	31.9 (20.9 – 43.0)

*Among households that chose to be relocated (n=96), excluding those that refused to answer whether anyone or everyone had returned back home (n=2).

Table 3. Households reporting that any member of the household experienced any of the following health symptoms believed to be related to the gas leak weighted to the entire sampling frame, Porter Ranch and Granada Hills, CA, March 2016.

	During active gas leak			After well was sealed		
	Number of households (n=210)	Projected number of households (n=7,755)	Weighted % of households (95% CI)	Number of households (n=210)	Projected number of households (n=7,755)	Weighted % of households (95% CI)
Any symptom(s)	170	6,278	81.3 (75.5 – 87.2)	130	4,801	62.5 (56.3 – 68.7)
Eye, nose and/or throat irritation	153	5,650	73.9 (67.2 – 80.6)	123	4,542	59.1 (52.6 – 65.7)
Headache/migraine	148	5,465	71.8 (65.3 – 78.4)	108	3,988	51.9 (45.0 – 58.9)
Respiratory complaint*	138	5,096	67.0 (60.6 – 73.3)	105	3,878	50.7 (44.1 – 57.4)
Stress	123	4,542	60.0 (52.4 – 67.6)	88	3,250	42.9 (36.1 – 49.8)
Dizziness/light headedness	121	4,468	59.9 (53.1 – 66.7)	81	2,991	39.9 (33.5 – 46.3)
Nausea/vomiting	112	4,136	54.4 (48.2 – 60.5)	83	3,065	40.7 (34.3 – 47.0)
Nosebleed(s)	97	3,582	46.9 (40.2 – 53.6)	64	2,363	30.9 (24.4 – 37.4)
Skin rash/irritated skin	95	3,508	46.1 (38.6 – 53.6)	76	2,807	37.3 (31.0 – 43.5)
Diarrhea	55	2,031	27.0 (21.1 – 32.8)	44	1,625	21.7 (15.5 – 27.8)
Fever	32	1,182	16.0 (10.7 – 21.3)	26	960	12.9 (8.7 – 17.1)

Note: Excluded missing during gas leak: any symptom (n=1); eye, nose and/or throat irritation (n=1); headache/migraine (n=1); respiratory (n=1); stress (n=1); dizziness (n=2); nausea/vomiting (n=2); nosebleeds (n=1); diarrhea (n=2); fever (n=3) and don't know: eye, nose and/or throat irritation (n=2); headache/migraine (n=3); respiratory (n=3); stress (n=4); dizziness (n=6); nausea/vomiting (n=2); nosebleeds (n=2); skin (n=3); diarrhea (n=4); fever (n=7). Excluded missing after leak: nausea/vomiting (n=1); and don't know: any symptom (n=2); eye, nose and/or throat irritation (n=2); headache/migraine (n=2); respiratory (n=3); stress (n=5); dizziness (n=7); nausea/vomiting (n=5); nosebleeds (n=3); skin (n=6); diarrhea (n=8); fever (n=8).

* Includes symptoms such as shortness of breath/difficulty breathing, chest tightness or heaviness, cough, wheezing, worsening of asthma or worsening of emphysema/chronic obstructive pulmonary disease (known as COPD).

Table 4. Proportion of sampled households that reported that symptoms got better when away from home or away from the area, Porter Ranch or Granada Hills, CA, March 2016.

Among households with any of the following symptoms, did the symptom get better when away from home or away from the area?*	During active gas leak Number of households (Unweighted %)	After well was sealed Number of households (Unweighted %)
Eye, nose and/or throat irritation	***n=153***	***n=123***
Yes	130 (87.2)	100 (83.3)
No	10 (6.7)	6 (5.0)
Don't know	9 (6.0)	14 (11.7)
Headache/migraine	***n=148***	***n=108***
Yes	126 (88.7)	93 (87.7)
No	8 (5.6)	4 (3.8)
Don't know	8 (5.6)	9 (8.5)
Respiratory complaint†	***n=138***	***n=105***
Yes	116 (87.2)	87 (84.5)
No	10 (7.5)	7 (6.8)
Don't know	7 (5.3)	9 (8.7)
Stress	***n=123***	***n=88***
Yes	82 (70.1)	54 (63.5)
No	25 (21.4)	21 (24.7)
Don't know	10 (8.5)	10 (11.8)
Dizziness/light headedness	***n=121***	***n=81***
Yes	99 (86.1)	67 (84.8)
No	6 (5.2)	5 (6.3)
Don't know	10 (8.7)	7 (8.9)
Nausea/vomiting	***n=112***	***n=83***
Yes	94 (85.5)	62 (77.5)
No	7 (6.4)	6 (7.5)
Don't know	9 (8.2)	12 (15.0)

Table 4 Continued. Proportion of sampled households that reported that symptoms got better when away from home or away from the area, Porter Ranch or Granada Hills, CA, March 2016.

Among households with any of the following symptoms, did the symptom get better when away from home or away from the area?*	During active gas leak Number of households* (Unweighted %)	After well was sealed Number of households* (Unweighted %)
Nosebleed(s)	***n=97***	***n=64***
Yes	85 (90.4)	48 (80.0)
No	7 (7.4)	6 (10.0)
Don't know	2 (2.1)	6 (10.0)
Skin rash/irritated skin	***n=95***	***n=76***
Yes	70 (76.1)	51 (68.0)
No	14 (15.2)	8 (10.7)
Don't know	8 (8.7)	16 (21.3)
Diarrhea	***n=55***	***n=44***
Yes	42 (77.8)	31 (73.8)
No	4 (7.4)	5 (5.1)
Don't know	8 (14.8)	6 (5.5)
Fever	***n=32***	***n=26***
Yes	24 (77.4)	20 (83.3)
No	3 (9.7)	0 (0.0)
Don't know	4 (12.9)	4 (16.7)

Note: Missing information regarding whether the symptom got better was excluded; therefore, the sum of these numbers may not equal the total number of households that reporting the symptom (eye, nose and/or throat irritation (n=4 during gas leak, n=3 after); headache/migraine (n=6 during; n=2 after); respiratory complaint (n=1 during; n=2 after); stress (n=6 during; n=3 after); dizziness/light headedness (n=6 during; n=2 after); nausea/vomiting (n=2 during; n=3 after); nosebleeds (n=3 during; n=4 after); skin rash/irritated skin (n=3 during; n=1 after); diarrhea (n=1 during; n=2 after); fever (n=1 during; n=2 after).

* Away from home (e.g. at work, school, or relocated housing) or away from their local residential area (e.g. Porter Ranch or Granada Hills)

† Includes symptoms such as shortness of breath/difficulty breathing, chest tightness or heaviness, cough, wheezing, worsening of asthma or worsening of emphysema/chronic obstructive pulmonary disease (known as COPD).

Table 5. Households reporting that any member of the household had experienced any of the following health symptoms believed to be related to the gas leak by distance to the well, Porter Ranch and Granada Hills, CA, March 2016.

	During active gas leak		After well was sealed	
	< 2 Miles (n=63)	2 – 3 Miles (n=147)	< 2 Miles (n=63)	2 – 3 Miles (n=147)
	Number of households (Unweighted %)	Number of households (Unweighted %)	Number of households (Unweighted %)	Number of households (Unweighted %)
Any symptom(s)	56 (90.3)	114 (77.6)	42 (67.7)	88 (60.3)
Eye, nose and/or throat irritation	49 (80.3)	104 (71.2)	41 (66.1)	82 (56.2)
Headache/migraine	53 (86.9)	95 (65.5)	36 (58.1)	72 (49.3)
Respiratory complaint*	48 (80.0)	90 (61.6)	40 (64.5)	65 (44.8)
Stress	43 (70.5)	80 (55.6)	30 (48.4)	58 (40.6)
Dizziness/light headedness	43 (72.9)	78 (54.5)	25 (41.7)	56 (39.2)
Nausea/vomiting	41 (67.2)	71 (49.0)	26 (43.3)	57 (39.6)
Nosebleed(s)	33 (55.0)	64 (43.5)	21 (33.9)	43 (29.7)
Skin rash/irritated skin	35 (58.3)	60 (41.1)	29 (48.3)	47 (32.6)
Diarrhea	18 (30.0)	37 (25.7)	11 (18.3)	33 (23.1)
Fever	12 (21.1)	20 (14.0)	10 (17.2)	16 (11.1)

Note: Excluded missing during gas leak: any symptom (n=1); eye, nose and/or throat irritation (n=1); headache/migraine (n=1); respiratory (n=1); stress (n=1); dizziness (n=2); nausea/vomiting (n=2); nosebleeds (n=1); diarrhea (n=2); fever (n=3) and don't know: eye, nose and/or throat irritation (n=2); headache/migraine (n=3); respiratory (n=3); stress (n=4); dizziness (n=6); nausea/vomiting (n=2); nosebleeds (n=2); skin (n=3); diarrhea (n=4); fever (n=7). Excluded missing after leak: nausea/vomiting (n=1); and don't know: any symptom (n=2); eye, nose and/or throat irritation (n=2); headache/migraine (n=2); respiratory (n=3); stress (n=5); dizziness (n=7); nausea/vomiting (n=5); nosebleeds (n=3); skin (n=6); diarrhea (n=8); fever (n=8).

