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June 3, 2010

Mr. Floyd Vergara
California Air Resources Board
Stationary Source Division
1001 "I" Street
P.O. Box 2815
Sacramento, CA 95812

Re: Compressed Natural Gas (CNG) Motor Vehicle Fuel Specifications Public Meeting

Dear Mr. Vergara,

On May 19, 2010, the Air Resources Board (ARB) held a public meeting to discuss and to identify concerns with existing fuel specifications as well as to lay the groundwork for evaluating potential approaches for improvements. The South Coast Air Quality Management District (District) recognizes and appreciates ARB's important role in maintaining CNG specifications that support low-emission/clean fuel programs and regulations. However, we believe that the current expedited pace by ARB to amend the CNG specifications by the fall of 2010 has not fully taken into account the scope of the potential impacts associated with relaxing the current standards. In particular, we ask that the ARB consider that modifying current CNG specifications may promote the use of higher polluting liquefied natural gas (LNG) imports. The direct and indirect impacts associated with the use of LNG, to both stationary and mobile sources, needs to be evaluated pursuant to the California Environmental Quality Act (CEQA).

Historically, California has received the majority of its natural gas from sources throughout North America. However, since the development of Energia Costa Azul, an LNG terminal in Baja, California, a new supply of natural gas is being imported from countries such as Russia, Indonesia and Australia and introduced into our pipeline system. At its point of origin, this imported natural gas is condensed to 1/600 of its gaseous state, which allows for the efficient transport by tankers. The LNG is then brought to Energia Costa Azul, where it is re-gasified and then introduced into the pipeline.

Importantly, while this LNG meets current standards established by the California Public Utilities Commission (CPUC), it fails to meet ARB's current specifications for Motor Vehicle Fuel CNG, as codified in Title 13 of the California Code of Regulations § 2292.5. Specifically, the LNG does not meet the ARB's Motor Vehicle Fuel Regulations specifications for a minimum inerts level of 1.5% or the maximum ethane level of 6.0%. Thus, any changes by the ARB to the current specifications which would reduce the minimum permissible level of inerts or increase the permissible percentage of ethane will have the effect of increasing the reliance on LNG. This is a potentially significant impact that needs to be analyzed under CEQA.

Furthermore, if ARB changes the current specifications by adopting alternative performance-based standards for CNG, including the Wobbe Index (WI) or Methane Number (MN), ARB must evaluate the broader impacts of the adoption of such standards. The WI is a measure of the heat released by a combustion system. The level of inerts and ethane, or other higher level hydrocarbons, are important components of natural gas because they affect the heating value of the gas. The presence of inert compounds, such as carbon dioxide and nitrogen, in natural gas reduces its heating value. Conversely, the presence of ethane and other higher hydrocarbons increases the heating value of natural gas. Therefore, the selection of a WI standard necessarily affects the quantity of inerts and ethane that may be present in the natural gas. Similarly, the MN bears an inverse relationship to ethane and other higher level hydrocarbons. Thus, while the ARB does not currently have any specifications for WI or MN, any proposed changes that would measure performance based on WI or MN, must evaluate the relationship between those numbers and the heating value of natural gas.

Gas with a higher heating value has been associated with increased air quality impacts, namely emissions of NOx and VOC. Although the District notes SoCalGas' general support for revisions to ARB's Motor Vehicle Fuel Regulations, SoCalGas themselves sponsored a study which found that several types of residential and commercial/industrial equipment exhibited a correlation between a higher WI and NOx emissions. That study also found that burners designed to decrease NOx emissions demonstrated a higher sensitivity to WI changes. (*see*, Exhibit "A", Southern California Gas Company, "Gas Quality and Liquefied Natural Gas Research Study" (April 2005) pg. 21.) Significantly, another study by SoCalGas found that the use of LNG could increase the Basin's NOx emissions by 0.29 to 0.34 tons per day, or 124 tons per year[1]. (*see*, Exhibit "B", Southern California Gas Company "The Impact of Using LNG-Derived Natural Gas in the South Coast Air Basin," Presentation prepared by Environ (March 2007) pg. 10.) This is important because, as you know, the South Coast air basin has been designated as in "extreme non-attainment" and must reduce NOx emissions by 78% by the year 2023 to achieve federal standards. Regulating natural gas by mandating a performance based standard such as MN or WI has the corresponding effect of regulating the level of inert gases and ethane in natural gas. Accordingly, performance based standards are important factors in determining the NOx and VOC emissions associated with the use of natural gas. Currently, the

[1] The District is of the position that the actual emission impacts would likely be much higher for two reasons. First, the study by SoCalGas used a limited number and variety of equipment. Second, the equipment had recently been tuned to accommodate the gas specifications used in the test. Thus, the test did not account for the fact that a significant source of emissions are caused by the inability of the equipment to efficiently handle a wide of range of gas specifications.

ARB does not have any measurement for WI or MN so any changes to the currently allowed natural gas specifications which introduces a measurement of WI or MN, must consider its potential impacts to air quality.

Since compliance with the ARB's motor vehicle fuel regulations falls upon the producer, distributor, and retailer of CNG, the broader consequences of modifying the specifications needs to be considered and evaluated under CEQA. In other words, relaxing current standards and thereby allowing the use of LNG, could potentially affect stationary as well as mobile sources. Importantly, the majority of stationary sources in the Basin rely on natural gas, ranging from small residential water heaters to large industrial boilers. These types of equipment are generally not tuned to handle natural gas with wide ranging heating values such that the introduction of LNG will potentially cause increased air quality emissions. At minimum, various studies have shown an increase in NOx and other regulated emissions from heavy duty engines used in "Legacy Fleet" vehicles fueled by LNG derived CNG.

Emission increases from LNG derived CNG are counterproductive for attainment of ambient air quality standards. All proposed changes to the CNG specifications, including performance based standards, must address stationary and mobile source emission impacts and must adopt mitigation measures for all emission increases. For instance, introducing inerts such as nitrogen into LNG, is one way of mitigating some of the potential emission impacts from LNG-derived natural gas. For these reasons, we strongly recommend that any expected emission impacts from both stationary and mobile sources resulting from proposed changes to the CNG specifications be addressed through CEQA.

The District looks forward to working with you to provide ARB with information necessary to complete a more thorough research that will fully assess and quantify potential emission impacts resulting from proposed changes to the CNG specifications. For instance, the District has adopted Rule 433 to determine whether NOx emissions will increase through the use of gas with a higher WI. The first set of data is expected in September of 2010 and may be useful in determining the impacts associated with adopting a WI performance standard. Also, UC Irvine and Lawrence Berkeley National Laboratory have modeled scenarios to assess the impact of LNG use on air quality in the South Coast Air Basin. The modeling scenarios include geographic information about where the LNG is most likely to be used and changes in the emission inventory due to LNG use. These models also may be helpful as you consider the broader implications of changing the specifications for CNG.

In addition, we have the following additional comments and/or questions on ARB's presentation and the presentations given at the public meeting by SoCalGas/SDG&E and San Diego Air Pollution Control District (SDAPCD).

Comments And Questions Regarding ARB's May 19, 2010 Presentation

- Slide 20 – Potential LNG Imports Gas Quality Fuel Composition
  The ethane content of the LNG sources referenced in this slide appears to be lower than usual. Please specify what data source you used.

- Slide 27 – CNG Studies and Test Programs
  Notably, other important studies that are listed on SoCalGas' website were not included in presentation. Specifically, the SwRI study entitled "Fuel Composition Testing Using DDC Series 50G Natural Gas Engines"(August 2006) is conspicuously absent. This study tested two Detroit Diesel Series 50G engines, older TK and newer MK. In 2008, the older TK and newer MK engines comprised about 31% of all heavy duty natural gas vehicles, such as transit buses, in the SCAQMD. This study concluded that high Wobbe Index gas blends produced increased NOx emissions with both engines.

- Slide 29 – I. Heavy Duty CNG Vehicle Report (SoCalGas & SDG&E, 2008)
  We were not able to find this report on SoCalGas' website. The only report that we could find is titled, "Southern California Heavy-Duty CNG Vehicle Report" (SoCalGas/SDG&E, March 30, 2009). Please identify the source of this report.

- Slide 30 – I. HD CNG Vehicle Report - Results
  The graph depicted in this slide only maps the 2008 heavy-duty CNG engine fleet population and, therefore, is incomplete. Emission impacts would be better represented by showing actual CNG usage by fleet type.

- Slide 31 – I. HD CNG Vehicle Report - Results
  The graph depicted in this slide maps Detroit Diesel GK "Legacy Fleet" CNG engines. However, the graph does not include the TK or the MK models which have higher emission impacts due to varying natural gas blends.

- Slide 34 – II. Heavy-Duty Engine Study (SwRI)
  It is important to note that the Detroit Diesel MK engine, which is prone to higher emission impacts from varying natural gas blends, was not included in this study.

- Slide 36 – II. SwRI HD Study – NOx Results
  The results of these studies are not reported in a manner that illustrates the relationship between NOx emissions and the WI. Accordingly, this slide does not show that an increase in the WI correlates to an increase in NOx emissions.

