BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Establish Policies and Rules to Ensure Reliable, Long-Term Supplies of Natural Gas to California	R.04-01-025
Informational Proceeding and Preparation of the California Energy Commission 2005 Integrated Energy Policy Report.	CEC Docket No. 04-IEP-01

COMMENTS OF THE INDICATED PRODUCERS, WESTERN STATES PETROLEUM ASSOCIATION AND CALIFORNIA INDEPENDENT PETROLEUM ASSOCIATION ON GAS QUALITY WORKSHOP REPORT

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I. INTRODUCTION

The Indicated Producers (IP),[1] the Western States Petroleum Association (WSPA) [2] and the California Independent Petroleum Association (CIPA) commend the California Public Utilities Commission, the California Energy Commission, the Air Resources Board, and the Department of Conservation (DOGGR) (collectively, the "Agencies") for their collaborative efforts to sponsor and report on the February 17-18 Gas Quality Workshop. The Agencies and stakeholders alike recognize that through targeted refinements of existing quality standards, California will bring a more diverse and reliable supply of natural gas to serve its growing energy needs. By bringing stakeholders together and encouraging a broader debate about these needed

[1] The Indicated Producers is an *ad hoc* coalition which includes, for the purposes of these comments, Aera Energy LLC, Chevron U.S.A. Inc., and Occidental of Elk Hills, Inc.

[2] WSPA members include 26 companies that produce, refine, transport and market petroleum and petroleum products in the six western states.

refinements, the Agencies have moved the State one step closer to these necessary refinements.

WSPA/CIPA/IP have considered the issues raised in the Workshops, as well as issues raised in the national debate, from a wide range of perspectives. Their members' direct concerns in this debate include:

- Provision of additional gas supplies through importation of LNG and successful development of LNG regasification terminals off the coast of California and/or Mexico;
- Continued deliveries of gas supplies from US and Canadian sources;
- Uninterrupted and expanded production and delivery of in-state natural gas supplies;
- Continued operation of industrial equipment to support oil and gas production and petroleum refining operations; and
- Continued operation of natural gas-fired cogeneration equipment to serve industrial electrical demand and to deliver excess electric power to the utility grid.

In reviewing the gas quality issues from members' varied perspectives, WSPA/CIPA/IP offer comments in five Areas.

Proposed Gas Quality Standards. Refinements to existing standards are required as the State considers new supply options. These refinements, however, should not limit the ability of historical supplies to reach the California market. Likewise, these refinements should not serve as an impediment to the development of new supplies that track with historical production trends. Proposed refinements to existing CPUC and CARB standards are offered in Section II. A brief comparison of these proposals with the SoCalGas "Straw Dog" (the utility proposal distributed following the April 5 stakeholder meeting) and the Calpine post-Workshop proposal is also provided.

Data Gaps. Additional data may provide further assurance to the jursidictional Agencies that the refinements are appropriate. Section III identifies data gaps requiring stakeholder and agency attention.

Transition Funding. Actions may be required to address technological limitations of "legacy" compressed natural gas (CNG) vehicles in the State – those roughly 3,300 heavy duty vehicles in the San Joaquin Valley, Coastal and Los Angeles basin areas for which engine manufacturer specifications require fuels with a methane number of 80 or higher without some further engine modification. While specific actions have not yet

been identified, Section IV identifies possible sources of funding that should be explored and developed to support necessary actions.

Technical Corrections. The Workshop Report reflected a reasonable perspective on the contributions offered by various stakeholders. Section V, however, provides corrections and refinements to the Workshop Report for agency consideration.

Path Forward. All stakeholders agree that an expedited resolution of the gas quality issues in this proceeding is required to encourage new supply entry into California. Section VI offers a potential framework and timeline for proceeding to a timely resolution of the issues.

The Workshop Report expressed a level of concern about achieving a balanced solution to the gas quality issues. The Report observed that "*[e]ach modification proposed by a stakeholder would change the system, likely counter to the interest of other stakeholders*." Workshop Report at 4. Tensions are bound to arise among issues raised by suppliers, developers, end-users and regulators. With an eye toward maximizing the reliable, low cost supply of natural gas to California, however, a consensus can be reached that addresses the key issues of safety, system integrity and air emissions.

II. PROPOSED GAS QUALITY STANDARDS

At the Workshop and the April 5 meeting sponsored by SoCalGas, the Agencies encouraged stakeholders to broaden their perspective and to present comprehensive proposals to resolve the gas quality issues. SoCalGas circulated its "Straw Dog" shortly after the April 5 meeting, inviting comment on its proposed standards for Rule 30 and the CARB CNG vehicle fuel specifications. In response to the Agencies' encouragement and SoCalGas' initial proposal, WSPA/CIPA/IP have developed their own statewide proposal, taking into account the Agencies' recent guidance. For ease of comparison, the WSPA/CIPA/IP proposal uses the SoCalGas' Straw Dog format and existing Rule 30. The proposal, however, is intended to extend statewide to include

utility investor-owned utility systems. As explained further below, WSPA/CIPA/IP largely agree with SoCalGas, but seek clarifications to ensure that the new rules do not prevent the continued entry of historical supplies into any utility system and to allow for the development of new supplies through exploration.

A. Proposed Rule 30 Model

The Workshop Report suggests that proposals were made during the workshop to "*[d]rop CPUC compositional standards in favor of performance standards, such as the Wobbe number*." Workshop Report at 4. The Workshop Report further poses the question "*[h]ow far can the constraints imposed by current specifications be relaxed in order to accommodate delivery into our systems from these new sources…?*" Workshop Report at 27-28. These observations and questions may mischaracterize the proposals offered during the workshop. Most proposals do not "drop" or relax existing CPUC standards, but tighten and refine these standards.

WSPA/CIPA/IP, like SoCalGas, base their statewide proposed standards on the existing language in Rule 30, with only two areas of change. The first change is to tighten Rule 30 specifications through the adoption of a maximum Wobbe value of 1400 and a Wobbe variation of +/- 4%. Both recommendations have been drawn from the work generated by the NGC+ Council over the past year. The second change, in light of the tightening of the existing standard, is a provision ensuring that this change does not result in the shut-in of the type of supplies that have been received on SoCalGas' system historically. Both changes are drawn from and consistent with the interim guidelines developed in the White Paper on Natural Gas Interchangeability and Non-Combustion End Use dated February 28, 2005 (NGC+ Guidelines). These changes are reflected in Attachment A, with changes to existing Rule 30 in double-underline text.