* Includes symptoms such as shortness of breath/difficulty breathing, chest tightness or heaviness, cough, wheezing, worsening of asthma or worsening of emphysema/chronic obstructive pulmonary disease (known as COPD).

Table 6. Medical care sought by households reporting symptoms in the past month believed to be related to the gas leak weighted to the entire sampling frame, Porter Ranch and Granada Hills, CA, March 2016.

	Number of households (n=130)	Projected number of households (n=4,801)	Weighted % of households (95% CI)
In the past month, did you or any member of your household seek medical care for symptoms related to the gas leak?*			
Yes	79	2,917	60.8 (53.1 – 68.5)
No	48	1,773	36.9 (28.7 – 45.1)
Don't know	3	–	–
If yes, where did you seek care?†			
Emergency room or hospital	14	517	17.7 (7.2 – 28.3)
Family doctor or urgent care	71	2,622	89.9 (82.7 – 97.1)
Specialist or other type of care	23	849	29.1 (19.4 – 38.8)

--- Data based on small numbers (n<10) may be unstable; therefore, weighted estimates are not presented.

* Among households that reported any household member experienced any symptoms in the past month thought to be caused by or related to the gas leak (n=130)

† Households could report seeking care at more than one place; therefore, the sum of these numbers exceed the total number of households that sought medical care (n=79).

Table 7. Odors and oily residue weighted to the entire sampling frame, Porter Ranch and Granada Hills, CA, March 2016.

	Number of households (n=210)	Projected number of households (n=7,755)	Weighted % of households (95% CI)
During the past month, did you or any member of your household smell "gas-like" odors?			
Yes	85	3,139	40.5 (34.2 – 46.8)
No	116	4,284	55.2 (49.3 – 61.1)
Don't know	9	–	–
If yes, where did you smell "gas-like" odors?*			
Inside home only	22	812	25.9 (15.6 – 36.2)
Outside (home or in neighborhood) only	37	1,366	43.5 (33.7 – 53.4)
Both inside and outside	26	960	30.6 (21.5 – 39.7)
For "gas-like" odors smelled inside, did airing out the home help to reduce the odors?†			
Yes	26	960	68.4 (50.6 – 86.3)
No	4	–	–
Don't know	8	–	–
Did you or any member of your household notice the appearance of oily residue?			
Yes	73	2,696	34.8 (26.6 – 42.9)
No	111	4,099	52.9 (43.9 – 61.8)
Don't know	26	960	12.4 (8.0 – 16.8)

--- Data based on small numbers (n<10) may be unstable; therefore, weighted estimates are not presented.

* Among households that reported smelling odors (n=85).

† Among households that reported smelling odors inside their home (n=48) and reported using methods such as running the central air conditioning system, opening windows and doors, using portable air purifiers, or using fans to try to reduce the odors inside the home (n=38). Households missing information about whether they used any methods to air out the home were excluded (n=10).

Table 8. Proportion of sampled households during the past month reporting any of the following health symptoms believed to be related to the gas leak by whether they smelled odors, Porter Ranch and Granada Hills, CA, March 2016.

	During the past month, did you or any member of your household smell "gas-like" odors?	
	Yes (n=85) Number of households (Unweighted %)	**No (n=114)** Number of households (Unweighted %)
Any symptom(s)	67 (78.8)	57 (50.0)
Eye, nose and/or throat irritation	64 (75.3)	53 (46.5)
Headache/migraine	60 (70.6)	42 (36.8)
Respiratory complaint*	57 (67.9)	42 (36.8)
Stress	46 (54.8)	36 (32.1)
Dizziness/light headedness	49 (57.6)	27 (24.5)
Nausea/vomiting	44 (51.8)	33 (30.0)
Nosebleed(s)	40 (47.1)	20 (17.7)
Skin rash/irritated skin	41 (50.0)	30 (26.5)
Diarrhea	29 (35.4)	12 (10.7)
Fever	13 (15.5)	10 (9.2)

Note: Missing values were excluded for nausea/vomiting (n=1); diarrhea (n=1). Reports of don't know were excluded for any symptom (n=2), plus respiratory (n=1); stress (n=3); dizziness (n=5); nausea/vomiting (n=3); nosebleeds (n=1); skin (n=4); diarrhea (n=4); fever (n=6); and smelling odors (n=9).

* Includes symptoms such as shortness of breath/difficulty breathing, chest tightness or heaviness, cough, wheezing, worsening of asthma or worsening of emphysema/chronic obstructive pulmonary disease (known as COPD).

Table 9. Odors and oily residue by distance to the well, Porter Ranch and Granada Hills, CA, March 2016.

	< 2 Miles (n=63) Number of households (Unweighted %)	**2 – 3 Miles (n=147)** Number of households (Unweighted %)
During the past month, did you or any member of your household smell "gas-like" odors?		
Yes	23 (36.5)	62 (42.2)
No	36 (57.1)	80 (54.4)
Don't know	4 (6.3)	5 (3.4)
If yes, where did you smell "gas-like" odors?*		
Inside home only	8 (34.8)	14 (22.6)
Outside (home or in neighborhood) only	8 (34.8)	29 (46.8)
Both inside and outside	7 (30.4)	19 (30.6)
Appearance of oily residue noticed during or after gas leak		
Yes	34 (54.0)	39 (26.5)
No	21 (33.3)	90 (61.2)
Don't know	8 (12.7)	18 (12.2)

* Among households that reported smelling odors: < 2 miles (n=23); 2-3 miles (n=62).

Table 10. Proportion of sampled households during the past month reporting any health symptoms believed to be related to the gas leak and whether they smelled odors and/or noticed oily residue, Porter Ranch and Granada Hills, CA, March 2016.

During the past month, did you or any member of your household smell "gas-like" odors or notice the appearance of oily residue?	Number of households (n=210)	Number of households reporting any symptoms, n=130 (Unweighted %)
No	70	30 (42.9)
Odors only	34	20 (58.8)
Oily residue only	33	20 (60.6)
Both odors and oily residue	38	36 (94.7)
Don't know to odors and/or oily residue	33	24 (72.7)

Note: Missing values were excluded for missing any symptoms among no odors/oily residue (n=1) and oily residue only (n=1).

Table 11. Devices used to improve indoor air quality weighted to the entire sampling frame, Porter Ranch and Granada Hills, CA, March 2016.

	Number of households (n=210)	Projected number of households (n=7,755)	Weighted % of households (95% CI)
Ever used in-duct air cleaning device or portable air purifier(s)?*			
In-duct air cleaning device only	51	1,883	24.3 (18.0 – 30.6)
Portable air purifier(s) only	45	1,662	21.4 (14.6 – 28.3)
In-duct device and portable air purifier(s)	60	2,216	28.6 (21.4 – 35.7)
None	49	1,810	23.3 (16.0 – 30.7)
Don't know†	5	–	–
In the past month, how often do you run the in-duct system or portable air purifier(s)?‡			
Daily	93	3,434	44.5 (37.6 – 51.4)
1 – 6 days per week	45	1,662	21.5 (14.6 – 28.5)
Never§	64	2,363	30.6 (23.1 – 38.1)
Don't know	7	–	–
SCG provided weather-proofing materials to seal gaps that allow air to enter home	89	3,287	42.8 (35.3 – 50.3)

--- Data based on small numbers (n<10) may be unstable; therefore, weighted estimates are not presented.

* An in-duct air cleaning system is built into or attached to part of a home's central heating/air conditioning/ventilation system.

† Includes households that responded don't know to ever used an in-duct air cleaning device and to ever used portable air purifiers (n=3), plus households that responded don't know to ever used an in-duct air cleaning device but responded yes to using portable air purifiers (n=2).

‡ Among households that used portable air purifiers (n=107), the frequency of use was specified for the portable air purifier that the household used most often.

§ Includes households that reported not having ever used an in-duct air cleaning device or portable air purifiers (n=49) and households that had ever used them but reported not using them in the past month (n=15).

Table 12. Activities of relocated households* as they prepare to moving back home or after returning home weighted to the entire sampling frame, Porter Ranch and Granada Hills, CA, March 2016.