- Slide 39 – II. SwRI HD Study – Results (cont.)
  The second bullet in this slide states that WI had an effect on regulated emissions. This would have been better illustrated with a NOx vs. WI graph.

- Slide 40 – II. ARB Staff's Observations
  The listed observations fail to mention the significant impacts to regulated emissions caused by changes in MN and WI.

- Slides 42, 43 & 44 – III. HD Statistical Analysis
  The maximum theoretical changes in NOx and NMHC under the "Existing Reg" column are based on the highest WI allowed by CPUC. This column should have been calculated based on the current system-wide average WI of approximately 1330-1340. This

comparison would have demonstrated a more representative emission impact as compared to the performance-based CNG regulation proposed by SoCalGas and SDG&E.

- Slide 46 – III. ARB Staff's Observations
  The listed observations do not mention the increase of NMHC and NOx emissions from present and fail to address how excess emissions will be mitigated.

- Slide 55 – V. Statistical Analysis of LD Vehicle Study – Results
  The findings state that the analysis found significant relationships between MN, WI, and vehicle emissions. This would have been better illustrated with a NOx vs. WI graph.

- Slide 56 – V. ARB Staff's Observations
  This slide fails to discuss the impacts of vehicle emissions on regulated emissions due to changes in MN and WI.

- Slide 59 – VI. CE-CERT HD and LD
  These test results should be highlighted at the next CNG Specifications public meeting.

- Slide 61 – 2008 CA Natural Gas Vehicle Population
  The excess emission potential would be better represented by a slide showing actual CNG usage by vehicle type.

- Slide 62 – Legacy CNG Engines in Operation
  The graph on slide 31 is not consistent with this slide.

- Slides 66 and 74 – Possible/Best Approaches
  When assessing possible approaches, the ARB must address associated expected emission impacts from both stationary and mobile sources through the CEQA process. This analysis must include the identification of mitigation measures.

- Slide 78 – Schedule
  Setting a fall 2010 Board Hearing date is premature. The regulation amendment process must address the expected emission impacts from both stationary and mobile sources resulting from proposed changes to the CNG specifications. CEQA requires that the ARB fully analyze the environmental impacts of the rule changes and identify appropriate mitigation measures. To date, the ARB has not given any indication that it has commenced any assessment of environmental impacts.

Comments Regarding SoCalGas/SDG&E May 19, 2010 Presentation Entitled "Proposal to Revise the CARB Motor Vehicle Fuel Regulations"

We do not agree with the claim in Slide 9 that there will be no impacts on stationary sources as a result of changes to the CNG specifications. Any revisions to the specifications that would have the effect of allowing the use of LNG will change the gas quality for stationary sources because, as explained in Slide 3, compliance with CARB Motor Vehicle Fuel Regulations falls upon the producer, the distributor, and the retailer of CNG. As a result, any changes will have wide-ranging emission impacts and so an assessment of impacts is warranted.

SoCalGas and SDG&E have requested that ARB issue an exemption for inert content. The recent limited data that was provided to SDAPCD by SoCalGas and SDG&E demonstrates that the inert content on the coastal line has been only slightly less than the 1.5% standard in February, March, and April of 2008 (1.370% appears to be the minimum). Given the fact that the coastal line only supplies about 5% of the gas to San Diego County (in a small area along the northern coast) and that the remainder of the county did not appear to have a problem, this data only supports an exemption that is narrow in scope, if any at all. Therefore, if an exemption were to be granted, it would have to be limited to the coastal line and not apply to the remaining SoCalGas and SDG&E territories. Furthermore, any such exemption should only go so far as to allow an inert level of no less than 1.25% because the data does not support the need for a lower inert requirement.

With respect to potential noncompliance of LNG-derived natural gas, SCG's parent company Sempra has an operational nitrogen (N_2) injection facility as part of the Energia Costa Azul LNG facility in Baja California that can provide an inert content of 1.5% in the LNG-derived natural gas they send out from their facility. Based on information from Sempra, the N_2 injection facility could provide a 1.5% N_2 level for 800 MMscf of LNG-derived natural gas--even without using any of the 50% reserve nitrogen capacity available. At the current time, only half of the facility that Sempra controls is operating, and has a nominal maximum LNG-derived gas send-out rate of 500 MMscf/day. Therefore, the facility could provide a 1.5% inert content for N_2 without relying on the reserves. As is commonly done at other LNG gasification facilities, introducing inerts, such as N_2 is one way of mitigating some of the adverse emission impacts from LNG-derived natural gas.

With the Energia Costa Azul LNG facility, Sempra now has the ability to indirectly change the inert content of the general gas supply. LNG-derived natural gas began entering the San Diego system as well as the SCAQMD, through Blythe in 2010[2] and possibly earlier (it appears to be about 10%+ of the total flow in March). The introduction of this LNG-derived natural gas will artificially depress the inert content of the general gas supply unless Sempra injects nitrogen to mitigate the impacts.

[2] Note that the LNG-derived flows prior to 2010 do not appear to be significant (except for the 3-5 day shakedown period in San Diego in May, 2008). This archived data can be viewed at the following SCG web site: https://envoyproj.sempra.com/#nav=/Public/ViewExternalDailyOperations.getDailyOperation%3Frand%3D104

Comments Regarding SDAPCD's May 19, 2010 Presentation Entitled "Impacts of Potential Revisions to CNG Fuel Standard"

This presentation by SDAPCD provided helpful background information about the potential implications of a revision to the CNG Specifications and also highlighted the following concerns of the District:

- The potential emission impacts from LNG use. All emission impacts must be addressed, including: (1) gas distribution emissions; (2) stationary source emissions; (3) vehicle emissions.
- Emission impacts must be accurately estimated.
- Impacts from changing the specifications for CNG must be adequately mitigated.
- Possible safety issues, if any, stemming from LNG use needs to be considered.

Should you have any questions, please feel free to contact me at your earliest convenience.

Sincerely,

SOUTH COAST AIR QUALITY
MANGEMENT DISTRICT

Alfonso Baez, Senior Air Quality Engineer
Veera Tyagi, Deputy District Counsel II
Lauren Nevitt, Deputy District Counsel I

By: ______________________________
Alfonso Baez, Senior Air Quality Engineer

cc: Aubrey Sideco, CARB
Stephen d'Esterhazy, CARB

EXHIBIT A

Southern California Gas Company

A Sempra Energy utility

Final Report

Gas Quality

and

Liquefied Natural Gas Research Study

April 2005

Southern California Gas Company

PO Box 513249 SC723B

Los Angeles, CA 90051

DISCLAIMER

Testing protocols used in this study were derived from industry standards and regulatory test procedures. Note, however, that based on the needs of this program and the operating and design characteristics of equipment tested, adherence to the industry and regulatory testing standards was not literal. The reader is cautioned that no inference can nor should be drawn as regards certification of these devices to the industry standards or regulatory requirements as a result of this program.

Southern California Gas Company (SCG)

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ACKNOWLEDGEMENTS

The Southern California Gas Company expresses appreciation to the Air Emission Advisory Committee (AEAC)[1], Gas Appliance Manufacturers' Association (GAMA) and numerous gas equipment manufacturers, Natural Gas Council + Task Group on Interchangeability and industry experts who made significant contributions to the success of this study and to the extension of knowledge, related to Natural Gas-fired equipment performance and emissions.

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[1] See Appendix E for Committee Members

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EXECUTIVE SUMMARY

This research study was designed to assess how residential and small commercial end-use equipment responded to changes in gas quality and to determine if Southern California Gas Company (SCG) needs to modify its current Gas Quality Standards (Rule 30). Furthermore, this assessment is important in light of changing natural gas supplies, both domestic and LNG, newer advanced combustion technologies and certification/testing procedures based on historic gas quality. While the potential exists for gas-fired equipment to exhibit varied performance characteristics when supplied natural gas fuel that varies in composition, this study focused on safety and performance of selected commercial and residential natural gas-fired appliances. The major objectives of the study were as follows:

1. Evaluate each selected unit to determine whether any issues exist relating to equipment safety and performance. Equipment safety includes changes in Carbon Monoxide (CO) levels, combustion stability and Lifting, Flashback, and Yellow Tipping.

2. Compare measured and observed results against the major natural gas Interchangeability Indices, including Wobbe Number, Lifting, Flashback, Yellow Tipping and Incomplete Combustion.

3. Collect NOx emission data during testing.

Thirteen different gas-fired appliances were tested in a formal test program that assessed the response of the devices to a range of natural gas compositions and characteristics. The gas compositions represented heating value and Wobbe Number boundaries of the current SCG Gas Quality Standards (Rule 30).

This study concludes and recommends that SCG needs to incorporate results of this study, national efforts on gas quality and other resources to develop an "Interim Range of Acceptability" encompassing on quality/composition for various end-use category. Other recommendations and findings are:

- Update Gas Quality Standards and Rule 30.
- Include interim Wobbe Number range from 1290 minimum to 1400 maximum.
- The test results were less clear on the need to adjust the 1150 Btu/scf High Heating Value (HHV) maximum limit.
- Neither HHV nor Wobbe Number is an absolute predictor of equipment performance.

