STATE OF WYOMING

BEFORE THE

ENVIRONMENTAL QUALITY COUNCIL OF THE

IN THE MATTER OF:)
KERN RIVER GAS TRANSMISSION CO.)
MUDDY CREEK COMPRESSOR STATION) Docket No. 09-2601
AIR QUALITY PERMIT MD-7883)

APPEAL OF AIR QUALITY PERMIT MD-7883

1. Kern River Gas Transmission Company ("Kern River") hereby appeals the air quality permit issued by the Wyoming Department of Environmental Quality, Permit No. MD-7883 dated February 17, 2009 ("the Permit"). The Permit is attached hereto as **Exhibit A**.
2. Kern River's address is 2755 E. Cottonwood Parkway, Suite 300, Salt Lake City, Utah 84121. Kern River is represented by Bret Reich, Senior Counsel, Kern River Gas Transmission Company.

I. Background Information

a. Application Process

3. Kern River applied for the issuance of an air quality permit to add a Solar Titan 130-20502S turbine ("Titan 130 turbine") to its existing Muddy Creek Compressor Station located approximately six (6) miles south-southwest of Opal in Lincoln County, Wyoming.

4. As part of the permitting process, The Wyoming Department of Environmental Quality, Air Quality Division ("the Division") requested additional information from Kern River on October 16, 2008.

5. On November 20, 2008, Kern River submitted the additional information requested from the Division. See **Exhibit B**, November 20, 2008 Letter from Kern River to the Division.

6. Part of the information submitted by Kern River was a discussion about pipeline gas compressor restaging. *Id.* The information submitted included the following:

    a. The proposed restaging is a relatively minor shift of the operating envelope of the pipeline gas compressor, to more efficiently match the compressor with the pipeline system increased maximum allowable operating pressure (MAOP). *Id.*

    b. During the restaging process, there is no change to the combustion air compressor or any other components of the gas turbine. *Id.*

    c. During the restaging process, power output, emissions and all other parameters of the gas turbine remain unchanged. *Id.*

7. In the materials provided to the Division on November 20, 2008, Kern River provided a letter from the manufacturer of the five (5) Solar Mars 100 T15000S gas turbines ("Mars 100 turbines"). *Id.*

8. The letter from Solar Turbines Incorporated explained that the purpose of restaging the existing pipeline gas compressor sets is to allow them to operate properly in the revised gas conditions. *Id.* It also explained the following:

a. The scope of work for the compressor restage is restricted to the pipeline gas compressors and does not impact the combustion turbines. *Id.*

b. Restaging is accomplished by changing the compressor's impellers and stators to operate more efficiently. *Id.*

c. The pipeline gas compressor is the driven equipment associated with the Mars 100 turbines. *Id.*

d. The scope of the pipeline gas compressor restage does not impact the operation of the existing Mars 100 turbines. *Id.*

e. The Mars 100 turbines will have identical horsepower, heat rate and emissions characteristics after the restage of the pipeline gas compressors as before the restage. *Id.*

f. There is no emissions increase associated with the pipeline gas compressor restage. *Id.*

9. Because the restaging is limited to the pipeline gas compressors and does not impact the combustion turbines, it is incorrect to identify the proposed restaging as the "restaging of turbines."

b. Proposed Permit Conditions by the Division

10. The Division issued proposed permit conditions as part of the permit application analysiswhich required Kern River to upgrade the Mars 100 turbines with SoLoNO$_x$ technology to achieve 15 ppm$_{vd}$ NOx at 15% O_2 and 25 ppm$_{vd}$ CO @ 15% O_2, and to do so at the first scheduled major turbine exchanges following commercial availability of the SoLoNO$_x$ retrofit.

11. The proposed permit conditions also required that Kern River repair and retest/monitor within seven (7) days any turbine that showed operation outside the emission limits established by the permit.

12. Kern River objected to the proposed permit conditions that required the repair and retest/monitor within seven (7) days of a turbine that demonstrated operation outside the permitted limits

13. Kern River objected to the proposed permit conditions that required Kern River to upgrade the Mars 100 turbines at the first scheduled major turbine exchange following commercial availability of the aforementioned SoLoNO$_x$ technology to achieve 15 ppm$_{vd}$ NOx at 15% O_2 and 25 ppm$_{vd}$ CO @ 15% O_2,.

14. The Division declined to grant additional time to repair and retest a turbine that shows emissions outside the permitted limits.

15. The Division concurred with Kern River that since the Solar Mars 100 turbines have been operating at capacity, restaging the existing Mars 100 turbines will not increase utilization and does not subject them to Prevention of Significant Deterioration review.

16. However, the Division determined that the restaging of the turbines falls under Chapter 6, Section 2 of the Wyoming Air Quality Standards and Regulations and the Best Available Control Technology ("BACT") requirements therein.

c. Issuance of Air Quality Permit MD 7883

17. The Division granted Air Quality Permit MD-7883 authorizing Kern River to install one (1) 16,551 hp Solar Titan 130 turbine and "restaging the compressors on the

existing five (5) 13,192 hp Mars 100-T15000S turbines." See Exhibit A, Permit No. MD-7883, pg. 1.

18. Condition 10(b) in the Permit requires Kern River to repair and retest/monitor within seven (7) days any turbine that shows operation outside the permitted emission limits.

19. Condition 13 of the Permit requires Kern River to submit a BACT analysis for approval prior to the next major turbine exchange for each of the Mars 100 turbines.

20. Condition 13 does not specify whether the requirement pertains to non-scheduled major turbine exchanges.[1]

II. Appeal

21. Kern River hereby appeals the Permit issued by the Division. In particular Kern River contests the inclusion of the permitting requirements in Conditions 10(b) and 13 of the Permit.

22. The Environmental Quality Council is authorized, pursuant to Wyoming Statute 35-11-112(a)(iv) to hear appeals arising from the Division's issuance of air quality permits.

III. Basis for Appeal

23. The requirements in Condition No. 10(b) are arbitrary and capricious, and not supported by the evidence in the record. It is not commercially reasonable to expect that Kern River can both repair a turbine and find a testing company to conduct testing within seven (7) calendar days. To permit a reasonable time period for Kern

[1] The Division has verbally agreed to clarify that Condition 13 only applies to scheduled major turbine exchanges. Kern River requested the Division amend the Permit in correspondence dated April 15, 2009. Because the Permit has not been amended, Kern River is including the issue in this appeal to preserve Kern River's rights under the administrative review process. Kern River believes the Division will address this issue by Permit amendment.

River to repair the turbine and conduct the required testing, Kern River requests the permit be amended to allow Kern River a minimum of sixty (60) days to perform such activities, with the opportunity to seek additional time from the Division, in writing, if necessary. The requirements in Conditon No. 13 of the Permit are not supported by the applicable state and/or federal regulations.

24. Wyoming Air Quality Standards and Regulations Chapter 6, Section 2 requires the application of BACT when seeking approval to construct a new source or modify an existing source.

25. The restaging conducted by Kern River, as described above, does not qualify as a new source or the modification of an existing source.

26. A modification is defined at 40 C.F.R. Part 60.2 as "any physical change in, or change in the method of operation of, an existing facility which increases the amount of any air pollutant (to which a standard applies) emitted into the atmosphere by that facility or which results in the emission of any air pollutant (to which a standard applies) into the atmosphere not previously emitted." (emphasis added).

27. The Division verbally indicated the basis of the decision to include the BACT analysis is 40 C.F.R. Section 60, Subpart GG and KKKK.

28. There is no mention of a compressor, generator or any other driven equipment in 40 C.F.R. Section 60, Subpart GG and KKKK.

