MEMO TO FILE

DATE: April 5, 2016

SUBJECT: Southern Ute Indian Reservation; BP America Production Company, National Historic Preservation Act

FROM: Victoria Parker-Christensen, EPA Region 8 Air Program

TO: Source Files:
205c AirTribal SU BP America Salvador I/II Central Delivery Point
SMNSR-SU-000009-2015.003
FRED # 108006

Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies to take into account the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment with regard to such undertakings. Under the ACHP's implementing regulations at 36 C.F.R. Part 800, Section 106 consultation is generally with state and tribal historic preservation officials in the first instance, with opportunities for the ACHP to become directly involved in certain cases. An "undertaking" is "a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; and those requiring a Federal permit, license or approval." 36 C.F.R. § 800.16(y).

If an undertaking is a type of activity that does not have the potential to cause effects on historic properties, assuming such historic properties were present, the federal agency has no further obligations under 36 C.F.R. § 800.3(a)(1). Under the NHPA Section 106 implementing regulations, federal agencies consult with relevant historic preservation partners to determine the area of potential effect (APE) of the undertaking, to identify historic properties that may exist in that area, and to assess and address any adverse effects that may be caused on such properties by the undertaking. Specifically, 36 C.F.R. § 800.4(b)(1) of the regulations states that federal agency officials shall make a "reasonable and good faith effort" to identify historic properties.

This memorandum describes EPA's efforts to identify historic properties and assess potential effects in connection with issuing a Clean Air Act (CAA) synthetic minor New Source Review (NSR) permit located within the exterior boundaries of the Southern Ute Indian Reservation in La Plata County, Colorado.

Region 8, Air Program Determination

The EPA reviewed the proposed action for potential impacts on historic properties in the area of potential effects (APE). The proposed permit action authorizes construction of a new emission source, and establishes legally and practically enforceable emission limitations for the new emissions source and an existing emissions source. While there is construction of a new emission source, the new source will

be located within the existing footprint of the facility in a previously disturbed area and does not require additional infrastructure (road, power line, pipeline). Because the EPA has determined that the federal action will have no effect, the agency is making the finding of "*No historic properties affected*" for the APE.

Area of Potential Effects

The APE for the existing facility is the location within the area currently occupied by the facility.

Regulation 36 C.F.R. 800.16(d) defines "area of potential effects" - as:

> "… the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking."

The new emission source will be constructed within the existing footprint of the facility in a previously disturbed area and no new infrastructure (road, power line, pipeline) is required.

Permit Request

On October 21, 2015, we received an application from BP America Production Company (BP) requesting a synthetic minor permit for a modification project at the existing Salvador I/II Central Delivery Point in accordance with the requirements of the Tribal Minor New Source Review (MNSR) Permit Program at 40 CFR Part 49. The Salvador I/II Central Delivery Point currently operates as a synthetic minor source of carbon monoxide (CO) with respect to the Prevention of Significant Deterioration (PSD) Permit Program at 40 CFR Part 52 and hazardous air pollutants (HAP) with respect to the National Emissions Standards for Hazardous Air Pollutants (NESHAP) at 40 CFR Part 63, through a synthetic minor MNSR permit (#SMNSR-SU-000009-2015.002) issued on December 4, 2014.

BP requested authorization to construct a new emission source, and establish legally and practically enforceable emission limitations for the new emissions source and an existing emissions source. BP has proposed to construct a new 1,874, or lower, site-rated horsepower (hp) four-stroke lean-burn (4SLB) compressor engine equipped with an oxidation catalyst control system and to establish CO and formaldehyde emission limits and associated operational limitations for the engine. Additionally, on October 30, 2015, BP replaced an existing unpermitted compressor engine with a maximum site-rated 1,138 hp 4SLB compressor engine, and has requested to establish legally and practically enforceable requirements to install and operate an oxidation catalyst control system on that engine and limit CO and formaldehyde emissions. The new emission source will be constructed within the existing footprint of the facility in a previously disturbed area and no new infrastructure (road, power line, pipeline) is required. The site location for the facility is:

S28, T33N, R7W
Latitude 37.07905247, Longitude -107.6182899

Registered Historic Places

The National Park Service maintains an internet resource that can be used to determine whether any registered historic places are within the area of potential effect. The resource is the National Register of Historic Places database, http://www.nps.gov/history/nr/research/index.htm. This resource indicates that the nearest registered historic places are 1) Labo Del Rio Bridge located approximately 11 miles from the facility and 2) several registered historic places located in the city of Durango approximately 19 miles from the facility outside the APE. While the locations of the three (3) sites with restricted addresses, Durango Rock Shelters Archeology Site, Spring Creek Archeological District and Ute Mountain Ute Mancos Canyon Historic District, are unknown, we know they are not within the area of potential effects.

State and Tribal Consultation

Because this proposed permit action does not does not have the potential to cause effects on historic properties, the EPA did not initiated consultation with the Colorado State Historic Preservation Officer.

The EPA offers the Tribal Government Leaders an opportunity to consult on each proposed permit action. The Tribal Government Leaders are asked to respond to the EPA's offer to consult within 30 days and if no response is received within that time, the EPA notifies the Tribal Government Leaders that the consultation period has closed. The Chairman of the Southern Ute Tribe has been offered an opportunity to consult on this permit action via letter dated February 29, 2016. To date, the EPA has not received a response to our offer to consult on this permit action.

MEMO TO FILE

DATE: March 9, 2016

SUBJECT: Southern Ute Indian Reservation; BP America Production Company, Environmental Justice

FROM: Victoria Parker-Christensen, EPA Region 8 Air Program

TO: Source Files:
205c AirTribal SU BP America Salvador I/II Central Delivery Point
SMNSR-SU-000009-2015.003
FRED # 108006

On February 11, 1994, the President issued Executive Order 12898, entitled "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." The Executive Order calls on each federal agency to make environmental justice a part of its mission by "identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority populations and low-income populations."

The EPA defines "Environmental Justice" as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and polices. The EPA's goal with respect to Environmental Justice in permitting is to enable overburdened communities to have full and meaningful access to the permitting process and to develop permits that address environmental justice issues to the greatest extent practicable under existing environmental laws. *Overburdened* is used to describe the minority, low-income, tribal and indigenous populations or communities in the United States that potentially experience disproportionate environmental harms and risks as a result of greater vulnerability to environmental hazards.

This discussion describes our efforts to identify environmental justice communities and assess potential effects in connection with issuing this permit in La Plata County, Colorado, within the exterior boundaries of the Southern Ute Indian Reservation.

Region 8 Air Program Determination

Based on the findings described in the following sections of this memorandum, we conclude that issuance of the permit is not expected to have disproportionately high or adverse human health effects on overburdened communities in the vicinity of the facility on the Southern Ute Indian Reservation.

Permit Request

On October 21, 2015, we received an application from BP America Production Company (BP) requesting a synthetic minor permit for a modification project at the existing Salvador I/II Central Delivery Point in accordance with the requirements of the Tribal Minor New Source Review (MNSR)

Permit Program at 40 CFR Part 49. The Salvador I/II Central Delivery Point currently operates as a synthetic minor source of carbon monoxide (CO) with respect to the Prevention of Significant Deterioration (PSD) Permit Program at 40 CFR Part 52 and hazardous air pollutants (HAP) with respect to the National Emissions Standards for Hazardous Air Pollutants (NESHAP) at 40 CFR Part 63, through a synthetic minor MNSR permit (#SMNSR-SU-000009-2015.002) issued on December 4, 2014.

BP requested authorization to construct a new emission source, and establish legally and practically enforceable emission limitations for the new emissions source and an existing emissions source. BP has proposed to construct a new 1,874, or lower, site-rated horsepower (hp) four-stroke lean-burn (4SLB) compressor engine equipped with an oxidation catalyst control system and to establish CO and formaldehyde emission limits and associated operational limitations for the engine. Additionally, on October 30, 2015, BP replaced an existing unpermitted compressor engine with a maximum site-rated 1,138 hp 4SLB compressor engine, and has requested to establish legally and practically enforceable requirements to install and operate an oxidation catalyst control system on that engine and limit CO and formaldehyde emissions. The site location for the facility is:

S28, T33N, R7W
Latitude 37.07905247, Longitude -107.6182899
Southern Ute Indian Reservation
La Plata County, Colorado

Environmental Impacts to Potential Environmental Justice Communities

Air Quality Review

The Federal Minor New Source Review Regulations at 40 CFR 49.154(d) require that an Air Quality Impact Assessment (AQIA) modeling analysis be performed if there is reason to be concerned that new construction would cause or contribute to a National Ambient Air Quality Standard (NAAQS) or PSD increment violation. If an AQIA reveals that the proposed construction could cause or contribute to a NAAQS or PSD increment violation, such impacts must be addressed before a pre-construction permit can be issued.

The proposed project is estimated to result in an increase in allowable emissions of 21.55 tpy NO_X and 16.23 tpy VOC, and a decrease of 18.91 tpy CO emissions. For both NO_X and VOC, the significant emission rates for existing major PSD sources is 40 tpy. Although the background concentration of ozone in La Plata County is considered relatively high in comparison to the NAAQS, a less than 22 tpy increase in NOx emissions and a less than 17 tpy increase in VOC emissions is expected to have very little effect on ozone relative to the draft ozone significant impact level (SIL) for PSD. Therefore, the impacts to local air quality from the proposed project are not expected to be significant and should not have an adverse impact on attainment of the NAAQS or cause or contribute to PSD increment violation. We have determined that an AQIA modeling analysis is not required for this permit action.

For purposes of Executive Order 12898 on environmental justice, the EPA has recognized that compliance with the NAAQS is "emblematic of achieving a level of public health protection that, based on the level of protection afforded by a primary NAAQS, demonstrates that minority or low-income

populations will not experience disproportionately high and adverse human health or environmental effects due to the exposure to relevant criteria pollutants." *In re Shell Gulf of Mexico, Inc. & Shell Offshore, Inc.*, 15 E.A.D., slip op. at 74 (EAB 2010). This is because the NAAQS are health-based standards, designed to protect public health with an adequate margin of safety, including sensitive populations such as children, the elderly, and asthmatics.

Furthermore, the permit contains a provision stating, "*The permitted source shall not cause or contribute to a National Ambient Air Quality Standard violation or a PSD increment violation.*" Noncompliance with this permit provision is a violation of the permit and is grounds for enforcement action and for permit termination or revocation. As a result, we conclude that issuance of the aforementioned permit will not have disproportionately high or adverse human health effects on communities in the vicinity of the Southern Ute Indian Reservation.

Tribal Consultation and Public Participation

The EPA offers the Tribal Government Leaders an opportunity to consult on each proposed permit action. The Tribal Government Leaders are asked to respond to the EPA's offer to consult within 30 days and if no response is received within that time, the EPA notifies the Tribal Government Leaders that the consultation period has closed. The Chairman of the Southern Ute Tribe has been offered an opportunity to consult on this permit action via letter dated February 29, 2016. To date, the EPA has not received a response to our offer to consult on this permit action.

All minor source applications (synthetic minor, modification to an existing facility, new true minor or general permit) are submitted to both the EPA and the Tribal Environmental Director per the application instructions (see http://epa.gov/region8/air/permitting/tmnsr.html). The Tribal Environmental Office has 10 business days to respond to the EPA with questions and comments on the application. In the event an Air Quality Impact Assessment (AQIA) is triggered, a copy of that document is emailed to the tribe within 5 business days of receipt by the EPA.

Given the presence of potential environmental justice communities in the vicinity of the facilities, the EPA is providing an enhanced public participation process for this permit. Interested parties can subscribe to an EPA listserve that notifies them of public comment opportunities on the Southern Ute Indian Reservation for draft air pollution control permits via email at http://epa.gov/region8/air/permitting/pubcomment.html.

Additionally, the Tribe's Environmental Director is notified of the public comment period for the proposed permit and provided copies of the notice of public comment opportunity to post in various locations on the Reservation that they deem fit. The Tribe is also notified of the issuance of the final permit.

Tribal Consultation and Enhanced Public Participation

Given the presence of potentially overburdened communities in the vicinity of the facility, we are providing an enhanced public participation process for this permit.

1. Interested parties can subscribe to an EPA listserve that notifies them of public comment opportunities on the Southern Ute Indian Reservation for proposed air pollution control permits via email at http://www2.epa.gov/region8/air-permit-public-comment-opportunities.

2. All minor source applications (synthetic minor, modification to an existing facility, new true minor or general permit) are submitted to both the Tribe and us per the application instructions (see http://www2.epa.gov/region8/tribal-minor-new-source-review-permitting).

3. The Tribe has 10 business days to respond to us with questions and comments on the application.

4. In the event an AQIA is triggered, we email a copy of that document to the Tribe within 5 business days from the date we receive it.

5. We notify the Tribe of the public comment period for the proposed permit and provide copies of the notice of public comment opportunity to post in various locations of their choosing on the Reservation. We also notify the Tribe of the issuance of the final permit.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
1595 Wynkoop Street
Denver, CO 80202-1129
Phone 800-227-8917
http://www.epa.gov/aboutepa/epa-region-8-mountains-and-plains

Ref: 8P-AR

FEB 2 9 2016

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

The Honorable Clement Frost
Chairman, Southern Ute Indian Tribe
P.O. Box 737
Ignacio, Colorado 81137-0737

RE: Notification of Consultation and Coordination with Respect to the Issuance of Air Pollution Control Construction Approval Permit Pursuant to the Tribal Minor New Source Review (MNSR) Permit Program

Dear Chairman Frost:

The U.S. Environmental Protection Agency Region 8 is initiating consultation and coordination with the Southern Ute Indian Tribe with respect to issuance of a construction approval permit for a modification of an existing BP America Production Company natural gas facility operating on the Southern Ute Indian Reservation.

BP America Production Company is requesting approval to make a modification to the existing Salvador I/II Central Delivery Point. The Salvador I/II Central Delivery Point is an existing minor source of air pollutant emissions through a MNSR permit the EPA issued in 2012 (Permit #SMNSR-SU-000009-2012.002) with enforceable restrictions on natural gas compressor engine emissions. Upon compliance with a final permit, the modification project would result in minor increases in air pollutant emissions, but the facility would remain a minor source of emissions.

This consultation and coordination process is being conducted based on the *EPA Policy on Consultation and Coordination with Indian Tribes* (www.epa.gov/tribal/consultation/consult-policy.htm). The EPA invites you and your designated consultation representative(s) to participate in this process. The EPA's anticipated timeline for the consultation and coordination period extends to 30 days after you receive this letter.

In addition to offering government-to-government consultation, the EPA plans to regularly coordinate and communicate with the Tribe's Environmental Program Division Head, Thomas Johnson, and the Air Quality Program Manager, Mark Hutson, for facilities located within the exterior boundaries of the Southern Ute Indian Reservation. If you would prefer to designate an alternative representative for communication on air pollution control permitting matters, please notify us of that person's name and contact information. We will keep the tribal government informed and will seek your input on these permits.

The EPA welcomes the opportunity to consult and coordinate with the Tribe. If you choose to consult about this permitting action, we will work with your tribal government to develop a consultation plan including a description of the process we would follow, opportunity for your input, and timeline for us to provide feedback and to complete the consultation. We will send a draft consultation plan for your review as soon as practical after we receive your reply to this letter. The agency's goal will be to ensure that you have an opportunity to provide tribal input into this permit action.

We request that you reply in writing to this letter within the next 30 days if the Tribe desires to consult on this permit action. The official EPA contact person for this consultation and coordination process is Claudia Smith, a permit engineer on my staff.

Thank you very much for your attention to this matter. Please contact me at (303) 312-6392 or your staff can contact Claudia Smith at (303) 312-6520 or smith.claudia@epa.gov should you have any questions on this action. We look forward to hearing from you on this important matter.

Sincerely,

Darcy O'Connor
Acting Assistant Regional Administrator
Office of Partnerships and Regulatory Assistance

cc: Thomas Johnson, Division Head, Environmental Program, Southern Ute Indian Tribe
Mark Hutson, Air Quality Program Manager, Southern Ute Indian Tribe
Randy Brown, Tribal Program Manager, EPA Region 8

MEMO TO FILE

DATE: February 5, 2016

SUBJECT: Southern Ute Indian Reservation; BP America Production Company, Endangered Species Act

FROM: Victoria Parker-Christensen, EPA Region 8 Air Program

TO: Source Files:
205c AirTribal SU BP America Salvador I/II Central Delivery Point
SMNSR-SU-000009-2015.003
FRED # 108006

Pursuant to Section 7 of the Endangered Species Act (ESA), 16 U.S.C. §1536, and its implementing regulations at 50 CFR, part 402, the EPA is required to ensure that any action authorized, funded, or carried out by the Agency is not likely to jeopardize the continued existence of any Federally-listed endangered or threatened species or result in the destruction or adverse modification of such species' designated critical habitat. Under ESA, those agencies that authorize, fund, or carry out the federal action are commonly known as "action agencies." If an action agency determines that its federal action "may affect" listed species or critical habitat, it must consult with the U.S. Fish and Wildlife Service (FWS). If an action agency determines that the federal action will have no effect on listed species or critical habitat, the agency will make a "no effect" determination. In that case, the action agency does not initiate consultation with the FWS and its obligations under Section 7 are complete.

In complying with its duty under ESA, the EPA, as the action agency, examined the potential effects on listed species and designated critical habitat relating to issuing this Clean Air Act (CAA) synthetic minor New Source Review (NSR) permit.

Region 8 Air Program Determination

The EPA has concluded that the proposed synthetic minor NSR permit action will have "*No effect"* on listed species or critical habitat. The proposed permit action authorizes construction of a new emission source, and establishes legally and practically enforceable emission limitations for the new emissions source and an existing emissions source. While there is construction of a new emission source, the new source will be located within the existing footprint of the facility in a previously disturbed area and does not require additional infrastructure (road, power line, pipeline). Because the EPA has determined that the federal action will have no effect, the agency made a *"No effect"* determination, did not initiate consultation with the FWS and its obligations under Section 7 are complete.

Permit Request

On October 21, 2015, we received an application from BP America Production Company (BP) requesting a synthetic minor permit for a modification project at the existing Salvador I/II Central Delivery Point in accordance with the requirements of the Tribal Minor New Source Review (MNSR) Permit Program at 40 CFR Part 49. The Salvador I/II Central Delivery Point currently operates as a synthetic minor source of carbon monoxide (CO) with respect to the Prevention of Significant Deterioration (PSD) Permit Program at 40 CFR Part 52 and hazardous air pollutants (HAP) with respect

to the National Emissions Standards for Hazardous Air Pollutants (NESHAP) at 40 CFR Part 63, through a synthetic minor MNSR permit (#SMNSR-SU-000009-2015.002) issued on December 4, 2014.

BP requested authorization to construct a new emission source, and establish legally and practically enforceable emission limitations for the new emissions source and an existing emissions source. BP has proposed to construct a new 1,874, or lower, site-rated horsepower (hp) four-stroke lean-burn (4SLB) compressor engine equipped with an oxidation catalyst control system and to establish CO and formaldehyde emission limits and associated operational limitations for the engine. Additionally, on October 30, 2015, BP replaced an existing unpermitted compressor engine with a maximum site-rated 1,138 hp 4SLB compressor engine, and has requested to establish legally and practically enforceable requirements to install and operate an oxidation catalyst control system on that engine and limit CO and formaldehyde emissions. The new emission source will be constructed within the existing footprint of the facility in a previously disturbed area and no new infrastructure (road, power line, pipeline) is required. The site location for the facility is:

S28, T33N, R7W
Latitude 37.07905247, Longitude -107.6182899

The Wild and Scenic Rivers Act, 16 U.S.C. § 1273 et seq.

There are no designated Wild and Scenic rivers or tributaries of any such rivers within proximity of the area of review for the Salvador I/II Central Delivery Point. The Wild and Scenic Rivers Act is not applicable to this action.

The Coastal Zone Management Act, 16 U.S.C. § 1451 et seq.

Not applicable

Smith, Claudia

From: Best, Julie A <Julie.Drinkwater@bp.com>
Sent: Friday, February 05, 2016 9:30 AM
To: Smith, Claudia
Cc: airquality@southernute-nsn.gov; Danny Powers; mhutson@southernute-nsn.gov; Robert, Rebecca
Subject: RE: Salvador I/II CDP SMNSR #3 Application Question
Attachments: Salvador I II CDP Footprint.pdf

Good morning Claudia,

Since Rebecca is on vacation, I am submitting an aerial view of the existing Salvador I/II CDP footprint. The exact placement of the new engine has not yet been determined, but it will be within the disturbed area of the existing site.

Please let me know if you have questions or require additional documentation.

Thank you,
Julie

Julie Best
Environmental Team Lead
BP America Production Company
970.375.7540

From: Smith, Claudia [mailto:Smith.Claudia@epa.gov]
Sent: Thursday, February 04, 2016 4:46 PM
To: Robert, Rebecca
Cc: airquality@southernute-nsn.gov; Danny Powers; mhutson@southernute-nsn.gov; Best, Julie A
Subject: Salvador I/II CDP SMNSR #3 Application Question

Hi, Rebecca,

The application says the construction will take place "at the site" and for ESA "Since the Salvador I/II Central Delivery Point is an existing facility and the proposed new engine will not impact the existing footprint of the site, an Endangered Species Act review is not included in the application."

Also for NHPA "Since the Salvador I/II Central Delivery Point is an existing facility and the proposed new engine will not impact the existing footprint of the site, a National Historic Preservation Act review is not included in the application."

Can you please clarify "will not impact the footprint of the site"? Specifically, will the new engine be placed on an existing pad or previously disturbed area? It would really help close the loop on our ESA/NHPA compliance obligation for this project, since there is no site drawing in the application, just an indication that the new engine will be placed near Unit 2.

Thank you,

Claudia

Claudia Young Smith
Environmental Scientist
US EPA Region 8 Air Program
Phone: (303) 312-6520
Fax: (303) 312-6064
http://www2.epa.gov/caa-permitting/caa-permitting-epas-mountains-and-plains-region
****
Air Program, Mail Code 8P-AR
US EPA Region 8
1595 Wynkoop Street
Denver, Colorado 80202
****

Salvador I/II CDP Existing Footprint

Smith, Claudia

From: Robert, Rebecca <Rebecca.Robert@bp.com>
Sent: Tuesday, February 02, 2016 12:43 PM
To: Smith, Claudia
Cc: airquality@southernute-nsn.gov; Danny Powers; mhutson@southernute-nsn.gov; Best, Julie A
Subject: RE: UPDATE to Salvador I/II CDP – Notification of Unpermitted Engine Replacement

Claudia,

As discussed during our telephone conversation this afternoon, BP requests to use the PTE calculations submitted in the revised synthetic minor NSR application (submitted in October 2015) as the basis of the allowable emissions for the proposed project. Please let me know if you have any questions or need additional information or documentation.

Thank you,

Rebecca Robert
Air Engineer
BP US Lower 48 Onshore
Office: (281) 366-3946
Cell: (713) 540-9959

From: Smith, Claudia [mailto:Smith.Claudia@epa.gov]
Sent: Monday, February 01, 2016 5:10 PM
To: Best, Julie A
Cc: airquality@southernute-nsn.gov; Robert, Rebecca; Danny Powers; mhutson@southernute-nsn.gov
Subject: RE: UPDATE to Salvador I/II CDP – Notification of Unpermitted Engine Replacement

Julie/Rebecca,

The potential emissions for the 1,138 hp replacement engine at Salvador I/II in this engine replacement submittal differ from the pre-catalyst emissions for that engine reported in the October 21, 2015 synthetic minor NSR application.

Could you please update the synthetic minor NSR application so that we have an accurate estimate of the potential increase in facility-wide emissions from the proposed project (i.e. current PTE compared to PTE after adding the 1,874 hp engine with oxidation catalyst and adding an oxidation catalyst to the 1,138 hp engine) before we put the proposed permit out to public comment?

Thank you,

Claudia

Claudia Young Smith
Environmental Scientist
US EPA Region 8 Air Program
Phone: (303) 312-6520
Fax: (303) 312-6064
http://www2.epa.gov/caa-permitting/caa-permitting-epas-mountains-and-plains-region
****

Air Program, Mail Code 8P-AR
US EPA Region 8
1595 Wynkoop Street
Denver, Colorado 80202
****

From: Best, Julie A [mailto:Julie.Drinkwater@bp.com]
Sent: Monday, January 25, 2016 10:24 AM
To: R8AirPermitting <R8AirPermitting@epa.gov>
Cc: airquality@southernute-nsn.gov; Robert, Rebecca <Rebecca.Robert@bp.com>
Subject: UPDATE to Salvador I/II CDP – Notification of Unpermitted Engine Replacement

Dear Federal Minor NSR Coordinator:

BP is submitting updated information for the engine replacement that occurred at the Salvador I/II CDP. Prior to the installation, the engine was modified which impacted the horsepower and potential emissions. The 1138 site-rated horsepower compressor engine started up on October 30, 2015. The corrected potential-to-emit calculations for the replacement engine, site emissions summaries, and supporting documentation are attached.

Since the potential-to-emit carbon monoxide emissions at the Salvador I/II CDP after the engine replacement is less than 100 tons per year, the site is not required to apply for an operating permit according to the the Southern Ute Indian Tribe/State of Colorado Environmental Commission's Reservation Air Code.

If you have any questions regarding this update, please contact me at (970) 375-7540.

Thank you,
Julie Best
Environmental Advisor
BP America Production Company

From: Robert, Rebecca
Sent: Monday, July 06, 2015 1:06 PM
To: R8airpermitting@epa.gov
Cc: airquality@southernute-nsn.gov; Best, Julie A
Subject: Salvador I/II CDP – Notification of Unpermitted Engine Replacement

Dear Federal Minor NSR Coordinator:

BP America Production Company (BP) is submitting this notification of an unpermitted engine replacement at the Salvador I/II Central Delivery Point (CDP). The site is an existing synthetic minor source with enforceable emission limitations and requirements established for two engines under permit number SMNSR-SU-000009-2012.002. BP is planning to replace an unpermitted 666 site-rated horsepower four-stroke lean burn compressor engine (identified as Emission Unit ID Unit 2 or C200) with a 1,073 site-rated horsepower four-stroke lean burn compressor engine in August 2015. Neither the existing engine nor the replacement engine requires any air emission control devices. Since the change in emissions results in an increase in nitrogen oxides emissions greater than the thresholds listed in Table 1 of EPA's Federal Minor New Source Review Program in Indian Country (40 CFR 49.153 – 49.161) for attainment areas, BP is submitting this notification to update the registration information for the site. The potential-to-emit calculations for

the replacement engine, updated site emissions summaries including the changes in emissions at the site, and supporting documentation are attached.

Within one year of commencing operation of the replacement engine, BP will submit an application for an operating permit in accordance with the Southern Ute Indian Tribe/State of Colorado Environmental Commission's Reservation Air Code since the potential-to-emit carbon monoxide emissions at the Salvador I/II CDP will be greater than 100 tons per year.

If you have any questions regarding this notification or require additional information, please contact me at (281) 366-3946 or Julie Best at (970) 375-7540.

Sincerely,

Rebecca Robert
Air Engineer
BP US Lower 48 Onshore
Office: (281) 366-3946
Cell: (713) 540-9959

*****NEW MAILING ADDRESS*****
737 North Eldridge Parkway
Houston, Texas 77079

Smith, Claudia

From: Best, Julie A <Julie.Drinkwater@bp.com>
Sent: Monday, January 25, 2016 10:24 AM
To: R8AirPermitting
Cc: airquality@southernute-nsn.gov; Robert, Rebecca
Subject: UPDATE to Salvador I/II CDP – Notification of Unpermitted Engine Replacement
Attachments: 2016-01 Salvador Part 49 C200 Updated Replacement Calcs & Backup.pdf

Dear Federal Minor NSR Coordinator:

BP is submitting updated information for the engine replacement that occurred at the Salvador I/II CDP. Prior to the installation, the engine was modified which impacted the horsepower and potential emissions. The 1138 site-rated horsepower compressor engine started up on October 30, 2015. The corrected potential-to-emit calculations for the replacement engine, site emissions summaries, and supporting documentation are attached.

Since the potential-to-emit carbon monoxide emissions at the Salvador I/II CDP after the engine replacement is less than 100 tons per year, the site is not required to apply for an operating permit according to the the Southern Ute Indian Tribe/State of Colorado Environmental Commission's Reservation Air Code.

If you have any questions regarding this update, please contact me at (970) 375-7540.

Thank you,
Julie Best
Environmental Advisor
BP America Production Company

From: Robert, Rebecca
Sent: Monday, July 06, 2015 1:06 PM
To: R8airpermitting@epa.gov
Cc: airquality@southernute-nsn.gov; Best, Julie A
Subject: Salvador I/II CDP – Notification of Unpermitted Engine Replacement

Dear Federal Minor NSR Coordinator:

BP America Production Company (BP) is submitting this notification of an unpermitted engine replacement at the Salvador I/II Central Delivery Point (CDP). The site is an existing synthetic minor source with enforceable emission limitations and requirements established for two engines under permit number SMNSR-SU-000009-2012.002. BP is planning to replace an unpermitted 666 site-rated horsepower four-stroke lean burn compressor engine (identified as Emission Unit ID Unit 2 or C200) with a 1,073 site-rated horsepower four-stroke lean burn compressor engine in August 2015. Neither the existing engine nor the replacement engine requires any air emission control devices. Since the change in emissions results in an increase in nitrogen oxides emissions greater than the thresholds listed in Table 1 of EPA's Federal Minor New Source Review Program in Indian Country (40 CFR 49.153 – 49.161) for attainment areas, BP is submitting this notification to update the registration information for the site. The potential-to-emit calculations for the replacement engine, updated site emissions summaries including the changes in emissions at the site, and supporting documentation are attached.

Within one year of commencing operation of the replacement engine, BP will submit an application for an operating permit in accordance with the Southern Ute Indian Tribe/State of Colorado Environmental Commission's Reservation Air Code since the potential-to-emit carbon monoxide emissions at the Salvador I/II CDP will be greater than 100 tons per year.

If you have any questions regarding this notification or require additional information, please contact me at (281) 366-3946 or Julie Best at (970) 375-7540.

Sincerely,

Rebecca Robert
Air Engineer
BP US Lower 48 Onshore
Office: (281) 366-3946
Cell: (713) 540-9959

*****NEW MAILING ADDRESS*****
737 North Eldridge Parkway
Houston, Texas 77079

BP America Production Company
Facility: **Salvador I/II Central Delivery Point**
Description: **Potential-to-Emit Emissions Summary**

Emission Unit ID	Description	Emissions (TPY)						
		NO_x	CO	PM	SO_2	VOC	CH_2O	HAPs
Unit 1	1334 hp Waukesha L7042GL Compressor Engine w/OxiCat	20.61	3.86	0.42	0.02	12.88	1.49	1.49
Unit 2	1138 hp Caterpillar G3516 Compressor Engine	28.12	19.23	0.37	0.02	5.82	2.53	2.53
Unit 3	1334 hp Waukesha L7042GL Compressor Engine	19.32	38.64	0.42	0.02	12.88	3.74	3.74
Unit 4	1467 hp Waukesha L7042GSI Compressor Engine w/NSCR and AFRC	28.33	34.00	0.97	0.03	14.17	0.71	0.71
--	500 gal TEG Tanks (3)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 gal Lube Oil Tanks (5)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 gal EG/Water (50/50) Tanks (2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 gal Used Oil Tanks (5)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	95 bbl Compressor/Dehy Drip Tanks (7)	0.00	0.00	0.00	0.00	0.03	0.00	0.00
--	500 bbl Produced Water Tanks (4)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	0.25 MMBtu/hr Tank Heaters (5)	0.54	0.45	0.04	0.00	0.03	0.00	0.00
--	0.15 MMBtu/hr Separator Heaters (2)	0.13	0.11	0.01	0.00	0.01	0.00	0.00
--	Tri-ethylene Glycol (TEG) Dehydrator Regenerator, 45 MMscfd	0.00	0.00	0.00	0.00	0.89	0.00	0.00
--	Tri-ethylene Glycol (TEG) Dehydrator Flash Tank Vent	0.00	0.00	0.00	0.00	0.20	0.00	0.00
--	300 bbl Oily Water Tanks (2)	0.00	0.00	0.00	0.00	0.01	0.00	0.00
--	0.26 MMBtu/hr Oily Water Breakout Tank Heater	0.11	0.09	0.01	0.00	0.01	0.00	0.00
--	500 gal Solvent Tank	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 bbl Oily Water Tank	0.00	0.00	0.00	0.00	0.01	0.00	0.00
--	37.5 bbl Used Oil Tank	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total Site Emissions	**97.16**	**96.39**	**2.24**	**0.11**	**46.93**	**8.47**	**8.47**

	Emissions (TPY)						
	NO_x	CO	PM	SO_2	VOC	CH_2O	HAPs
Prior Total Site Emissions	78.69	96.45	2.08	0.10	47.54	7.80	7.80
Prior Unit 2 (666 hp Waukesha F3521GL Compressor Engine)	9.65	19.29	0.21	0.01	6.43	1.86	1.86
Replacement Unit 2 (1138 hp Caterpillar G3516 Compressor Engine)	28.12	19.23	0.37	0.02	5.82	2.53	2.53
Project PTE Change	**18.47**	**-0.06**	**0.16**	**0.01**	**-0.61**	**0.66**	**0.66**

BP America Production Company

Facility: **Salvador I/II Central Delivery Point**

Description: **1138 hp Four-Stroke Lean Burn Engine[1]**

Emission Unit ID: **Unit 2**

Source Information:

Maximum Rating[1]	1150	hp
Site Altitude	6371	ft
Site Rating[1]	**1138**	hp
Operating Capacity[2]	100	%
Hours of Operation[2]	8760	hr/yr
Fuel Consumption[1]	7466	Btu/hp-hr
Heat Input[3]	8.50	MMBtu/hr
Emissions Controls	None	

Maximum Fuel Usage: [3]

Hourly Fuel Usage	10.6	Mscf/hr
Daily Fuel Usage	0.3	MMscf/day
Annual Fuel Usage	93.0	MMscf/yr

Regulated Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Emissions (lb/hr)	Emissions (TPY)
NO_X[4]			6.42	28.1196
CO[1]	1.75	g/hp-hr	4.3904	19.2301
VOC[1]	0.53	g/hp-hr	1.3297	5.8240
SO_2[5]	5.88E-04	lb/MMBtu	0.0050	0.0219
PM[5]	9.99E-03	lb/MMBtu	0.0849	0.3717
PM_{10}[5]	7.71E-05	lb/MMBtu	0.0007	0.0029
$PM_{2.5}$[5]	7.71E-05	lb/MMBtu	0.0007	0.0029
CH_2O[1]	0.23	g/hp-hr	0.5770	2.5274

Example Calculations:

NO_X Emissions (lb/hr) = 1138 hp * 0.00 g/hp-hr * lb/453.6 g = 6.42

NO_X Emissions (TPY) = 6.42 lb/hr * 8760 hr/yr * 1 Ton/2000 lb = 28.12

[1] Based on Caterpillar Gas Engine Rating Pro Version 5.05.00 (Ref. Data Set DM8620-05-001) for Caterpillar G3516, 1200 rpm, 8:1 CR, 130 ^oF aftercooler water inlet, TA aspiration, ADEM3 & AFR, maximum rating. Site rating based on deducting 3% for every 1000 feet above 6000 feet. Using fuel consumption (HHV) value. VOC emission factor is the sum of the NMNEHC and CH_2O emission factors.

[2] Conservatively based on full time operating hours and full capacity.

[3] Heat input based on fuel consumption and site-rated HP. Fuel usage rates based on fuel consumption x site-rated hp / 800 Btu/scf conservative heating value.

[4] NOx emission factor is from 12/9/15 NSPS JJJJ Test and is higher than the manufacturer's specification (test 2.55 g/hp-hr, spec 2.0 g/hp-hr). Engine was tested above 100% load so mass emission rate (lb/hr) is being used for PTE calculation to be conservative.

[5] Based on AP-42, Fifth Edition, Volume 1, Chapter 3, Section 3.2, Table 3.2-2 Uncontrolled Emission Factors For 4-Stroke Lean-Burn Engines, 7/00. PM emission factor is the sum of $PM_{filterable}$ and $PM_{condensable}$.

BP America Production Company
Facility: **Salvador I/II Central Delivery Point**
Description: **Potential-to-Emit Greenhouse Gas Emissions Summary**

Emission Unit ID	Description	Emissions (TPY)			
		CO_2	CH_4	N_2O	$CO2_e$
Unit 1	1334 hp Waukesha L7042GL Compressor Engine w/OxiCat	4,886.6770	0.0922	0.0092	4,891.7278
Unit 2	1138 hp Caterpillar G3516 Compressor Engine	4,353.1731	0.0820	0.0082	4,357.6690
Unit 3	1334 hp Waukesha L7042GL Compressor Engine	4,886.6770	0.0922	0.0092	4,891.7278
Unit 4	1467 hp Waukesha L7042GSI Compressor Engine w/NSCR and AFRC	5,858.3172	0.1105	0.0110	5,864.3722
--	500 gal TEG Tanks (3)	0.0000	0.0000	0.0000	0.0000
--	500 gal Lube Oil Tanks (5)	0.0000	0.0000	0.0000	0.0000
--	500 gal EG/Water (50/50) Tanks (2)	0.0000	0.0000	0.0000	0.0000
--	500 gal Used Oil Tanks (5)	0.0000	0.0000	0.0000	0.0000
--	95 bbl Compressor/Dehy Drip Tanks (7)	0.0000	0.0000	0.0000	0.0000
--	500 bbl Produced Water Tanks (4)	0.0000	0.0000	0.0000	0.0000
--	0.25 MMBtu/hr Tank Heaters	639.9679	0.3018	0.3597	640.6293
--	0.15 MMBtu/hr Separator Heaters	153.5923	0.0724	0.0863	153.7510
--	TEG Dehydration Still Vent	197.5380	1,073.7993	0.0000	27,042.5205
--	Flash Tank for TEG Dehydration Unit	53.8740	53.8329	0.0000	1,399.6965
--	300 bbl Oily Water Tanks (2)	0.0000	0.0000	0.0000	0.0000
--	0.26 MMBtu/hr Breakout Tank Heater	133.1133	0.0628	0.0748	133.2509
--	< 100 gal Corrosion Inhibitor Tank	0.0000	0.0000	0.0000	0.0000
--	500 gal Solvent Tank	0.0000	0.0000	0.0000	0.0000
--	< 100 gal Baker Petrolite DF03009 Defoamer Tank	0.0000	0.0000	0.0000	0.0000
--	500 bbl Oily Water Tank	0.0000	0.0000	0.0000	0.0000
--	37.5 bbl Used Oil Tank	0.0000	0.0000	0.0000	0.0000
--	500 gal F-20 Soap tank	0.0000	0.0000	0.0000	0.0000
--	Compressor Blowdowns and Starts	0.5781	5.1385	0.0000	129.0405
--	Facility Blowdowns	0.1700	1.5113	0.0000	37.9520
--	Natural Gas Pneumatic Device Venting	58.9433	523.9600	0.0000	13,157.9421
--	Natural Gas Pneumatic Pump Venting	2.1709	19.2977	0.0000	484.6128
--	Reciprocating Compressor Rod Packing Venting	56.9073	505.8614	0.0000	12,703.4412
--	Well Venting for Liquids Unloading	--	--	--	6,369.1529
	Total Site Emissions	**21,281.70**	**2,184.21**	**0.56**	**82,257.49**

	Emissions (TPY)			
	CO_2	CH_4	N_2O	$CO2_e$
Prior Total Site Emissions	19,401.62	2,184.18	0.55	80,375.46
Prior Unit 2 (666 hp Waukesha F3521GL Compressor Engine)	2,473.09	0.05	0.00	2,475.65
Replacement Unit 2 (1138 hp Caterpillar G3516 Compressor Engine)	4,353.17	0.08	0.01	4,357.67
Project PTE Change	**1,880.08**	**0.04**	**0.00**	**1,882.02**

BP America Production Company

Facility: **Salvador I/II Central Delivery Point**

Description: **1073 hp Four-Stroke Lean Burn Engine**[1]

Emission Unit ID: **Unit 2**

Source Information:

Maximum Rating[1]	1150 hp
Site Altitude	6371 feet
Site Rating[1]	**1138** hp
Operating Capacity[2]	100 %
Hours of Operation[2]	8760 hr/yr
Fuel Consumption[1]	7466 Btu/hp-hr
Heat Input[3]	8.50 MMBtu/hr
Emissions Controls	None

Greenhouse Gas (GHG) Emission Calculations[4]

Pollutant	Uncontrolled Emission Factor[4]	Factor Units[4]	Emissions (lb/hr)	Emissions (TPY)	Global Warming Potential (GWP)[4]	CO_2e Emissions (TPY)
CO_2	53.06	kg/MMBtu	993.8751	4353.1731	1	4353.1731
CH_4	0.001	kg/MMBtu	0.0187	0.0820	25	2.0511
N_2O	0.0001	kg/MMBtu	0.0019	0.0082	298	2.4449
TOTAL GHGs	--	--	**993.90**	**4353.26**	--	--
TOTAL GHGs (CO_2e)	--	--	--	--	--	**4357.67**

[1] Based on Caterpillar Gas Engine Rating Pro Version 5.05.00 (Ref. Data Set DM8620-05-001) for Caterpillar G3516, 1200 rpm, 8:1 CR, 130 oF aftercooler water inlet, TA aspiration, ADEM3 & AFR, maximum rating. Site rating based on deducting 3% for every 1000 feet above 6000 feet. Using fuel consumption (HHV) value.