In preparation to moving back home or after returning home…	Number of households (n=96)	Projected number of households (n=4,201)	Weighted % of households (95% CI)
Was your home aired out for at least 2 hours or cleaned?†			
Aired out only	14	517	14.9 (8.4 – 21.4)
Cleaned only	13	480	13.8 (6.0 – 21.7)
Aired out and cleaned	46	1,699	48.9 (41.4 – 56.4)
None	17	628	18.1 (10.4 – 25.8)
Don't know	4	–	–
Among those that had their home cleaned, did anyone experience symptoms while home was being cleaned or later that same day?‡			
Yes	13	480	22.0 (12.7 – 31.4)
No	37	1,366	62.7 (52.6 – 72.8)
Don't know	9	–	–
Have faucets in the home been run for at least 60 seconds?§			
Yes, all	34	1,256	36.6 (26.0 – 47.1)
Yes, some	37	1,366	39.8 (26.5 – 53.1)
No	19	702	20.4 (12.4 – 28.5)
Don't know	3	–	–
Have toilets in the home been flushed at least once?			
Yes, all	62	2,290	66.7 (56.7 – 76.6)
Yes, some	20	739	21.5 (12.8 – 30.2)
No	10	369	10.8 (3.4 – 18.1)
Don't know	1	–	–

--- Data based on small numbers (n<10) may be unstable; therefore, weighted estimates are not presented.
* Among households that ever relocated temporarily in response to the gas leak (n=96).
† Households missing information about whether they aired out or cleaned their homes were excluded (n=2).
‡ Among households that reported that their homes had been cleaned (n=59).
§ Households missing information about whether faucets were run were excluded (n=3).
£ Households missing information about whether toilets were flushed were excluded (n=3).

Table 13. Households' greatest need weighted to the entire sampling frame, Porter Ranch and Granada Hills, CA, March 2016.

	Number of households (n=210)*	Projected number of households (n=7,755)	Weighted % of households (95% CI)
Nothing	54	1,994	25.7 (19.5 – 31.9)
To have home and property cleaned, including oily residue	28	1,034	13.3 (7.1 – 19.6)
Solutions to the decline in property values	23	849	11.0 (6.4 – 15.5)
Assurance that the gas leak and similar incidents will not happen again	20	739	9.5 (5.0 – 14.0)
Testing for pollutants inside homes and to ensure that homes are safe	19	702	9.0 (4.7 – 13.4)
Follow-up for health risks in the future	16	591	7.6 (3.5 – 11.8)
Recovery from current health symptoms	13	480	6.2 (3.2 – 9.2)
Air purifiers or weather stripping from SCG	12	443	5.7 (1.9 – 9.6)
Honest information about the gas leak	10	369	4.8 (1.5 – 8.0)
Clean air	9	–	–
Reimbursement for relocation expenses	8	–	–
Return to "normal life" after relocation, particularly for local schools	7	–	–
Safe water in swimming pools and for drinking	6	–	–

--- Data based on small numbers (n<10) may be unstable; therefore, weighted number of households are not presented.

* Households could report more than one greatest need; therefore, the sum of these numbers exceed the total number of households interviewed (n=210).

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Appendix A

(Verbal Consent, Resource List and Referral Forms)

Consent Script

Community Assessment for Public Health Emergency Response

Good morning/afternoon sir/madam, my name is _____ and this is _____. We are with the _____ County Public Health and the California Department of Public Health. We are talking to randomly selected households about their experiences regarding the Aliso Canyon gas leak incident.

- ✓ We are talking to residents about how the Aliso Canyon gas leak incident has affected them and how they are doing now that the well has been permanently sealed.
- ✓ We want to get an idea of how the county can better serve residents that have been affected by the gas leak incident.
- ✓ Your house is one of 210 that has been randomly chosen to be in this survey.
- ✓ If you agree to participate, we will not ask you any personal questions such as those about your job, education, or place of birth. All the questions are about your entire household.
- ✓ The survey should take approximately 25 minutes to complete. Your answers will be kept private, and you can refuse to take part in the survey or refuse to answer any of the questions. Nothing will happen to you or your household if you choose not to take part in the survey.
- ✓ We also have some information we would like to leave with you from the County that may be of interest to you and your household.

If you have any questions about this survey you can ask anyone here right now. If you would like to confirm that we were sent by the Los Angeles County Department of Public Health, you can call 213-738-3220.

[**SURVEYOR: WAIT FOR RESPONDENT TO CLEARLY ANSWER YES OR NO after each question below**]

1. **Would you like to participate in this survey?** ☐Yes ☐ No
2. **Do you live in this home?** ☐Yes ☐ No
   If "NO" **Is there someone else who lives in this home that we can speak to?** ☐Yes ☐ No
3. **Are you at least 18 years or older?** ☐Yes ☐ No
   If "NO" **Is there someone else who lives in this home that we can speak to?** ☐Yes ☐ No

[**CONDUCT INTERVIEW IF RESPONDENT ANSWERED YES TO ALL THREE QUESTIONS**]

[**IF NOT, tell them: Thank you very much for your time.**]

Aliso Canyon Gas Leak Resources

Department of Public Health: *Report Health Symptoms, Health Information, Assessment Activities*
www.publichealth.lacounty.gov/media/gasleak/
213-738-3220

Public Health Vet
http://publichealth.lacounty.gov/vet/Aliso_leak.htm
213-989-7060

Local Assistance Center: *Department of Public Health is staffing this center:*
Location: Mason Recreation Center, Youth Center Building - 10520 Mason Avenue, Chatsworth 91311
Thursday & Friday Hours: Open from 10 a.m. to 8 p.m.
Saturday Hours: Open from 10 a.m. to 3 p.m.
Closed Sunday through Wednesday

Air Quality Management District: *Report Odors, Air Monitoring Data and Criteria, Infrared Imaging*
www.aqmd.gov/home/regulations/compliance/aliso-canyon-update
1-800-CUT-SMOG

California Air Resources Board: *Air Monitoring Data and Criteria, Infrared Imaging of Well*
www.arb.ca.gov/research/aliso_canyon_natural_gas_leak.htm
1-800-242-4450

Office of Environmental Health and Hazard Assessment: *Evaluation of Health Concerns, Independent Scientific Expert Panel, Evaluation of Air Quality Criteria for Aliso Canyon*
www.oehha.ca.gov/public_info/emergency/alisocanyon.html

California Public Utilities Commission: *Regulatory activities, investigation and inquiries to determine cause of the leak*
www.cpuc.ca.gov/aliso/

Division of Oil, Gas and geothermal Resources: *Regulatory activities*
www.conservation.ca.gov/dog/Pages/AlisoCanyon.aspx

Southern California Gas Company
www.alisoupdates.com
Aliso Hotline: 818-435-7707
Expense Reimbursement: 213-244-5151
Oily Residue Cleaning: 818-435-7707, ResidueCleaning@socalgas.com

Community Assessment for Public Health Emergency Response

Confidential Referral Form

Date:___/___/___ Time:___:___

Cluster No: _____

Interviewer's Initials: _____

Name: _____

Address: _____

Contact information:

Home telephone: ____-____-_____

Cell phone: ____-____-_____

Email:_____

Summary of Need:

_____

_____

_____

_____

_____

_____

_____

Referral Made: Yes ☐ No ☐

Referral to: _____

Appendix B

(Questionnaire)

Aliso Canyon Gas Leak CASPER Questionnaire

To be completed by interview team BEFORE the interview			
1. Date (MM/DD/YY):	**2.**Time: (am/pm)	**3.** Cluster #:	**4.** Survey #:
5. Team member initials:		**5a.** Team name:	

6. Home type: ***Check one.***

□ Single family home (detached) □ Attached home/duplex □ Multi-unit apartment/condo
□ Mobile home □ Other, specify:_____

7. Garage type: ***Check one.***

□ Detached garage □ Attached garage □ Carport □ No garage

First, we would like to ask you some general questions about your household and your home. Please respond for all members of your household.

8. Including yourself, how many people live in your household? _____ □ DK □ Refused

9. Including yourself, how many people living in your household are:

0 – 5 years _____ 6 – 17 years _____ 18 – 39 years_____ □ DK

40 – 64 years _____ 65 years and older _____ □ Refused

Next we would like to ask you some questions about recent health symptoms experienced by you or any member of your household in relation to the natural gas leak incident in Aliso Canyon. Later in the survey, we will be asking about health symptoms during the active gas leak, but for now we are just asking about symptoms experienced after the gas leak was controlled. Please respond for all members of your household and tell us about symptoms experienced during the past month only.