29. The regulations define "Stationary combustion turbine" as "all equipment, including but not limited to the turbine, the fuel, air, lubrication and exhaust gas systems, control systems (except emissions control equipment), heat recovery system, and any ancillary components and sub-components comprising any simple cycle stationary

combustion turbine, any regenerative/recuperative cycle stationary combustion turbine, any combined cycle combustion turbine, and any combined heat and power combustion turbine based system. Stationary means that the combustion turbine is not self propelled or intended to be propelled while performing its function. It may, however, be mounted on a vehicle for portability."

30. The driven pipeline gas compressor, where the restaging will occur, is not within the definition of "Stationary combustion turbine."

31. The restaging identified above pertains to the driven pipeline gas compressor, not the combustion turbine.

32. Restaging the pipeline gas compressor driven by the existing Mars 100 turbines will not result in a physical change in the turbine or a change in the method of operation of the turbine that results in an increase in emissions or the emission of a pollutant not previously emitted.

33. The condition required by the Division in paragraph 13 of the Permit therefore has no engineering or environmental quality foundation and is without basis.

34. Condition 13 of the Permit is also objectionable if a BACT analysis is required for a like-kind turbine replacement necessitated by an unexpected turbine failure.

35. A BACT analysis would take weeks to complete and likely several additional days for review and approve by the Division.

36. However, if the BACT analysis were to show a 15 ppm NOx turbine replacement is "economically reasonable," then Kern River would require additional time to restore the capacity of the facility capacity. This is because a 15 ppm NOx turbine may not be readily available, and once located and available, such equipment would require

significant changes to Kern River's turbine control and fuel systems.

37. Kern River estimates that design changes necessitated to accommodate the BACT equipment will take six (6) months simply to locate the equipment and complete the installations.

38. The delay imposed by the Division in returning Kern River's facility to service following an outage is contrary to the public interest and Kern River's existing regulatory and contractual obligations.

39. Should one of the Mars 100 turbines fail without warning, Kern River must act to promptly restore the facility to normal operation and to provide federally-regulated interstate natural gas transmission service under the tariff approved by the Federal Energy Regulatory Commission.

40. The Permit conditions unreasonably interfere with Kern River's ability to meet its tariff obligation.

41. Moreover, there is no basis in the record for the Division to require Kern River to submit BACT analysis for approval prior to the next major turbine exchange for each existing Mars 100 turbine.

III. Conclusion and Request for Hearing

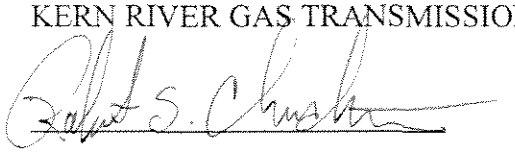
42. Because Condition No. 10(b) establishes a replacement requirement that is unattainable, arbitrarily established and unsupported by the record, Kern River respectfully requests that it be removed from the Permit.

43. Since Condition No. 13 imposes unreasonable conditions that are without record basis, Kern River asks that Condition No. 13 be removed from the Permit.

44. Kern River respectfully requests a hearing on all issues presented by this Appeal before the Environmental Quality Council.

Dated this 15 day of April, 2009

KERN RIVER GAS TRANSMISSION COMPANY



Robert S. Checketts, Vice President Operations, IT and Engineering

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Salt Lake City, Utah 84121

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robert.checketts@kernrivergas.com

CERTIFICATE OF SERVICE

I hereby certify that I mailed two copies of the Appeal by registered mail, return receipt requested to each of the following:

Mr. Dennis M. Boal,
Chairman of the Environmental Quality Council
122 West 25th Street, Room 1714
Herschler Building
Cheyenne, WY 82002

Mr. John Corra,
Director of the Wyoming Department of Environmental Quality
122 West 25th Street
Herschler Building
Cheyenne, WY 82002

Dated this 15th day of April, 2009.

Deanne M Young

EXHIBIT A

Department of Environmental Quality

To protect, conserve and enhance the quality of Wyoming's environment for the benefit of current and future generations.

Dave Freudenthal, Governor

John Corra, Director

February 17, 2009

Mr. Lee Bauerle
Environmental Specialist
Kern River Gas Transmission Company
2755 E. Cottonwood Pkwy., Suite 300
Salt Lake City, UT 84121

RE: Permit No. MD-7883

Dear Mr. Bauerle:

Enclosed please find Air Quality Permit MD-7883 authorizing Kern River Gas Transmission Company to modify the equipment configuration at the Muddy Creek Compressor Station by installing one (1) 16,551 hp Solar Titan 130-20502S turbine and restaging the compressors on the existing five (5) 13,192 hp Mars 100-T15000S turbines. The Muddy Creek Compressor Station is located in the NW1/4 of Section 25, T20N, R115W, approximately six (6) miles south-southwest of Opal, in Lincoln County, Wyoming.

The Division received your comments on January 29, 2009. Our response is as follows:

Comment 1: Condition 10b requires Kern River Gas Transmission Company (KRGT) to repair and retest/monitor the turbine within seven (7) calendar days of a failed test to demonstrate that the turbine is operating within the permitted emission limits. The comment states that more than seven days may be needed to repair the turbine and find an emission testing company to conduct testing on short notice. The comment also included suggested rewording of Condition 10b.

Division's Response to Comment 1: The intent of Condition 10b is to clarify for all operators, in a condition that is practically enforceable, the Division's expectations for repair and retesting when periodic testing required by the permit shows operation outside the permitted emission limits. The timeframe required in Condition 10b is consistent with similar permitting actions and will not be changed. If Kern River Gas Transmission Company cannot meet this timeframe for repair and retesting, then you are encouraged to contact Greg Meeker, District 4 Compliance Engineer, to formally request an extension in which to repair and retest the turbine.

Comment 2: Condition 13 requires KRGT to upgrade the Solar Mars 100-T15000S turbines (S1-S5) with SoLoNO$_x$ technology to achieve 15 ppm$_{vd}$ NO$_x$ at 15% O$_2$ and 25 pmm$_{vd}$ CO @ 15% O$_2$ at the first scheduled major turbine exchanges following commercial availability of the SoLoNO$_x$ retrofit. The comment states that there is no regulatory basis for this condition, and it should be removed.

Division's Response to Comment 2: The Division concurs with KGRT that since the Solar Mars 100-T15000S turbines have been operating at capacity, restaging the existing Mars 100-T15000S turbines will not increase utilization and does not subject them to PSD applicability review. However, the restaging of the turbines falls under Chapter 6, Section 2 of the Wyoming Air Quality Standards and Regulations (WAQSR) and the BACT requirements therein. Through conversations on PSD applicability, the

Division discussed with KRGT the expectation that during the next turbine exchange each Solar Mars 100-T15000S turbine would be upgraded with SoLoNO$_x$ technology once commercially available as a retrofit. Based upon those discussions, the Division did not pursue Chapter 6, Section 2 BACT for the Solar Mars 100-T15000S turbines during the preparation of the application analyses. Therefore, in the interest of the KRGT comment and timely issuance of the permit, Condition 13 has been modified to require the submittal of a BACT analysis for approval prior to the next major turbine exchange for each of the Solar Mars 100-T15000S turbines (S1-S5).

If we may be of further assistance to you, please feel free to contact this office.

Sincerely,

David A. Finley
Administrator
Air Quality Division

cc: Greg Meeker

Department of Environmental Quality

To protect, conserve and enhance the quality of Wyoming's environment for the benefit of current and future generations.