[2] Conservatively based on full time operating hours and full capacity.

[3] Heat input based on fuel consumption and site-rated HP.

[4] Based on 40 CFR 98 Subpart C, 98.33(a)(1)(i), Tier 1 Methodology, Equation C-1 and using source specific heat input.

GHG Emissions (lb/hr) = EF_{GHG} (kg/MMBtu) * 2.204623 lb/kg * Source Specific Heat Input (MMbtu/hr) * % Operating Capacity

GHG Emissions (TPY) = GHG Emissions (lb/hr) * 8760 hr/yr * 1 Ton/2000 lb

CO_2e Emissions (TPY) = Σ (GHG Emissions (tpy) * GWP)

Where:

EF_{GHG} = Fuel-specific default CO_2, CH_4, or N_2O emission factors from Table C-1 for CO_2 (Natural gas - Weighted U.S. Average) and Table C-2 for CH_4 and N_2O (Natural Gas) of 40 CFR Part 98, Subpart C (kg/MMBtu)

Heat Input = Btu/hp-hr x Site-rated hp x (1 MMBtu/1,000,000 Btu) = MMBtu/hr

GWP = Global Warming Potentials, 40 CFR 98, Subpart A, Table A-1

Example Calculations:

CO_2 Emissions (lb/hr) = 53.06 kg/MMBtu * 2.204623 lb/kg * 8.50 MMBtu/hr * 100% Capacity = 993.8751

CO_2 Emissions (TPY) = 993.8751 lb/hr * 8760 hr/yr * 1 Ton/2000 lb = 4353.1731

CO_2e Emissions (TPY) = (4353.1731 TPY * 1) + (0.0820 TPY * 25) + (0.0082 TPY * 298) = 4357.6690

G3516

GAS ENGINE TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED (rpm):	1200	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	8	APPLICATION:	GAS COMPRESSION
AFTERCOOLER TYPE:	SCAC	RATING LEVEL:	CONTINUOUS
AFTERCOOLER WATER INLET (°F):	130	FUEL:	NAT GAS
JACKET WATER OUTLET (°F):	210	FUEL SYSTEM:	HPG IMPCO
ASPIRATION:	TA		WITH AIR FUEL RATIO CONTROL
COOLING SYSTEM:	JW+OC, AC	FUEL PRESSURE RANGE(psig):	35.0-40.0
CONTROL SYSTEM:	ADEM3	FUEL METHANE NUMBER:	80
EXHAUST MANIFOLD:	ASWC	FUEL LHV (Btu/scf):	905
COMBUSTION:	LOW EMISSION	ALTITUDE CAPABILITY AT 77°F INLET AIR TEMP. (ft):	6125
NOx EMISSION LEVEL (g/bhp-hr NOx):	2.0		

RATING		NOTES	LOAD	100%	75%	50%
ENGINE POWER	(WITHOUT FAN)	(1)	bhp	1150	862	575
ENGINE EFFICIENCY	(ISO 3046/1)	(2)	%	34.7	33.5	31.0
ENGINE EFFICIENCY	(NOMINAL)	(2)	%	34.1	32.8	30.4

ENGINE DATA						
FUEL CONSUMPTION	(ISO 3046/1)	(3)	Btu/bhp-hr	7324	7605	8216
FUEL CONSUMPTION	(NOMINAL)	(3)	Btu/bhp-hr	7466	7753	8375
AIR FLOW (77°F, 14.7 psia)	(WET)	(4) (5)	ft3/min	2453	1864	1276
AIR FLOW	(WET)	(4) (5)	lb/hr	10875	8266	5660
FUEL FLOW (60ºF, 14.7 psia)			scfm	158	123	89
COMPRESSOR OUT PRESSURE			in Hg(abs)	76.8	65.2	50.4
COMPRESSOR OUT TEMPERATURE			°F	302	253	189
AFTERCOOLER AIR OUT TEMPERATURE			°F	131	129	128
INLET MAN. PRESSURE		(6)	in Hg(abs)	68.8	54.3	38.6
INLET MAN. TEMPERATURE	(MEASURED IN PLENUM)	(7)	°F	134	133	134
TIMING		(8)	°BTDC	33	33	33
EXHAUST TEMPERATURE - ENGINE OUTLET		(9)	°F	846	843	840
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	(10) (5)	ft3/min	6460	4906	3363
EXHAUST GAS MASS FLOW	(WET)	(10) (5)	lb/hr	11308	8604	5903

EMISSIONS DATA - ENGINE OUT					
NOx (as NO2)	(11)(12)	g/bhp-hr	2.00	2.00	2.00
CO	(11)(13)	g/bhp-hr	1.75	1.81	1.92
THC (mol. wt. of 15.84)	(11)(13)	g/bhp-hr	2.98	3.13	3.42
NMHC (mol. wt. of 15.84)	(11)(13)	g/bhp-hr	0.45	0.47	0.51
NMNEHC (VOCs) (mol. wt. of 15.84)	(11)(13)(14)	g/bhp-hr	0.30	0.31	0.34
HCHO (Formaldehyde)	(11)(13)	g/bhp-hr	0.23	0.22	0.22
CO2	(11)(13)	g/bhp-hr	466	481	503
EXHAUST OXYGEN	(11)(15)	% DRY	8.4	8.2	7.9
LAMBDA	(11)(15)		1.58	1.55	1.47

ENERGY BALANCE DATA					
LHV INPUT	(16)	Btu/min	143098	111442	80306
HEAT REJECTION TO JACKET WATER (JW)	(17)(24)	Btu/min	36337	31480	26352
HEAT REJECTION TO ATMOSPHERE	(18)	Btu/min	4554	3795	3038
HEAT REJECTION TO LUBE OIL (OC)	(19)(24)	Btu/min	5419	4695	3930
HEAT REJECTION TO EXHAUST (LHV TO 77°F)	(20)(21)	Btu/min	39536	29811	20210
HEAT REJECTION TO EXHAUST (LHV TO 350°F)	(20)	Btu/min	25159	19038	13031
HEAT REJECTION TO AFTERCOOLER (AC)	(22)(25)	Btu/min	7509	4110	1403
PUMP POWER	(23)	Btu/min	977	977	977

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1. (Standard reference conditions of 77°F, 29.60 in Hg barometric pressure.) No overload permitted at rating shown. Consult the altitude deration factor chart for applications that exceed the rated altitude or temperature.

Emission levels are at engine exhaust flange prior to any after treatment. Values are based on engine operating at steady state conditions, adjusted to the specified NOx level at 100% load. Tolerances specified are dependent upon fuel quality. Fuel methane number cannot vary more than ± 3.

For notes information consult page three.

FUEL USAGE GUIDE

CAT METHANE NUMBER	25	30	35	40	45	50	55	60	65	70	75	80	100
SET POINT TIMING	-	19	21	22	23	24	26	27	28	30	31	33	33
DERATION FACTOR	0	0.90	0.90	0.90	1	1	1	1	1	1	1	1	1

ALTITUDE DERATION FACTORS AT RATED SPEED

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1	1	1	1	0.95	0.89	0.83	0.78	0.68	0.53	No Rating	No Rating	No Rating
120	1	1	1	1	0.99	0.93	0.86	0.81	0.75	0.61	No Rating	No Rating	No Rating
110	1	1	1	1	1	0.96	0.90	0.84	0.78	0.68	0.54	No Rating	No Rating
100	1	1	1	1	1	0.99	0.93	0.87	0.81	0.75	0.61	No Rating	No Rating
90	1	1	1	1	1	1	0.96	0.90	0.84	0.78	0.69	0.54	No Rating
80	1	1	1	1	1	1	1	0.94	0.87	0.81	0.76	0.62	No Rating
70	1	1	1	1	1	1	1	0.97	0.91	0.85	0.79	0.70	0.55
60	1	1	1	1	1	1	1	1	0.94	0.88	0.82	0.76	0.63
50	1	1	1	1	1	1	1	1	0.98	0.92	0.86	0.80	0.72

ALTITUDE (FEET ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS (ACHRF)

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1.40	1.47	1.53	1.60	1.66	1.73	1.80	1.81	1.81	1.81	No Rating	No Rating	No Rating
120	1.32	1.38	1.45	1.51	1.58	1.64	1.71	1.72	1.72	1.72	No Rating	No Rating	No Rating
110	1.24	1.30	1.36	1.43	1.49	1.56	1.62	1.63	1.63	1.63	1.63	No Rating	No Rating
100	1.16	1.22	1.28	1.34	1.40	1.47	1.53	1.54	1.54	1.54	1.54	No Rating	No Rating
90	1.08	1.14	1.20	1.26	1.32	1.38	1.45	1.46	1.46	1.46	1.46	1.46	No Rating
80	1	1.05	1.11	1.17	1.23	1.29	1.36	1.37	1.37	1.37	1.37	1.37	No Rating
70	1	1	1.03	1.09	1.15	1.21	1.27	1.28	1.28	1.28	1.28	1.28	1.28
60	1	1	1	1	1.06	1.12	1.18	1.19	1.19	1.19	1.19	1.19	1.19
50	1	1	1	1	1	1.03	1.09	1.10	1.10	1.10	1.10	1.10	1.10

ALTITUDE (FEET ABOVE SEA LEVEL)

MINIMUM SPEED CAPABILITY AT THE RATED SPEED'S SITE TORQUE (RPM)

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	940	990	1040	1150	1200	1200	1200	1080	1030	1090	No Rating	No Rating	No Rating
120	930	970	1010	1090	1200	1200	1200	1200	1060	1070	No Rating	No Rating	No Rating
110	910	950	990	1050	1150	1200	1200	1200	1200	1100	1120	No Rating	No Rating
100	900	930	970	1020	1090	1200	1200	1200	1200	1200	1200	No Rating	No Rating
90	900	910	950	990	1060	1150	1200	1200	1200	1200	1200	1200	No Rating
80	900	900	930	970	1020	1100	1200	1200	1200	1200	1200	1200	No Rating
70	900	900	910	950	990	1060	1150	1200	1200	1200	1200	1200	1200
60	900	900	900	930	970	1020	1100	1190	1200	1200	1200	1200	1200
50	900	900	900	910	950	990	1060	1140	1200	1200	1200	1200	1200

ALTITUDE (FEET ABOVE SEA LEVEL)

FUEL USAGE GUIDE:

This table shows the derate factor and full load set point timing required for a given fuel. Note that deration and set point timing adjustment may be required as the methane number decreases. Methane number is a scale to measure detonation characteristics of various fuels. The methane number of a fuel is determined by using the Caterpillar methane number calculation.

ALTITUDE DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information along with the fuel usage guide chart to help determine actual engine power for your site.

ACTUAL ENGINE RATING:

To determine the actual rating of the engine at site conditions, one must consider separately, limitations due to fuel characteristics and air system limitations. The Fuel Usage Guide deration establishes fuel limitations. The Altitude/Temperature deration factors and RPC (reference the Caterpillar Methane Program) establish air system limitations. RPC comes into play when the Altitude/Temperature deration is less than 1.0 (100%). Under this condition, add the two factors together. When the site conditions do not require an Altitude/ Temperature derate (factor is 1.0), it is assumed the turbocharger has sufficient capability to overcome the low fuel relative power, and RPC is ignored. To determine the actual power available, take the lowest rating between 1) and 2).

1) Fuel Usage Guide Deration
2) 1-((1-Altitude/Temperature Deration) + (1-RPC))

AFTERCOOLER HEAT REJECTION FACTORS(ACHRF):

To maintain a constant air inlet manifold temperature, as the inlet air temperature goes up, so must the heat rejection. As altitude increases, the turbocharger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor (ACHRF) to adjust for inlet air temp and altitude conditions. See note 25 for application of this factor in calculating the heat exchanger sizing criteria. Failure to properly account for these factors could result in detonation and cause the engine to shutdown or fail.

MINIMUM SPEED CAPABILITY AT THE RATED SPEED'S SITE TORQUE (RPM):

This table shows the minimum allowable engine turndown speed where the engine will maintain the Rated Speed's Torque for the given ambient conditions.

NOTES:

1. Engine rating is with two engine driven water pumps. Tolerance is ± 3% of full load.
2. ISO 3046/1 engine efficiency tolerance is (+)0, (-)5% of full load % efficiency value. Nominal engine efficiency tolerance is ± 3.0% of full load % efficiency value.
3. ISO 3046/1 fuel consumption tolerance is (+)5, (-)0% of full load data. Nominal fuel consumption tolerance is ± 3.0% of full load data.
4. Air flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 5 %.
5. Inlet and Exhaust Restrictions must not exceed A&I limits based on full load flow rates from the standard technical data sheet.
6. Inlet manifold pressure is a nominal value with a tolerance of ± 5 %.
7. Inlet manifold temperature is a nominal value with a tolerance of ± 9°F.
8. Timing indicated is for use with the minimum fuel methane number specified. Consult the appropriate fuel usage guide for timing at other methane numbers.
9. Exhaust temperature is a nominal value with a tolerance of (+)63°F, (-)54°F.
10. Exhaust flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 6 %.
11. Emissions data is at engine exhaust flange prior to any after treatment.
12. NOx values are "Not to Exceed".
13. CO, CO2, THC, NMHC, NMNEHC, and HCHO values are "Not to Exceed" levels. THC, NMHC, and NMNEHC do not include aldehydes. An oxidation catalyst may be required to meet Federal, State or local CO or HC requirements.
14. VOCs - Volatile organic compounds as defined in US EPA 40 CFR 60, subpart JJJJ
15. Exhaust Oxygen tolerance is ± 0.5; Lambda tolerance is ± 0.05. Lambda and Exhaust Oxygen level are the result of adjusting the engine to operate at the specified NOx level.
16. LHV rate tolerance is ± 3.0%.
17. Heat rejection to jacket water value displayed includes heat to jacket water alone. Value is based on treated water. Tolerance is ± 10% of full load data.
18. Heat rejection to atmosphere based on treated water. Tolerance is ± 50% of full load data.
19. Lube oil heat rate based on treated water. Tolerance is ± 20% of full load data.
20. Exhaust heat rate based on treated water. Tolerance is ± 10% of full load data.
21. Heat rejection to exhaust (LHV to 77°F) value shown includes unburned fuel and is not intended to be used for sizing or recovery calculations.
22. Heat rejection to aftercooler based on treated water. Tolerance is ±5% of full load data.
23. Pump power includes engine driven jacket water and aftercooler water pumps. Engine brake power includes effects of pump power.
24. Total Jacket Water Circuit heat rejection is calculated as: (JW x 1.1) + (OC x 1.2). Heat exchanger sizing criterion is maximum circuit heat rejection at site conditions, with applied tolerances. A cooling system safety factor may be multiplied by the total circuit heat rejection to provide additional margin.
25. Total Aftercooler Circuit heat rejection is calculated as: AC x ACHRF x 1.05. Heat exchanger sizing criterion is maximum circuit heat rejection at site conditions, with applied tolerances. A cooling system safety factor may be multiplied by the total circuit heat rejection to provide additional margin.

ENGINE POWER (bhp):	1150	COOLING SYSTEM:	JW+OC, AC
ENGINE SPEED (rpm):	1200	AFTERCOOLER WATER INLET (°F):	130
EXHAUST MANIFOLD:	ASWC	JACKET WATER OUTLET (°F):	210

Free Field Mechanical and Exhaust Noise

SOUND PRESSURE LEVEL (dB)										
			Octave Band Center Frequency (OBCF)							
100% Load Data			dB(A)	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Mechanical Sound	Distance from the Engine (ft)	3.3	96.3	95.5	92.1	86.3	87.3	90	91.6	88.4	80
		23.0	86.7	85.9	82.5	76.7	77.7	80.4	82	78.8	70.4
		49.2	81.3	80.6	77.2	71.4	72.4	75.1	76.7	73.5	65
Exhaust Sound	Distance from the Engine (ft)	3.3	111.6	99.8	103.6	105.7	102.2	103	105.1	106.9	100.3
		23.0	98.3	89.5	91.8	93.2	89.6	92	91.8	92.2	85.2
		49.2	91.6	82.9	85.2	86.6	83	85.4	85.2	85.6	78.5

SOUND PARAMETER DEFINITION:

Data Variability Statement:
Sound data presented by Caterpillar has been measured in accordance with ISO 6798 in a Grade 3 test environment. Measurements made inaccordance with ISO 6798 will result in some amount of uncertainty. The uncertainties depend not only on the accuracies with which sound pressurelevels and measurement surface areas are determined, but also on the 'near-field error' which increases for smaller measurement distances and lowerfrequencies. The uncertainty for a Grade 3 test environment, that has a source that produces sounds that are uniformly distributed in frequency over thefrequency range of interest, is equal to 4 dB (A-weighted). This uncertainty is expressed as the largest value of the standard deviation.

Stack Emissions Test Report

Testing Date: December 9, 2015
Reporting Date: January 6, 2016
Last Revision Date: January 12, 2016

BP America Production Company

Salvador I/II Central Delivery Point
EMISSION UNIT:
UNIT C200, SERIAL NUMBER 4EK00106

SECTION 28, TOWNSHIP 33 NORTH, RANGE 7 WEST
LA PLATA COUNTY, COLORADO

Prepared for
BP AMERICA PRODUCTION COMPANY
380A AIRPORT ROAD
DURANGO, COLORADO 81303

Prepared by

envirotech
505-632-0615 · 800-362-1879
5796 US Highway 64, Farmington, NM 87401

Prepared and Reviewed by:

Rene Garcia Reyes, Chemist, QSTI

Greg Crabtree, PE, Environmental Manager

Table 2-2
Summary of Emissions
Average of 3 Runs Unit C200

Component	Emission Rates					Standards	
	(ppmvd)	(ppmvd, 15% O2)	g/(HP*Hr)	pph	tpy	(ppmvd, 15% O2)	g/(HP*Hr)
Total NOx	398	184	2.55	6.42	28.1	**250.0**	**3.00**
Carbon Monoxide	388.7	180	1.51	3.80	16.6	**540.0**	**4.00**
VOC's	27	13	0.17	0.42	1.8	**86.0**	**1.00**

SECTION 3: SAMPLING AND ANALYTICAL PROCEDURES

On December 9, 2015 Envirotech, Inc. conducted stack emissions testing on one (1) compressor engine located at the Salvador I/II Central Delivery Point. The test was conducted as required by table 2 to subpart JJJJ of Part 60 of title 40 of the CFR. Each test consisted of three (3) runs. Each run consisted of a sample collection lasting one (1) hour plus additional time for Quality Control procedures. Each run consisted of a minimum of 60 one (1)-minute average exhaust stream samples plus extra samples used to comply with the quality control section of the testing method. The volumetric flow rate for the engine was also determined during the test. The following sections discuss the methods and techniques used to sample and analyze the exhaust stream from the engine.

3.1 Test Methods

The emission test conducted on the affected units was performed using the methods noted in Table 3-1.

Table 3-1
Test Methods Unit C200

Sampling location and sampling points validation	USEPA Method 1
Stack Gas Flow Rate	USEPA Method 2
CO, NOx, VOC's, Carbon dioxide (CO_2) and water vapor (H_2O)	ASTM Method D 6348-03
Oxygen (O_2)	USEPA Method 3A

Table 3.2-2. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE LEAN-BURN ENGINES[a]
(SCC 2-02-002-54)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
Criteria Pollutants and Greenhouse Gases		
NO_x[c] 90 - 105% Load	4.08 E+00	B
NO_x[c] <90% Load	8.47 E-01	B
CO[c] 90 - 105% Load	3.17 E-01	C
CO[c] <90% Load	5.57 E-01	B
CO_2[d]	1.10 E+02	A
SO_2[e]	5.88 E-04	A
TOC[f]	1.47 E+00	A
Methane[g]	1.25 E+00	C
VOC[h]	1.18 E-01	C
PM10 (filterable)[i]	7.71 E-05	D
PM2.5 (filterable)[i]	7.71 E-05	D
PM Condensable[j]	9.91 E-03	D
Trace Organic Compounds		
1,1,2,2-Tetrachloroethane[k]	<4.00 E-05	E
1,1,2-Trichloroethane[k]	<3.18 E-05	E
1,1-Dichloroethane	<2.36 E-05	E
1,2,3-Trimethylbenzene	2.30 E-05	D
1,2,4-Trimethylbenzene	1.43 E-05	C
1,2-Dichloroethane	<2.36 E-05	E
1,2-Dichloropropane	<2.69 E-05	E
1,3,5-Trimethylbenzene	3.38 E-05	D
1,3-Butadiene[k]	2.67E-04	D
1,3-Dichloropropene[k]	<2.64 E-05	E
2-Methylnaphthalene[k]	3.32 E-05	C
2,2,4-Trimethylpentane[k]	2.50 E-04	C
Acenaphthene[k]	1.25 E-06	C

Table 3.2-2. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE LEAN-BURN ENGINES (Continued)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
Acenaphthylene[k]	5.53 E-06	C
Acetaldehyde[k,l]	8.36 E-03	A
Acrolein[k,l]	5.14 E-03	A
Benzene[k]	4.40 E-04	A
Benzo(b)fluoranthene[k]	1.66 E-07	D
Benzo(e)pyrene[k]	4.15 E-07	D
Benzo(g,h,i)perylene[k]	4.14 E-07	D
Biphenyl[k]	2.12 E-04	D
Butane	5.41 E-04	D
Butyr/Isobutyraldehyde	1.01 E-04	C
Carbon Tetrachloride[k]	<3.67 E-05	E
Chlorobenzene[k]	<3.04 E-05	E
Chloroethane	1.87 E-06	D
Chloroform[k]	<2.85 E-05	E
Chrysene[k]	6.93 E-07	C
Cyclopentane	2.27 E-04	C
Ethane	1.05 E-01	C
Ethylbenzene[k]	3.97 E-05	B
Ethylene Dibromide[k]	<4.43 E-05	E
Fluoranthene[k]	1.11 E-06	C
Fluorene[k]	5.67 E-06	C
Formaldehyde[k,l]	5.28 E-02	A
Methanol[k]	2.50 E-03	B
Methylcyclohexane	1.23 E-03	C
Methylene Chloride[k]	2.00 E-05	C
n-Hexane[k]	1.11 E-03	C
n-Nonane	1.10 E-04	C

Table 3.2-2. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE LEAN-BURN ENGINES
(Continued)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
n-Octane	3.51 E-04	C
n-Pentane	2.60 E-03	C
Naphthalene[k]	7.44 E-05	C
PAH[k]	2.69 E-05	D
Phenanthrene[k]	1.04 E-05	D
Phenol[k]	2.40 E-05	D
Propane	4.19 E-02	C
Pyrene[k]	1.36 E-06	C
Styrene[k]	<2.36 E-05	E
Tetrachloroethane[k]	2.48 E-06	D
Toluene[k]	4.08 E-04	B
Vinyl Chloride[k]	1.49 E-05	C
Xylene[k]	1.84 E-04	B

[a] Reference 7. Factors represent uncontrolled levels. For NO_x, CO, and PM10, "uncontrolled" means no combustion or add-on controls; however, the factor may include turbocharged units. For all other pollutants, "uncontrolled" means no oxidation control; the data set may include units with control techniques used for NOx control, such as PCC and SCR for lean burn engines, and PSC for rich burn engines. Factors are based on large population of engines. Factors are for engines at all loads, except as indicated. SCC = Source Classification Code. TOC = Total Organic Compounds. PM-10 = Particulate Matter ≤ 10 microns (μm) aerodynamic diameter. A "<" sign in front of a factor means that the corresponding emission factor is based on one-half of the method detection limit.

[b] Emission factors were calculated in units of (lb/MMBtu) based on procedures in EPA Method 19. To convert from (lb/MMBtu) to (lb/10^6 scf), multiply by the heat content of the fuel. If the heat content is not available, use 1020 Btu/scf. To convert from (lb/MMBtu) to (lb/hp-hr) use the following equation:

$$\text{lb/hp-hr} = (\text{lb/MMBtu})\ (\text{heat input, MMBtu/hr})\ (\text{1/operating HP, 1/hp})$$

[c] Emission tests with unreported load conditions were not included in the data set.

[d] Based on 99.5% conversion of the fuel carbon to CO_2. CO_2 [lb/MMBtu] = (3.67)(%CON)(C)(D)(1/h), where %CON = percent conversion of fuel carbon to CO_2, C = carbon content of fuel by weight (0.75), D = density of fuel, 4.1 E+04 lb/10^6 scf, and

h = heating value of natural gas (assume 1020 Btu/scf at 60°F).

[e] Based on 100% conversion of fuel sulfur to SO_2. Assumes sulfur content in natural gas of 2,000 gr/10^6scf.

[f] Emission factor for TOC is based on measured emission levels from 22 source tests.

[g] Emission factor for methane is determined by subtracting the VOC and ethane emission factors from the TOC emission factor. Measured emission factor for methane compares well with the calculated emission factor, 1.31 lb/MMBtu vs. 1.25 lb/MMBtu, respectively.

[h] VOC emission factor is based on the sum of the emission factors for all speciated organic compounds less ethane and methane.

[i] Considered $\leq$ 1 μm in aerodynamic diameter. Therefore, for filterable PM emissions, PM10(filterable) = PM2.5(filterable).

[j] PM Condensable = PM Condensable Inorganic + PM-Condensable Organic

[k] Hazardous Air Pollutant as defined by Section 112(b) of the Clean Air Act.

[l] For lean burn engines, aldehyde emissions quantification using CARB 430 may reflect interference with the sampling compounds due to the nitrogen concentration in the stack. The presented emission factor is based on FTIR measurements. Emissions data based on CARB 430 are available in the background report.

40 CFR Part 98, Table C-1 to subpart C - Default Co2 Emission Factors and High Heat Values for Various Types of Fuel

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Table C-1 to Subpart C of Part 98 Default Co_2 Emission Factors and High Heat Values for Various Types of Fuel

Default CO_2 Emission Factors and High Heat Values for Various Types of Fuel

Fuel type	Default high heat value	Default CO_2 emission factor
Coal and coke	mmBtu/short ton	kg CO_2/mmBtu
Anthracite	25.09	103.69
Bituminous	24.93	93.28
Subbituminous	17.25	97.17
Lignite	14.21	97.72
Coal Coke	24.80	113.67
Mixed (Commercial sector)	21.39	94.27
Mixed (Industrial coking)	26.28	93.90
Mixed (Industrial sector)	22.35	94.67
Mixed (Electric Power sector)	19.73	95.52
Natural gas	mmBtu/scf	kg CO_2/mmBtu
(Weighted U.S. Average)	1.026×10^{-3}	53.06
Petroleum products	mmBtu/gallon	kg CO_2/mmBtu
Distillate Fuel Oil No. 1	0.139	73.25
Distillate Fuel Oil No. 2	0.138	73.96
Distillate Fuel Oil No. 4	0.146	75.04
Residual Fuel Oil No. 5	0.140	72.93
Residual Fuel Oil No. 6	0.150	75.10
Used Oil	0.138	74.00
Kerosene	0.135	75.20
Liquefied petroleum gases (LPG)[1]	0.092	61.71

40 CFR Part 98, Table C-2 to subpart C - Default Ch4 and N2o Emission Factors for Various Types of Fuel

Table C-2 to Subpart C of Part 98 Default Ch_4 and N_2o Emission Factors for Various Types of Fuel

Fuel type	Default CH_4 emission factor (kg CH_4/mmBtu)	Default N_2O emission factor (kg N_2O/mmBtu)
Coal and Coke (All fuel types in Table C-1)	1.1×10^{-02}	1.6×10^{-03}
Natural Gas	1.0×10^{-03}	1.0×10^{-04}
Petroleum (All fuel types in Table C-1)	3.0×10^{-03}	6.0×10^{-04}
Fuel Gas	3.0×10^{-03}	6.0×10^{-04}
Municipal Solid Waste	3.2×10^{-02}	4.2×10^{-03}
Tires	3.2×10^{-02}	4.2×10^{-03}
Blast Furnace Gas	2.2×10^{-05}	1.0×10^{-04}
Coke Oven Gas	4.8×10^{-04}	1.0×10^{-04}
Biomass Fuels-Solid (All fuel types in Table C-1, except wood and wood residuals)	3.2×10^{-02}	4.2×10^{-03}
Wood and wood residuals	7.2×10^{-03}	3.6×10^{-03}
Biomass Fuels-Gaseous (All fuel types in Table C-1)	3.2×10^{-03}	6.3×10^{-04}
Biomass Fuels-Liquid (All fuel types in Table C-1)	1.1×10^{-03}	1.1×10^{-04}

Note: Those employing this table are assumed to fall under the IPCC definitions of the “Energy Industry” or “Manufacturing Industries and Construction”. In all fuels except for coal the values for these two categories are identical. For coal combustion, those who fall within the IPCC “Energy Industry” category may employ a value of 1g of CH_4/mmBtu.

[78 FR 71952, Nov. 29, 2013]

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Smith, Claudia

From: Best, Julie A <Julie.Drinkwater@bp.com>
Sent: Monday, January 25, 2016 10:24 AM
To: R8AirPermitting
Cc: airquality@southernute-nsn.gov; Robert, Rebecca
Subject: UPDATE to Salvador I/II CDP – Notification of Unpermitted Engine Replacement
Attachments: 2016-01 Salvador Part 49 C200 Updated Replacement Calcs & Backup.pdf

Dear Federal Minor NSR Coordinator:

BP is submitting updated information for the engine replacement that occurred at the Salvador I/II CDP. Prior to the installation, the engine was modified which impacted the horsepower and potential emissions. The 1138 site-rated horsepower compressor engine started up on October 30, 2015. The corrected potential-to-emit calculations for the replacement engine, site emissions summaries, and supporting documentation are attached.

Since the potential-to-emit carbon monoxide emissions at the Salvador I/II CDP after the engine replacement is less than 100 tons per year, the site is not required to apply for an operating permit according to the the Southern Ute Indian Tribe/State of Colorado Environmental Commission's Reservation Air Code.

If you have any questions regarding this update, please contact me at (970) 375-7540.

Thank you,
Julie Best
Environmental Advisor
BP America Production Company

From: Robert, Rebecca
Sent: Monday, July 06, 2015 1:06 PM
To: R8airpermitting@epa.gov
Cc: airquality@southernute-nsn.gov; Best, Julie A
Subject: Salvador I/II CDP – Notification of Unpermitted Engine Replacement

Dear Federal Minor NSR Coordinator:

BP America Production Company (BP) is submitting this notification of an unpermitted engine replacement at the Salvador I/II Central Delivery Point (CDP). The site is an existing synthetic minor source with enforceable emission limitations and requirements established for two engines under permit number SMNSR-SU-000009-2012.002. BP is planning to replace an unpermitted 666 site-rated horsepower four-stroke lean burn compressor engine (identified as Emission Unit ID Unit 2 or C200) with a 1,073 site-rated horsepower four-stroke lean burn compressor engine in August 2015. Neither the existing engine nor the replacement engine requires any air emission control devices. Since the change in emissions results in an increase in nitrogen oxides emissions greater than the thresholds listed in Table 1 of EPA's Federal Minor New Source Review Program in Indian Country (40 CFR 49.153 – 49.161) for attainment areas, BP is submitting this notification to update the registration information for the site. The potential-to-emit calculations for the replacement engine, updated site emissions summaries including the changes in emissions at the site, and supporting documentation are attached.

Within one year of commencing operation of the replacement engine, BP will submit an application for an operating permit in accordance with the Southern Ute Indian Tribe/State of Colorado Environmental Commission's Reservation Air Code since the potential-to-emit carbon monoxide emissions at the Salvador I/II CDP will be greater than 100 tons per year.

If you have any questions regarding this notification or require additional information, please contact me at (281) 366-3946 or Julie Best at (970) 375-7540.

Sincerely,

Rebecca Robert
Air Engineer
BP US Lower 48 Onshore
Office: (281) 366-3946
Cell: (713) 540-9959

*****NEW MAILING ADDRESS*****
737 North Eldridge Parkway
Houston, Texas 77079

BP America Production Company

Federal Minor New Source Review Program in Indian Country

Synthetic Minor Permit Application
to Construct a 1,874 HP Four-Stroke Lean Burn Compressor Engine
with Oxidation Catalyst and
to Establish Legally and Practically Enforceable Limitations and
Requirements on Two Engines

Salvador I/II Central Delivery Point
La Plata County, CO

August 2015, revised October 2015

TABLE OF CONTENTS

LIST OF SUPPLEMENTAL DOCUMENTS

SECTION 1
INTRODUCTION

1.1 Purpose

On July 1, 2011, the United States Environmental Protection Agency (USEPA) published 40 CFR 49.151-161, the Federal Minor New Source Review (mNSR) Program in Indian Country, which became effective on August 30, 2011. BP America Production Company's (BP) Salvador I/II Central Delivery Point is an existing synthetic minor source with nitrogen oxides (NO_x), carbon monoxide (CO), and formaldehyde (CH_2O) emission limits established for two compressor engines under permit number SMNSR-SU-000009-2012-002. BP is submitting this permit application to construct a 1,874, or lower, site-rated horsepower (hp) four-stroke lean burn compressor engine with oxidation catalyst at the site and to establish legally and practically enforceable CO and CH_2O limitations and requirements for this engine as well as for a 1,138, or lower, site rated hp four-stroke lean burn compressor engine that will replace an unpermitted engine at the site. BP notified USEPA of this planned unpermitted engine replacement on July 6, 2015. Upon issuance of the requested synthetic mNSR permit, the Salvador I/II Central Delivery Point will continue to be a synthetic minor source for Hazardous Air Pollutants (HAPs) and Prevention of Significant Deterioration (PSD) thresholds. BP will submit an application for an operating permit in accordance with the Southern Ute Indian Tribe/State of Colorado Environmental Commission's Reservation Air Code within one year of commencing operation of the replacement 1,138, or lower, hp four-stroke lean burn compressor engine.

1.2 Application Forms for Synthetic Minor Limit

The following application forms are included as attachments:

- Application for New Construction (Form NEW); and
- Application for Synthetic Minor Limit (Form SYNMIN).

Additional information requested in the forms is included in this application, as referenced.

1 – Form NEW

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
FEDERAL MINOR NEW SOURCE REVIEW PROGRAM IN INDIAN COUNTRY
40 CFR 49.151

Application for New Construction

(Form NEW)

Please check all that apply to show how you are using this form:

- ☐ **Proposed Construction of a New Source**
- ☑ **Proposed Construction of New Equipment at an Existing Source**
- ☐ **Proposed Modification of an Existing Source**
- ☑ **Other – Please Explain –** *Establish legally and practically enforceable limitations and requirements on new and existing equipment at an existing source*

Use of this information request form is voluntary and not yet approved by the Office of Management and Budget. The following is a check list of the type of information that Region 8 will use to process information on your proposed project. While submittal of this form is not required, it does offer details on the information we will use to complete your requested approval and providing the information requested may help expedite the process. Use of application forms for this program is currently under Office of Management and Budget review and these information request forms will be replaced/updated after that review is completed.

Please submit information to following two entities:

Federal Minor NSR Permit Coordinator
U.S. EPA, Region 8
1595 Wynkoop Street, 8P-AR
Denver, CO 80202-1129
R8airpermitting@epa.gov

For more information, visit:
http://www2.epa.gov/region8/tribal-minor-new-source-review-permitting

The Tribal Environmental Contact for the specific reservation:

If you need assistance in identifying the appropriate Tribal Environmental Contact and address, please contact:

R8airpermitting@epa.gov

A. GENERAL SOURCE INFORMATION

1. (a) **Company Name** (Who owns this facility?) **BP America Production Company** (b) **Operator Name** (Is the company that operates this facility different than the company that owns this facility? What is the name of the company?) **BP America Production Company**	2. **Facility Name** **Salvador I/II Central Delivery Point**
3. Type of Operation **Natural gas compressor station**	4. Portable Source? ☐ Yes ☑ No 5. Temporary Source? ☐ Yes ☑ No
6. NAICS Code **211111**	7. SIC Code **1311**

8. Physical Address (Or, home base for portable sources)
From Ignacio, CO, proceed south out of town on Highway 172 past the intersection to Highway 318, a distance of 1.7 miles, to the entrance of the Salvador I/II Central Delivery Point, which is on the left. Colorado, 81303.

9. Reservation*	10. County*	11a. Latitude (decimal format)*	11b. Longitude (decimal format)*
Southern Ute Indian	**La Plata**	**37.079052**	**-107.61829**
12a. Quarter Quarter Section*	12b. Section*	12c. Township*	12d. Range*
NE ¼, NW ¼	**28**	**33N**	**7W**

*Provide all proposed locations of operation for portable sources

B. PREVIOUS PERMIT ACTIONS (Provide information in this format for each permit that has been issued to this source. Provide as an attachment if additional space is necessary)

Facility Name on the Permit **BP America Production Company, Salvador I/II Central Delivery Point**
Permit Number (xx-xxx-xxxxx-xxxx.xx) **SMNSR-SU-000009-2012.002**
Date of the Permit Action **December 4, 2014**

Facility Name on the Permit **BP America Production Company, Salvador I/II Central Delivery Point**
Permit Number (xx-xxx-xxxxx-xxxx.xx) **SMNSR-SU-000009-2012.001**
Date of the Permit Action **September 18, 2014**

Facility Name on the Permit
Permit Number (xx-xxx-xxxxx-xxxx.xx)
Date of the Permit Action

Facility Name on the Permit
Permit Number (xx-xxx-xxxxx-xxxx.xx)
Date of the Permit Action

Facility Name on the Permit
Permit Number (xx-xxx-xxxxx-xxxx.xx)
Date of the Permit Action

C. CONTACT INFORMATION

Company Contact (Who is the primary contact for the company that owns this facility?**)** **BP America Production Company** **Devin Newby**	Title **Area Manager, Midstream**
Mailing Address **380 Airport Road, Durango, CO 81303**	
Email Address **devin.newby@bp.com**	
Telephone Number **(970) 394-4815**	Facsimile Number

Operator Contact (Is the company that operates this facility different than the company that owns this facility? Who is the primary contact for the company that operates this facility?)	Title
Mailing Address	
Email Address	
Telephone Number	Facsimile Number

Permitting Contact (Who is the person primarily responsible for Clean Air Act permitting for the company? We are seeking one main contact for the company. Please do not list consultants.) **Rebecca Robert**	Title **Air Engineer**
Mailing Address **737 North Eldridge Parkway, Houston, TX 77079**	
Email Address **rebecca.robert@bp.com**	
Telephone Number **(281) 366-3946**	Facsimile Number **(281) 366-7105**

Compliance Contact (Is the person responsible for Clean Air Act compliance for this company different than the person responsible for Clean Air Act permitting? Who is the person primarily responsible for Clean Air Act compliance for the company? We are seeking one main contact for the company. Please do not list consultants.) **Devin Newby**	Title **Area Manager, Midstream**
Mailing Address **380 Airport Road, Durango, CO 81303**	
Email Address **devin.newby@bp.com**	
Telephone Number **(970) 394-4815**	Facsimile Number

D. ATTACHMENTS

Include all of the following information (see the attached instructions)

*Please do not send Part 71 Operating Permit Application Forms in lieu of the check list below.

☑ **FORM SYNMIN -** New Source Review Synthetic Minor Limit Request Form, if synthetic minor limits are being requested. ***See Section 1.***

☑ Narrative description of the proposed production processes. This description should follow the flow of the process flow diagram to be submitted with this application. ***See Section 2.***

☑ Process flow chart identifying all proposed processing, combustion, handling, storage, and emission control equipment. ***See Section 2.***

☑ A list and descriptions of all proposed emission units and air pollution-generating activities. ***See Section 3 and emission calculations.***

☑ Type and quantity of fuels, including sulfur content of fuels, proposed to be used on a daily, annual and maximum hourly basis. ***See Section 3 and emission calculations.***

☑ Type and quantity of raw materials used or final product produced proposed to be used on a daily, annual and maximum hourly basis. ***See Section 3 and emission calculations.***

☑ Proposed operating schedule, including number of hours per day, number of days per week and number of weeks per year. ***See Section 2.***

☑ A list and description of all proposed emission controls, control efficiencies, emission limits, and monitoring for each emission unit and air pollution generating activity. ***See Section 3 and emission calculations.***

☑ **Criteria Pollutant Emissions -** Estimates of Current Actual Emissions, Current Allowable Emissions, Post-Change Uncontrolled Emissions, and Post-Change Allowable Emissions for the following air pollutants: particulate matter, PM_{10}, $PM_{2.5}$, sulfur oxides (SOx), nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compound (VOC), lead (Pb) and lead compounds, fluorides (gaseous and particulate), sulfuric acid mist (H_2SO_4), hydrogen sulfide (H_2S), total reduced sulfur (TRS) and reduced sulfur compounds, including all calculations for the estimates. ***See Section E of this form and emission calculations.***

These estimates are to be made for each emission unit, emission generating activity, and the project/source in total. Note, there are no insignificant emission units or activities in this permitting program, only exempted units and activities. Please see the regulation for a list of exempted units and activities.