- The Range of Acceptability concept may need to replace the current approach which utilizes AGA Interchangeability Indices: Lifting Index, Flashback Index, and Yellow Tip Index. These indices have performed well for appliances and equipment designed and installed up to the 1990's but may not be accurate for newer, more efficient, and less polluting equipment.
- Additional metrics need to be added for better predictions, such as Methane Number which is currently utilized by engine manufacturers for Internal Combustion (I.C.) Engine performance. Turbines or feedstock applications may also require metrics or compositional limits other than the AGA Interchangeability Indices.
- Establish longer term goals for a wide "Range of Acceptability" based on national standards.

Long term, SCG will work with industry, manufacturers and government on the development and implementation of national gas quality standards that allow for the broadest range of gas compositions without significant impact on utilization equipment. Further recommendations include:

- Develop a target "Range of Acceptability", provide a transition period and encourage equipment manufacturers to produce equipment that operates safely over the entire range.
- Simplify testing standards and protocols. Single standard testing/protocols should be adopted for certification, performance, safety and emission testing.
- Continue to work to promote testing of large equipment by manufacturers, possibly with DOE sponsorship.
- Continue to work with manufacturers and agencies on development of testing protocols and test gas specifications.
- Determine if adjustment gas or gases could be used during equipment set-up to allow for the widest range of acceptable gas composition. This determination should be based on sound statistical methodologies.

INTRODUCTION

During this study, laboratory tests on a variety of Natural Gas-fired residential and commercial equipment were conducted to evaluate safety and performance and to gather emissions data. The evaluation focused on how equipment operating characteristics changed as a function of changes in natural gas composition.

Different gas compositions, which represented a range of potential gas compositions that could enter the Southern California Gas Company (SCG) distribution system from Liquefied Natural Gas (LNG) supplies, California-produced gas, traditional out-of-state gas supplies or supplies from non-traditional sources, were used in the study. Specific study objectives were to assess SCG's current Gas Quality Standards (Rule 30) to ensure they will continue to provide customer safety and equipment performance as it relates to:

1) Higher heat content and higher Wobbe Number natural gas supplies that may enter SCG's system;

2) Transient and steady state equipment performance changes through the range of gas compositions;

3) New and emerging end-use combustion technologies; and

4) The relationship between changing gas compositions and combustion performance.

SCG and the gas industry have identified a need to examine the effects of changing Natural Gas composition for each type of end use equipment and combustion technology in the residential, commercial and industrial service categories. End use equipment that needs to be assessed includes residential appliances, small and large Commercial/Industrial equipment, reciprocating engines, turbines and non-combustion applications. Within each end use equipment category there are older combustion technologies, current technologies still being installed and newer emerging combustion technologies. This study focused on end use equipment representing residential appliances and small commercial equipment.

Equipment tests were conducted at Bourns College of Engineering-Center for Environmental Research and Technology (CE-CERT), located at the University of California, Riverside, at the SCG's Engineering Analysis Center, located in Pico

Rivera, California, and at several manufacturer locations.

An Air Emissions Advisory Committee (AEAC) was established by SCG to review, advise and provide oversight in the air emissions element of the study. The AEAC was composed of technical representatives from interested regulatory agencies and LNG terminal proponents. (See Appendix E)

BACKGROUND

SCG and San Diego Gas & Electric Company (SDG&E) provide gas distribution services to approximately six million customers in southern California. The largest portion of this area's current gas supply that reaches our customers originates from the Rocky Mountains, the Permian Basin, and the San Juan Basin. A smaller portion is produced within California.

While supplies have traditionally been adequate to meet demand, a nationwide natural gas supply imbalance is developing, as new gas reserves are not being discovered and developed at a rate matching the overall increase in demand. The rapid growth in natural gas demand and a slowdown in developing new North American gas supplies have led to increased gas commodity prices. At current and projected natural gas prices, importation of natural gas, shipped as LNG, has become an economically viable option. The US Department of Energy's (DOE) "Energy Outlook 2003" projects a ten-fold increase in LNG imports from 2001 to 2025. Five west coast LNG supply projects are in various stages of development. At this time, we cannot predict which projects will initiate operation. However, we believe that LNG will provide a substantial portion of future California natural gas supplies and will access end users through new receipt points close to load centers.

Supplies of LNG for the SCG system would originate primarily from Pacific Rim countries, such as Indonesia, Russia, and Australia. The respective chemical compositions and heating values of LNG supplies from these sources differ from natural gas supplied to southern California from out-of-state domestic sources as some ethane, propane and butanes have been removed from out-of-state domestic natural gas prior to shipment via interstate pipelines. Furthermore, gas components such as CO_2, N_2, and O_2 and heavier hydrocarbon components ($>C_4$), which are common in domestic natural gas supplies, are virtually nonexistent in LNG. California-produced gas can exhibit concentrations of higher ethane and propane similar to LNG.

Completion of just one proposed LNG terminal on the West Coast could deliver from 500MMscf to a 1Bscf of natural gas into the SCG and SDG&E gas distribution systems each day, replacing gas from sources currently supplying this region. Multiple terminals could deliver much more. Thus, significant numbers of SCG and SDG&E customers' utilization equipment could experience a change in gas composition from out-of-state domestic natural gas to gas supplies from LNG. Furthermore, given the operating characteristics of the SCG/SDG&E transmission and distribution systems and customer usage patterns, many customers may be subject to "swings" in gas composition from traditional interstate supplies to new supplies or vice versa in relatively short timeframes.

SCG has actively tested appliances and small industrial/commercial equipment to monitor equipment performance over broad ranges of gas composition. Extensive testing in the laboratory and field in the mid 90's led to the establishment of an upper Btu limit for SCG's Gas Quality Standards (Rule 30). During those tests, it was noted that for a few tested appliances test results were not consistent with the interchangeability indices calculations. Subsequent testing over the next several years confirmed that some newer end-use combustion technologies, such as premix/powered combustion, yielded results that were not predictable within the conventional interchangeability indices calculations. These combustion systems, although resulting in better efficiencies and lower NOx, seem to be more sensitive to changes in gas quality and rate of change in gas quality.

SCOPE

This research study was designed to assess current Gas Quality Standards (Rule 30) and the potential need to modify these standards based on safety and performance of selected, representative commercial and residential natural gas-fired appliances.

The major objectives of the study were as follows:

1. Evaluate each selected unit to determine any issues relating to equipment safety and performance. Equipment safety includes changes in Carbon Monoxide (CO) levels, combustion stability, lifting, flashback, and yellow tipping.
2. Compare measured and observed results against the major natural gas interchangeability indices, including Wobbe Number, Lifting, Flashback, Yellow Tipping and incomplete combustion.
3. Collect NOx emission data during testing.

Based upon earlier studies, a list of potentially sensitive equipment was drafted as a starting point. This list and a detailed questionnaire were provided to industry experts for review and comments. Manufacturer associations and more than 40 companies representing residential equipment manufacturers, burner manufacturers, boiler manufacturers and food service equipment manufacturers were contacted. Several industry consultants were retained to provide advice and SCG received valuable advice from these various external sources on the list of candidate equipment types to be tested. Further input and guidance was provided through internal SCG surveys, meetings and discussions with SCG industrial service technicians, research managers and highly experienced industrial/customer service training instructors.

Combustion systems and equipment were categorized as residential, commercial or industrial equipment. In order to maximize the number of different combustion systems and equipment types to be tested, equipment represented in more than one equipment type category would only be tested in one of the categories.

Once the list of equipment to be tested was finalized (Table 1), significant assistance was provided by SCG field service personnel, the AEAC and industry participants by providing access to test equipment on a loan basis. SCG also purchased equipment either new from retailed outlets, or salvaged from homes. Brand name and model number anonymity have been maintained to encourage full participation of all.

The study approach was to test the selected natural gas-fired equipment at gas composition boundary conditions within the existing Gas Quality Standards (Rule 30) limits. Equipment selection and prioritization was based on surveys of SCG employees (Field Service and Applied Technology), input from equipment manufacturers, analysis of other technical studies and input from industry experts and the Air Emissions Advisory Committee. Equipment selection was reviewed against and guided by specific criteria:

1. Critical time-controlled processes with limited or no temperature control
2. Narrow air/fuel ratio operating band
3. Performance/safety possibly dependent on flame characteristics
4. Safety concerns related to flue gases
5. Existence of sophisticated heat exchanger/combustion system
6. Historical combustion system related safety concerns
7. High population density in southern California
8. Recommendations from credible industry experts
9. Information from background and industry research
10. Technology entering southern California marketplace

Table 1 below shows the equipment selected and tested during this study. In addition to the Service Type Categories, Burner Type, and Size, it also shows the selection criteria that were identified for each device.