Dave Freudenthal, Governor

John Corra, Director

February 17, 2009

Mr. Lee Bauerle
Environmental Specialist
Kern River Gas Transmission Company
2755 E. Cottonwood Pkwy., Suite 300
Salt Lake City, UT 84121

Permit No. **MD-7883**

Dear Mr. Bauerle:

The Division of Air Quality of the Wyoming Department of Environmental Quality has completed final review of Kern River Gas Transmission Company's application to modify the equipment configuration at the Muddy Creek Compressor Station by installing one (1) 16,551 hp Solar Titan 130-20502S turbine and restaging the compressors on the existing five (5) 13,192 hp Mars 100-T15000S turbines. The Muddy Creek Compressor Station is located in the NW1/4 of Section 25, T20N, R115W, approximately six (6) miles south-southwest of Opal, in Lincoln County, Wyoming.

Following this agency's proposed approval of the request as published January 15, 2009 and in accordance with Chapter 6, Section 2(m) of the Wyoming Air Quality Standards and Regulations, the public was afforded a 30-day period in which to submit comments concerning the proposed modification, and an opportunity for a public hearing. No public comments have been received. Therefore, on the basis of the information provided to us, approval to modify the Muddy Creek Compressor Station as described in the application is hereby granted pursuant to Chapter 6, Section 2 of the regulations with the following conditions:

1. That authorized representatives of the Division of Air Quality be given permission to enter and inspect any property, premise or place on or at which an air pollution source is located or is being constructed or installed for the purpose of investigating actual or potential sources of air pollution and for determining compliance or non-compliance with any rules, standards, permits or orders.

2. That all substantive commitments and descriptions set forth in the application for this permit, unless superseded by a specific condition of this permit, are incorporated herein by this reference and are enforceable as conditions of this permit.

3. That Kern River Gas Transmission Company shall modify their operating permit for the Muddy Creek Compressor Station in accordance with Chapter 6, Section 3 of the WAQSR.

4. That all notifications, reports and correspondences associated with this permit shall be submitted to the Stationary Source Compliance Program Manager, Air Quality Division, 122 West 25th Street, Cheyenne, WY 82002 and a copy shall be submitted to the District Engineer, Air Quality Division, 510 Meadowview Drive, Lander, WY 82520.

5. The owner or operator shall furnish the Administrator written notification of: (i) the anticipated date of initial startup not more than 60 days or less than 30 days prior to such date, and; (ii) the actual date of initial start-up within 15 days after such date in accordance with Chapter 6, Section 2(i) of the WAQSR.

6. That the date of commencement of construction shall be reported to the Administrator within 30 days of commencement. In accordance with Chapter 6, Section 2(h) of the WAQSR, approval to construct or modify shall become invalid if construction is not commenced within 24 months after receipt of such approval or if construction is discontinued for a period of 24 months or more. The Administrator may extend the period based on satisfactory justification of the requested extension.

7. That performance tests be conducted, in accordance with Chapter 6, Section 2(j) of the WAQSR, within 30 days of achieving a maximum design rate but not later than 90 days following initial start-up, and a written report of the results be submitted. The operator shall provide 15 days prior notice of the test date. If a maximum design rate is not achieved within 90 days of start-up, the Administrator may require testing be done at the rate achieved and again when a maximum rate is achieved.

8. Initial performance tests, as required by Condition 7 of this permit, shall be conducted on the following sources:

   i. Solar Titan 130-20502S (S6) turbine:

      NO_x Emissions: Compliance testing for NO_x shall be conducted using EPA Reference Methods 1-4, 7E, 20, and the requirements of 40 CFR part 60, subpart KKKK. Compliance with the lb/hr emission limits shall be determined with three 1-hour tests conducted while the turbine is operating near full load.

      CO Emissions: Compliance testing for CO shall be conducted using EPA Reference Methods 1-4, and 10. Compliance with the lb/hr emission limits shall be determined with three 1-hour tests conducted while the turbine is operating near full load.

   A test protocol shall be submitted for review and approval prior to testing. Notification of the test date shall be provided to the Division fifteen (15) days prior to testing. Results shall be submitted to this Division within 45 days of completion.

9. That emissions from the Solar Titan 130-20502S turbine (S6) at ambient temperatures greater than 0°F shall be limited as follows:

ID	Source	NO_x			CO		
		ppm_{vd} @ 15% O_2	lb/hr	tpy	ppm_{vd} @ 15% O_2	lb/hr	tpy
S6	Solar Titan 130-20502S	15	7.4	32.5	25	7.5	32.9

10a. That the Solar Titan 130-20502S turbine shall be maintained per manufacturer's specifications. Annually, or as otherwise specified by the Administrator, the turbine (S6) shall be tested to determine NO_x and CO emissions. The first annual tests are required the following calendar year after completion of the initial performance tests. Testing for NO_x shall be conducted in accordance with §60.4400 of Subpart KKKK, 40 CFR part 60. Testing for CO shall be conducted concurrently with NO_x testing using EPA reference methods. Emissions in terms of lb/hr shall be calculated using EPA Reference Method 19 and the fuel consumption recorded during testing. Fuel consumption recorded during the tests and a representative gas analysis shall be included in the test report. The Division shall be notified 15 days prior to testing. The results shall be submitted within 45 days of completing the tests.

10b. The Air Quality Division shall be notified within 24-hours of the testing/monitoring required by (a) of this condition shows operation outside the permitted emission limits. By no later than 7-calendar days of such testing/monitoring event, the owner or operator shall repair and retest/monitor the affected turbine to demonstrate that the turbine has been returned to operation within the permitted emission limits. Compliance with this permit condition regarding repair and retesting/monitoring shall not be deemed to limit the authority of the Air Quality Division to cite the owner or operator for an exceedance of the permitted emission limits for any testing/monitoring required by (a) of this condition which shows noncompliance.

11. That the stack height for the Solar Titan 130-20502S turbine (S6) shall be a minimum of 1.5 times the building height.

12. That Kern River Gas Transmission Company shall comply with the requirements of 40 CFR part 60, subpart KKKK for the Solar Titan 130-20502S turbine (S6).

13. That Kern River Gas Transmission Company shall submit a BACT analysis for approval prior to the next major turbine exchange for each of the Solar Mars 100-T15000S turbines (S1-S5).

14. That during startup, shutdown, and blowdown, Kern River Gas Transmission Company shall minimize emissions to the extent practicable. Startup, shutdown, and blowdown activities shall be documented to include the estimated emissions, the number of events, and the steps taken to minimize emissions. Records shall be made available to the Division upon request.

15. That any records required by the conditions of this permit shall be kept and maintained for a period of 5 years.

It must be noted that this approval does not relieve you of your obligation to comply with all applicable county, state, and federal standards, regulations or ordinances. Special attention must be given to Chapter 6, Section 2 of the Wyoming Air Quality Standards and Regulations, which details the requirements for compliance with conditions 3, 5, 6 and 7. Any appeal of this permit as a final action of the Department must be made to the Environmental Quality Council within sixty (60) days of permit issuance per Section 16, Chapter I, General Rules of Practice and Procedure, Department of Environmental Quality.

If we may be of further assistance to you, please feel free to contact this office.

Sincerely,

David A. Finley
Administrator
Air Quality Division

John V. Corra
Director
Dept. of Environmental Quality

cc: Greg Meeker

Table 1: Turbine Emission Factors (ppm)				
Condition	NO_x	CO	UHC	VOC [1]
Solar Titan 130-20502S				
Temp. @ 0 °F	15	25	25	5

[1] VOCs are estimated to be 20% of UHC based on manufacturer information.

Table 2: Turbine Emissions								
Source	NO_x		CO		VOC		Formaldehyde [1]	
	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
Titan 130-20502S	7.4	32.5	7.5	32.9	0.9	3.8	0.09	0.38

[1] Formaldehyde emissions are based on AP-42 Table 3.1-3.