☑ **Air Quality Review** – ***See Section 4.***

☐ **ESA (Endangered Species Act) –** ***Since the Salvador I/II Central Delivery Point is an existing facility and the proposed new engine will not impact the existing footprint of the site, an Endangered Species Act review is not included in the application.***

☐ **NHPA (National Historic Preservation Act) –** ***Since the Salvador I/II Central Delivery Point is an existing facility and the proposed new engine will not impact the existing footprint of the site, a National Historic Preservation Act review is not included in the application.***

E. TABLE OF ESTIMATED EMISSIONS

The following tables provide the total emissions in tons/year for all pollutants from the calculations required in Section D of this form, as appropriate for the use specified at the top of the form.

E(i) – Proposed New Source*

Pollutant	Potential Emissions (tpy)	Proposed Allowable Emissions (tpy)	
PM			PM - Particulate Matter PM_{10} - Particulate Matter less than 10 microns in size $PM_{2.5}$ - Particulate Matter less than 2.5 microns in size SO_2 - Sulfur Oxides NOx - Nitrogen Oxides CO - Carbon Monoxide VOC - Volatile Organic Compound Pb - Lead and lead compounds Fluorides - Gaseous and particulates H_2SO_4 - Sulfuric Acid Mist H_2S - Hydrogen Sulfide TRS - Total Reduced Sulfur RSC - Reduced Sulfur Compounds
PM_{10}			
$PM_{2.5}$			
SO_2			
NO_x			
CO			
VOC			
Pb			
Fluorides			
H_2SO_4			
H_2S			
TRS			
RSC			

This application is for proposed construction of new equipment at an existing synthetic minor source and for establishing legally and practically enforceable limitations and requirements on new and existing equipment at an existing synthetic minor source.

Emissions calculations must include fugitive emissions if the source is one the following listed sources, pursuant to CAA Section 302(j): ***Fugitive emissions are not required to be included since the source is not one of the following listed sources.***

(a) Coal cleaning plants (with thermal dryers);
(b) Kraft pulp mills;
(c) Portland cement plants;
(d) Primary zinc smelters;
(e) Iron and steel mills;
(f) Primary aluminum ore reduction plants;
(g) Primary copper smelters;
(h) Municipal incinerators capable of charging more than 250 tons of refuse per day;
(i) Hydrofluoric, sulfuric, or nitric acid plants;
(j) Petroleum refineries;
(k) Lime plants;
(l) Phosphate rock processing plants;
(m) Coke oven batteries;
(n) Sulfur recovery plants;
(o) Carbon black plants (furnace process);
(p) Primary lead smelters;
(q) Fuel conversion plants;
(r) Sintering plants;
(s) Secondary metal production plants;
(t) Chemical process plants
(u) Fossil-fuel boilers (or combination thereof) totaling more than 250 million British thermal units per hour heat input;
(v) Petroleum storage and transfer units with a total storage capacity exceeding 300,000 barrels;
(w) Taconite ore processing plants;
(x) Glass fiber processing plants;
(y) Charcoal production plants;
(z) Fossil fuel-fired steam electric plants of more that 250 million British thermal units per hour heat input, and
(aa) Any other stationary source category which, as of August 7, 1980, is being regulated under section 111 or 112 of the Act.

E(ii) – Proposed New Construction at an Existing Source or Modification of an Existing Source*

Pollutant	Current Actual Emissions (tpy)**	Current Allowable Emissions (tpy)**	Post-Change Potential Emissions (tpy)**	Post-Change Allowable Emissions (tpy)
PM	2.07	2.26	2.84	2.84
PM_{10}	2.07	2.26	2.84	2.84
$PM_{2.5}$	2.07	2.26	2.84	2.84
SO_2	0.10	0.11	0.14	0.14
NO_x	78.36	89.76	103.68	111.31
CO	95.97	103.37	150.20	84.46
VOC	47.33	49.09	65.31	65.31
Pb				
Fluorides				
H_2SO_4				
H_2S				
TRS				
RSC				

**** This application is for proposed construction of new equipment at an existing synthetic minor source and for establishing legally and practically enforceable limitations and requirements on new and existing equipment at an existing synthetic minor source. The values in the above table represent total site emissions. BP is requesting federally enforceable limits for existing equipment (Emission Unit 2, which are 0.64 lb/hr CO; 0.32 lb/hr CH_2O) and for new equipment (Emission Unit 5, which are: 1.03 lb/hr CO; 0.46 lb/hr CH_2O). The facility-wide potential to emit (post-change allowable emissions) is not federally enforceable.***

*****The current actual emissions are based on the actual emissions of the units in operation at the Salvador CDP during the preceding 2014 calendar year. The current allowable emissions represent the site totals with the Unit 2 engine replacement. Post-change potential emissions include the potential uncontrolled emissions from the proposed project in the site total.***

PM - Particulate Matter
PM_{10} - Particulate Matter less than 10 microns in size
$PM_{2.5}$ - Particulate Matter less than 2.5 microns in size
SO_2 - Sulfur Oxides
NOx - Nitrogen Oxides
CO - Carbon Monoxide
VOC - Volatile Organic Compound
Pb - Lead and lead compounds
Fluorides - Gaseous and particulates
H_2SO_4 - Sulfuric Acid Mist
H_2S - Hydrogen Sulfide
TRS - Total Reduced Sulfur
RSC - Reduced Sulfur Compounds

The public reporting and recordkeeping burden for this collection of information is estimated to average 20 hours per response, unless a modeling analysis is required. If a modeling analysis is required, the public reporting and recordkeeping burden for this collection of information is estimated to average 60 hours per response .Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed form to this address.

2 – Form SYNMIN

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
FEDERAL MINOR NEW SOURCE REVIEW PROGRAM IN INDIAN COUNTRY
40 CFR 49.151

Application For Synthetic Minor Limit

(Form SYNMIN)

Use of this information request form is voluntary and not yet approved by the Office of Management and Budget. The following is a check list of the type of information that Region 8 will use to process information on your proposed project. While submittal of this form is not required, it does offer details on the information we will use to complete your requested approval and providing the information requested may help expedite the process. Use of application forms for this program is currently under Office of Management and Budget review and these information request forms will be replaced/updated after that review is completed.

Please submit information to following two entities:

Federal Minor NSR Permit Coordinator
U.S. EPA, Region 8
1595 Wynkoop Street, 8P-AR
Denver, CO 80202-1129
R8airpermitting@epa.gov

For more information, visit:
http://www2.epa.gov/region8/tribal-minor-new-source-review-permitting

The Tribal Environmental Contact for the specific reservation:

If you need assistance in identifying the appropriate Tribal Environmental Contact and address, please contact:

R8airpermitting@epa.gov

A. GENERAL INFORMATION

Company Name (Who owns this facility?) **BP America Production Company**	**Facility Name** **Salvador I/II Central Delivery Point**
Company Contact (Who is the primary contact for the company that owns this facility?**)** **Devin Newby**	Title **Area Manager, Midstream**
Mailing Address **380 Airport Road, Durango, CO 81303**	
Email Address **devin.newby@bp.com**	
Telephone Number **(970) 394-4815**	Facsimile Number

B. ATTACHMENTS

For each criteria air pollutant, hazardous air pollutant and for all emission units and air pollutant-generating activities to be covered by a limitation, include the following:

☑ **Item 1 -** The proposed limitation and a description of its effect on current actual, allowable and the potential to emit. ***See Section 3 and emission calculations.***

☑ **Item 2 -** The proposed testing, monitoring, recordkeeping, and reporting requirements to be used to demonstrate and assure compliance with the proposed limitation. ***See Section 3.***

☑ **Item 3 -** A description of estimated efficiency of air pollution control equipment under present or anticipated operating conditions, including documentation of the manufacturer specifications and guarantees. ***See Section 3 and emission calculations.***

☑ **Item 4 -** Estimates of the Post-Change Allowable Emissions that would result from compliance with the proposed limitation, including all calculations for the estimates. ***See Section 3 and emission calculations.***

☑ **Item 5 –** Estimates of the potential emissions of Greenhouse Gas (GHG) pollutants. ***See Section 3 and emission calculations.***

SECTION 2
FACILITY INFORMATION

2.1 Process and Product Description

The Salvador I/II Central Delivery Point is a natural gas compression facility located in southwestern Colorado. The Salvador I portion of the facility is located on fee land and the Salvador II portion is located on trust land within the exterior boundary of the Southern Ute Indian Reservation.

The Salvador I/II Central Delivery Point provides natural gas field compression. Upstream of the facility are Fruitland Gas (coal bed methane) wells which are connected to a gathering pipeline system and the inlet of the facility. The Salvador Gas Unit A #1 wellsite is located within the fence line of the facility, and the wellsite natural gas commingles with the field gas coming into the facility and passes through one inlet separator. The commingled natural gas composition is primarily methane. In addition, the gas contains some carbon dioxide and is saturated with water vapor. No condensate or natural gas liquids are produced. Free liquid water, water vapor, and entrained lubricating oil are removed from the gas, and the gas is compressed and sent on to third party or BP-owned gathering systems.

2.2 Process Flow Diagram

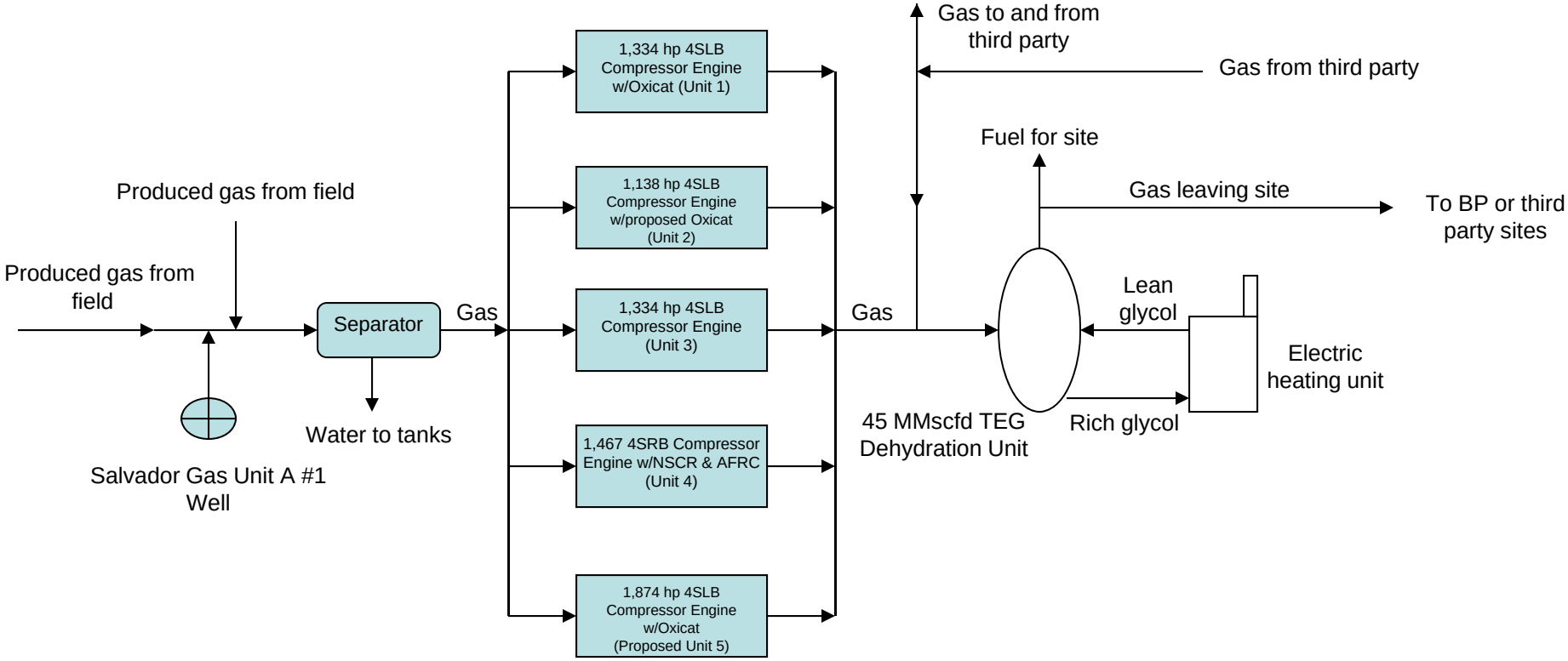
A simplified process flow diagram of the Salvador I/II Central Delivery Point is included in the application and includes the proposed new engine and proposed control equipment.

2.3 Operating Schedule

The proposed operating schedule for each of the affected emission units is twenty-four (24) hours per day, seven (7) days per week, and fifty-two (52) weeks per year. Emission calculations are based on 8,760 hours of operation per year.

3 – Simplified Process Flow Diagram

Salvador I/II Central Delivery Point
Simplified Process Flow Diagram



Note: The site also includes emissions from tank heaters, separator heaters, and various storage tanks.

SECTION 3
AFFECTED EMISSION UNITS

3.1 Affected Emission Units and Emission Calculations

BP is submitting this minor New Source Review (mNSR) permit application to construct the proposed Emission Unit 5 at the Salvador I/II Central Delivery Point, which is an existing synthetic minor source permitted under Permit #SMNSR-SU-000009-2012.002, and to establish federally enforceable CO and CH_2O emission limits for Emission Unit 2 and Emission Unit 5. Emission Unit 2 is a 1,138, or lower, hp four-stroke lean burn (4SLB) compressor engine with proposed oxidation catalyst controls. Emission Unit 5 is a proposed 1,874, or lower, hp 4SLB compressor engine with oxidation catalyst controls.

Potential-to-emit calculations, including greenhouse gases and controlled and uncontrolled emissions from Emission Unit IDs Unit 2 and Unit 5, and current actual emissions for the preceding calendar year are included in the application. Since the facility does not belong to one of the source categories listed in 40 CFR 52.21(b)(1)(iii), fugitive emissions are not included in the potential-to-emit calculations. Estimates of actual emissions are calculated for Emission Unit IDs Unit 1, Unit 2, Unit 3, and Unit 4 for the previous 2014 calendar year. Actual emissions for Unit 2 are based on the 666 hp 4SLB compressor engine that was in operation in 2014. BP is planning to replace this unit with the 1,138, or lower, hp 4SLB compressor engine in October 2015.

3.2 Identification and Description of Existing Air Pollution Control Equipment and Requested Synthetic Minor Limits

For Emission Unit 2, BP is proposing to install an oxidation catalyst capable of reducing uncontrolled emissions of carbon monoxide (CO) emissions by at least 90% and formaldehyde (CH_2O) emissions by at least 55% at a maximum operating rate (90% to 110% of engine capacity at site elevation). The requested permit limits are 0.64 lb/hr CO and 0.32 lb/hr CH_2O for the proposed controls.

The proposed Emission Unit 5 will be equipped with an oxidation catalyst capable of reducing uncontrolled emissions of CO emissions by at least 90% and CH_2O emissions by at least 60% at a maximum operating rate (90% to 110% of engine capacity at site elevation). The requested permit limits are 1.03 lb/hr CO and 0.46 lb/hr CH_2O.

Since engineering design is not presently in detailed progress, the catalyst manufacturers and models have not been selected yet. However, the requested federally enforceable CO and CH_2O limits will be met regardless of the catalyst manufacturer or model. The control efficiencies are not federally enforceable.

3.3 Proposed Testing, Monitoring, Recordkeeping and Reporting Requirements

In accordance with 40 CFR 49.158(a)(1)(ii)(B), BP is including proposed testing, monitoring, recordkeeping, and reporting requirements to be used to demonstrate and assure compliance with the proposed emission limitations for Emission Unit 2 and Emission Unit 5. These requirements recognize the oxidation catalyst equipment that will be installed on both engines for limiting the potential-to-emit CO and CH_2O emissions. The proposed requirements are included as a Supplemental Document beginning on page 3-3 of the application.

3.4 Type and Quantity of Fuel and Raw Materials Used

The affected emission units at the Salvador I/II Central Delivery Point will be fired with natural gas only. The heat content of this natural gas at the site ranges from approximately 800 – 1000 Btu/ft^3. The maximum sulfur content of the gas is 1×10^{-7} percent. The daily, annual, and maximum hourly fuel use for each source is provided in the emission calculations.

4 - Proposed Operational, Testing, Monitoring, Recordkeeping & Reporting Requirements

Proposed Operational, Testing, Monitoring, Recordkeeping & Reporting Requirements

The below proposed operational, testing, monitoring, recordkeeping, and reporting requirements are requested to recognize emissions control equipment on engine units Unit 2 and Unit 5 for limiting the potential-to-emit (PTE) of carbon monoxide (CO) and formaldehyde (CH_2O) [40 CFR 49.155(a)(1)(iii)]. These requirements are identical to the requirements for the 1,334 hp 4SLB compressor engine in permit number SMNSR-SU-000009-2012.002 for the Salvador I/II Central Delivery Point, with the exception of the additional text in underlined italics font.

Proposed Revision of Operational Requirements

(i) The Permittee may rebuild or replace an existing permitted engine with an engine of the same *or lower* horsepower rating, and configured to operate in the same manner as the engine being rebuilt or replaced. Any emission limits, requirements, control technologies, testing or other provisions that apply to the permitting engines that are replaced shall also apply to the rebuilt or replacement engines.

Proposed Testing Requirements

(a) Performance tests shall be conducted on the engines for measuring CO and CH_2O emissions to demonstrate compliance with each emission limitation in this permit. The performance tests shall be conducted in accordance with appropriate reference methods specified in 40 CFR Part 60, Appendix A and 40 CFR Part 63, Appendix A, or an EPA-approved American Society for Testing and Materials (ASTM) method. The Permittee may submit to the EPA a written request for approval of an alternate test method, but shall only use that alternate test method after obtaining approval from the EPA.

(i) The initial performance test shall be conducted within 90 calendar days of startup of a new engine.
(ii) Subsequent performance tests for CH_2O emissions shall be conducted on the engines within 12 months of the most recent performance test.
(iii) Performance tests shall be conducted within 90 calendar days of the *initial installation or* replacement of the catalyst on each engine.
(iv) Performance tests shall be conducted within 90 calendar days of startup of all rebuilt and replacement engines.

(b) The Permittee shall not perform engine tuning or make any adjustments to engine settings, catalytic control system settings, processes, or operational parameters the day of or during the engine testing. Any such tuning or adjustments may result in a determination by the EPA that the test is invalid. Artificially increasing an engine load to meet test requirements is not considered engine tuning or adjustments.

(c) The Permittee shall not abort any engine tests that demonstrate non-compliance with any CO or CH_2O emission limits in this permit.

(d) Performance tests conducted on the engines for measuring CO and CH_2O emissions shall meet the following requirements:

(i) The pressure drop across each catalyst bed and the inlet temperature to each catalyst bed shall be measured and recorded at least once per test during all performance tests.

(ii) The Permittee shall measure NO_x emissions from the engines simultaneously with all performance tests for CO emissions. NO_x emissions shall be measured using a portable analyzer and protocol approved in writing by the EPA. *[Note to Permittee: Although the permit does not contain NO_x emission limits for this engine, NO_x measurement requirements have been included as an indicator to ensure compliance with Condition C.4(b) above.]*

(iii) All performance tests shall be conducted at maximum operating rate (90% to 110% of the maximum achievable load available at the time of the test). The Permittee may submit to the EPA a written request for approval of an alternate load level for testing, but shall only test at that alternate load level after obtaining written approval from the EPA.

(iv) During each test run, data shall be collected on all parameters necessary to document how emissions were measured and calculated (such as test run length, minimum sample volume, volumetric flow rate, moisture and oxygen corrections, etc.).

(v) Each test shall consist of at least three 1-hour or longer valid test runs. Emission results shall be reported as the arithmetic average of all valid test runs and shall be in terms of the emission limits in this permit.

(vi) Performance test plans shall be submitted to the EPA for approval 60 calendar days prior to the date the test is planned.

(vii) Performance test plans that have already been approved by the EPA for the emission units approved in this permit *or for similar emission units approved in another BP permit* may be used in lieu of new test plans unless the EPA requires the submittal and approval of new test plans. The Permittee may submit new plans for EPA approval at any time.

(viii) The test plans shall include and address the following elements:

(A) Purpose of the test;

(B) Engines and catalytic control systems to be tested;

(C) Expected engine operating rate(s) during the test;

(D) Sampling and analysis procedures (sampling locations, test methods, laboratory identification);

(E) Quality assurance plan (calibration procedures and frequency, sample recovery and field documentation, chain of custody procedures); and

(F) Data processing and reporting (description of data handling and quality control procedures, report content).

(e) The Permittee shall notify the EPA at least 30 calendar days prior to scheduled performance testing. The Permittee shall notify the EPA at least 1 week prior to scheduled performance testing if the testing cannot be performed.

(f) If the results of a complete and valid performance test of the emissions from any permitted engine demonstrate noncompliance with the emission limits in this permit, the engine shall be shut down as soon as safely possible, and appropriate corrective action shall be taken (e.g., repairs, catalyst cleaning, catalyst replacement). The Permittee shall notify the EPA in writing within 24 hours of each such shut down. The engine must be retested within 7 days of being restarted and the emissions must meet the applicable limits in this permit. If the retest shows that the emissions continue to exceed the limits in this permit, the engine shall again be shut down as soon as safely possible, and the engine may not operate, except for purposes of startup and testing, until the Permittee demonstrates through testing that the emissions do not exceed the emission limits in this permit.

(g) If a permitted engine is not operating, the Permittee does not need to start up the engine solely to conduct a performance test. The Permittee may conduct the performance test when the engine is started up again.

Proposed Monitoring Requirements [40 CFR 49.155(a)(3)]

(a) The Permittee shall continuously monitor the engine exhaust temperature at the inlet to the catalyst bed on each engine.

(b) Except during startups, which shall not exceed 30 minutes, if the engine's exhaust temperature at the inlet to the catalyst bed on any one (1) engine deviates from the acceptable ranges specified in this permit then the following actions shall be taken. The Permittee's completion of any or all of these actions shall not constitute, nor qualify as, an exemption from any other emission limits in this permit.

(i) Within 24 hours of determining a deviation of the engine exhaust temperature at the inlet to the catalyst bed, the Permittee shall investigate. The investigation shall include testing the temperature sensing device, inspecting the engine for performance problems and assessing the catalytic control system for possible damage that could affect catalytic system effectiveness (including, but not limited to, catalyst housing damage, and fouled, destroyed or poisoned catalyst).

(ii) If the engine exhaust temperature at the inlet to the catalyst bed can be corrected by following the engine manufacturer recommended procedures or equivalent procedures developed by the Permittee or vendor and the catalytic control system has not been damaged, then the Permittee shall correct the engine exhaust temperature at the inlet to the catalyst bed within 24 hours of inspecting the engine and catalytic control system.

(iii) If the engine exhaust temperature at the inlet to the catalyst bed cannot be corrected using the engine manufacturer recommended procedures or equivalent procedures developed by the Permittee or vendor, or the catalytic control system has been damaged, then the affected engine shall cease operating immediately and shall not be returned to routine service until the following has been met:

(A) The engine exhaust temperature at the inlet to the catalyst bed is measured and found to be within the acceptable temperature range for that engine; and

(B) The catalytic control system has been repaired or replaced, if necessary.

(c) The Permittee shall monitor the pressure drop across the catalyst bed on each engine every 30 days using pressure sensing devices before and after the catalyst bed to obtain a direct reading of the pressure drop (also referred to as the differential pressure). *[Note to Permittee: Differential pressure measurements, in general, are used to show the pressure across the filter elements. This information will determine when the elements in the catalyst bed are fouling, blocked or blown out and thus require cleaning or replacement.]*

(d) The Permittee shall perform the first measurement of the pressure drop across the catalyst bed on each engine no more than 30 days from the date of the initial performance test. Thereafter, the Permittee shall measure the pressure drop across the catalyst bed, at a minimum every 30 days. Subsequent performance tests, as required in this permit, can be used to meet the periodic pressure drop monitoring requirement provided it occurs within the

30-day window. The pressure drop reading can be a one-time measurement on that day, the average of performance test runs conducted on that day, or an average of all the measurements taken on that day if continuous readings are taken.

(e) If the pressure drop reading exceeds ± 2 inches of water from the baseline pressure drop reading taken during the most recent performance test, then the following actions shall be taken. The Permittee's completion of any or all of these actions shall not constitute, nor qualify as, an exemption from any other emission limits in this permit:

(i) Within 24 hours of determining a deviation of the pressure drop across the catalyst bed, the Permittee shall investigate. The investigation shall include testing the pressure transducers and assessing the catalytic control system for possible damage that could affect catalytic system effectiveness (including, but not limited to, catalyst housing damage, and plugged, fouled, destroyed or poisoned catalyst).

(ii) If the pressure drop across the catalyst bed can be corrected by following the catalytic control system manufacturer recommended procedures or equivalent procedures developed by the Permittee or vendor, and the catalytic control system has not been damaged, then the Permittee shall correct the problem within 24 hours of inspecting the catalytic control system.

(iii) If the pressure drop across the catalyst bed cannot be corrected using the catalytic control system manufacturer recommended procedures or equivalent procedures developed by the Permittee or vendor, or the catalytic control system is damaged, then the Permittee shall do one of the following:

(A) Conduct a performance test within 90 calendar days, as specified in this permit, to ensure that the emission limits are being met and to re-establish the pressure drop across the catalyst bed. The Permittee shall perform a portable analyzer test for CO and NO_x to establish a new temporary pressure drop baseline until a performance test can be scheduled and completed; or

(B) Cease operating the affected engine immediately. The engine shall not be returned to routine service until the pressure drop is measured and found to be within the acceptable pressure range for that engine as determined from the most recent performance test. Corrective action may include removal and cleaning of the catalyst or replacement of the catalyst.

(f) The Permittee shall monitor CO and NO_x emissions from the exhaust of the catalytic control system on each engine at least quarterly, to demonstrate compliance with each engines' emission limits in this permit. To meet this requirement, the Permittee shall:

(i) Measure CO and NO_x emissions at the normal operating load using a portable analyzer and a monitoring protocol approved by the EPA or conduct a performance test as specified in this permit;

(ii) Measure the CO and NO_x emissions simultaneously; and

(iii) Commence monitoring for CO and NO_x emissions within 90 calendar days of the Permittee's submittal of the initial performance test results for CO emissions, as appropriate, to the EPA.

(g) The Permittee shall not perform engine tuning or make any adjustments to engine settings, catalytic control system settings, processes or operational parameters the day of or during

measurements. Any such tuning or adjustments may result in a determination by the EPA that the result is invalid. Artificially increasing an engine load to meet testing requirements is not considered engine tuning or adjustments.

(h) For any one (1) engine: If the results of consecutive quarterly portable analyzer measurements demonstrate compliance with the CO emission limits, the required monitoring frequency may change from quarterly to semi-annually.

(i) For any one (1) engine: If the results of consecutive semi-annual portable analyzer measurements demonstrate non-compliance with the CO emission limits, the required test frequency shall revert back to quarterly.

(j) The Permittee shall submit portable analyzer specifications and monitoring protocols to the EPA at the following address for approval at least 45 calendar days prior to the date of initial portable analyzer monitoring:

U.S. Environmental Protection Agency, Region 8
Office of Enforcement, Compliance & Environmental Justice
Air Toxics and Technical Enforcement Program, 8ENF-AT
1595 Wynkoop Street
Denver, Colorado 80202

The protocol may be submitted via electronic mail to r8airreportenforcement@epa.gov.

(k) Portable analyzer specifications and monitoring protocols that have already been approved by the EPA for the emission units approved in this permit *or for similar emission units approved in another BP permit* may be used in lieu of new protocols unless the EPA determines it is necessary to require the submittal and approval of a new protocol. The Permittee may submit a new protocol for EPA approval at any time.

(l) The Permittee is not required to conduct emissions monitoring and parametric monitoring of exhaust temperature and catalyst differential pressure on engines that have not operated during the monitoring period. The Permittee shall certify that the engine(s) did not operate during the monitoring period in the annual report.

Proposed Recordkeeping Requirements [40 CFR 49.155(a)(4)]

(a) Records shall be kept of manufacturer and/or vendor specifications and maintenance requirements developed by the manufacturer, vendor, or Permittee for each engine, catalytic control system, temperature-sensing device, and pressure-measuring device.

(b) Records shall be kept of all calibration and maintenance conducted for each engine, catalytic control system, temperature-sensing device, and pressure-measuring device.

(c) Records shall be kept that are sufficient to demonstrate that the fuel for each engine is pipeline quality natural gas in all respects, with the exception of CO2 concentrations.

(d) Records shall be kept of all temperature measurements required in this permit, as well as a description of any corrective actions taken pursuant to this permit.

(e) Records shall be kept of all pressure drop measurements required in this permit, as well as a description of any corrective actions taken pursuant to this permit.

(f) Records shall be kept of all required testing and monitoring in this permit. The records shall include the following:

(i) The date, place, and time of sampling or measurements;
(ii) The date(s) analyses were performed;
(iii) The company or entity that performed the analyses;
(iv) The analytical techniques or methods used;
(v) The results of such analyses or measurements; and
(vi) The operating conditions as existing at the time of sampling or measurement.

(g) Records shall be kept of all catalyst replacements or repairs, engine rebuilds, and replacements.

(h) Records shall be kept of each rebuilt or replacement engine break-in period, pursuant to the requirements of this permit, where an existing engine that has been rebuilt or replaced resumes operation without the catalyst control system, for a period not to exceed 200 hours.

(i) Records shall be kept of each time any engine is shut down due to a deviation in the inlet temperature to the catalyst bed or pressure drop across a catalyst bed. The Permittee shall include in the record the cause of the problem, the corrective action taken, and the timeframe for bringing the pressure drop and inlet temperature range into compliance.

Requirements for Records Retention

(a) The Permittee shall retain all records required by this permit for a period of at least 5 years from the date the record was created.

(b) Records shall be kept in the vicinity of the facility, such as at the facility, the location that has day-to-day operational control over the facility, or the location that has day-to-day responsibility for compliance of the facility.

Proposed Reporting Requirements [40 CFR 49.155(a)(5)]

1. Annual Emission Reports

(a) The Permittee shall submit a written annual report of the actual annual emissions from all emission units at the facility covered under this permit, including emissions from startups, shutdowns, and malfunctions, each year no later than April 1st. The annual report shall cover the period for the previous calendar year. All reports shall be certified to truth and accuracy by the person primarily responsible for Clean Air Act compliance for the Permittee.

(b) The report shall include CO and CH_2O emissions.

(c) The report shall be submitted to:

U.S. Environmental Protection Agency, Region 8

Office of Partnerships and Regulatory Assistance
Tribal Air Permitting Program, 8P-AR
1595 Wynkoop Street
Denver, Colorado 80202

The report may be submitted via electronic mail to r8AirPermitting@epa.gov.

2. All other documents required to be submitted under this permit, with the exception of the **Annual Emission Reports**, shall be submitted to:

U.S. Environmental Protection Agency, Region 8
Office of Enforcement, Compliance & Environmental Justice
Air Toxics and Technical Enforcement Program, 8ENF-AT
1595 Wynkoop Street
Denver, Colorado 80202

All documents may be submitted electronically to r8airreportenforcement@epa.gov.

3. The Permittee shall promptly submit to the EPA a written report of any deviations of permit requirements, a description of the probable cause of such deviations, and any corrective actions or preventative measures taken. A "prompt" deviation report is one that is post marked or submitted via electronic mail to r8airreportenforcement@epa.gov as follows:

(a) Within 30 days from the discovery of any deviation of the emission limits or operational limits that is left un-corrected for more than 5 days after discovering the deviation;

(b) By April 1st for the discovery of a deviation of recordkeeping or other permit conditions during the preceding calendar year that do not affect the Permittee's ability to meet the emission *or operational* limits.

4. The Permittee shall submit a written report for any required performance tests to the EPA Regional Office within 60 days after completing the tests.

5. The Permittee shall submit any record or report required by this permit upon EPA request.

5 – Potential-to-Emit Emission Calculations and Supporting Documentation

BP America Production Company
Facility: **Salvador I/II Central Delivery Point**
Description: **Potential-to-Emit Emissions Summary**

Emission Unit ID	Description	Emissions (TPY)						
		NO_x	CO	PM	SO_2	VOC	CH_2O	HAPs
Unit 1	1334 hp Waukesha L7042GL Compressor Engine w/OxiCat	20.61	3.86	0.42	0.02	12.88	1.49	1.49
Unit 2	1138 hp Caterpillar G3516 Compressor Engine w/OxiCat	24.17	2.78	0.42	0.02	8.46	1.38	1.38
Unit 3	1334 hp Waukesha L7042GL Compressor Engine	19.32	38.64	0.42	0.02	12.88	3.74	3.74
Unit 4	1467 hp Waukesha L7042GSI Compressor Engine w/NSCR and AFRC	28.33	34.00	0.97	0.03	14.17	0.71	0.71
Unit 5	1874 hp Caterpillar G3606 Compressor Engine w/OxiCat	18.10	4.52	0.55	0.03	15.74	2.03	2.03
--	500 gal TEG Tanks (3)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 gal Lube Oil Tanks (5)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 gal EG/Water (50/50) Tanks (2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 gal Used Oil Tanks (5)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	95 bbl Compressor/Dehy Drip Tanks (7)	0.00	0.00	0.00	0.00	0.03	0.00	0.00
--	500 bbl Produced Water Tanks (4)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	0.25 MMBtu/hr Tank Heaters (5)	0.54	0.45	0.04	0.00	0.03	0.00	0.00
--	0.15 MMBtu/hr Separator Heaters (2)	0.13	0.11	0.01	0.00	0.01	0.00	0.00
--	Tri-ethylene Glycol (TEG) Dehydrator Regenerator, 45 MMscfd	0.00	0.00	0.00	0.00	0.89	0.00	0.00
--	Tri-ethylene Glycol (TEG) Dehydrator Flash Tank Vent	0.00	0.00	0.00	0.00	0.20	0.00	0.00
--	300 bbl Oily Water Tanks (2)	0.00	0.00	0.00	0.00	0.01	0.00	0.00
--	0.26 MMBtu/hr Oily Water Breakout Tank Heater	0.11	0.09	0.01	0.00	0.01	0.00	0.00
--	500 gal Solvent Tank	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 bbl Oily Water Tank	0.00	0.00	0.00	0.00	0.01	0.00	0.00
--	37.5 bbl Used Oil Tank	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total Site Emissions	**111.31**	**84.46**	**2.84**	**0.14**	**65.31**	**9.35**	**9.35**

	Emissions (TPY)						
	NO_x	CO	PM	SO_2	VOC	CH_2O	HAPs
Prior Total Site Emissions	89.76	103.37	2.26	0.11	49.09	8.84	8.84
Prior Unit 2 (1138 hp Caterpillar G3516 Compressor Engine or similar) without oxidation catalyst controls	21.98	27.80	0.42	0.02	8.46	3.08	3.08
Unit 2 (1138 hp Caterpillar G3516 Compressor Engine or similar) with oxidation catalyst controls	24.17	2.78	0.42	0.02	8.46	1.38	1.38
Unit 5 (1874 hp Caterpillar 3606 Compressor Engine or similar) with oxidation catalyst controls	18.10	4.52	0.55	0.03	15.74	2.03	2.03
Project PTE Change	**21.55**	**-18.91**	**0.58**	**0.03**	**16.23**	**0.51**	**0.51**

BP America Production Company
Facility: **Salvador I/II Central Delivery Point**
Description: **1138, or lower, hp Four-Stroke Lean Burn Engine[1]**
Emission Unit ID: **Unit 2**

Source Information:

Maximum Rating[1]	1150 hp
Site Altitude	6371 ft
Site Rating[1]	**1138** hp
Operating Capacity[3]	100 %
Hours of Operation[3]	8760 hr/yr
Fuel Consumption[2]	8383 Btu/hp-hr
Heat Input[4]	9.54 MMBtu/hr
Emissions Controls	Oxidation Catalyst

Maximum Fuel Usage: [4]

Hourly Fuel Usage	11.9 Mscf/hr
Daily Fuel Usage	0.3 MMscf/day
Annual Fuel Usage	104.5 MMscf/yr

Controlled Regulated Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Control Efficiency[7]	Emissions (lb/hr)	Emissions (TPY)
NO_X[2,5]	2.20	g/hp-hr	N/A	5.5194	24.1750
CO[2]	2.53	g/hp-hr	90%	0.6347	2.7801
VOC[2]	0.77	g/hp-hr	N/A	1.9318	8.4612
SO_2[6]	5.88E-04	lb/MMBtu	N/A	0.0056	0.0246
PM[6]	9.99E-03	lb/MMBtu	N/A	0.0953	0.4173
PM_{10}[6]	7.71E-05	lb/MMBtu	N/A	0.0007	0.0032
$PM_{2.5}$[6]	7.71E-05	lb/MMBtu	N/A	0.0007	0.0032
CH_2O[2]	0.28	g/hp-hr	55%	0.3161	1.3846

Uncontrolled Regulated Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Emissions (lb/hr)	Emissions (TPY)
NO_X[2]	2.00	g/hp-hr	5.0176	21.9772
CO[2]	2.53	g/hp-hr	6.3473	27.8012
VOC[2]	0.77	g/hp-hr	1.9318	8.4612
SO_2[6]	5.88E-04	lb/MMBtu	0.0056	0.0246
PM[6]	9.99E-03	lb/MMBtu	0.0953	0.4173
PM_{10}[6]	7.71E-05	lb/MMBtu	0.0007	0.0032
$PM_{2.5}$[6]	7.71E-05	lb/MMBtu	0.0007	0.0032
CH_2O[2]	0.28	g/hp-hr	0.7025	3.0768

Example Calculations:

NO_X Emissions (lb/hr) = 1138 hp * 2.00 g/hp-hr * lb/453.6 g = 5.02

NO_X Emissions (TPY) = 5.02 lb/hr * 8760 hr/yr * 1 Ton/2000 lb = 21.98

[1] Based on LEHW0036-00 for Caterpillar G3516 DM8620-01, 1200 rpm, 130 oF aftercooler water inlet, TA aspiration, maximum rating. Site rating based on deducting 3% for every 1000 feet above 6000 feet. Horsepower from this engine configuration is being used as it results in the highest potential emissions.

[2] Based on Caterpillar Gas Engine Rating Pro Version 5.02.01 (Ref. Data Set DM0107-09-001) for Caterpillar G3516, 1200 rpm, 8:1 CR, 130 oF aftercooler water inlet, TA aspiration, maximum rating. Emission factors and fuel consumption from this engine configuration are being used as they result in the highest potential emissions and heat input. VOC emission factor is the sum of the NMNEHC and CH2O emission factors.

[3] Conservatively based on full time operating hours and full capacity.

[4] Heat input based on fuel consumption and site-rated HP. Fuel usage rates based on fuel consumption x site-rated hp / 800 Btu/scf conservative heating value.

[5] In BP's experience with the combustion of oxidation catalysts, there is a slight increase in the NO_x emission factor. The manufacturer emission factor for NOx, 2.00 g/hp-hr, has been increased to 2.20 g/hp-hr to account for the oxidation catalyst. If actual emissions are determined to be higher, BP will update the potential-to-emit calculations with an updated factor.

[6] Based on AP-42, Fifth Edition, Volume 1, Chapter 3, Section 3.2, Table 3.2-2 Uncontrolled Emission Factors For 4-Stroke Lean-Burn Engines, 7/00. PM emission factor is the sum of PMfilterable and PMcondensable.

[7] BP's lb/hr limits assume a 90% reduction in CO and a 55% reduction of CH2O at full load. Although the engine may operate at loads other than 100%, the lb/hr limits will be met at any load. The control efficiencies are not federally enforceable. An engine CO limit of 0.64 lb/hr and a CH2O limit of 0.32 lb/hr are enforceable.