Table 1 - List of Equipment Tested

Unit	Description	Service Categories	Burner Type	Rated Input (BTU/hr)	Selection Criteria[2]
1	Horizontal Condensing Forced Air Furnace	Residential	Low NOX, induced combustion system with in shot burners firing into a tube-type heat exchanger	105,000	3,4,5,8,9,10
2	Flammable Vapor Ignition Resistant Water Heater	Residential	Atmospheric (with limited air)	36,000	3,4,8,9,10
3	Instantaneous Water Heater	Residential	Low NOX	117,000	2,3,4,5,8,10
4	Legacy Water Heater	Residential	Atmospheric	32,000	3,4,7
5	Legacy Floor Furnace	Residential	Atmospheric	32,000	3,4,6,7,8
6	Gravity Built-in Wall Furnace	Residential	Atmospheric	35,000	3,4,6,7,8
7	Pool Heater	Residential	Low NOX	250,000	2,3,5,10
8	Condensing Hot Water Boiler	Commercial	Low NOX	199,000	3,4,5,8,10
9	Hot Water Boiler	Commercial/ Industrial	Low NOX	500,000	3,4,5,7,8
10	Steam Boiler	Commercial/ Industrial	Low NOX	300,000	3,4,5,7,8
11	Steam Boiler	Commercial/ Industrial	Ultra Low NOX	660,000	3,4,5,7,8,10
12	Deep Fat Fryer	Commercial	Powered, surface-type	86,000	3,4,5,7,8
13	Chain-Driven Char Broiler	Commercial	Radiant tile operating in blue-flame mode	96,000/ 75,000	1,3,5,7,8

[2] The selection criteria were updated on the basis of the final equipment selected and additional information from manufacturers or industry experts.

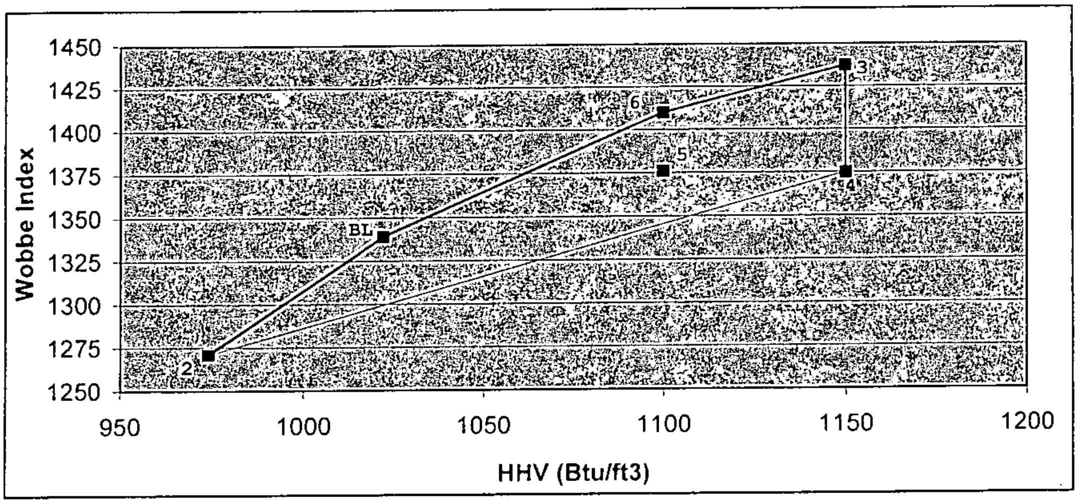
For the purposes of this study, operational safety is defined primarily by CO concentration in the flue gas. Other parameters, such as lifting, flashback, yellow tipping, etc., are taken into account in the overall safety evaluation, but the main parameter is CO. The CO concentration used as this safety indicator is 400 ppmv air-free, although we recognize that some appliances have different levels of acceptable safety performance related to CO and combustion stability. Also, certification/acceptance is with a specific test gas composition at STP (Standard Temperature and Pressure) which may not be applicable to other natural gas compositions. However, as noted, this study used 400 ppmv air-free as the basis for safety performance with all test gases as a reference to "safe" performance.

Test gas compositions selected for this study were based on current SCG Gas Quality Standards (Rule 30) and the potential HHV and Wobbe Number of acceptable future natural gas supplies. The approach used in selecting these "test gases" was to develop compositions that reflected HHV and Wobbe at boundary conditions within the current SCG Gas Quality Standard utilizing minimum and maximum components within the current standard. Intermediate gas compositions were utilized to further test equipment that exhibited sensitivities at the boundary condition in order to determine upper operating ranges for safety and performance and to provide input on HHV and Wobbe Number impacts. In some cases the selected compositions reflect actual gas compositions that may be present currently in the SCG system. However, they were not specific to compositions in either existing supplies or known LNG gas supplies. The test gas matrix was developed in a multi-tier system: primary and secondary. Primary gas blends are:

- Baseline gas (BL) corresponding to the average gas quality in the SCG system. 1020 Btu HHV and 1330 Wobbe Number.
- Low Btu/Low Wobbe Number (Gas 2) - The lowest combination of higher heating value and Wobbe Number within current Gas Quality Standards (Rule 30). 970 Btu HHV and 1271 Wobbe Number.
- High Btu/High Wobbe (Gas 3) - The highest possible combination of HHV and Wobbe Number that complies with current Gas Quality Standards (Rule 30). 1150 Btu HHV and 1437 Wobbe Number.
- High Btu/Low Wobbe Number (Gas 4) - This is the lowest Wobbe Number for the highest heating value in the Gas Quality Standards (Rule 30). 1150 Btu HHV and 1375 Wobbe Number.

Secondary blends were selected to test any sensitivity observed while testing the Primary gas blends. These were blended by holding the Wobbe Number constant at 1375 (Gas 4) and lowering the HHV to 1100 Btu HHV (Gas 5). The other secondary gas blend held the 1100 Btu HHV and raised the Wobbe Number to 1400 (Gas 6).

FIGURE 1 - GAS COMPOSITION MATRIX



In order to ensure commonality between all tests, gas compositions were either blended with a mass-flow mixing system or supplied from pre-mixed bottled gases. Then, for each equipment test the respective test gases were supplied in a specified order. The units were first run on Baseline gas and then Gas 2 and Gas 3 in succession. If any sensitivities were observed, the remaining Gases 4 - 6 were tested, as necessary. Not only were changes in gas components noted for the various test gases, but the rate of change from one to the other was also observed. Gases 4a and 5a were subsets used to see if there was any influence resulting from the number of hydrocarbons used to prepare the mixtures (e.g., mixture of high heating value and Wobbe that contained a mixture of only three hydrocarbons -methane, ethane, and propane or five hydrocarbons - methane, ethane, propane, butanes, C5+).

Note that there were limitations in the mass-flow gas blending system used in this study, which precluded the use of Gases 6a, 7a and 7b. These gases had been identified in the original test design and were listed in the "White Paper" (Appendix D).

The specific test gas compositions used in this study are presented in Table 2. Table 3 presents the Gas Indices for each of the test gases.

Table 2 - Gas Composition[3]

Primary	METHANE	ETHANE	PROPANE	iso-BUTANE	n-BUTANE	iso-PENTANE	n-PENTANE	C6 plus	CARBON DIOXIDE	NITROGEN	MN	Wobbe#	HHV
1 Baseline, Line.Gas	96.08	1.78	0.37	0.06	0.06	0.01		0.03	1.18	0.44	100	1338.9	1022
2 970 Btu Gas	96.00								3.00	1.00	108	1271	974
or 1000 Btu Gas	97.00	0.75	0.10						2.00	0.15	106	1315	1000
3 1150 Btu Gas, Hi Wobbe	87.03	9.23	2.76	0.99					0.00	0.00	75	1437	1150
4 1150 Btu Gas, Lo Wobbe	84.92	4.79	2.40	1.20	1.20	0.60	0.60	0.30	3.00	1.00	68	1375	1150
(w/Nitrogen)	84.92	4.79	2.40	1.20	1.20	0.60	0.60	0.30	0.00	4.00	68	1392	1150
4a or 4 component mix	84.45		11.55						3.00	1.00	68	1375	1150
Secondary													
If fails test gas 4													
5 1100 Btu Gas, Avg. Wobbe	88.88	5.28	2.61	0.34	0.50	0.11	0.06	0.06	1.40	0.75	79	1376	1100
5a or 4 component mix	90.85		7.00						1.40	0.75	79	1376	1099
6	91.83	5.81	1.74	0.31	0.31						84	1410	1100

[3] The study allowed for a +/- 1% in both heating value and Wobbe and individual components were targets not absolutes to reach the Btu / Wobbe numbers. Actual Btu and Wobbe Numbers are identified in individual reports.

Table 3 - Test Gas Indices

Test Gas	Base	2	3	4	5	6	Limits
Heating Value (Btu/cf)	1020	970	1150	1150	1100	1100	970 to 1150
Wobbe Number	1332	1270	1437	1375	1376	1400	5%
AGA Indexes							
Lifting	1	1.06	0.92	0.98	0.97	0.935	<= 1.06
Flashback	1.01	1.01	1.03	1.03	1.02	1.018	<= 1.2
Yellow Tipping	1	1.10	0.81	0.80	0.88	0.857	>= 0.8
Weaver Indexes							
Flashback	0	0.044	-0.065	-0.022	-0.024	-0.055	<= 0.26
Yellow tipping	0	-0.076	0.209	0.207	0.128	0.141	<= 0.3
Incomplete Combustion	0	-0.053	0.099	0.060	0.049	0.074	<= 0.05
Lifting	1	0.933	1.124	1.050	1.052	1.091	>= 0.64
Heat Rate	1	0.953	1.077	1.029	1.031	1.060	0.95 to 1.05
Primary Air Ratio	1	0.953	1.077	1.030	1.031	1.060	0.80 to 1.20

Historical Gas Interchangeability Indices, identified in Table 3, were developed for atmospheric type burners from data gathered from testing residential appliances and a specially developed AGA test burner[4]. The indices indicated that several of the test gases were not interchangeable with the Baseline gas as indicated by the highlighted numbers. Some equipment tested in this study would have been expected to demonstrate performance problems or sensitivity with Gases 3, 4 and 6. However, test results showed sensitivity only with Gas 3.