Table 3: Muddy Creek Compressor Station Emissions									
ID	Source	NO_x		CO		VOC		HAPs	
		lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
S1	13,192 hp Mars 100-T15000S	9.9	43.4	12.1	53.0	3.0	13.1	0.31	1.36
S2	13,192 hp Mars 100-T15000S	9.9	43.4	12.1	53.0	3.0	13.1	0.31	1.36
S3	13,192 hp Mars 100-T15000S	9.9	43.4	12.1	53.0	3.0	13.1	0.31	1.36
S4	13,192 hp Mars 100-T15000S	9.9	43.4	12.1	53.0	3.0	13.1	0.31	1.36
S5	13,192 hp Mars 100-T15000S	9.9	43.4	12.1	53.0	3.0	13.1	0.31	1.36
S6	16,551 hp Titan 130-20502S	7.4	32.5	7.5	32.9	0.9	3.8	0.39	1.71
G1	704 hp Waukesha L36GSI [1]	1.3	0.3	1.3	0.3	0.2	<0.1	<0.01	<0.01
G2	851 hp Waukesha L7042GU [1]	13.0	3.2	21.9	5.5	0.2	<0.1	<0.01	<0.01
H1	3.85 MMBtu/hr heater	0.4	1.7	0.3	1.4	<0.1	0.1	<0.01	0.01
H2	3.85 MMBtu/hr heater	0.4	1.7	0.3	1.4	<0.1	0.1	<0.01	0.01
Facility Total		**72.0**	**256.4**	**91.8**	**306.5**	**16.3**	**69.5**	**1.94**	**8.53**

[1] Limited to 500 hours of annual operation.

EXHIBIT B

2755 E. Cottonwood Pkwy. Suite 300
Salt Lake City, UT 84121
(801) 937-6085 office
(801) 937-6312 fax

November 20, 2008

Chad Schlichtemeier
New Source Review Program Manager
Wyoming Department of Environmental Quality
Air Quality Division
122 West 25th Street
Cheyenne, WY 82002

Subject: WAQSR Chapter 6, Section 2 Permit Application
Muddy Creek Compressor Station (AP-7883)

Dear Mr. Schlichtemeier:

Kern River Gas Transmission Company (Kern River) is submitting this letter in response to your October 16, 2008 letter requesting additional information for the Muddy Creek Compressor Station Wyoming Air Quality Standards and Regulations (WAQSR), Chapter 6, Section 2 permit application (AP-7883). The WAQSR Chapter 6, Section 2 permit application was submitted subsequent to Kern River's application filed with the Federal Energy Regulatory Commission (FERC) to increase the pipeline system maximum allowable operating pressure (MAOP) and gas throughput. At Muddy Creek Compressor Station, one new Titan turbine will be used to increase the facility gas throughput. Each existing pipeline gas compressor will be restaged to adapt to the increased pipeline MAOP. Without the compressor restage, the existing pipeline gas compressors will be subject to unfavorable surge conditions which could result in damage to the equipment.

Startup, Shutdown, and Maintenance (Blowdown) Emissions

The average number of startups, shutdowns, and blow downs for each turbine compressor at the Muddy Creek Compressor Station during calendar years 2006 and 2007 has been tabulated and emissions are presented in the attached spreadsheets. Emissions are estimated based on information provided by the turbine manufacturer (see attached Solar Turbine's Product Information Letter 170) and the average number of startups and shutdowns occurring each year. Blow down emissions are estimated based on the anticipated volume of gas blown down each year along with representative gas quality information.

It is Kern River's objective to minimize start up, shutdown and blowdowns. In order to minimize emissions from these activities, Kern River will conduct the following:

- Maintain pressure in the compressor case for extended periods when the compressor is shutdown;
- During normal operation and maintenance, blow down only the compressor case and associated piping, not the whole station piping; and
- Avoid unnecessary compressor starts and stops through planning and control of day-to-day operations.

Gas Throughput and Facility Design Capacity

Historical gas throughput (scheduled flow) and design capacity data for the Muddy Creek Compressor Station are shown on the attached graph entitled *Historical and Proposed Muddy Creek Station Data* along with the design capacity of the facility following the proposed modification. Note that gas throughput data are available only from July 2001 to present. The future gas throughput following the modification is not provided as it is unknown and based on system demand. It is important to note that permitted Mars 100 turbine emissions are based on each unit's maximum design rating at 8,760 hours per year and are not affected by facility gas throughput.

Gas Compressor Restaging and PSD Applicability

Based on information submitted in the Muddy Creek minor source permit application and subsequent communication with the WDEQ, Kern River has been asked to revisit PSD applicability of the proposed project. In the WDEQ's October 16, 2008 letter, it is stated "please note that changes to the method of operation, including debottlenecking and increasing reliability, must be considered when determining PSD applicability." As explained below, the proposed pipeline gas compressor restage is not a modification to the turbine, is not a change in the method of operation of the turbine, and does not result in debottlenecking of the facility.

Information on the definition of modification and combustion turbine terminology is warranted for the purposes of PSD applicability to the proposed project. The PSD rules at 40 CFR 52.01 define *modification* as "any physical change in, or change in the method of operation of, a stationary source which increases the emission rate of any pollutant for which a national standard has been promulgated under part 50 of this chapter or which results in the emission of any such pollutant not previously emitted …"

The existing facility consists of five Solar Mars 100-15000S turbine packages as shown in Figure 1 of the attached *Pipeline Compressor Restage Document* that are used to drive pipeline compressors. Kern River is not proposing to modify any part of the turbine. Instead, it is the pipeline gas compressor, being driven by each turbine, which will be restaged (please refer to attached *Pipeline Compressor Restage Document*). Restaging the pipeline gas compressor will not result in a physical change in, or change in the method of operation of the Mars 100 turbines, nor will restaging each pipeline gas compressor result in an increase in emissions from the Mars turbines (see attached letter from Solar Turbines, Inc.). The restage scope of work is restricted to

replacement of the existing pipeline gas compressor components (impellers and stators) as required to operate at the increased pipeline MAOP.

To expand upon Kern River's October 10, 2008 letter, the pipeline compressor restage only matches the increase in compressor discharge pressure to the increase in pipeline MAOP. The facility throughput will increase following the proposed project solely due to the addition of the new Titan turbine.

The EPA provides the following information on debottlenecking in their proposed three improvements to specific areas of the New Source Review (NSR) program, proposed on September 8, 2006:

A major stationary source often consists of multiple emitting and non-emitting units that comprise integrated processes at the source. As part of the operations of the source or within a process, various pieces of equipment may provide input to or accept output from other equipment or units at the source. These equipment and units at the source may have different operating capacities. When equipment and units of different capacities operate, one unit may constrain other units from operating at their full design capacity or maximum output rating either by limiting inputs to those other units or by limiting usable output. Such constraining equipment and units are commonly called ''bottlenecks'' in a process. The constrained emissions unit(s) can be situated in the process either in advance of the constraining emissions unit (i.e., ''upstream'') or after it (''downstream''). When a constraining unit or piece of equipment is changed to increase its capacity, another unit may increase its operations (depending on whether some or all of the constraint was removed) to provide input to the changed unit or use output from it. We have historically referred to this phenomenon as ''debottlenecking.'' This increased operation of the upstream or downstream emissions unit(s) can contribute to increased emissions from the unit(s).