BP America Production Company

Facility: **Salvador I/II Central Delivery Point**

Description: **1874 hp Four-Stroke Lean Burn Engine[1]**

Emission Unit ID: **Unit 5**

Source Information:

Maximum Rating[1]	1895	hp
Site Altitude	6371	ft
Site Rating[1]	**1874**	hp
Operating Capacity[2]	100	%
Hours of Operation[2]	8760	hr/yr
Fuel Consumption[1]	6741	Btu/hp-hr
Heat Input [3]	12.63	MMBtu/hr
Emission Controls	Oxidation Catalyst	

Maximum Fuel Usage: [3]

Hourly Fuel Usage	15.8	Mscf/hr
Daily Fuel Usage	0.4	MMscf/day
Annual Fuel Usage	138.3	MMscf/yr

Controlled Regulated Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Control Efficiency[7]	Emissions (lb/hr)	Emissions (TPY)
NO_X[1], [4]	1.0	g/hp-hr	N/A	4.1314	18.0955
CO[1]	2.50	g/hp-hr	90%	1.0328	4.5239
VOC[1]	0.87	g/hp-hr	N/A	3.5943	15.7431
SO_2[5]	5.88E-04	lb/MMBtu	N/A	0.0074	0.0325
PM[5]	9.99E-03	lb/MMBtu	N/A	0.1262	0.5526
PM_{10}[5]	7.71E-05	lb/MMBtu	N/A	0.0010	0.0043
$PM_{2.5}$[5]	7.71E-05	lb/MMBtu	N/A	0.0010	0.0043
CH_2O[1], [6]	0.28	g/hp-hr	60%	0.4627	2.0267

Uncontrolled Regulated Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Emissions (lb/hr)	Emissions (TPY)
NO_X[1], [4]	0.7	g/hp-hr	2.8920	12.6669
CO[1]	2.50	g/hp-hr	10.3285	45.2388
VOC[1]	0.87	g/hp-hr	3.5943	15.7431
SO_2[5]	5.88E-04	lb/MMBtu	0.0074	0.0325
PM[5]	9.99E-03	lb/MMBtu	0.1262	0.5526
PM_{10}[5]	7.71E-05	lb/MMBtu	0.0010	0.0043
$PM_{2.5}$[5]	7.71E-05	lb/MMBtu	0.0010	0.0043
CH_2O[1], [6]	0.28	g/hp-hr	1.1568	5.0667

[1] Based on Caterpillar Gas Engine Rating Pro Version 5.04.00 (Ref. Data Set DM5432-08-001) for Caterpillar G3606, 1000 rpm, 9.2:1 CR, 90 oF aftercooler water inlet, TA aspiration. Site rating based on deducting 3% for every 1000 feet above 6000 feet. The VOC emission factor is the sum of the NMNEHC and CH2O emission factors.

[2] Conservatively based on full time operating hours and full capacity.

[3] Heat input based on fuel consumption and site-rated HP. Fuel usage rates based on fuel consumption x site-rated hp / 800 Btu/scf conservative heating value.

[4] In BP's experience with the combustion of oxidation catalysts, there is a slight increase in the NO_x emission factor. For controlled emissions, the emission factor for NO_x has been increased to 1.0 g/hp-hr to account for the oxidation catalyst.

[5] Based on AP-42, Fifth Edition, Volume 1, Chapter 3, Section 3.2, Table 3.2-2 Uncontrolled Emission Factors For 4-Stroke Lean-Burn Engines, 7/00. PM emission factor is the sum of PMfilterable and PMcondensable.

[6] Based on the 2011 results of formaldehyde testing of Caterpillar 3606 engines located at BP sites in Colorado. Although the manufacturer factor for CH_2O is 0.26 g/hp-hr, the uncontrolled factor has been increased to 0.28 g/hp-hr.

[7] BP's lb/hr limits assume a 90% reduction in CO and a 60% reduction in CH_2O at full load. Although the engine may operate at loads other than 100%, the lb/hr emission limits will still be met. The control efficiencies are not federally enforceable. An engine CO limit of 1.03 lb/hr and a CH_2O limit of 0.46 lb/hr are enforceable.

Example Calculations:

NO_X Emissions (lb/hr) = 1874 hp * 0.70 g/hp-hr * lb/453.6 g = 2.89

NO_X Emissions (TPY) = 2.89 lb/hr * 8760 hr/yr * 1 Ton/2000 lb = 12.67

SO_2 Emissions (lb/hr) = 1874 hp * 6741 Btu/hp-hr * 0.000588 lb/MMBtu * 1 MMBtu/1,000,000 Btu = 0.0074

SO_2 Emissions (TPY) = 0.0074 lb/hr * 8760 hr/yr * 1 Ton/2000 lb = 0.0325

BP America Production Company
Facility: **Salvador I/II Central Delivery Point**
Description: **Potential-to-Emit Greenhouse Gas Emissions Summary**

Emission Unit ID	Description	Emissions (TPY)			
		CO_2	CH_4	N_2O	$CO2_e$
Unit 1	1334 hp Waukesha L7042GL Compressor Engine w/OxiCat	4,886.6770	0.0922	0.0092	4,891.7278
Unit 2	1138 hp Caterpillar G3516 Compressor Engine w/OxiCat	4,887.8449	0.0921	0.0092	4,892.8931
Unit 3	1334 hp Waukesha L7042GL Compressor Engine	4,886.6770	0.0922	0.0092	4,891.7278
Unit 4	1467 hp Waukesha L7042GSI Compressor Engine w/NSCR and AFRC	5,858.3172	0.1105	0.0110	5,864.3722
Unit 5	1874 hp Caterpillar G3606 Compressor Engine w/OxiCat	6,472.4634	0.1220	0.0122	6,479.1481
--	500 gal TEG Tanks (3)	0.0000	0.0000	0.0000	0.0000
--	500 gal Lube Oil Tanks (5)	0.0000	0.0000	0.0000	0.0000
--	500 gal EG/Water (50/50) Tanks (2)	0.0000	0.0000	0.0000	0.0000
--	500 gal Used Oil Tanks (5)	0.0000	0.0000	0.0000	0.0000
--	95 bbl Compressor/Dehy Drip Tanks (7)	0.0000	0.0000	0.0000	0.0000
--	500 bbl Produced Water Tanks (4)	0.0000	0.0000	0.0000	0.0000
--	0.25 MMBtu/hr Tank Heaters	639.9679	0.3018	0.3597	640.6293
--	0.15 MMBtu/hr Separator Heaters	153.5923	0.0724	0.0863	153.7510
--	TEG Dehydration Still Vent	197.5380	1,073.7993	0.0000	27,042.5205
--	Flash Tank for TEG Dehydration Unit	53.8740	53.8329	0.0000	1,399.6965
--	300 bbl Oily Water Tanks (2)	0.0000	0.0000	0.0000	0.0000
--	0.26 MMBtu/hr Breakout Tank Heater	133.1133	0.0628	0.0748	133.2509
--	< 100 gal Corrosion Inhibitor Tank	0.0000	0.0000	0.0000	0.0000
--	500 gal Solvent Tank	0.0000	0.0000	0.0000	0.0000
--	< 100 gal Baker Petrolite DF03009 Defoamer Tank	0.0000	0.0000	0.0000	0.0000
--	500 bbl Oily Water Tank	0.0000	0.0000	0.0000	0.0000
--	37.5 bbl Used Oil Tank	0.0000	0.0000	0.0000	0.0000
--	500 gal F-20 Soap tank	0.0000	0.0000	0.0000	0.0000
--	Compressor Blowdowns and Starts	0.5781	5.1385	0.0000	129.0405
--	Facility Blowdowns	0.1700	1.5113	0.0000	37.9520
--	Natural Gas Pneumatic Device Venting	58.9433	523.9600	0.0000	13,157.9421
--	Natural Gas Pneumatic Pump Venting	2.1709	19.2977	0.0000	484.6128
--	Reciprocating Compressor Rod Packing Venting	56.9073	505.8614	0.0000	12,703.4412
--	Well Venting for Liquids Unloading	--	--	--	6,369.1529
	Total Site Emissions	**28,288.83**	**2,184.35**	**0.57**	**89,271.86**

	Emissions (TPY)			
	CO_2	CH_4	N_2O	$CO2_e$
Prior Total Site Emissions	21,537.19	2,184.22	0.56	82,513.24
Unit 5 (1874 hp Caterpillar 3606 Compressor Engine or similar) with oxidation catalyst controls	6,472.46	0.12	0.01	6,479.15
Project PTE Change	**6,751.65**	**0.13**	**0.01**	**6,758.62**

BP America Production Company

Facility: **Salvador I/II Central Delivery Point**

Description: **1874 hp Four-Stroke Lean Burn Engine**[1]

Emission Unit ID: **Unit 5**

Source Information:

Maximum Rating[1]	1895 hp
Site Altitude	6371 ft
Site Rating[1]	**1874** hp
Operating Capacity[2]	100 %
Hours of Operation[2]	8760 hr/yr
Fuel Consumption[1]	6741 Btu/hp-hr
Heat Input[3]	12.63 MMBtu/hr
Emissions Controls	Oxidation Catalyst

Greenhouse Gas (GHG) Emission Calculations[4]

Pollutant	Uncontrolled Emission Factor[4]	Factor Units[4]	Emissions (lb/hr)	Emissions (TPY)	Global Warming Potential (GWP)[4]	CO_2e Emissions (TPY)
CO_2	53.06	kg/MMBtu	1477.7314	6472.4634	1	6472.4634
CH_4	0.001	kg/MMBtu	0.0279	0.1220	25	3.0496
N_2O	0.0001	kg/MMBtu	0.0028	0.0122	298	3.6351
TOTAL GHGs	--	--	**1477.76**	**6472.60**	--	--
TOTAL GHGs (CO_2e)	--	--	--	--	--	**6479.15**

[1] Based on Caterpillar Gas Engine Rating Pro Version 4.01.00 (Ref. Data Set DM5432-06-001) for Caterpillar G3606, 1000 rpm, 9:1 CR, 90 oF aftercooler water inlet, TA aspiration. Site rating based on deducting 3% for every 1000 feet above 6000 feet.

[2] Conservatively based on full time operating hours and full capacity.

[3] Heat input based on fuel consumption and site-rated HP.

[4] Based on 40 CFR 98 Subpart C, 98.33(a)(1)(i), Tier 1 Methodology, Equation C-1 and using source specific heat input.

GHG Emissions (lb/hr) = EF_{GHG} (kg/MMBtu) * 2.204623 lb/kg * Source Specific Heat Input (MMbtu/hr) * % Operating Capacity

GHG Emissions (TPY) = GHG Emissions (lb/hr) * 8760 hr/yr * 1 Ton/2000 lb

CO_2e Emissions (TPY) = Σ (GHG Emissions (tpy) * GWP)

Where:

EF_{GHG} = Fuel-specific default CO_2, CH_4, or N_2O emission factors from Table C-1 for CO_2 (Natural gas - Weighted U.S. Average) and Table C-2 for CH_4 and N_2O (Natural Gas) of 40 CFR Part 98, Subpart C (kg/MMBtu)

Heat Input = Btu/hp-hr x Site-rated hp x (1 MMBtu/1,000,000 Btu) = MMBtu/hr

GWP = Global Warming Potentials, 40 CFR 98, Subpart A, Table A-1

Example Calculations:

CO_2 Emissions (lb/hr) = 53.06 kg/MMBtu * 2.204623 lb/kg * 12.63 MMBtu/hr * 100% Capacity = 1477.7314

CO_2 Emissions (TPY) = 1477.7314 lb/hr * 8760 hr/yr * 1 Ton/2000 lb = 6472.4634

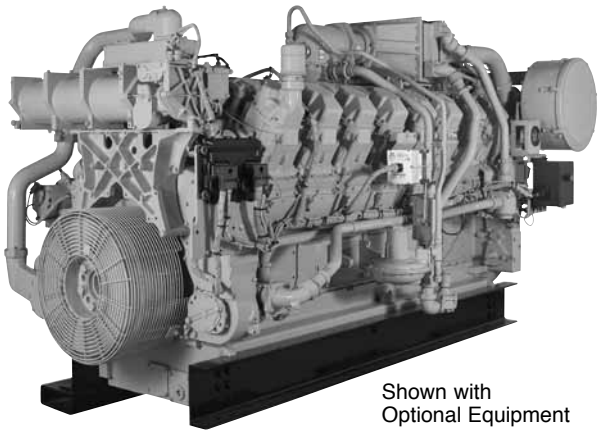
CO_2e Emissions (TPY) = (6472.4634 TPY * 1) + (0.1220 TPY * 25) + (0.0122 TPY * 298) = 6479.1481

CATERPILLAR®

G3516 LE Gas Petroleum Engine

858-999 bkW
1150-1340 bhp
1200-1400 rpm

2.0 g/bhp-hr NOx (NTE)



Shown with Optional Equipment

CAT® ENGINE SPECIFICATIONS

V-16, 4-Stroke-Cycle

Bore	170 mm (6.7 in.)
Stroke	190 mm (7.5 in.)
Displacement	69 L (4210 cu. in.)
Aspiration	Turbocharged-Aftercooled
Digital Engine Management Governor and Protection	Electronic (ADEM™ A3)
Combustion	Low Emission (Lean Burn)
Engine Weight, net dry (approx)	8015 kg (17,670 lb)
Power Density	8 kg/kW (13.2 lb/bhp)
Power per Displacement	19.3 bhp/L
Total Cooling System Capacity	217.7 L (57.5 gal)
Jacket Water	200.6 L (53 gal)
Aftercooler Circuit	17 L (4.5 gal)
Lube Oil System (refill)	424 L (112 gal)
Oil Change Interval	1000 hours
Rotation (from flywheel end)	Counterclockwise
Flywheel and Flywheel Housing	SAE No. 00
Flywheel Teeth	183

FEATURES

Engine Design
- Proven reliability and durability
- Ability to burn a wide spectrum of gaseous fuels
- Robust diesel strength design prolongs life and lowers owning and operating costs
- Broad operating speed range

Emissions
Meets U.S. EPA Spark Ignited Stationary NSPS Emissions for 2007/8

Lean Burn Engine Technology
Lean-burn engines operate with large amounts of excess air. The excess air absorbs heat during combustion reducing the combustion temperature and pressure, greatly reducing levels of NOx. Lean-burn design also provides longer component life and excellent fuel consumption.

Advanced Digital Engine Management
ADEM A3 control system providing integrated ignition, speed governing, protection, and controls, including detonation-sensitive variable ignition timing. ADEM A3 has improved: user interface, display system, shutdown controls, and system diagnostics.

Ease of Operation
Side covers on block allow for inspection of internal components

Full Range of Attachments
Large variety of factory-installed engine attachments reduces packaging time

Testing
Every engine is full-load tested to ensure proper engine performance.

Gas Engine Rating Pro
GERP is a PC-based program designed to provide site performance capabilities for Cat® natural gas engines for the gas compression industry. GERP provides engine data for your site's altitude, ambient temperature, fuel, engine coolant heat rejection, performance data, installation drawings, spec sheets, and pump curves.

Product Support Offered Through Global Cat Dealer Network
More than 2,200 dealer outlets

Cat factory-trained dealer technicians service every aspect of your petroleum engine

Cat parts and labor warranty

Preventive maintenance agreements available for repair-before-failure options

S•O•S℠ program matches your oil and coolant samples against Caterpillar set standards to determine:
- Internal engine component condition
- Presence of unwanted fluids
- Presence of combustion by-products
- Site-specific oil change interval

Over 80 Years of Engine Manufacturing Experience
Over 60 years of natural gas engine production

Ownership of these manufacturing processes enables Caterpillar to produce high quality, dependable products.
- Cast engine blocks, heads, cylinder liners, and flywheel housings
- Machine critical components
- Assemble complete engine

Web Site
For all your petroleum power requirements, visit www.catoilandgas.cat.com.

STANDARD EQUIPMENT

Air Inlet System
Air cleaner — intermediate-duty with service indicator

Control System
A3 ECU
Air-fuel ratio control

Cooling System
Thermostats and housing
Jacket water pump
Aftercooler water pump
Aftercooler core for sea-air atmosphere
Aftercooler thermostats and housing

Exhaust System
Watercooled exhaust manifolds

Flywheels & Flywheel Housings
SAE No. 00 flywheel
SAE No. 00 flywheel housing
SAE standard rotation

Fuel System
Gas pressure regulator
Natural gas carburetor

Ignition System
A3 ECU

Instrumentation
PL1000 Advisor panel

Lubrication System
Crankcase breather — top mounted
Oil cooler
Oil filter — RH
Oil bypass filter
Oil pan — shallow
Oil sampling valve
Turbo oil accumulator

Mounting System
Rails, engine mounting — 254 mm (10 in)

Protection System
Electronic shutoff system
Gas shutoff valve

General
Paint — Cat yellow
Vibration damper and guard — dual 484 mm (23 in)

OPTIONAL EQUIPMENT

Air Inlet System
Remote air inlet adapters
Precleaner

Charging System
Battery chargers
Charging alternators

Cooling System
Aftercooler core
Thermostatic valve
Temperature switch
Connections
Expansion and overflow tank
Water level switch gauge

Exhaust System
Flexible fittings
Elbows
Flange
Flange and exhaust expanders
Rain cap
Mufflers

Fuel System
Low pressure gas conversions
Propane gas valve and jet kits
Fuel filter

Instrumentation
PL1000 communications modules

Lubrication System
Oil bypass filter removal and oil pan accessories
Sump pump
Air prelube pump
Manual prelube pump
Lubricating oil

Mounting System
Rails
Vibration isolators

Power Take-Offs
Front accessory drives
Auxiliary drive shafts and pulleys
Front stub shaft
Pulleys

Protection System
Explosion relief valves, status control box interconnect wiring harness

Starting System
Air starting motor
Air pressure regulator
Air silencer
Electric air start controls
Electric starting motors — dual 24-volt
Starting aids
Battery sets (24-volt dry), cables, and rack

General
Flywheel intertia weight
Guard removal
Engine barring group
Premium 8:1 pistons
Premium cylinder heads

TECHNICAL DATA

G3516 LE Gas Petroleum Engine

Fuel System		2 g NOx NTE Rating DM8618-01	2 g NOx NTE Rating DM8620-01
Engine Power			
@ 100% Load	bkW (bhp)	999 (1340)	858 (1150)
@ 75% Load	bkW (bhp)	749 (1004)	643 (862)
Engine Speed	rpm	**1400**	**1200**
Max Altitude @ Rated Torque and 38°C (100°F)	m (ft)	304.8 (1000)	1219.2 (4000)
Speed Turndown @ Max Altitude, Rated Torque, and 38°C (100°F)	%	25	9.2
SCAC Temperature	°C (°F)	54 (130)	54 (130)
Emissions*			
NOx	g/bkW-hr (g/bhp-hr)	2.68 (2)	2.68 (2)
CO	g/bkW-hr (g/bhp-hr)	2.49 (1.86)	2.35 (1.75)
CO_2	g/bkW-hr (g/bhp-hr)	632 (471)	624 (466)
VOC**	g/bkW-hr (g/bhp-hr)	0.35 (0.26)	0.4 (0.3)
Fuel Consumption***			
@ 100% Load	MJ/bkW-hr (Btu/bhp-hr)	10.48 (7405)	10.36 (7324)
@ 75% Load	MJ/bkW-hr (Btu/bhp-hr)	10.79 (7628)	10.76 (7605)
Heat Balance			
Heat Rejection to Jacket Water			
@ 100% Load	bkW (Btu/mn)	741 (42,123)	639 (36,343)
@ 75% Load	bkW (Btu/mn)	616.7 (35,075)	554 (31,480)
Heat Rejection to Aftercooler			
@ 100% Load	bkW (Btu/mn)	167.8 (9546)	131.9 (7509)
@ 75% Load	bkW (Btu/mn)	108.6 (6179)	72.2 (4108)
Heat Rejection to Exhaust			
@ 100% Load LHV to 25° C (77° F)	bkW (Btu/mn)	837.8 (47,643)	694.6 (39,536)
@ 75% Load LHV to 25° C (77° F)	bkW (Btu/mn)	630.4 (35,848)	524.1 (29,806)
Exhaust System			
Exhaust Gas Flow Rate			
@ 100% Load	m^3/min (cfm)	217.0 (7663)	182.9 (6460)
@ 75% Load	m^3/min (cfm)	163.8 (5785)	138.9 (4905)
Exhaust Stack Temperature			
@ 100% Load	°C (°F)	467.22 (873)	452.2 (846)
@ 75% Load	°C (°F)	467.22 (873)	450.5 (843)
Intake System			
Air Inlet Flow Rate			
@ 100% Load	m^3/min (scfm)	80.6 (2847)	69.5 (2453)
@ 75% Load	m^3/min (scfm)	60.8 (2147)	52.8 (1864)
Gas Pressure	kPag (psig)	241.5-275.8 (35-40)	241.5-275.8 (35-40)

*at 100% load and speed, all values are listed as not to exceed

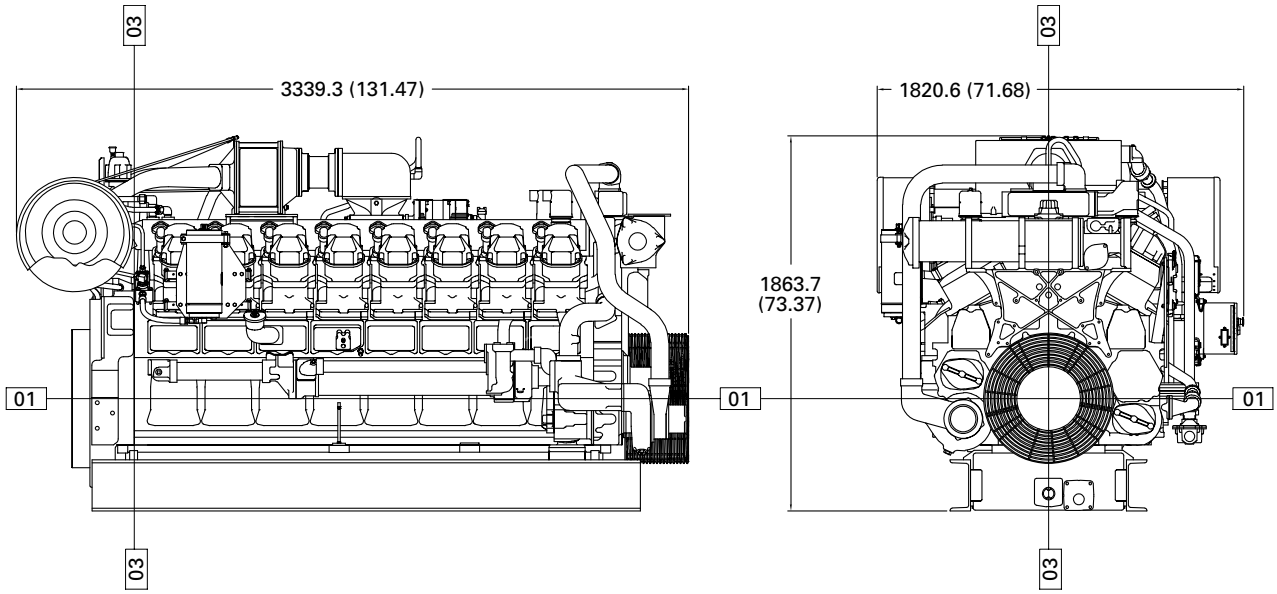
**Volatile organic compounds as defined in U.S. EPA 40 CFR 60, subpart JJJJ

***ISO 3046/1

G3516 LE GAS PETROLEUM ENGINE

858-999 bkW (1150-1340 bhp)

GAS PETROLEUM ENGINE



DIMENSIONS		
Length	mm (in.)	3339.3 (131.47)
Width	mm (in.)	1820.6 (71.68)
Height	mm (in.)	1863.7 (73.37)
Shipping Weight	kg (lb)	8015 (17,670)

Note: General configuration not to be used for installation. See general dimension drawings for detail (drawing #289-2971).

Dimensions are in mm (inches).

RATING DEFINITIONS AND CONDITIONS

Engine performance is obtained in accordance with SAE J1995, ISO3046/1, BS5514/1, and DIN6271/1 standards.

Transient response data is acquired from an engine/ generator combination at normal operating temperature and in accordance with ISO3046/1 standard ambient conditions. Also in accordance with SAE J1995, BS5514/1, and DIN6271/1 standard reference conditions.

Conditions: Power for gas engines is based on fuel having an LHV of 33.74 kJ/L (905 Btu/cu ft) at 101 kPa (29.91 in. Hg) and 15° C (59° F). Fuel rate is based on a cubic meter at 100 kPa (29.61 in. Hg) and 15.6° C (60.1° F). Air flow is based on a cubic foot at 100 kPa (29.61 in. Hg) and 25° C (77° F). Exhaust flow is based on a cubic foot at 100 kPa (29.61 in. Hg) and stack temperature.

Performance Numbers: DM8618-01, DM8620-01
LEHW0036-00 (11-09)
Supersedes LEHW6046-02

G3516

NON-CURRENT

GAS COMPRESSION APPLICATION

GAS ENGINE SITE SPECIFIC TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED (rpm):	1200	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	8:1	RATING LEVEL:	CONTINUOUS
AFTERCOOLER TYPE:	SCAC	FUEL SYSTEM:	HPG IMPCO
AFTERCOOLER WATER INLET (°F):	130	**SITE CONDITIONS:**	
JACKET WATER OUTLET (°F):	210	FUEL:	Field Gas
ASPIRATION:	TA	FUEL PRESSURE RANGE(psig):	35.0-40.0
COOLING SYSTEM:	JW+OC, AC	FUEL METHANE NUMBER:	62.1
CONTROL SYSTEM:	EIS	FUEL LHV (Btu/scf):	1027
EXHAUST MANIFOLD:	ASWC	ALTITUDE(ft):	6360
COMBUSTION:	LOW EMISSION	MAXIMUM INLET AIR TEMPERATURE(°F):	100
NOx EMISSION LEVEL (g/bhp-hr NOx):	2.0	STANDARD RATED POWER:	1085 bhp@1200rpm
SET POINT TIMING:	27		

			MAXIMUM RATING	SITE RATING AT MAXIMUM INLET AIR TEMPERATURE		
RATING	**NOTES**	**LOAD**	**100%**	**100%**	**75%**	**55%**
ENGINE POWER (WITHOUT FAN)	(1)	bhp	1085	986	739	543
INLET AIR TEMPERATURE		°F	49	100	100	100
ENGINE DATA						
FUEL CONSUMPTION (LHV)	(2)	Btu/bhp-hr	7586	7647	7864	8282
FUEL CONSUMPTION (HHV)	(2)	Btu/bhp-hr	8383	8450	8689	9151
AIR FLOW (@inlet air temp, 14.7 psia) (WET)	(3)(4)	ft3/min	2160	2169	1577	1048
AIR FLOW (WET)	(3)(4)	lb/hr	10105	9220	6703	4454
FUEL FLOW (60ºF, 14.7 psia)		scfm	134	122	94	73
INLET MANIFOLD PRESSURE	(5)	in Hg(abs)	61.8	56.9	42.9	30.1
EXHAUST TEMPERATURE - ENGINE OUTLET	(6)	°F	885	875	872	902
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia) (WET)	(7)(4)	ft3/min	6175	5592	4073	2798
EXHAUST GAS MASS FLOW (WET)	(7)(4)	lb/hr	10500	9583	6983	4670
EMISSIONS DATA - ENGINE OUT						
NOx (as NO2)	(8)(9)	g/bhp-hr	2.00	2.00	2.81	3.78
CO	(8)(9)	g/bhp-hr	2.53	2.67	2.88	2.65
THC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	2.80	2.83	2.58	2.04
NMHC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	0.73	0.73	0.67	0.53
NMNEHC (VOCs) (mol. wt. of 15.84)	(8)(9)(10)	g/bhp-hr	0.49	0.49	0.45	0.36
HCHO (Formaldehyde)	(8)(9)	g/bhp-hr	0.28	0.29	0.32	0.34
CO2	(8)(9)	g/bhp-hr	527	531	554	574
EXHAUST OXYGEN	(8)(11)	% DRY	7.7	7.6	7.1	6.7
HEAT REJECTION						
HEAT REJ. TO JACKET WATER (JW)	(12)	Btu/min	35481	33363	28629	25838
HEAT REJ. TO ATMOSPHERE	(12)	Btu/min	4554	4276	3587	3037
HEAT REJ. TO LUBE OIL (OC)	(12)	Btu/min	5610	5275	4527	4086
HEAT REJ. TO AFTERCOOLER (AC)	(12)(13)	Btu/min	9313	9313	4510	1330
COOLING SYSTEM SIZING CRITERIA						
TOTAL JACKET WATER CIRCUIT (JW+OC)	(13)	Btu/min	45761			
TOTAL AFTERCOOLER CIRCUIT (AC)	(13)(14)	Btu/min	9779			
A cooling system safety factor of 0% has been added to the cooling system sizing criteria.						

CONDITIONS AND DEFINITIONS

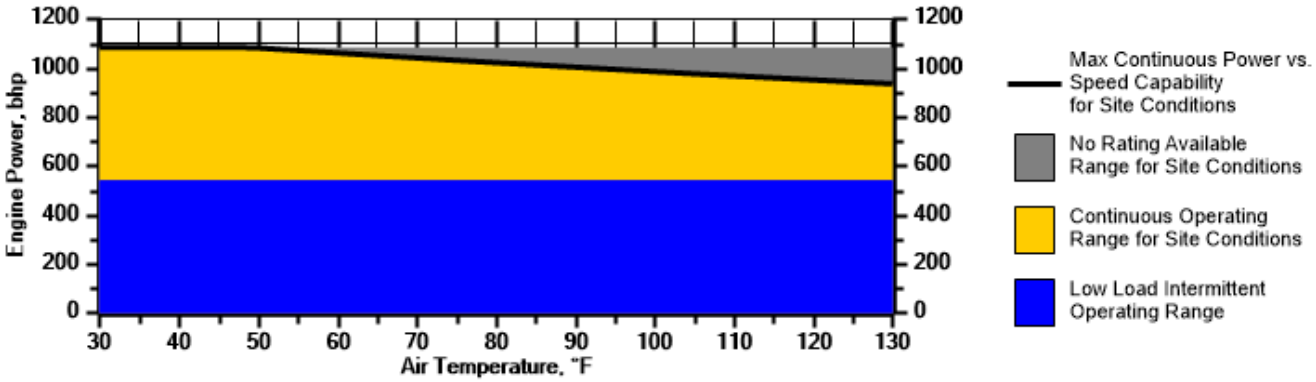
Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature. 100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature. Maximum rating is the maximum capability at the specified aftercooler inlet temperature for the specified fuel at site altitude and reduced inlet air temperature. Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

For notes information consult page three.

PREPARED BY:
Data generated by Gas Engine Rating Pro Version 5.02.01
Ref. Data Set DM0107-09-001, 4EK, Printed 18Jun2015

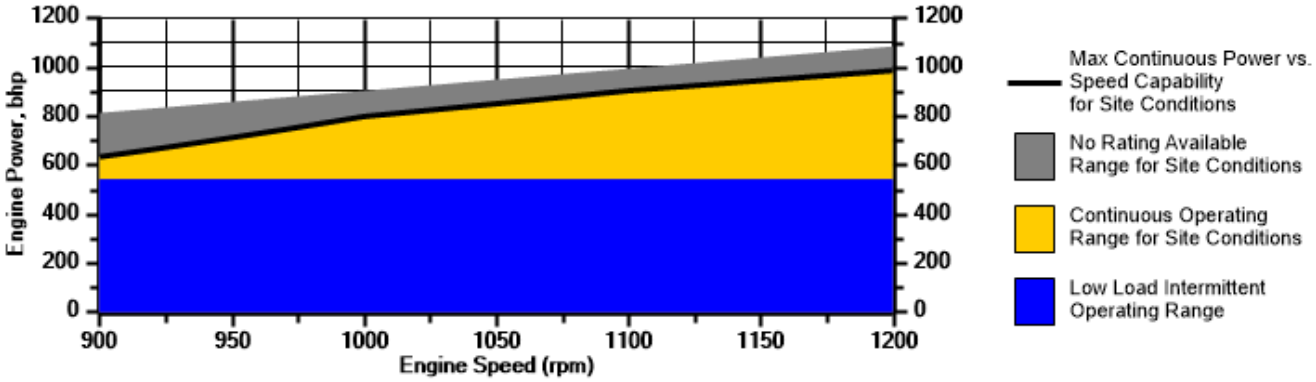
Engine Power vs. Inlet Air Temperature

Data represents temperature sweep at 6360 ft and 1200 rpm



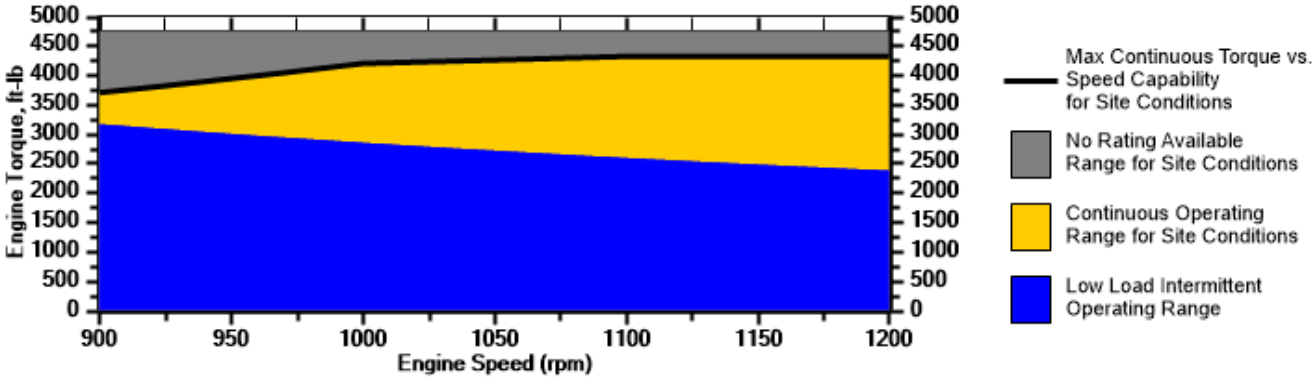
Engine Power vs. Engine Speed

Data represents speed sweep at 6360 ft and 100 °F



Engine Torque vs. Engine Speed

Data represents speed sweep at 6360 ft and 100 °F



Note: At site conditions of 6360 ft and 100°F inlet air temp., constant torque can be maintained down to 1100 rpm. The minimum speed for loading at these conditions is 900 rpm.

NOTES

1. Engine rating is with two engine driven water pumps. Tolerance is ± 3% of full load.

2. Fuel consumption tolerance is ± 3.0% of full load data.

3. Air flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 5 %.

4. Inlet and Exhaust Restrictions must not exceed A&I limits based on full load flow rates from the standard technical data sheet.

5. Inlet manifold pressure is a nominal value with a tolerance of ± 5 %.

6. Exhaust temperature is a nominal value with a tolerance of (+)63°F, (-)54°F.

7. Exhaust flow value is on a "wet" basis. Flow is a nominal value with a tolerance of ± 6 %.

8. Emissions data is at engine exhaust flange prior to any after treatment.

9. Emission values are based on engine operating at steady state conditions, adjusted to the specified NOx level at 100% load. Fuel methane number cannot vary more than ± 3. NOx values are set points and will vary with operating conditions. All other emission values listed are higher than nominal levels to allow for instrumentation, measurement, and engine-to-engine variations. They indicate "Not to Exceed" values. THC, NMHC, and NMNEHC do not include aldehydes. Part load data may require engine adjustment.

10. VOCs - Volatile organic compounds as defined in US EPA 40 CFR 60, subpart JJJJ

11. Exhaust Oxygen level is the result of adjusting the engine to operate at the specified NOx level. Tolerance is ± 0.5.

12. Heat rejection values are nominal. Tolerances, based on treated water, are ± 10% for jacket water circuit, ± 50% for radiation, ± 20% for lube oil circuit, and ± 5% for aftercooler circuit.

13. Aftercooler heat rejection includes an aftercooler heat rejection factor for the site elevation and inlet air temperature specified. Aftercooler heat rejection values at part load are for reference only. Do not use part load data for heat exchanger sizing.

14. Cooling system sizing criteria are maximum circuit heat rejection for the site, with applied tolerances.

Constituent	Abbrev	Mole %	Norm
Water Vapor	H2O	2.5211	2.5211
Methane	CH4	86.6340	86.6340
Ethane	C2H6	4.9767	4.9767
Propane	C3H8	3.5670	3.5670
Isobutane	iso-C4H1O	0.0000	0.0000
Norbutane	nor-C4H1O	1.8211	1.8211
Isopentane	iso-C5H12	0.0000	0.0000
Norpentane	nor-C5H12	0.4802	0.4802
Hexane	C6H14	0.0000	0.0000
Heptane	C7H16	0.0000	0.0000
Nitrogen	N2	0.0000	0.0000
Carbon Dioxide	CO2	0.0000	0.0000
Hydrogen Sulfide	H2S	0.0000	0.0000
Carbon Monoxide	CO	0.0000	0.0000
Hydrogen	H2	0.0000	0.0000
Oxygen	O2	0.0000	0.0000
Helium	HE	0.0000	0.0000
Neopentane	neo-C5H12	0.0000	0.0000
Octane	C8H18	0.0000	0.0000
Nonane	C9H20	0.0000	0.0000
Ethylene	C2H4	0.0000	0.0000
Propylene	C3H6	0.0000	0.0000
TOTAL (Volume %)		100.0000	100.0000

Fuel Makeup:	Field Gas
Unit of Measure:	English

Calculated Fuel Properties

Caterpillar Methane Number:	62.1
Lower Heating Value (Btu/scf):	1027
Higher Heating Value (Btu/scf):	1135
WOBBE Index (Btu/scf):	1274
THC: Free Inert Ratio:	Not Applicable
Total % Inerts (% N2, CO2, He):	0%
RPC (%) (To 905 Btu/scf Fuel):	100%
Compressibility Factor:	0.997
Stoich A/F Ratio (Vol/Vol):	10.68
Stoich A/F Ratio (Mass/Mass):	16.43
Specific Gravity (Relative to Air):	0.650
Specific Heat Constant (K):	1.297

CONDITIONS AND DEFINITIONS

Caterpillar Methane Number represents the knock resistance of a gaseous fuel. It should be used with the Caterpillar Fuel Usage Guide for the engine and rating to determine the rating for the fuel specified. A Fuel Usage Guide for each rating is included on page 2 of its standard technical data sheet.

RPC always applies to naturally aspirated (NA) engines, and turbocharged (TA or LE) engines only when they are derated for altitude and ambient site conditions.

Project specific technical data sheets generated by the Caterpillar Gas Engine Rating Pro program take the Caterpillar Methane Number and RPC into account when generating a site rating.

Fuel properties for Btu/scf calculations are at 60F and 14.696 psia.

Caterpillar shall have no liability in law or equity, for damages, consequently or otherwise, arising from use of program and related material or any part thereof.

FUEL LIQUIDS

Field gases, well head gases, and associated gases typically contain liquid water and heavy hydrocarbons entrained in the gas. To prevent detonation and severe damage to the engine, hydrocarbon liquids must not be allowed to enter the engine fuel system. To remove liquids, a liquid separator and coalescing filter are recommended, with an automatic drain and collection tank to prevent contamination of the ground in accordance with local codes and standards.

To avoid water condensation in the engine or fuel lines, limit the relative humidity of water in the fuel to 80% at the minimum fuel operating temperature.

