

Natural Gas Compressor Engine Survey for Gas Production and Processing Facilities

H68 FINAL REPORT

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EXECUTIVE SUMMARY

The objective of this study funded by the Texas Environmental Research Consortium (TERC) was to collect the technical information required by the Texas Commission on Environmental Quality (TCEQ) to estimate the distribution of compressor engines associated with natural gas production, processing and transportation in the eastern portion of Texas. This study is a follow-up to a previous TERC effort, published in HARC Report: *H40, Natural Gas Compressor Engine Survey and Engine NO_x Emissions at Gas Production Facilities*.

The first two tasks conducted under this study revised the previous inventory developed for the H40 study by inventorying engines greater than 500 hp, separating engines less than 50 hp from the engines between 50 and 499 HP in the previous inventory, and adding the year 2000 to the previous inventory. The second task under this study contributed to the updating of TCEQ's State of Texas Air Reporting System (STARS) inventory by collecting information from 26 of the 58 facilities suspected of having reciprocating engines, but not included in STARS.

Some of the findings of this H68 study include:

1. Generally, less than 1% of the well-head engine capacity is comprised by engines smaller than 50 hp.
2. Generally, 50 to 73% of the well-head engine capacity is comprised by engines greater than 500 hp, depending on the region.
3. Of 26 facilities identified as missing from the STARS inventory, only three had reciprocating engines. A total of 5 engines were at the 3 facilities.
4. If the trend observed at facilities contacted were to hold for the remainder of the 58 facilities flagged by TCEQ as being of interest, then 2 additional sites would have 2 reciprocating engines, each, for a total of 4 additional engines, as yet missing from the STARS inventory.

A primary recommendation arising from this study is that the remaining compressor facilities possibly omitted from the STARS inventory be contacted to determine if they use reciprocating engines to drive their compressors and the technical specifications of any such engines.

The second purpose of this study was to gather as much data as possible about large natural gas-fired reciprocating engines in the natural gas industry that had been omitted from the STARS inventory, compiled by TCEQ. A quick review of the equipment used by the natural gas industry suggested that large reciprocating engines were most likely used to drive compressors located at pipeline compressor stations, at gas storage facilities, and at gas processing plants. TCEQ identified 58 facilities that were potentially missing from STARS, however resources would only allow the contacting of 26 facilities. A survey of the 26 facilities that had the possibility of using reciprocating engines revealed that only 3 facilities were using a total of 5 engines.

Section 2 of this report presents the methodology used to update the previous H40 inventory of well-head compressor engines to separate the engines of less than 50 hp, from the engines between 50 and 499 hp and the engines greater than 500 hp, and to add the year 2000 to the inventory. Section 3 of this report presents the methodology used to collect missing engine from major pipeline and processing facilities in the natural gas industry.

2.0 REVISED GAS WELL INVENTORY

The purpose of this effort was to update a previous inventory of fuel use by natural gas-fired reciprocating engines, which was conducted by ERG in 2005 for the HARC: *H40, Natural Gas Compressor Engine Survey and Engine NO_x Emissions at Gas Production Facilities*. The H40 study estimated fuel use by reciprocating engines less than 500 hp for the years: 1999, 2002, 2007 and 2010. The revised H40 inventory included an inventory of engines greater than 500 hp, separated engines less than 50 hp from engines between 50 and 499 hp, and added the year 2000 to the inventory. All other aspects of the H40 inventory were kept the same; there was no change to the list of 110 counties included in the inventory and the calculation methodology remained the same. In this report we will discuss how we obtained the new data required for the revised H40 inventory and we will summarize the findings of the revised inventory.

The two new sets of data required to revise the H40 inventory were engine population characteristics for engine sizes greater than 500 hp and less than 50 hp, and natural gas production data for the 110 counties in the year 2000. New engine population data was obtained from the same engine leasing companies contacted in the H40 study. Please refer to the H40 report for a list of these companies and their representatives who provided the data. The new data provided by the leasing companies included the population of engines greater than 500 hp and less than 50 hp, separated by engine size, type, manufacturer and model.

We sorted the data provided by the leasing companies into two combustion categories, two engine stroke configurations, three size categories, two control strategies and three regions. This sort of the engine data yielded the following table of engine distributions.

Table 2-1. Distribution of Engine Capacity by County NAAQS Status

Engine Type	Fraction of Total Engine Capacity (hp)		
	Attainment	Houston Non-Attainment	Dallas Non-Attainment
4 stroke, rich, <50 hp	1%	0%	0%
4 stroke, rich, 50 - 499 hp	25%	0%	14%
4 stroke, rich w/ NSCR, 50 - 499 hp	0%	45%	3%
4 stroke, rich w/ NSCR, ≥500 hp	22%	20%	49%
4 stroke, lean, 50 - 499 hp	0%	1%	0%
4 stroke, lean, ≥500 hp	35%	30%	24%
2 stroke, lean, 50 - 499 hp	12%	4%	10%
2 stroke, lean, ≥500 hp	5%	0%	0%
Total	100%	100%	100%

Table 2-2. Brake Specific Fuel Consumption for Compressor Engines

Engine Type	Representative Model	Size (hp)	Fuel Consumption (MMBtu/hp-hr)_{HHV}
4 stroke, rich, <50 hp	Waukesha F11G	90	0.009020
4 stroke, rich, 50 - 499 hp	Caterpillar G3306 NA	145	0.008769
4 stroke, rich w/ NSCF, 50 - 499 hp	Caterpillar G3306 NA	145	0.008769
4 stroke, rich w/ NSCF, ≥500 hp	Waukesha L7042GSI	1232	0.008580
4 stroke, lean, 50 - 499 hp	Waukesha F18GL	375	0.008103
4 stroke, lean, ≥500 hp	Caterpillar G3516TALE	1340	0.008583
2 stroke, lean, 50 - 499 hp	Ajax DPC-180	134	0.009324
2 stroke, lean, ≥500 hp	Ajax DPC-2803LE	600	0.008580

The most common engine model in each category of engine type was used to obtain the fuel consumption data for the engine type category. When the manufacturer of the Waukesha VRG220 engine (the most common model in the 4 stroke, rich, <50 hp category) was asked for the specification sheets on that engine model, they reported that the specifications on fuel consumption were not available. However, they were able to provide fuel consumption information on the 90 hp Waukesha F11G engine, which they said was an engine with almost identical performance to the VRG220 engine. Therefore, this 90 hp engine's fuel consumption rate was used for the <50 hp engine category.

The second piece of information required to update the H40 inventory was the natural gas well production data for the year 2000. This data was obtained from the Texas Railroad Commission in the same manner that the production data for other years was obtained for the H40 study. Please see Section 4.3 of H40 for this methodology. The production data for 2000 is presented in Appendix A.

3.0 LARGE FACILITY DATA GATHERING

The purpose of this task was to gather as much data as possible about natural gas-fired reciprocating engines used by the natural gas industry that are 500 hp and greater and had been omitted from the STARS inventory, compiled by TCEQ. A quick review of the equipment used by the natural gas industry suggested that large reciprocating engines were most likely used to drive compressors located at pipeline compressor stations, at gas storage facilities, and at gas processing plants.

The first activity under this task was to obtain a copy of the 2003 STARS inventory from the TCEQ. We also contacted PennWell Publishing Company for a copy of their latest inventory of natural gas industry facilities in Texas. PennWell Publishing is generally considered to have the most comprehensive inventory of U.S. natural gas industry activities. PennWell Publishing provided two files of gas industry data from an inventory compiled in 2003: a file that listed all natural gas processing facilities in Texas and a graphic file of natural gas pipeline facilities in Texas. The pipeline facilities file included both compressor stations and storage facilities. The file for the gas processing facilities is presented in Appendix B and the geographic file, due to size, is included on a CD-ROM disk accompanying this report.

Using facility names, owner names and facility location, we compared the industry data compiled by PennWell to the STARS inventory to identify gas industry facilities that might have been omitted from STARS. The result of this comparison was a list of 6 gas plants and 58 pipeline facilities that may have been omitted from the STARS inventory. This list of potentially missing facilities was submitted to TCEQ for review against their various permit and inventory databases, other than STARS. Due to limited resources, it was determined that only 24 facilities could be contacted for inventory information. Therefore on the lists submitted to TCEQ, we identified the 24 largest facilities as our recommended subjects for inventory data gathering.

The TCEQ review of our lists against their permit files determined that they had sufficient data on 5 of the gas plants and 21 of the pipeline facilities within their existing files. As a result, the TCEQ provided us with a list of 1 gas plant and 37 pipeline facilities that they were interested in us contacting for gas-fired reciprocating engine information. The TCEQ list of these facilities is presented in Appendix C.

Our next activity was to contact the first 24 of the facilities listed in Appendix C for which we could obtain valid contact information. Ultimately contact information was obtained for 26 of the facilities on the list. These 26 facilities are listed in Appendix D. A major hurdle in completing these contacts was the fact that the gas industry has gone through a tremendous restructuring over the past four years. Of the 26 facilities contacted, 25 had changed ownership in the last 4 years. Many of the facilities had changed owners as many as three times in this period.

The contacts with the facilities were conducted by telephone, until the manager responsible for the environmental performance of the facility was reached. If the facility operated reciprocating engines, they were provided a questionnaire and a letter of our authority to collect this information for the TCEQ. The questionnaire and authority letter are presented in Appendix E.

The environmental managers were requested to respond to the questionnaire by whichever medium they preferred, including: mail, e-mail, or by telephone.

The results of our contacts with the 26 facilities are summarized in Appendix XX3 and reveal that:

- 12 facilities had no compressors,
- 3 facilities were shut down,
- 1 facility was a duplicate of another facility on the list,
- 2 facilities do not use reciprocating engines (1 uses turbines and 1 uses electric motors),
- 5 facilities had been transferred to owners which could not be identified,
- 3 facilities used reciprocating engines (a total of 5 engines at these sites).

The detailed data that was collected on the five engines at the three facilities using engines are presented in Appendix F.

If the trend observed among the 21 sites successfully contacted were to hold for the remainder of the 58 facilities flagged by TCEQ as being of interest, then 2 additional sites would have 2 reciprocating engines, each, for a total of 4 additional engines, as yet missing from the STARS inventory. The majority of the sites determined to not have compressor engines were metering stations used by the industry to document the custody transfer of natural gas from one corporation to another corporation. These metering stations are equipped with accurate gas flow meters, used to measure the gas that is transferred between two parties.

APPENDIX A

County	FIP Code	Natural Gas Production 2000 (Mscf/yr)
ANDERSON	001	12,963,522
ANGELINA	005	600,822
ARANSAS	007	7,294,068
ATASCOSA	013	10,782,131
AUSTIN	015	21,209,583
BASTROP	021	823,314
BEE	025	24,397,375
BELL	027	0
BEXAR	029	1,071
BOSQUE	035	0
BOWIE	037	522,883
BRAZORIA	039	34,077,082
BRAZOS	041	24,904,095
BURLESON	051	20,631,174
CALDWELL	055	510,799
CALHOUN	057	8,479,182
CAMP	063	101,135
CASS	067	9,060,736
CHAMBERS	071	44,003,784
CHEROKEE	073	16,693,628
COLLIN	085	0
COLORADO	089	35,249,409
COMAL	091	0
COOKE	097	613,137
DALLAS	113	13,130
DE WITT	123	19,128,723
DELTA	119	0
DENTON	121	28,101,925
ELLIS	139	17
FALLS	145	12,459
FANNIN	147	0
FAYETTE	149	50,062,106
FORT BEND	157	36,136,174
FRANKLIN	159	5,888,698
FREESTONE	161	139,073,305
GALVESTON	167	43,253,136
GOLIAD	175	38,831,003
GONZALES	177	1,556,676
GRAYSON	181	7,958,726
GREGG	183	57,092,105
GRIMES	185	32,370,293