In the context of the language above, there is no bottleneck on the existing Mars turbines that constrain their operation. The power output and other operating parameters of the Mars gas turbines remain unchanged. The restage of the pipeline gas compressor does not result in a capacity increase. As explained in the attached *Pipeline Compressor Restage Document* and illustrated in Figure 3, gas throughput will actually slightly decrease with the restage. The restage will, however, allow the unit to discharge gas at a higher pressure without approaching its surge limit (surge is what happens after the stability limit of the compressor is passed and can result in damage to the equipment). The higher discharge gas pressure is necessary to meet the proposed increase in MAOP along the Kern River Gas Transmission pipeline system. The higher pipeline MAOP allows Kern River to increase system-wide gas throughput without the need for physical changes to the existing pipeline. Installation of the proposed Titan turbine will contribute to the overall increase of system-wide throughput, and will be the only source of increase in gas throughput at the Muddy Creek station.

Summary

In summary, restaging each pipeline gas compressor driven by the existing Mars 100 turbines will not result in a modification to the turbines as 1) it will not result in an increase in emissions and 2) it will not result in the emission of any air pollutant into the atmosphere not previously emitted. Furthermore, restaging each pipeline gas compressor driven by the existing Mars 100 turbines will not debottleneck the facility as the existing Mars turbines are not a bottleneck on the facility.

If you have any questions or require additional information, please contact me at (801) 937-6085.

Sincerely,

H. Lee Bauerle
Environmental Specialist - Land and Environment

cc: Greg Meeker (WDEQ – Lander)

Attachments

Startup, Shutdown, and Maintenance Emissions

Approximate Startup and Shutdown Emissions Profile
Kern River Gas Transmission Company Muddy Creek Compressor Station

Emission Unit Name/Model	Annual Average Startups	Annual Average Shutdowns	Combustion Emissions Per Start (lbs) NO_x	CO	VOC	Combustion Emissions Per Shutdown (lbs) NO_x	CO	VOC	Gas Loss per Start (lbs) VOC	Total Emissions NO_x (ton/yr)	CO (ton/yr)	VOC (ton/yr)
Titan 130-20502S Unit 6	17	17	1.43	132.68	1.52	1.80	155.70	1.79	37.49	0.03	2.45	0.35
Mars 100-15000S Unit 1	17	17	0.98	89.63	1.02	1.28	107.40	1.23	31.24	0.02	1.67	0.28
Mars 100-15000S Unit 2	17	17	0.98	89.63	1.02	1.28	107.40	1.23	31.24	0.02	1.67	0.28
Mars 100-15000S Unit 3	17	17	0.98	89.63	1.02	1.28	107.40	1.23	31.24	0.02	1.67	0.28
Mars 100-15000S Unit 4	17	17	0.98	89.63	1.02	1.28	107.40	1.23	31.24	0.02	1.67	0.28
Mars 100-15000S Unit 5	17	17	0.98	89.63	1.02	1.28	107.40	1.23	31.24	0.02	1.67	0.28
									Total	0.1	10.8	1.8

Notes:

1. The annual average startups and shutdowns are based on CY-2006 and CY-2007 operation. The number of starts/stops ranged from a low of 7 to a high of 25. The average number of starts/stops for the five existing turbines for CY-2006 and CY-2007 was 17.
2. As the Titan turbine has not yet commenced operation, the number of startups/shutdowns per year is unknown. As the average number of startups of the other turbines is 17 per year, this number is used for the Titan turbine.
3. The actual number of turbine startups and shutdowns may exceed the annual average of 17 due to commissioning activities, mechanical munfunction, or operational requirements.
4. Each turbine uses a gas-assisted starter for each startup. Each Mars 100 turbine uses 50,000 scf of gas per start and the Titan 130 turbine uses 60,000 scf of gas per start.
5. Startup and shutdown emissions are provided by Solar Turbines (see PIL 170) and are for ISO conditions (i.e., sea level, 59F, 60% RH). Emissions will be approximately 25% less at 6600 feet elevation.
6. VOC emissions = 20 percent of UHC emissions per Solar Turbine's recommendation.
7. Each turbine startup is 9 minutes in duration and each turbine shutdown is 8.5 minutes in duration.

Approximate Maintenance (Blowdown) Emissions
Kern River Gas Transmission Company Muddy Creek Compressor Station

Source Description	Annual Blowdown Volume (Mscf) [1]	VOC Emissions (tons)
Facility	564	**0.06**

mass emitted (ton) = gas volume (scf) / 379.3 (scf/lb-mol) * mol % * MW (lb/lb-mol) * (ton / 2000 lb)

Gas Quality Information

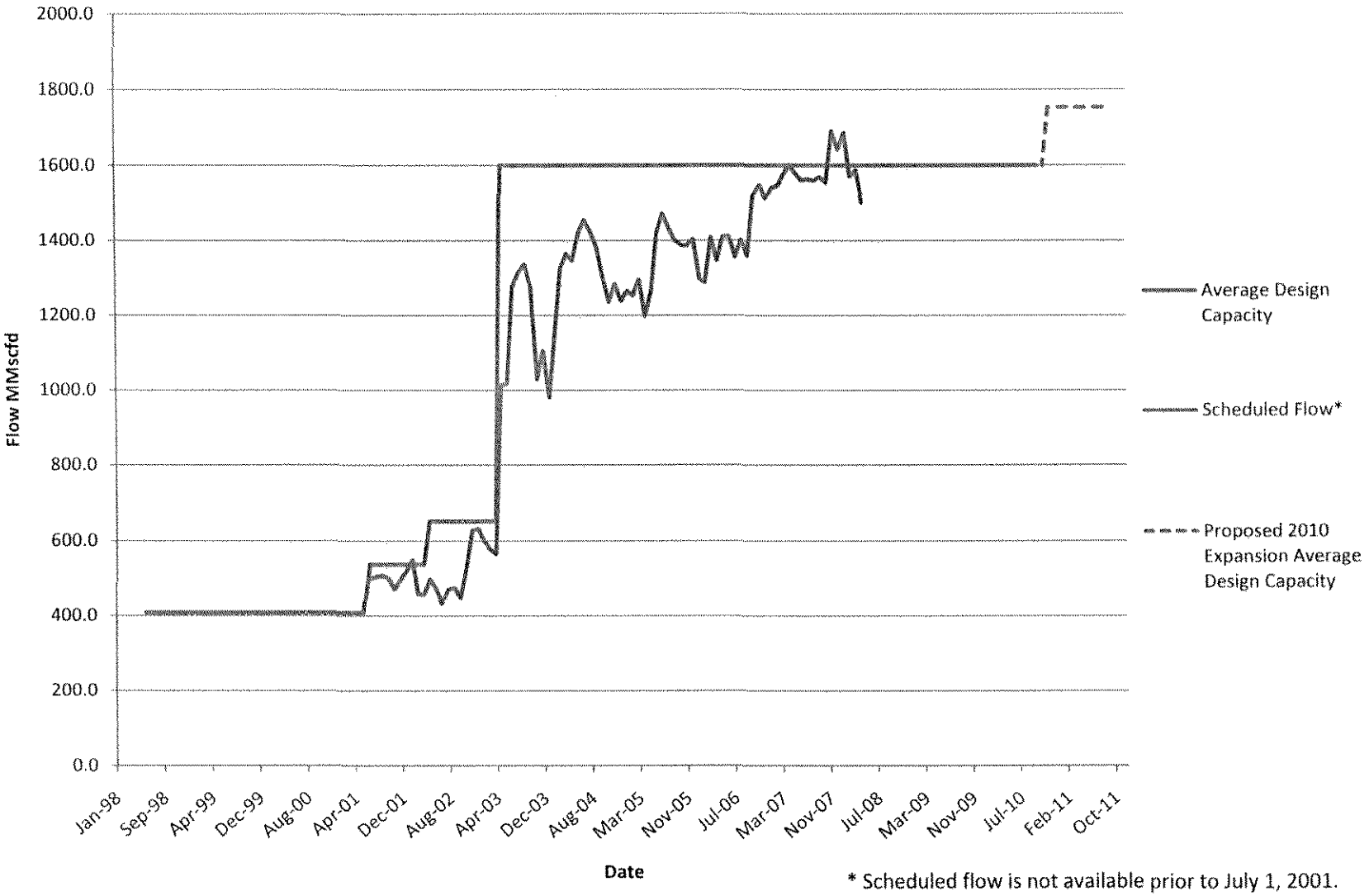
Component	Mole %	MW (lb/lb-mol)	Weighted Sum
H_2S	0	34.08	0.000
N_2	0.297	28.02	0.083
CO_2	0.602	44.01	0.265
C_1	95.478	16.04	15.315
C_2	3.128	30.07	0.941
C_3	0.348	44.09	0.153
i-C_4	0.047	58.12	0.027
n-C_4	0.041	58.12	0.024
i-C_5	0.013	72.15	0.009
n-C_5	0.009	72.15	0.006
C_{6+}	0.019	86.18	0.016
Total	99.98	---	16.840
Total VOC	0.477		

[1] The annual blowdown volume is based on 47,000 scf of gas from each compressor on the Mars 100 turbines.