G3606

GAS ENGINE TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED (rpm):	1000	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	9.2:1	APPLICATION:	GAS COMPRESSION
AFTERCOOLER TYPE:	SCAC	RATING LEVEL:	CONTINUOUS
AFTERCOOLER WATER INLET (°F):	90	FUEL:	NAT GAS
JACKET WATER OUTLET (°F):	190	FUEL SYSTEM:	GAV
ASPIRATION:	TA		WITH AIR FUEL RATIO CONTROL
COOLING SYSTEM:	JW, OC+AC	FUEL PRESSURE RANGE(psig):	42.8-47.0
CONTROL SYSTEM:	CIS/ADEM3	FUEL METHANE NUMBER:	80
EXHAUST MANIFOLD:	DRY	FUEL LHV (Btu/scf):	905
COMBUSTION:	LOW EMISSION	ALTITUDE CAPABILITY AT 77°F INLET AIR TEMP. (ft):	5000
NOx EMISSION LEVEL (g/bhp-hr NOx):	0.7		

RATING		NOTES	LOAD	100%	75%	50%
ENGINE POWER	(WITHOUT FAN)	(1)	bhp	1895	1421	948
ENGINE EFFICIENCY	(ISO 3046/1)	(2)	%	38.7	37.1	34.6
ENGINE EFFICIENCY	(NOMINAL)	(2)	%	37.7	36.3	33.8

ENGINE DATA						
FUEL CONSUMPTION	(ISO 3046/1)	(3)	Btu/bhp-hr	6581	6849	7352
FUEL CONSUMPTION	(NOMINAL)	(3)	Btu/bhp-hr	6741	7016	7531
AIR FLOW (77°F, 14.7 psia)	(WET)	(4) (5)	ft3/min	4857	3723	2530
AIR FLOW	(WET)	(4) (5)	lb/hr	21536	16508	11216
FUEL FLOW (60ºF, 14.7 psia)			scfm	235	184	131
COMPRESSOR OUT PRESSURE			in Hg(abs)	76.1	59.3	42.5
COMPRESSOR OUT TEMPERATURE			°F	300	243	163
AFTERCOOLER AIR OUT TEMPERATURE			°F	100	97	93
INLET MAN. PRESSURE		(6)	in Hg(abs)	73.4	56.9	40.6
INLET MAN. TEMPERATURE	(MEASURED IN PLENUM)	(7)	°F	108	104	99
TIMING			°BTDC	20	20	19
EXHAUST TEMPERATURE - ENGINE OUTLET		(8)	°F	832	869	932
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	(9) (5)	ft3/min	12457	9829	7013
EXHAUST GAS MASS FLOW	(WET)	(9) (5)	lb/hr	22181	17012	11576

EMISSIONS DATA - ENGINE OUT					
NOx (as NO2)	(10)(11)	g/bhp-hr	0.70	0.70	0.70
CO	(10)(12)	g/bhp-hr	2.50	2.50	2.50
THC (mol. wt. of 15.84)	(10)(12)	g/bhp-hr	5.90	6.13	6.34
NMHC (mol. wt. of 15.84)	(10)(12)	g/bhp-hr	0.89	0.92	0.95
NMNEHC (VOCs) (mol. wt. of 15.84)	(10)(12)(13)	g/bhp-hr	0.59	0.61	0.63
HCHO (Formaldehyde)	(10)(12)	g/bhp-hr	0.26	0.27	0.29
CO2	(10)(12)	g/bhp-hr	438	456	489
EXHAUST OXYGEN	(10)(14)	% DRY	12.3	11.9	10.9
LAMBDA	(10)(14)		2.11	2.07	1.96

ENERGY BALANCE DATA					
LHV INPUT	(15)	Btu/min	212893	166183	118930
HEAT REJECTION TO JACKET WATER (JW)	(16)(23)	Btu/min	18645	16144	13093
HEAT REJECTION TO ATMOSPHERE	(17)	Btu/min	7452	6980	6541
HEAT REJECTION TO LUBE OIL (OC)	(18)(24)	Btu/min	9581	9141	8920
HEAT REJECTION TO EXHAUST (LHV TO 77°F)	(19)(20)	Btu/min	76566	61016	44080
HEAT REJECTION TO EXHAUST (LHV TO 350°F)	(19)	Btu/min	47184	39065	29995
HEAT REJECTION TO AFTERCOOLER (AC)	(21)(24)	Btu/min	17337	9677	3157
PUMP POWER	(22)	Btu/min	2957	2957	2957

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1. (Standard reference conditions of 77°F, 29.60 in Hg barometric pressure.) No overload permitted at rating shown. Consult the altitude deration factor chart for applications that exceed the rated altitude or temperature.

Emission levels are at engine exhaust flange prior to any after treatment. Values are based on engine operating at steady state conditions, adjusted to the specified NOx level at 100% load. Tolerances specified are dependent upon fuel quality. Fuel methane number cannot vary more than ± 3.

For notes information consult page three.

FUEL USAGE GUIDE

CAT METHANE NUMBER	25	30	35	40	45	50	55	60	65	70	100
DERATION FACTOR	0	0.69	0.74	0.79	0.84	0.90	0.95	1	1	1	1

TOTAL DERATION FACTORS - ALTITUDE & COOLING AT RATED SPEED

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1	1	1	0.98	0.95	0.91	0.87	0.83	0.79	0.76	0.72	0.69	0.66
120	1	1	1	1	0.96	0.93	0.89	0.86	0.82	0.79	0.76	0.73	0.69
110	1	1	1	1	0.98	0.94	0.91	0.87	0.84	0.80	0.77	0.74	0.71
100	1	1	1	1	1	0.96	0.92	0.89	0.85	0.82	0.79	0.75	0.72
90	1	1	1	1	1	0.98	0.94	0.90	0.87	0.83	0.80	0.77	0.74
80	1	1	1	1	1	0.99	0.96	0.92	0.88	0.85	0.81	0.78	0.75
70	1	1	1	1	1	1	0.97	0.94	0.90	0.86	0.83	0.80	0.76
60	1	1	1	1	1	1	0.99	0.95	0.92	0.88	0.85	0.81	0.78
50	1	1	1	1	1	1	1	0.97	0.94	0.90	0.86	0.83	0.79

ALTITUDE (FEET ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS (ACHRF)

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1.35	1.40	1.46	1.51	1.57	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63
120	1.28	1.33	1.39	1.44	1.50	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55
110	1.21	1.26	1.31	1.37	1.42	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48
100	1.14	1.19	1.24	1.29	1.35	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
90	1.07	1.12	1.17	1.22	1.27	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33
80	1	1.05	1.10	1.15	1.20	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
70	1	1	1.02	1.07	1.13	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18
60	1	1	1	1	1.05	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
50	1	1	1	1	1	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03

ALTITUDE (FEET ABOVE SEA LEVEL)

MINIMUM SPEED CAPABILITY AT THE RATED SPEED'S SITE TORQUE (RPM)

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	750	750	780	800	800	800	800	790	790	780	770	760	760
120	750	750	760	800	800	800	800	800	800	800	800	800	800
110	750	750	750	790	800	800	800	800	800	800	800	800	800
100	750	750	750	770	800	800	800	800	800	800	800	800	800
90	750	750	750	750	790	800	800	800	800	800	800	800	800
80	750	750	750	750	770	800	800	800	800	800	800	800	800
70	750	750	750	750	750	790	800	800	800	800	800	800	800
60	750	750	750	750	750	770	800	800	800	800	800	800	800
50	750	750	750	750	750	750	790	800	800	800	800	800	800

ALTITUDE (FEET ABOVE SEA LEVEL)

FUEL USAGE GUIDE:

This table shows the derate factor required for a given fuel. Note that deration occurs as the methane number decreases. Methane number is a scale to measure detonation characteristics of various fuels. The methane number of a fuel is determined by using the Caterpillar methane number calculation program.

ALTITUDE DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information along with the fuel usage guide chart to help determine actual engine power for your site.

ACTUAL ENGINE RATING:

To determine the actual rating of the engine at site conditions, one must consider separately, limitations due to fuel characteristics and air system limitations. The Fuel Usage Guide deration establishes fuel limitations. The Altitude/Temperature deration factors and RPC (reference the Caterpillar Methane Program) establish air system limitations. RPC comes into play when the Altitude/Temperature deration is less than 1.0 (100%). Under this condition, add the two factors together. When the site conditions do not require an Altitude/Temperature derate (factor is 1.0), it is assumed the turbocharger has sufficient capability to overcome the low fuel relative power, and RPC is ignored. To determine the actual power available, take the lowest rating between 1) and 2).

AFTERCOOLER HEAT REJECTION FACTORS(ACHRF):

To maintain a constant air inlet manifold temperature, as the inlet air temperature goes up, so must the heat rejection. As altitude increases, the turbocharger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor (ACHRF) to adjust for inlet air temp and altitude conditions. See note 24 for application of this factor in calculating the heat exchanger sizing criteria. Failure to properly account for these factors could result in detonation and cause the engine to shutdown or fail.

MINIMUM SPEED CAPABILITY AT THE RATED SPEED'S SITE TORQUE (RPM):

This table shows the minimum allowable engine turndown speed where the engine will maintain the Rated Speed’s Torque for the given ambient conditions.

NOTES:

1. Engine rating is with two engine driven water pumps. Tolerance is ± 3% of full load.
2. ISO 3046/1 engine efficiency tolerance is (+)0, (-)5% of full load % efficiency value. Nominal engine efficiency tolerance is ± 2.5% of full load % efficiency value.
3. ISO 3046/1 fuel consumption tolerance is (+)5, (-)0% of full load data. Nominal fuel consumption tolerance is ± 2.5% of full load data.
4. Air flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 5 %.
5. Inlet and Exhaust Restrictions must not exceed A&I limits based on full load flow rates from the standard technical data sheet.
6. Inlet manifold pressure is a nominal value with a tolerance of ± 5 %.
7. Inlet manifold temperature is a nominal value with a tolerance of ± 9°F.
8. Exhaust temperature is a nominal value with a tolerance of (+)63°F, (-)54°F.
9. Exhaust flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 6 %.
10. Emissions data is at engine exhaust flange prior to any after treatment.
11. NOx values are "Not to Exceed".
12. CO, CO2, THC, NMHC, NMNEHC, and HCHO values are "Not to Exceed" levels. THC, NMHC, and NMNEHC do not include aldehydes. An oxidation catalyst may be required to meet Federal, State or local CO or HC requirements.
13. VOCs - Volatile organic compounds as defined in US EPA 40 CFR 60, subpart JJJJ
14. Exhaust Oxygen tolerance is ± 0.5; Lambda tolerance is ± 0.05. Lambda and Exhaust Oxygen level are the result of adjusting the engine to operate at the specified NOx level.
15. LHV rate tolerance is ± 2.5%.
16. Heat rejection to jacket water value displayed includes heat to jacket water alone. Value is based on treated water. Tolerance is ± 10% of full load data.
17. Heat rejection to atmosphere based on treated water. Tolerance is ± 50% of full load data.
18. Lube oil heat rate based on treated water. Tolerance is ± 20% of full load data.
19. Exhaust heat rate based on treated water. Tolerance is ± 10% of full load data.
20. Heat rejection to exhaust (LHV to 77°F) value shown includes unburned fuel and is not intended to be used for sizing or recovery calculations.
21. Heat rejection to aftercooler based on treated water. Tolerance is ±5% of full load data.
22. Pump power includes engine driven jacket water and aftercooler water pumps. Engine brake power includes effects of pump power.
23. Total Jacket Water Circuit heat rejection is calculated as: JW x 1.1. Heat exchanger sizing criterion is maximum circuit heat rejection at site conditions, with applied tolerances. A cooling system safety factor may be multiplied by the total circuit heat rejection to provide additional margin.
24. Total Aftercooler Circuit heat rejection is calculated as: (OC x 1.2) + (AC x ACHRF x 1.05). Heat exchanger sizing criterion is maximum circuit heat rejection at site conditions, with applied tolerances. A cooling system safety factor may be multiplied by the total circuit heat rejection to provide additional margin.

ENGINE POWER (bhp):	1895	COOLING SYSTEM:	JW, OC+AC
ENGINE SPEED (rpm):	1000	AFTERCOOLER WATER INLET (°F):	90
EXHAUST MANIFOLD:	DRY	JACKET WATER OUTLET (°F):	190

Free Field Mechanical and Exhaust Noise

SOUND POWER LEVEL (dB)										
		Octave Band Center Frequency (OBCF)								
100% Load Data	**dB(A)**	**32 Hz**	**63 Hz**	**125 Hz**	**250 Hz**	**500 Hz**	**1 kHz**	**2 kHz**	**4 kHz**	**8 kHz**
Mechanical Sound	118.4	-	-	119.6	116.9	115.5	113.6	108.6	109	99.8
Exhaust Sound	136.6	119.2	130.3	127.2	122.2	119.9	123.1	128.8	133.3	131.4
Air Inlet Sound	127	104.4	113.8	115.8	115	112.9	112	117.4	122.6	123

SOUND PARAMETER DEFINITION:
Sound Power Level Data - DM8702-02

Sound power is defined as the total sound energy emanating from a source irrespective of direction or distance. Sound power level data is presented under two index headings:
Sound power level -- Mechanical
Sound power level -- Exhaust

Mechanical: Sound power level data is calculated in accordance with ISO 6798. The data is recorded with the exhaust sound source isolated.

Exhaust: Sound power level data is calculated in accordance with ISO 6798 Annex A. Exhaust data is post-catalyst on gas engine ratings labeled as "Integrated Catalyst".

Measurements made in accordance with ISO 6798 for engine and exhaust sound level only. No cooling system noise is included unless specifically indicated. Sound level data is indicative of noise levels recorded on one engine sample in a survey grade 3 environment.

How an engine is packaged, installed and the site acoustical environment will affect the site specific sound levels. For site specific sound level guarantees, sound data collection needs to be done on-site or under similar conditions.

Table 3.2-2. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE LEAN-BURN ENGINES[a]
(SCC 2-02-002-54)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
Criteria Pollutants and Greenhouse Gases		
NO_x[c] 90 - 105% Load	4.08 E+00	B
NO_x[c] <90% Load	8.47 E-01	B
CO[c] 90 - 105% Load	3.17 E-01	C
CO[c] <90% Load	5.57 E-01	B
CO_2[d]	1.10 E+02	A
SO_2[e]	5.88 E-04	A
TOC[f]	1.47 E+00	A
Methane[g]	1.25 E+00	C
VOC[h]	1.18 E-01	C
PM10 (filterable)[i]	7.71 E-05	D
PM2.5 (filterable)[i]	7.71 E-05	D
PM Condensable[j]	9.91 E-03	D
Trace Organic Compounds		
1,1,2,2-Tetrachloroethane[k]	<4.00 E-05	E
1,1,2-Trichloroethane[k]	<3.18 E-05	E
1,1-Dichloroethane	<2.36 E-05	E
1,2,3-Trimethylbenzene	2.30 E-05	D
1,2,4-Trimethylbenzene	1.43 E-05	C
1,2-Dichloroethane	<2.36 E-05	E
1,2-Dichloropropane	<2.69 E-05	E
1,3,5-Trimethylbenzene	3.38 E-05	D
1,3-Butadiene[k]	2.67E-04	D
1,3-Dichloropropene[k]	<2.64 E-05	E
2-Methylnaphthalene[k]	3.32 E-05	C
2,2,4-Trimethylpentane[k]	2.50 E-04	C
Acenaphthene[k]	1.25 E-06	C

Table 3.2-2. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE LEAN-BURN ENGINES (Continued)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
Acenaphthylene[k]	5.53 E-06	C
Acetaldehyde[k,l]	8.36 E-03	A
Acrolein[k,l]	5.14 E-03	A
Benzene[k]	4.40 E-04	A
Benzo(b)fluoranthene[k]	1.66 E-07	D
Benzo(e)pyrene[k]	4.15 E-07	D
Benzo(g,h,i)perylene[k]	4.14 E-07	D
Biphenyl[k]	2.12 E-04	D
Butane	5.41 E-04	D
Butyr/Isobutyraldehyde	1.01 E-04	C
Carbon Tetrachloride[k]	<3.67 E-05	E
Chlorobenzene[k]	<3.04 E-05	E
Chloroethane	1.87 E-06	D
Chloroform[k]	<2.85 E-05	E
Chrysene[k]	6.93 E-07	C
Cyclopentane	2.27 E-04	C
Ethane	1.05 E-01	C
Ethylbenzene[k]	3.97 E-05	B
Ethylene Dibromide[k]	<4.43 E-05	E
Fluoranthene[k]	1.11 E-06	C
Fluorene[k]	5.67 E-06	C
Formaldehyde[k,l]	5.28 E-02	A
Methanol[k]	2.50 E-03	B
Methylcyclohexane	1.23 E-03	C
Methylene Chloride[k]	2.00 E-05	C
n-Hexane[k]	1.11 E-03	C
n-Nonane	1.10 E-04	C

Table 3.2-2. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE LEAN-BURN ENGINES
(Continued)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
n-Octane	3.51 E-04	C
n-Pentane	2.60 E-03	C
Naphthalene[k]	7.44 E-05	C
PAH[k]	2.69 E-05	D
Phenanthrene[k]	1.04 E-05	D
Phenol[k]	2.40 E-05	D
Propane	4.19 E-02	C
Pyrene[k]	1.36 E-06	C
Styrene[k]	<2.36 E-05	E
Tetrachloroethane[k]	2.48 E-06	D
Toluene[k]	4.08 E-04	B
Vinyl Chloride[k]	1.49 E-05	C
Xylene[k]	1.84 E-04	B

[a] Reference 7. Factors represent uncontrolled levels. For NO_x, CO, and PM10, "uncontrolled" means no combustion or add-on controls; however, the factor may include turbocharged units. For all other pollutants, "uncontrolled" means no oxidation control; the data set may include units with control techniques used for NOx control, such as PCC and SCR for lean burn engines, and PSC for rich burn engines. Factors are based on large population of engines. Factors are for engines at all loads, except as indicated. SCC = Source Classification Code. TOC = Total Organic Compounds. PM-10 = Particulate Matter ≤ 10 microns (μm) aerodynamic diameter. A "<" sign in front of a factor means that the corresponding emission factor is based on one-half of the method detection limit.

[b] Emission factors were calculated in units of (lb/MMBtu) based on procedures in EPA Method 19. To convert from (lb/MMBtu) to (lb/10^6 scf), multiply by the heat content of the fuel. If the heat content is not available, use 1020 Btu/scf. To convert from (lb/MMBtu) to (lb/hp-hr) use the following equation:

$$\text{lb/hp-hr} = (\text{lb/MMBtu})\ (\text{heat input, MMBtu/hr})\ (\text{1/operating HP, 1/hp})$$

[c] Emission tests with unreported load conditions were not included in the data set.

[d] Based on 99.5% conversion of the fuel carbon to CO_2. CO_2 [lb/MMBtu] = (3.67)(%CON)(C)(D)(1/h), where %CON = percent conversion of fuel carbon to CO_2, C = carbon content of fuel by weight (0.75), D = density of fuel, 4.1 E+04 lb/10^6 scf, and

h = heating value of natural gas (assume 1020 Btu/scf at 60°F).

[e] Based on 100% conversion of fuel sulfur to SO_2. Assumes sulfur content in natural gas of 2,000 gr/10^6scf.

[f] Emission factor for TOC is based on measured emission levels from 22 source tests.

[g] Emission factor for methane is determined by subtracting the VOC and ethane emission factors from the TOC emission factor. Measured emission factor for methane compares well with the calculated emission factor, 1.31 lb/MMBtu vs. 1.25 lb/MMBtu, respectively.

[h] VOC emission factor is based on the sum of the emission factors for all speciated organic compounds less ethane and methane.

[i] Considered $\leq$ 1 μm in aerodynamic diameter. Therefore, for filterable PM emissions, PM10(filterable) = PM2.5(filterable).

[j] PM Condensable = PM Condensable Inorganic + PM-Condensable Organic

[k] Hazardous Air Pollutant as defined by Section 112(b) of the Clean Air Act.

[l] For lean burn engines, aldehyde emissions quantification using CARB 430 may reflect interference with the sampling compounds due to the nitrogen concentration in the stack. The presented emission factor is based on FTIR measurements. Emissions data based on CARB 430 are available in the background report.

40 CFR Part 98, Table C-1 to subpart C - Default Co2 Emission Factors and High Heat Values for Various Types of Fuel

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Table C-1 to Subpart C of Part 98 Default Co_2 Emission Factors and High Heat Values for Various Types of Fuel

Default CO_2 Emission Factors and High Heat Values for Various Types of Fuel

Fuel type	Default high heat value	Default CO_2 emission factor
Coal and coke	mmBtu/short ton	kg CO_2/mmBtu
Anthracite	25.09	103.69
Bituminous	24.93	93.28
Subbituminous	17.25	97.17
Lignite	14.21	97.72
Coal Coke	24.80	113.67
Mixed (Commercial sector)	21.39	94.27
Mixed (Industrial coking)	26.28	93.90
Mixed (Industrial sector)	22.35	94.67
Mixed (Electric Power sector)	19.73	95.52
Natural gas	mmBtu/scf	kg CO_2/mmBtu
(Weighted U.S. Average)	1.026×10^{-3}	53.06
Petroleum products	mmBtu/gallon	kg CO_2/mmBtu
Distillate Fuel Oil No. 1	0.139	73.25
Distillate Fuel Oil No. 2	0.138	73.96
Distillate Fuel Oil No. 4	0.146	75.04
Residual Fuel Oil No. 5	0.140	72.93
Residual Fuel Oil No. 6	0.150	75.10
Used Oil	0.138	74.00
Kerosene	0.135	75.20
Liquefied petroleum gases (LPG)[1]	0.092	61.71

40 CFR Part 98, Table C-2 to subpart C - Default Ch4 and N2o Emission Factors for Various Types of Fuel

Table C-2 to Subpart C of Part 98 Default Ch_4 and N_2o Emission Factors for Various Types of Fuel

Fuel type	Default CH_4 emission factor (kg CH_4/mmBtu)	Default N_2O emission factor (kg N_2O/mmBtu)
Coal and Coke (All fuel types in Table C-1)	1.1×10^{-02}	1.6×10^{-03}
Natural Gas	1.0×10^{-03}	1.0×10^{-04}
Petroleum (All fuel types in Table C-1)	3.0×10^{-03}	6.0×10^{-04}
Fuel Gas	3.0×10^{-03}	6.0×10^{-04}
Municipal Solid Waste	3.2×10^{-02}	4.2×10^{-03}
Tires	3.2×10^{-02}	4.2×10^{-03}
Blast Furnace Gas	2.2×10^{-05}	1.0×10^{-04}
Coke Oven Gas	4.8×10^{-04}	1.0×10^{-04}
Biomass Fuels-Solid (All fuel types in Table C-1, except wood and wood residuals)	3.2×10^{-02}	4.2×10^{-03}
Wood and wood residuals	7.2×10^{-03}	3.6×10^{-03}
Biomass Fuels-Gaseous (All fuel types in Table C-1)	3.2×10^{-03}	6.3×10^{-04}
Biomass Fuels-Liquid (All fuel types in Table C-1)	1.1×10^{-03}	1.1×10^{-04}

Note: Those employing this table are assumed to fall under the IPCC definitions of the “Energy Industry” or “Manufacturing Industries and Construction”. In all fuels except for coal the values for these two categories are identical. For coal combustion, those who fall within the IPCC “Energy Industry” category may employ a value of 1g of CH_4/mmBtu.

[78 FR 71952, Nov. 29, 2013]

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6 - Actual Emission Calculations and Supporting Documentation

BP America Production Company
Facility: **Salvador I/II Central Delivery Point**
Description: **2014 Calendar Year Actual Emissions[1]**

Emission Unit ID	Description	Emissions (TPY)						
		NO_x	CO	PM[2]	SO_2	VOC[3]	CH_2O	HAPs
Unit 1	1334 hp Waukesha L7042GL Compressor Engine w/OxiCat	20.5417	3.8516	0.4161	0.0245	12.8386	1.4893	1.4893
Unit 2	666 hp Waukesha F3521GL Compressor Engine	9.5969	19.1938	0.2102	0.0124	6.3979	1.8554	1.8554
Unit 3	1334 hp Waukesha L7042GL Compressor Engine	19.1763	38.3525	0.4144	0.0244	12.7842	3.7074	3.7074
Unit 4	1467 hp Waukesha L7042GSI Compressor Engine w/ NSCR and AFR	28.2663	33.9195	0.9706	0.0294	14.1331	0.7067	0.7067
--	500 gal TEG Tanks (3)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 gal Lube Oil Tanks (5)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 gal EG/Water (50/50) Tanks (2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 gal Used Oil Tanks (5)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	95 bbl Compressor/Dehy Drip Tanks (7)	0.00	0.00	0.00	0.00	0.03	0.00	0.00
--	500 bbl Produced Water Tanks (4)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	0.25 MMBtu/hr Tank Heaters (5)	0.54	0.45	0.04	0.00	0.03	0.00	0.00
--	0.15 MMBtu/hr Separator Heaters (2)	0.13	0.11	0.01	0.00	0.01	0.00	0.00
--	Tri-ethylene Glycol (TEG) Dehydrator Regenerator, 45 MMscfd	0.00	0.00	0.00	0.00	0.89	0.00	0.00
--	Tri-ethylene Glycol (TEG) Dehydrator Flash Tank Vent	0.00	0.00	0.00	0.00	0.20	0.00	0.00
--	300 bbl Oily Water Tanks (2)	0.00	0.00	0.00	0.00	0.01	0.00	0.00
--	0.26 MMBtu/hr Oily Water Breakout Tank Heater	0.11	0.09	0.01	0.00	0.01	0.00	0.00
--	500 gal Solvent Tank	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 bbl Oily Water Tank	0.00	0.00	0.00	0.00	0.01	0.00	0.00
--	37.5 bbl Used Oil Tank	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**78.3583**	**95.9702**	**2.0704**	**0.0953**	**47.3340**	**7.7593**	**7.7593**

[1] Actual emissions are calculated for the engines only. Actual emissions for all other equipment is the calculated potential-to-emit.

[2] Total PM emissions represent the sum of the filterable PM and condensable PM. Assuming Total PM is total PM_{10} and total $PM_{2.5}$.

[3] VOC emissions from emission units includes HAPs (i.e., formaldehyde).

[4] The 666 hp compressor engine represented as Unit 2 above will be replaced with the 1,073 hp four-stroke lean burn compressor engine without oxidation catalyst in August or September 2015. A notification of the engine replacement was submitted in July 2015.

BP America Production Company
Facility: **Salvador I/II Central Delivery Point**
Description: **1334 hp Waukesha L7042GL Compressor Engine w/OxiCat**
Emission Unit ID: **Unit 1**

Source Information:

Maximum Rating[1]	1478 hp
Site Altitude	6371 ft
Site Rating[2]	**1334** hp
Operating Capacity[3]	100 %
Hours of Operation[3]	8731 hr/yr
Fuel Consumption[1]	7155 Btu/hp-hr
Heat Input[4]	9.54 MMBtu/hr
Emissions Controls	Oxidation Catalyst

Maximum Fuel Usage: [4]

Hourly Fuel Usage	11.9 Mscf/hr
Daily Fuel Usage	0.3 MMscf/day
Annual Fuel Usage	104.2 MMscf/yr

Controlled Regulated Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Control Efficiency[5]	Emissions (lb/hr)	Emissions (TPY)
NO_X[1]. [6], [7]	1.6	g/hp-hr	N/A	4.7055	20.5417
CO[6]	3.0	g/hp-hr	90%	0.8823	3.8516
VOC[1], [6]	1.0	g/hp-hr	N/A	2.9409	12.8386
SO_2[8]	5.88E-04	lb/MMBtu	N/A	0.0056	0.0245
PM[8]	9.99E-03	lb/MMBtu	N/A	0.0953	0.4161
CH_2O[6]	0.29	g/hp-hr	60%	0.3411	1.4893

[1] Based on historical *Waukesha Bulletin 7005 0102* for L7042GL VHP Series engine, 130 oF I.C., Water Temperature, 10.5:1 CR, 1200 rpm, continuous rating. The current *Waukesha Bulletin 7005 0710* for L7042GL VHP engine, 130 ^{o}F I.C. Water Temperature, 10.5:1 CR, 1200 rpm, continuous rating, indicates the model has a maximum rating of 1480 hp. However, according to a WPI representative on 10/25/11, the updated rating represents a rounded hp number from the previously published 1478 hp and no known internal changes have been made to this engine model. Using 1478 hp and associated 7155 Btu/hp-hr to maintain current limits.

[2] Based on *Waukesha Power Adjustments* , dated 3/11, page 3, for a Turbocharged and Intercooled VHP GL engine. For continuous power, deduct 2% for each 1000 feet above 1500 feet.
Site Rating = [1478 hp x (1 - (0.02/1000 ft x (6370 ft - 1500 ft)))]

[3] Based on full operating capacity and actual hours of operation.

[4] Heat input based on fuel consumption and site-rated HP. Fuel usage rates based on fuel consumption x site-rated hp / 800 Btu/scf conservative heating value.

[5] BP's lb/hr limits assume a 90% reduction in CO at full load and a 60% reduction in CH_2O at full load. Although the engines may operate at loads other than 100%, the lb/hr limits will be met at any load.

[6] NO_X, VOC, and CH_2O based on *Waukesha Gas Engine Exhaust Emission Levels,* dated 3/11, pages 3 & 8, VHP Emission Levels GL. For CO, the 3/11 *Waukesha Gas Engine Exhaust Emissions Level* data identifies a 2.65 g/hp-hr factor for CO, while the *Waukesha Bulletin 7005 0710* technical data identifies a 2.70 g/hp-hr factor. In order to remain conservative, calculations use the 3.0 g/hp-hr CO factor from *Waukesha Bulletin 7005 0102* for low fuel consumption settings from the previous October 2006 Part 71 application.

[7] In BP's experience with the combustion of oxidation catalysts, there is a slight increase in the NO_x emission factor. The manufacturer emission factor for NO_x, 1.5 g/hp-hr, has been increased to 1.6 g/hp-hr to account for the oxidation catalyst.

[8] Based on AP-42, Fifth Edition, Volume 1, Chapter 3, Section 3.2, Table 3.2-2 Uncontrolled Emission Factors For 4-Stroke Lean-Burn Engines, 7/00. PM emission factor is the sum of $PM_{filterable}$ and $PM_{condensable}$.

Example Calculations:

CO Emissions (lb/hr) = 1334 hp * 3.00 g/hp-hr * lb/453.6 g * (1 - 0.90) = 0.88
CO Emissions (TPY) = 0.8823 lb/hr * 1334 hr/yr * 1 Ton/2000 lb = 3.8516
SO_2 Emissions (lb/hr) = 1334 hp * 7155 Btu/hp-hr * 0.000588 lb/MMBtu * 1 MMBtu/1,000,000 Btu = 0.0056
SO_2 Emissions (TPY) = 0.0056 lb/hr * 8731 hr/yr * 1 Ton/2000 lb = 0.0245

BP America Production Company
Facility: **Salvador I/II Central Delivery Point**
Description: **666 hp Waukesha F3521GL Compressor Engine**
Emission Unit ID: **Unit 2**

Source Information:

Maximum Rating[1]	738 hp
Site Altitude	6371 feet
Site Rating[2]	**666** hp
Operating Capacity[3]	100 %
Hours of Operation[3]	8715 hr/yr
Fuel Consumption[1]	7253 Btu/hp-hr
Heat Input[4]	4.83 MMBtu/hr
Emissions Controls	None

Maximum Fuel Usage: [4]

Hourly Fuel Usage	6.0 Mscf/hr
Daily Fuel Usage	0.1 MMscf/day
Annual Fuel Usage	52.6 MMscf/yr

Regulated Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Emissions (lb/hr)	Emissions (TPY)
NO_X[1], [5]	1.5	g/hp-hr	2.2024	9.5969
CO[1], [5]	3.0	g/hp-hr	4.4048	19.1938
VOC[1], [5]	1.0	g/hp-hr	1.4683	6.3979
SO_2[6]	5.88E-04	lb/MMBtu	0.0028	0.0124
PM[6]	9.99E-03	lb/MMBtu	0.0482	0.2102
CH_2O[5]	0.29	g/hp-hr	0.4258	1.8554

[1] Based on *Waukesha Bulletin 7002 0710* for F3521GL VHP engine, 130 ^{o}F I.C. Water Temperature, 10.5:1 CR, 1200 rpm, continuous rating.

[2] Based on *Waukesha Power Adjustments*, dated 3/11, page 3, for a Turbocharged and Intercooled VHP GL engine. For continuous power, deduct 2% for each 1000 feet above 1500 feet.
Site Rating = [738 hp x (1 - (0.02/1000 ft x (6370 ft - 1500 ft)))]

[3] Based on full operating capacity and actual hours of operation.

[4] Heat input based on fuel consumption and site-rated HP. Fuel usage rates based on fuel consumption x site-rated hp / 800 Btu/scf conservative heating value.

[5] NO_X, VOC, and CH_2O based on *Waukesha Gas Engine Exhaust Emission Levels,* dated 3/11, pages 3 & 8, VHP Emission Levels GL. For CO, the 3/11 *Waukesha Gas Engine Exhaust Emissions Level* data identifies a 2.65 g/hp-hr factor for CO, while the *Waukesha Bulletin 7005 0710* technical data identifies a 2.70 g/hp-hr factor. In order to remain conservative, calculations use the 3.0 g/hp-hr CO factor from *Waukesha Bulletin 7005 0102* for low fuel consumption settings from the previous October 2006 application.

[6] Based on AP-42, Fifth Edition, Volume 1, Chapter 3, Section 3.2, Table 3.2-2 Uncontrolled Emission Factors For 4-Stroke Lean-Burn Engines, 7/00. PM emission factor is the sum of $PM_{filterable}$ and $PM_{condensable}$.

Example Calculations:

CO Emissions (lb/hr) = 666 hp * 3.00 g/hp-hr * lb/453.6 g = 4.40
CO Emissions (TPY) = 4.40 lb/hr * 8715 hr/yr * 1 Ton/2000 lb = 19.19
SO_2 Emissions (lb/hr) = 666 hp * 7253 Btu/hp-hr * 0.000588 lb/MMBtu * 1 MMBtu/1,000,000 Btu = 0.0124
SO_2 Emissions (TPY) = 0.0028 lb/hr * 8715 hr/yr * 1 Ton/2000 lb = 0.0124

BP America Production Company
Facility: **Salvador I/II Central Delivery Point**
Description: **1334 hp Waukesha L7042GL Compressor Engine**
Emission Unit ID: **Unit 3**

Source Information:

Maximum Rating[1]	1478	hp
Site Altitude	6371	ft
Site Rating[2]	**1334**	hp
Operating Capacity[3]	100	%
Hours of Operation[3]	8694	hr/yr
Fuel Consumption[1]	7155	Btu/hp-hr
Heat Input[4]	9.54	MMBtu/hr
Emissions Controls	None	

Maximum Fuel Usage: [4]

Hourly Fuel Usage	11.9	Mscf/hr
Daily Fuel Usage	0.3	MMscf/day
Annual Fuel Usage	103.7	MMscf/yr

Regulated Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Emissions (lb/hr)	Emissions (TPY)
NO_X[1], [5]	1.5	g/hp-hr	4.4114	19.1763
CO[5]	3.0	g/hp-hr	8.8228	38.3525
VOC[1], [5]	1.0	g/hp-hr	2.9409	12.7842
SO_2[6]	5.88E-04	lb/MMBtu	0.0056	0.0244
PM[6]	9.99E-03	lb/MMBtu	0.0953	0.4144
CH_2O[5]	0.29	g/hp-hr	0.8529	3.7074

[1] Based on historical *Waukesha Bulletin 7005 0102* for L7042GL VHP Series engine, 130 oF I.C., Water Temperature, 10.5:1 CR, 1200 rpm, continuous rating. The current *Waukesha Bulletin 7005 0710* for L7042GL VHP engine, 130 ^{o}F I.C. Water Temperature, 10.5:1 CR, 1200 rpm, continuous rating, indicates the model has a maximum rating of 1480 hp. However, according to a WPI representative on 10/25/11, the updated rating represents a rounded hp number from the previously published 1478 hp and no known internal changes have been made to this engine model. Using 1478 hp and associated 7155 Btu/hp-hr to maintain current limits.

[2] Based on *Waukesha Power Adjustments* , dated 3/11, page 3, for a Turbocharged and Intercooled VHP GL engine. For continuous power, deduct 2% for each 1000 feet above 1500 feet. Site Rating = [1478 hp x (1 - (0.02/1000 ft x (6370 ft - 1500 ft)))]

[3] Based on full operating capacity and actual hours of operation.

[4] Heat input based on fuel consumption and site-rated HP. Fuel usage rates based on fuel consumption x site-rated hp / 800 Btu/scf conservative heating value.

[5] NO_X, VOC, and CH_2O based on *Waukesha Gas Engine Exhaust Emission Levels,* dated 3/11, pages 3 & 8, VHP Emission Levels GL. For CO, the 3/11 *Waukesha Gas Engine Exhaust Emissions Level* data identifies a 2.65 g/hp-hr factor for CO, while the *Waukesha Bulletin 7005 0710* technical data identifies a 2.70 g/hp-hr factor. In order to remain conservative, calculations use the 3.0 g/hp-hr CO factor from *Waukesha Bulletin 7005 0102* for low fuel consumption settings from the previous October 2006 Part 71 application.

[6] Based on AP-42, Fifth Edition, Volume 1, Chapter 3, Section 3.2, Table 3.2-2 Uncontrolled Emission Factors For 4-Stroke Lean-Burn Engines, 7/00. PM emission factor is the sum of $PM_{filterable}$ and $PM_{condensable}$.

Example Calculations:

CO Emissions (lb/hr) = 1334 hp * 3.00 g/hp-hr * lb/453.6 g = 8.82

CO Emissions (TPY) = 8.82 lb/hr * 8694 hr/yr * 1 Ton/2000 lb = 38.35

SO_2 Emissions (lb/hr) = 1334 hp * 7155 Btu/hp-hr * 0.000588 lb/MMBtu * 1 MMBtu/1,000,000 Btu = 0.0244

SO_2 Emissions (TPY) = 0.0056 lb/hr * 8694 hr/yr * 1 Ton/2000 lb = 0.0244

BP America Production Company
Facility: **Salvador I/II Central Delivery Point**
Description: **1467 hp Waukesha L7042GSI Compressor Engine w/ NSCR and AFR**
Emission Unit ID: **Unit 4**

Source Information:

Maximum Rating[1]	1478 hp
Site Altitude	6371 feet
Site Rating[2]	**1467** hp
Operating Capacity[3]	100 %
Hours of Operation[3]	8740 hr/yr
Fuel Consumption[1]	7800 Btu/hp-hr
Heat Input[4]	11.44 MMBtu/hr
Emissions Controls	NSCR w/AFR

Maximum Fuel Usage: [4]

Hourly Fuel Usage	14.3 Mscf/hr
Daily Fuel Usage	0.3 MMscf/day
Annual Fuel Usage	125.0 MMscf/yr

Controlled Regulated Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Emissions (lb/hr)	Emissions (TPY)
NO_X[5]	2.0	g/hp-hr	6.4683	28.2663
CO[5]	2.4	g/hp-hr	7.7619	33.9195
VOC[6]	1.0	g/hp-hr	3.2341	14.1331
SO_2[7]	5.88E-04	lb/MMBtu	0.0067	0.0294
PM[7]	1.94E-02	lb/MMBtu	0.2221	0.9706
CH_2O[6]	0.05	g/hp-hr	0.1617	0.7067

[1] Based on historical *Waukesha Bulletin 7011 0102* for L7042G/GSI VHP Series engine, 130 oF I.C., Water Temperature, 8:1 CR, 1200 rpm, continuous rating. The current *Waukesha Bulletin 7011 1010* for L7042GSI VHP engine, 130 oF I.C. Water Temperature, 8:1 CR, 1200 rpm, continuous rating, indicates the model has a maximum rating of 1480 hp. However, according to a WPI representative on 10/25/11, the updated rating represents a rounded hp number from the previously published 1478 hp and no known internal changes have been made to this engine model. Using 1478 hp and associated 7800 Btu/hp-hr to maintain current limits.

[2] Based on *Waukesha Power Adjustments* , dated 3/11, page 2, for a Turbocharged and Intercooled VHP L7042GSI engine. For continuous power, deduct 2% for each 1000 feet above 6000 feet.

Site Rating = [1478 hp x (1 - (0.02/1000 ft x (altitude ft - 6000 ft)))]

[3] Based on full operating capacity and actual hours of operation.

[4] Heat input based on fuel consumption and site-rated HP. Fuel usage rates based on fuel consumption x site-rated hp / 800 Btu/scf conservative heating value.

[5] Federally enforceable controlled lb/hr emission limits for NO_x and CO.

[6] CH_2O based on *Waukesha Gas Engine Exhaust Emission Levels,* dated 3/11, page 8, VHP Emission Levels GSI, Rich Burn. Conservatively using 1 g/hp-hr for VOC emission factor.

[7] Based on AP-42, Fifth Edition, Volume 1, Chapter 3, Section 3.2, Table 3.2-3 Uncontrolled Emission Factors For 4-Stroke Rich-Burn Engines, 7/00. PM emission factor is the sum of $PM_{filterable}$ and $PM_{condensable}$.

Example Calculations:

CO Emissions (lb/hr) = 1467 hp * 2.40 g/hp-hr * lb/453.6 g = 7.76
CO Emissions (TPY) = 7.76 lb/hr * 8740 hr/yr * 1 Ton/2000 lb = 33.92
SO_2 Emissions (lb/hr) = 1467 hp * 7800 Btu/hp-hr * 0.000588 lb/MMBtu * 1 MMBtu/1,000,000 Btu = 0.0067
SO_2 Emissions (TPY) = 0.0067 lb/hr * 8740 hr/yr * 1 Ton/2000 lb = 0.0294

4
AIR QUALITY REVIEW

As requested in Form NEW of the application, an Air Quality Review for the proposed project is provided below. Based on this review, BP concludes that the proposed project will not cause or contribute to a National Ambient Air Quality Standard (NAAQS) or Prevention of Significant Deterioration (PSD) increment violation, and therefore, an air quality impacts analysis is not required.