It should also be noted that SoCalGas Rule 30 and PG&E Rule 21 provide that gas delivered into the utilities' systems shall conform to the gas quality specifications included in applicable agreements with upstream suppliers or, in the absence of a contract, with minimum specifications. Any new rule or specifications should take into account and honor existing contracts.

1. Wobbe Index Value and Variation

WSPA/CIPA/IP propose to tighten the current Rule 30 specifications. Specifically, the proposal incorporates a Wobbe value in the interchangeability guidelines and establishes a limit on variations from that value.

The present version of Rule 30 includes a section addressing gas interchangeability (§I.2.m). One of the interchangeability criteria included in this Section, the Wobbe number, is not a specific value. Rather, the existing tariff requires that gas entering the SoCalGas system to be within 90% to 110% of the Wobbe number for the gas flowing through the system at the point where gas is received.

The NGC+ study, lead by the Natural Gas Council over the past year, reviewed the need for and appropriate level for a Wobbe value. The group concluded that the single most effective measure of interchangeability was the Wobbe number, and that a Wobbe value of 1400 was reasonable. This study received broad input from 66 individual participants and 54 companies, agencies and organizations, including a number of key representatives from California. The working group reviewed extensive historical data, studies and research reports on natural gas interchangeability, combustion characteristics, and end-use equipment. Natural gas analyses from 26 major cities around the U.S. were reviewed, involving approximately 7,000 individual gas samples. The data showed a range of Wobbe numbers around the U.S. ranging

from 1201 to 1418. Importantly, the data set included 12 locations and 1,200 of 7,000 samples in California. Prior studies for U.S. and international gas interchangeability were reviewed and the recommendations considered.

The NGC+ Guidelines also recommended a variation of Wobbe number in a given service area of not more than +/- 4% from the local historical average. This recommendation was based on input from the end-user stakeholders on the NGC+ council, representing power generation, appliance manufacturers and others. The particular concern was with respect to end-use device capability to burn a gas with different combustion characteristics than the historic norm for a given area. The group concluded that the +/- 4% range was a "*conservative operating range*."

For these reasons, WSPA/CIPA/IP support the inclusion of the following language in the Rule 30 model:

a. Wobbe Number

Range: The minimum Wobbe Number is one thousand two hundred and ninety (1290). The maximum Wobbe Number is one thousand four hundred (1400). The Wobbe Number will be calculated in accordance with American Gas Association's Bulletin No. 36.

Variation: The allowable variation of Wobbe Number is +/- 4% maximum.

2. Exception for Historical Supplies

As the existing quality standards are tightened, the CPUC must exercise caution in ensuring that the tightening does not result in pushing historical and native supply sources off the system. The NGC+ Guidelines recognized this concern, observing that "*[g]as interchangeability guidelines must consider historical regional gas compositional variability as well as future gas supply trends*." NGC+ Guidelines at 17, ¶6.

This principle bears particular importance if California is going to continue utilizing its native energy resources to help meet the State's demand. The quality of

natural gas supplies received into utility systems may vary by geographic region. SoCalGas, for example, highlights certain of these differences in its tariff; "Btu districts" with differing historic Btu ranges are identified in Rule 2. Likewise, PG&E's Rule 21 today provides that gas quality standards may differ among receipt points and pipelines (Section C).

Consistent with this principle and with the NGC+ Guidelines, WSPA/CIPA/IP urge the Agencies to establish standards that accommodate the continued receipt of historical [3]supplies and allow for the introduction of new in-state production meeting historical standards. Specifically, WSPA/CIPA/IP propose the adoption of subsection b in the Rule 30 model, as follows:

b. *<u>Exception:</u> Portions of the utility's service territory with demonstrated experience receiving supplies exceeding these Wobbe, Heating Value and/or composition Limits shall continue to receive supplies conforming to this experience as long as it does not unduly contribute to safety and utilization problems of end-use equipment.*

This exception will ensure that the changes in existing gas quality standards do not unduly ***narrow*** the range of supplies available to the utility system. Narrowing available supplies would be a clear step backward for the state.

B. CARB CNG Vehicle Specifications

Regulators and stakeholders alike have observed that the current CARB compositional standard for compressed natural gas vehicles would benefit from replacement by a Methane Number standard. WSPA/CIPA/IP, like SoCalGas, propose movement to a minimum Methane Number of MN80. Significant evidence suggests a statewide standard of MN 80 is consistent with the needs of the majority of the State's existing CNG vehicle fleet. CARB, in fact, has extended a waiver from its compositional

[3] The term "historical" supplies is intended generally to refer to supply sources that are currently flowing on the utility system or have historically been received for delivery by the utility.

standard for the past several years allowing SoCalGas to supply MN 80 quality fuel to CNG customers in specified regions. The MN 80 value was solidly based on analysis by the CARB staff in 1992.[4] The extension of the waiver does not appear to have created any material problems for the fleet, nor would CARB have granted the waiver if there were deemed to be significant negative impacts to air quality. Additionally, the Energy Commission has worked closely with CNG engine manufacturers in recent years toward the development of newer generation engines (*e.g.,* the Cummins "plus" engine series) that would be capable of performing well with MN values as low as MN 65.[5]

The MN80 standard would be complemented with immediate and permanent waivers to allow MN 73 gas in the Coastal and San Joaquin Valley to accommodate receipt of historical in-state supplies. Movement to MN 73 should occur by January 1, 2008, in other regions where a retrofit, trade, or replacement of all "legacy" vehicles in the affected region or local fuel blending can be accomplished "Legacy" vehicles are heavy-duty compressed natural gas vehicle engines that require a manufacturer recommended fuel specification of MN80 or higher.

Failing immediate adoption of regional MN 73 standards for the San Joaquin Valley and Coastal regions, it will be critical to the continued receipt of historical supplies that SoCalGas continue to meet the CARB specification in those regions

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[4] *See generally Proposed Amendments to the California Alternative Fuels for Motor Vehicle Regulations, Staff Report: Initial Statement of Reasons*, at http://www.arb.ca.gov/regact/cng-lpg/isor.pdf. (Of particular interest are references at page I-3, ¶3.a and pages V-21 through IV-23, ¶B (Rationale). These two sections describe the basis for the CARB staff recommendation to make the change to the CNG fuel specification. They reference various classes of NGV vehicles, and testing performed on existing engines, along with engine manufacturers' plans to develop their newer engines in such a way as to accommodate a wider range of MN fuels.)

[5] *See* Panel 3 Workshop Presentation of William E. Liss and David M. Rue, on behalf of the Gas Technology Institute, at Slide 6.

through a combination of system and local fuel blending. Shutting in existing supplies – a consequence that would arise if the current practices were discontinued – would reduce, rather than enhance, the State's natural gas supply sources and associated oil production. This would be a step in the wrong direction.