10. In the past month, have you or any member of your household experienced any health symptoms that you or they think were caused by or related to the natural gas leak incident? ***Check one.***

□ Yes *(proceed to **10a**.)* □ No *(proceed to **13**.)* □ DK □ Refused

10a. Which of the following symptoms experienced in the past month do you think were caused by or related to the gas leak? ***Read each symptom. Check all that apply.***		***10b. Only ask of "YES" symptoms from 10a.*** Did any of the symptoms get better when you or your household member were away from your home or away from the Porter Ranch/Granada Hills area?	
Dry or irritated throat	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Cough	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Dry or irritated nose	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Stuffy or runny nose	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Nosebleed(s)	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Dry or irritated eyes	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Skin rash	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Dry, irritated or itchy skin	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Fever	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Shortness of breath or difficulty breathing	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Chest tightness or heaviness	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Wheezing	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Worsening of asthma	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Worsening of emphysema or chronic obstructive pulmonary disease (COPD)	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Headache	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Migraine	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Nausea/upset stomach	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Vomiting	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Diarrhea	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Dizziness or light headedness	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Trouble sleeping	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Fatigue	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Feeling agitated or irritated	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Stress	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Depression	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Other, specify:_____	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R

Thinking about the health symptoms we just discussed…

11. In the past month, did you or any member of your household seek medical help for any of the health symptoms from a health care provider? ***Check one.***

□ Yes *(proceed to **11a**.)* □ No *(proceed to **12**.)* □ DK □ Refused

11a. Where did you/they seek medical care? ***Check all that apply.***

□ Family doctor □ Hospital □ DK
□ Urgent care center □ ER □ Refused
□ Specialist, specify:_____ □ Other: _____

12. If you or any member of your household did not seek medical care, please indicate why? ***Check all that apply.***

□ No symptoms reported □ Have no insurance □ DK
□ Symptoms not bad enough □ Have no transportation □ Refused
□ Have no physician □ Other: _____

Now we are going to ask you about symptoms that you or any member of your household experienced during the active gas leak.

13. Did you or any member of your household have any health symptoms that you or they think were caused by or related to the active gas leak that lasted from late October through early February? ***Check one.***

□ Yes *(proceed to **13a**.)* □ No *(proceed to **14**.)* □ DK □ Refused

13a. Which of the following symptoms experienced between late October and early February do you think were caused by or related to the active gas leak? ***Read each symptom. Check all that apply.***		***13b. Only ask of "YES" symptoms from 13a.*** Did any of the symptoms get better when you or your household member were away from your home or away from the Porter Ranch/Granada Hills area?	
Dry or irritated throat	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Cough	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Dry or irritated nose	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Stuffy or runny nose	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Nosebleed(s)	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Dry or irritated eyes	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Skin rash	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Dry, irritated or itchy skin	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Fever	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Shortness of breath or difficulty breathing	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Chest tightness or heaviness	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Wheezing	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Worsening of asthma	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Worsening of emphysema or chronic obstructive pulmonary disease (COPD)	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Headache	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Migraine	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Nausea/upset stomach	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Vomiting	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Diarrhea	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Dizziness or light headedness	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Trouble sleeping	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Fatigue	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Feeling agitated or irritated	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Stress	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Depression	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R
Other, specify:_____	□ Yes □ No □ DK □ R	□ Yes □ No □ DK □ R

Next we would like to ask you some questions about you indoor home environment.

14. Have you or any member of your household ever used a portable air purifier/cleaner/filter inside your home? ***Check one. Refer to handout with images of portable air purifier/cleaner/filters.***

□ Yes *(proceed to **14a**.)* □ No *(proceed to **15**.)* □ DK □ Refused

14a. Was the portable air purifier/cleaner/filter(s)…
Read each item. Check all that apply.

Newly purchased since the gas leak incident began	□ Yes	□ No	□ DK	□ Refused
Provided by Southern California Gas Company	□ Yes	□ No	□ DK	□ Refused
Owned prior to the gas leak incident	□ Yes	□ No	□ DK	□ Refused

14b. In the past month, how many portable air purifier/cleaner/filter(s) have you or any member of your household used inside your home? ***Write in the number.***

_____

14c. Thinking about the portable air purifier/cleaner/filter that is used most often, how many days per week was it used inside your home in the past month? ***Check one.***

□ Less than 1 day per week □ 3 – 4 days per week □ Every day □ DK
□ 1 – 2 days per week □ 5 – 6 days per week □ Refused

14d. How long did you typically run the air purifier/cleaner/filter each day that you ran it in the past month? ***Check one.***

□ Less than 1 hour □ 5 – 12 hours □ 24 hours continuously □ DK
□ 1 – 4 hours □ 12 – 23 hours □ Refused

15. Have you or any member of your household ever used an "in-duct air cleaning system" inside your home? An "in-duct system" is built into or attached to part of a home's central heating, air conditioning or ventilation system? ***Check one. Refer to handout with images of the "in-duct air cleaning system."***

□ Yes *(proceed to **15a**.)* □ No *(proceed to **16**.)* □ DK □ Refused

15a. Was the in-duct air cleaning system…
Read each item. Check all that apply.

Newly purchased since the gas leak incident began	□ Yes	□ No	□ DK	□ Refused
Provided by Southern California Gas Company (e.g. Air Scrubber Plus)	□ Yes	□ No	□ DK	□ Refused
Owned prior to the gas leak incident	□ Yes	□ No	□ DK	□ Refused

15b. Thinking about the in-duct air cleaning system, how many days per week was it used inside your home in the past month? ***Check one.***

□ Less than 1 day per week □ 3 – 4 days per week □ Every day □ DK
□ 1 – 2 days per week □ 5 – 6 days per week □ Refused

15c. How long did you typically run the in-duct air cleaning system each day that you ran it in the past month? ***Check one.***

□ Less than 1 hour □ 5 – 12 hours □ 24 hours continuously □ DK
□ 1 – 4 hours □ 12 – 23 hours □ Refused

Now we would like to ask you some additional questions about your indoor home environment. Please respond for all members of your household.

16. In the past month, have you or any member of your household used a humidifier or de-humidifier inside your home? ***Check all that apply.***

□ Yes, humidifier □ Yes, de-humidifier □ No □ DK □ Refused

17. In the past month, have you, any member of your household, or any visitor(s) used any of the following in your home?

Read each item. Check all that apply. Refer to handout with images of these items.

Air freshener or room deodorizer	□ Yes	□ No	□ DK	□ Refused
Burning candles, incense or oil	□ Yes	□ No	□ DK	□ Refused
Bug spray or pesticides	□ Yes	□ No	□ DK	□ Refused
Paint, paint thinner or paint stripper	□ Yes	□ No	□ DK	□ Refused
Ammonia or chlorine bleach cleaning products	□ Yes	□ No	□ DK	□ Refused

18. Have you, any member of your household, or any visitor(s) ever smoked cigarettes or cigars, or used any smokeless tobacco products such as electronic cigarettes inside your home? ***Check one.***

□ Yes □ No □ DK □ Refused

19. Do you have any gas appliances in your home? For example, a gas stove, gas water heater or gas fireplace?

□ Yes □ No □ DK □ Refused

20. Did the Southern California Gas Company provide you or any member of your household with weather-proofing materials to seal windows, doors or other gaps that allow air to enter your home? ***Check one.***

□ Yes □ No □ DK □ Refused

21. In the past month, have you or any member of your household smelled a "gas-like" odor while inside your home? ***Check one.***

□ Yes (proceed to **21a**.) □ No (proceed to **22**.) □ DK □ Refused

21a. What times of day have you or any member of your household smelled a "gas-like" odor while inside your home in the past month?

Check all that apply.

Morning	*Afternoon*	*Evening*	*Other*
□ 6am – 8am	□ noon – 2pm	□ 6pm – 8pm	□ midnight – 6am
□ 8am – 10am	□ 2pm – 4pm	□ 8pm – 10pm	□ DK
□ 10am – noon	□ 4pm – 6pm	□ 10pm – midnight	□ Refused

21b. Did you or any member of your household do any of the following to reduce the "gas-like" odor inside your home in the past month? ***Read each item. Check all that apply.***						***21c. Only ask of "YES" items from 21b.*** Did it reduce the odor?			
Run home's central air system	□ Yes	□ No	□ Not Appl	□ DK	□ R	□ Yes	□ No	□ DK	□ R
Run portable air purifier/cleaner/filter(s)	□ Yes	□ No	□ Not Appl	□ DK	□ R	□ Yes	□ No	□ DK	□ R
Open doors/windows	□ Yes	□ No	□ Not Appl	□ DK	□ R	□ Yes	□ No	□ DK	□ R
Use ceiling/portable fan(s)	□ Yes	□ No	□ Not Appl	□ DK	□ R	□ Yes	□ No	□ DK	□ R
Other:_____	□ Yes	□ No	□ Not Appl	□ DK	□ R	□ Yes	□ No	□ DK	□ R

The last few questions are about your outdoor home environment. For these questions we want you to think about the past month and respond for all members of your household.

22. In the past month, have you or any member of your household smelled a "gas-like" odor while spending time outdoors at your home or in your neighborhood? ***Check all that apply.***

□ Yes, outdoors at home (proceed to **22a**.) □ No (proceed to **23**.) □ DK □ Refused
□ Yes, outdoors in neighborhood (proceed to **22a**.)

22a. What times of day have you or any member of your household smelled a "gas-like" odor while spending time outdoors at your home or in your neighborhood in the past month?
Check all that apply.