GUADELUPE	187	179,685
HARDIN	199	15,584,463
HARRIS	201	160,111,031
HARRISON	203	59,675,833
HAYS	209	0
HENDERSON	213	35,734,320
HILL	217	11
HOOD	221	1,237,622
HOPKINS	223	1,699,995
HOUSTON	225	3,455,167
HUNT	231	0
JACKSON	239	26,538,886
JASPER	241	13,433,332
JEFFERSON	245	50,636,863
JOHNSON	251	20,902
KARNES	255	8,874,220
KAUFMAN	257	22,162
LAMAR	277	0
LAVACA	285	119,023,517
LEE	287	22,670,608
LEON	289	29,454,215
LIBERTY	291	20,422,936
LIMESTONE	293	42,504,516
LIVE OAK	297	29,695,495
MADISON	313	5,945,248
MARION	315	4,730,500
MATAGORDA	321	51,396,997
MCLENNAN	309	60
MILAM	331	456,038
MONTAGUE	337	1,863,378
MONTGOMERY	339	26,863,683
MORRIS	343	0
NACOGDOCHES	347	24,410,342
NAVARRO	349	348,573
NEWTON	351	5,227,197
NUECES	355	51,209,537
ORANGE	361	9,468,477
PANOLA	365	260,854,120
PARKER	367	6,782,580
POLK	373	52,302,883
RAINS	379	9,077,577
RED RIVER	387	18,882
REFUGIO	391	41,614,514
ROBERTSON	395	29,994,987
ROCKWALL	397	0
RUSK	401	79,866,274
SABINE	403	599,625
SAN AUGUSTINE	405	549,229

SAN JACINTO	407	5,516,680
SAN PATRICIO	409	15,976,767
SHELBY	419	16,032,295
SMITH	423	8,464,091
SOMERVELL	425	20,908
TARRANT	439	751,848
TITUS	449	5,145
TRAVIS	453	12
TRINITY	455	360,468
TYLER	457	1,074,832
UPSHUR	459	57,765,489
VAN ZANDT	467	12,702,802
VICTORIA	469	29,412,266
WALKER	471	554,541
WALLER	473	8,267,547
WASHINGTON	477	70,025,034
WHARTON	481	86,075,118
WILLIAMSON	491	5,428
WILSON	493	58,463
WISE	497	95,245,086
WOOD	499	13,570,892

APPENDIX B

PennWell Publishing Compilation of Natural Gas Processing Facilities in Texas in 2003

Company, plant location	MMcfd		Process/ condition method	Production 1,000 gpd (average based on the past 12 months)								
	Gas capacity	Gas through- put		Ethane	Prop.	Isobut.	Normal or unsplit butane	LPG mix	Raw NGL mix	Debut. nat. gasol.	Other	Total products
Enogex Products Corp.—												
Calumet, Canadian Co.												
NE 4 28-14n-9w	250.0	104.0	2		36.0				58.0			94.0
Canute, Washita 28-14n-9w	60.0	53.0	7						117.0			117.0
Clinton, Custer Co. SW 23-12n-15w	75.0	56.0	7						109.0			109.0
Comanche Tap, Grady Co. 26-4n-6w	60.0	41.0	7		19.0				80.0			99.0
Cox City, Grady Co. 26-4n-6w	120.0	116.0	7						254.0			254.0
Custer, Custer Co. 5-13n-17w	200.0	98.0	7						196.0			196.0
Davenport, Lincoln Co. 4-14n-5e	18.0	11.0	7						57.0			57.0
Greasy Creek, Hughes Co. 29-8n-11e	80.0	37.0	7		28.0				57.0			85.0
Harran, Oklahoma Co. 15-12n-1e	38.0	29.0	7						156.0			156.0
Thomas, Custer Co. 33-14n-15w	150.0	107.0	7						231.0			231.0
ExxonMobil Corp.—												
Dover Hennessey, Kingfisher Co. 1-18n-7w	80.0	24.0	6						107.0			107.0
Magnum Hunter Resources—												
Elmore City, Garvin Co. 17-1n-2w	40.0	14.0	7						45.3			45.3
Mustang Fuel Corp.—												
Spring Valley, Garfield Co. 5-22n-4w	15.0	10.0	7						31.9		4.0	31.9
Octagon Resources Inc.—												
H.U.D. Pawnee Co. NW 1/4 7-20n-8e	10.0	1.5	3						6.2			6.2
Oreck Field Services—												
Antelope Hills-A, Roger Mills Co. 30-16n-24w	50.0	33.0	7						79.2		90.1	79.3
Binger, Caddo Co. 26-16n-11w	10.0	2.6	7						27.5			27.5
Custer, Custer Co. SW NW 34-14n-15w	80.0	80.0	7						192.0		91.9	193.9
El Reno, Canadian Co.												
NW SW 33-14n-7w	75.0	34.0	7						81.6		95.0	86.6
Leadley, Roger Mills Co. 32-16n-21w	50.0	19.3	7						70.1			70.1
Panther Creek, Custer Co. 3-12n-20w	90.0	78.0	7						187.1		1.0	188.1
Ringwood, Major Co. 34-22n-10w	22.0	18.3	7						53.4			53.4
Rodman, Garfield Co. 27-20n-8w	85.0	52.0	7						217.1			217.1
Springer, Carter 12-3S-1E	9.5	5.0	2						6.8			6.8
Springer, Carter Co. 12-2s-1e	9.5	6.2	3						7.7			7.7
Stephens, Stephens Co. 14-1s-5w	30.0	27.0	7						64.8		4.0	64.8
Woodward, Woodward Co. 39-23n-21w	75.0	49.0	7						117.6		92.4	120.0
Questar Gas Management Co.—												
Beaver, Beaver Co. 30-4n-20e	20.0	8.9	7						10.8			10.8
Spectrum Field Services—												
Velma, Stephens Co. 23-1s-5w	100.0	61.6	7						248.4			248.4
Timberland Gathering & Processing Co. Inc.—Tyrone, Texas Co.												
SW 11-6n-18e	48.0	31.0	7						41.4			41.4
Unocal—												
Caddo, Carter Co. 23-3s-1e	10.0	4.5	3		7.2				4.9		90.2	12.3
Western Gas Resources Inc.—												
Chaney Dell, Major Co. 35-23n-10w	130.0	71.0	2,7	66.4	68.1	11.8	28.5		30.8		615.4	221.0
Chester, Woodward Co. 2-20n-17w	45.0	66.0	7	5.1	3.8	0.8	1.7		1.7		95.4	18.5
Williams Cos.—												
Antioch, Garvin Co. 17-3n-2w	10.0	5.9	3					16.0				16.0
Pauls Valley, Garvin Co. 12-3n-1w	1.0	0.3	3					0.9				0.9
West Guthrie, Logan Co. 30-15n-2w	15.0	11.0	7					40.0				40.0
Total	3,577.0	2,351.7		347.4	347.9	37.1	97.7	56.9	5,705.9	109.8	31.5	6,734.2
PENNSYLVANIA												
El Paso Field Services Co.—												
Waynesburg, Greene Co.	14.0	8.4	3		5.1		4.2			3.7		13.0
Elkhorn Field Services—												
Lewis Run, McKean	4.0	2.7	6,3						3.8			3.8
Roystone, Warrar	7.0	6.1	6		8.8		4.7			1.7		15.2
MSL Inc.—												
Lafayette, McKean Co.	2.0	1.0	3		1.0			1.0				2.0
Tembec Co.—												
Waynesburg fractionator, Greene Co.			+		(1.6)		(1.5)			(1.3)		(4.4)
Total	27.0	18.2		0.0	14.9	0.0	8.9	1.0	3.8	5.4	0.0	34.0
TENNESSEE												
Global Energy Reserves—												
Livingston	5.0	1.5										
Champ	3.0											
Total	8.0	1.5		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TEXAS												
Abxaxas Petroleum Corp.—												
East White Point, San Patricio Co. G. H. Paul subdiv. of Coleman Fulton Pasture Lands	25.0	8.5	7						16.8			16.8
Portillo, San Patricio Co. M. S. Welder	20.0	17.0	9,2						8.0			8.0
Altura Energy Ltd.—												
Mallett CO, removal, Hockley Co. Labors 16-17 Laague 49 Scurry Co. School Land	120.0	107.0	1,2,3,4,5							49.5		49.5
Slaughter, Hockley Co. 14-1S-49	57.0	31.9	7,8		107.0	21.9	57.5			55.9	123.1	365.4
Edwards & Scurry CSL	25.0	19.0	7	25.0	15.0	2.0	4.0			4.0		50.0
American Central Gas Cos. Inc.—												
George West, Live Oak Co.	20.0	6.8	7						26.0			26.0
American Processing LP—												
Carson Co., Carson Co. 4-5-N&GN	70.0	50.5	7						12.4		53.6	16.0
Apache Corp.—												
Hastings, Brazoria Co. 1-ACH-DA-416												

Company, plant location	MMcfd		Process/ condition method	Production 1,000 gpd (average based on the past 12 months)							Total products	
	Gas capacity	Gas through- put		Ethane	Prop.	Isobut.	Normal or unsplit butane	LPG mix	Raw NGL mix	Debut. nat. gas.		Other
Aquila Gas Pipeline Corp.—												
La Grange, Fayette Co.	225.0	160.0	7	403.7	240.0	56.6	96.4			87.0		663.7
Somerville, Burleson Co.	75.0	20.0	7	51.5	23.0	5.5	8.4			10.0		59.4
Black Hawk Gasoline Corp.—												
Black Hawk, Jack Co. R. Stanton												
A-1329	10.0	4.0	2					1.0	0.2			1.2
BP PLC—												
Block 31, Crane Co. 33-31 Univ. Lands	250.0	240.0	2,7						285.0			285.0
Crane, Upton Co.												
128-0, CCS&RR Co.	20.0	18.0	7						80.0			80.0
Hemphill, Hemphill Co.												
223 Blk. C Grimb&A	50.0	35.0	7						123.1			123.1
Hobbs Fractionation, Gaines Co.												
509-SSL 24 BA AX			*	(20.0)	(6.0)							(26.0)
Longview, Gregg Co. J. Moseley	28.0	14.5	7								191.6	191.6
Midland Farms, Andrews Co.												
842-T-1-N GBMMBSA	25.0	24.0	3,4,5,7,8	49.9	50.0	0.4	20.9			22.5		151.8
Offl Ocean, Brazoria Co.												
Charles Breen League A-46	175.0	132.5	4,7,5,6,7	80.0	40.0	11.0	11.0			29.0		171.0
Silsbee, Hardin Co. George W.												
Brooks A-4	25.0	17.4	7						54.0			54.0
Suway, Moore Co. 170 Blk. 3-T	190.0	150.0	7,8						537.9			537.9
Texas City, John Grant Survey A-72	70.0	52.0	7						23.6		728.9	52.5
Wasson CO, removal, Yoakum Co.												
805-0 JH Gibson Survey	60.0	77.5	2						111.9			111.9
Willard, Yoakum Co.	73.0	35.0	8						63.0		92.0	65.0
Brunn Petroleum Inc.—												
Hainesville, Wood Co.	15.0	2.7	3	2.2	2.9	1.1	1.7		11.3		61.0	20.1
C&I Processors—												
Forkins, Coke Co. Blk. 1-2 H&TC	40.0	21.0	7						126.2		67.2	133.9
Cantera Resources—												
Gilliland, Knox Co.												
M&TC RR Co. blk. c.	12.0	9.5	3						13.7			13.7
Gordon, Palo Pinto Co.												
Thomas Reed A-384	40.0	30.0	7						94.3			94.3
Pueblo, Eastland Co. sec. 454	20.0	18.0	7						83.7			93.7
Ranger, Eastland Co. RR 4-4	10.0	7.7	3						37.7			37.7
Springtown, Parker Co.												
Jl. Yacops A-890	75.0	55.0	7						203.4			203.4
Trinidad, Henderson Co.												
N. Addison A-17	65.0	62.0	7						75.5			75.5
Carrera Gas Co.—												
McLean, Gray Co. 68-23 H&GN RR	25.0	18.1	7						26.9			26.9
Chevron Texaco Corp.—												
Bradford Ranch, Midland Co.												
13-39-3s T&P RR	17.0	12.2	7						60.8			60.8
Chancelata Bayou, Brazoria Co.												
Sec. 5 Abstract #221	20.0	12.5	7						33.9			33.9
*Headline Devonian, East-Midland Co.												
NE NW 29-41-2s T&PRR	200.0	163.6	7						210.0			210.0
Ozona, Crockett												
N 1/2 3-MN GC&SF RR	45.0	40.4	7						122.8			122.8
South Kermit, Winkler Co.												
SW 22 B-3 PSL	24.0	12.4	7						27.3			27.3
CMS Field Services, Inc.—												
Hamlin, Fisher Co. 9-R-26	9.0	5.8	7,7,8						48.2		92.6	50.8
Shackelford, Callahan Co. nw corner												
24 sw corner 23 Bayland Orphan												
Home Land	30.0	8.5	2						29.8		64.9	34.7
Conoco Inc.—												
Comptel, Sterling Co. sec. 14 blk. 30	25.0	21.6	7									
Mertzon, Iron Co. Tom Green CSL-1	50.0	47.9	7	121.0	92.0	12.5	29.0			23.6	677.0	355.1
Sterling City, Sterling Co.												
Sec. 14 Blk. 30	62.0	58.1	7	143.0	120.0	13.0	33.0			14.0	622.0	345.0
Cornerstone Natural Gas Inc.—												
Iola, Grimes Co.	40.0	40.0	7						120.0			120.0
Corpus Christi Natural Gas Co.—												
Gregory, San Patricio Co.												
Gerardino Valdez A-269	95.0	69.0	7,2		19.4		16.2			10.0		45.6
Crockett Gas Processing Co.—												
Ozona, Crockett Co.												
10-45-DP GC&SF RR	20.0	17.8	5,7	17.2	11.1	1.6	3.5			3.6		37.0
Davie Gas Processing Inc.—												
Big Lake, Reagan Co.												
8 mi. e of Big Lake	16.0	16.0	2						64.0			64.0
Bowie, Montague Co.												
3 mi. ne of Bowie	8.0	2.0	2		6.0				6.0			12.0
Cedar Hill, Post Co. 2 mi. s of Post	8.0	3.0	3						18.0			18.0
Concho, Concho Co.												
4 mi. s of Paint Rock	10.0	2.0	2		3.0				3.0			6.0
Iron (Rocker B-II), Iron Co.												
8 mi. n of Barnhart	15.0	6.0	2						36.0			36.0
Nalah, 5 mi. sw of McCamey	10.0	4.0	3						12.0			12.0
Stiles, Reagan Co.	6.0	2.5	2						12.0			12.0
Devon Gas Services LP—												
Barton Chapel, Jack Co.	18.0	13.5	7						63.0			63.0
Bridgeport, Wise Co.	430.0	264.1	7		130.0	24.9	14.4		785.0	52.0		1,006.3
Bryan Hicks fractionator, Brazos Co.			*		(27.6)							(27.6)
Huckabay, Erath Co.	20.0	16.7	7						79.4			79.4
Jameson, Coke Co.	65.0	58.0	6		35.3		5.8		250.7	3.7		295.5
Lone Camp, Palo Pinto Co.	50.0	29.9	7						130.5			130.5
Madison, Madison Co.	60.0	47.9	7						142.8			142.8