The Salvador I/II CDP, and thus the proposed project, are located within the boundaries of the Southern Ute Indian Reservation (Reservation) in La Plata County, Colorado. The area is currently considered in attainment for the NAAQS pollutants. BP reviewed 2012 – 2014 data from EPA's Air Quality Statistics Reports for La Plata County.[i] These reports confirmed that the air quality in La Plata County has not exceeded the NAAQS standards for criteria pollutants (CO, Nitrogen Dioxide (NO_2), Ozone (O_3), and Particulate Matter ($PM_{2.5}$ and PM_{10})) in the last three years. A summary of this data is provided in the table below:

NAAAQS Pollutant & Standard Criteria	2012	2013	2014	NAAQS Standard	NAAQS Exceeded?
CO – 2nd Max, 1-hr (ppm)	0.8	1.7	1.3	35	No
CO – 2nd Max, 8-hr (ppm)	0.6	1	1	9	No
NO_2 – 98th Percentile, 1-hr (ppb)	29	35	24	100	No
O_3 – 4th Max, 8-hr (ppm)	0.069	0.072	0.067	0.075	No
$PM_{2.5}$ – 98th Percentile, 24-hr ($\mu g/m^3$)	10	29	6	35	No
$PM_{2.5}$ – Weighted Mean, 24-hr ($\mu g/m^3$)	4.3	4.5	3.4	12 (primary); 15 (secondary);	No
PM_{10} – 2nd Max, 24-hr ($\mu g/m^3$)	59	38	34	150	No

The project falls within the scope of the broader oil and gas development on the Reservation, which is detailed in the *Programmatic Environmental Assessment for 80 Acre Infill Oil and Gas Development on the Southern Ute Indian Reservation, Volume 1.* Sections 3.2.2 and 3.2.4 of this assessment provides a description of the topography and meteorology for the Reservation. The Salvador CDP is located at an elevation of 6,371 feet. The area immediately surrounding the site is relatively flat with gently sloping terrain. The annual average precipitation for 2010 – 2014 was 12.58 inches, with the highest annual precipitation

of 15.18 inches occurring in 2013. The average highest temperature during this timeframe was 94 degrees Fahrenheit, while the average lowest temperature was -10.6 degrees Fahrenheit. The highest temperatures were measured during the months of June, July, and August, while the lowest temperatures were measured in January and December.[ii]

Since engineering design is not fully underway for the proposed project, the catalyst manufacturers and models have not been selected yet. The compressor skids were designed by third parties. The Unit 2 and Unit 5 stack heights are estimated to be approximately twenty feet and twenty-three feet above the ground, respectively. Unit 5 is proposed to be installed near the southeast corner of the site near Unit 2 and near the fence line of the property.

The site is an existing synthetic minor PSD source. The proposed project does not constitute a major modification, nor does the project constitute a major new source, as defined under PSD, since the potential to emit of each regulated new source review pollutant that is not a greenhouse gas is less than 250 tons per year and the change in emissions are below the significant emissions rate for PSD pollutants in 40 CFR 52.21(b)(23)(i). The changes in potential site emissions attributable to the proposed project are provided in Section 3 of the application.

[i] 2012–2014 data accessed from EPA's AirData Air Quality Statistics Report website, http://www.epa.gov/airdata/ad_rep_con.html, for La Plata County. Sulfur dioxide is not monitored in La Plata County.

[ii] 2010–2014 data accessed from the National Centers for Environmental Information, National Oceanic and Atmospheric Administration, Climate Data Online website, http://www.ncdc.noaa.gov/cdo-web/, for the Ignacio 8E station (Latitude: 37.086° N, Longitude: 107.533° W).

BP America Production Company

Federal Minor New Source Review Program in Indian Country

Synthetic Minor Permit Application
to Construct a 1,874 HP Four-Stroke Lean Burn Compressor Engine
with Oxidation Catalyst and
to Establish Legally and Practically Enforceable Limitations and
Requirements on Two Engines

Salvador I/II Central Delivery Point
La Plata County, CO

August 2015

TABLE OF CONTENTS

LIST OF SUPPLEMENTAL DOCUMENTS

SECTION 1
INTRODUCTION

1.1 Purpose

On July 1, 2011, the United States Environmental Protection Agency (USEPA) published 40 CFR 49.151-161, the Federal Minor New Source Review (mNSR) Program in Indian Country, which became effective on August 30, 2011. BP America Production Company's (BP) Salvador I/II Central Delivery Point is an existing synthetic minor source with nitrogen oxides (NO_x), carbon monoxide (CO), and formaldehyde (CH_2O) emission limits established for two compressor engines under permit number SMNSR-SU-000009-2012-002. BP is submitting this permit application to construct a 1,874 site-rated horsepower (hp) four-stroke lean burn compressor engine with oxidation catalyst at the site and to establish legally and practically enforceable CO and CH_2O limitations and requirements for this engine as well as for the 1,073 hp four-stroke lean burn compressor engine that will replace an unpermitted engine at the site. BP notified USEPA of this planned unpermitted engine replacement on July 6, 2015. Upon issuance of the requested synthetic mNSR permit, the Salvador I/II Central Delivery Point will continue to be a synthetic minor source for Hazardous Air Pollutants (HAPs) and Prevention of Significant Deterioration (PSD) thresholds. BP will submit an application for an operating permit in accordance with the Southern Ute Indian Tribe/State of Colorado Environmental Commission's Reservation Air Code within one year of commencing operation of the replacement 1,073 hp four-stroke lean burn compressor engine.

1.2 Application Forms for Synthetic Minor Limit

The following application forms are included as attachments:

- Application for New Construction (Form NEW); and
- Application for Synthetic Minor Limit (Form SYNMIN).

Additional information requested in the forms is included in this application, as referenced.

1 – Form NEW

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
FEDERAL MINOR NEW SOURCE REVIEW PROGRAM IN INDIAN COUNTRY
40 CFR 49.151

Application for New Construction

(Form NEW)

Please check all that apply to show how you are using this form:

- ☐ **Proposed Construction of a New Source**
- ☑ **Proposed Construction of New Equipment at an Existing Source**
- ☐ **Proposed Modification of an Existing Source**
- ☑ **Other – Please Explain –** *Establish legally and practically enforceable limitations and requirements on new and existing equipment at an existing source*

Use of this information request form is voluntary and not yet approved by the Office of Management and Budget. The following is a check list of the type of information that Region 8 will use to process information on your proposed project. While submittal of this form is not required, it does offer details on the information we will use to complete your requested approval and providing the information requested may help expedite the process. Use of application forms for this program is currently under Office of Management and Budget review and these information request forms will be replaced/updated after that review is completed.

Please submit information to following two entities:

Federal Minor NSR Permit Coordinator
U.S. EPA, Region 8
1595 Wynkoop Street, 8P-AR
Denver, CO 80202-1129
R8airpermitting@epa.gov

For more information, visit:
http://www2.epa.gov/region8/tribal-minor-new-source-review-permitting

The Tribal Environmental Contact for the specific reservation:

If you need assistance in identifying the appropriate Tribal Environmental Contact and address, please contact:

R8airpermitting@epa.gov

A. GENERAL SOURCE INFORMATION

1. (a) **Company Name** (Who owns this facility?) **BP America Production Company** (b) **Operator Name** (Is the company that operates this facility different than the company that owns this facility? What is the name of the company?) **BP America Production Company**	2. **Facility Name** **Salvador I/II Central Delivery Point**
3. Type of Operation **Natural gas compressor station**	4. Portable Source? ☐ Yes ☑ No 5. Temporary Source? ☐ Yes ☑ No
6. NAICS Code **211111**	7. SIC Code **1311**

8. Physical Address (Or, home base for portable sources)
From Ignacio, CO, proceed south out of town on Highway 172 past the intersection to Highway 318, a distance of 1.7 miles, to the entrance of the Salvador I/II Central Delivery Point, which is on the left. Colorado, 81303.

9. Reservation*	10. County*	11a. Latitude (decimal format)*	11b. Longitude (decimal format)*
Southern Ute Indian	**La Plata**	**37.079052**	**-107.61829**
12a. Quarter Quarter Section*	12b. Section*	12c. Township*	12d. Range*
NE ¼, NW ¼	**28**	**33N**	**7W**

*Provide all proposed locations of operation for portable sources

B. PREVIOUS PERMIT ACTIONS (Provide information in this format for each permit that has been issued to this source. Provide as an attachment if additional space is necessary)

Facility Name on the Permit **BP America Production Company, Salvador I/II Central Delivery Point**
Permit Number (xx-xxx-xxxxx-xxxx.xx) **SMNSR-SU-000009-2012.002**
Date of the Permit Action **December 4, 2014**

Facility Name on the Permit **BP America Production Company, Salvador I/II Central Delivery Point**
Permit Number (xx-xxx-xxxxx-xxxx.xx) **SMNSR-SU-000009-2012.001**
Date of the Permit Action **September 18, 2014**

Facility Name on the Permit
Permit Number (xx-xxx-xxxxx-xxxx.xx)
Date of the Permit Action

Facility Name on the Permit
Permit Number (xx-xxx-xxxxx-xxxx.xx)
Date of the Permit Action

Facility Name on the Permit
Permit Number (xx-xxx-xxxxx-xxxx.xx)
Date of the Permit Action

C. CONTACT INFORMATION

Company Contact (Who is the primary contact for the company that owns this facility?**)** **BP America Production Company** **Devin Newby**	Title **Area Manager, Midstream**
Mailing Address **380 Airport Road, Durango, CO 81303**	
Email Address **devin.newby@bp.com**	
Telephone Number **(970) 394-4815**	Facsimile Number

Operator Contact (Is the company that operates this facility different than the company that owns this facility? Who is the primary contact for the company that operates this facility?)	Title
Mailing Address	
Email Address	
Telephone Number	Facsimile Number

Permitting Contact (Who is the person primarily responsible for Clean Air Act permitting for the company? We are seeking one main contact for the company. Please do not list consultants.) **Rebecca Robert**	Title **Air Engineer**
Mailing Address **737 North Eldridge Parkway, Houston, TX 77079**	
Email Address **rebecca.robert@bp.com**	
Telephone Number **(281) 366-3946**	Facsimile Number **(281) 366-7105**

Compliance Contact (Is the person responsible for Clean Air Act compliance for this company different than the person responsible for Clean Air Act permitting? Who is the person primarily responsible for Clean Air Act compliance for the company? We are seeking one main contact for the company. Please do not list consultants.) **Devin Newby**	Title **Area Manager, Midstream**
Mailing Address **380 Airport Road, Durango, CO 81303**	
Email Address **devin.newby@bp.com**	
Telephone Number **(970) 394-4815**	Facsimile Number

D. ATTACHMENTS

Include all of the following information (see the attached instructions)

*Please do not send Part 71 Operating Permit Application Forms in lieu of the check list below.

☑ **FORM SYNMIN -** New Source Review Synthetic Minor Limit Request Form, if synthetic minor limits are being requested. ***See Section 1.***

☑ Narrative description of the proposed production processes. This description should follow the flow of the process flow diagram to be submitted with this application. ***See Section 2.***

☑ Process flow chart identifying all proposed processing, combustion, handling, storage, and emission control equipment. ***See Section 2.***

☑ A list and descriptions of all proposed emission units and air pollution-generating activities. ***See Section 3 and emission calculations.***

☑ Type and quantity of fuels, including sulfur content of fuels, proposed to be used on a daily, annual and maximum hourly basis. ***See Section 3 and emission calculations.***

☑ Type and quantity of raw materials used or final product produced proposed to be used on a daily, annual and maximum hourly basis. ***See Section 3 and emission calculations.***

☑ Proposed operating schedule, including number of hours per day, number of days per week and number of weeks per year. ***See Section 2.***

☑ A list and description of all proposed emission controls, control efficiencies, emission limits, and monitoring for each emission unit and air pollution generating activity. ***See Section 3 and emission calculations.***

☑ **Criteria Pollutant Emissions -** Estimates of Current Actual Emissions, Current Allowable Emissions, Post-Change Uncontrolled Emissions, and Post-Change Allowable Emissions for the following air pollutants: particulate matter, PM_{10}, $PM_{2.5}$, sulfur oxides (SOx), nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compound (VOC), lead (Pb) and lead compounds, fluorides (gaseous and particulate), sulfuric acid mist (H_2SO_4), hydrogen sulfide (H_2S), total reduced sulfur (TRS) and reduced sulfur compounds, including all calculations for the estimates. ***See Section E of this form and emission calculations.***

These estimates are to be made for each emission unit, emission generating activity, and the project/source in total. Note, there are no insignificant emission units or activities in this permitting program, only exempted units and activities. Please see the regulation for a list of exempted units and activities.

☑ **Air Quality Review** – ***See Section 4.***

☐ **ESA (Endangered Species Act) –** ***Since the Salvador I/II Central Delivery Point is an existing facility and the proposed new engine will not impact the existing footprint of the site, an Endangered Species Act review is not included in the application.***

☐ **NHPA (National Historic Preservation Act) –** ***Since the Salvador I/II Central Delivery Point is an existing facility and the proposed new engine will not impact the existing footprint of the site, a National Historic Preservation Act review is not included in the application.***

E. TABLE OF ESTIMATED EMISSIONS

The following tables provide the total emissions in tons/year for all pollutants from the calculations required in Section D of this form, as appropriate for the use specified at the top of the form.

E(i) – Proposed New Source*

Pollutant	Potential Emissions (tpy)	Proposed Allowable Emissions (tpy)	
PM			PM - Particulate Matter PM_{10} - Particulate Matter less than 10 microns in size $PM_{2.5}$ - Particulate Matter less than 2.5 microns in size SO_2 - Sulfur Oxides NOx - Nitrogen Oxides CO - Carbon Monoxide VOC - Volatile Organic Compound Pb - Lead and lead compounds Fluorides - Gaseous and particulates H_2SO_4 - Sulfuric Acid Mist H_2S - Hydrogen Sulfide TRS - Total Reduced Sulfur RSC - Reduced Sulfur Compounds
PM_{10}			
$PM_{2.5}$			
SO_2			
NO_x			
CO			
VOC			
Pb			
Fluorides			
H_2SO_4			
H_2S			
TRS			
RSC			

This application is for proposed construction of new equipment at an existing synthetic minor source and for establishing legally and practically enforceable limitations and requirements on new and existing equipment at an existing synthetic minor source.

Emissions calculations must include fugitive emissions if the source is one the following listed sources, pursuant to CAA Section 302(j): ***Fugitive emissions are not required to be included since the source is not one of the following listed sources.***

(a) Coal cleaning plants (with thermal dryers);
(b) Kraft pulp mills;
(c) Portland cement plants;
(d) Primary zinc smelters;
(e) Iron and steel mills;
(f) Primary aluminum ore reduction plants;
(g) Primary copper smelters;
(h) Municipal incinerators capable of charging more than 250 tons of refuse per day;
(i) Hydrofluoric, sulfuric, or nitric acid plants;
(j) Petroleum refineries;
(k) Lime plants;
(l) Phosphate rock processing plants;
(m) Coke oven batteries;
(n) Sulfur recovery plants;
(o) Carbon black plants (furnace process);
(p) Primary lead smelters;
(q) Fuel conversion plants;
(r) Sintering plants;
(s) Secondary metal production plants;
(t) Chemical process plants
(u) Fossil-fuel boilers (or combination thereof) totaling more than 250 million British thermal units per hour heat input;
(v) Petroleum storage and transfer units with a total storage capacity exceeding 300,000 barrels;
(w) Taconite ore processing plants;
(x) Glass fiber processing plants;
(y) Charcoal production plants;
(z) Fossil fuel-fired steam electric plants of more that 250 million British thermal units per hour heat input, and
(aa) Any other stationary source category which, as of August 7, 1980, is being regulated under section 111 or 112 of the Act.

E(ii) – Proposed New Construction at an Existing Source or Modification of an Existing Source*

Pollutant	Current Actual Emissions (tpy)**	Current Allowable Emissions (tpy)**	Post-Change Potential Emissions (tpy)**	Post-Change Allowable Emissions (tpy)
PM	2.07	2.26	2.81	2.81
PM_{10}	2.07	2.26	2.81	2.81
$PM_{2.5}$	2.07	2.26	2.81	2.81
SO_2	0.10	0.11	0.14	0.14
NO_x	78.36	89.76	102.43	109.93
CO	95.97	103.37	148.61	84.30
VOC	47.33	49.09	64.83	64.83
Pb				
Fluorides				
H_2SO_4				
H_2S				
TRS				
RSC				

**** This application is for proposed construction of new equipment at an existing synthetic minor source and for establishing legally and practically enforceable limitations and requirements on new and existing equipment at an existing synthetic minor source. The values in the above table represent total site emissions. BP is requesting federally enforceable limits for existing equipment (Emission Unit 2, which are 0.60 lb/hr CO; 0.33 lb/hr CH_2O) and for new equipment (Emission Unit 5, which are: 1.03 lb/hr CO; 0.46 lb/hr CH_2O). The facility-wide potential to emit (post-change allowable emissions) is not federally enforceable.***

*****The current actual emissions are based on the actual emissions of the units in operation at the Salvador CDP during the preceding 2014 calendar year. The current allowable emissions represent the site totals submitted in the July 2015 Unit 2 engine replacement notification. Post-change potential emissions include the potential uncontrolled emissions from the proposed project in the site total.***

PM - Particulate Matter
PM_{10} - Particulate Matter less than 10 microns in size
$PM_{2.5}$ - Particulate Matter less than 2.5 microns in size
SO_2 - Sulfur Oxides
NOx - Nitrogen Oxides
CO - Carbon Monoxide
VOC - Volatile Organic Compound
Pb - Lead and lead compounds
Fluorides - Gaseous and particulates
H_2SO_4 - Sulfuric Acid Mist
H_2S - Hydrogen Sulfide
TRS - Total Reduced Sulfur
RSC - Reduced Sulfur Compounds

The public reporting and recordkeeping burden for this collection of information is estimated to average 20 hours per response, unless a modeling analysis is required. If a modeling analysis is required, the public reporting and recordkeeping burden for this collection of information is estimated to average 60 hours per response .Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed form to this address.

2 – Form SYNMIN

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
FEDERAL MINOR NEW SOURCE REVIEW PROGRAM IN INDIAN COUNTRY
40 CFR 49.151

Application For Synthetic Minor Limit

(Form SYNMIN)

Use of this information request form is voluntary and not yet approved by the Office of Management and Budget. The following is a check list of the type of information that Region 8 will use to process information on your proposed project. While submittal of this form is not required, it does offer details on the information we will use to complete your requested approval and providing the information requested may help expedite the process. Use of application forms for this program is currently under Office of Management and Budget review and these information request forms will be replaced/updated after that review is completed.

Please submit information to following two entities:

Federal Minor NSR Permit Coordinator
U.S. EPA, Region 8
1595 Wynkoop Street, 8P-AR
Denver, CO 80202-1129
R8airpermitting@epa.gov

For more information, visit:
http://www2.epa.gov/region8/tribal-minor-new-source-review-permitting

The Tribal Environmental Contact for the specific reservation:

If you need assistance in identifying the appropriate Tribal Environmental Contact and address, please contact:

R8airpermitting@epa.gov

A. GENERAL INFORMATION

Company Name (Who owns this facility?) **BP America Production Company**	**Facility Name** **Salvador I/II Central Delivery Point**
Company Contact (Who is the primary contact for the company that owns this facility?**)** **Devin Newby**	Title **Area Manager, Midstream**
Mailing Address **380 Airport Road, Durango, CO 81303**	
Email Address **devin.newby@bp.com**	
Telephone Number **(970) 394-4815**	Facsimile Number

B. ATTACHMENTS

For each criteria air pollutant, hazardous air pollutant and for all emission units and air pollutant-generating activities to be covered by a limitation, include the following:

☑ **Item 1 -** The proposed limitation and a description of its effect on current actual, allowable and the potential to emit. ***See Section 3 and emission calculations.***

☑ **Item 2 -** The proposed testing, monitoring, recordkeeping, and reporting requirements to be used to demonstrate and assure compliance with the proposed limitation. ***See Section 3.***

☑ **Item 3 -** A description of estimated efficiency of air pollution control equipment under present or anticipated operating conditions, including documentation of the manufacturer specifications and guarantees. ***See Section 3 and emission calculations.***

☑ **Item 4 -** Estimates of the Post-Change Allowable Emissions that would result from compliance with the proposed limitation, including all calculations for the estimates. ***See Section 3 and emission calculations.***

☑ **Item 5 –** Estimates of the potential emissions of Greenhouse Gas (GHG) pollutants. ***See Section 3 and emission calculations.***

SECTION 2
FACILITY INFORMATION

2.1 Process and Product Description

The Salvador I/II Central Delivery Point is a natural gas compression facility located in southwestern Colorado. The Salvador I portion of the facility is located on fee land and the Salvador II portion is located on trust land within the exterior boundary of the Southern Ute Indian Reservation.

The Salvador I/II Central Delivery Point provides natural gas field compression. Upstream of the facility are Fruitland Gas (coal bed methane) wells which are connected to a gathering pipeline system and the inlet of the facility. The Salvador Gas Unit A #1 wellsite is located within the fence line of the facility, and the wellsite natural gas commingles with the field gas coming into the facility and passes through one inlet separator. The commingled natural gas composition is primarily methane. In addition, the gas contains some carbon dioxide and is saturated with water vapor. No condensate or natural gas liquids are produced. Free liquid water, water vapor, and entrained lubricating oil are removed from the gas, and the gas is compressed and sent on to third party or BP-owned gathering systems.

2.2 Process Flow Diagram

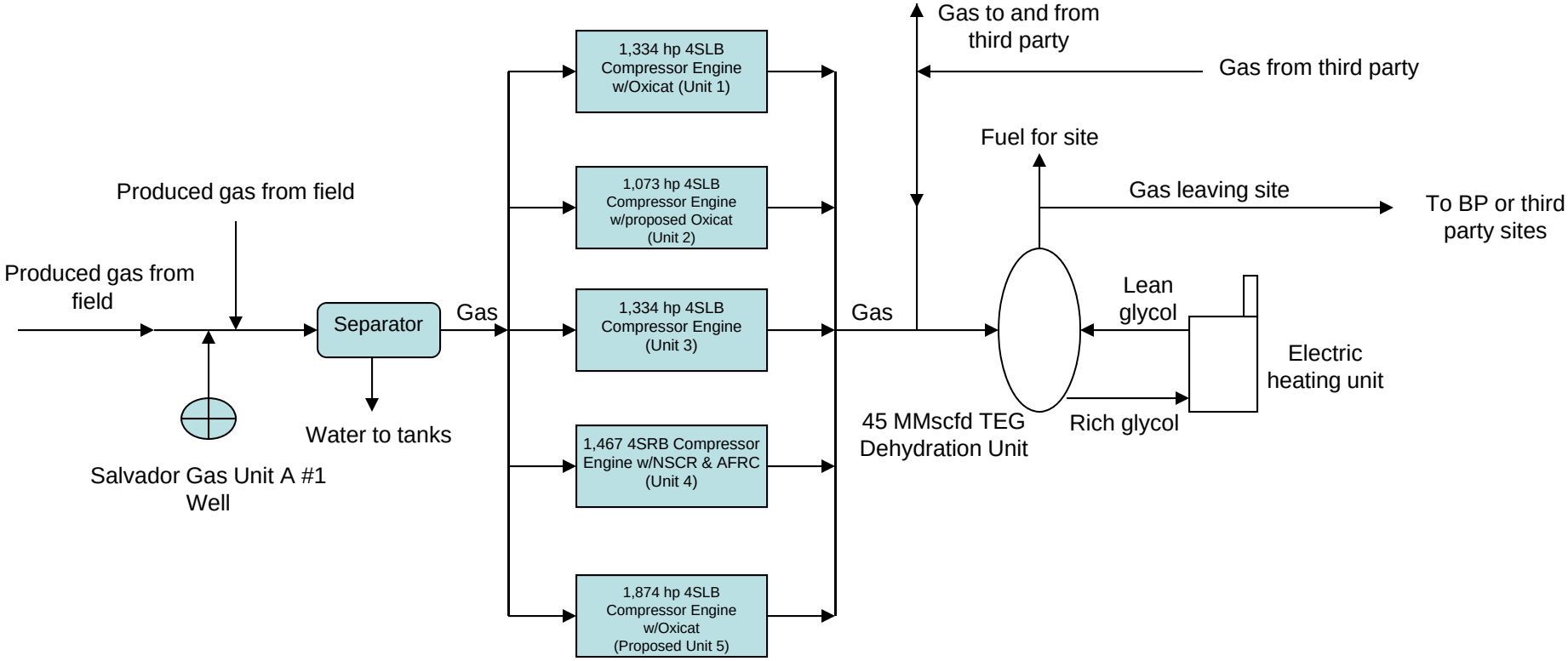
A simplified process flow diagram of the Salvador I/II Central Delivery Point is included in the application and includes the proposed new engine and proposed control equipment.

2.3 Operating Schedule

The proposed operating schedule for each of the affected emission units is twenty-four (24) hours per day, seven (7) days per week, and fifty-two (52) weeks per year. Emission calculations are based on 8,760 hours of operation per year.

3 – Simplified Process Flow Diagram

Salvador I/II Central Delivery Point
Simplified Process Flow Diagram



Note: The site also includes emissions from tank heaters, separator heaters, and various storage tanks.

SECTION 3
AFFECTED EMISSION UNITS

3.1 Affected Emission Units and Emission Calculations

BP is submitting this minor New Source Review (mNSR) permit application to construct the proposed Emission Unit 5 at the Salvador I/II Central Delivery Point, which is an existing synthetic minor source permitted under Permit #SMNSR-SU-000009-2012.002, and to establish federally enforceable CO and CH_2O emission limits for Emission Unit 2 and Emission Unit 5. Emission Unit 2 is a 1,073 hp four-stroke lean burn (4SLB) compressor engine with proposed oxidation catalyst controls. Emission Unit 5 is a proposed 1,874 4SLB compressor engine with oxidation catalyst controls.

Potential-to-emit calculations, including greenhouse gases and controlled and uncontrolled emissions from Emission Unit IDs Unit 2 and Unit 5, and current actual emissions for the preceding calendar year are included in the application. Since the facility does not belong to one of the source categories listed in 40 CFR 52.21(b)(1)(iii), fugitive emissions are not included in the potential-to-emit calculations. Estimates of actual emissions are calculated for Emission Unit IDs Unit 1, Unit 2, Unit 3, and Unit 4 for the previous 2014 calendar year. Actual emissions for Unit 2 are based on the 666 hp 4SLB compressor engine that was in operation in 2014. BP is planning to replace this unit with the 1,073 hp 4SLB compressor engine in August or September 2015.

3.2 Identification and Description of Existing Air Pollution Control Equipment and Requested Synthetic Minor Limits

For Emission Unit 2, BP is proposing to install an oxidation catalyst capable of reducing uncontrolled emissions of carbon monoxide (CO) emissions by at least 90% and formaldehyde (CH_2O) emissions by at least 50% at a maximum operating rate (90% to 110% of engine capacity at site elevation). The requested permit limits are 0.60 lb/hr CO and 0.33 lb/hr CH_2O for the proposed controls.

The proposed Emission Unit 5 will be equipped with an oxidation catalyst capable of reducing uncontrolled emissions of CO emissions by at least 90% and CH_2O emissions by at least 60% at a maximum operating rate (90% to 110% of engine capacity at site elevation). The requested permit limits are 1.03 lb/hr CO and 0.46 lb/hr CH_2O.

Since engineering design is not presently in detailed progress, the catalyst manufacturers and models have not been selected yet. However, the requested federally enforceable CO and CH_2O limits will be met regardless of the catalyst manufacturer or model. The control efficiencies are not federally enforceable.

3.3 Proposed Testing, Monitoring, Recordkeeping and Reporting Requirements

In accordance with 40 CFR 49.158(a)(1)(ii)(B), BP is including proposed testing, monitoring, recordkeeping, and reporting requirements to be used to demonstrate and assure compliance with the proposed emission limitations for Emission Unit 2 and Emission Unit 5. These requirements recognize the oxidation catalyst equipment that will be installed on both engines for limiting the potential-to-emit CO and CH_2O emissions. The proposed requirements are included as a Supplemental Document beginning on page 3-3 of the application.

3.4 Type and Quantity of Fuel and Raw Materials Used

The affected emission units at the Salvador I/II Central Delivery Point will be fired with natural gas only. The heat content of this natural gas at the site ranges from approximately 800 – 1000 Btu/ft^3. The maximum sulfur content of the gas is 1×10^{-7} percent. The daily, annual, and maximum hourly fuel use for each source is provided in the emission calculations.

4 - Proposed Testing, Monitoring, Recordkeeping and Reporting Requirements

Proposed Testing, Monitoring, Recordkeeping and Reporting Requirements

The below proposed testing, monitoring, recordkeeping, and reporting requirements are requested to recognize emissions control equipment on engine units Unit 2 and Unit 5 for limiting the potential-to-emit (PTE) of carbon monoxide (CO) and formaldehyde (CH_2O) [40 CFR 49.155(a)(1)(iii)]. These requirements are identical to the requirements for the 1,334 hp 4SLB compressor engine in permit number SMNSR-SU-000009-2012.002 for the Salvador I/II Central Delivery Point, with the exception of the additional text in underlined italics font.

Proposed Testing Requirements

(a) Performance tests shall be conducted on the engines for measuring CO and CH_2O emissions to demonstrate compliance with each emission limitation in this permit. The performance tests shall be conducted in accordance with appropriate reference methods specified in 40 CFR Part 60, Appendix A and 40 CFR Part 63, Appendix A, or an EPA-approved American Society for Testing and Materials (ASTM) method. The Permittee may submit to the EPA a written request for approval of an alternate test method, but shall only use that alternate test method after obtaining approval from the EPA.

(i) The initial performance test shall be conducted within 90 calendar days of startup of a new engine.
(ii) Subsequent performance tests for CH_2O emissions shall be conducted on the engines within 12 months of the most recent performance test.
(iii) Performance tests shall be conducted within 90 calendar days of the *initial installation or* replacement of the catalyst on each engine.
(iv) Performance tests shall be conducted within 90 calendar days of startup of all rebuilt and replacement engines.

(b) The Permittee shall not perform engine tuning or make any adjustments to engine settings, catalytic control system settings, processes, or operational parameters the day of or during the engine testing. Any such tuning or adjustments may result in a determination by the EPA that the test is invalid. Artificially increasing an engine load to meet test requirements is not considered engine tuning or adjustments.

(c) The Permittee shall not abort any engine tests that demonstrate non-compliance with any CO or CH_2O emission limits in this permit.

(d) Performance tests conducted on the engines for measuring CO and CH_2O emissions shall meet the following requirements:

(i) The pressure drop across each catalyst bed and the inlet temperature to each catalyst bed shall be measured and recorded at least once per test during all performance tests.
(ii) The Permittee shall measure NO_x emissions from the engines simultaneously with all performance tests for CO emissions. NO_x emissions shall be measured using a portable analyzer and protocol approved in writing by the EPA. *[Note to Permittee: Although the permit does not contain NO_x emission limits for this engine, NO_x measurement requirements have been included as an indicator to ensure compliance with Condition C.4(b) above.]*
(iii) All performance tests shall be conducted at maximum operating rate (90% to 110% of the maximum achievable load available at the time of the test). The Permittee may

submit to the EPA a written request for approval of an alternate load level for testing, but shall only test at that alternate load level after obtaining written approval from the EPA.

(iv) During each test run, data shall be collected on all parameters necessary to document how emissions were measured and calculated (such as test run length, minimum sample volume, volumetric flow rate, moisture and oxygen corrections, etc.).

(v) Each test shall consist of at least three 1-hour or longer valid test runs. Emission results shall be reported as the arithmetic average of all valid test runs and shall be in terms of the emission limits in this permit.

(vi) Performance test plans shall be submitted to the EPA for approval 60 calendar days prior to the date the test is planned.

(vii) Performance test plans that have already been approved by the EPA for the emission units approved in this permit *or for similar emission units approved in another BP permit* may be used in lieu of new test plans unless the EPA requires the submittal and approval of new test plans. The Permittee may submit new plans for EPA approval at any time.

(viii) The test plans shall include and address the following elements:

(A) Purpose of the test;

(B) Engines and catalytic control systems to be tested;

(C) Expected engine operating rate(s) during the test;

(D) Sampling and analysis procedures (sampling locations, test methods, laboratory identification);

(E) Quality assurance plan (calibration procedures and frequency, sample recovery and field documentation, chain of custody procedures); and

(F) Data processing and reporting (description of data handling and quality control procedures, report content).

(e) The Permittee shall notify the EPA at least 30 calendar days prior to scheduled performance testing. The Permittee shall notify the EPA at least 1 week prior to scheduled performance testing if the testing cannot be performed.

(f) If the results of a complete and valid performance test of the emissions from any permitted engine demonstrate noncompliance with the emission limits in this permit, the engine shall be shut down as soon as safely possible, and appropriate corrective action shall be taken (e.g., repairs, catalyst cleaning, catalyst replacement). The Permittee shall notify the EPA in writing within 24 hours of each such shut down. The engine must be retested within 7 days of being restarted and the emissions must meet the applicable limits in this permit. If the retest shows that the emissions continue to exceed the limits in this permit, the engine shall again be shut down as soon as safely possible, and the engine may not operate, except for purposes of startup and testing, until the Permittee demonstrates through testing that the emissions do not exceed the emission limits in this permit.

(g) If a permitted engine is not operating, the Permittee does not need to start up the engine solely to conduct a performance test. The Permittee may conduct the performance test when the engine is started up again.

Proposed Monitoring Requirements [40 CFR 49.155(a)(3)]

(a) The Permittee shall continuously monitor the engine exhaust temperature at the inlet to the catalyst bed on each engine.

(b) Except during startups, which shall not exceed 30 minutes, if the engine's exhaust temperature at the inlet to the catalyst bed on any one (1) engine deviates from the acceptable ranges specified in this permit then the following actions shall be taken. The Permittee's completion of any or all of these actions shall not constitute, nor qualify as, an exemption from any other emission limits in this permit.

(i) Within 24 hours of determining a deviation of the engine exhaust temperature at the inlet to the catalyst bed, the Permittee shall investigate. The investigation shall include testing the temperature sensing device, inspecting the engine for performance problems and assessing the catalytic control system for possible damage that could affect catalytic system effectiveness (including, but not limited to, catalyst housing damage, and fouled, destroyed or poisoned catalyst).

(ii) If the engine exhaust temperature at the inlet to the catalyst bed can be corrected by following the engine manufacturer recommended procedures or equivalent procedures developed by the Permittee or vendor and the catalytic control system has not been damaged, then the Permittee shall correct the engine exhaust temperature at the inlet to the catalyst bed within 24 hours of inspecting the engine and catalytic control system.

(iii) If the engine exhaust temperature at the inlet to the catalyst bed cannot be corrected using the engine manufacturer recommended procedures or equivalent procedures developed by the Permittee or vendor, or the catalytic control system has been damaged, then the affected engine shall cease operating immediately and shall not be returned to routine service until the following has been met:

(A) The engine exhaust temperature at the inlet to the catalyst bed is measured and found to be within the acceptable temperature range for that engine; and

(B) The catalytic control system has been repaired or replaced, if necessary.

(c) The Permittee shall monitor the pressure drop across the catalyst bed on each engine every 30 days using pressure sensing devices before and after the catalyst bed to obtain a direct reading of the pressure drop (also referred to as the differential pressure). *[Note to Permittee: Differential pressure measurements, in general, are used to show the pressure across the filter elements. This information will determine when the elements in the catalyst bed are fouling, blocked or blown out and thus require cleaning or replacement.]*

(d) The Permittee shall perform the first measurement of the pressure drop across the catalyst bed on each engine no more than 30 days from the date of the initial performance test. Thereafter, the Permittee shall measure the pressure drop across the catalyst bed, at a minimum every 30 days. Subsequent performance tests, as required in this permit, can be used to meet the periodic pressure drop monitoring requirement provided it occurs within the 30-day window. The pressure drop reading can be a one-time measurement on that day, the average of performance test runs conducted on that day, or an average of all the measurements taken on that day if continuous readings are taken.

(e) If the pressure drop reading exceeds ± 2 inches of water from the baseline pressure drop reading taken during the most recent performance test, then the following actions shall be taken. The Permittee's completion of any or all of these actions shall not constitute, nor qualify as, an exemption from any other emission limits in this permit:

(i) Within 24 hours of determining a deviation of the pressure drop across the catalyst bed, the Permittee shall investigate. The investigation shall include testing the pressure transducers and assessing the catalytic control system for possible damage that could affect catalytic system effectiveness (including, but not limited to, catalyst housing damage, and plugged, fouled, destroyed or poisoned catalyst).

(ii) If the pressure drop across the catalyst bed can be corrected by following the catalytic control system manufacturer recommended procedures or equivalent procedures developed by the Permittee or vendor, and the catalytic control system has not been damaged, then the Permittee shall correct the problem within 24 hours of inspecting the catalytic control system.

(iii) If the pressure drop across the catalyst bed cannot be corrected using the catalytic control system manufacturer recommended procedures or equivalent procedures developed by the Permittee or vendor, or the catalytic control system is damaged, then the Permittee shall do one of the following:

(A) Conduct a performance test within 90 calendar days, as specified in this permit, to ensure that the emission limits are being met and to re-establish the pressure drop across the catalyst bed. The Permittee shall perform a portable analyzer test for CO and NO_x to establish a new temporary pressure drop baseline until a performance test can be scheduled and completed; or

(B) Cease operating the affected engine immediately. The engine shall not be returned to routine service until the pressure drop is measured and found to be within the acceptable pressure range for that engine as determined from the most recent performance test. Corrective action may include removal and cleaning of the catalyst or replacement of the catalyst.

(f) The Permittee shall monitor CO and NO_x emissions from the exhaust of the catalytic control system on each engine at least quarterly, to demonstrate compliance with each engines' emission limits in this permit. To meet this requirement, the Permittee shall:

(i) Measure CO and NO_x emissions at the normal operating load using a portable analyzer and a monitoring protocol approved by the EPA or conduct a performance test as specified in this permit;

(ii) Measure the CO and NO_x emissions simultaneously; and

(iii) Commence monitoring for CO and NO_x emissions within 90 calendar days of the Permittee's submittal of the initial performance test results for CO emissions, as appropriate, to the EPA.

(g) The Permittee shall not perform engine tuning or make any adjustments to engine settings, catalytic control system settings, processes or operational parameters the day of or during measurements. Any such tuning or adjustments may result in a determination by the EPA that the result is invalid. Artificially increasing an engine load to meet testing requirements is not considered engine tuning or adjustments.

(h) For any one (1) engine: If the results of consecutive quarterly portable analyzer measurements demonstrate compliance with the CO emission limits, the required monitoring frequency may change from quarterly to semi-annually.

(i) For any one (1) engine: If the results of consecutive semi-annual portable analyzer measurements demonstrate non-compliance with the CO emission limits, the required test frequency shall revert back to quarterly.

(j) The Permittee shall submit portable analyzer specifications and monitoring protocols to the EPA at the following address for approval at least 45 calendar days prior to the date of initial portable analyzer monitoring:

U.S. Environmental Protection Agency, Region 8
Office of Enforcement, Compliance & Environmental Justice
Air Toxics and Technical Enforcement Program, 8ENF-AT
1595 Wynkoop Street
Denver, Colorado 80202

The protocol may be submitted via electronic mail to r8airreportenforcement@epa.gov.

(k) Portable analyzer specifications and monitoring protocols that have already been approved by the EPA for the emission units approved in this permit *or for similar emission units approved in another BP permit* may be used in lieu of new protocols unless the EPA determines it is necessary to require the submittal and approval of a new protocol. The Permittee may submit a new protocol for EPA approval at any time.

(l) The Permittee is not required to conduct emissions monitoring and parametric monitoring of exhaust temperature and catalyst differential pressure on engines that have not operated during the monitoring period. The Permittee shall certify that the engine(s) did not operate during the monitoring period in the annual report.

Proposed Recordkeeping Requirements [40 CFR 49.155(a)(4)]

(a) Records shall be kept of manufacturer and/or vendor specifications and maintenance requirements developed by the manufacturer, vendor, or Permittee for each engine, catalytic control system, temperature-sensing device, and pressure-measuring device.

(b) Records shall be kept of all calibration and maintenance conducted for each engine, catalytic control system, temperature-sensing device, and pressure-measuring device.

(c) Records shall be kept that are sufficient to demonstrate that the fuel for each engine is pipeline quality natural gas in all respects, with the exception of CO2 concentrations.

(d) Records shall be kept of all temperature measurements required in this permit, as well as a description of any corrective actions taken pursuant to this permit.

(e) Records shall be kept of all pressure drop measurements required in this permit, as well as a description of any corrective actions taken pursuant to this permit.

(f) Records shall be kept of all required testing and monitoring in this permit. The records shall include the following:

(i) The date, place, and time of sampling or measurements;
(ii) The date(s) analyses were performed;

(iii) The company or entity that performed the analyses;
(iv) The analytical techniques or methods used;
(v) The results of such analyses or measurements; and
(vi) The operating conditions as existing at the time of sampling or measurement.

(g) Records shall be kept of all catalyst replacements or repairs, engine rebuilds, and replacements.

(h) Records shall be kept of each rebuilt or replacement engine break-in period, pursuant to the requirements of this permit, where an existing engine that has been rebuilt or replaced resumes operation without the catalyst control system, for a period not to exceed 200 hours.

(i) Records shall be kept of each time any engine is shut down due to a deviation in the inlet temperature to the catalyst bed or pressure drop across a catalyst bed. The Permittee shall include in the record the cause of the problem, the corrective action taken, and the timeframe for bringing the pressure drop and inlet temperature range into compliance.