Morning	*Afternoon*	*Evening*	*Other*
□ 6am – 8am	□ noon – 2pm	□ 6pm – 8pm	□ midnight – 6am
□ 8am – 10am	□ 2pm – 4pm	□ 8pm – 10pm	□ DK
□ 10am – noon	□ 4pm – 6pm	□ 10pm – midnight	□ Refused

23. Have you or any member of your household ever noticed any "oily residue" outdoors of your home or outside in your neighborhood since the natural gas leak began? For example, have you noticed any brownish-black spots on any outdoor surfaces such as cars or patio furniture?
Check one. Refer to handout with images of oily residue.
□ Yes □ No □ DK □ Refused

Lastly,

24. Did you or any member of your household choose to be relocated by the gas company? ***Check one.***
□ Yes *(skip **25**, proceed to **26**.)* □ No *(proceed to **25**.)* □ DK □ Refused

25. What is your household's greatest need right now?

_____

_____

That's the end of our survey. Thank you for your time.

ASK THIS PAGE OF QUESTIONS FOR ONLY THOSE THAT HAVE BEEN RELOCATED

Since you or other members of your household were relocated by the gas company, we would like to know about your relocation and about your move back home.

26. What month(s) did you or any member of your household relocate? ***Check all that apply.***

□ November □ December □ January □ February □ March □ DK □ Refused

27. Has everyone in your household moved back home from relocation? ***Check one.***

□ Yes □ No □ DK □ Refused

28. Of those who have moved back home from relocation, what month(s) did you or any member of your household move back home? ***Check all that apply.***

□ November □ December □ January □ February □ March □ DK □ Refused

29. In preparation to move back home or after returning home, have you or any member of your household aired out your home for at least 2 hours?

□ Yes *(proceed to **29a**.)* □ No *(proceed to **30**.)* □ DK □ Refused

29a. What did you or any member of your household use to air out your home? ***Check all that apply.***

□ Central air conditioning system
□ Window air conditioning unit(s)
□ Portable air filter
□ Open doors/windows
□ Ceiling/portable fan(s)
□ Other:_____
□ DK
□ Refused

30. In preparation to move back home or after returning home, has the inside of your home been cleaned?

□ Yes *(proceed to **30a**.)* □ No *(proceed to **31**.)* □ DK □ Refused

30a. Did you or any member of your household experience any health symptoms while your home was being cleaned or later that same day? ***Check one.***

□ Yes □ No □ DK □ Refused

31. In preparation to move back home or after returning home, have some or all of the faucets in your home been run for at least 60 seconds?

□ Yes, all faucets □ Yes, some faucets □ No, none □ DK □ Refused

32. In preparation to move back home or after returning home, have some or all of the toilets in your home been flushed at least once?

□ Yes, all toilets □ Yes, some toilets □ No, none □ DK □ Refused

33. What is your household's greatest need right now?

_____

_____

That's the end of our survey. Thank you for your time.

Technical Assessment

Critical Review of Aliso Canyon Winter Risk Assessment and Action Plan

Prepared for Food & Water Watch

By

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August 31, 2016

Table of Contents

1.0 Executive Summary

The August 22, 2016 *Winter Risk Assessment* and *Winter Action Plan* prepared by the California Energy Commission , the California Public Utilities Commission the California Independent System Operator, the Los Angeles Department of Water and Power and Southern California Gas Company (SoCalGas)[1] demonstrate that the mitigation measures applied to Los Angeles Basin natural gas users will ensure adequate natural gas supply to reliably meet winter peak demand without the Aliso Canyon Storage Facility (Aliso Canyon). Permanent closure of Aliso Canyon will not compromise L.A. Basin natural gas supply, on either the summer peak day or winter peak day, as long as the key mitigation measures described in these documents are kept in place permanently.

The economic benefit to SoCalGas core customers (ratepayers) of the permanent closure of Aliso Canyon is in the range of $70 million per year. No quantitative information is provided in either the *Winter Risk Assessment* or the *Winter Action Plan* on the magnitude of the economic impact of the mitigation measures on non-core customers (large commercial or wholesale customers). An economic analysis should be conducted that compares the cost savings to SoCalGas core customers realized by permanently closing Aliso Canyon to the cost to non-core customers to comply on a permanent basis with tighter gas balancing rules in the absence of Aliso Canyon.

2.0 Critique of Alison Canyon *Winter Risk Assessment Technical Report*, *Winter Action Plan,* and *Independent Evaluator Report*

A. Review of August 22, 2016 *Winter Risk Assessment Technical Report*

The *Winter Risk Assessment* states that the minimum SoCalGas supply available in the winter of 2016-2017 without use of Aliso Canyon will be 5.1 billion cubic feet per day (Bcfd) when a mass balance calculation approach is used to determine available supply, and 4.5 to 4.7 Bcfd based on pipeline hydraulic model simulations.[2] The *Winter Risk Assessment* also states that, factoring in the new winter 2016-2017 mitigation measures and the continued application of summer 2016 mitigation measures, the maximum 1-in-10 year demand will be 4.1 to 4.2 Bcfd.[3]

Supply will exceed demand by 0.9 to 1.0 Bcfd without Aliso Canyon assuming the mass balance calculation of available supply. Supply will exceed demand by 0.3 to 0.6 Bcfd without Aliso Canyon assuming the more conservation hydraulic model simulation

[1] SoCalGas is listed as a co-author on the cover of the Winter Risk Assessment. SoCalGas is not listed a co-author of the Winter Action Plan.
[2] Winter Risk Assessment, Table 1, p. 19.
[3] Ibid, p. 5; Winter Action Plan, Table 1, p. 11 and pp. 17-18 (substituting either 22 MMcfd normal condition or 96 MMcfd N-1 contingency condition for 1,031 MMcfd electric generator forecast).

results. Given the surplus of supply in either scenario, there is no need for Aliso Canyon withdrawals to ensure L.A. Basin natural gas supply reliability in the winter of 2016-2017.

Yet despite the body of the executive summary of the *Winter Risk Assessment* providing the supply and demand values necessary to determine that there is no reliability need for Aliso Canyon to ensure natural gas reliability this winter, the executive summary begins with this erroneous statement (p. 3):

> This technical assessment is based on the 1-in-10-year cold winter day design standard that the CPUC established for the SoCalGas/San Diego Gas & Electric (SDG&E) service territories to meet the gas requirements of core and noncore customers on the coldest day with a 10-year recurrence interval. The assessment finds that this standard cannot be met without withdrawing supply from Aliso Canyon during the coming winter months.

On p. 9, in contrast to the supply/demand data already presented, the *Winter Risk Assessment* states:

> Without Aliso Canyon providing supply to the Los Angeles Basin, SoCalGas will have to choose whether to send supplies to the Los Angeles Basin or to other Southern California communities.

These statements do not make sense in the context of the supply and demand values provided in the Winter Risk Assessment. The authors state in the executive summary that the forecast winter peak day demand is 5.2 Bcfd of natural gas.[4] Of this total, 1.0 Bcfd is electric generator (EG) demand. Reliably available SoCalGas winter peak supply is identified as 4.7 Bcfd, and potentially as low as 4.5 Bcfd. With no change to the EG demand this represents a shortfall of 0.5 to 0.7 Bcfd of supply on the peak winter day.

However, the California Independent System Operator (CAISO) and the Los Angeles Department of Water and Power (LADWP) confirm that less than 0.1 Bcfd is needed to provide the minimum amount of electric generation necessary to maintain grid reliability in the L.A. Basin.[5] CAISO and LADWP have the ability to shift generation outside of the L.A. Basin to minimize EG natural gas demand on forecast peak winter days. One of the winter mitigation measures authorizes CAISO to establish a natural gas burn operating

[4] The winter peak demand forecast stated in the Aliso Canyon *Winter Action Plan Winter Action Plan Winter Action Plan* is 5.077 Bcfd, Table 1, p. 11, not 5.2 Bcfd.

[5] Winter Risk Assessment, p. 4.
"The LADWP/California ISO joint powerflow study found that electric reliability can be satisfied . . . . with a minimum gas burn of 96 million cubic feet per (MMcfd) by electric generation in the SoCalGas/SD G&E service territories in response to post N-1 contingency conditions and as low as a gas burn of 22 MMcfd (with somewhat higher risk) under normal pre-contingency conditions and the ability to import generation into the Los Angeles Basin."

ceiling for electric generation in the L.A. Basin in advance of potential peak demand days.[6]

The joint parties and SoCalGas project a winter peak load of 4.1 to 4.2 Bcfd when the advance gas burn operating ceiling is imposed and EG is shifted out of the L.A. Basin on winter peak days.[7] This winter peak demand is well below the minimum of 4.5 to 4.7 Bcfd of supply available on the winter peak day without Aliso Canyon.

This shifting of generation outside the L.A. Basin is not a curtailment, which is generally understood as a cut-off of natural gas in response to an emergency condition. It would be a pre-planned redirection of electricity production to other generating units located outside of the L.A. Basin to meet electric load in the L.A. Basin.[8] The joint parties and SoCalGas indicate that electric generator dispatch costs would increase with this strategy, although they do not provide quantitative estimate of the increase in dispatch costs.[9]

Winter peak and near-peak demand conditions are likely to occur only a few days each winter. For example, SCE testified in 2007 that SoCalGas pipeline receipt capacity of 3,875 million cubic feet per day (MMcfd) was only exceeded on 9 days in the winter of 2006.[10,11] As a result, any increase in dispatch costs caused by the shifting of electric generation outside the L.A. Basin due to the imposition of a gas burn operating ceiling would be only for a few days.