Company, plant location	MMcfd			Production 1,000 gpd (average based on the past 12 months)								
	Gas capacity	Gas throughput	Process/condition method	Ethane	Prop.	Isobut.	Normal or unsplit butane	LPG mix	Raw NGL mix	Debut. nat. gaso.	Other	Total products
Seven Gaks, Polk Co.												
Brookeland, Jasper Co.												
A-245 H&TCRR	100.0	42.8	7.8						145.0			145.0
Bryan, Brazos Co.												
30 697 lat. / 96. 46 long	60.0											
Conroe, Montgomery Co.	70.0	35.6	7						40.9			40.9
Coyanosa, Pecos Co. 48-DW TTRR	125.0	46.9	7.8	58.4	33.0	5.2	12.5			15.9	61.7	126.7
Dumas, Moore Co.												
181-44 H&TC survey	60.0	46.0	7.8						212.7			212.7
East Texas, Panola Co.	780.0	683.7	7						1,750.0			1,750.0
East Texas fractionator, Panola Co.					(13.0)					(100.0)	2(460.0)	(573.0)
Fullerton, Andrews Co.												
Center S-17 A-32 PSL	70.0	54.1	6,7.8	192.1	164.5	25.2	66.2			41.9	650.1	540.0
George Gray, Panola Co.	120.0	100.0	7						260.0			260.0
Giddings, Fayette Co.												
David Green A-193	90.0	79.5	7						523.0			523.0
Goldsmith, Ector Co.												
sq4-33-44 T&P-1n	160.0	138.2	7.8	409.3	278.4	39.6	110.0			75.9	655.6	978.8
Gulf Plains, Nueces Co.	170.0	125.6	7						373.0			373.0
Gulf Plains fractionator, Nueces Co.				(167.0)	(77.7)			(48.0)		(45.0)	6(23.0)	(360.0)
Hobart Ranch B, Hemphill Co.												
70 A-2 NSGN	70.0	52.0	7						145.0			145.0
Hulldale, Schleicher Co.												
SE 4 sec 81 blk. TT&TC R R	12.0	10.0	7	24.1	18.5	2.8	6.5			5.3	64.2	61.4
LaGloria, Jim Wells Co.	270.0	219.2	7						425.0			425.0
LaGloria fractionator, Jim Wells Co.				(235.0)	(95.0)	(35.0)	(27.0)			(69.9)		(461.0)
North Fayette Treater, Fayette Co.	50.0	26.7	8								613.0	13.0
Ozona, Crockett Co.	120.0	96.2	7	209.9	122.7	18.6	41.6		40.7			433.5
Pegasus, Midland Co.												
E 1/2 30-40-45 T&PRR	90.0	75.7	7	183.4	102.0	13.6	38.9			38.9	615.0	391.8
Port Arthur, Jefferson Co.												
A-415/T&ND RR A-239	205.0	110.7	7						135.0			135.0
Roberts Ranch, Midland Co.	85.0	43.8	3	117.0	62.0	7.4	22.8			21.6	61.5	232.3
Rock Creek, Hutchinson Co.												
NW 4-22 A&B	165.0	133.0	7.8								2(633.0)	833.0
Seeligson, Jim Wells Co.												
Los Jabonillos Grant	265.0	212.0	7									
Sherman, Hansford Co. 7&8-1 PSL	280.0	210.5	7.8					524.6	46.3			570.9
Sonora, Sutton Co. HE&WT RR A-352	90.0	86.0	7	89.8	60.1	15.6	12.6			6.0	622.9	207.0
Sonora II, Sutton Co.												
HE & WT 14 A-1566	20.0	20.0	7	25.5	4.0	2.6	4.5			6.1	6c	42.7
Southwest Ozona, Crockett Co.												
2-2 HGN RR 28 mi sw of Ozona township	100.0	45.1	7	98.7	57.4	9.3	19.6			25.9	610.0	220.8
Spraberry, Midland Co.												
SE 4-25-37 T-3-5	60.0	50.6	6,7.8	141.1	122.7	14.2	43.2			20.8	627.0	369.0
Three Rivers, Live Oak Co.												
J. D. Jamison 168 A-268	120.0	71.4	7						123.0			123.0
Waha, Pecos Co. 5-C3 PSL	125.0	85.4	7	88.4	50.7	9.4	21.2			29.1	69.0	207.8
West Beaumont, Jefferson Co.	100.0	89.6	7						307.0			307.0
Wharton, El Campo A-245 H&GN RR	20.0	15.0	7						35.0			35.0
Wilcox, Lavaca Co. J. Ragsdale A-377	200.0	208.0	7						485.0			485.0
Wilcox fractionator, Lavaca Co.												
J. Ragsdale A-377				(285.0)	(100.0)			(147.0)				(532.0)
Dynegy Midstream Services LP												
Bridgeport, Wise Co.	150.0		7									
Chico, Wise Co. 3 GH&HRR A-384	115.0	85.0	7.8	188.2	173.3	18.7	61.7			50.6		492.5
Chico, Wise Co. 3 GH&HRR A-384	150.0											
Monahans, Ward Co. 4-F G&MMB&A	31.0	24.5	7,7.8						57.9			57.9
Mooras Orchard, Fort Bend Co.												
German Emigration No. 8 A-117	7.0	3.4	7,7.8						3.0			3.0
Puckett, Pecos Co. 13-126-T	60.0	61.0										
Sand Hills, Crane Co. 21-PSL B-21	150.0	132.0	7.8						203.0			203.0
Sherman, Grayson Co.												
Uriah Burns A-121	33.0	20.0	2		11.3							40.0
Waskom, Harrison Co. J. Blair Survey	150.0	119.0	7	113.5	50.9	14.8	16.0			36.1		231.3
El Paso Field Services Co.												
Armstrong, DeWitt Co.												
James A. Moody A-333	250.0	215.0	7	159.7	82.3	25.8	26.5			50.4		354.7
Clarkson, Sutton Co.	20.0	17.0	7						31.0			31.0
Delmita, Starr Co. Survey												
239 S. D. & R. G. N. G. RR; A-225	145.0	130.0	7	123.8	65.1	24.5	22.2			46.6		282.2
Gilmore, Hidalgo Co.												
TexMex RR A-211	260.0	225.0	7	119.0	104.0	38.0	32.0			79.0		371.0
Indian Springs, Folk Co.	150.0	70.0	7	129.0	65.0	20.0	20.0			40.0		274.0
Matagorda Gas Plant, Matagorda Co.												
Lot 29 Moore Pasture subdiv	250.0	46.0	7	41.0	18.3	9.6	5.0			12.8		86.7
San Martin, Bexar Co.												
4010 F. Farias 15 A-2	200.0	165.0	7	172.8	94.7	24.2	30.8			45.1		367.4
Shilling, Webb Co. BS 1-4 A-1954	110.0	60.0	7	57.0	32.0	9.0	10.0			19.0		127.0
Shoup, Nueces Co. AB&M 409 A-555	285.0	240.0	7	180.0	84.0	34.0	28.0			70.0		396.0
Shoup Fractionator, Nueces Co.												
AB&M 409 A-555				(974.0)	(521.0)	(181.0)	(197.0)			(378.0)		(2,251.0)
Sonora, Sutton Co.												
122 HE&WTRR A-1117	100.0	80.0	7	51.0	33.3	5.8	10.6			14.0		114.5