The amount of gas blown down from the Titan compressor is unknown but expected to be similar to that for the compressor on a Mars 100 turbine.
The facility is blown down twice per year for maintenance.
The blow down volumes do not include station piping or potential ESD events.

Gas Throughput and Facility Design Capacity Information

Historical and Proposed Muddy Creek Station Data



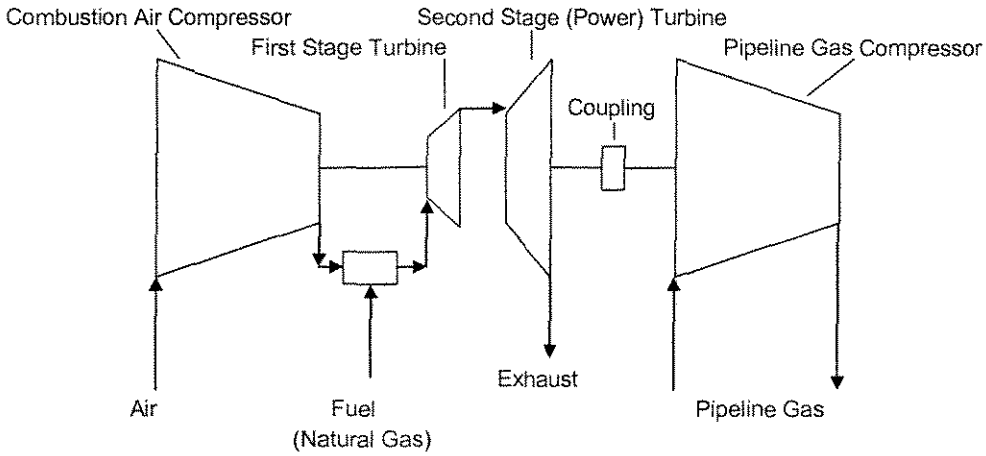
* Scheduled flow is not available prior to July 1, 2001.

Pipeline Compressor Restage Discussion

Kern River Gas Transmission Company
Muddy Creek Compressor Station
Discussion of Pipeline Compressor Restage – Units 1 through 5.

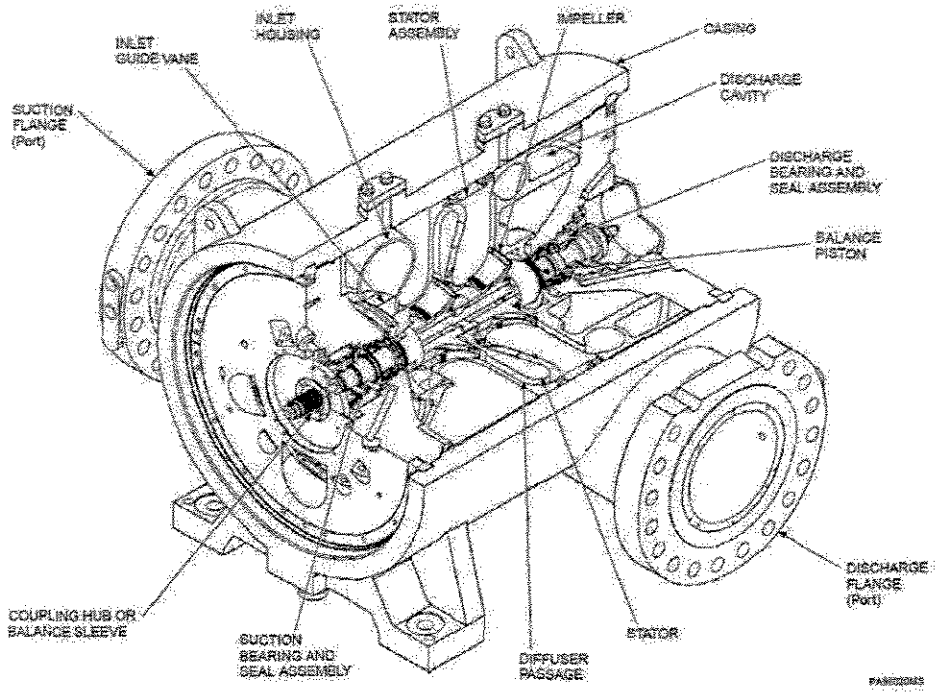
The existing compressor units at the Muddy Creek station each consists of a Solar C-505 pipeline compressor driven by a Solar Mars two-shaft gas turbine with an ISO rating of 15,000 HP. Each Mars gas turbine comprises a 15 stage axial flow combustion air compressor, which is driven by the first stage turbine. Air from this compressor flows to a combustion chamber where natural gas is burned to produce a stream of hot gas which turns the first stage turbine before passing to the second stage (power) turbine, mounted on a separate shaft, and connected through a coupling to the pipeline gas compressor. The general arrangement is shown schematically in Figure 1.

Figure 1: Gas Turbine Driven Pipeline Compressor



Internally, the Muddy Creek pipeline gas compressors are of the centrifugal design with five stages of compression, each stage consisting of a rotating component (impeller), and stationary components (stator), as shown in Figure 2. (For clarity, the Figure illustrates a two stage compressor, but the concept is similar for the five stage units). Changes in pipeline operating conditions may necessitate a change to some or all of these internal components in order to provide a better match between the compressor performance and the pipeline flows and pressures.

Figure 2: Typical Centrifugal Pipeline Gas Compressor



At Muddy Creek, the pipeline system expansion project including the increase in pipeline system MAOP, will require a higher discharge pressure from the station, while the inlet pressure remains unchanged, due to contractual commitments with the upstream suppliers. Because the power available from the Mars gas turbines remains unchanged, and the pressure increase through the compressor increases in order to achieve the higher discharge pressure, then the gas volumetric flow through each compressor will decrease (flow is directly proportional to power, but inversely proportional to pressure increase within the compressor). To achieve the desired operating capability for the increased pipeline system MAOP, it is proposed that the existing compressors will be "restaged", that is, certain internal components will be replaced with others of a slightly different design to provide the desired performance. Specifically, the proposed changes for each stage are as follows:

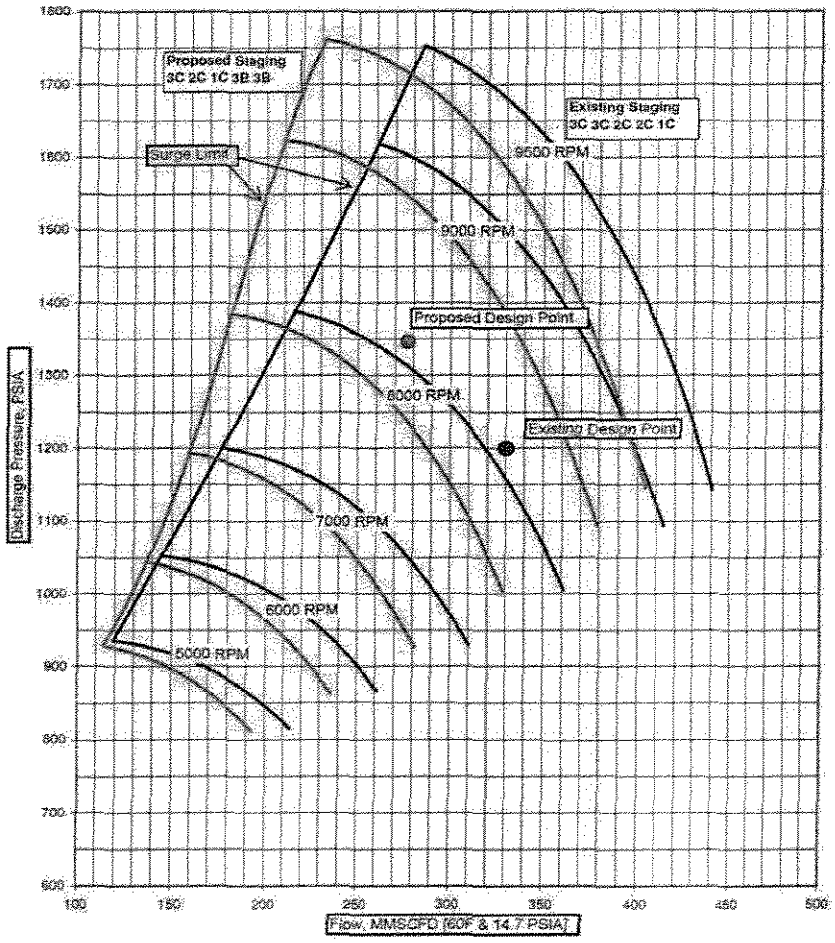
- Stage 1: No change;
- Stage 2: Replace stator;
- Stage 3: Replace stator;
- Stage 4: Replace both stator and impeller;
- Stage 5: Replace both stator and impeller.

The operating diagram for the compressors with the existing and proposed staging is shown in Figure 3. Also shown are the operating points before and after the expansion. This figure shows that the new operating point for the proposed expansion is in fact within the operating envelope for the existing compressor staging, but is close to the surge limit (surge is what happens after the stability limit of the compressor is passed and can result in damage to the equipment). The proposed restage results in the new operating point being in a more efficient and stable region of the operating envelope. Note that the gas throughput decreases slightly with the pipeline compressor restage.

In summary, the proposed restage is a relatively minor shift of the operating envelope of the pipeline gas compressor, to more efficiently match the compressor with the pipeline system increased MAOP. There is no change to the compustion air compressor or any other components of the gas turbine. Power output, emissions and all other parameters of the gas turbine remain unchanged.

Figure 3

Muddy Creek – Existing Compressors



Solar Turbine's Letter

Solar Turbines

A Caterpillar Company

Solar Turbines, Inc.
6973 High Tech Drive
Midvale, UT 84047
Phone: 801-352-5100
Fax: 801-352-5151

November 7, 2008

Mr. Lee Bauerle
Kern River Gas Transmission Company
2755 E. Cottonwood Parkway, Suite 300
Salt Lake City, Utah 84121

Muddy Creek Existing Gas Compressor Restages

Dear Mr. Bauerle,

Kern River Gas Transmission asked Solar Turbines Incorporated to provide Gas Compressor Restage Selections for the five existing *Mars*® 100S compressor sets currently installed and operating at the Muddy Creek Compressor Station. The purpose and eventual result of restaging the existing compressors is to allow them to operate properly in the revised gas conditions.

The scope of work is for the compressor restage is restricted to the gas compressors and does not impact the combustion turbines. Specifically the gas compressor's impellers and stators are being restaged as necessary to operate within the revised site gas conditions.

The gas compressor is the driven equipment associated with the *Mars* 100 15000S combustion turbines. The scope of the gas compressor restage does not impact the operation of the existing *Mars* 100S 15000S combustion turbines. The existing *Mars* 100s are not being modified in conjunction with the gas compressor restage thus the existing *Mars* 100 combustion turbines will have identical horsepower, heat rate, and emissions characteristics after the restage as before the restage. In summary, there is no emissions increase associated with the gas compressor restage.

Regards,
Mike Clay

Accounts Manager
Solar Turbines Inc.
Office: 801-352-5160
Fax: 801-352-5151
Cell: 801-244-1376

Solar Turbines Product Information Letter 170

Solar Turbines
A Caterpillar Company
PIL 170
Product Information Letter

Emission Estimates at Start-up, Shutdown, and Commissioning for *SoLoNOx*™ Products

Leslie Witherspoon
Solar Turbines Incorporated

PURPOSE

Regulatory agencies are asking gas turbine users to quantify emissions during start-up and shutdown events in their air permit. The purpose of this PIL is to provide emission estimates for start-up and shutdown events. The commissioning process is also discussed.

INTRODUCTION

The information presented in this document is representative for both generator set and compressor set/mechanical drive (CS/MD) combustion turbine applications. Operation of duct burners and/or any add-on control equipment is not accounted for in the emissions estimates. Emissions related to the start-up, shutdown, and commissioning of combustion turbines will not be guaranteed.

Combustion turbine start-up occurs in one of three modes: cold, warm, or hot. On large, utility size, combustion turbines, the start-up time varies by the "mode". The start-up duration for a hot, warm, or cold *Solar* turbine is less than 10 minutes in simple-cycle and most combined heat and power applications.

Heat recovery steam generator (HRSG) steam pressure is usually 250 psig or less. At 250 psig or less, thermal stress within the HRSG is minimized and, therefore, firing ramp-up is not limited. However, some combined heat and power plant applications will desire or dictate longer start-up times, therefore emissions assuming a 60-minute start are also estimated.

A typical shutdown for a *Solar* turbine is <10 minutes. Emissions estimates for an elongated shutdown, 30-minutes, are also included.

Start-up and Shutdown emissions estimates for the *Mercury* 50 are found in PIL 205.

For start-up and shutdown emissions estimates for conventional combustion turbines, landfill gas, digester gas, or other alternative fuel applications, contact Solar's Environmental Programs Department.

START-UP EMISSION ESTIMATES

The start-up sequence, or getting to *SoLoNOx* mode, takes three steps:

1. Purge-crank
2. Ignition and acceleration to idle
3. Loading / thermal stabilization

During the "purge-crank" step, rotation of the turbine shaft is accomplished with a starter motor to remove any residual fuel gas in the engine flow path and exhaust. During "igni-

tion and acceleration to idle," fuel is introduced into the combustor and ignited in a diffusion flame mode and the engine rotor is accelerated to idle speed.

The third step consists of applying up to 50% load[1] while allowing the combustion flame to transition and stabilize. Once 50% load is achieved, the turbine transitions to *SoLoNOx* mode and the engine control system begins to hold the combustion primary zone temperature and limit pilot fuel to achieve the targeted nitrogen oxides (NOx), carbon monoxide (CO), and unburned hydrocarbons (UHC) emission levels. Steps 2 and 3 are short-term transient conditions making up less than 10 minutes.

SHUTDOWN EMISSIONS

Normal, planned cool down/shutdown duration varies by engine model. The *Centaur* 40, *Centaur* 50, *Taurus* 60, and *Taurus* 65 take about five minutes. The *Taurus* 70, *Mars* 90 and 100, *Titan* 130 and 250 take about 10 minutes. Typically, once the shutdown process starts, the emissions will remain in *SoLoNOx* mode for ~ 90 seconds and move into a transitional mode for the balance of the estimated shutdown time (assumes unit was operating at full-load).