The reduction in available winter peak supply from 4.7 to 4.5 Bcfd assumes that Line 3000 is out-of-service during the 2016-2017 winter peak.[12] But that assumption contradicts the action taken by SoCalGas in response to the June 30 – July 1, 2015 curtailment. In that case, a pipeline section (Line 4000) that was out-of-service for remediation work at the time was returned to service and the remediation activities postponed until October 2015, when the summer peak season had passed.[13] This same commonsense approach to preventative maintenance on Line 3000 should be applied this winter. The *Winter Risk Assessment* identifies Line 3000 as a critical pipeline but does not explain why elective (non-emergency) maintenance or upgrading would be

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[6] Winter Action Plan, p. 25.
[7] Ibid, p. 5.
[8] Ibid, p. 14. Impressively, LADWP can meets its LA Basin winter peak day grid reliability requirements with no (LA Basin) gas-fired generation: "*The LADWP will meet reliability requirements even with all gas fired basin generation off, provided two synchronous condensers are available at Scattergood and two are available at Haynes for voltage regulation and support. This is true even after assuming all known planned outages scheduled during December when the winter peak may occur*."
[9] Ibid, p. 5.
[10] SCE, SoCalGas/SDG&E/SCE Application A.06-08-026, *SoCalGas/SDG&E/SCE Omnibus Application - Rebuttal Testimony of Dr. Michael Alexander*, April 17, 2007, pp. 8-9, lines 15-17. "There were only nine days this winter in which core demand exceeded the firm receipt point capacity of the SoCalGas system." Firm receipt capacity = 3,875 MMcfd (p. 8).
[11] 2011 California Gas Report Supplement, p. 17. The SoCalGas winter peak day demand in 2006 was 4,145 MMcfd.
[12] Winter Risk Assessment, Table 1, p. 19.
[13] Summer 2016 Aliso Canyon Risk Assessment Technical Report, April 5, 2016, Appendix A, p. 54.

potentially conducted on Line 3000 at the time of the winter peak demand.[14] Either the resources to complete the maintenance activities by November 2016 should be committed to the project, or the project should be delayed until March or April 2017. The net effect of this action would be to increase available winter peak supply from 4.5 to 4.7 Bcfd.

The *Winter Risk Assessment* states that the "*The Southern System currently lacks supply diversity*."[15] Contracting for additional supply at the Otay Mesa receipt point is an off-the-shelf option for increasing winter peak supply from 4.7 Bcfd up to 5.1 Bcfd and is a reasonable winter mitigation measure to consider.[16] Although SoCalGas parent company Sempra Energy owns the Costa Azul LNG terminal near Ensenada which could supply natural gas to Otay Mesa, Shell Energy controls 50 percent of the LNG storage capacity at the facility.[17] Contracting for this capacity from Shell would eliminate the affiliate transaction concern associated with contracting for Sempra LNG-sourced supply. However, there is does not appear to be a need for this additional supply source when a minimum of 4.5 to 4.7 Bcfd of supply is already assumed to be available to meet a projected SoCalGas winter peak of 4.1 to 4.2 Bcfd.

B. Review of August 22, 2016 Aliso Canyon Winter Action Plan

The primary conclusion of the *Winter Action Plan* is that there will be adequate natural gas reliability in the L.A. Basin this winter with: 1) the suite of mitigation measures available to manage natural gas supply and demand, and 2) without Aliso Canyon. These mitigation measures include:

- 5 percent daily balancing by non-core customers.
- Daily balancing by SoCalGas for core customers.
- Imposition of electric generator gas consumption limits on forecast winter peak days.

SoCalGas was not a co-author of the *Winter Action Plan*, but did co-author the *Winter Risk Assessment.* This may be one reason why the *Winter Action Plan* conclusions on winter natural gas reliability without Aliso Canyon are more consistent with the underlying supply/demand data that is presented in the Winter Action Plan.

The *Winter Risk Assessment* states that SoCalGas also has tested Line 3000 between the Topock, Arizona, receipt point and the compressor station at Newberry in compliance with CPUC safety requirements and that test results are not expected until late fall. It goes on to state that SoCalGas anticipates, based on experience with testing of pipelines

[14] Winter Risk Assessment, p.29.
[15] Ibid, p. 21.
[16] B. Powers – Powers Engineering, *Is Aliso Canyon Needed to Assure Natural Gas Reliability in Southern California?*, April 8, 2016, Table 1, p. 6. TGN Otay Mesa receipt capacity = 400 MMcfd.
[17] Wall Street Journal, *Sempra's Flow to Natural Gas Proves Timely Investment in LNG Comes as Utilities Begin to Shun Coal*, April 7, 2008. "Shell Oil Co., the U.S. arm of Royal Dutch Shell PLC, is leasing half the terminal for 20 years. Sempra is retaining control of the other half and is importing gas from Indonesia under an arrangement with BP PLC."

of this vintage, that remediation work will be required.[18] The *Winter Risk Assessment* uses this explanation as a basis for assuming that Line 3000 will be unavailable this winter. No explanation is provided as to why SoCalGas would immediately take this remote pipeline out-of-service for remediation as the winter peak season is beginning instead of waiting until March 2017 when the winter peak season is over.

Two heat waves have occurred to date in the summer of 2016 (through August 31st), triggering Flex Alerts requesting that consumers conserve energy, and associated other activities aimed at avoiding gas curtailments and electricity outages.[19]

The first of these heat waves began on June 20, 2016. Southern California Edison (SCE) experienced its second highest 1 –hour peak load ever recorded in its service territory on Monday, June 20, at 23,564 MW, between 3 and 4 pm. LADWP reached 6,080 MW on that day, the highest ever LADWP load in June and close to its highest ever 1-hr demand of 6,396 MW. There were no gas curtailments on June 20th in the L.A. Basin, no withdrawals from Aliso Canyon, and no back-up fuel was burned by LADWP. The 5 percent daily balancing summer 2016 mitigation measure was in effect for non-core customers during this heat event and it was effective.

The second heat wave occurred from July 18 – July 22, 2016. The peak SCE electricity demand was approximately 21,500 MW on Thursday, July 21, and exceeded 22,000 MW on Friday, July 22.[20] There were no gas curtailments on June 20th in the L.A. Basin. There were no curtailments, no withdrawals from Aliso Canyon, and no back-up fuel burned by LADWP during this heat event.

The SCE peak loads were 2,000 MW to 4,000 MW higher during the two 2016 heat waves than on the June 30-July 1, 2015. On those two days, SoCalGas implemented curtailments to a limited number of electric generators in the L.A. Basin.[21] These curtailments were called at a time when substantially less rigorous balancing requirements were in place for non-core customers. See **Attachment A** for a comparison of the SCE peak loads during the two summer 2016 heat waves and the June 30 – July 1, 2015 SoCalGas curtailment events.

SoCalGas came within 2 percent of its projected 2016 summer peak demand of 3,380 MMcfd on August 16, 2016,[22] when natural gas demand reached 3,321 MMcfd.[23,24] On that day, only 396 MMcfd was withdrawn from storage to meet the total natural gas

[18] Winter Action Plan, p. 9.
[19] Ibid, p. 8.
[20] CAISO OASIS Database, System Demand – Actual, July 18 - July 22, 2016. See: http://oasis.caiso.com/mrioasis/logon.do.
[21] Summer 2016 Aliso Canyon Risk Assessment Technical Report, April 5, 2016, Appendix A, pp. 53-56.
[22] 2016 California Gas Report, p. 93.
[23] SoCalGas total BTU Factor (Dth/Mcf) = 1.0353, p. 95.
[24] SoCalGas Envoy database, August 16, 2016. Sendout = 3,438,000 Decatherms (Dth). Withdrawals from storage = 410,000 Dth. Therefore, total sendout in mmcfd = 3,438,000 Dth ÷ 1.0353 Dth/Mcf = 3,320,777 Mcf (3,321 mmcfd). Total withdrawal from storage = 410,000 Dth ÷ 1.0353 Dth/Mcf = 396,020 Mcf (396 mmcfd).

demand, no gas was withdrawn from Aliso Canyon, and no backup fuel was burned by LADWP. By way of comparison the *Winter Action Plan* states that 1,490 MMcfd is expected to be available for withdrawal from SoCalGas storage this winter, assuming only Honor Rancho, Goleta, and Playa del Rey are available and Aliso Canyon is not utilized.[25]

The *Winter Action Plan* identifies the forecast 1-in-10 year winter peak day demand as 5.077 Bcfd.[26] However, the actual 1-in-10 year SoCalGas winter peak over the last ten winters was 4.910 Bcfd.[27] The average peak winter day demand during this period was approximately 4.4 Bcfd as shown in **Attachment B**. In 2015, the SoCalGas winter peak day demand reached only 4.036 Bcfd.[28] Natural gas consumption is declining at a projected rate of 1.4 percent per year over the next 20 years.[29] The somewhat inflated 1-in-10 year SoCalGas winter peak day demand assumed in the *Winter Action Plan* and *Winter Risk Assessment* add a layer of conservatism to the supply and demand balances in both documents that further reinforces that lack of need for Aliso Canyon to meet the winter peak demand.