The longer term goal for CNG vehicle fuel specifications should be to reduce the Methane Number to MN 73 by January 1, 2008. This movement should be conditioned on a consensus among stakeholders and regulatory agencies that there would be no cumulative negative impact to air quality. With the exception of the roughly 3,300 "legacy" fleet vehicles, existing and new CNG vehicles can operate on fuel meeting this proposed specification.[6]

The WSPA/CIPA/IP proposal is reflected in Attachment B.

C. Comparison of WSPA/CIPA/IP and SoCalGas Proposals

The WSPA/CIPA/IP proposal bears considerable resemblance to the SoCalGas Straw Dog, and the parties share agreement on most issues. The proposals differ, however, in four material ways: (1) Btu range, (2) Wobbe variation, (3) application of historical exceptions and (4) transitional measures to new CARB standards.

1. Btu Range

SoCalGas has proposed a reduction of the upper end of the Btu range from 1150 down to 1110. This change was aimed, in part, to reflect the heating value limit in the NGC+ Guidelines. WSPA/CIPA/IP recommend, instead, that California retain the existing 1150 Btu maximum.

Retaining the existing standard for heating value is a reasonable approach for California. First, this maximum is a known and long-standing measure of gas quality –

[6] "Legacy" fleet vehicles are further discussed below in Section V.B.

one that has not been challenged for decades. Second, SoCalGas has extensive history of varied Btu ranges within its service territory. The utility has established "Btu Districts", as described in Rule 2, section B, "Heating Value of Gas Served". The minimum and maximum range of BTU in that rule are from 1,000 to 1,200. Rule 2 further states that "*[t]he monthly average heating values … of the gas served in the major portion of the Utility's service area are within the range of 1000 - 1060, and the maximum variation will rarely exceed 100 BTU above or below this range*." Third, the Btu range is reasonably consistent with the NGC+ Guidelines. The Guidelines state expressly that they were proposed "*for new gas supplies to those market areas without extended experience with gas supplies characterized by … gross heating values higher than 1,100 Btu/scf*." NGC+ Guidelines at 25. Given California's long-standing standard and experience with heating values higher than 1110, the Guidelines would not suggest a modification of the existing 1150 standard. Fourth, as a practical matter, retaining the existing standard will ensure that supplies between 1110 and 1150, which have historically been permitted to enter SoCalGas' system, will not be shut-in as the result of new standards. Finally, on a broad basis, 1150 falls well within the range of interstate natural gas pipeline standards across the country.[7]

Although SoCalGas has proposed an 1110 heating value in its Straw Dog, the utility's February 17 presentation suggests that there may be no need to reduce the heating value from the current 1150 level. SoCalGas' presentation appears to suggest that as long as the Wobbe number is at or below 1400, and the Btu content is at or below 1150, there is far less of a tendency for the tested appliances to generate

[7] A table summarizing natural gas quality standards on a variety of interstate pipelines is included as Attachment C.

elevated levels of NOx.[8] At a minimum, it is certainly not clear from a review of the data presented at the Workshop that there is a marked difference in NOx emissions from gas at 1110 Btu when compared with 1150 Btu gas if the Wobbe remains at or below 1400.

2. Wobbe Variation

The WSPA/CIPA/IP proposal includes the NGC+ Guideline recommendation that the variation of the Wobbe number should be within +/- 4% of the local historical average gas in the service area. This recommendation was based on input from the end-user stakeholders on the NGC+ council, representing power generation, appliance manufactures and others. SoCalGas' Straw Dog omits this element of the NGC+ recommendation.

3. Exceptions

The NGC+ Guidelines and SoCalGas' Straw Dog incorporate an exception for historical supplies. These exceptions, however, use permissive language; the utility "may" receive historical supplies. WSPA/CIPA/IP have modified this language to provide that the utility "shall" receive historical supplies that are consistent with historical quality ranges as long as the supplies do not unduly threaten safety or end-use equipment utilization. Taking this approach will ensure safety, system integration and equipment durability, while continuing to permit receipt of supplies conforming with actual historical quality, and will minimize the potential for arbitrary application of the standard among supply sources.

[8] *See generally* Panel 5 Presentation of Larry Sasadeuz on behalf of SDG&E/SoCalGas. Mr. Sasadeuz concludes at Slide 9 that the results of testing are "less clear" on the need to adjust the existing higher heating value limit in Rule 30.

4. Transition to Revised CARB Standards

SoCalGas and WSPA/CIPA/IP generally agree on the roadmap to a final CARB CNG natural gas vehicle fuel specification. Both proposals urge CARB to move immediately from the current compositional standard to an MN 80 standard. Both proposals urge timely movement from MN 80 to MN 73 as technology, blending and changes in engine manufacturers' specifications permit. The difference arises in the WSPA/CIPA/IP proposal to move immediately to an MN 73 standard in the San Joaquin Valley and Coastal regions and other limited areas where CARB has previously granted specific waivers.

SoCalGas does not address these regions specifically. Consequently, its proposal consequently risks the shut-in of in-state production that flows into its system today and a limitation of new in-state resources. As demonstrated in SoCalGas' presentation at the workshop, a failure to address this issue would mean a reduction in California production of up to 74%. [9]

Once again, an examination of gas quality standards was sparked by the anticipation of new supply sources reaching the state. Nothing in the revised standards should aim to shut-in existing supplies flowing today over the utilities' systems or limit new supplies. Constricting, rather than expanding, supply sources would be a step backwards for the State.

D. Comparison of WSPA/CIPA/IP and Calpine Proposals

Calpine raised concerns in the development of its gas quality straw proposal concerning the quality of natural gas supplied to gas-fired turbines. WSPA/CIPA/IP

[9] SoCalGas representative Lee Stewart stated during the Workshop that 5% of California production currently meets the CARB compositional standard and that only 26% would meet an MN 80 standard. Transcript vol. 1, February 17, 2005, at 21.

members share some of Calpine's concerns; together, WSPA/CIPA/IP companies operate over 1000 MW of gas-fired generation in this State. While the Agencies must continue to explore these issues, their resolution should not impede a consensus among stakeholders.

The specifications proposed by Calpine closely resemble OEM fuel specifications for a natural gas turbine manufacturer. Attached to these comments as Attachment D is a table that reflects these and other manufacturer specifications. The wide range of acceptable specifications suggests that turbines, as a category of use, could support a broad quality specification range. Moreover, discussions among stakeholders have suggested that for individual engines that may fall outside that broad range, a variety of emissions offset programs could be applied to mitigate any potential air quality impacts.