Company, plant location	MMcfd		Process/ condition method	Production 1,000 gpd (average based on the past 12 months)								
	Gas capacity	Gas through- put		Ethane	Prop.	Isobut.	Normal or unsplit butane	LPG mix	Raw NGL mix	Debut. nat. gaso.	Other	Total products
Thompsonville, Jim Hogg Co Sec. A-244	300.0	295.0	7	260.9	134.2	45.5	41.2	—	—	95.7	—	577.5
Enbridge Inc.— East Texas, Marion Co John H. Kernel A-236	90.0	30.0	7	—	14.5	—	13.2	—	—	9.6	—	37.3
Roberts Co.	10.0	7.0	287	11.0	9.0	1.0	3.0	—	—	3.0	—	27.0
Enarfin Resources Co.— Langhorn, Archer Co 5 mi. s of Wichita Falls	1.5	1.5	4	—	—	—	—	—	6.6	—	—	6.6
Enogex Products Corp.— Benedum, Upton Co	110.0	92.0	7	—	—	—	—	—	485.0	—	—	485.0
Midway Lane, Crockett	25.0	10.0	7	—	—	—	—	—	38.0	—	—	38.0
Enterprise Products Operating LP— Mont Belvieu fractionator, Chambers A-12	—	—	4	(3,102.8)	(1,657.8)	(553.6)	(977.7)	—	—	(949.3)	—	(7,241.2)
ExxonMobil Corp.— Clear Lake, Harris Co James Lindsey A-43	190.0	127.0	192	69.0	63.0	18.0	14.0	—	—	24.0	—	188.0
Cardona Lake, Crane Co	10.0	8.0	11,354	—	—	—	—	—	18.0	—	—	18.0
NW 1/4 Juan Cardona Survey	5.0	2.0	3.6	—	—	—	—	—	11.0	—	—	11.0
East Texas, Rusk Co. I. J. Martin	140.0	113.0	192	—	—	—	—	—	100.0	—	—	100.0
Hawkins, Wood Co. H. Watson	25.0	16.0	7	—	—	—	—	—	2.0	—	—	2.0
Hawkins, Cryogenic, Wood Co H. Watson	950.0	270.0	192	227.0	171.0	32.0	51.0	—	—	45.0	—	526.0
Katy, Waller Co T. S. Reese 110 A-332	925.0	853.0	192	534.0	344.0	99.0	96.0	—	—	205.0	—	1,278.0
King Ranch, Kleberg Co R. King A-172	135.0	134.0	282	—	—	—	—	—	165.0	—	—	165.0
Salt Creek, Kent Co WSNW RR G-193	4.0	1.0	3	—	—	—	—	—	4.0	—	—	4.0
Fort Chadbourne Corp.— Box Elmdale, Callahan Co 4 miles e of Abilene	—	—	4	—	—	—	—	—	—	—	—	—
Gulf Coast Fractionators— Mont Belvieu, Chambers Co	—	—	4	—	—	—	—	—	—	—	—	—
Mont Belvieu, Chambers Co	—	—	4	—	—	—	—	—	—	—	—	—
Hunt Oil Co.— *Fairway, Henderson Co Jose Mora A-497	88.0	78.0	2	—	—	—	—	—	114.7	—	—	114.7
J.L. Davis— Luling, Caldwell Co N. corner John Henry A-12	8.0	3.0	6	—	—	—	—	—	16.0	—	—	16.0
Pearsall, Frio Co	12.0	2.0	6	—	—	—	—	—	2.0	—	—	2.0
Koch Industries Inc.— Mont Belvieu I, Chambers Co Henry Giffin League A-12	—	—	4	(1,589.6)	(1,175.8)	(261.5)	(654.2)	—	—	(571.8)	—	(4,152.9)
Lone Star Pipeline— Santa Anna, Hardeman Co L. Bechtol Survey Sec. 2	3.0	0.2	3	—	—	—	—	—	1.4	—	—	1.4
Louisiana Western— Quilman, Wood Co SG Purse A-456	5.0	1.0	3	—	—	—	—	—	5.3	—	—	5.3
Marathon Oil Co.— Yates, Pecos Co I. G. Yates 194 SF 1234-1	160.0	96.0	283	—	—	—	—	—	35.8	—	—	35.8
Merit Resources— Allen Hill Gas Plant, Tom Green Co 10 blk 22 h&c r r co. survey	1.5	0.6	6	0.1	0.3	0.1	0.2	—	—	0.3	—	1.0
Mustang Fuel Corp.— Chapel Hill, Smith Co Stillwell Box A-169	15.0	5.1	7	—	5.4	1.6	2.0	—	—	5.4	0.5	15.3
Noram Energy Corp.— Willow Springs, Gregg Co P. P. Hains	10.0	8.0	3	—	—	—	—	—	6.5	—	—	6.5
Northridge Corp.— *Daedmona, Eastland Co	1.0	0.8	3	—	—	—	—	—	4.3	—	—	4.3
Onex Field Services— Arrington, Carson Co 62Blk. A2, H&GN RR	40.0	30.1	2,3	—	—	—	—	—	54.9	—	—	54.9
Canadian complex, Hemphill Co 216 G&MMB&A	25.0	25.5	7	—	—	—	—	—	67.6	—	—	67.6
Cargray, Carson Co. 46-4 H&GN	30.0	7.1	7	—	—	—	—	—	76.8	—	—	76.8
Gray, Gray Co. 152 Blk. 3 H&GN RR	20.0	17.4	7	—	—	—	—	—	104.2	—	—	104.2
Lafors, Gray Co. 2-1-ACH&B	11.0	9.0	7	—	—	—	—	—	86.6	—	—	86.6
Sinnett, Moore Co. 1 TT RR	80.0	38.9	7	—	—	—	—	—	178.2	—	—	178.2
Onyx Gathering Co. (Arch Petroleum)— Taff, San Patricio Co Coleman Fulton Pasture Land	40.0	15.8	282	—	3.8	—	3.6	—	—	3.3	0.5	11.2
Oxy USA Inc.— Welch, Dawson Co. 67-EL&RR-M	15.0	10.6	283	—	—	—	—	—	14.4	—	—	14.4
Penacole Gas Treating Inc.— Fishing, Atascosa, and Karnes Cos.	65.0	24.5	192,288	—	—	—	—	—	0.5	—	—	0.5
Propeiter Natural Resources USA— Fain, Potter Co. GSM 1D-1B1-B	140.0	97.4	6,7.8	—	—	—	—	—	392.5	—	0.5	506.7

Company, plant location	MMcfd		Process/ condition method	Production 1,000 gpd (average based on the past 12 months)								
	Gas capacity	Gas through- put		Ethane	Prop.	Isobut.	Normal or unsplit butane	LPG mix	Raw NGL mix	Debut. nat. gaso.	Other	Total products
Pawnee, Bee Co. BS&F A-127 W1/2 NE	50.0	29.0	78									
Questar Gas Management Co.— Kelton, Wheeler Co.	20.0	11.8	7						36.3			36.3
Rayco Inc.— Novice, Coleman Co. 24 blk. 2	4.5	0.2	3						<			
Regard Resources Co. Inc.— Huntsville, Walker Co.	1.5	0.8	4						0.5			0.5
Longview, Gregg Co.	1.5	0.5	4						0.3			0.3
Samis Oil Co.— Armadillo, Pecos Co. GC&SF R-3-5	2.0	0.0	2									
Shannon Energy Corp.— Mobeetie, Wheeler Co. 46-B&K A-5 H&GN	2.3	1.0	3						2.5			2.5
Shell Western EBP Inc.— Denver Unit CO., Yoakum Co. NW 1/4 B27 SW 1/4 B.	140.0	202.4	2	57.9	139.1	24.1	58.6		79.4			359.1
Houston Central, Colorado Co. F. Mayhar A-400 K. Winn A-589	700.0	488.0	2.7	181.6	135.6	33.7	38.6			82.1		471.6
Terrill, Terrill Co. SW 4 SE 4	250.0	145.7	1									
Tippett, Crockett Co. 39-31-H&TC RR	55.0	4.0	6	5.1	4.3							11.8
Sid Richardson Energy Services Ltd.— Coyanosa, Pecos Co. 18-143-T&SL RR	100.0	100.3	7.78						249.5		612.6	262.1
Keystone, Winkler Co. 5-BZ PSL	160.0	93.1	7.8						385.5		67.3	392.8
Tippett, Crockett Co. 39-31-H&TC RR	58.0	55.3	7						190.2			190.2
Sulphur River Exploration— * Bryan's Mill, Cass Co. B. F. Lynn A-651	70.0	30.7	2									11.4
Edgewood, Van Zandt Co. 2 Roberts A-702	65.0	28.0			11.2					6.1	691.4	61.9
Jonesville, Harrison Co.	25.0	20.0	182						30.0			30.0
Sulphur River Gathering LP— East Texas, Gregg Co. William Castleberry A-38	34.0	20.1	7.8						142.0			142.0
Eustace, Henderson Co.	70.0	32.2	6.7.8						84.1			84.1
New Hope, Franklin Co.	30.0	16.4							41.7			41.7
Tejas Gas Corp.— Runge, Karnes Co.	27.0	13.0	7						22.0			22.0
Tidelands Oil & Gas— Chittim, Maverick Co. 35-6	22.0	1.0	7		2.0		2.0			1.0		5.0
Torch Operating Co.— Snyder, Scurry Co. 16-1 JP Smith	60.0	15.0	7		35.0				208.0			244.0
TriStar Gas Co.— Benedum, Upton Co. W 1/2 46 Y MK&T RR	90.0	90.5	7	187.7	121.7	14.3	37.2			27.4		388.3
Bypass, Upton Co.	30.0	28.6	7	41.0	19.1	2.7	7.7			5.9		76.4
United Texas Transmission Co.— Galveston Bay, Chambers Co. J. Armstrong A-2	40.0	10.5	7						4.1		60.1	4.2
Universal Resources Corp.— Kelton, Wheeler Co. AB8BA sec. 3	20.0	9.7	7						26.5			26.5
Unocal—Dollard, Andrews Co. 25-452-PSL	13.0	8.5	6						61.2			61.2
North Riley, Gaines Co. 365-G-CCSDRNGG	2.5	2.3	3						12.0			12.0
Van, Van Zandt Co. JWS A-891	15.0	11.9	361		6.7		11.3			13.4		31.4
Upton Oil & Gas Co.— Bridgeport, Wise Co. Wm. Harsee survey	10.0	4.0	292		5.0		2.8		4.0			11.8
Holland, Palo Pinto Henry Bird Survey	2.0	1.0	3						4.1			4.1
USAgas Pipeline Co.— McLeod I, Williams R. Myers a-766	15.0	12.0	7						18.0		60.4	18.4
McLeod II, Williams R. Myers a-766	8.0	8.0	7						8.0			8.0
Valenco Operating Co.— Cumo, Hopkins Co. Nacogdoches Univ. #19 A-703	40.0	23.5	7.8				28.9				636.5	65.4
W.W. Solt Inc.— Markley, Jack Co. SFRR A-583	2.0	0.2	3						0.6			0.6
West Texas Gas Inc.— Jack County System, Jack Co. a of Antelope	12.0	3.0	4									
Midway Lane, Crockett	25.0	11.0	4						50.0			50.0
West Texas Gas Processing LP— East Vealmoor, Howard Co. 20-27-H&TC	42.0	22.0	2						250.0			250.0
Western Gas Resources Inc.— Sole Ranch, Martin Co. 23-27-1n	16.0	10.0							70.0			70.0
Midkiff-Benedum, Reagan Co. Upton Co.	165.0	148.0	6.7	157.7	181.8	20.4	65.4			41.2	664.3	530.8
Mitchell Puckett, Pecos Co.	120.0	75.0	3									
Whiting Petroleum— Sable	4.0	2.2									61.2	1.2
Williams Cos.— Bee County, Bee Co.	58.0	38.0	7						52.7			52.7
Wiser Oil Co.— Wellman, Terry Co.	28.0	27.0	3									
Total	16,654.3	11,745.5		5,610.0	4,211.6	840.6	1,458.0	539.4	13,751.7	1,687.3	1,870.4	29,968.9

APPENDIX C

TCEQ List of Facilities of Interest for Gas-fired Reciprocating Engine Information

County	Facility Owner/ Name	Pipeline Size (in)	STARs Acct number	RN	Last em inv date	Notes
1. Angelina	Koch/Lufkin	24	none			RRC data shows TETC as only 24" pipeline operator in Angelina. One TE 4922 acct, RN102575529, has air acct no., AC0149G (Lufkin Pump Station) but no available permit or STARs info; Other 4922s w/info in Angelina: AC0119P, RN101927960 - Vantex Diboll Compressor Stn, lies along pipeline S. of Lufkin, pmt35568 - 2 Cat engines (700 hp G398TA and 415 hp G379TA); ; Others that do not apply: RN104663984, MME Desoto, lies along MME pipeline just E. of Lufkin, 1 889 hp engine; RN104925003 - HPL Zavalla site, 3 engines, 98.77 tpy NOx, but not on pipeline route;
2. Austin	FC/PLC	?	no info			Only 2 4922 in CR: RN100681410 - Bellville Compressor Station - Enterprise (formerly El Paso / Gulfterra) - no STARs or permit info; RN104661293, Kinder Morgan San Felipe, one 1,175 hp and one 3,350 hp Cat engines, Nox 71.99 tpy
3. Bee	Coastal/Burnell Pettus Jct.	4	BE0030Q ?	RN102662814	1990	1995 registration indicates one 350 hp compressor on the site; no other equipment; Coastal acquired by El Paso Corporation in 2001
4. Bee	TETC/Karon	18	none	RN101992857		No permit or inventory info
5. Bee	Coastal/Beeville	4	none	no info		Coastal acquired by El Paso in 2001
6. Bosque	LS/Walnut Springs	6	none	RN102910924	none	listed under SIC 1311; no air permit info listed
7. Brazas	FCPLC	8	none			there is an account, BM0072J, RN102568847, permit by rule 14696(1983), covering a 1,000 hp compresso
8. Brazas	FCPLC	8	none			
9. Brazas	FCPLC	8	none			
10. Camp	Koch/Gilmer	19, 8	no info	RN102319985 / RN104318498		Now Delhi; no air permits info
11. Collin	LS/Collin SE	20	see comment			Does SE refer to steam electric? CP0065C is a TXU (former parent of Lone Star) natural gas fired plant, SIC 4911. 4922 accts in Central Registry, but with no permit or account info, are RN104201116, DUKE ENERGY FIELD SERVICES PIPELINE COLLIN COUNTY and RN104584198, ETC TEXAS PL PIPELINE COLLIN COUNTY