These indices do not apply to the engines, turbines, and feedstock equipment categories. Other indices or gas composition requirements are utilized for safety and performance, such as Methane Number for engines.

[4] AGA Bulletin 36

STANDARDS AND PROTOCOLS

Testing protocols used in this study were derived from industry standards and regulatory test procedures. However, based on the needs of this program and the operating and design characteristics of equipment tested, it should be noted that adherence to the industry and regulatory testing standards was not literal. The reader is cautioned that no inference can nor should be drawn with regard to certification of these devices to the industry or regulatory requirements as a result of this program.

Prior to testing each piece of equipment, a detailed test protocol was developed by SCG, CE-CERT and industry experts/consultants, who were either members of the AEAC or separately contacted to provide input and guidance. The approach used in developing the test protocols for each appliance type was largely to combine and simplify testing standards.

Deviations from the standards were included when specific sections were believed to be superfluous or inappropriate to specific appliances or operating/installation realities. While standard industry or regulatory certification test standards provide consistent test methodologies and a basis for comparing test results, they are not always valid for observing the operation of natural gas-fired equipment installed at an end user's location. For instance, many of the standards define that a specific ambient temperature range be maintained at the test site. While this is appropriate for ensuring comparable results between test units, it does not address equipment performance at ambient conditions encountered in the field. Thus, professional experience and engineering judgment were required to develop the appropriate tests for each unit tested.

As a final quality assurance control measure, all protocols were thoroughly reviewed by SCG, CE-CERT and industry experts prior to testing.

Various standards from the following organizations were used as inputs or as the basis for the test protocols used in this study:

- ANSI - American National Standards Institute.
- AOAC - Association of Official Analytical Chemists.
- ASHRAE - American Society of Heating, Refrigeration and Air Conditioning Engineers.
- ASTM - American Society of Testing and Materials.

- SCAQMD - South Coast Air Quality Management District.
- UL - Underwriters Laboratories.
- Manufacturer Test Guidelines

GENERAL TEST PROCEDURE

The testing of each natural gas-fired appliance was conducted according to the individual equipment-specific individual test protocols. Test objectives were to determine safety and performance, and to gather emissions data as a function of fuel composition. These objectives were met through a series of tests conducted at steady state and transient (sudden gas changing) conditions.

The general protocol incorporated in each equipment-specific test protocol is described below. Detailed test protocols for each piece of equipment can be found in the individual reports in Appendices A, B and C.

1. The end-user equipment was installed and set-up according to the appropriate test standard(s) and/or manufacturers' specifications.

2. Appliance testing at "as received" conditions was performed with Baseline Gas and/or Baseline and Primary Gases. Data were monitored and collected for each gas tested. These data included CO, CO_2, O_2 and NO_x emissions, flame lifting, flashback, yellow tipping, temperature fluctuations, smooth ignition and production output and quality.

3. After testing at "as received" conditions, the gas input rate was adjusted to "rated input" conditions, if necessary. Then, appliances were tested at "rated input" conditions with Baseline Gas. High speed switching was used as test gases were changed. Data were monitored and collected for each gas tested. These data included CO, CO_2, O_2 and NO_x emissions, flame lifting, flashback, yellow tipping, temperature fluctuations, smooth ignition and production output and quality.

4. After testing at "rated input" conditions, additional tests, as required by the equipment-specific test protocol, were performed (i.e., over -fire and under-fire testing with Baseline Gas and/or Baseline and Primary Gases). Data were monitored and collected for each gas tested. These data included CO, CO_2, O_2 and NO_x emissions, flame lifting, flashback, yellow tipping, temperature fluctuations, smooth ignition and production output and quality.

5. Hot and/or cold ignition tests with Baseline and Secondary Gases at rated input, under fired or over-fired conditions were performed. During this time, visual observation of the flame, ignition delays and other observed phenomena were documented.

SUMMARY OF FINDINGS

The research study was designed to assess current Gas Quality Standards (Rule 30) and the potential need to modify these standards due to changing gas supplies and newer advanced combustion technologies. The following findings were identified relative to the stated objectives identified in the Scope section of this document. The numbering scheme is for reference only and does not indicate level of importance.

Objective 1 - Safety and Performance

1. There were no performance issues observed in the equipment tested that might have resulted from rapid changes in gas composition through the range of test gases.

2. All equipment tested operated safely within the context of this study and performed satisfactorily when set up to Baseline gas (BL) and operated with 970 HHV/ 1270 Wobbe Number (Gas 2), 1150 HHV / 1375 Wobbe Number (Gas 4), 1100 HHV / 1375 Wobbe Number (Gas 5) and 1100 HHV / 1400 Wobbe Number (Gas 6).

3. Most of the equipment operated satisfactorily on the 1150 HHV/ 1437 Wobbe Number (Gas 3), however, safety problems were encountered on some equipment.

    - The gravity built-in wall furnace showed significant CO emission level sensitivity to the High HHV / High Wobbe Number. However, the other legacy (used) residential indoor appliances tested were quite forgiving with respect to gas composition changes.

    - The deep fat fryer produced elevated CO levels when operating with the highest HHV and Wobbe Number gas. However, it maintained consistent food quality over all test conditions.

4. The CO levels for two other units, condensing boiler and pool heater, neared the Critical Point with 1150 HHV / 1437 Wobbe Number (Gas 3). (For purposes of this study the Critical Point is assessed as a change in CO concentration of 75 ppmv between baseline gas and other gas mixtures.) (See Figure 2).

5. The temperature changes for all units, except the deep fat fryer, increased when burning gases with higher HHV and higher Wobbe Number than baseline gas. This exception is believed to be the result of incomplete combustion due to limited air supply. (The actual combustion or flame temperatures could not be measured on all of the test units. For these units, either the stack temperature or heat exchanger temperature was used as the temperature change.) (See Figure 3).

6. The chain driven charbroiler (time-based cooking) exhibited several product quality problems. When the equipment was tuned to the high HHV/high Wobbe Gas (Gas 3) and switched to baseline gas, the meat sometimes came out undercooked. When tuned to baseline gas and switched to high HHV/high Wobbe Number gas, meat patties were sometimes overcooked.

7. Overall, neither HHV value nor Wobbe Number of the gas consistently correlated with equipment performance.

Objective 2- Interchangeability Indices

1. Interchangeability Indices in Table 3 indicated a potential for problems with three of the gas blends. However, with the exception of the 1150 HHV/ 1437 Wobbe Gas (Gas 3), when combusted in the gravity built-in wall furnace and the deep fat fryer the historic gas interchangeability analysis techniques did not always provide a means for predicting the acceptability of a fuel composition for the equipment tested.

Objective 3 - Emissions Data

1. HHV and Wobbe Number generally showed positive correlation with NOx emissions with Wobbe Number having the higher correlation.

2. All Low-NOx units showed higher NOx emission levels with the higher HHV / higher Wobbe Number gases, except for the horizontal condensing forced air unit. (See Figure 4).

3. Several of the units tested exhibited more NOx sensitivities with a greater number of hydrocarbon species in a given HHV / Wobbe Number gas.

4. Of the boilers tested in this study, one, the ultra Low-NOx boiler (the

newest technology and meeting one of the tightest emissions standards) showed little NOx emissions sensitivity over the range of gases. This unit also showed the least CO sensitivity.

5. Indoor residential appliances tested did not exhibit significant NOx sensitivities to gas composition changes. Some appliances showed small increases and others showed small decreases in NOx emissions concentration between study gas blends.

6. Low NOx pool heater showed NOx emissions sensitivity to changes in gas composition.

Other Key Findings

1. During this study, it was apparent from contacts with manufacturers and industry experts that there is a general lack of awareness regarding the wide range of gas compositions and characteristics distributed within SCG's territory and throughout the nation.

2. The "as-received" fuel input rates for several of the new, residential units tested in this study were at less than 90% of the nameplate rating values.

3. Initial testing of the instantaneous hot water heater indicated elevated CO levels when supplied with all study gases. During subsequent testing, it was discovered that the burner was extremely sensitive to slight gas supply pressure pulsations caused by an upstream regulator. The unit was retested with a different regulator and this test sequence did not indicate elevated CO levels.

Note: The individual equipment test reports are contained in Appendices A, B and C. The test reports contain detailed test results for each equipment unit tested at CE-CERT laboratory in Riverside, California and at the SCG Engineering Analysis Center in Pico Rivera, California.