Activities at the national level suggest that a solution is at hand for the electric turbine issues. In recent April 8 comments before the Federal Energy Regulatory Commission regarding the NGC+ Guidelines, The Edison Electric Institute (EEI) and its Alliance of Energy Suppliers (AES) support the NGC+ Guidelines with gas quality parameters similar to those already found in Rule 30 and Rule 21 pending completion of remaining research.[10] Remaining turbine tests include one scheduled to be run this quarter in Florida, which will address issues surrounding the level of gas quality variation acceptable in a turbine. It is important to note that together EEI and AES members represent nearly 70 percent of all electricity generated by U.S. electric utilities.

[10] Docket No. PL04-3-000, Comments of the Edison Electric Institute on the Natural Gas Council White Paper on Natural Gas Interchangeability and Non-Combustion End Use, April 8, 2005, at 13.

III. IDENTIFYING AND FILLING DATA GAPS

All stakeholders agree that certain data gaps must be filled before reaching a final conclusion and consensus on gas quality standard refinements for California. Those gaps have best been identified by the NGC+ Council in Table 1 to the Guidelines. Table 1 is attached to these Comments as a starting point for identifying and filling these gaps as Attachment E.

IV. FUNDING THE TRANSITION TO REVISED STANDARDS

The Workshop Report recognized the utility concerns regarding the potential need to fund modifications to conform certain existing CNG vehicles to the refined standards. It stated: "*Both SoCalGas/SDG&E and PG&E also wish for a commitment to securing funding for upgrading of older CNG engines, and wish CPUC and CEC to join with ARB to compel engine manufacturers to cooperate with research efforts dedicated to allowing heavy duty CNG engines to burn natural gas with a methane number of 73*." Workshop Report at 20. Should it be necessary to modify older NGV engines to accept natural gas with lower methane numbers, these engine modifications can be funded through a variety of sources. Potential sources of funding that should be explored include AB 1002 Gas Public Purpose R&D fund, the Carl Moyer fund, the SDG&E/SoCalGas NGV balancing accounts (to the extent they are over collected), potential funding from CARB, the CEC, local air pollution control districts and other creative funding partnerships. A statewide Emissions Working Group should be formed, including the Utilities, California air agencies, WSPA/CIPA/IP and other stakeholders to begin timely exploration regarding the availability of these funds and the scope of activities that might be covered by each.[11] Included with this Working Group activity

[11] These activities could be coordinated with the existing Air Advisory Panel organized by SoCalGas.

should be an evaluation of possible linkages with other similar efforts already under discussion, like the Community Air Benefits Program and others that would provide the necessary flexibility to address any emissions impact.

V. WORKSHOP REPORT OBSERVATIONS

A. Evaluating Emissions Impact

One of the most challenging issues in reaching a solution on gas quality standards appears to be finding agreement on how to evaluate the impact on air emissions of changing gas quality standards. A difference of opinion arose in the Workshop over the optimal method of comparing the potential emissions impact of higher Btu gas with the emissions under today's standards. In particular, the SCAQMD focuses on the concentration of NOx, or parts per million (ppm); other participants, including SoCalGas, Chevron U.S.A. Inc. and Occidental of Elk Hills Inc., suggested that the proper point of comparison would be the mass or total emissions.

WSPA/CIPA/IP acknowledge that higher Btu gas may lead to higher instantaneous NOx ppm at the exhaust source. It is critical to note, however, that an instantaneous increase in NOx emissions does not necessarily correlate to higher mass emissions. Parties should be looking at and comparing total mass emissions from the turbine, tail pipe, stack or other stationary source for a particular usage. The most appropriate way to capture this comparison is by measuring the mass rate of emission (i.e. pounds per hour) of the task being performed.

If one only looks at the concentration of emissions per Standard Cubic Foot, it would appear that the emissions are higher. However, if one looks at the total mass emissions for the task completed, the total emission generated, the net effect is

negligible. In general, higher Btu gas means less gas is needed to accomplish the same tasks, *i.e.* higher efficiency.

In its post workshop filing the SCAQMD stated, **"**For a given fuel, the mass of emissions per million Btus of fuel heating value is directly proportional to the concentration of the pollutant corrected to a constant value of oxygen, which is how the NOx values were expressed." SCAQMD is correct that for a given fuel, the mass emissions are directly proportional to the concentration of pollutant. It is important to note, however, that *the mass rate of emissions is also directly proportional to the mass flow rate of the fuel being burned*. While the pollutant concentrations as measured in ppm generally increase with an increase in heating value, the mass flow rate of fuel (and related combustion air) decreases with an increase in heating value. The percentage reduction in fuel use is approximately the same as the percentage increase in heating value. Thus, quantifying the total net effect of gas quality on the mass rate of pollutant emissions is much more complex than mere extrapolation of instantaneous emissions values.

SCAQMD further stated:

> *If one was to focus on mass emissions, then the effect of the hotter gases on thermal efficiency should also be considered. The SoCalGas data show that the hotter gases caused the heat input of the units to increase, but the combustion efficiencies generally declined with the hotter gases. Therefore, more Btus of fuel would have to be burned to provide the same heat output.*

This statement misses its mark. Higher Btu content gas will result in a higher temperature flame. Depending on the type of burner, this higher temperature can be translated directly into the combustion zone. This is why the overall volumetric fuel rate decreases with higher BTU fuel.

Typically, turbines operate on temperature control that is linked to the fuel flow valve. As BTU content increases, the flame temperature increases. This increase is sensed by the thermocouple which then throttles back the fuel flow valve to help maintain optimal temperature. This is the mechanism that results in a lower volumetric fuel rate when higher BTU gas is used. Working with the Original Equipment Manufacturer, the operator will fine tune or adjust the equipment to a mid-point of the expected range of fuel composition. With advance knowledge, prudent operators will make such adjustments and improve the operations of the units to meet existing emission requirements to resolve the issue of emissions increase with firing of "rich" gas; in many cases, this adjustment can result in an overall *reduction* of total emissions.

Finally, the Agencies and stakeholders should consider more than just NOx emissions. Combustion efficiency is a measure of the ability to convert the Btu's in the gas to useful work or energy. In the case of natural gas derived from LNG, the combustion efficiency can be expected to be better than that of domestically produced gas given the purity of LNG. For LNG generated natural gas, the amount of non-hydrocarbon components in the gas stream is much less than that of pipeline supplied gas. These non-hydrocarbon components (i.e. water vapor, nitrogen) in pipeline gas will absorb some of the heat of the combustion, thus reducing combustion efficiencies.