12. Colorado	NGPL/Hruzek	30	none			2 RNs found for 4922s in Colorado, that match the 30" pipeline routes, but no air permit info listed for 1(near Provident City) and could not find details on info listed for the other(Unit Tx Transmission in Eagle Lake). 30" pipeline operators in Colorado are HPL, KM, and El Paso(El Paso near Hruzek settlement by Nada).
13. Cooke	LS/Gainesville W.	16	none	RN102198090 ?		Only 2 4922 in CR: RN100729995, Cooke County Gas Pipeline Co, NSR acct CV0057J, no other permit info; and RN104317250, Enbridge Gathering, listed w/ Air Permits but no info.
14. Denton	LS/Denton #3	16	DF0097I?	RN102310224	1998	Could not find Denton #3 site; this is the only Lone Star or Atmos 4922 account in Denton Co with any air related info; site has received inventory requests as recently as 2004, but has not met update requirements since 1998.
15. Fannin	LS/Valler S.E.	10, 16				Does this refer to Valley Steam Electric plant? Found no STARS 4922 accts; found 3 Central Registry 4922 accts, but no air permit info listed for any
16. Freestone	LS/Big Brown S.E.	12	see comment			Does SE refer to steam electric? F10020W is a TXU coal fired plant with a natural gas fired boiler. Checked STARS, Central Registry, Google
17. Goliad	TGPL/#5	24		RN102567559		No info in STARS or air permits other than air permits account - GF00151, owned by Transcontinental Gas Pipeline Corp.
18. Houston	Koch/Crockett	6				Koch has a site in STARS with 6 active turbines(1997), but it is SIC 1321 and listed as Grapeland; three 4922s other than TPCC/#7 were listed, but could not find any STARS or air permit info for these
19. Lavaca	Shell-Valero	20				No Valero in STARS; 3 in Central Reg, but no air permit info listed for those
20. Limestone	LS/Waco	24	no info			checked STARS, Central Registry, Google search
21. Limestone	LS/Thelma	12	no info			checked STARS, Central Registry, Google search
22. Limestone	LS/Kirk	12	no info			checked STARS, Central Registry, Google search
23. Limestone	LS/Box Church Dehyd. Pt.	4	LI0073E? LI0095R (95R not in STARS)		1994?	1994 data for LI0073E (Pennzoil) has a glycol unit; no engines listed in STARS; under SIC 1311 there also is a Box Church Compression unit owned by St. Mary Land & Exploration (RN100833730, LI0095R) is authorized under exemption 38160 which shows 4 engines for 4200 hp total and sitewide NOx PTE of 69 tpy

24. Limestone	LS/Olethe	10	none in STARs			Possible sites RN100837087, LI0072G (Marathon; PBRs 25008 (1996 to 2003), 31555, and PBR 47361); RN104271556, no acct # (ETC, PBR 72111, 2004);
25. Limestone	LS/McBee	10	none			Central Registry has a TXU Fuel Company McBee Compressor station, active RN102579364, air acct LI0053K, but no permit info, and no permit info from IMS or Groupwise; no info on Google
26. McLennan	LS/SE Tradinghouse Creek	20				No 4922 accts for McLennan county in STARs or Cent Registry; there is a TXU Tradinghouse SE (Steam Electric) Plant
27. McLennan	LS/Tradinghouse	20				same as above?
28. Morris	Reliant/Lone Star	12				Three 4922 sites in Morris County, but no STARs or air permit info associated with them
29. Panola	Valero/Beckville	20	PB0047O	RN102941663	1990	Now owned by Enterprise; permit data shows one permit by rule (25613) authorizing a 3,600 hp turbine; 3 turbines are listed in STARs, but that is 1990 data
30. Panola	Reliant/E. Carthege	20				checked STARs, Central Registry, Google search
31. Panola	Reliant/Sabine	20	PB0125T	RN102495470	never	no structure in STARs, Central Registry shows Centerpoint as the company now; covered by NSR Permit by Rule 36846; 1998 documents from this show two 530 hp CAT G398TA engines
32. Panola	Reliant/Beckville	?	PBA004 D?			found a Markwest SIC 4922 station, RN104401930, PBA004D, RNPermit by rule 73823, with 10 engines and 195 tpy potential Nox.
33. Robertson	LS/Bryan	24	none			No STARs 4922 for Robertson Co. ; found five 4922 accts in Central Registry, 2 with air permit info RN102563327, Devon Bald Praire(near Kosse), 3 >500 hp engines; and RN104340666, Tom Brown Inc Tom Brown Honea site (near Franklin), one 1,340 hp Cat
34. Rusk	HPL/Mt. Enterprise	30	no info	RN104205687 ?		RRC data shows a 30" pipeline under HPL. TCEQ data shows 2 RNs under HPL for Rusk. One is the Henderson Compressor Stn, a 1311 acct with an account number but no other data; the other is for the pipeline segments. No Mt. Enterprise listed in STARs. A Mt. Enterprise gathering site was found through an electronic search of New Source Review Permit documents - exemption 36408 - 1997 docs show one 418 hp engine and a glycol unit run by Standard Gas Services. Best match may be RN104621586, PBR 76040 covers a Energy Transfer's Minden-HPL compressor station with 2 - 1,340 hp Cat engines (site is 10

						miles N of Mt Enterprise).
35. Tarrant	LS/North Main	20	none			No air permits info listed for 492.. Sites in Tarrant
36. Tarrant	LS/Saginaw	10	none			No air permits info listed for 492.. Sites in Tarrant
37. Tarrant	LS/Eagle Mountain	16	none	RN102441284		No air permits info listed for 492.. Sites in Tarrant
38. Walker	TPCC/#6	26	none	RN102964525		Now owned by Kinder Morgan; RN listed with air permits, but no other info

APPENDIX D

Major Gas Processing and Pipeline Facilities Contacted by ERG

County	Former Owner/Plant Name	Pipeline Size (in)	Current Owner/Plant Name	Information Provided by Owner
Bosque	Lone Star-Walnut Springs	6	Unknown	Neither Atmos nor Energy Transfer Co. knows about this site.
Burleson	Aquila Gas Pipeline-Somerville	Gas Plant	Energy Transfer Co.-Somerville	The plant and all compressors have been removed. There were four compressors on site.
Collin	Lone Star-Collin SE	20	Atmos-Collin S.E.	This is a metering station for a TXU Steam Electric Plant. No compression occurs here.
Cooke	Lone Star-Gainesville W.	16	Atmos-Gainesville W.	This site has no compressors and is not a compression station.
Denton	Lone Star-Denton #3	16	Atmos-Denton #3	This site has no compressors and is not a compression station.
Fannin	Lone Star-Valley S.E.	10, 16	Atmos-Valley S.E.	This is a metering station for a TXU Steam Electric Plant. No compression occurs here.
Freestone	Lone Star-Big Brown S.E.	12	Atmos-Big Brown S.E.	This is a metering station for a TXU Steam Electric Plant. No compression occurs here.
Limestone	Lone Star Waco	24	Unknown	Neither Atmos nor Energy Transfer Co. knows about this site.
Limestone	Lone Star Thelma	12	Energy Transfer-Thelma	This site has no compressors and is not a compression station.
Limestone	Lone Star-Kirk	12	Energy Transfer-Kirk	This site has no compressors and is not a compression station.
Limestone	Lone Star-Groesbeck -XXX	18, 20	Atmos-Groesback	This Site has compressor engines.
Limestone	Lone Star-Box Church Dehy. Pt.	4	Atmos-Box Church Dehy Pt.	This site has no compressors and is not a compression station.
Limestone	Lone Star-Olethe	10	Energy Transfer-Olethe	This site has no compressors and is not a compression station.
Limestone	Lone Star-McBee	10	Energy Transfer-McBee	This Site has compressor engines.
McLennan	Lone Star-Tradinghouse Creek SE	20	Atmos-Tradinghouse Creek	This is a metering station for a TXU Steam Electric Plant. No compression occurs here.
McLennan	Lone Star-Tradinghouse	20		Duplicate of the Tradinghouse Creek site.
Morris	Reliant-Lone Star	12	Centerpoint-Lonestar plant	Inoperative for past ten years.
Panola	Reliant-E. Carthege	20	Unknown	Not owned by Reliant/Centerpoint
Panola	Reliant-Sabine	20	Centerpoint-Sabine plant	This Site has compressor engines.
Panola	Reliant-Beckville	?	Unknown	Not owned by Reliant/Centerpoint
Panola	Valero-Beckville	20	Valero-Beckville	The facility has 3 Solar turbines, but no engines.

Robertson	Lone Star-Bryan	24	Unknown	Neither Atmos nor Energy Transfer Co. knows about this site.
Rusk	HPL-Mt. Enterprise	30	Energy Transfer Co.-Mt. Enterprise	This site has no compressors and is not a compression station.
Tarrant	Lone Star-North Main	20	n/a	The North Main site is now closed.
Tarrant	Lone Star-Saginaw	10	Atmos-Saginaw	This site has no compressors and is not a compression station.
Tarrant	Lone Star-Eagle Mountain	16	Energy Transfer Co.-Eagle Mountain	This is a compressor station but it is has two electric units.

APPENDIX E

Questionnaire and Authority Letter Sent To Surveyed Facilities

Kathleen Hartnett White, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
Larry R. Soward, *Commissioner*
Glenn Shankle, *Executive Director*



TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

Re: Request for participation in a project: inventory of emissions from compressor engines in the natural gas industry

Dear Potential Site Participants:

The Texas Commission on Environmental Quality (TCEQ) is conducting research on emissions from natural gas compressor engines. Specifically, the study will focus on engines with capacities larger than 500-horsepower operating at oil or gas wellhead sites, gas plants, and pipeline compressor stations located in counties east of Interstate Highway 35. The data collected from the facilities will be used to develop a more complete emissions inventory for compressors in the east Texas counties.

The Houston Advanced Research Center (HARC) is assisting the TCEQ in this effort by sponsoring research on this source type. The TCEQ is seeking your company's assistance with this study by asking you to participate in a survey conducted by HARC's contractor, Eastern Research Group (ERG). The TCEQ, HARC, and ERG have worked together in the planning and development of this survey. For your convenience, a survey form is enclosed to obtain necessary data from compressor engines operating at your site. Only relevant data will be used in the development of a countywide emissions inventory for the above stated group of compressor engines.

Upon completion, the final report developed from this survey from HARC to TCEQ will not disclose the site names, locations, or operating companies. HARC is not conducting this study in conjunction with a TCEQ investigation and the study results will not be used to target specific sites for future TCEQ investigations. However, participation in this study will not preclude the TCEQ from investigating any participating sites according to standard agency operation and procedures in the future.

Please complete the enclosed form and return it to Mr. Clint Burklin of ERG by July 21, 2006, using the return address on the form. To request more information about participation in this

P.O. Box 13087 • Austin, Texas 78711-3087 • 512/239-1000 • Internet address: www.tceq.state.tx.us

Potential Site Participant
Page 2

study, please contact Mr. Burklin at (919) 468-7874, or by emailing him at Clint.Burklin@erg.com.

The TCEQ appreciates your assistance in this study. To request more information regarding this study, please feel free to contact Mr. Bertie Fernando, P.E., of my staff by emailing him at BFERNAND@tceq.state.tx.us, or by calling him at (512) 239-1536.

Sincerely,

A handwritten signature in black ink that reads "Candice Garrett". The signature is written in a cursive style.

Candice Garrett, Director
Air Quality Planning and Implementation Division
Texas Commission on Environmental Quality

Enclosure

CG/BF/mh

Houston Advanced Research Center Survey of Gas Compressor Engines Please complete this form for the natural gas compressor stations in _____ County. Once completed, please fold the form so that the stamp and return address are outside, tape the form closed, and drop in the mail by _____. Thank you very much for helping with this study.