Figure 2 - Changes in CO Emissions Relative to Baseline Gas

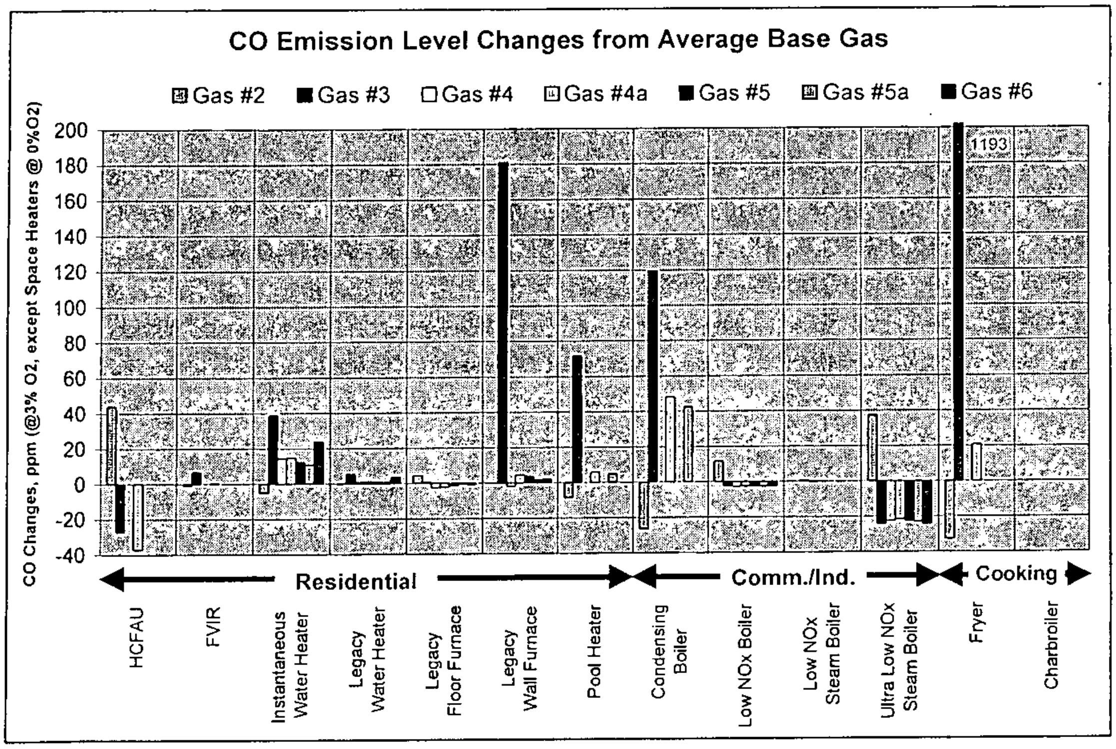
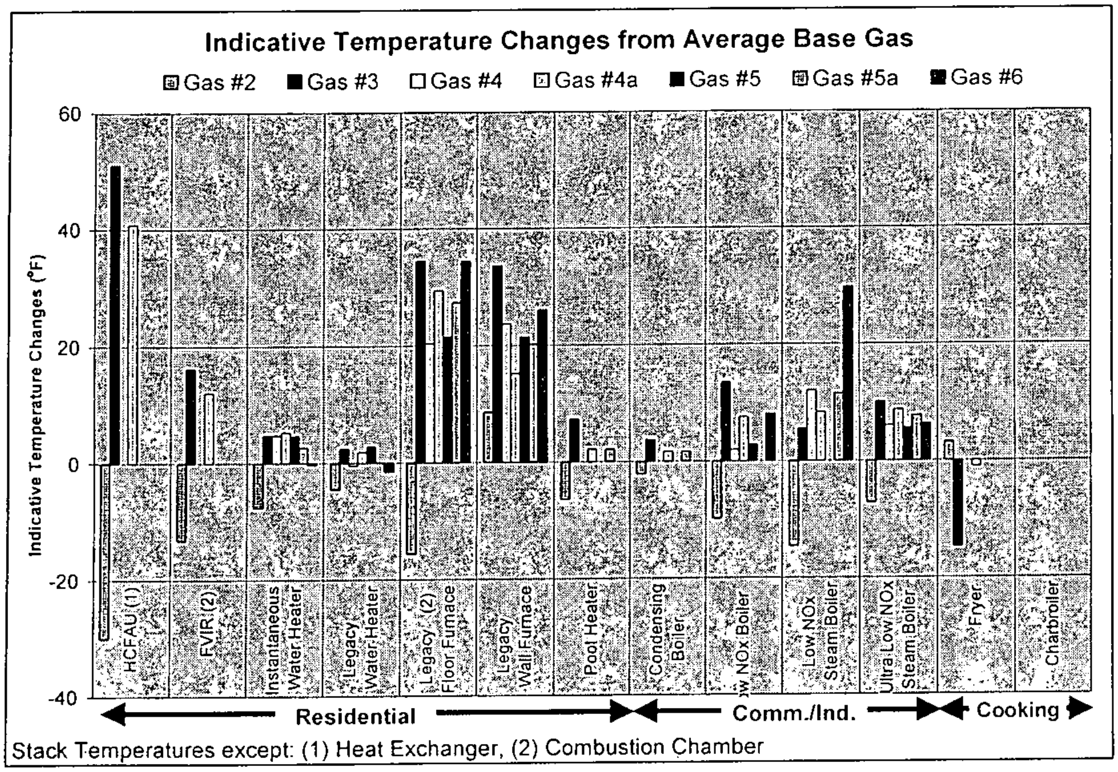
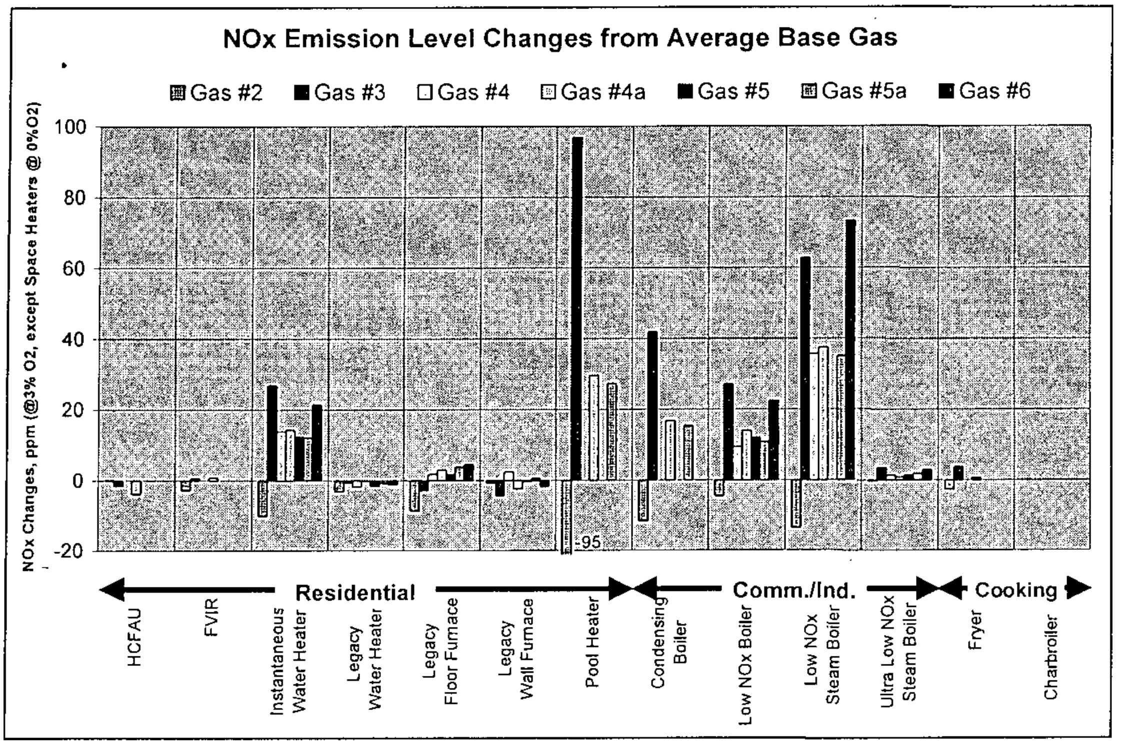


Figure 3 - Changes in Indicative Temperatures Relative to Baseline Gas



Stack Temperatures except: (1) Heat Exchanger, (2) Combustion Chamber

Figure 4 - Changes in NOx Emissions Relative to Baseline Gas



CONCLUSIONS

The following conclusions are based on data gathered during tests of the individual pieces of equipment. Global generalizations should not be extrapolated without more statistically based results, since other end-use equipment may have different parameters.