For all of these reasons, the Emissions Working Group should develop and agree on methodologies for assessing the impacts in emissions that could result from changes in gas composition. At a minimum, rigorous measurement and analysis must be employed to account for efficiencies associated with various gas compositions and any associated changes in the mass rate of emissions.

B. "Legacy" Systems

A shared vocabulary will be important in bringing consensus around refinements to existing gas quality standards. The use of the term "Legacy Systems" should be reviewed to ensure that parties use this and related terms in a similar manner.

The Workshop Report uses "Legacy Systems" to refer very broadly to existing technology. It states that "*California's natural gas infrastructure and **all the existing equipment** that use natural gas are "legacy systems", designed to be fed natural gas conforming to historic norms of composition and performance*." Workshop Report at 2. Using this term throughout the document, it concludes that "*The crux of the issue California must now deal with, in the face of changing circumstances, is that our legacy systems were not designed to utilize some of the new supplies that are anticipated to be available to the market*." Workshop Report at 8.

As a preliminary matter, it has not been demonstrated that "*our legacy systems were not designed*" to utilize a changing gas composition. The ability of existing systems to respond to changing gas composition is precisely the matter under continuing study at the federal and state level. Some existing systems will be able to respond, and other systems may have a more limited ability to respond.

This important point of distinction should not be overlooked and arose in a specific area of discussion within the Workshop Report. During the February workshop and in the long-standing discussions over CARB CNG vehicle fuel specifications, the term "legacy vehicles" was used to refer to a very specific population of systems. Specifically, CARB and other parties have used the term "legacy vehicles" to mean heavy duty vehicles with engines *whose manufacturer had not certified them to operate on gas with a methane number (MN) below 80*. The Workshop Report, however,

incorrectly characterizes the "legacy" fleet as the term has been used by CARB and stakeholders in the past. The Report states that the number of California's legacy CNG vehicles is approximately 25,000 – 30,000. Workshop Report at 20. While the *total* CNG vehicle population in the state is estimated at 25,000 – 30,000, the majority of these vehicles can conform to anticipated changes in gas composition. In fact, using the definition of "legacy vehicles" mentioned above, the legacy vehicle population is only about 3,300.

C. CARB Standard Application

The Workshop Report observes that the CARB standard for CNG vehicle fuel is "*not incorporated into CPUC-adopted standards contained in PG&E Rule 21 and SoCalGas Rule 30*…." Workshop Report at 4. This observation is correct. It highlights an issue, however, that may eventually require explicit resolution. SoCalGas and WSPA/CIPA/IP long have been at odds about whether the CARB standards are receipt standards or, instead, standards for vehicle fuel at the nozzle. WSPA/CIPA/IP contend that in-state produced gas is "commercial" natural gas, and not "compressed natural gas" subject to the CARB standard. Moreover, as the data demonstrated at the workshop, applying CARB standards directly as an inlet standard has significant implications for the ability of LNG and in-state supplies to enter the system. [12]

It is not clear that these implications were fully considered when CARB standards were designed. In the Workshop, Dean Simeroth of CARB made the following statement with respect to the compressed natural gas fuel standard: *"In developing these specifications, they were intended to be as consensus standard, in effect, as they were, at least to the people we had talked to. Somehow in doing this, the coal (sic) [co-]*

[12] *See* Transcript vol. 1 at 21 (SoCalGas/Stewart).

produced gas and its quality issues were not fully considered"*…Virtually none of the coal(sic) [co-] produced gas meets the CNG specification*." TR at 66-67.

Resolution of the question of how CARB standards should be applied – *i.e.*, at the inlet to the pipeline or at the nozzle – is not a "front burner" issue today. The question may eventually be only academic, depending upon the ultimate formulation of the refined standards. WSPA/CIPA/IP thus propose to reserve the issue for future review until the impact of the changing CARB standards comes into clearer focus.

D. Current Wobbe Number

The Workshop Report states that "*California's current system average Wobbe number is 1325*." Workshop Report at 30. The basis for this statement is not cited, nor is it supported today by an adequate data set. Thus, the conclusion reached by SCAQMD's Chung Liu -- that any higher value would cause emissions problems for the agency -- is premature. The emissions associated with a range of gas composition is likely to be the primary focus of ongoing research and testing in order to substantiate a consensus recommendation concerning gas quality specification changes for California.

E. CNG Vehicle Engine Life Cycles

The Workshop Report , in reviewing CNG vehicle implications, refers to representations by Roger Gault of the Engine Manufacturers Association of America (EMA). Workshop Report at 19. The EMA pointed out that "*many of the CNG engines on the road today will not complete their life cycles until 2019*." The issues surrounding CNG vehicles would be advanced if the Agencies could explore the basis of the EMA's conclusions on engine life cycles.

F. Processing Implications

Occidental of Elk Hills Inc. (OEHI) observed in its presentation on California production that further gas processing to remove ethanes and propanes would result in increased energy use and increased emissions. These changes, OEHI submitted, need to be considered in evaluating alternatives.

The same issue arises in the LNG setting. The Workshop Report mentions several times that Sound Energy Solutions and BHP Billiton claim that their facilities are adaptable to any standard. *See, e.g.,* Workshop Report at 37. While this may be true, the statement overlooks broader implications. In order to meet the CARB CNG vehicle fuel specification, for example, additional equipment and systems would need to be installed either at the point of the LNG liquefaction facility or at the terminal location to remove propane and ethane. These hydrocarbon products, if removed at the receiving terminal location, would need to be transported by pipeline (ethane) or by truck or railcar (propane). All of the additional equipment and processing would consume energy and generate emissions. These impacts should not be overlooked in the overall assessment of alternatives available to maximize California natural gas supplies.[13]

G. Technical Corrections

1. CNG Vehicle Fleet Populations

The Workshop Report, in discussing CNG vehicle fleet implications, states that "*there are legacy vehicles in multiple locations throughout California, primarily school and transit buses, which still require a more stringent fuel specification than the newer technologies allow. Therefore any changes in the specifications must be accompanied*

[13] The SES and BHP Billiton statements also overlook the fact that the final standards will dictate the flexibility of the terminal facilities in receiving varied supplies, including distressed cargo.

by some provision for these legacy vehicles." While this is true technically, it is also misleading.

Legacy fleets are concentrated in three regions, and this can be construed more as a local issue than a statewide issue. These fleets also tend to be serviced by the same fueling station, thereby further isolating the true extent of the problem. Finally, because of the regional concentration, targeted solutions may be possible.