Owner Name: _____

Name of person completing this form: _____

Site Name: _____

Title: _____

On-site Activities: (circle) compression, dehydration, NGL separation, NG storage Phone _____

Numbers: _____ Site Location: _____

Email address: _____

Engine Information	Engine 1	Engine 2	Engine 3	Engine 4	Engine 5
Engine HP					
Date Engine placed into service					
Burn type and cycle (2 cycles/4 cycles, rich burn/lean burn)					
2000 fuel use (thousand scf)					
2002 fuel use (thousand scf)					
August 2002 fuel use (thousand scf)					
2002 Compressor throughput (thousand scf/yr)					
Weekly operating hours for 2000					
Weekly operating hours for 2002					
Engine load during operating hours for 2000					
Engine load during operating hours for 2002					
Engine manufacturer and model					
Engine emission controls (i.e. NSCR catalyst)					
Est'd NOx emissions (in g/hp-hr) and basis: test data, AP-42, vendor certification)					
Estimated annual NOx emissions for 2002 (tons/yr)					

APPENDIX F

Engine Data Submitted by Facilities

Site 1:

Owner Name: Atmos Energy Corp

Name of person completing this form: Rob Bennett

Title: Manager, Environmental Services

Site Name: Groesbeck Compressor Station

On-site Activities: (circle) compression, dehydration, NGL separation, NG storage

Phone Numbers: (214) 206-2858

Site Location: 2 miles north of Groesbeck on Hwy 14, Limestone County

Email address: robert.bennett@atmosenergy.com

Engine Information	Engine 1	Engine 2
Fuel (natural gas, diesel)	natural gas	natural gas
Engine HP	1350	1350
Date Engine placed into service	1978	1978
Burn type and cycle (2 cycles/4 cycles, rich burn/lean burn)	lean burn	lean burn
2000 fuel use (thousand scf)		
2002 fuel use (thousand scf)		
August 2002 fuel use (thousand scf)		
2002 Compressor throughput (thousand scf/yr)		
Weekly operating hours for 2000		
Weekly operating hours for 2002		
Engine load during operating hours for 2000		
Engine load during operating hours for 2002		
Engine manufacturer and model	Fairbanks, MEP-6	Fairbanks, MEP-6
Engine emission controls (i.e. NSCR catalyst)	None	None
Est'd NOx emissions (in g/hp-hr) and basis: test data, AP-42, vendor certification)	4.4689 lbs/mmbtu, Manufacturer	4.4689 lbs/mmbtu, Manufacturer
Estimated annual NOx emissions for 2002 (tons/yr)		

Houston Advanced Research Center Survey of Gas Compressor Engines

Please complete this form for the natural gas compressor stations in Parola County. We have 3 sites - Carthage, Sabine, and Beckville. Once completed, please email back the completed form. Thank you very much for helping with this study.

Owner Name: Center Point Energy Gas Transmission

Name of person completing this form: Lynette Jaynes

Site Name: Sabine

Title: Environmental Specialist

On-site Activities: (circle compressor) dehydration, NGL separation, NG storage

Phone Numbers: (518) 429-3036

Site Location: Sabine Texas

Email address: lynette.jaynes@centerpointenergy.com

Engine Information	Engine 1	Engine 2	Engine 3	Engine 4	Engine 5
Engine HP	550HP	550HP			
Date Engine placed into service	1976	1976			
Burn type and cycle (2 cycles/4 cycles, rich burn/lean burn)	4 th Rich	4 th Rich			
2000 fuel use (thousand scf)	35,040	35,040			
2002 fuel use (thousand scf)	35,040	35,040			
August 2002 fuel use (thousand scf)	2976	2976			
2002 Compressor throughput (thousand scf/yr)	2,732,800	2,732,800			
Weekly operating hours for 2000	8760	8760			
Weekly operating hours for 2002	8760	8760			
Engine load during operating hours for 2000	90-100%	90-100%			
Engine load during operating hours for 2002	90-100%	90-100%			
Engine manufacturer and model	CATERPILLAR 6.3187A	CATERPILLAR 6.3187A			
Engine emission controls (i.e. NSCR catalyst)	w/c	w/c			
Est'd NOx emissions (in g/hp-hr) and basis: test data, AP-42, vendor certification)	2.00 g/hp-hr Test Data	2.00 g/hp-hr Test Data			
Estimated annual NOx emissions for 2002 (tons/yr)	21.22	21.22			

Site 2:

Site 3:

E-mail from Environmental Manager for the site-

>>> "Cowan, Clint" <Clint.Cowan@energytransfer.com> 8/7/2006 1:53:29 PM >>>

The compressor at the McBee pipeline compressor station in Limestone county has recently been changed out. Currently the site will have a Cat 3508 TAW a(545hp) and will operate 8760 hr/yr/. The permit application was submitted to the TCEQ last week. The old compressor was removed from the site last week.

APPENDIX G
QUALITY ASSURANCE PROJECT PLAN

**NATURAL GAS COMPRESSOR ENGINE SURVEY AND ENGINE NO_x
EMISSIONS AT GAS PRODUCTION FACILITIES**

Quality Assurance Project Plan

Prepared by
Eastern Research Group, Inc.
Morrisville, NC

March 30, 2005
Revised December 9, 2005
Revised January 16, 2006

Clint Burklin, ERG Project Manager: _____

Ray Merrill, ERG QA Manager: _____

Alex Cuclis, HARC Project Manager: _____

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A3. Distribution List

Clint Burklin	ERG	clint.burklin@erg.com	919-468-7874
Mike Heaney	ERG	mike.heaney@erg.com	919-468-7870
Ray Merrill,	ERG	ray.merrill@erg.com	919-468-7887
Regi Oommen	ERG	regi.oommen@erg.com	919-468-7829
Jennifer O'Neil	ERG	Jennifer.oneil@erg.com	919-468-7811
Melodie Vines	ERG	melodie.vines@erg.com	919-468-7823
Scott Sholar	ERG	scott.sholar@erg.com	919-468-7951
Alex Cuclis	HARC	acuclis@harc.edu	281-364-4049
Bertie Fernando	TCEQ	bfernand@tceq.state.tx.us	512-239-1536
Dave Harper	TCEQ	dharper@tceq.state.tx.us	512-239-1463
Charlie Rubic	TCEQ	crubic@tceq.state.tx.us	512-239-1478
Steve Anderson	TCEQ	sanderson@tceq.state.tx.us	512-239-1246

A4. Project Organization

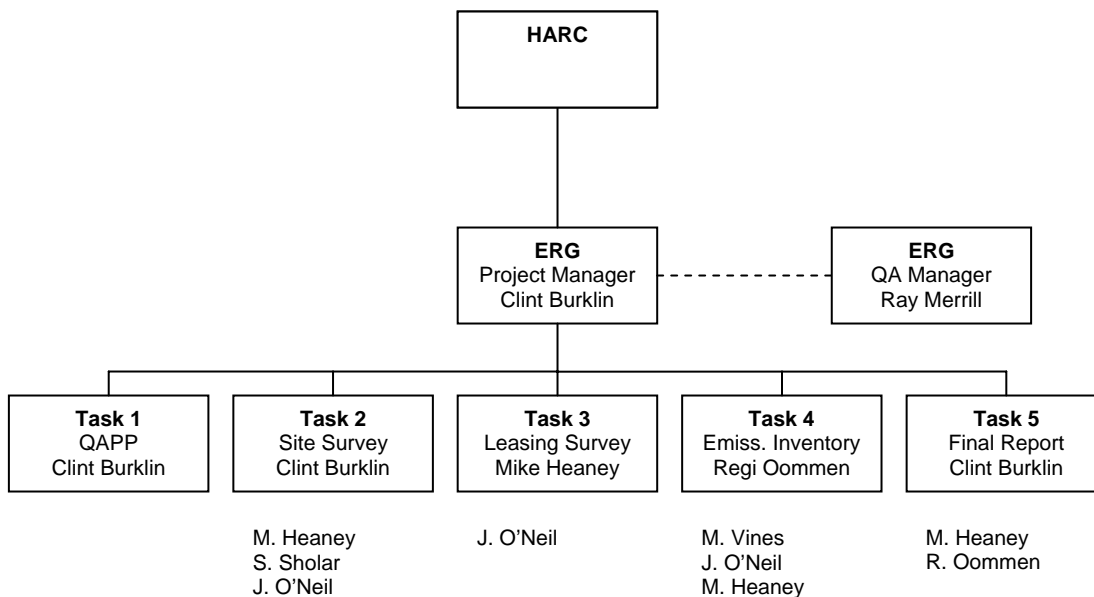
A4.1 Purpose of Study

The purpose of Phase 1 of this project is to collect relevant technical information to estimate the distribution of compressor engines associated with natural gas wells. The information will be collected from gas production operations that are located in the counties bisected by and east of Texas Interstate Highways 35 and 37 (IH-35 & 37). The technical data collected under the scope of work will be used by the Texas Commission on Environmental Quality (TCEQ) to compare equipment parameters and equipment usage, to quantify accurately nitrogen oxide (NOx) emissions and to perform control strategy analyses on compressor engine emissions associated with gas producing operations in eastern Texas.

The purpose of Phase 2 of this project is to inventory all remaining compressor engines used in the production and distribution of natural gas in the counties bisected by and east of Texas Interstate Highways 35 and 37 (IH-35 & 37), that were not covered in Phase 1 of the study.

A4.2 Roles and Responsibilities

The project organization is presented in the figure below. The responsibilities of each staff are listed following the figure.



Clint Burklin:

Task 1: Quality Assurance Project Plan

- Develop QAPP
- Provide audit materials to QA Manager
- Respond to corrective action requests from QA Manager

Task 2: Survey of Gas Well Compressor Sites

- Provide technical direction to technical team
- Develop the criteria for selecting questionnaire recipients
- Prepare cover letter for questionnaire
- Manage selection of producers for site visits
- Train field survey team

Task 3: Survey of Leasing Companies

- Peer review questionnaire for Leasing companies
- Peer review list of leasing companies for survey

Task 4: Develop Emission Inventory

- Peer review inventory factors
- Peer review inventory algorithms and results
- Peer review projection factors for 2007

Task 5: Final Report

- Prepare monthly progress reports
- Manage preparation of final report

Task 6: Phase 2 Study

- Peer review data collection
- Manage preparation of Phase 2 Report

Mike Heaney

Task 2: Survey of Gas Well Compressor Sites

- Identify all descriptive well and compressor data at TRRC
- Assemble questionnaire
- Assemble field survey forms
- Design database

Task 3: Survey of Leasing Companies

- Develop survey form
- Conduct leasing survey

- Develop inventory factors from field survey and leasing survey

Task 4: Develop Emission Inventory

- Implement inventory using TRRC data, inventory factors, AP-42 factors
- Identify available TRRC data for projecting activity in 2007

Task 5: Final Report

- Report on field and lease survey findings
- Report on development of inventory factors, activity data, emission factors
- Report on projecting 2007 emissions

Task 6: Phase 2 Study

- Data collection for engines ≥ 500 hp
- Preparation of Phase 2 Report for engines ≥ 500 hp

Regi Oommen

Task 4: Develop Emission Inventory

- Manage inventory development
- Direct development of emission inventory database
- Direct development of NEI database
- Establish criteria for modeling ozone season day

Task 5: Final Report

- Report on development of emission inventory database
- Report on developing NEI database

Task 6: Phase 2 Study

- Manage inventory development
- Direct development of emission inventory database
- Direct development of NEI database
- Establish criteria for modeling ozone season day

Ray Merrill

Task 1: Quality Assurance Project Plan

- Review QAPP
- Execute QA activities throughout project
- Monitor response to corrective action requests

Jennifer O'Neil

Task 2: Survey of Gas Well Compressor Sites

- Obtain addresses and contact information for 50-80 gas producers
- Coordinate mail-out of questionnaires
- Enter data from questionnaire respondents into database
- Schedule site visits
- Enter site survey data into database

Task 3: Survey of Leasing Companies

- Enter leasing survey data into database

Task 4: Develop Emission Inventory

- Enter TRRC data into inventory database

Scott Sholar

Task 2: Survey of Gas Well Compressor Sites

- Conduct site surveys
- Complete site survey forms

Melodie Vines

Task 4: Develop Emission Inventory

- Code NEI Database using the Emission Inventory Database

Task 6: Phase 2 Study

- Code NEI Database using the Emission Inventory Database

A5. Project Definition and Background

The purpose of Phase 1 of this project is to collect relevant technical information to estimate the distribution of compressor engines associated with natural gas wells. The information will be collected from gas production operations that are located in 115 counties bisected by and east of Texas Interstate Highways 35 and 37 (IH-35 & 37). The development of emission estimates for gas compressor engines will require detailed information of actual activity data as well as the engines distribution and population in a number of selected representative gas producing counties. The compressor engine data that is currently available does not meet the requirements needed to perform emissions estimations for compressor engines. The project activities will collect data that will be used to estimate and allocate compressor emissions by identifying the distribution of compressor engines, their capacities, fuel type and usage, operating parameters, and the spatial allocation of the engines and temporal allocation of the engines' operations. The database containing this information will be used in conjunction with AP-42 emission factors and TRRC activity data to develop the county level inventory of criteria pollutants.