Requirements for Records Retention

(a) The Permittee shall retain all records required by this permit for a period of at least 5 years from the date the record was created.

(b) Records shall be kept in the vicinity of the facility, such as at the facility, the location that has day-to-day operational control over the facility, or the location that has day-to-day responsibility for compliance of the facility.

Proposed Reporting Requirements [40 CFR 49.155(a)(5)]

1. Annual Emission Reports

(a) The Permittee shall submit a written annual report of the actual annual emissions from all emission units at the facility covered under this permit, including emissions from startups, shutdowns, and malfunctions, each year no later than April 1st. The annual report shall cover the period for the previous calendar year. All reports shall be certified to truth and accuracy by the person primarily responsible for Clean Air Act compliance for the Permittee.

(b) The report shall include CO and CH_2O emissions.

(c) The report shall be submitted to:

U.S. Environmental Protection Agency, Region 8
Office of Partnerships and Regulatory Assistance
Tribal Air Permitting Program, 8P-AR
1595 Wynkoop Street
Denver, Colorado 80202

The report may be submitted via electronic mail to r8AirPermitting@epa.gov.

2. All other documents required to be submitted under this permit, with the exception of the **Annual Emission Reports**, shall be submitted to:

U.S. Environmental Protection Agency, Region 8
Office of Enforcement, Compliance & Environmental Justice
Air Toxics and Technical Enforcement Program, 8ENF-AT
1595 Wynkoop Street
Denver, Colorado 80202

All documents may be submitted electronically to r8airreportenforcement@epa.gov.

3. The Permittee shall promptly submit to the EPA a written report of any deviations of permit requirements, a description of the probable cause of such deviations, and any corrective actions or preventative measures taken. A "prompt" deviation report is one that is post marked or submitted via electronic mail to r8airreportenforcement@epa.gov as follows:

(a) Within 30 days from the discovery of any deviation of the emission limits or operational limits that is left un-corrected for more than 5 days after discovering the deviation;

(b) By April 1st for the discovery of a deviation of recordkeeping or other permit conditions during the preceding calendar year that do not affect the Permittee's ability to meet the emission *or operational* limits.

4. The Permittee shall submit a written report for any required performance tests to the EPA Regional Office within 60 days after completing the tests.

5. The Permittee shall submit any record or report required by this permit upon EPA request.

5 – Potential-to-Emit Emission Calculations and Supporting Documentation

BP America Production Company
Facility: **Salvador I/II Central Delivery Point**
Description: **Potential-to-Emit Emissions Summary**

Emission Unit ID	Description	Emissions (TPY)						
		NO_x	CO	PM	SO_2	VOC	CH_2O	HAPs
Unit 1	1334 hp Waukesha L7042GL Compressor Engine w/OxiCat	20.61	3.86	0.42	0.02	12.88	1.49	1.49
Unit 2	1073 hp Caterpillar G3516 Compressor Engine w/OxiCat	22.79	2.62	0.39	0.02	7.98	1.45	1.45
Unit 3	1334 hp Waukesha L7042GL Compressor Engine	19.32	38.64	0.42	0.02	12.88	3.74	3.74
Unit 4	1467 hp Waukesha L7042GSI Compressor Engine w/NSCR and AFRC	28.33	34.00	0.97	0.03	14.17	0.71	0.71
Unit 5	1874 hp Caterpillar G3606 Compressor Engine w/OxiCat	18.10	4.52	0.55	0.03	15.74	2.03	2.03
--	500 gal TEG Tanks (3)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 gal Lube Oil Tanks (5)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 gal EG/Water (50/50) Tanks (2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 gal Used Oil Tanks (5)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	95 bbl Compressor/Dehy Drip Tanks (7)	0.00	0.00	0.00	0.00	0.03	0.00	0.00
--	500 bbl Produced Water Tanks (4)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	0.25 MMBtu/hr Tank Heaters (5)	0.54	0.45	0.04	0.00	0.03	0.00	0.00
--	0.15 MMBtu/hr Separator Heaters (2)	0.13	0.11	0.01	0.00	0.01	0.00	0.00
--	Tri-ethylene Glycol (TEG) Dehydrator Regenerator, 45 MMscfd	0.00	0.00	0.00	0.00	0.89	0.00	0.00
--	Tri-ethylene Glycol (TEG) Dehydrator Flash Tank Vent	0.00	0.00	0.00	0.00	0.20	0.00	0.00
--	300 bbl Oily Water Tanks (2)	0.00	0.00	0.00	0.00	0.01	0.00	0.00
--	0.26 MMBtu/hr Oily Water Breakout Tank Heater	0.11	0.09	0.01	0.00	0.01	0.00	0.00
--	500 gal Solvent Tank	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 bbl Oily Water Tank	0.00	0.00	0.00	0.00	0.01	0.00	0.00
--	37.5 bbl Used Oil Tank	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total Site Emissions	**109.93**	**84.30**	**2.81**	**0.14**	**64.83**	**9.42**	**9.42**

	Emissions (TPY)						
	NO_x	CO	PM	SO_2	VOC	CH_2O	HAPs
Prior Total Site Emissions	89.76	103.37	2.26	0.11	49.09	8.84	8.84
Prior Unit 2 (1073 hp Caterpillar G3516 Compressor Engine or similar) without oxidation catalyst controls	20.72	26.21	0.39	0.02	7.98	2.90	2.90
Unit 2 (1073 hp Caterpillar G3516 Compressor Engine or similar) with oxidation catalyst controls	22.79	2.62	0.39	0.02	7.98	1.45	1.45
Unit 5 (1874 hp Caterpillar 3606 Compressor Engine or similar) with oxidation catalyst controls	18.10	4.52	0.55	0.03	15.74	2.03	2.03
Project PTE Change	**20.17**	**-19.07**	**0.55**	**0.03**	**15.74**	**0.58**	**0.58**

BP America Production Company

Facility: **Salvador I/II Central Delivery Point**

Description: **1073 hp Four-Stroke Lean Burn Engine[1]**

Emission Unit ID: **Unit 2**

Source Information:

Maximum Rating[1]	1085 hp
Site Altitude	6371 ft
Site Rating[1]	**1073** hp
Operating Capacity[2]	100 %
Hours of Operation[2]	8760 hr/yr
Fuel Consumption[1]	8383 Btu/hp-hr
Heat Input[3]	8.99 MMBtu/hr
Emissions Controls	Oxidation Catalyst

Maximum Fuel Usage: [3]

Hourly Fuel Usage	11.2 Mscf/hr
Daily Fuel Usage	0.3 MMscf/day
Annual Fuel Usage	98.5 MMscf/yr

Controlled Regulated Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Control Efficiency[6]	Emissions (lb/hr)	Emissions (TPY)
NO_X[1], [4]	2.2	g/hp-hr	N/A	5.2041	22.7942
CO[1]	2.53	g/hp-hr	90%	0.5985	2.6213
VOC[1]	0.77	g/hp-hr	N/A	1.8215	7.9780
SO_2[5]	5.88E-04	lb/MMBtu	N/A	0.0053	0.0232
PM[5]	9.99E-03	lb/MMBtu	N/A	0.0898	0.3935
PM_{10}[5]	7.71E-05	lb/MMBtu	N/A	0.0007	0.0030
$PM_{2.5}$[5]	7.71E-05	lb/MMBtu	N/A	0.0007	0.0030
CH_2O[1]	0.28	g/hp-hr	50%	0.3312	1.4505

Uncontrolled Regulated Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Emissions (lb/hr)	Emissions (TPY)
NO_X[1]	2.00	g/hp-hr	4.7310	20.7220
CO[1]	2.53	g/hp-hr	5.9848	26.2133
VOC[1]	0.77	g/hp-hr	1.8215	7.9780
SO_2[5]	5.88E-04	lb/MMBtu	0.0053	0.0232
PM[5]	9.99E-03	lb/MMBtu	0.0898	0.3935
PM_{10}[5]	7.71E-05	lb/MMBtu	0.0007	0.0030
$PM_{2.5}$[5]	7.71E-05	lb/MMBtu	0.0007	0.0030
CH_2O[1]	0.28	g/hp-hr	0.6623	2.9011

Example Calculations:

NO_X Emissions (lb/hr) = 1073 hp * 2.00 g/hp-hr * lb/453.6 g = 4.73

NO_X Emissions (TPY) = 4.73 lb/hr * 8760 hr/yr * 1 Ton/2000 lb = 20.72

[1] Based on Caterpillar Gas Engine Rating Pro Version 5.02.01 (Ref. Data Set DM0107-09-001) for Caterpillar G3516, 1200 rpm, 8:1 CR, 130 oF aftercooler water inlet, TA aspiration, maximum rating. Site rating based on deducting 3% for every 1000 feet above 6000 feet. Using fuel consumption (HHV) value. VOC emission factor is the sum of the NMNEHC and CH2O emission factors.

[2] Conservatively based on full time operating hours and full capacity.

[3] Heat input based on fuel consumption and site-rated HP. Fuel usage rates based on fuel consumption x site-rated hp / 800 Btu/scf conservative heating value.

[4] In BP's experience with the combustion of oxidation catalysts, there is a slight increase in the NO_x emission factor. The manufacturer emission factor for NOx, 2.00 g/hp-hr, has been increased to 2.20 g/hp-hr to account for the oxidation catalyst. If actual emissions are determined to be higher, BP will update the potential-to-emit calculations with an updated factor.

[5] Based on AP-42, Fifth Edition, Volume 1, Chapter 3, Section 3.2, Table 3.2-2 Uncontrolled Emission Factors For 4-Stroke Lean-Burn Engines, 7/00. PM emission factor is the sum of PMfilterable and PMcondensable.

[6] BP's lb/hr limits assume a 90% reduction in CO and a 50% reduction of CH2O at full load. Although the engine may operate at loads other than 100%, the lb/hr limits will be met at any load. The control efficiencies are not federally enforceable. An engine CO limit of 0.60 lb/hr and a CH2O limit of 0.33 lb/hr are enforceable.

BP America Production Company

Facility: **Salvador I/II Central Delivery Point**

Description: **1874 hp Four-Stroke Lean Burn Engine[1]**

Emission Unit ID: **Unit 5**

Source Information:

Maximum Rating[1]	1895	hp
Site Altitude	6371	ft
Site Rating[1]	**1874**	hp
Operating Capacity[2]	100	%
Hours of Operation[2]	8760	hr/yr
Fuel Consumption[1]	6741	Btu/hp-hr
Heat Input [3]	12.63	MMBtu/hr
Emission Controls	Oxidation Catalyst	

Maximum Fuel Usage: [3]

Hourly Fuel Usage	15.8	Mscf/hr
Daily Fuel Usage	0.4	MMscf/day
Annual Fuel Usage	138.3	MMscf/yr

Controlled Regulated Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Control Efficiency[7]	Emissions (lb/hr)	Emissions (TPY)
NO_X[1], [4]	1.0	g/hp-hr	N/A	4.1314	18.0955
CO[1]	2.50	g/hp-hr	90%	1.0328	4.5239
VOC[1]	0.87	g/hp-hr	N/A	3.5943	15.7431
SO_2[5]	5.88E-04	lb/MMBtu	N/A	0.0074	0.0325
PM[5]	9.99E-03	lb/MMBtu	N/A	0.1262	0.5526
PM_{10}[5]	7.71E-05	lb/MMBtu	N/A	0.0010	0.0043
$PM_{2.5}$[5]	7.71E-05	lb/MMBtu	N/A	0.0010	0.0043
CH_2O[1], [6]	0.28	g/hp-hr	60%	0.4627	2.0267

Uncontrolled Regulated Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Emissions (lb/hr)	Emissions (TPY)
NO_X[1], [4]	0.7	g/hp-hr	2.8920	12.6669
CO[1]	2.50	g/hp-hr	10.3285	45.2388
VOC[1]	0.87	g/hp-hr	3.5943	15.7431
SO_2[5]	5.88E-04	lb/MMBtu	0.0074	0.0325
PM[5]	9.99E-03	lb/MMBtu	0.1262	0.5526
PM_{10}[5]	7.71E-05	lb/MMBtu	0.0010	0.0043
$PM_{2.5}$[5]	7.71E-05	lb/MMBtu	0.0010	0.0043
CH_2O[1], [6]	0.28	g/hp-hr	1.1568	5.0667

[1] Based on Caterpillar Gas Engine Rating Pro Version 5.04.00 (Ref. Data Set DM5432-08-001) for Caterpillar G3606, 1000 rpm, 9.2:1 CR, 90 oF aftercooler water inlet, TA aspiration. Site rating based on deducting 3% for every 1000 feet above 6000 feet. The VOC emission factor is the sum of the NMNEHC and CH2O emission factors.

[2] Conservatively based on full time operating hours and full capacity.

[3] Heat input based on fuel consumption and site-rated HP. Fuel usage rates based on fuel consumption x site-rated hp / 800 Btu/scf conservative heating value.

[4] In BP's experience with the combustion of oxidation catalysts, there is a slight increase in the NO_x emission factor. For controlled emissions, the emission factor for NO_x has been increased to 1.0 g/hp-hr to account for the oxidation catalyst.

[5] Based on AP-42, Fifth Edition, Volume 1, Chapter 3, Section 3.2, Table 3.2-2 Uncontrolled Emission Factors For 4-Stroke Lean-Burn Engines, 7/00. PM emission factor is the sum of PMfilterable and PMcondensable.

[6] Based on the 2011 results of formaldehyde testing of Caterpillar 3606 engines located at BP sites in Colorado. Although the manufacturer factor for CH_2O is 0.26 g/hp-hr, the uncontrolled factor has been increased to 0.28 g/hp-hr.

[7] BP's lb/hr limits assume a 90% reduction in CO and a 60% reduction in CH_2O at full load. Although the engine may operate at loads other than 100%, the lb/hr emission limits will still be met. The control efficiencies are not federally enforceable. An engine CO limit of 1.03 lb/hr and a CH_2O limit of 0.46 lb/hr are enforceable.

Example Calculations:

NO_X Emissions (lb/hr) = 1874 hp * 0.70 g/hp-hr * lb/453.6 g = 2.89

NO_X Emissions (TPY) = 2.89 lb/hr * 8760 hr/yr * 1 Ton/2000 lb = 12.67

SO_2 Emissions (lb/hr) = 1874 hp * 6741 Btu/hp-hr * 0.000588 lb/MMBtu * 1 MMBtu/1,000,000 Btu = 0.0074

SO_2 Emissions (TPY) = 0.0074 lb/hr * 8760 hr/yr * 1 Ton/2000 lb = 0.0325

BP America Production Company
Facility: **Salvador I/II Central Delivery Point**
Description: **Potential-to-Emit Greenhouse Gas Emissions Summary**

Emission Unit ID	Description	Emissions (TPY)			
		CO_2	CH_4	N_2O	$CO2_e$
Unit 1	1334 hp Waukesha L7042GL Compressor Engine w/OxiCat	4,886.6770	0.0922	0.0092	4,891.7278
Unit 2	1073 hp Caterpillar G3516 Compressor Engine w/OxiCat	4,608.6622	0.0869	0.0087	4,613.4220
Unit 3	1334 hp Waukesha L7042GL Compressor Engine	4,886.6770	0.0922	0.0092	4,891.7278
Unit 4	1467 hp Waukesha L7042GSI Compressor Engine w/NSCR and AFRC	5,858.3172	0.1105	0.0110	5,864.3722
Unit 5	1874 hp Caterpillar G3606 Compressor Engine w/OxiCat	6,472.4634	0.1220	0.0122	6,479.1481
--	500 gal TEG Tanks (3)	0.0000	0.0000	0.0000	0.0000
--	500 gal Lube Oil Tanks (5)	0.0000	0.0000	0.0000	0.0000
--	500 gal EG/Water (50/50) Tanks (2)	0.0000	0.0000	0.0000	0.0000
--	500 gal Used Oil Tanks (5)	0.0000	0.0000	0.0000	0.0000
--	95 bbl Compressor/Dehy Drip Tanks (7)	0.0000	0.0000	0.0000	0.0000
--	500 bbl Produced Water Tanks (4)	0.0000	0.0000	0.0000	0.0000
--	0.25 MMBtu/hr Tank Heaters	639.9679	0.3018	0.3597	640.6293
--	0.15 MMBtu/hr Separator Heaters	153.5923	0.0724	0.0863	153.7510
--	TEG Dehydration Still Vent	197.5380	1,073.7993	0.0000	27,042.5205
--	Flash Tank for TEG Dehydration Unit	53.8740	53.8329	0.0000	1,399.6965
--	300 bbl Oily Water Tanks (2)	0.0000	0.0000	0.0000	0.0000
--	0.26 MMBtu/hr Breakout Tank Heater	133.1133	0.0628	0.0748	133.2509
--	< 100 gal Corrosion Inhibitor Tank	0.0000	0.0000	0.0000	0.0000
--	500 gal Solvent Tank	0.0000	0.0000	0.0000	0.0000
--	< 100 gal Baker Petrolite DF03009 Defoamer Tank	0.0000	0.0000	0.0000	0.0000
--	500 bbl Oily Water Tank	0.0000	0.0000	0.0000	0.0000
--	37.5 bbl Used Oil Tank	0.0000	0.0000	0.0000	0.0000
--	500 gal F-20 Soap tank	0.0000	0.0000	0.0000	0.0000
--	Compressor Blowdowns and Starts	0.5781	5.1385	0.0000	129.0405
--	Facility Blowdowns	0.1700	1.5113	0.0000	37.9520
--	Natural Gas Pneumatic Device Venting	58.9433	523.9600	0.0000	13,157.9421
--	Natural Gas Pneumatic Pump Venting	2.1709	19.2977	0.0000	484.6128
--	Reciprocating Compressor Rod Packing Venting	56.9073	505.8614	0.0000	12,703.4412
--	Well Venting for Liquids Unloading	--	--	--	6,369.1529
	Total Site Emissions	**28,009.65**	**2,184.34**	**0.57**	**88,992.39**

	Emissions (TPY)			
	CO_2	CH_4	N_2O	$CO2_e$
Prior Total Site Emissions	21,537.19	2,184.22	0.56	82,513.24
Unit 5 (1874 hp Caterpillar 3606 Compressor Engine or similar) with oxidation catalyst controls	6,472.46	0.12	0.01	6,479.15
Project PTE Change	**6,472.46**	**0.12**	**0.01**	**6,479.15**

BP America Production Company

Facility: **Salvador I/II Central Delivery Point**

Description: **1874 hp Four-Stroke Lean Burn Engine**[1]

Emission Unit ID: **Unit 5**

Source Information:

Maximum Rating[1]	1895 hp
Site Altitude	6371 ft
Site Rating[1]	**1874** hp
Operating Capacity[2]	100 %
Hours of Operation[2]	8760 hr/yr
Fuel Consumption[1]	6741 Btu/hp-hr
Heat Input[3]	12.63 MMBtu/hr
Emissions Controls	Oxidation Catalyst

Greenhouse Gas (GHG) Emission Calculations[4]

Pollutant	Uncontrolled Emission Factor[4]	Factor Units[4]	Emissions (lb/hr)	Emissions (TPY)	Global Warming Potential (GWP)[4]	CO_2e Emissions (TPY)
CO_2	53.06	kg/MMBtu	1477.7314	6472.4634	1	6472.4634
CH_4	0.001	kg/MMBtu	0.0279	0.1220	25	3.0496
N_2O	0.0001	kg/MMBtu	0.0028	0.0122	298	3.6351
TOTAL GHGs	--	--	**1477.76**	**6472.60**	--	--
TOTAL GHGs (CO_2e)	--	--	--	--	--	**6479.15**

[1] Based on Caterpillar Gas Engine Rating Pro Version 4.01.00 (Ref. Data Set DM5432-06-001) for Caterpillar G3606, 1000 rpm, 9:1 CR, 90 oF aftercooler water inlet, TA aspiration. Site rating based on deducting 3% for every 1000 feet above 6000 feet.

[2] Conservatively based on full time operating hours and full capacity.

[3] Heat input based on fuel consumption and site-rated HP.

[4] Based on 40 CFR 98 Subpart C, 98.33(a)(1)(i), Tier 1 Methodology, Equation C-1 and using source specific heat input.

GHG Emissions (lb/hr) = EF_{GHG} (kg/MMBtu) * 2.204623 lb/kg * Source Specific Heat Input (MMbtu/hr) * % Operating Capacity

GHG Emissions (TPY) = GHG Emissions (lb/hr) * 8760 hr/yr * 1 Ton/2000 lb

CO_2e Emissions (TPY) = Σ (GHG Emissions (tpy) * GWP)

Where:

EF_{GHG} = Fuel-specific default CO_2, CH_4, or N_2O emission factors from Table C-1 for CO_2 (Natural gas - Weighted U.S. Average) and Table C-2 for CH_4 and N_2O (Natural Gas) of 40 CFR Part 98, Subpart C (kg/MMBtu)

Heat Input = Btu/hp-hr x Site-rated hp x (1 MMBtu/1,000,000 Btu) = MMBtu/hr

GWP = Global Warming Potentials, 40 CFR 98, Subpart A, Table A-1

Example Calculations:

CO_2 Emissions (lb/hr) = 53.06 kg/MMBtu * 2.204623 lb/kg * 12.63 MMBtu/hr * 100% Capacity = 1477.7314

CO_2 Emissions (TPY) = 1477.7314 lb/hr * 8760 hr/yr * 1 Ton/2000 lb = 6472.4634

CO_2e Emissions (TPY) = (6472.4634 TPY * 1) + (0.1220 TPY * 25) + (0.0122 TPY * 298) = 6479.1481

G3516

NON-CURRENT

GAS COMPRESSION APPLICATION

GAS ENGINE SITE SPECIFIC TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED (rpm):	1200	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	8:1	RATING LEVEL:	CONTINUOUS
AFTERCOOLER TYPE:	SCAC	FUEL SYSTEM:	HPG IMPCO
AFTERCOOLER WATER INLET (°F):	130	**SITE CONDITIONS:**	
JACKET WATER OUTLET (°F):	210	FUEL:	Field Gas
ASPIRATION:	TA	FUEL PRESSURE RANGE(psig):	35.0-40.0
COOLING SYSTEM:	JW+OC, AC	FUEL METHANE NUMBER:	62.1
CONTROL SYSTEM:	EIS	FUEL LHV (Btu/scf):	1027
EXHAUST MANIFOLD:	ASWC	ALTITUDE(ft):	6360
COMBUSTION:	LOW EMISSION	MAXIMUM INLET AIR TEMPERATURE(°F):	100
NOx EMISSION LEVEL (g/bhp-hr NOx):	2.0	STANDARD RATED POWER:	1085 bhp@1200rpm
SET POINT TIMING:	27		

			MAXIMUM RATING	SITE RATING AT MAXIMUM INLET AIR TEMPERATURE		
RATING	**NOTES**	**LOAD**	**100%**	**100%**	**75%**	**55%**
ENGINE POWER (WITHOUT FAN)	(1)	bhp	1085	986	739	543
INLET AIR TEMPERATURE		°F	49	100	100	100
ENGINE DATA						
FUEL CONSUMPTION (LHV)	(2)	Btu/bhp-hr	7586	7647	7864	8282
FUEL CONSUMPTION (HHV)	(2)	Btu/bhp-hr	8383	8450	8689	9151
AIR FLOW (@inlet air temp, 14.7 psia) (WET)	(3)(4)	ft3/min	2160	2169	1577	1048
AIR FLOW (WET)	(3)(4)	lb/hr	10105	9220	6703	4454
FUEL FLOW (60ºF, 14.7 psia)		scfm	134	122	94	73
INLET MANIFOLD PRESSURE	(5)	in Hg(abs)	61.8	56.9	42.9	30.1
EXHAUST TEMPERATURE - ENGINE OUTLET	(6)	°F	885	875	872	902
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia) (WET)	(7)(4)	ft3/min	6175	5592	4073	2798
EXHAUST GAS MASS FLOW (WET)	(7)(4)	lb/hr	10500	9583	6983	4670
EMISSIONS DATA - ENGINE OUT						
NOx (as NO2)	(8)(9)	g/bhp-hr	2.00	2.00	2.81	3.78
CO	(8)(9)	g/bhp-hr	2.53	2.67	2.88	2.65
THC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	2.80	2.83	2.58	2.04
NMHC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	0.73	0.73	0.67	0.53
NMNEHC (VOCs) (mol. wt. of 15.84)	(8)(9)(10)	g/bhp-hr	0.49	0.49	0.45	0.36
HCHO (Formaldehyde)	(8)(9)	g/bhp-hr	0.28	0.29	0.32	0.34
CO2	(8)(9)	g/bhp-hr	527	531	554	574
EXHAUST OXYGEN	(8)(11)	% DRY	7.7	7.6	7.1	6.7
HEAT REJECTION						
HEAT REJ. TO JACKET WATER (JW)	(12)	Btu/min	35481	33363	28629	25838
HEAT REJ. TO ATMOSPHERE	(12)	Btu/min	4554	4276	3587	3037
HEAT REJ. TO LUBE OIL (OC)	(12)	Btu/min	5610	5275	4527	4086
HEAT REJ. TO AFTERCOOLER (AC)	(12)(13)	Btu/min	9313	9313	4510	1330
COOLING SYSTEM SIZING CRITERIA						
TOTAL JACKET WATER CIRCUIT (JW+OC)	(13)	Btu/min	45761			
TOTAL AFTERCOOLER CIRCUIT (AC)	(13)(14)	Btu/min	9779			
A cooling system safety factor of 0% has been added to the cooling system sizing criteria.						

CONDITIONS AND DEFINITIONS

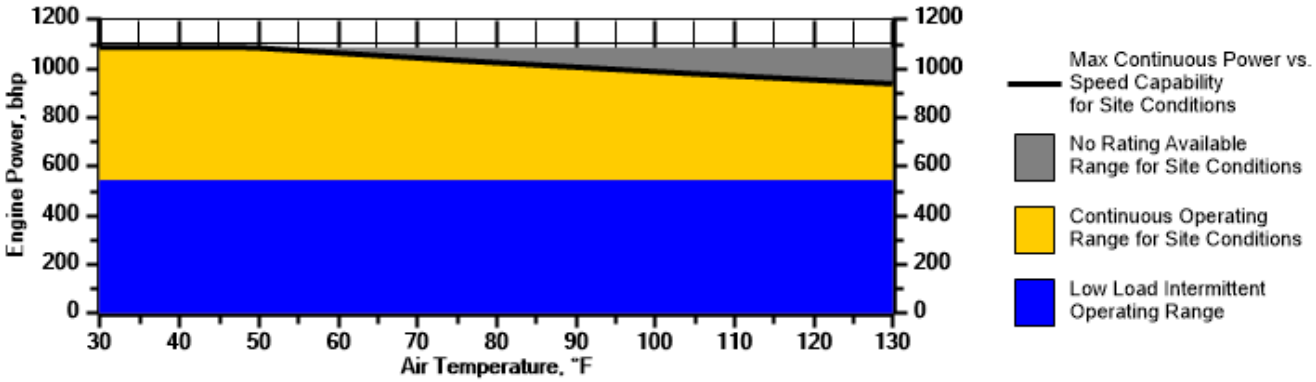
Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature. 100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature. Maximum rating is the maximum capability at the specified aftercooler inlet temperature for the specified fuel at site altitude and reduced inlet air temperature. Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

For notes information consult page three.

PREPARED BY:
Data generated by Gas Engine Rating Pro Version 5.02.01
Ref. Data Set DM0107-09-001, 4EK, Printed 18Jun2015

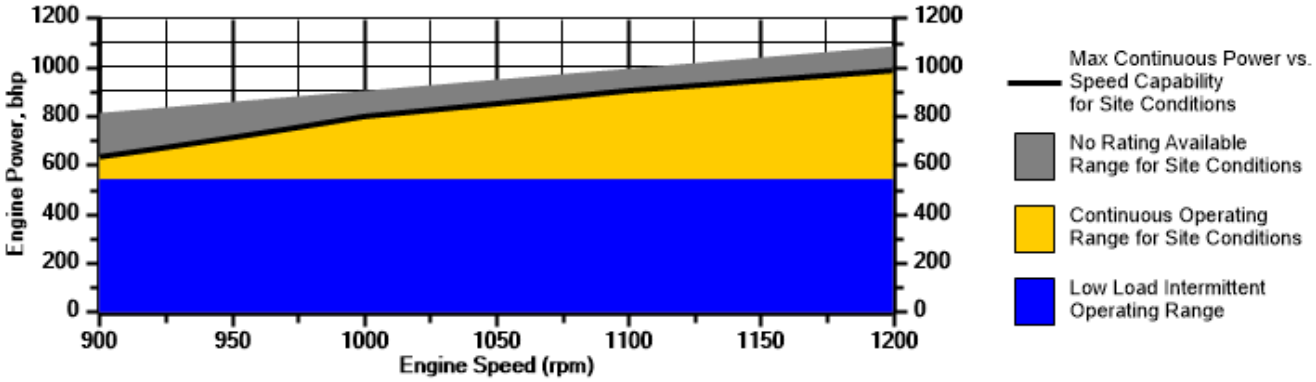
Engine Power vs. Inlet Air Temperature

Data represents temperature sweep at 6360 ft and 1200 rpm



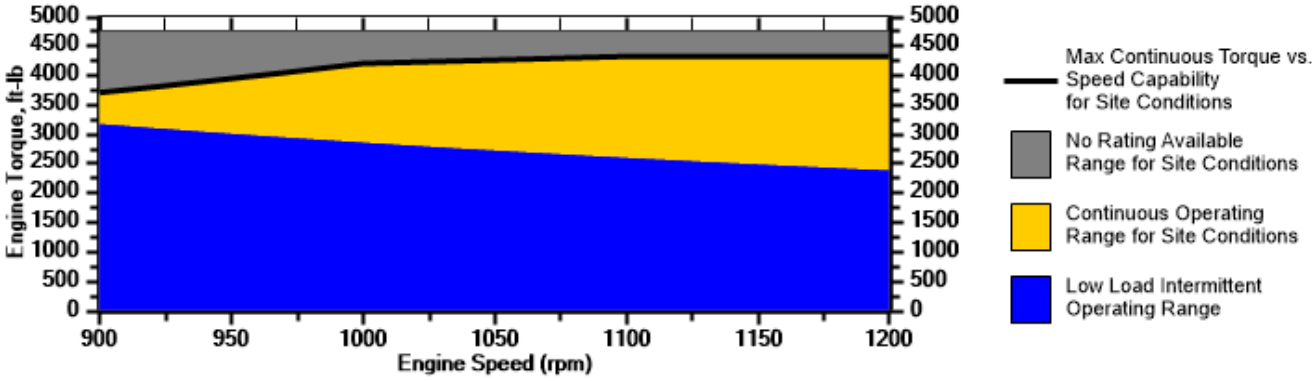
Engine Power vs. Engine Speed

Data represents speed sweep at 6360 ft and 100 °F



Engine Torque vs. Engine Speed

Data represents speed sweep at 6360 ft and 100 °F



Note: At site conditions of 6360 ft and 100°F inlet air temp., constant torque can be maintained down to 1100 rpm. The minimum speed for loading at these conditions is 900 rpm.

NOTES

1. Engine rating is with two engine driven water pumps. Tolerance is ± 3% of full load.

2. Fuel consumption tolerance is ± 3.0% of full load data.

3. Air flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 5 %.

4. Inlet and Exhaust Restrictions must not exceed A&I limits based on full load flow rates from the standard technical data sheet.

5. Inlet manifold pressure is a nominal value with a tolerance of ± 5 %.

6. Exhaust temperature is a nominal value with a tolerance of (+)63°F, (-)54°F.

7. Exhaust flow value is on a "wet" basis. Flow is a nominal value with a tolerance of ± 6 %.

8. Emissions data is at engine exhaust flange prior to any after treatment.

9. Emission values are based on engine operating at steady state conditions, adjusted to the specified NOx level at 100% load. Fuel methane number cannot vary more than ± 3. NOx values are set points and will vary with operating conditions. All other emission values listed are higher than nominal levels to allow for instrumentation, measurement, and engine-to-engine variations. They indicate "Not to Exceed" values. THC, NMHC, and NMNEHC do not include aldehydes. Part load data may require engine adjustment.

10. VOCs - Volatile organic compounds as defined in US EPA 40 CFR 60, subpart JJJJ

11. Exhaust Oxygen level is the result of adjusting the engine to operate at the specified NOx level. Tolerance is ± 0.5.

12. Heat rejection values are nominal. Tolerances, based on treated water, are ± 10% for jacket water circuit, ± 50% for radiation, ± 20% for lube oil circuit, and ± 5% for aftercooler circuit.

13. Aftercooler heat rejection includes an aftercooler heat rejection factor for the site elevation and inlet air temperature specified. Aftercooler heat rejection values at part load are for reference only. Do not use part load data for heat exchanger sizing.

14. Cooling system sizing criteria are maximum circuit heat rejection for the site, with applied tolerances.

Constituent	Abbrev	Mole %	Norm
Water Vapor	H2O	2.5211	2.5211
Methane	CH4	86.6340	86.6340
Ethane	C2H6	4.9767	4.9767
Propane	C3H8	3.5670	3.5670
Isobutane	iso-C4H1O	0.0000	0.0000
Norbutane	nor-C4H1O	1.8211	1.8211
Isopentane	iso-C5H12	0.0000	0.0000
Norpentane	nor-C5H12	0.4802	0.4802
Hexane	C6H14	0.0000	0.0000
Heptane	C7H16	0.0000	0.0000
Nitrogen	N2	0.0000	0.0000
Carbon Dioxide	CO2	0.0000	0.0000
Hydrogen Sulfide	H2S	0.0000	0.0000
Carbon Monoxide	CO	0.0000	0.0000
Hydrogen	H2	0.0000	0.0000
Oxygen	O2	0.0000	0.0000
Helium	HE	0.0000	0.0000
Neopentane	neo-C5H12	0.0000	0.0000
Octane	C8H18	0.0000	0.0000
Nonane	C9H20	0.0000	0.0000
Ethylene	C2H4	0.0000	0.0000
Propylene	C3H6	0.0000	0.0000
TOTAL (Volume %)		100.0000	100.0000

Fuel Makeup:	Field Gas
Unit of Measure:	English

Calculated Fuel Properties

Caterpillar Methane Number:	62.1
Lower Heating Value (Btu/scf):	1027
Higher Heating Value (Btu/scf):	1135
WOBBE Index (Btu/scf):	1274
THC: Free Inert Ratio:	Not Applicable
Total % Inerts (% N2, CO2, He):	0%
RPC (%) (To 905 Btu/scf Fuel):	100%
Compressibility Factor:	0.997
Stoich A/F Ratio (Vol/Vol):	10.68
Stoich A/F Ratio (Mass/Mass):	16.43
Specific Gravity (Relative to Air):	0.650
Specific Heat Constant (K):	1.297

CONDITIONS AND DEFINITIONS

Caterpillar Methane Number represents the knock resistance of a gaseous fuel. It should be used with the Caterpillar Fuel Usage Guide for the engine and rating to determine the rating for the fuel specified. A Fuel Usage Guide for each rating is included on page 2 of its standard technical data sheet.

RPC always applies to naturally aspirated (NA) engines, and turbocharged (TA or LE) engines only when they are derated for altitude and ambient site conditions.

Project specific technical data sheets generated by the Caterpillar Gas Engine Rating Pro program take the Caterpillar Methane Number and RPC into account when generating a site rating.

Fuel properties for Btu/scf calculations are at 60F and 14.696 psia.

Caterpillar shall have no liability in law or equity, for damages, consequently or otherwise, arising from use of program and related material or any part thereof.

FUEL LIQUIDS

Field gases, well head gases, and associated gases typically contain liquid water and heavy hydrocarbons entrained in the gas. To prevent detonation and severe damage to the engine, hydrocarbon liquids must not be allowed to enter the engine fuel system. To remove liquids, a liquid separator and coalescing filter are recommended, with an automatic drain and collection tank to prevent contamination of the ground in accordance with local codes and standards.

To avoid water condensation in the engine or fuel lines, limit the relative humidity of water in the fuel to 80% at the minimum fuel operating temperature.

G3606

GAS ENGINE TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED (rpm):	1000	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	9.2:1	APPLICATION:	GAS COMPRESSION
AFTERCOOLER TYPE:	SCAC	RATING LEVEL:	CONTINUOUS
AFTERCOOLER WATER INLET (°F):	90	FUEL:	NAT GAS
JACKET WATER OUTLET (°F):	190	FUEL SYSTEM:	GAV
ASPIRATION:	TA		WITH AIR FUEL RATIO CONTROL
COOLING SYSTEM:	JW, OC+AC	FUEL PRESSURE RANGE(psig):	42.8-47.0
CONTROL SYSTEM:	CIS/ADEM3	FUEL METHANE NUMBER:	80
EXHAUST MANIFOLD:	DRY	FUEL LHV (Btu/scf):	905
COMBUSTION:	LOW EMISSION	ALTITUDE CAPABILITY AT 77°F INLET AIR TEMP. (ft):	5000
NOx EMISSION LEVEL (g/bhp-hr NOx):	0.7		

RATING		NOTES	LOAD	100%	75%	50%
ENGINE POWER	(WITHOUT FAN)	(1)	bhp	1895	1421	948
ENGINE EFFICIENCY	(ISO 3046/1)	(2)	%	38.7	37.1	34.6
ENGINE EFFICIENCY	(NOMINAL)	(2)	%	37.7	36.3	33.8

ENGINE DATA						
FUEL CONSUMPTION	(ISO 3046/1)	(3)	Btu/bhp-hr	6581	6849	7352
FUEL CONSUMPTION	(NOMINAL)	(3)	Btu/bhp-hr	6741	7016	7531
AIR FLOW (77°F, 14.7 psia)	(WET)	(4) (5)	ft3/min	4857	3723	2530
AIR FLOW	(WET)	(4) (5)	lb/hr	21536	16508	11216
FUEL FLOW (60ºF, 14.7 psia)			scfm	235	184	131
COMPRESSOR OUT PRESSURE			in Hg(abs)	76.1	59.3	42.5
COMPRESSOR OUT TEMPERATURE			°F	300	243	163
AFTERCOOLER AIR OUT TEMPERATURE			°F	100	97	93
INLET MAN. PRESSURE		(6)	in Hg(abs)	73.4	56.9	40.6
INLET MAN. TEMPERATURE	(MEASURED IN PLENUM)	(7)	°F	108	104	99
TIMING			°BTDC	20	20	19
EXHAUST TEMPERATURE - ENGINE OUTLET		(8)	°F	832	869	932
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	(9) (5)	ft3/min	12457	9829	7013
EXHAUST GAS MASS FLOW	(WET)	(9) (5)	lb/hr	22181	17012	11576

EMISSIONS DATA - ENGINE OUT					
NOx (as NO2)	(10)(11)	g/bhp-hr	0.70	0.70	0.70
CO	(10)(12)	g/bhp-hr	2.50	2.50	2.50
THC (mol. wt. of 15.84)	(10)(12)	g/bhp-hr	5.90	6.13	6.34
NMHC (mol. wt. of 15.84)	(10)(12)	g/bhp-hr	0.89	0.92	0.95
NMNEHC (VOCs) (mol. wt. of 15.84)	(10)(12)(13)	g/bhp-hr	0.59	0.61	0.63
HCHO (Formaldehyde)	(10)(12)	g/bhp-hr	0.26	0.27	0.29
CO2	(10)(12)	g/bhp-hr	438	456	489
EXHAUST OXYGEN	(10)(14)	% DRY	12.3	11.9	10.9
LAMBDA	(10)(14)		2.11	2.07	1.96

ENERGY BALANCE DATA					
LHV INPUT	(15)	Btu/min	212893	166183	118930
HEAT REJECTION TO JACKET WATER (JW)	(16)(23)	Btu/min	18645	16144	13093
HEAT REJECTION TO ATMOSPHERE	(17)	Btu/min	7452	6980	6541
HEAT REJECTION TO LUBE OIL (OC)	(18)(24)	Btu/min	9581	9141	8920
HEAT REJECTION TO EXHAUST (LHV TO 77°F)	(19)(20)	Btu/min	76566	61016	44080
HEAT REJECTION TO EXHAUST (LHV TO 350°F)	(19)	Btu/min	47184	39065	29995
HEAT REJECTION TO AFTERCOOLER (AC)	(21)(24)	Btu/min	17337	9677	3157
PUMP POWER	(22)	Btu/min	2957	2957	2957

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1. (Standard reference conditions of 77°F, 29.60 in Hg barometric pressure.) No overload permitted at rating shown. Consult the altitude deration factor chart for applications that exceed the rated altitude or temperature.

Emission levels are at engine exhaust flange prior to any after treatment. Values are based on engine operating at steady state conditions, adjusted to the specified NOx level at 100% load. Tolerances specified are dependent upon fuel quality. Fuel methane number cannot vary more than ± 3.

For notes information consult page three.