2. Particulate Matter and Emissions

The Workshop Report identifies emissions-related concerns perceived to arise from higher Btu gas. It states, among other things, that "*[p]articulate matter (PM), though, is another concern regarding higher Btu gas, according to Bevilacqua-Knight's Steve Sokolsky, and it was not clear from the workshop whether or not a Wobbe number adjustment would address this concern as well.*" Workshop Report at 29. This statement is inaccurate. Clean Air Vehicle Testing Center results show that the range of emissions from low Btu fuels (MN-99) is actually higher for particulate matter than the other fuels tested.[14]

3. Comparative Gas Specifications

A table in the Report compares elements of the CPUC-approved tariff gas specifications for PG&E Rule 21 and SoCalGas Rule 30. The Rule 30 column requires several technical corrections.

- Carbon Dioxide is limited to a maximum of 3%, not 1% as listed.
- Mercaptan Sulfur is limited to 0.3 grans/100 scf, not 0.5 grains as listed.
- The Wobbe number description should be revised to reflect that the Wobbe number of the producer gas entering the utility pipeline system must be between 90% and 110% of the Wobbe number of the gas in the utility pipeline at the point of receipt.

[14] *See* Workshop Presentation of Steve Sokolsky on behalf of Bevilacqua-Knight, Inc. at Slides 11-12.

VI. A PATH FORWARD

Stakeholders have expressed a strong interest in moving forward quickly to refine gas quality standards. Regulatory certainty in this area is critical to the timely development and entry of new natural gas supplies. The CPUC, CEC and CARB have committed to facilitate timely action as consensus builds around a solution. With these shared interests and growing momentum, the Agencies should immediately establish a process and schedule to ensure continued progress.

Refined standards will require adoption by the CPUC and CARB. The scope of CPUC rulemaking will focus on the utilities' existing gas quality rules (e.g., SoCalGas Rule 30). The CARB will focus its rulemaking process on refinement of the existing CNG vehicle fuel specification. Although the Agencies employ different rulemaking processes, it would be the most effective use of resources to consider these refinements together in a single process, in coordination with the CEC.

WSPA/CIPA/IP urge the Agencies to consider adopting the following general approach to resolving the gas quality issues.

1. Encourage stakeholders to work together as often as possible on an informal basis to find consensus.

2. Establish a formal discussion process, administered under the relevant agency dockets, to bring together stakeholder work on a regular basis. This process could include both broad meetings and technical subcommittees on targeted issues (*e.g.*, impact on turbines, regional variation, CNG fleet solutions, emissions impacts). A CEC or CPUC commissioner or staff may be an appropriate facilitator to ensure discussion progress.

3. Establish a stakeholder oversight process to ensure data gaps are identified and testing completed on a timely basis.

4. Support a statewide discussion on emissions impacts and mitigation through an Emissions Working Group, incorporating the ongoing activities of the Air Advisory Panel organized by SoCalGas.

5. Establish a hearing schedule to accommodate hearings on limited issues if necessary to meet the targeted decision date.

A formal procedural schedule employing this approach could be structured as follows:

May 13	Detailed comments on Straw Proposal(s).
May 19-20	Roundtable technical discussion facilitated by CEC Staff
May 23	Distribute revised Straw Proposal
May 25-26	Roundtable technical discussion facilitated by CEC Staff
May 30	Distribute revised Straw Proposal
June 1-2	Roundtable technical discussion facilitated by CEC Staff
June 10	Written Comments to CPUC/CEC/CARB on final Straw Proposal
June 24	Joint Agency Ruling on Completion of Process, including identification of issues for hearing and further briefing.
July 15	Testimony as necessary for hearing
July 22	Reply testimony as necessary for hearing
August 1-5	Hearings as necessary
August 16	Opening briefs
August 23	Reply briefs
September 23	ALJ Draft Decision
October 3	Comments on ALJ Draft Decision
October 10	Reply Comments
October 27	Adoption of final CPUC decision

This schedule would ensure that the CPUC has an opportunity to fully review the issues in the course of R.04-01-025.

In coordination with the formal procedural schedule, stakeholders and the Agencies could establish a schedule to complete all studies necessary to fill data gaps on a schedule that would accommodate the targeted decision date. Again, it may be

useful to ask the CEC staff to take the role of ensuring and coordinating progress on these studies to meet the established deadlines.

Respectfully submitted,

Evelyn Kahl

Counsel to the Indicated Producers and the Western States Petroleum Association

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Edward Poole

Counsel to the California Independent Petroleum Association

April 25, 2005

ATTACHMENT A

Proposed Revisions to SoCalGas Rule 30

Rule 30: (proposed modifications of Rule 30 highlighted with double underline)

Proposal Summary

	Minimum	Maximum
Wobbe Index		**1400**
Btu/scf	**970**	**1150**
Ethane, vol. %	**N/S**	**N/S**
Propane, vol. %	**N/S**	**N/S**
Butane (C4+), vol %		**1.5%**
Total Inerts, vol %		**4%**
Wobbe variation, %+/-		**+/4%**

Proposed Changes to Rule 30 Text:

a. Heating Value Range The minimum heating value is nine hundred and seventy (970) BTU (gross) per standard cubic foot on a dry basis. The maximum heating value is one thousand one hundred fifty (1150) per standard cubic foot on a dry basis.

b. Wobbe Number

Range: The minimum Wobbe Number is one thousand two hundred and ninety (1290). The maximum Wobbe Number is one thousand four hundred (1400). The Wobbe Number will be calculated in accordance with American Gas Association's Bulletin No. 36.

Variation: The allowable variation of Wobbe Number is +/- 4% maximum.

c. Maximum C4 Plus Hydrocarbons: The gas shall not at any time contain in excess of one and one-half percent (1.5%) of C4 Plus hydrocarbons.

d. Mercaptan Sulfur The mercaptan sulfur is not to exceed three tenths (0.3) grains per hundred standard cubic foot.

e. Moisture Content or Water Content For gas delivered at or below a pressure of eight hundred (800) psig, the gas shall have a water content not in excess of seven (7) pounds per million standard cubic feet. For gas delivered at a pressure exceeding eight hundred (800) psig, the gas shall have a water dew point not exceeding 20 F at delivery pressure.

f. Hydrogen Sulfide The gas shall not contain more than twenty-five hundredths (0.25) of one (1) grain of hydrogen sulfide per one hundred (100) standard cubic feet. The gas shall not contain any entrained hydrogen sulfide treatment chemical (solvent) or its by-products in the gas stream.