The purpose of Phase 2 of this project is to inventory all remaining compressor engines used in the production and distribution of natural gas in the counties bisected by and east of Texas Interstate Highways 35 and 37 (IH-35 & 37), that were not covered in Phase 1 of the study. This includes engines used in gas plant compressors and gas transmission compressors. The efforts under Phase 2 of the study are described in Task 6 of the project description.

A6. Project Description

Task 1: Quality Assurance/Quality Control (QA/QC) Procedures

ERG will develop a draft and final Quality Assurance Project Plan (QAPP), with a discussion of the quality assurance/quality control procedures to be followed by the ERG staff. The QAPP will meet Environmental Protection Agency (EPA) QAPP requirements found in EPA/240/B-01/-003. All work will be completed in accordance with the QA/QC procedures specified in the QAPP. Within 10 days of receiving HARC comments, ERG will finalize the QAPP. The final QAPP must be approved before Task 2, 3, 4, and 5 are conducted.

Task 1 Deliverables: A draft and final QAPP.

Deliverables Dates: Draft QAPP due January 17, 2005
Final QAPP due February 7, 2005

Task 2: Survey of Gas Well Compressor Sites

A field survey will be conducted for 45 representative gas well compressor sites owned or operated by 30 different companies. The 45 gas well compression sites for the field survey will be from counties located east of IH-35 and 37, or transected by IH-35 and 37. A minimum of 10 representative gas well companies will be selected from each of the three Texas Railroad Commissions (TRRC) gas districts # 2, 3 and 6. The following items will be identified and agreed upon in consultation with the HARC Project Manager prior to the survey activity begins:

- Selection of representative survey sites
- Development of survey forms and planning of the field surveys
- All other activities related to the Compressor field survey

Initially, 200 or more different gas producing or operating companies will be selected and survey questionnaires will be mailed to the selected producers or operators, based on gas production capacities. Based on their response, 45 gas compressor sites will be chosen from 30 companies for field surveys, 15 gas compressor sites in each of three TRCC districts. The chosen gas well compressor sites will be representative of the range of compressors operating in the counties east of Texas IH-35 & 37. A wide range of gas well owners or operators will be selected such that in a given TRRC gas district there shall be no more than two sites that will be owned or operated by the same company. However, if more than two compressor sites are located in the same vicinity which are owned or operated by the same company, then ERG will collect as much survey data on the additional compressor sites as practical (on the day of the initially planned survey of two sites). This additional data will be in addition to the minimum number of 45 survey data sets

required. This effort will maximize the collection of data from a wide range of gas wells using a variety of equipment and also cover a wide range of equipment usage in the field, based on the

well operator's equipment requirements, and experience. The selection of counties and associated gas well compression sites will be made with the consultation and approval of the HARC Project Manager. The initial well information and well identifications will be obtained from the TRRC well information database. The questionnaires mailed to the gas well producers or operators will include the following information requests:

1. Identification of recommended representative compressors to be surveyed,
2. The gas well(s) TRRC ID number(s), and the TRRC site location data for the gas wells that supply gas to the recommended compressor,
3. Information that can be used to assess the accessibility of compressor sites prior to the survey, and
4. The names and points of contact for the producers/operators.

The sites will be moderately accessible. Appropriate permissions from the owner/operator will be obtained prior to the survey activities. The gas wells will be selected to encompass a spectrum of production and operating parameters to provide representative characteristics of the selected sites. ERG will document that the selected wells are representative of other gas wells based on available TRRC parameters such as well head pressures, gas chemical composition, production rates, production activities and the equipment size/usage as compared to those of the other wells in the same production or reservoir area.

ERG will identify the name and gas capacity of the reservoir which supplies the candidate compressor's feed using TRRC information. We will identify low and high pressure wellhead values of the gas wells selected. If necessary to complete a questionnaire, ERG will follow-up the questionnaires mailed to the gas well producers or operators and the resulting response information by interviewing the producers or operators.

The HARC project manager must approve the selected sites.

The field survey visits will collect the information required to estimate the criteria pollutant emissions from the compressor engines, and to model the emissions from all engines east of IH-35 & 37. A field survey form will be developed by ERG and approved by HARC prior to conducting the fields survey. Example information for the survey form includes:

1. Total number of compressor engines at a site, the engine heat input, the estimated engine design horse power and brake horse power, the engine manufacturer, and the engine model number as it may appear on the engine for each engine,
2. Number of each engine type (4-stroke, 2-stroke, . . .),
3. Rate and type of fuel burned for each engine,
4. Burn type: rich/medium/lean for each engine,

5. Natural gas throughput (by hour and estimated by month and year), flow rate and/or meter readings (use flow meter readings), inlet and outlet compressor pressures (use gauge values), and pipe diameters for each engine,
6. Estimated number of hours of engine operation per month and per year for each engine,
7. The number of wells that are supplying gas to each compressor,
8. The identification of the well(s) supplying gas to each compressor. (Identification numbers of each of the gas wells connected to the compressor shall follow the TRRC system of well identifications.),
9. The actual compressor location (latitude and longitude) shall be identified by using GPS or other means as approved by HARC so that the well(s) locations can be referenced to the TRRC data,
10. Crank RPMs (to be used to estimate load factor),
11. Well location (with RRC references and measured GIS data) and a “plan” sketch of the well sites, including the gathering pipes and compressor locations,
12. Gas wellhead pressure,
13. Indicate if compressor engines selected are operating under TCEQ permit or under Permit by Rule requirements and document all relevant permit and operating data,
14. Air pollution controls used (if any),
15. Any other supporting data that will help develop a comprehensive database to prepare information on the distribution of compressor engine horse power ratings, operating parameters, and their distribution,
16. Typical compressor engine load profile (percent time @ 100, 90, 80, 70, . . . percent full load) or simply the typical compressor engine load (running at steady state), and
17. Date of compressor engine manufacture.

The field data sheets will be recorded clearly and legibly, and will be entered into a spreadsheet database immediately following the field trip. All field data will be available for HARC to review as needed.

Task 2 Deliverables: Deliverables will include the survey plans for site visits to 45 or more sites, locations visited, the methods and information used to make the site selections, and all essential data required to be collected as indicated above. The questionnaires mailed to the gas well producers or operators and the resulting response information, the methods and information used to make the site selections, the survey plan, and the field survey data collected will be documented in electronic format, such as Excel spreadsheets and will be delivered to the HARC project representative for HARC review and comments. If additional site visits are planned, ERG will provide the reasons for having to perform additional visits.

<i>Deliverables Dates:</i> Draft questionnaire, survey form, recipient list	January 31, 2005
Final questionnaire, survey form, recipient list	February 14, 2005
Mail questionnaires,	February 14, 2005
Submit survey database structure	February 28, 2005
Receive questionnaires	March 7, 2005
Submit proposed survey sites	March 21, 2005
Complete site visits	May 6, 2005
Submit completed survey database	May 16, 2005

Task 3: Survey of Leasing Companies, Data Analysis, and hp-hr/MCF Factors Estimation Methodology Development

Under this task, ERG will develop a survey form and perform a survey of 6 to 10 compressor leasing companies that offer the potential for obtaining information on compressor engines. The leasing company survey form will be approved by the HARC project manager before the survey is started. Accurate data may be obtained on the size of engines and the compressors, throughput and other “essential information” used in the field in this manner. The leasing companies will be surveyed to collect the following data on their leased fleet of compressors/engines by county (or region):

1. The total number of compressor engines they have in service,
2. An estimate of the total number of gas line compressor engines in service in addition to the ones they supply,
3. Estimation of the total horsepower all companies currently having to operate in each county they serve (> 500 hp and < 500 hp),
4. The ratio of the number of compressor engines with less than 500 hp to engines to the number of compressor engines with greater than 500 hp engines,
5. Of the engines < 500 hp, what percentage are < 400 hp, < 300 hp, < 200 hp, and < 100 hp,

For the remainder of the list, the leasing companies survey will also collect data on compressor engines in the ranges from 500 to 401 hp, 400 to 301 hp, 300 to 201 hp, 200 to 101 hp, and 100 to 0 hp, by county (or region).

6. Typical compressor engine hp requirements to compress million cubic feet of natural gas per day within a typical operating pressure range (for different hp ranges),
7. Estimated typical compressor operating gas throughput profile (mcf/hr, day, week, month, and/or year),
8. Estimate of percent of engine types (2 cycle, 4 cycle, and any other type),
9. Estimate of age distribution of compressor engines,
10. Typical number of stages of the compressors,
11. Estimate of typical compressor engine burn type (i.e. rich, medium, or lean),
12. Estimate of typical fuel used by the engines,

13. Typical compressor engine load profile (percent time @ 100, 90, 80, 70, . . . percent full load) or simply the typical compressor engine load (running at steady state),
14. Typical inlet and the outlet gas pressures and pipe diameters of the compressors,
15. Typical Number of wells and gas flows serviced,
16. Air pollution control technology type, if any,
17. Estimated pollution control efficiency (if any), by control technology type,
18. Estimated percentage of time the compressor engines operate in the field (monthly, annually),
19. Estimated percentage of time engines in the above stated ranges of hp operate in the field (monthly, annually),
20. Estimated range of gas well-head pressures with respect to the gas field and/or gas reservoirs,
21. Estimated range of gas pipe line sizes and their operating pressures, and
22. Date of compressor engine manufacture.

The field survey data, the leasing company’s data, and the relevant TRRC data will be compared to flag any errors or inconsistencies that need to be resolved before developing emission factors and emissions estimates for gas compressor engines.

Based on the data collected from the field survey and the leasing company survey, ERG will develop hp-hr/MCF factors for engines in the ranges from 500 to 401 hp, 400 to 301 hp, 300 to 201 hp, 200 to 101 hp, and 100 to 0 hp. The hp-hr/MCF factors, will be a function of variables such as engines hp ranges, throughput, fuel type, engine age, engine type, engine burn type, load profiles, percentage of engines in operation per month. Using the total county monthly gas production rates, ERG will estimate what percentage of the gas is compressed by the compressor engines covered in the survey.

The HARC project manager will approve the methodologies and hp-hr/MCF factors developed before Task 4 can begin.

Task 3 Deliverables: The leasing companies survey form, the survey information and data collected, the relevant TRRC data, documentation of the analysis the data, documentation of the development of the new methodology for developing emission factors and emissions estimates for gas compressor engines, the new hp-hr/MCF factors, and estimates will be submitted in electronic format, such as Excel spreadsheets and etc. If needed, HARC will request the contractor to submit original data or document collected in the survey.

<i>Deliverable Date:</i>	Draft lease survey form and list of recipients	February 28, 2005
	Final lease survey from and list of recipients	March 15, 2005
	Complete lease survey	March 28, 2005
	Enter lease survey into database	April 11, 2005
	Submit AP-42 factors and TRRC activity data	May 2, 2005
	Submit Emission factors and activity factors	May 30, 2005

Task 4: Develop an Emissions Inventory

ERG will use TRRC data, TCEQ information on gas compressor engines, the survey data collected, the ERG derived correlations of hp-hr/MCF, EPA traceable emission factors, and projections of future gas production to estimate ozone season day and annual total emissions for each pollutant (NO_x, VOC, SO₂, CO₂, and PM 2.5) from compressor engines for each Texas county east of HI 35 & 37 (This area is inclusive of counties IH-35 and 37 pass through.) for the years 1999, 2002, and 2007. The total annual emissions will be in tons per year for each pollutant and also daily emissions will be in tons per day for each pollutant.

Task 4 Deliverables: Emission inventory information as detailed in Task 4 and the data will be submitted in hard copies and in electronic format, such as Excel spreadsheets. In addition the data will be submitted in the EPA's National Emissions Inventory format.

<i>Deliverable Date:</i>	Draft inventory	July 1, 2005
	Final Inventory	July 29, 2005

Task 5: Final Report

At the conclusion of the study ERG will prepare a final report that includes all relevant documents, and all relevant data, including the information collected in the surveys, the results of all derived data and correlations with reference to each county surveyed, and technical discussions of the patterns of the compressor engine distributions in terms of variables such as their capacities, hp ranges, throughputs, and other operating parameters. All other data collected in this study will be documented with the supporting data in the final report. The emissions inventory will be included in the final report with estimates of the uncertainty of the emissions estimates. The final report will make recommendations for improving the inventory for this category of sources and potential practical control strategies.