The *Winter Action Plan* notes the need to study delivery of natural gas derived from LNG stored at the Sempra LNG near Ensenada, Mexico as further supply support this winter to ensure adequate supply without Aliso Canyon.[30] As noted, Shell Energy North America and Sempra share the LNG capacity at this import terminal, and either company could provide natural gas derived from imported LNG at the Otay Mesa receipt point. However, there is no compelling reason to pay for additional backup supply of natural gas at Otay Mesa given the significant winter peak day supply surplus projected with the summer and winter mitigation measures in place.

Finally, the *Winter Action Plan* identifies curtailment of natural gas supplies to refineries as a potential mitigation measure if needed, with the warning that "*The economic consequences of them not being able to operate could be large*."[31] However, the economic consequences of idling a significant portion of the L.A. Basin's refining capacity are well understood. ExxonMobil's (now PBF Energy) Torrance Refinery, which provides 20 percent of Southern California's fuel, was shut down for over a year after a February 2015 explosion at the facility.[32,33] In contrast to the actual extended forced outage at the Torrance Refinery, any hypothetical natural gas curtailments to refineries due to L.A. Basin natural gas supply constraints would last a few days at most,

[25] Winter Action Plan, p. 16.
[26] Ibid, Table 1, p. 11.
[27] 2011 California Gas Report Supplement, p. 17.
[28] 2016 California Gas Report, p. 29.
[29] Ibid, p. 4.
[30] Winter Action Plan, p. 22.
[31] Winter Action Plan, p. 22.
[32] Los Angeles Times, *Torrance refinery unit to restart after major explosion; start-up to temporarily increase emissions*, May 9, 2016.
[33] Los Angeles Times, *Refinery outages and delays in Torrance repairs cause higher L.A. gas prices*, June 11, 2016. "Loss of refining capacity at the Torrance facility caused gas prices to rise as the plant supplies 10% of the refined gasoline in the state and 20% in Southern California."

at a time of year when fuel demand is reduced compared to the summer peak driving season.[34]

C. Review of August 19, 2016 Independent Evaluator Assessment of Modeling Used in *Winter Risk Assessment Technical Report*

The *Independent Evaluator Report* makes two sound observations in the recommendations section:[35]

- Tightening balancing rules to more closely align with standards for interstate pipelines that do not rely on storage facilities, and which are subject to daily balancing requirements, would be an effective mitigation measure.
- Deferring maintenance so that planned pipeline and storage outages do not occur simultaneously, especially during times of peak winter demand, if possible, would also be an effective mitigation measure.

The first observation indirectly acknowledges that there are pipeline systems that do not rely on storage systems that maintain reliability by use tighter balancing rules,[36] and that these pipeline systems achieve reliable operation by (in part) use of daily balancing requirements. The effectiveness of daily balancing was demonstrated in the summer of 2016 in the L.A. Basin.

The second observation is a common sense response to concerns about adequate supply resources to meet the winter peak demand. It makes sense to defer maintenance activities to periods when peak demand does not occur. However, in the specific case of Line 3000, regulators and SoCalGas are assuming that remediation work will not be deferred on this line in the winter of 2016. As a result, SoCalGas will lose access to at least 200 MMcfd of net pipeline natural gas supply on the peak winter day. In the summer of 2015, similar work on Line 4000 was deferred to avoid Line 4000 being out-of-service at a time when summer curtailments had the potential to occur.[37]

However, while providing sound observations on how to operate the SoCalGas system reliably without Aliso Canyon, the *Independent Evaluator Report* also makes unsupported statements regarding the need for Aliso Canyon in the section titled "Review of Modeling Outcomes." In fact, these statements appear to be a repetition of unsupported and incorrect hearsay in the *Risk Assessment*. They ignore the winter peak supply/demand balance achieved when the mitigation measures are imposed, which will provide sufficient reliable supply to meet the winter peak without Aliso Canyon:[38]

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[34] U.S. Energy Information Administration, *Refinery Outages: Fourth-Quarter 2015*, October 2015, pp. 5-7.
[35] Independent Evaluator Report, p. 18.
[36] See a discussion of this issue in: B. Powers – Powers Engineering, *Is Aliso Canyon Needed to Assure Natural Gas Reliability in Southern California?*, April 8, 2016, p 13.
[37] Summer 2016 Aliso Canyon Risk Assessment Technical Report, April 5, 2016, Appendix A, pp. 53-56.
[38] Ibid, p. 16.

- Using the gas stored in Aliso Canyon is very important to reducing the risk of gas curtailments and electrical service interruption this coming winter.
- Without this reserve available, SoCalGas will have to choose whether to maintain service to their peripheral customers or to supply those within the basin.

The operational changes represented by the summer and winter mitigation measures have eliminated the risk of gas curtailments this winter without use of Aliso Canyon. There will be at least 4.5 to 4.7 Bcfd of supply to meet 4.1 to 4.2 Bcfd of demand on the winter peak day as a result of these operational changes. Supply and demand flows on the SoCalGas L.A. Basin pipeline network will be tightly balanced. SoCalGas will not have to choose whether to maintain service to peripheral customers or supply those within the L.A. Basin.

3.0 Root Cause of Erroneous Curtailment Projections in Aliso Canyon Summer 2016 Risk Assessment and Action Plan

Erroneous claims of up to 14 days of L.A. Basin gas curtailments in the summer of 2016 reverberated unchallenged in the press for months because SoCalGas and regulators failed to update the Summer 2016 Aliso Canyon Risk Assessment (April 5, 2016) in a timely manner. They did not assess summer 2016 curtailment risk in the context of the much tighter summer 2016 supply-demand requirement imposed as a mitigation measure on large non-core natural gas users in the L.A. Basin as of June 1st, and instead relied on the substantially less rigorous monthly balancing requirements then in place to assess curtailment risk. This was a major and preventable disservice to the residents of the L.A. Basin.

Shell Energy North America and the Alliance for Retail Energy Markets advised regulators to update the assessment less than three weeks after it was issued, on April 22, 2016, stating:[39]

> The Reliability Plan should be updated to acknowledge that the [natural gas supply-demand balancing] protocol reduces the potential for gas (and electric) curtailment. . . . No evidence has been produced to show that the current protocol [5% daily balancing] is not adequate to address system-wide balancing issues.

This observation by Shell Energy North America and the Alliance for Retail Energy Markets has been demonstrated to be accurate over the course of the summer. Daily balancing of supply and demand by non-core customers has been adequate to address the potential for summer peak curtailments without Aliso Canyon. The April 2016 Risk Assessment said as much in a hypothetical manner, that application of 5 percent daily balancing by non-core customers would address the potential for summer curtailments,

[39] Joint Comments of the Alliance for Retail Energy Markets and Shell Energy North America (US), L.P. on the Aliso Canyon Action Plan to Preserve Gas and Electric Reliability for the Los Angeles Basin, April 22, 2016, pp. 2-3.

but failed to assume that 5 percent daily balancing would be imposed on non-core during the summer of 2016 when projecting the potential for gas curtailments.[40]

4.0 Permanent Closure of Aliso Canyon Represents Potential Net Economic Benefit to Core Customers

The ongoing cost to operate Aliso Canyon storage facility, including routine operations and maintenance (O&M), new wells, and the amortized cost of the new $200 million Aliso Canyon turbine replacement project, is on the order of $70 million per year.[41,42,43] This annual cost does not include emergency expenses associated with integrity testing, injection tubing installation or plugging, and safety value installation in the wake of the Well SS-25 blowout in October 2015.

The wholesale gas cost has not measurably increased at the Southern California border, a primary receipt point for the SoCalGas pipeline system, relative to other trading hubs as a result of the tighter gas balancing rules imposed on non-core customers in June 2016. A comparison of the spot natural gas price trend over the last year at the Southern California border (SoCal Border) trading hub, the Opal (WY) trading hub, and Henry Hub (LA) is included **Attachment C**. As a result, at least for core customers, a permanent shutdown of Aliso Canyon appears to be economically beneficial.