g. Total Sulfur The gas shall not contain more than seventy-five hundredths (0.75) of a grain of total sulfur compounds per one hundred (100) standard cubic feet. This includes COS and CS2, hydrogen sulfide, mercaptans, and mono, di and poly sulfides.

h. Carbon Dioxide The gas shall not have a total carbon dioxide content in excess of three percent (3%) by volume.

i. Oxygen The gas shall not at any time have an oxygen content in excess of two-tenths of one percent (0.2%) by volume, and customer will make every reasonable effort to keep the gas free of oxygen.

j. Inerts The gas shall not at any time contain in excess of four percent (4%) total inerts (the total combined carbon dioxide, nitrogen, oxygen and any other inert compound) by volume.

k. Hydrocarbons For gas delivered at a pressure of 800 psig or less, the gas hydrocarbon dew point is not to exceed 45 F at 400 psig or at the delivery pressure if the delivery pressure is below 400 psig. For gas delivered at a pressure higher than 800 psig, the gas hydrocarbon dew point is not to exceed 20 F at a pressure of 400 psig.

l. Dust, Gums and Other Objectionable Matter The gas shall be commercially free from dust, gums and other foreign substances.

m. Hazardous Substances The gas must not contain hazardous substances (including but not limited to toxic and/or carcinogenic substances and/or reproductive toxins) concentrations which would prevent or restrict the normal marketing of gas, be injurious to pipeline facilities, or which would present a health and/or safety hazard to Utility employees and/or the general public.

n. Delivery Temperature The gas delivery temperature is not to be below 50 F or above 105 F.

o. Interchangeability The gas shall meet Lifting Index, Flashback Index and Yellow Tip interchangeability indices for high methane gas relative to a typical composition of gas in the Utility system near the points of receipt. Acceptable specification ranges are:

Lifting Index (IL)
IL<=1.06

Flashback Index (IF)
IF<=1.2

Yellow Tip Index (IY)
IY>=0.8

p. Exception: Portions of the utility's service territory with demonstrated experience receiving supplies exceeding these Wobbe, Heating Value and/or composition Limits shall continue to receive supplies conforming to this experience as long as it does not unduly contribute to safety and utilization problems of end-use equipment.

ATTACHMENT B

Proposed Changes to CARB CNG Vehicle Specifications

1. The current ARB “compositional” standard for compressed natural gas vehicles shall be replaced by a Methane Number standard as described below.

2. The minimum Methane Number is MN80, with immediate waivers to allow MN 73 gas in the Coastal and San Joaquin Valley regions and in regions governed on and after June 10, 2004 by a Memorandum of Exemptions between SoCalGas and ARB. Immediate movement to MN 73 shall occur where a retrofit, trade or replacement of all “legacy” vehicles in the affected region has occurred. “Legacy” vehicles are heavy-duty compressed natural gas vehicle engines that require a manufacturer recommended fuel specification of MN80 or higher.

3. The minimum Methane Number will be reduced to MN73 on or before January 1, 2008.

ATTACHMENT C

Interstate Pipeline	*Alliance*	*ANR*	*CIG*	*Col Gulf*	*Destin*	*EPNG*	*Florida*	*Gulf South*	*Kern River*	*NGPL*	*N. Border*	*Northwest*	*Panhandle*	*PG&E-NW*	*Questar*	*Sonat*	*Southern Star*	*Tennessee*	*TETCO*	*Texas Gas*	*Trailblazer*	*Transco*	*Transwestern*	*Trunkline*	*Wyoming Interstate*
max temperature	122	120	120	120	120	120	120	120	120	120		120	120	110	120	120	120	120	120	120	120	120	120	120	120
min temperature		40		40		50		40	40	40					35	40					20		40		20
Free Liquids	none	none	none	none	none	none	none	none	none	none	none	none	none		none	none	none	none	none		none		none	none	none
Max H2O vapor, #/MMscf	4	7	5/7	7	7	7	7	7	7	7	4	7	7	4	5	7	7/5	7	7	7	5	7	7	7	5
Hydrocarbon Dew Point F	14		25		0 @800 psia	20		< .2 gal C5+	15		-5	15		15			40								25
Liquefiable Hydrocarbons																.3 gpm C5+			0.2% C5+						
Total Sulfur, gr./100 scf	5	20	5	20	10	5	10	320 ppm	0.75	0.5	2	20	20	10	5	20	20	20	10	20	20	20	0.75	20	5
H2S, gr./ 100 scf	1.0	1/.25	0.25	1.0	0.25	0.25	0.25	16 ppm	0.25	0.25	0.30	0.25	1.0	0.25	0.25	1.0	0.25	0.25	0.5	1.0	1.0	0.3	0.25	1.0	0.25
Mercaptan Sulfur, gr./100 scf						0.75			0.3	0.25	0.30												0.3		
Organic Sulfur, gr./100 scf						1.25																			
Oxygen, max vol %	.4/free	1	0.001	1	.2 mol%	0.2	0.25	0.2	0.2	10 ppm	0.40	0.2	0.005	0.4	10 ppm	1	0.2	0.2	0.2	0.1	0.001		0.2	0.005	10 ppm/ free
CO2, max vol %	2	2.0	3.0	3.0	2.0	2.0		3.0	3.0	2.0	2.0	3.0	2.0	2.0		3.0	1.0	3.0	3.0	2.0	3.0		2.0	2.0	3.0
Max Inerts, vol %				4.0	3.0	3.0	3.0		4.0			5.0			3.0			4.0	4.0	4.5			3.0	3.0	
Nitrogen, vol %		3.0						3.0		3.0		3.0													
Hydrogen, ppm					.1 mol%			400 ppm		400							trace			0					
Dust, gums, solids	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none		none
Min heating value, Btu/scf	962	967	968	978		967	1000	950	970	950	967	985	950	995	950	950	950	967	967	967	950	980	970	950	
Max heating value, Btu/scf		1200	1235		1300	n/a		1175					1200		1150			1100				1100		1200	
Mercury					In accordance with CFR 24 Part 1910							none													