1. SCG Gas Quality Standard has an allowable range of 970 - 1150 HVV and allows for the Wobbe Number to be within +/- 10% of the typical composition of gas within the system. Theoretically, within the current Standard the Wobbe Number Limit could reach 1437 +. Based on the results of this study, SCG needs to modify the Gas Quality Standard to include a maximum and minimum numeric Wobbe Number limit. All units tested performed satisfactorily over a wide range of gas compositions and characteristics up to the 1150 HHV and 1400 Wobbe Number study limits.
2. The test results were less clear on the need to adjust the 1150 Btu HHV maximum limit. All units tested performed satisfactorily on an 1150 Btu HHV / 1375 Wobbe Gas (Gas 4) composition while some experienced problems with the 1150 Btu HHV / 1437 Wobbe Number Gas (Gas 3).
3. Other aspects of the SCG Gas Quality Standard need to be reviewed and updated:
   - Additional metrics need to be added for better predictions. Neither HHV nor Wobbe Number is an absolute predictor of equipment performance.
   - A "Range of Acceptability" concept may need to replace current approach utilizing AGA Interchangeability Indices: Lifting Index, Flashback Index, and Yellow Tip Index. These indices generally have performed well for appliances and equipment designed and installed up to the 1990's but may not be good predictors for newer, more efficient, less polluting equipment.
   - Engine manufacturers currently utilize Methane Number as an I.C. Engine performance indicator. Gas turbines or feedstock applications require metrics or compositional limits other than AGA Interchangeability Indices
4. Standard safety and NOx emission testing procedures/protocols that use specific test gas compositions may not be applicable nor are they a true indicator of performance in actual end use installations. Testing or certifying over a range of gas compositions may be more appropriate. Differences in building codes, and safety and environmental regulations in different geographic locations may also necessitate changes to acceptance protocols in different geographical locations.

RECOMMENDATIONS

1. SCG needs to incorporate results of this study, national efforts on gas quality and other inputs to develop an "Interim Range of Acceptability" based on quality/composition for each end-use category.
   - Update Gas Quality Standards and Rule 30.
   - Include interim Wobbe Number range from 1290 minimum to 1400 maximum.
   - Establish longer term goals for wide "Range of Acceptability" based on national standards.

2. SCG will work with industry, manufacturers and government to develop and implement new, nationally applicable gas quality standards that allow for the broadest range of gas compositions that may reasonably be encountered.
   - Develop a target "Range of Acceptability", provide a transition period and require equipment manufacturers to produce equipment that operates safely over the entire range.
   - Simplify the testing standards and protocols. Single standard testing/protocols should be adopted for certification, performance, safety and emission testing.
   - Continue to promote testing of large equipment by manufacturers, possibly with DOE sponsorship.
   - Work with manufacturers and agencies to develop testing protocols and standardize a range of test gases.
   - Determine, based on sound statistical methodologies, if an adjustment gas or gases could be used for equipment set-up to allow for the widest range of acceptable gas compositions.

EXHIBIT B

The Impact of Using LNG-Derived Natural Gas in the South Coast Air Basin

Prepared by ENVIRON International for Southern California Gas Company

March 2007

ENVIRON

Background

- Future natural gas demand in the United States will rise
- Traditional natural gas sources are increasing in cost and new supplies will not meet demand
- Regasification of LNG imports is commercially feasible and economically beneficial
- Imported LNG typically has higher heat content and Wobbe Index (WI) than current gas in the South Coast
  - More ethane, propane, butane
  - Less N_2, CO_2, and O_2

Air Quality Background

- South Coast is a severe-17 ozone non-attainment and serious PM2.5 non-attainment area
  - Draft 2007 AQMP: "NO_x Heavy" strategy, extreme bump-up
    - reduce NO_x by 76% (2002 to 2024)
- Combustion of higher WI gas may increase NO_x and CO from some types of equipment
- Draft 2007 AQMP control measure CMB-04 proposes upper limit of 1360 WI (CPUC WI limit is 1385)
  - Import high-methane LNG,
  - Condensing (e.g. extracting) out higher hydrocarbons,
  - Adding inerts (e.g. N_2), and/or
  - Blending (so that end user gas is ≤ 1360 WI)
- Question: What would be the impact of higher WI gas on South Coast emissions and air quality?

Impact Analysis Approach

- Review relevant emission inventories for SCAB natural gas combustion emission categories
  - Compare to overall SCAB inventory
- Review equipment test data that compare the combustion emissions from higher WI gas to those from base gas
- Apply emission ratio to appropriate SCAB stationary source natural gas combustion inventory categories and assess the inventory impact on the inventory
- Apply appropriate SCAQMD regulatory limits, where possible, and assess inventory impact

High WI Gas Emission Impact Analyses (1Bcf per day replacement scenario)

- **Analysis 1: Natural Gas OIR (December 2005) Analysis**
  - Initial SoCalGas 2005 Test Report
  - Impact of WI 1400 to base gases: 1.2 tons/day
- **Analysis 2: WI 1385 – WI 1360 Analysis (December 2006)**
  - Interpolated previous test results for WI=1360 and 1385
  - WI 1385 - WI 1360: 0.34 tons/day
- **Analysis 3: New Test Data Analysis (February 2007)**
  - SCAB 2005 engine results replace Ventura 2003 results
  - Broiler test results were added
  - Additional boiler tests and boiler distribution data

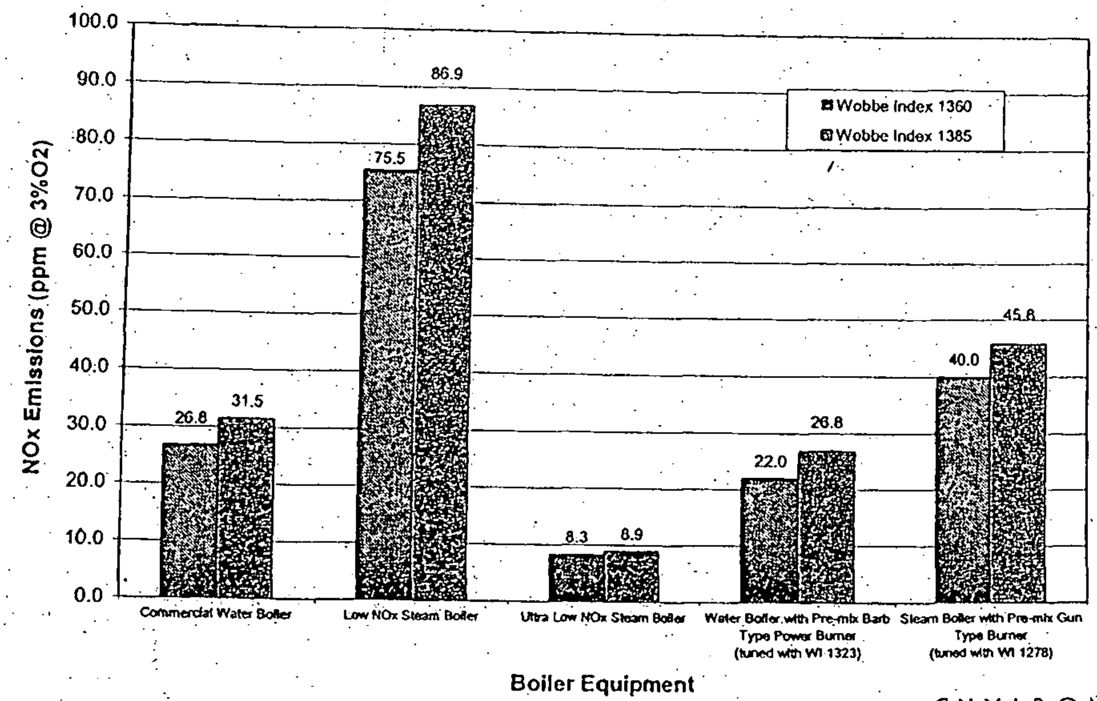
Applicable Test Results

Emission Source Category	Tested Equipment[1]	2003 NO_x Emissions (tons/day)
All ICEs	Internal Combustion Engine[2]	6.9
All boilers categories	Commercial water boiler for Analyses 1 and 2 Range of boilers for Analysis 3	7.8
Residential, service and commercial space heating	HCFAU[3]	10.6
Residential, service and commercial water heating	Legacy water heater	10.7
Residential cooking	None in Analyses 1 and 2 Residential broiler for Analysis 3	2.0
gas turbines, oven heaters, in-process fuel, other	None available (no adjustment)	14.9*

* 3.8 tpd from residential (other) and 3.3 tpd from gas turbine engines generally in RECLAIM

1. LNG study April 2005, except as noted
2. 2003 Ventura engine for Analyses 1&2, 2005 SCAB engine for Analysis 3
3. Gas #3 results used

Boiler Test Data



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Rule Adjustments

- **Almost all in-basin sources that emit over 4 tons/year of NO_x are in RECLAIM (Cap-and-Trade)**
  - Net Basin emissions change from those sources = zero
  - Sophisticated control equipment historically has managed variations in fuel quality
  - If emissions increase, there would be increased demand for RTCs and probably higher prices
- **RECLAIM applied to:**
  - All electric utilities, co-generation, oil / gas production, petroleum refining, and industrial / manufacturing categories
  - 2003 baseline emissions: 20.1 tons/day (Actual 2005 RECLAIM emissions: 33.5 tons/day)
- **No rule or permit limits applied to any other categories:**
  - All combustion equipment under food & agriculture, service and commercial, and residential categories
  - 2003 baseline emissions: 32.8 tons/day