In contrast, neither the *Winter Risk Assessment* nor the *Winter Action Plan* address how much additional cost is being borne by the non-core users under the mitigation measures now in place. Only qualitative statements are made regarding the costs to non-core users associated with the mitigation measures:[44]

- Some of the new measures are aimed at reducing the impacts to customers, including electric generators, who have experienced additional cost to absorb the operational impact caused by the loss of Aliso Canyon.
- These steps imposed significant cost on LADWP and its customers. Other measur es likewise added costs for other customers.
- Noncore customers other than electric generators, including oil refineries and associated facilities that move petroleum products, represent key infrastructure that is essential to California's economy and security. These customers have

[40] CPUC, CEC, CAISO, LADWP, SoCalGas, *Aliso Canyon Risk Assessment Technical Report*, April 5, 2016, p. 18, pp. 30-31.
[41] B. Powers – Powers Engineering, *Is Aliso Canyon Needed to Assure Natural Gas Reliability in Southern California?*, April 8, 2016, p. 15. Ongoing O&M and new wells, $40 million per year.
[42] CPUC, Decision D.13-11-023, *Decision Addressing Application of Southern California Gas Company to Amend Its Certificate Of Public Convenience and Necessity for the Aliso Canyon Gas Storage Facility*, November 14, 2013, p. 2. Capital cost = $200.9 million.
[43] Energy, Economics, and Environment, Inc. (E3), 33% Renewable Portfolio Standard Calculator 2009 Public Version, "Resource Characterizations" worksheet, cell V71, annualized IOU capital cost factor over 20-year = 0.1676. Therefore the annualized cost of the $200.9 million turbine replacement project investment would be: $200.9 million × 0.1676 = $33.7 million per year.
[44] Winter Action Plan, p. 5, p. 8, p.19.

undoubtedly experienced additional costs, like the electric generators, complying with the tighter balancing rules.

The L.A. Basin electric generator usage ceiling would only be necessary on the order of a handful of days each winter, so the additional cost of limiting L.A. Basin generation would likely be nominal. Without some quantitative supporting documentation on the actual costs being incurred by non-core customers in the L.A. Basin to comply with the mitigation measures in the Winter Action Plan,[45] it is not possible to assess whether the net economic impact of a permanent shutdown of Aliso Canyon is positive or negative.

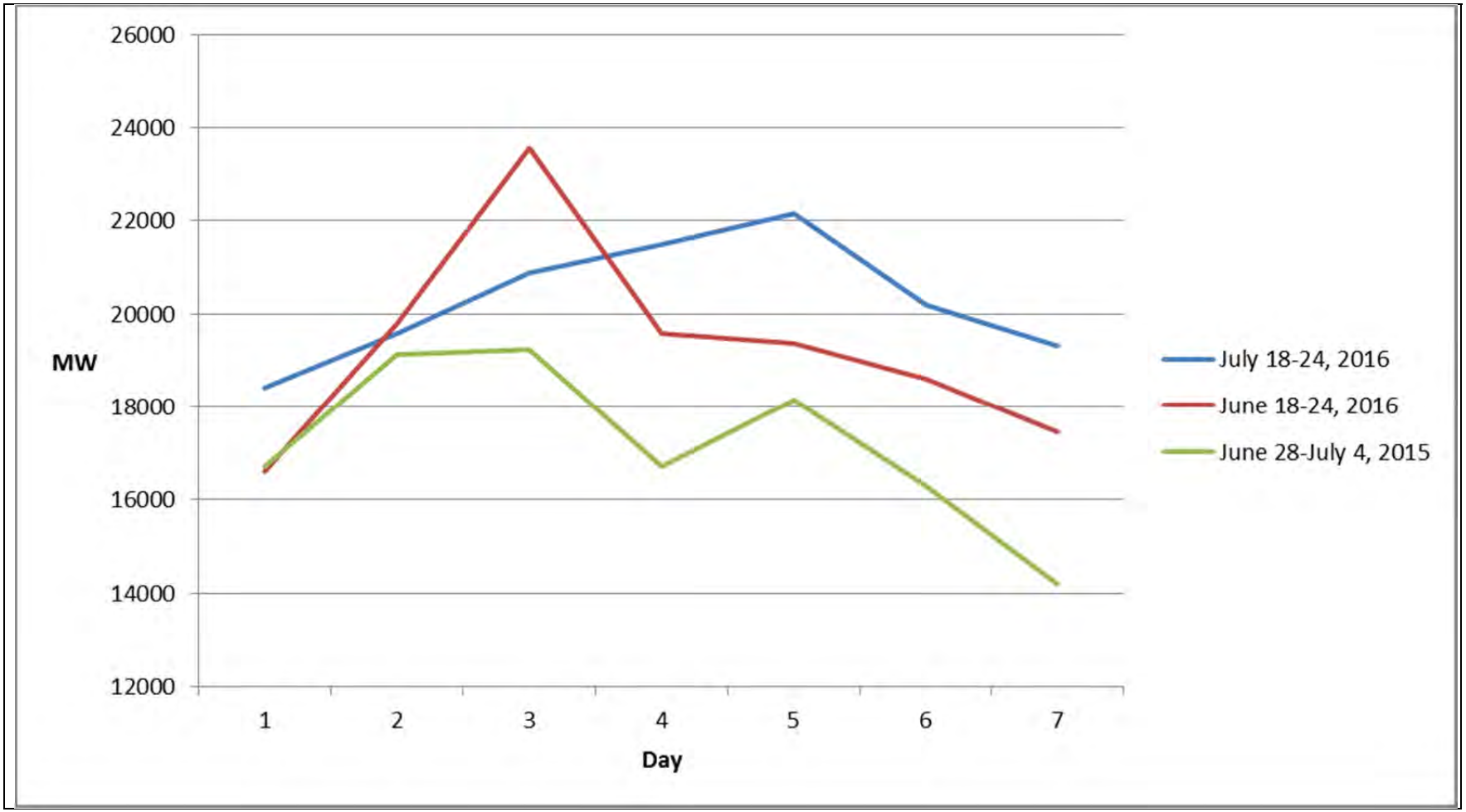
5.0 Conclusions

The *Winter Risk Assessment* and *Winter Action Plan* demonstrate that the mitigation measures applied to L.A. Basin natural gas users will ensure adequate natural gas supply to reliably meet winter peak demand without Aliso Canyon. The peak demand on the SoCalGas system occurs in winter. Permanent closure of Aliso Canyon will not compromise L.A. Basin natural gas supply, on either the summer peak day or winter peak day, as long as the key mitigation measures are kept in place permanently.

It is recommended that an economic analysis be conducted that compares the savings to SoCalGas core customers realized by the permanent closure of Aliso Canyon to the cost increases borne by non-core customers to comply with the permanent imposition of tighter gas balancing rules and other key mitigation measures.

[45] Ibid, Appendix A, pp. 24-25.

Attachment A. SCE Peak 1-Hour Load Trend During Two Summer 2016 Heat Waves Compared to 1-Hour Load Trend During June 30 – July 1, 2015 When SoCalGas Ordered Gas Curtailments to Some Electric Generators in the LA Basin



Attachment B. SoCalGas Peak Winter Day Natural Gas Demand, 2006-2015

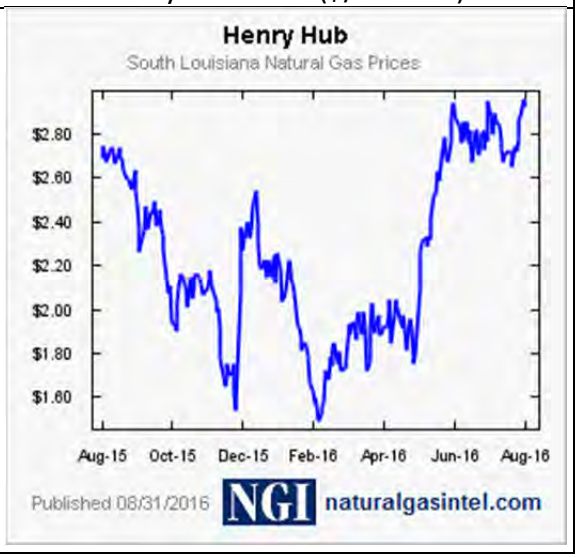
Year	Day	Peak Winter Day Sendout (MMcfd)
2006	12/19/2006	4,145
2007	01/15/2007	4,577
2008	12/17/2008	4,910
2009	12/08/2009	4,505
2010	11/29/2010	4,356
2011	12/12/2011	4,152
2012	12/19/2012	4,294
2013	12/09/2013	4,881
2014	12/31/2014	4,325
2015	12/29/2015	4,036

Sources: 2011 California Gas Report Supplement, p. 17; 2016 California Gas Report, p. 29.

10-year average SoCalGas winter peak day demand = 4,418 MMcfd

Attachment C. SoCal Border, Opal (WY), and Henry Hub (LA): Spot Prices, August, 2015 – August, 2016

[The same macro-price pattern trend is visible in major U.S. natural gas hubs, before and after June 1, 2016. No discernible price spike at SoCal Border following imposition of 5 percent daily balancing on non-core customers.]

SoCal Border Price ($/MMBtu)	Opal Price ($/MMBtu)	Henry Hub Price ($/MMBtu)
		

http://www.naturalgasintel.com/data/data_products/daily?region_id=south-louisiana&location_id=SLAHH



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