Intrastate Pipeline			*GTT*	*AEP - HPL*		*Tejas*	*Lone Star*			*AEP - LIG*	*Bridgeline*	*Acadian*	*OGE*	*Kinder Morgan*											
max temperature				120		120	120						120												
min temperature				40		40	40						40												
Free Liquids							none						none	none											
Max H2O vapor, #/MMscf				7		7	7						7	7											
Hydrocarbon Dew Point F							40						40	25											
Liquefiable Hydrocarbons																									
Total Sulfur, gr./100 scf				20		5	5						0.5	5+1											
H2S, gr./ 100 scf				0.25		0.25	0.25						0.25	0.25											
Mercaptan Sulfur, gr./100 scf							1						0.25												
Organic Sulfur, gr./100 scf																									
Oxygen, max vol %				0.2		0	0.05						0.001	10 ppm											
CO2, max vol %				2		2	3						1	2											
Max Inerts, vol %				3		3	6																		
Nitrogen, vol %													2												
Hydrogen, ppm																									
Dust, gums, solids				none		none	none						none	none											
Min heating value, Btu/scf				950		950	950						975	950											
Max heating value, Btu/scf						1150	1100						1050	1100											
Mercury																									

ATTACHMENT D

OEM Turbine Specification Comparison

OEM SPECIFICATION MATRIX

	OEM “A”	OEM “B”	OEM “C”	OEM”D”	OEM “E”
WOBBE RANGE	±5%	±2%	N/S	N/S	N/S
MAX WOBBE	1391	N/S	1420	1497	1497
MIN WOBBE	929	N/S	1130	1153	1109
WOBBE RATE	N/S	2%/min	0.5%/sec	N/S	N/S
MAX ETHANE	15	16	N/S	N/S	N/S
MAX PROPANE	15	2.5	10	N/S	N/S
MAX C4+	5	1	N/S	N/S	N/S
MAX LHV	N/S	N/S	1475	1200	1200
MIN LHV	300	770	645	800	900

WOBBE BASED ON REAL GAS PROPERTIES, HHV, SPECIFIC GRAVITY AT 60°F AND 14.73 PSIA

ATTACHMENT E

Table 1 Data Gaps -Combustion Applications

COMMON REQUIREMENTS END-USE EQUIPMENT	ADDITIONAL REQUIREMENTS/NOTES Appliances	Turbines & Micro-turbines & Power Boilers	Industrial & Commercial Burners	Stationary & Vehicle Engines
A. Review and Classification of Equipment • Types of equipment, burners. • List of manufacturers. • Rank by sensitivity to fuel composition. • Emissions issues and mitigation strategies.	• Review existing interchangeability project results. • Work with GAMA and others to identify new appliance types.	• All major types and manufacturers can be identified.	• Classify burners and combustion systems by types. • Must consider legacy, operating burners and new types under development.	• Survey of manufacturers and equipment models. • Review operations and emissions measurements and requirements.
B. Collection of Available Data • Previous US and international studies (GTI, TIAX, SoCalGas, etc). • Manufacturers' data on – Emissions, – Efficiency, – Service life, – Combustion changes, – Mitigation alternatives and costs. • Impacts of slow and rapid fuel gas changes. • Determination of major data gaps.	• Standardizing results of previous interchange-ability studies. • Identify common conclusions • Previous data for interchangeability parameters (Wobbe, Weaver, AGA Bulletin #36, etc), • CO production.	• Most data is proprietary and in the hands of manufacturers. • Collect published data and performance data from users.	• Data may not currently be available. • Performance data from different manufacturers is not on a consistent basis.	• Collect as much manufacturer data as possible. • Collect data from publications and users.
C. Determination of Testing Needs and Standardized Testing Protocols • Documentation of test methods. • Repeatability of testing. • Selection and measurement of all pertinent parameters. • Develop test gas strategies: – Define acceptability criteria (Btu, Wobbe, Methane Number, other), – Define range of acceptability, – Testing at limits of acceptability range, – Compositional issues (C_1, C_2, C_3, C_4, etc). • Specification of clocking and tuning strategies. • Fundamental combustion properties of natural gas mixtures	• Evaluation of current standards for appliance testing and emissions limits. • Long-term testing of sensitive appliances. • Statistical analysis may replace some testing.	• Testing and resulting data may be proprietary • Measurement methods must be established • Method development may be required. • ·C_4+ issues • Significance of Methane Number. • Fundamental property evaluation, combustion stability etc.	• Method development may be necessary. • Selected testing methods to be based on combustion practice and made public.	
D. Equipment Testing • Possible field and/or laboratory testing. • Examine interchangeability parameters under controlled conditions. • Fill data gaps.	• Statistically relevant group of appliances with a range of types and ages. • Statistical evaluation of appliance “mal-adjustment” over time.	• Test stand studies preferred whenever possible. • Testing with working power turbines, only if necessary.	• Representative examples of the most sensitive types of burners and combustion systems to be tested in the laboratory. • Most sensitive burners to be field tested.	• Test engines in lab setting. • Test existing and older engines in place.
E. Data Analysis and Expected Results • Identify relationships between performance and fuel composition, if these exist. • Establish/confirm applicable interchangeability parameters. • Predictive tools for effect of changing fuel composition on performance.	• Determine if limit gas testing is recommended to enhance equipment flexibility with varying fuel supply compositions.	• Recommended equipment. • Retrofits and additional long-term testing if required.	• Recommended equipment • Retrofits and additional long-term testing is required. • New types of indices may be developed.	• Recommended controls and equipment retrofits. • Additional long term testing if required.

Table 1 Data Gaps -Combustion Applications

COMMON REQUIREMENTS	ADDITIONAL REQUIREMENTS/NOTES			
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G. Collection of Available Data • Previous US and international studies (GTI, TIAX, SoCalGas, etc). • Manufacturers' data on – Emissions, – Efficiency, – Service life, – Combustion changes, – Mitigation alternatives and costs. • Impacts of slow and rapid fuel gas changes. • Determination of major data gaps.	• Standardizing results of previous interchange-ability studies. • Identify common conclusions • Previous data for interchangeability parameters (Wobbe, Weaver, AGA Bulletin #36, etc), • CO production.	• Most data is proprietary and in the hands of manufacturers. • Collect published data and performance data from users.	• Data may not currently be available. • Performance data from different manufacturers is not on a consistent basis.	• Collect as much manufacturer data as possible. • Collect data from publications and users.
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M. Collection of Available Data • Previous US and international studies (GTI, TIAX, SoCalGas, etc). • Manufacturers' data on – Emissions, – Efficiency, – Service life, – Combustion changes, – Mitigation alternatives and costs. • Impacts of slow and rapid fuel gas changes. • Determination of major data gaps.	• Standardizing results of previous interchange-ability studies. • Identify common conclusions • Previous data for interchangeability parameters (Wobbe, Weaver, AGA Bulletin #36, etc), • CO production.	• Most data is proprietary and in the hands of manufacturers. • Collect published data and performance data from users.	• Data may not currently be available. • Performance data from different manufacturers is not on a consistent basis.	• Collect as much manufacturer data as possible. • Collect data from publications and users.
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