Response to EPA Information Request
OCI Beaumont LLC
Greenhouse Gas PSD Application

On behalf of OCI Beaumont LLC (OCI), this document is submitted to respond to the GHG PSD permit application completeness determination dated July 25, 2013. OCI is responding to these questions in the same order. For ease of review, the EPA questions are duplicated here with the OCI response following each question.

1. On page 1-1 of the permit application, it is stated that the Methanol Plant's capacity will be increased by the addition of a Pre-Reformer, Pre-Reformer Fired Heater, Saturator Column and a new flare to control MSS emissions from the reformer vent during emission events, startups, and shutdowns. It is also stated in the BACT analysis that OCI Beaumont (OCI) proposes a reformer tube replacement. The "OCI Process Energy Efficiency Improvement Study", located in the Appendix of the application, states that the existing reformer tubes will be replaced with larger diameter and thinner walled thickness tubes. It is important that all new, modified and affected (existing non-modified emission points where emissions will increase) units and emission points are properly identified on the process flow diagram. Will there be piping modifications to accommodate the increased methanol and/or ammonia production? If so, please identify on the process flow diagram.

OCI – There will be piping modifications due to addition of the new equipment. These component changes are addressed in the TCEQ permit application for this project. Attachment A to this response is a revised block flow diagram (BFD). The overall BFD is highlighted to indicate modified and new emission points. Detailed plant flow diagrams (PFDs) are included for the new and modified equipment to show more detail. Please note the detailed PFDs are considered confidential.

2. In addition to the previous comment, please supplement the OCI process flow diagram with the following information. It is suggested that OCI consider enhancing or revising the process flow diagram to distinguish the new, modified, and affected units or emission points.

OCI – Please see our response to No. 1. Attachment A contains the revised BFD and PFDs.

A. On page 1-1 of the permit application, it is stated that this project allows the recovery and recycling of two former waste water streams (Stripper Tails and Dehydrator Tails) and one atmospheric vent (CO2 Stripper Vent) through the Saturator Column for recovery of organics for organic feedstock. The process flow diagram does not include a representation of the Stripper or the Dehydrator. Please supplement the process flow diagram with these two pieces of equipment and also show the streams (Stripper Tails and Dehydrator Tails) directed to the new Saturator Column. Will there be piping modifications/additions associated with these changes?
Will there be a change in the fugitive leak emissions? If so, please provide supplemental emission calculations that accounts for these increases. Where will these streams be directed when the Saturator Column is shut-down for maintenance? Please indicate this alternate route on the process flow diagram.

OCI – The tails from the stripper and dehydrator columns are represented on the overall BFD by the block labeled “Refining/Dehy”. The individual streams are shown on PFD SK-06 in Attachment A.

The piping equipment component counts (fugitives) are represented in the TCEQ permit application. OCI will be submitting an updated fugitive count in the revised permit application document to EPA. The saturator will shut down when the plant shuts down. There is no provision for the streams to go anyplace else. The plant cannot operate without the saturator. The alternate routes depicted on the BFD are for start-up scenarios only.

B. Currently the process flow diagram does not show the CO2 Stripper Vent directed to the Saturator Column. The process flow diagram indicates the CO2 Stripper Vent stream directed to the atmosphere. Please supplement the process flow diagram showing this vent stream directed to the Saturator Column. Will this vent stream be directed to the atmosphere when the Saturator Column is shut-down? Please revise the process flow diagram to show all the options where this stream can be directed. What is the compliance strategy for this stream during the times when the Saturator Column is shutdown? Will there be piping modifications/additions associated with these changes? Will there be a change in the fugitive leak emissions? If so, please provide supplemental emission calculations that account for these increases.

OCI – The CO2 stripper vent will not be routed directly to the saturator. As part of the Methanol and Ammonia plant debottlenecking project; the process condensate that would have gone to the CO2 stripper will now be directed to the Saturator through the connected process condensate line. With all the process condensate flowing to the Saturator there will be no routine emissions from the CO2 stripper. The old CO2 stripper vent will be used for MSS (maintenance, startup and shutdown) in the future. BFD and PFDs are included in Attachment A that clarify the new and old routes of the process condensate. Any related fugitive component count changes are addressed in the TCEQ permit application. OCI will be submitting an updated fugitive count in the revised permit application document to EPA.