ENVIRON

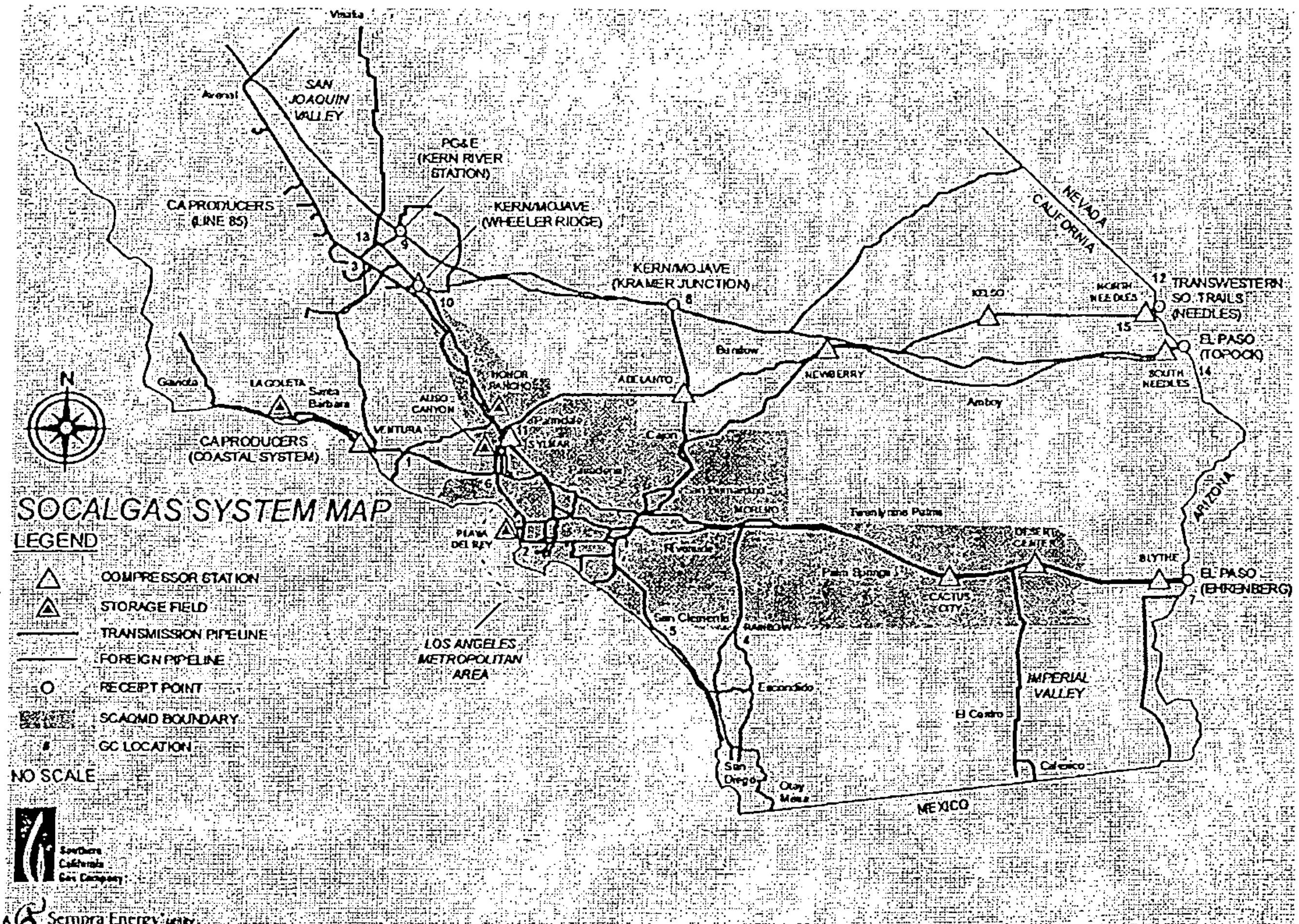
NO_x Impact of Higher WI Gas – Analysis 3 (1Bcf per day replacement scenario)

	Change in NOx Emissions
WI 1437 - 1385	0.61 tons/day
WI 1385 - 1360	0.29 tons/day

- **Sensitivity Analysis: If boiler emission changes eliminated due to appropriate tuning of all boilers:**
  Δ 0.11 tons/day NO_x (WI 1385-1360)

Conclusions

- **Latest analysis (1Bcf per day replacement scenario):**
  - 0.34 ton/day NO_x difference between WI 1385 and 1360 if previous equipment test results used
  - 0.29 ton/day NO_x difference between WI 1385 and 1360 if additional equipment test results and boiler distribution information used
  - Does **not** account for reductions from proper tuning and/or sophisticated control equipment
  - Does **not** account for impact of non-RECLAIM rules or permit limits
- **Ozone and PM2.5 air quality impact expected to be negligible**



1	Center Road	L-406, L-404, L-324		
2	Big GEMS at El Segundo	Line 1170		
3	Lake Station	Line 85		
4	SD&E at Rainbow	Lines 6900, 1027, 1028	1335	03/02/2007 07:00 AM PCT
5	Big GEMS at San Clemente	Line 1018	1348	03/02/2007 07:00 AM PCT
6	Westside Station	Line 404, Line 406		
7	El Paso at Blythe	Lines 2000, 2001, 5000	1330	03/02/2007 07:00 AM PCT
8	Kern/Mojave at Kramer Junction	Line 6905	1365	03/02/2007 07:00 AM PCT
9	PG&E at Kern River Station	Line 7200	1367	03/02/2007 07:00 AM PCT
10	Kern/Mojave at Wheeler Ridge	Line 225	1359	03/02/2007 07:00 AM PCT
11	Newhall Station	Line 163, Line 120 south	1360	03/02/2007 07:00 AM PCT
12	Transwestern at North Needles	Line 235	1313	03/02/2007 07:00 AM PCT
13	Oxy Elk Hills	Line 225, Line 7200	1359	03/02/2007 07:00 AM PCT
14	El Paso at Topock	Line 3000	1330	03/02/2007 07:00 AM PCT
15	Questar at North Needles	Line 235	1330	03/02/2007 07:00 AM PCT

The Wobbe number, or Wobbe index, of a fuel gas is found by dividing the high heating value of the gas in Btu per standard cubic foot (scf) by the square root of its specific gravity with respect to air.

Example of Wobbe Index Data from http://www.socalgas-envoy.com/

Wobbe Index

Date: 03/30/2007 01:15 PM PCT

GC Location/Description	Pipeline	Wobbe Index	Last Updated
SD&E at Rainbow	Lines 6900, 1027, 1028	1336	03/30/2007 00:00 PM PCT
Big GEMS at San Clemente	Line 1018	1339	03/30/2007 00:00 PM PCT
El Paso at Blythe	Lines 2000, 2001, 5000	1330	03/30/2007 00:00 PM PCT
Center Road	Line 324	1361	03/30/2007 00:00 PM PCT
Center Road	Line 404	1359	03/30/2007 00:00 PM PCT
Center Road	Line 406	1358	03/30/2007 00:00 PM PCT
Kern/Mojave at Kramer Junction	Line 6905	1362	03/30/2007 00:00 PM PCT
PG&E at Kern River Station	Line 7200	1364	03/30/2007 00:00 PM PCT
Lake Station	Line 85	1354	03/30/2007 00:00 PM PCT
Kern/Mojave at Wheeler Ridge	Line 225	1347	03/30/2007 00:00 PM PCT
Newhall Station	Line 120 South	1395	03/30/2007 00:00 PM PCT
Newhall Station	Line 163		
Transwestern at North Needles	Line 235	1314	03/30/2007 00:00 PM PCT
Oxy Elk Hills	Lines 225, 7200	1361	03/30/2007 00:00 PM PCT
El Paso at Topock	Line 3000	1336	03/30/2007 00:00 PM PCT
Questar at North Needles	Line 235	1325	03/30/2007 00:00 PM PCT
Westside Station		1352	03/30/2007 00:00 PM PCT

The Wobbe number, or Wobbe index, of a fuel gas is found by dividing the high heating value of the gas in Btu per standard cubic foot (scf) by the square root of its specific gravity with respect to air.

For information regarding your facilities location, please contact your SoCalGas representative.

Disclaimer

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Southern California Gas Company
Extracted from Monthly Billing Factor

Wobbe Number
for BTU districts in SCAQMD

03/28/2007

BTU	District	2000 Avg	2001 Avg	2002 Avg	2003 Avg	2004 Avg
11	LOS ANGELES BASIN	1331	1337	1335	1338	1338
12	TRANS LINES-CASTAIC	1343	1363	1347	1347	1347
15	ANTELOPE VLY-WRGHTWD	1331	1338	1335	1337	1338
16	SANTA MONICA	1333	1343	1342	1346	1349
17	LAS FLORES-MALIBU	1335	1339	1339	1343	1347
18	HARBOR	1327	1332	1331	1334	1334
19	SAN GABRIEL VALLEY	1329	1336	1332	1334	1339
20	COVINA-WEST	1328	1334	1330	1329	1331
21	POMONA-ONTARIO	1325	1330	1330	1334	1335
22	WESTERN ORANGE CNTY	1324	1328	1329	1334	1335
23	SN JN CPSTRN-SN CLMN	1324	1328	1330	1335	1336
40	RIVERSIDE-IMPERIAL	1328	1335	1333	1331	1329
41	SAN BERNARDINO	1325	1329	1328	1328	1328
56	GREELY-TEN SECTION	1343	1363	1347	1348	1349