Under the reporting task, monthly progress reports will be submitted at the beginning of each month. Monthly reports will follow the format provided by HARC. These monthly reports will include information on any deliverables that have been completed

Task 5 Deliverables: Deliverables will be a draft final and a final report and spreadsheets listing all data collected including the survey information. The final report will be comprehensive and will include the methodologies used in obtaining all information and producing all correlations and emissions estimates.

<i>Deliverable Date:</i>	Draft Final Report	July 11, 2005
	Final Report	July 29, 2005

Task 6: Phase 2

Phase 2 will extend the Phase 1 inventory to include all compressor engines in the gas industry, providing the results in a NIF file.

Well Head Compressor Engines: All well head and casing head gas compressor engines will be inventoried as an area source, using the HARC-40 methodology. The compressors will be grouped by engine type and size. Types will be 2 or 4 stroke, rich or lean burn. Size groups are: <50hp, 50-499hp, and \geq 500hp.

Gas Plant Compressor Engines: These sources should be in the existing NEI, since they are major NO_x sources. We will cross-check the NEI with the latest TCEQ databases of gas plants located in the 110 counties, and will flag any missing gas plants. We will contact the missing gas plants and obtain the necessary compressor engine data for completing the inventory, including engine hp capacities. The FIN and EPN will be retrieved along with the emission data from the TCEQ databases and the NEI. AP-42 emission factors will be used to complete missing emission data.

Pipeline Compressor Station Engines: Some of these sources will be in the existing NEI since they are major NO_x sources. We will cross-check the NEI with a list of compressor stations in the 110 counties, and will flag any missing compressor stations. We will contact the missing compressor stations and obtain the necessary compressor engine data for completing the inventory, including engine hp capacities. The FIN and EPN will be retrieved along with the emission data from the TCEQ databases and the NEI. AP-42 emission factors will be used to complete missing emission data.

Task 6 Deliverables:

1. A supplement to the Phase 1 Final Report to define the assumptions and calculations conducted in this annex activity, including a sample calculation for engines \geq 500 hp.
2. A NIF file with a composite area-source inventory for well head compressor engines and a point source inventory for gas plant and pipeline compressor engines.
3. A CD-ROM of all files and spreadsheets created during this study.

Deliverable Dates:

- | | |
|---|--------------|
| 1. Revise the HARC-40 QAPP- | Dec 15, 2005 |
| 2. Complete the identification of missing gas plants and compressor stations- | Jan 31, 2006 |
| 3. Complete the contact of missing point sources- | Feb 28, 2006 |
| 4. Complete the compilation of the area source NIF file- | Feb 15, 2006 |
| 5. Complete the compilation of the point source NIF file- | Mar 31, 2006 |
| 6. Receive review comments on Draft deliverables- | Apr 15, 2006 |
| 7. Address review comments from HARC- | Apr 30, 2006 |

A7. Quality Objectives and Criteria

The objective of Phase 1 of this study is to develop an accurate county level inventory of natural gas fired compressor engines east of IH-35 & 37. County level gas well activity data will be obtained from TRRC, for the specific years of the inventory. Emission factors for gas fired engines will be obtained from AP-42. The field and lease survey data collected in this study will be used to relate the TRRC activity data and the AP-42 emission factors to yield a county level emission inventory. Therefore the activity-engine relationships developed in this study must be representative of the engines used in eastern Texas, considering variables such as:

- Leased and owned engines,
- High and low volume gas wells,
- High and low pressure gas fields,
- Sparse and compacted well densities.

We will select 45 compressor sites from 30 operators and at least 6 leasing companies to collect the required data. No more than two sites will be selected from any one operator and the 30 operators will be selected equally from three separate TRRC districts with the greatest activity (# 2, 3, and 6).

The databases developed in this study must be well organized, well labeled, and well documented, so that a third party researcher can utilize the data, and reproduce the factors and relationships developed from the database.

Phase 2 of the study will inventory the remaining compressors used throughout the natural gas industry in the counties lying east of IH-35 & 37. All well head and casing head gas compressor engines will be inventoried as an area source, using the Phase 1 methodology. The compressors will be grouped by engine type (stroke and burn) and size (<50 hp, 50-499 hp, and \geq 500 hp). Gas plant compressor engines will be extracted from the existing NEI, since they are major NO_x sources. We will cross-check the NEI with a list of gas plants in the 110 counties, and will flag any missing gas plants. We will contact the missing gas plants and obtain the necessary compressor engine data for completing the inventory. The FIN and EPN will be retrieved along with the emission data from the TCEQ databases and the NEI. Pipeline compressor station engines will be extracted from the existing NEI since they are major NO_x sources. We will cross-check the NEI with a list of compressor stations in the 110 counties, and will flag any missing compressor stations. We will contact the missing compressor stations and obtain the necessary compressor engine data for completing the inventory. The FIN and EPN will be retrieved along with the emission data from the TCEQ databases and the NEI.

A8. Special Training and Certifications

There will be no special training or certifications required for the staff conducting this study. The staff that are developing the activity relationships have more than 25 years experience, each, in emission estimation for engines and similar equipment. The staff that are responsible for compiling the inventory and the NEI database have been performing inventory and NEI quality audits for EPA's Office of Air Quality Planning and Standards for the last 5 years.

A9. Documents and Records

A9.1. Information Included in the Reporting Package

The following documents and records will be developed and maintained by ERG in the conduct of this study. Each item will be submitted to HARC and its designees as a draft for review before being submitted in final form.

Questionnaire and Field Survey Database

A Microsoft Excel 2003 spreadsheet will be developed to store the data collected with the questionnaires and the field surveys. All information in the forms collected by ERG will be entered into the spreadsheet. The database will be submitted to HARC in electronic form. A numeric label will be assigned to each questionnaire and survey form collected in this study and cross referenced to the database entry. At the conclusion of this study the questionnaires and survey forms will be submitted to HARC for documentation.

Leasing Company Database

A Microsoft Excel 2003 spreadsheet will be developed to store the data collected from the leasing company surveys. All information in the survey forms completed by ERG will be entered into the spreadsheet. The database will be submitted to HARC in electronic form. A numeric label will be assigned to each survey form collected in this study and cross referenced to the database entry. At the conclusion of this study the survey forms will be submitted to HARC for documentation.

Compressor Engine Inventory

A Microsoft Excel 2003 spreadsheet will be developed to provide a county level inventory of gas-field and oil-field gas compressor engine emissions in eastern Texas. The spreadsheet will contain activity data from TRRC and emission factors from AP-42. These data will be compartmentalized such that newer data can be substituted at any time to update the inventory. The specific references for all data used in the spreadsheet will be footnoted on the sheet where it appears. The activity relationships developed by ERG will be used in the spreadsheet to estimate the annual tons/yr and the tons/ozone-day county-wide emissions of: NO_x, VOC, SO₂, CO₂, and PM 2.5.

NEI Files

A Microsoft Access 2003 database containing the above compressor inventory and the inventory of gas plant and pipeline compressors will be submitted in NEI 3.0 format to HARC. The *NIF 3.0 Users Guide and Specifications* provided at: <http://www.epa.gov/ttn/chief/nif/index.html> will be used to format and QA/QC the NIF files.

Final Report

The final report in Microsoft Word format will be submitted to HARC at the conclusion of this study. The report will summarize the information collected in the surveys, the derivation of correlations used in the inventory, and technical discussions of the patterns of the compressor engine distributions in terms of variables such as their capacities, hp ranges, throughputs, and other operating parameters. A summary of the emissions inventory will be included in the final report with estimates of the uncertainty of the emissions estimates. The final report will make recommendations for improving the inventory for this category of sources and potential practical control strategies.

Phase 2 Report

The Phase 2 report will be a supplement to the Phase 1 Final Report. It will define the assumptions and calculations conducted in the Phase 2 activity and will provide example calculations.

A9.2. References

There are several references that we will require to conduct this study. These references include:

1. The TRRC Database of gas well information,
2. The TCEQ inventory of Gas Engines,
3. The TCEQ permit files- PBR, and Title V,
4. EPA's compilation of Air Pollutant Emission Factors, AP-42,
5. EPA's Guidelines for Submitting data to the National Emissions Inventory.

Since no environmental samples or analysis will be collected on this project the majority of Section B is not applicable. Section B5 will address quality control of data collection.

B5. Quality Control

It is important that the field survey sites and the leasing companies selected for this study are representative of the activities east of IH-35 & 37 and yield the best inventory possible. When selecting the field survey sites, we will identify sites that represent the range of gas producing sites in eastern Texas. The parameters that will be varied when selecting the survey sites are:

- High and low volume gas wells,
- High and low pressure gas fields,
- Sparse and compacted well densities, and

We will select 45 compressor sites from 30 operators to collect the required data. No more than two sites will be selected from any one operator and the 30 operators will be selected equally from three separate TRRC districts with the greatest activity (# 2, 3, and 6). The list of selected survey sites will be submitted to HARC, along with supporting rationale, for their review and approval.

Since there are relatively few large leasing companies, we will attempt to survey all of the major companies. It is possible that 6 to 8 companies will represent 90% or more of the leased compressor engines and almost 50% of total engines in the gas fields. Therefore a list of at least 6 leasing companies will be submitted to HARC, along with supporting rationale, for their review and approval.

B9. Non-Direct Measurements

The following method will be used to inventory gas and oil well compressor emissions for a given county:

Preliminary talks with engine leasing companies determined that the compression requirements at a site are not predictable based on field characteristics. This is because so many other variables come into play, including age of well, formation porosity, depth, pressure of local gathering lines, etc. However, we may find that there are similarities of compression requirements and compressor station designs between the various TRRC districts.

$$E = \sum_i Q \times F_i \times H_i \times EF_i \times C$$

Where:

E = annual emissions for the county (Ton/yr)

Q = annual gas production for the county (MMscf/yr)

F_i = fraction of compressors using engine type “i”

H_i = heat rate for engine type “i” (mscf of gas/hph of compression)

EF_i = emission factor for engine type “i” (lb/mscf of gas burned)

C = compression requirements of the district (hph/MMscf gas produced)

Factors “F” and “C” will vary by TRRC district, and will be derived from our survey of the compressor station designs used in each district. “EF” will come from AP-42, U.S. EPA’s emission factor manual. “H” is available from engine performance data available from each manufacturer. “Q” is available from the TRRC database of Texas gas wells.

The engine types represented by variable “i” in the above equation include all applicable permutations of 2-stroke/4-stroke, rich-burn/lean-burn, catalyst/non-catalyst, and <50hp/50-499hp/≥500hp.

All data for the gas plant and pipeline compressors will be obtained directly from the NEI or the facilities, and will not be modeled.

C1. Assessments and Response Action

The following table presents the review responsibilities under this project.

Deliverable	Developer	Reviewer
Field survey spreadsheet	J. O'Neil	M. Vines
Lease survey spreadsheet	J. O'Neil	M. Vines
Emission Inventory Spreadsheet	M. Heaney	C. Burklin
NEI Database	M. Vines	R. Oommen
Calculation of Inventory Factors	M Heaney	C. Burklin

The reviewer will note all required corrections on the product, along with their name and the review date. A copy will be returned to the product developer, a copy will be provided to Clint Burklin and a copy will be kept on file. When the corrections are made by the developer, the corrections will be verified by the original reviewer and the name of the reviewer and the date of the "final review" will be placed on the final product.

C2. Reports to Management

Copies of all interim and final reviewed versions of the products listed in Section C2 containing the notes on the correction requirements will be sent to Clint Burklin upon completing each review. A copy of each review iteration will also be kept on file for review by Ray Merrill, the QA Manager and by HARC representatives.

D1. Data Review, Verification and Validation

All spreadsheets and databases will be created with Microsoft Office 2003 products. All columns and rows will have full labels. Footnotes will be provided for each data range in the spreadsheets to indicate the source of the data. All data entered by the ERG will be fully checked by a second team member. All algorithms entered into the software will be checked through manual calculation by a second team member. The staff conducting data entry and the staff conducting reviews will be designated on each page of the software with the date of their activity. The name of each file will include a version number or version date. All versions will be kept for quality control until the completion of the project.

D3. Reconciliation with User Requirements

A memorandum will be prepared for HARC that documents the methodology that will be used to inventory the compressor engines east of IH-35 & 37. The methodology will develop the most accurate county level inventory possible, within the constraints of the AP-42 emission factors and the TRRC activity database. The methodology memorandum will define the available activity data from TRRC, and how it will be used with the results of the survey to estimate the quantity and type of compressor engines used in each county. Supporting documentation will also be submitted with the memorandum for HARC review.