C. On page 1-1 of the permit application, it is stated that this project proposes to direct two atmospheric vent streams (DME Eductor and the Stripper Tails Tank Vent) to the Methanol Unit Plant Flare for destruction. Will these vent streams be directed to Methanol Unit Flare, EPN: 45? Please supplement the process flow diagram showing this equipment and the vent streams from the equipment going to the Methanol Unit Flare.

OCI – Please see the updated flow diagrams in Attachment A. The DME MSS vent will not be able to go to the flare due to inadequate pressure. The vent will remain as is currently permitted. The stripper tails tank condenser vent is routed to EPN FL42 flare instead of flare EPN 45.

D. On page 3-1 of the permit application, it states that the heat generated in the reformers is used to preheat the natural gas, preheat the process steam, and produce steam for use in the plant. This heat recovery is not shown on the process flow diagram. Please supplement the process flow diagram to show the heat recovery described. Is the natural gas that is preheated in the reformer the "natural gas feedstock" indicated by Stream 1 on the process flow diagram; or the "natural gas fuel", indicated by Stream 2 on the process flow diagram?

OCI – The natural gas that is preheated in the Reformer is "natural gas feedstock". The overall BFD shows the entire waste heat recovery section of the pre-reformer and the reformers as simple block with SCR. However, the attached PFD (SK-2) shows all heat recovery coils/exchangers with associated tie-in streams for clarification. The PFDs are found in Attachment A

E. The process flow diagram does not show natural gas/fuel gas and/or combustion air directed to the Pre-Reformer Fired Heater that is used to heat the gases before the gases are fed to the Pre-Reformer. Please supplement the process flow diagram. Also, please ensure this addition is done for all combustion units.

OCI – The updated BFD shows fuel and air to the Pre-reformer and the Reformers. Air is pulled to the burners from atmosphere because the furnace maintains slight negative pressure by induced draft fan at the flue gas outlet. The reformer has a combustion air preheat (by steam in heat exchanger) system as shown on Sketch-A. See Attachment B.

F. On page 3-2 of the permit application, it states the mixture leaving the reactors is cooled to separate the condensable liquid from the non-condensable gases using a water cooled heat exchanger. The water cooled heat exchanger does not appear to be shown on the process flow diagram. Please revise the process flow diagram to include this heat exchanger.

OCI – The BFD does not show it but PFD (SK-05), included in Attachment A, shows a water-cooled condenser, as the final cooler for each reactor train.

G. On page 3-2 of the permit application, it states that a packed tower wet scrubber (Crude Tank Scrubber) is used to recover methanol vapors from the Crude Storage Tank off-gas. In addition, on page 3-3 of the permit application, it is stated that the Methanol Product Storage Tanks vent to a water scrubber system (Shore Tank Scrubber). The Shore Tank Scrubber also controls the venting from the Shore Tank. The liquid effluent from the Shore Tank Scrubber can be sent either to the Crude Tank Scrubber as a supplemental scrubber water supply or directly to the Crude Tank for recovery of the methanol. The process diagram indicates the liquid effluent from the Shore Tank Scrubber as the sole water supply, rather than supplemental water, to the Crude Tank Scrubber. Is this depiction correct? Is there another water supply to the Crude Tank Scrubber? Please supplement the process flow diagram by labeling which water scrubber is the Crude Tank Scrubber and which water scrubber is the Shore Tank Scrubber. The current process flow diagram shows the liquid effluent from the Shore Tank Scrubber being sent to either the Crude Tank Scrubber or to Refining, not to the Crude Tank. The process flow diagram does not show this liquid going to the Crude Tank, as is stated in the process description. Please resolve the inconsistency.

OCI – Please see the updated BFD in Attachment A. The crude tank scrubber can also be supplied with supplemental water (Demin) other than that from the shore tank scrubber.