Tables 1 through 5 summarize the pounds of emissions per start-up and shutdown event for each product. Emissions estimates are presented for both generator and CS/MD applications on both natural gas and liquid fuel (diesel #2). The emissions estimates are calculated using empirical exhaust characteristics.

COMMISSIONING EMISSIONS

Commissioning generally takes place over a two-week period. Static testing, where no combustion occurs, usually requires one week and no emissions are expected. Dynamic testing, where combustion will occur, will see the engine start and shutdown a number of times and a variety of loads will be placed on the system. It is impossible to predict how long the turbine will run and in what combustion / emissions mode it will be running. The dynamic testing period is generally followed by one to two days of "tune-up" during which the turbine is running at various loads, most likely within low emissions mode (warranted emissions range).

Solar Turbines Incorporated
9330 Sky Park Court
San Diego, CA 92123-5398

[1] 40% load for a Titan 250 on Natural gas. 65% load for liquid fuel (80% load for Centaur 40 and Mars 90).

Table 1. Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx Generator Set Applications
10 Minute Start-up and 10 Minute Shutdown
Natural Gas Fuel

Data will NOT be warranted under any circumstances

	Centaur 40 4701S			Centaur 50 6201S			Taurus 60 7801S			Taurus 60 7901S			Taurus 65 8401S		
	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)
Total Emissions per Start (lbs)	0.6	58.1	3.3	0.8	75.0	4.3	0.8	71.9	4.1	0.8	78.5	4.5	0.9	85.8	4.9
Total Emissions per Shutdown (lbs)	0.3	25.5	1.5	0.4	31.1	1.8	0.4	33.0	1.9	0.4	34.7	2.0	0.4	38.2	2.2

	Taurus 70 10301S			Mars 90 13002S GSC			Mars 100 15002S GSC			Titan 130 20501S			Titan 250 30002S		
	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)
Total Emissions per Start (lbs)	1.2	113.0	6.5	1.4	129.0	7.4	1.5	142.7	8.2	2.1	195.6	11.2	3.0	273.1	15.6
Total Emissions per Shutdown (lbs)	1.4	118.2	6.8	1.7	147.9	8.4	1.8	153.5	8.8	2.4	210.0	12.0	3.8	325.6	18.6

Assumes ISO conditions: 59F, 60% RH, sea level, no losses

Assumes unit is operating at full load prior to shutdown.

Assumes natural gas fuel; ES 9-98 compliant.

Table 2. Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx Generator Set Applications
60 Minute Start-up and 30 Minute Shutdown
Natural Gas Fuel

Data will NOT be warranted under any circumstances

	Centaur 40 4701S			Centaur 50 6201S			Taurus 60 7801S			Taurus 60 7901S			Taurus 65 8401S		
	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)
Total Emissions per Start (lbs)	4.1	219.4	13.0	5.0	272.4	16.1	5.4	279.9	16.6	5.7	299.8	17.8	6.1	326.5	19.3
Total Emissions per Shutdown (lbs)	1.8	121.1	7.1	2.3	163.3	9.5	2.3	145.4	8.5	2.5	163.5	9.6	2.6	177.2	10.4

	Taurus 70 10301S			Mars 90 13002S			Mars 100 15002S			Titan 130 20501S			Titan 250 30002S		
	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)
Total Emissions per Start (lbs)	7.5	420.4	24.8	10.5	570.8	33.7	10.6	544.0	32.3	13.8	740.4	43.8	15.3	548.1	34.1
Total Emissions per Shutdown (lbs)	3.4	238.0	13.9	4.3	277.0	16.2	4.6	296.5	17.4	6.0	405.3	23.7	6.4	324.3	19.5

Assumes ISO conditions: 59F, 60% RH, sea level, no losses.

Assumes unit is operating at full load prior to shutdown.

Table 3. Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx CS/MD Applications
10 Minute Start-up and 10 Minute Shutdown
Natural Gas Fuel

Data will NOT be warranted under any circumstances

	Centaur 40 4702S			Centaur 50 6102S			Taurus 60 7802S		
	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)
Total Emissions per Start (lbs)	0.7	64.4	3.7	0.8	69.1	4.0	0.7	64.3	3.7
Total Emissions per Shutdown (lbs)	0.3	30.2	1.7	0.4	35.4	2.0	0.4	33.0	1.9

	Taurus 70 10302S			Mars 90 13002S CSMD			Mars 100 15002S CSMD			Titan 130 20502S			Titan 250 30002S		
	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)
Total Emissions per Start (lbs)	0.8	73.1	4.2	1.2	109.3	6.2	1.3	119.5	6.8	1.9	176.9	10.1	3.1	284.8	16.3
Total Emissions per Shutdown (lbs)	1.1	93.4	5.3	1.5	132.6	7.6	1.7	143.2	8.2	2.4	207.6	11.9	3.6	313.4	17.9

Assumes ISO conditions: 59F, 60% RH, sea level, no losses.

Assumes unit is operating at full load prior to shutdown.

Assumes natural gas fuel; ES 9-98 compliant.

Table 4. Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx Generator Set
10 Minute Start-up and 10 Minute Shutdown
Liquid Fuel (Diesel #2)

Data will NOT be warranted under any circumstances

	Centaur 40 4701S			Centaur 50 6201S			Taurus 60 7801S			Taurus 60 7901S			Taurus 65 8401S		
	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)
Total Emissions per Start (lbs)	1.3	44.5	7.4	1.7	59.0	9.8	1.6	54.1	8.9	1.7	59.8	9.9	1.9	65.3	10.8
Total Emissions per Shutdown (lbs)	0.6	17.3	2.8	0.7	21.2	3.4	0.8	22.3	3.6	0.8	23.5	3.8	0.9	25.9	4.2

	Taurus 70 10301S			Mars 100 15002S GSC			Titan 130 20501S		
	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)
Total Emissions per Start (lbs)	2.5	86.2	14.3	3.1	106.6	17.6	4.3	147.5	24.4
Total Emissions per Shutdown (lbs)	2.7	78.9	12.8	3.5	102.3	16.6	4.7	139.1	22.6

Assumes ISO conditions: 59F, 60% RH, sea level, no losses.

Assumes unit is operating at full load prior to shutdown.

Assumes #2 Diesel fuel; ES 9-98 compliant.

Table 5. Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx Generator Set
60 Minute Start-up and 30 Minute Shutdown
Liquid Fuel (Diesel #2)

Data will NOT be warranted under any circumstances

	Centaur 40 4701S			Centaur 50 6201S			Taurus 60 7801S			Taurus 60 7901S			Taurus 65 8401S		
	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)
Total Emissions per Start (lbs)	11.7	194.7	30.9	15.2	271.9	43.3	15.6	267.5	42.5	14.7	282.6	45.0	15.5	303.6	48.4
Total Emissions per Shutdown (lbs)	4.4	84.7	13.6	6.7	164.3	27.0	6.4	142.4	23.2	6.3	159.0	26.0	6.7	170.8	28.0

	Taurus 70 10301S			Mars 100 15002S			Titan 130 20501S		
	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)
Total Emissions per Start (lbs)	18.6	380.2	60.8	26.3	500.7	79.9	34.4	677.0	108.0
Total Emissions per Shutdown (lbs)	8.3	226.6	37.3	11.2	281.2	46.1	15.0	388.6	63.7

Assumes ISO conditions: 59F, 60% RH, sea level, no losses.

Assumes unit is operating at full load prior to shutdown.

Assumes #2 Diesel fuel; ES 9-98 compliant.