FUEL USAGE GUIDE

CAT METHANE NUMBER	25	30	35	40	45	50	55	60	65	70	100
DERATION FACTOR	0	0.69	0.74	0.79	0.84	0.90	0.95	1	1	1	1

TOTAL DERATION FACTORS - ALTITUDE & COOLING AT RATED SPEED

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1	1	1	0.98	0.95	0.91	0.87	0.83	0.79	0.76	0.72	0.69	0.66
120	1	1	1	1	0.96	0.93	0.89	0.86	0.82	0.79	0.76	0.73	0.69
110	1	1	1	1	0.98	0.94	0.91	0.87	0.84	0.80	0.77	0.74	0.71
100	1	1	1	1	1	0.96	0.92	0.89	0.85	0.82	0.79	0.75	0.72
90	1	1	1	1	1	0.98	0.94	0.90	0.87	0.83	0.80	0.77	0.74
80	1	1	1	1	1	0.99	0.96	0.92	0.88	0.85	0.81	0.78	0.75
70	1	1	1	1	1	1	0.97	0.94	0.90	0.86	0.83	0.80	0.76
60	1	1	1	1	1	1	0.99	0.95	0.92	0.88	0.85	0.81	0.78
50	1	1	1	1	1	1	1	0.97	0.94	0.90	0.86	0.83	0.79

ALTITUDE (FEET ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS (ACHRF)

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1.35	1.40	1.46	1.51	1.57	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63
120	1.28	1.33	1.39	1.44	1.50	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55
110	1.21	1.26	1.31	1.37	1.42	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48
100	1.14	1.19	1.24	1.29	1.35	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
90	1.07	1.12	1.17	1.22	1.27	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33
80	1	1.05	1.10	1.15	1.20	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
70	1	1	1.02	1.07	1.13	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18
60	1	1	1	1	1.05	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
50	1	1	1	1	1	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03

ALTITUDE (FEET ABOVE SEA LEVEL)

MINIMUM SPEED CAPABILITY AT THE RATED SPEED'S SITE TORQUE (RPM)

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	750	750	780	800	800	800	800	790	790	780	770	760	760
120	750	750	760	800	800	800	800	800	800	800	800	800	800
110	750	750	750	790	800	800	800	800	800	800	800	800	800
100	750	750	750	770	800	800	800	800	800	800	800	800	800
90	750	750	750	750	790	800	800	800	800	800	800	800	800
80	750	750	750	750	770	800	800	800	800	800	800	800	800
70	750	750	750	750	750	790	800	800	800	800	800	800	800
60	750	750	750	750	750	770	800	800	800	800	800	800	800
50	750	750	750	750	750	750	790	800	800	800	800	800	800

ALTITUDE (FEET ABOVE SEA LEVEL)

FUEL USAGE GUIDE:

This table shows the derate factor required for a given fuel. Note that deration occurs as the methane number decreases. Methane number is a scale to measure detonation characteristics of various fuels. The methane number of a fuel is determined by using the Caterpillar methane number calculation program.

ALTITUDE DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information along with the fuel usage guide chart to help determine actual engine power for your site.

ACTUAL ENGINE RATING:

To determine the actual rating of the engine at site conditions, one must consider separately, limitations due to fuel characteristics and air system limitations. The Fuel Usage Guide deration establishes fuel limitations. The Altitude/Temperature deration factors and RPC (reference the Caterpillar Methane Program) establish air system limitations. RPC comes into play when the Altitude/Temperature deration is less than 1.0 (100%). Under this condition, add the two factors together. When the site conditions do not require an Altitude/Temperature derate (factor is 1.0), it is assumed the turbocharger has sufficient capability to overcome the low fuel relative power, and RPC is ignored. To determine the actual power available, take the lowest rating between 1) and 2).

AFTERCOOLER HEAT REJECTION FACTORS(ACHRF):

To maintain a constant air inlet manifold temperature, as the inlet air temperature goes up, so must the heat rejection. As altitude increases, the turbocharger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor (ACHRF) to adjust for inlet air temp and altitude conditions. See note 24 for application of this factor in calculating the heat exchanger sizing criteria. Failure to properly account for these factors could result in detonation and cause the engine to shutdown or fail.

MINIMUM SPEED CAPABILITY AT THE RATED SPEED'S SITE TORQUE (RPM):

This table shows the minimum allowable engine turndown speed where the engine will maintain the Rated Speed’s Torque for the given ambient conditions.

NOTES:

1. Engine rating is with two engine driven water pumps. Tolerance is ± 3% of full load.
2. ISO 3046/1 engine efficiency tolerance is (+)0, (-)5% of full load % efficiency value. Nominal engine efficiency tolerance is ± 2.5% of full load % efficiency value.
3. ISO 3046/1 fuel consumption tolerance is (+)5, (-)0% of full load data. Nominal fuel consumption tolerance is ± 2.5% of full load data.
4. Air flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 5 %.
5. Inlet and Exhaust Restrictions must not exceed A&I limits based on full load flow rates from the standard technical data sheet.
6. Inlet manifold pressure is a nominal value with a tolerance of ± 5 %.
7. Inlet manifold temperature is a nominal value with a tolerance of ± 9°F.
8. Exhaust temperature is a nominal value with a tolerance of (+)63°F, (-)54°F.
9. Exhaust flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 6 %.
10. Emissions data is at engine exhaust flange prior to any after treatment.
11. NOx values are "Not to Exceed".
12. CO, CO2, THC, NMHC, NMNEHC, and HCHO values are "Not to Exceed" levels. THC, NMHC, and NMNEHC do not include aldehydes. An oxidation catalyst may be required to meet Federal, State or local CO or HC requirements.
13. VOCs - Volatile organic compounds as defined in US EPA 40 CFR 60, subpart JJJJ
14. Exhaust Oxygen tolerance is ± 0.5; Lambda tolerance is ± 0.05. Lambda and Exhaust Oxygen level are the result of adjusting the engine to operate at the specified NOx level.
15. LHV rate tolerance is ± 2.5%.
16. Heat rejection to jacket water value displayed includes heat to jacket water alone. Value is based on treated water. Tolerance is ± 10% of full load data.
17. Heat rejection to atmosphere based on treated water. Tolerance is ± 50% of full load data.
18. Lube oil heat rate based on treated water. Tolerance is ± 20% of full load data.
19. Exhaust heat rate based on treated water. Tolerance is ± 10% of full load data.
20. Heat rejection to exhaust (LHV to 77°F) value shown includes unburned fuel and is not intended to be used for sizing or recovery calculations.
21. Heat rejection to aftercooler based on treated water. Tolerance is ±5% of full load data.
22. Pump power includes engine driven jacket water and aftercooler water pumps. Engine brake power includes effects of pump power.
23. Total Jacket Water Circuit heat rejection is calculated as: JW x 1.1. Heat exchanger sizing criterion is maximum circuit heat rejection at site conditions, with applied tolerances. A cooling system safety factor may be multiplied by the total circuit heat rejection to provide additional margin.
24. Total Aftercooler Circuit heat rejection is calculated as: (OC x 1.2) + (AC x ACHRF x 1.05). Heat exchanger sizing criterion is maximum circuit heat rejection at site conditions, with applied tolerances. A cooling system safety factor may be multiplied by the total circuit heat rejection to provide additional margin.

ENGINE POWER (bhp):	1895	COOLING SYSTEM:	JW, OC+AC
ENGINE SPEED (rpm):	1000	AFTERCOOLER WATER INLET (°F):	90
EXHAUST MANIFOLD:	DRY	JACKET WATER OUTLET (°F):	190

Free Field Mechanical and Exhaust Noise

SOUND POWER LEVEL (dB)										
		Octave Band Center Frequency (OBCF)								
100% Load Data	**dB(A)**	**32 Hz**	**63 Hz**	**125 Hz**	**250 Hz**	**500 Hz**	**1 kHz**	**2 kHz**	**4 kHz**	**8 kHz**
Mechanical Sound	118.4	-	-	119.6	116.9	115.5	113.6	108.6	109	99.8
Exhaust Sound	136.6	119.2	130.3	127.2	122.2	119.9	123.1	128.8	133.3	131.4
Air Inlet Sound	127	104.4	113.8	115.8	115	112.9	112	117.4	122.6	123

SOUND PARAMETER DEFINITION:
Sound Power Level Data - DM8702-02

Sound power is defined as the total sound energy emanating from a source irrespective of direction or distance. Sound power level data is presented under two index headings:
Sound power level -- Mechanical
Sound power level -- Exhaust

Mechanical: Sound power level data is calculated in accordance with ISO 6798. The data is recorded with the exhaust sound source isolated.

Exhaust: Sound power level data is calculated in accordance with ISO 6798 Annex A. Exhaust data is post-catalyst on gas engine ratings labeled as "Integrated Catalyst".

Measurements made in accordance with ISO 6798 for engine and exhaust sound level only. No cooling system noise is included unless specifically indicated. Sound level data is indicative of noise levels recorded on one engine sample in a survey grade 3 environment.

How an engine is packaged, installed and the site acoustical environment will affect the site specific sound levels. For site specific sound level guarantees, sound data collection needs to be done on-site or under similar conditions.

Table 3.2-2. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE LEAN-BURN ENGINES[a]
(SCC 2-02-002-54)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
Criteria Pollutants and Greenhouse Gases		
NO_x[c] 90 - 105% Load	4.08 E+00	B
NO_x[c] <90% Load	8.47 E-01	B
CO[c] 90 - 105% Load	3.17 E-01	C
CO[c] <90% Load	5.57 E-01	B
CO_2[d]	1.10 E+02	A
SO_2[e]	5.88 E-04	A
TOC[f]	1.47 E+00	A
Methane[g]	1.25 E+00	C
VOC[h]	1.18 E-01	C
PM10 (filterable)[i]	7.71 E-05	D
PM2.5 (filterable)[i]	7.71 E-05	D
PM Condensable[j]	9.91 E-03	D
Trace Organic Compounds		
1,1,2,2-Tetrachloroethane[k]	<4.00 E-05	E
1,1,2-Trichloroethane[k]	<3.18 E-05	E
1,1-Dichloroethane	<2.36 E-05	E
1,2,3-Trimethylbenzene	2.30 E-05	D
1,2,4-Trimethylbenzene	1.43 E-05	C
1,2-Dichloroethane	<2.36 E-05	E
1,2-Dichloropropane	<2.69 E-05	E
1,3,5-Trimethylbenzene	3.38 E-05	D
1,3-Butadiene[k]	2.67E-04	D
1,3-Dichloropropene[k]	<2.64 E-05	E
2-Methylnaphthalene[k]	3.32 E-05	C
2,2,4-Trimethylpentane[k]	2.50 E-04	C
Acenaphthene[k]	1.25 E-06	C

Table 3.2-2. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE LEAN-BURN ENGINES (Continued)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
Acenaphthylene[k]	5.53 E-06	C
Acetaldehyde[k,l]	8.36 E-03	A
Acrolein[k,l]	5.14 E-03	A
Benzene[k]	4.40 E-04	A
Benzo(b)fluoranthene[k]	1.66 E-07	D
Benzo(e)pyrene[k]	4.15 E-07	D
Benzo(g,h,i)perylene[k]	4.14 E-07	D
Biphenyl[k]	2.12 E-04	D
Butane	5.41 E-04	D
Butyr/Isobutyraldehyde	1.01 E-04	C
Carbon Tetrachloride[k]	<3.67 E-05	E
Chlorobenzene[k]	<3.04 E-05	E
Chloroethane	1.87 E-06	D
Chloroform[k]	<2.85 E-05	E
Chrysene[k]	6.93 E-07	C
Cyclopentane	2.27 E-04	C
Ethane	1.05 E-01	C
Ethylbenzene[k]	3.97 E-05	B
Ethylene Dibromide[k]	<4.43 E-05	E
Fluoranthene[k]	1.11 E-06	C
Fluorene[k]	5.67 E-06	C
Formaldehyde[k,l]	5.28 E-02	A
Methanol[k]	2.50 E-03	B
Methylcyclohexane	1.23 E-03	C
Methylene Chloride[k]	2.00 E-05	C
n-Hexane[k]	1.11 E-03	C
n-Nonane	1.10 E-04	C

Table 3.2-2. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE LEAN-BURN ENGINES
(Continued)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
n-Octane	3.51 E-04	C
n-Pentane	2.60 E-03	C
Naphthalene[k]	7.44 E-05	C
PAH[k]	2.69 E-05	D
Phenanthrene[k]	1.04 E-05	D
Phenol[k]	2.40 E-05	D
Propane	4.19 E-02	C
Pyrene[k]	1.36 E-06	C
Styrene[k]	<2.36 E-05	E
Tetrachloroethane[k]	2.48 E-06	D
Toluene[k]	4.08 E-04	B
Vinyl Chloride[k]	1.49 E-05	C
Xylene[k]	1.84 E-04	B

[a] Reference 7. Factors represent uncontrolled levels. For NO_x, CO, and PM10, "uncontrolled" means no combustion or add-on controls; however, the factor may include turbocharged units. For all other pollutants, "uncontrolled" means no oxidation control; the data set may include units with control techniques used for NOx control, such as PCC and SCR for lean burn engines, and PSC for rich burn engines. Factors are based on large population of engines. Factors are for engines at all loads, except as indicated. SCC = Source Classification Code. TOC = Total Organic Compounds. PM-10 = Particulate Matter ≤ 10 microns (μm) aerodynamic diameter. A "<" sign in front of a factor means that the corresponding emission factor is based on one-half of the method detection limit.

[b] Emission factors were calculated in units of (lb/MMBtu) based on procedures in EPA Method 19. To convert from (lb/MMBtu) to (lb/10^6 scf), multiply by the heat content of the fuel. If the heat content is not available, use 1020 Btu/scf. To convert from (lb/MMBtu) to (lb/hp-hr) use the following equation:

$$\text{lb/hp-hr} = (\text{lb/MMBtu})\ (\text{heat input, MMBtu/hr})\ (\text{1/operating HP, 1/hp})$$

[c] Emission tests with unreported load conditions were not included in the data set.

[d] Based on 99.5% conversion of the fuel carbon to CO_2. CO_2 [lb/MMBtu] = (3.67)(%CON)(C)(D)(1/h), where %CON = percent conversion of fuel carbon to CO_2, C = carbon content of fuel by weight (0.75), D = density of fuel, 4.1 E+04 lb/10^6 scf, and

h = heating value of natural gas (assume 1020 Btu/scf at 60°F).

[e] Based on 100% conversion of fuel sulfur to SO_2. Assumes sulfur content in natural gas of 2,000 gr/10^6scf.

[f] Emission factor for TOC is based on measured emission levels from 22 source tests.

[g] Emission factor for methane is determined by subtracting the VOC and ethane emission factors from the TOC emission factor. Measured emission factor for methane compares well with the calculated emission factor, 1.31 lb/MMBtu vs. 1.25 lb/MMBtu, respectively.

[h] VOC emission factor is based on the sum of the emission factors for all speciated organic compounds less ethane and methane.

[i] Considered $\leq$ 1 μm in aerodynamic diameter. Therefore, for filterable PM emissions, PM10(filterable) = PM2.5(filterable).

[j] PM Condensable = PM Condensable Inorganic + PM-Condensable Organic

[k] Hazardous Air Pollutant as defined by Section 112(b) of the Clean Air Act.

[l] For lean burn engines, aldehyde emissions quantification using CARB 430 may reflect interference with the sampling compounds due to the nitrogen concentration in the stack. The presented emission factor is based on FTIR measurements. Emissions data based on CARB 430 are available in the background report.

40 CFR Part 98, Table C-1 to subpart C - Default Co2 Emission Factors and High Heat Values for Various Types of Fuel

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Table C-1 to Subpart C of Part 98 Default Co_2 Emission Factors and High Heat Values for Various Types of Fuel

Default CO_2 Emission Factors and High Heat Values for Various Types of Fuel

Fuel type	Default high heat value	Default CO_2 emission factor
Coal and coke	mmBtu/short ton	kg CO_2/mmBtu
Anthracite	25.09	103.69
Bituminous	24.93	93.28
Subbituminous	17.25	97.17
Lignite	14.21	97.72
Coal Coke	24.80	113.67
Mixed (Commercial sector)	21.39	94.27
Mixed (Industrial coking)	26.28	93.90
Mixed (Industrial sector)	22.35	94.67
Mixed (Electric Power sector)	19.73	95.52
Natural gas	mmBtu/scf	kg CO_2/mmBtu
(Weighted U.S. Average)	1.026×10^{-3}	53.06
Petroleum products	mmBtu/gallon	kg CO_2/mmBtu
Distillate Fuel Oil No. 1	0.139	73.25
Distillate Fuel Oil No. 2	0.138	73.96
Distillate Fuel Oil No. 4	0.146	75.04
Residual Fuel Oil No. 5	0.140	72.93
Residual Fuel Oil No. 6	0.150	75.10
Used Oil	0.138	74.00
Kerosene	0.135	75.20
Liquefied petroleum gases (LPG)[1]	0.092	61.71

40 CFR Part 98, Table C-2 to subpart C - Default Ch4 and N2o Emission Factors for Various Types of Fuel

Table C-2 to Subpart C of Part 98 Default Ch_4 and N_2o Emission Factors for Various Types of Fuel

Fuel type	Default CH_4 emission factor (kg CH_4/mmBtu)	Default N_2O emission factor (kg N_2O/mmBtu)
Coal and Coke (All fuel types in Table C-1)	1.1×10^{-02}	1.6×10^{-03}
Natural Gas	1.0×10^{-03}	1.0×10^{-04}
Petroleum (All fuel types in Table C-1)	3.0×10^{-03}	6.0×10^{-04}
Fuel Gas	3.0×10^{-03}	6.0×10^{-04}
Municipal Solid Waste	3.2×10^{-02}	4.2×10^{-03}
Tires	3.2×10^{-02}	4.2×10^{-03}
Blast Furnace Gas	2.2×10^{-05}	1.0×10^{-04}
Coke Oven Gas	4.8×10^{-04}	1.0×10^{-04}
Biomass Fuels-Solid (All fuel types in Table C-1, except wood and wood residuals)	3.2×10^{-02}	4.2×10^{-03}
Wood and wood residuals	7.2×10^{-03}	3.6×10^{-03}
Biomass Fuels-Gaseous (All fuel types in Table C-1)	3.2×10^{-03}	6.3×10^{-04}
Biomass Fuels-Liquid (All fuel types in Table C-1)	1.1×10^{-03}	1.1×10^{-04}

Note: Those employing this table are assumed to fall under the IPCC definitions of the “Energy Industry” or “Manufacturing Industries and Construction”. In all fuels except for coal the values for these two categories are identical. For coal combustion, those who fall within the IPCC “Energy Industry” category may employ a value of 1g of CH_4/mmBtu.

[78 FR 71952, Nov. 29, 2013]

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6 - Actual Emission Calculations and Supporting Documentation

BP America Production Company
Facility: **Salvador I/II Central Delivery Point**
Description: **2014 Calendar Year Actual Emissions[1]**

Emission Unit ID	Description	Emissions (TPY)						
		NO_x	CO	PM[2]	SO_2	VOC[3]	CH_2O	HAPs
Unit 1	1334 hp Waukesha L7042GL Compressor Engine w/OxiCat	20.5417	3.8516	0.4161	0.0245	12.8386	1.4893	1.4893
Unit 2	666 hp Waukesha F3521GL Compressor Engine	9.5969	19.1938	0.2102	0.0124	6.3979	1.8554	1.8554
Unit 3	1334 hp Waukesha L7042GL Compressor Engine	19.1763	38.3525	0.4144	0.0244	12.7842	3.7074	3.7074
Unit 4	1467 hp Waukesha L7042GSI Compressor Engine w/ NSCR and AFR	28.2663	33.9195	0.9706	0.0294	14.1331	0.7067	0.7067
--	500 gal TEG Tanks (3)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 gal Lube Oil Tanks (5)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 gal EG/Water (50/50) Tanks (2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 gal Used Oil Tanks (5)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	95 bbl Compressor/Dehy Drip Tanks (7)	0.00	0.00	0.00	0.00	0.03	0.00	0.00
--	500 bbl Produced Water Tanks (4)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	0.25 MMBtu/hr Tank Heaters (5)	0.54	0.45	0.04	0.00	0.03	0.00	0.00
--	0.15 MMBtu/hr Separator Heaters (2)	0.13	0.11	0.01	0.00	0.01	0.00	0.00
--	Tri-ethylene Glycol (TEG) Dehydrator Regenerator, 45 MMscfd	0.00	0.00	0.00	0.00	0.89	0.00	0.00
--	Tri-ethylene Glycol (TEG) Dehydrator Flash Tank Vent	0.00	0.00	0.00	0.00	0.20	0.00	0.00
--	300 bbl Oily Water Tanks (2)	0.00	0.00	0.00	0.00	0.01	0.00	0.00
--	0.26 MMBtu/hr Oily Water Breakout Tank Heater	0.11	0.09	0.01	0.00	0.01	0.00	0.00
--	500 gal Solvent Tank	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--	500 bbl Oily Water Tank	0.00	0.00	0.00	0.00	0.01	0.00	0.00
--	37.5 bbl Used Oil Tank	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**78.3583**	**95.9702**	**2.0704**	**0.0953**	**47.3340**	**7.7593**	**7.7593**

[1] Actual emissions are calculated for the engines only. Actual emissions for all other equipment is the calculated potential-to-emit.

[2] Total PM emissions represent the sum of the filterable PM and condensable PM. Assuming Total PM is total PM_{10} and total $PM_{2.5}$.

[3] VOC emissions from emission units includes HAPs (i.e., formaldehyde).

[4] The 666 hp compressor engine represented as Unit 2 above will be replaced with the 1,073 hp four-stroke lean burn compressor engine without oxidation catalyst in August or September 2015. A notification of the engine replacement was submitted in July 2015.

BP America Production Company
Facility: **Salvador I/II Central Delivery Point**
Description: **1334 hp Waukesha L7042GL Compressor Engine w/OxiCat**
Emission Unit ID: **Unit 1**

Source Information:

Maximum Rating[1]	1478 hp
Site Altitude	6371 ft
Site Rating[2]	**1334** hp
Operating Capacity[3]	100 %
Hours of Operation[3]	8731 hr/yr
Fuel Consumption[1]	7155 Btu/hp-hr
Heat Input[4]	9.54 MMBtu/hr
Emissions Controls	Oxidation Catalyst

Maximum Fuel Usage: [4]

Hourly Fuel Usage	11.9 Mscf/hr
Daily Fuel Usage	0.3 MMscf/day
Annual Fuel Usage	104.2 MMscf/yr

Controlled Regulated Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Control Efficiency[5]	Emissions (lb/hr)	Emissions (TPY)
NO_X[1]. [6], [7]	1.6	g/hp-hr	N/A	4.7055	20.5417
CO[6]	3.0	g/hp-hr	90%	0.8823	3.8516
VOC[1], [6]	1.0	g/hp-hr	N/A	2.9409	12.8386
SO_2[8]	5.88E-04	lb/MMBtu	N/A	0.0056	0.0245
PM[8]	9.99E-03	lb/MMBtu	N/A	0.0953	0.4161
CH_2O[6]	0.29	g/hp-hr	60%	0.3411	1.4893

[1] Based on historical *Waukesha Bulletin 7005 0102* for L7042GL VHP Series engine, 130 oF I.C., Water Temperature, 10.5:1 CR, 1200 rpm, continuous rating. The current *Waukesha Bulletin 7005 0710* for L7042GL VHP engine, 130 ^{o}F I.C. Water Temperature, 10.5:1 CR, 1200 rpm, continuous rating, indicates the model has a maximum rating of 1480 hp. However, according to a WPI representative on 10/25/11, the updated rating represents a rounded hp number from the previously published 1478 hp and no known internal changes have been made to this engine model. Using 1478 hp and associated 7155 Btu/hp-hr to maintain current limits.

[2] Based on *Waukesha Power Adjustments* , dated 3/11, page 3, for a Turbocharged and Intercooled VHP GL engine. For continuous power, deduct 2% for each 1000 feet above 1500 feet.
Site Rating = [1478 hp x (1 - (0.02/1000 ft x (6370 ft - 1500 ft)))]

[3] Based on full operating capacity and actual hours of operation.

[4] Heat input based on fuel consumption and site-rated HP. Fuel usage rates based on fuel consumption x site-rated hp / 800 Btu/scf conservative heating value.

[5] BP's lb/hr limits assume a 90% reduction in CO at full load and a 60% reduction in CH_2O at full load. Although the engines may operate at loads other than 100%, the lb/hr limits will be met at any load.

[6] NO_X, VOC, and CH_2O based on *Waukesha Gas Engine Exhaust Emission Levels,* dated 3/11, pages 3 & 8, VHP Emission Levels GL. For CO, the 3/11 *Waukesha Gas Engine Exhaust Emissions Level* data identifies a 2.65 g/hp-hr factor for CO, while the *Waukesha Bulletin 7005 0710* technical data identifies a 2.70 g/hp-hr factor. In order to remain conservative, calculations use the 3.0 g/hp-hr CO factor from *Waukesha Bulletin 7005 0102* for low fuel consumption settings from the previous October 2006 Part 71 application.

[7] In BP's experience with the combustion of oxidation catalysts, there is a slight increase in the NO_x emission factor. The manufacturer emission factor for NO_x, 1.5 g/hp-hr, has been increased to 1.6 g/hp-hr to account for the oxidation catalyst.

[8] Based on AP-42, Fifth Edition, Volume 1, Chapter 3, Section 3.2, Table 3.2-2 Uncontrolled Emission Factors For 4-Stroke Lean-Burn Engines, 7/00. PM emission factor is the sum of $PM_{filterable}$ and $PM_{condensable}$.

Example Calculations:

CO Emissions (lb/hr) = 1334 hp * 3.00 g/hp-hr * lb/453.6 g * (1 - 0.90) = 0.88
CO Emissions (TPY) = 0.8823 lb/hr * 1334 hr/yr * 1 Ton/2000 lb = 3.8516
SO_2 Emissions (lb/hr) = 1334 hp * 7155 Btu/hp-hr * 0.000588 lb/MMBtu * 1 MMBtu/1,000,000 Btu = 0.0056
SO_2 Emissions (TPY) = 0.0056 lb/hr * 8731 hr/yr * 1 Ton/2000 lb = 0.0245

BP America Production Company
Facility: **Salvador I/II Central Delivery Point**
Description: **666 hp Waukesha F3521GL Compressor Engine**
Emission Unit ID: **Unit 2**

Source Information:

Maximum Rating[1]	738 hp
Site Altitude	6371 feet
Site Rating[2]	**666** hp
Operating Capacity[3]	100 %
Hours of Operation[3]	8715 hr/yr
Fuel Consumption[1]	7253 Btu/hp-hr
Heat Input[4]	4.83 MMBtu/hr
Emissions Controls	None

Maximum Fuel Usage: [4]

Hourly Fuel Usage	6.0 Mscf/hr
Daily Fuel Usage	0.1 MMscf/day
Annual Fuel Usage	52.6 MMscf/yr

Regulated Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Emissions (lb/hr)	Emissions (TPY)
NO_X[1], [5]	1.5	g/hp-hr	2.2024	9.5969
CO[1], [5]	3.0	g/hp-hr	4.4048	19.1938
VOC[1], [5]	1.0	g/hp-hr	1.4683	6.3979
SO_2[6]	5.88E-04	lb/MMBtu	0.0028	0.0124
PM[6]	9.99E-03	lb/MMBtu	0.0482	0.2102
CH_2O[5]	0.29	g/hp-hr	0.4258	1.8554

[1] Based on *Waukesha Bulletin 7002 0710* for F3521GL VHP engine, 130 ^{o}F I.C. Water Temperature, 10.5:1 CR, 1200 rpm, continuous rating.

[2] Based on *Waukesha Power Adjustments*, dated 3/11, page 3, for a Turbocharged and Intercooled VHP GL engine. For continuous power, deduct 2% for each 1000 feet above 1500 feet.
Site Rating = [738 hp x (1 - (0.02/1000 ft x (6370 ft - 1500 ft)))]

[3] Based on full operating capacity and actual hours of operation.

[4] Heat input based on fuel consumption and site-rated HP. Fuel usage rates based on fuel consumption x site-rated hp / 800 Btu/scf conservative heating value.

[5] NO_X, VOC, and CH_2O based on *Waukesha Gas Engine Exhaust Emission Levels,* dated 3/11, pages 3 & 8, VHP Emission Levels GL. For CO, the 3/11 *Waukesha Gas Engine Exhaust Emissions Level* data identifies a 2.65 g/hp-hr factor for CO, while the *Waukesha Bulletin 7005 0710* technical data identifies a 2.70 g/hp-hr factor. In order to remain conservative, calculations use the 3.0 g/hp-hr CO factor from *Waukesha Bulletin 7005 0102* for low fuel consumption settings from the previous October 2006 application.

[6] Based on AP-42, Fifth Edition, Volume 1, Chapter 3, Section 3.2, Table 3.2-2 Uncontrolled Emission Factors For 4-Stroke Lean-Burn Engines, 7/00. PM emission factor is the sum of $PM_{filterable}$ and $PM_{condensable}$.

Example Calculations:

CO Emissions (lb/hr) = 666 hp * 3.00 g/hp-hr * lb/453.6 g = 4.40
CO Emissions (TPY) = 4.40 lb/hr * 8715 hr/yr * 1 Ton/2000 lb = 19.19
SO_2 Emissions (lb/hr) = 666 hp * 7253 Btu/hp-hr * 0.000588 lb/MMBtu * 1 MMBtu/1,000,000 Btu = 0.0124
SO_2 Emissions (TPY) = 0.0028 lb/hr * 8715 hr/yr * 1 Ton/2000 lb = 0.0124

BP America Production Company
Facility: **Salvador I/II Central Delivery Point**
Description: **1334 hp Waukesha L7042GL Compressor Engine**
Emission Unit ID: **Unit 3**

Source Information:

Maximum Rating[1]	1478	hp
Site Altitude	6371	ft
Site Rating[2]	**1334**	hp
Operating Capacity[3]	100	%
Hours of Operation[3]	8694	hr/yr
Fuel Consumption[1]	7155	Btu/hp-hr
Heat Input[4]	9.54	MMBtu/hr
Emissions Controls	None	

Maximum Fuel Usage: [4]

Hourly Fuel Usage	11.9	Mscf/hr
Daily Fuel Usage	0.3	MMscf/day
Annual Fuel Usage	103.7	MMscf/yr

Regulated Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Emissions (lb/hr)	Emissions (TPY)
NO_X[1], [5]	1.5	g/hp-hr	4.4114	19.1763
CO[5]	3.0	g/hp-hr	8.8228	38.3525
VOC[1], [5]	1.0	g/hp-hr	2.9409	12.7842
SO_2[6]	5.88E-04	lb/MMBtu	0.0056	0.0244
PM[6]	9.99E-03	lb/MMBtu	0.0953	0.4144
CH_2O[5]	0.29	g/hp-hr	0.8529	3.7074

[1] Based on historical *Waukesha Bulletin 7005 0102* for L7042GL VHP Series engine, 130 oF I.C., Water Temperature, 10.5:1 CR, 1200 rpm, continuous rating. The current *Waukesha Bulletin 7005 0710* for L7042GL VHP engine, 130 ^{o}F I.C. Water Temperature, 10.5:1 CR, 1200 rpm, continuous rating, indicates the model has a maximum rating of 1480 hp. However, according to a WPI representative on 10/25/11, the updated rating represents a rounded hp number from the previously published 1478 hp and no known internal changes have been made to this engine model. Using 1478 hp and associated 7155 Btu/hp-hr to maintain current limits.

[2] Based on *Waukesha Power Adjustments* , dated 3/11, page 3, for a Turbocharged and Intercooled VHP GL engine. For continuous power, deduct 2% for each 1000 feet above 1500 feet. Site Rating = [1478 hp x (1 - (0.02/1000 ft x (6370 ft - 1500 ft)))]

[3] Based on full operating capacity and actual hours of operation.

[4] Heat input based on fuel consumption and site-rated HP. Fuel usage rates based on fuel consumption x site-rated hp / 800 Btu/scf conservative heating value.

[5] NO_X, VOC, and CH_2O based on *Waukesha Gas Engine Exhaust Emission Levels,* dated 3/11, pages 3 & 8, VHP Emission Levels GL. For CO, the 3/11 *Waukesha Gas Engine Exhaust Emissions Level* data identifies a 2.65 g/hp-hr factor for CO, while the *Waukesha Bulletin 7005 0710* technical data identifies a 2.70 g/hp-hr factor. In order to remain conservative, calculations use the 3.0 g/hp-hr CO factor from *Waukesha Bulletin 7005 0102* for low fuel consumption settings from the previous October 2006 Part 71 application.

[6] Based on AP-42, Fifth Edition, Volume 1, Chapter 3, Section 3.2, Table 3.2-2 Uncontrolled Emission Factors For 4-Stroke Lean-Burn Engines, 7/00. PM emission factor is the sum of $PM_{filterable}$ and $PM_{condensable}$.

Example Calculations:

CO Emissions (lb/hr) = 1334 hp * 3.00 g/hp-hr * lb/453.6 g = 8.82

CO Emissions (TPY) = 8.82 lb/hr * 8694 hr/yr * 1 Ton/2000 lb = 38.35

SO_2 Emissions (lb/hr) = 1334 hp * 7155 Btu/hp-hr * 0.000588 lb/MMBtu * 1 MMBtu/1,000,000 Btu = 0.0244

SO_2 Emissions (TPY) = 0.0056 lb/hr * 8694 hr/yr * 1 Ton/2000 lb = 0.0244

BP America Production Company
Facility: **Salvador I/II Central Delivery Point**
Description: **1467 hp Waukesha L7042GSI Compressor Engine w/ NSCR and AFR**
Emission Unit ID: **Unit 4**

Source Information:

Maximum Rating[1]	1478 hp
Site Altitude	6371 feet
Site Rating[2]	**1467** hp
Operating Capacity[3]	100 %
Hours of Operation[3]	8740 hr/yr
Fuel Consumption[1]	7800 Btu/hp-hr
Heat Input[4]	11.44 MMBtu/hr
Emissions Controls	NSCR w/AFR

Maximum Fuel Usage: [4]

Hourly Fuel Usage	14.3 Mscf/hr
Daily Fuel Usage	0.3 MMscf/day
Annual Fuel Usage	125.0 MMscf/yr

Controlled Regulated Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Emissions (lb/hr)	Emissions (TPY)
NO_X[5]	2.0	g/hp-hr	6.4683	28.2663
CO[5]	2.4	g/hp-hr	7.7619	33.9195
VOC[6]	1.0	g/hp-hr	3.2341	14.1331
SO_2[7]	5.88E-04	lb/MMBtu	0.0067	0.0294
PM[7]	1.94E-02	lb/MMBtu	0.2221	0.9706
CH_2O[6]	0.05	g/hp-hr	0.1617	0.7067

[1] Based on historical *Waukesha Bulletin 7011 0102* for L7042G/GSI VHP Series engine, 130 oF I.C., Water Temperature, 8:1 CR, 1200 rpm, continuous rating. The current *Waukesha Bulletin 7011 1010* for L7042GSI VHP engine, 130 oF I.C. Water Temperature, 8:1 CR, 1200 rpm, continuous rating, indicates the model has a maximum rating of 1480 hp. However, according to a WPI representative on 10/25/11, the updated rating represents a rounded hp number from the previously published 1478 hp and no known internal changes have been made to this engine model. Using 1478 hp and associated 7800 Btu/hp-hr to maintain current limits.

[2] Based on *Waukesha Power Adjustments* , dated 3/11, page 2, for a Turbocharged and Intercooled VHP L7042GSI engine. For continuous power, deduct 2% for each 1000 feet above 6000 feet.

Site Rating = [1478 hp x (1 - (0.02/1000 ft x (altitude ft - 6000 ft)))]

[3] Based on full operating capacity and actual hours of operation.

[4] Heat input based on fuel consumption and site-rated HP. Fuel usage rates based on fuel consumption x site-rated hp / 800 Btu/scf conservative heating value.

[5] Federally enforceable controlled lb/hr emission limits for NO_x and CO.

[6] CH_2O based on *Waukesha Gas Engine Exhaust Emission Levels,* dated 3/11, page 8, VHP Emission Levels GSI, Rich Burn. Conservatively using 1 g/hp-hr for VOC emission factor.

[7] Based on AP-42, Fifth Edition, Volume 1, Chapter 3, Section 3.2, Table 3.2-3 Uncontrolled Emission Factors For 4-Stroke Rich-Burn Engines, 7/00. PM emission factor is the sum of $PM_{filterable}$ and $PM_{condensable}$.

Example Calculations:

CO Emissions (lb/hr) = 1467 hp * 2.40 g/hp-hr * lb/453.6 g = 7.76
CO Emissions (TPY) = 7.76 lb/hr * 8740 hr/yr * 1 Ton/2000 lb = 33.92
SO_2 Emissions (lb/hr) = 1467 hp * 7800 Btu/hp-hr * 0.000588 lb/MMBtu * 1 MMBtu/1,000,000 Btu = 0.0067
SO_2 Emissions (TPY) = 0.0067 lb/hr * 8740 hr/yr * 1 Ton/2000 lb = 0.0294

4
AIR QUALITY REVIEW

As requested in Form NEW of the application, an Air Quality Review for the proposed project is provided below. Based on this review, BP concludes that the proposed project will not cause or contribute to a National Ambient Air Quality Standard (NAAQS) or Prevention of Significant Deterioration (PSD) increment violation, and therefore, an air quality impacts analysis is not required.

The Salvador I/II CDP, and thus the proposed project, are located within the boundaries of the Southern Ute Indian Reservation (Reservation) in La Plata County, Colorado. The area is currently considered in attainment for the NAAQS pollutants. BP reviewed 2012 – 2014 data from EPA's Air Quality Statistics Reports for La Plata County.[i] These reports confirmed that the air quality in La Plata County has not exceeded the NAAQS standards for criteria pollutants (CO, Nitrogen Dioxide (NO_2), Ozone (O_3), and Particulate Matter ($PM_{2.5}$ and PM_{10})) in the last three years. A summary of this data is provided in the table below:

NAAAQS Pollutant & Standard Criteria	2012	2013	2014	NAAQS Standard	NAAQS Exceeded?
CO – 2nd Max, 1-hr (ppm)	0.8	1.7	1.3	35	No
CO – 2nd Max, 8-hr (ppm)	0.6	1	1	9	No
NO_2 – 98th Percentile, 1-hr (ppb)	29	35	24	100	No
O_3 – 4th Max, 8-hr (ppm)	0.069	0.072	0.067	0.075	No
$PM_{2.5}$ – 98th Percentile, 24-hr ($\mu g/m^3$)	10	29	6	35	No
$PM_{2.5}$ – Weighted Mean, 24-hr ($\mu g/m^3$)	4.3	4.5	3.4	12 (primary); 15 (secondary);	No
PM_{10} – 2nd Max, 24-hr ($\mu g/m^3$)	59	38	34	150	No

The project falls within the scope of the broader oil and gas development on the Reservation, which is detailed in the *Programmatic Environmental Assessment for 80 Acre Infill Oil and Gas Development on the Southern Ute Indian Reservation, Volume 1.* Sections 3.2.2 and 3.2.4 of this assessment provides a description of the topography and meteorology for the Reservation. The Salvador CDP is located at an elevation of 6,371 feet. The area immediately surrounding the site is relatively flat with gently sloping terrain. The annual average precipitation for 2010 – 2014 was 12.58 inches, with the highest annual precipitation

of 15.18 inches occurring in 2013. The average highest temperature during this timeframe was 94 degrees Fahrenheit, while the average lowest temperature was -10.6 degrees Fahrenheit. The highest temperatures were measured during the months of June, July, and August, while the lowest temperatures were measured in January and December.[ii]

Since engineering design is not fully underway for the proposed project, the catalyst manufacturers and models have not been selected yet. The compressor skids were designed by third parties. The Unit 2 and Unit 5 stack heights are estimated to be approximately twenty feet and twenty-three feet above the ground, respectively. Unit 5 is proposed to be installed near the southeast corner of the site near Unit 2 and near the fence line of the property.

The site is an existing synthetic minor PSD source. The proposed project does not constitute a major modification, nor does the project constitute a major new source, as defined under PSD, since the potential to emit of each regulated new source review pollutant that is not a greenhouse gas is less than 250 tons per year and the change in emissions are below the significant emissions rate for PSD pollutants in 40 CFR 52.21(b)(23)(i). The changes in potential site emissions attributable to the proposed project are provided in Section 3 of the application.

[i] 2012–2014 data accessed from EPA's AirData Air Quality Statistics Report website, http://www.epa.gov/airdata/ad_rep_con.html, for La Plata County. Sulfur dioxide is not monitored in La Plata County.

[ii] 2010–2014 data accessed from the National Centers for Environmental Information, National Oceanic and Atmospheric Administration, Climate Data Online website, http://www.ncdc.noaa.gov/cdo-web/, for the Ignacio 8E station (Latitude: 37.086° N, Longitude: 107.533° W).