H. On page 4-7 of the permit application, it is stated that the Pre-Reformer Fired Heater is utilized to preheat the feed to the Pre-Reformer and to preheat the Pre-Reformer effluent prior to introduction in the North and South Reformers. Please supplement the process flow diagram to reflect the heat recovery step utilized to preheat the Pre-Reformer effluent prior to introduction in the North and South Reformers ENG

OCI – Please see the flow diagrams in Attachment A.

3. Please confirm the basis of PSD applicability for the project. Please indicate if OCI is an existing major stationary source for a regulated NSR pollutant that is not GHGs. Would PSD review for non-GHGs (VOC, CO, PM, PM2.5) be required anyway (40CFR 52.2l(b)(49)(iv))? Or is this project and/or existing source major for GHGs only (40 CFR 52.21(b)(49)(v))?

OCI – OCI is an existing major stationary source for non GHG, regulated pollutants. The site is major for NOx, VOC, and CO. The debottlenecking project is a major modification for VOC, PM2.5 and CO. These modifications are addressed in the TCEQ permit application.

4. Please confirm the total CO2e annual emissions for the project. The CO2e emissions located in Table l (a) entitled "Emission Point Summary" appear to add up to 1,470,737 tons per year; however, the total annual CO2e emissions on page 4 of 9 of the Form PI-l are given as 1,470,750.6 tons per year.

OCI – The emissions referenced above were from the December 2012 Application. As part of a Permit Application revision in May 2013, a typographical error was discovered which changed these values. OCI will be compiling these changes and submitting an updated permit application document to you.

5. On page 3-1 of the permit application, it states that methanol production can be increased by the addition of CO2. In addition, on page 3-2 of the permit application, it is stated that the process gas leaving the Reformers is cooled and then combined with by-product CO2 from the Crude Methanol Tank and other potential CO2 sources such as pipeline delivery from offsite. Does the pipeline for CO2 from outside sources already exist? Is this a current practice for the existing Methanol production? How often is it anticipated that CO2 will be received from outside sources once the project is completed?

OCI – Supplemental CO2 was used by the previous owners of the plant to produce methanol. OCI is not currently using supplemental CO2. OCI is actively looking for a source of supplemental CO2 for the plant. When a source of supplemental CO2 is found it will be used all of the time it is available. Supplemental CO2 improves the energy efficiencies of the overall process.

6. Will there be an increase in fugitive leak emissions due to the increased production of methanol and ammonia? If so, please provide supplemental data that includes the emission increases and the calculations performed to obtain these increases. Will there be any modifications and/or additions to accommodate the increased methanol and ammonia production in the process or loading facilities? If so, please provide supplemental data to the 5-step BACT analysis for fugitive leak emissions that

includes a comprehensive evaluation of the technologies considered to reduce fugitive leak emissions and a basis for elimination, or information detailing why fugitive emissions will not be emitted from this project. Also, please identify the areas/piping on the process flow diagram where throughput will be new, modified, or affected.

OCI – This information is included in the TCEQ permit application. OCI will be submitting an updated fugitive count in the revised permit application document to EPA.

7. On page 3-3 of the permit application, it is stated that to control the buildup of excess H2 and undesirable gases (CH4 and N2) in the synthesis loop, a portion of the un-reacted high-pressure gas is continually purged from the system. When the Ammonia Plant is not operating, the purge gas is routed to the reformer fuel gas system and burned as supplementary fuel gas. When the Ammonia Plant is in operation this stream goes to the pressure swing absorber (PSA) to separate the hydrogen from the CH4, CO, CO2, and residual methanol. The pure H2 is for ammonia synthesis and the remaining purge stream (H2, CO, CO2 and CH4) is sent to the reformers as supplementary fuel gas. How does the operation of the Ammonia Plant affect the operation of the Methanol Reformers? Does the difference in fuel gas concentration affect the GHG production in the reformers? Also, on page 3-4 of the permit application, it is stated that H2 can be imported via pipeline from local suppliers and joins with a N2 stream supplied by local suppliers via pipeline after the PSA unit. The process flow diagram does indicate the N2 pipeline, however it does not reflect the hydrogen tie-in. Please revise the process flow diagram to show the hydrogen connection.

OCI -- The methanol plant reformer feed remains the same and independent from the operation of the ammonia plant. However, the fuel system of the reformer is configured to process three types of fuels available in the plant: natural gas, PSA tail gas, and methanol purge gas. Therefore operation of the ammonia plant has an effect on the composition of the reformer fuel gas. When there are changes of tail gas or purge gas flow due to PSA or ammonia plant operation, the natural gas component of the combined fuel system will be automatically adjusted to keep the fuel heating value within a pre-determined range. The changes in fuel gas composition and their effect on GHG production, are noted in the four different cases shown in the permit application with the emissions for each fuel gas case. The overall BFD has been updated to show the hydrogen pipeline tie-in. Please see Attachment A.

8. On page 3-3 of the permit application, it is stated that water is used as the cooling medium in several shell and tube heat exchangers throughout the plant. A seven-cell, induced draft Marley cooling tower removes that heat in the return water. Also, it is stated that methanol is not found in the process water unless equipment failure has occurred. Is there a potential for CH4 to be present in the cooling tower during an equipment failure? Because the project will increase methanol production, will there be an increase in the potential GHG emissions due to an equipment failure that could be emitted from the cooling towers? Is there a leak detection program in place for monitoring the cooling tower? Please provide any emission calculations for the increases in the potential GHG emissions from the cooling tower due to equipment failure.

OCI – There is a potential for CH4 to be present in the cooling tower water if an equipment failure occurs, however this project does not increase the emission potential of GHGs from the cooling tower due to potential equipment failures. OCI monitors the cooling towers under the SOCMI HON rules for cooling towers. OCI proposes to monitor for CH4 in the cooling water by using the existing SOCMI HON program and adding an additional test for total organic carbon (TOC) as a surrogate for CH4 if requested to do so by EPA. The equipment of concern currently exists.

9. On page 3-5 of the permit application, it is stated that non-ammonia process safety valves and start-up/shutdown vents are routed to the existing Methanol Plant Flare (EPN: 45). Also, on page 1-1 it is stated that OCI proposes to add a new flare to control MSS emissions from the reformers during emission events, startups, and shutdowns (Reformer MSS Flare, EPN: FL42). It is not clear which flare will be used for MSS emissions (emission events, startups and shutdowns). Please clarify which streams from this project and from which production plant will be directed to the flares. Please ensure that the analysis provided for vent stream to each flare reflects operation after the project. Also, this analysis should include carbon content and heat valve for the vent streams to each flare. If both flares are used in conjunction with each other, it is suggested that OCI provides a separate process flow diagram for the flares to show the vent streams directed to the flares and to explain the control scheme used for the vent streams directed to the flares. Please provide supplemental information explaining the operational scenario for the flares. What specific operating parameters will be monitored to ensure VOC destruction? What will ensure the optimum amount of natural gas to be utilized for destruction? Will there be continuous monitoring?

Also, on page 3-2 of the permit application, it states that the synthesis of methanol occurs in two vessels, called methanol reactors, in the presence of a catalyst. Does the operation of the methanol plant involve the reactivation of this catalyst? Does the reactivation of the catalyst create GHG emissions in an existing unit? Because the project involves an increase in methanol production, will the GHG emissions created by catalyst reactivation be affected (increased or decreased)? Is this vent stream directed to the Methanol Plant Flare or the Reformer MSS Flare?

OCI – Please refer to the table in Attachment C for additional information about the flares. The flares are independent sources with specific streams routed to each flare. All flares can be used for MSS purposes. Specific details about the waste gas compositions and carbon content of the streams is found in the emission calculations in the permit application and the table in Attachment C. The flares will comply with TCEQ imposed (through permit) §60.18 requirements for Btu value and tip velocity. OCI meets the heat content limits of §60.18 by assuring each individual stream has a net heat value greater than 200 Btu/scf. Please refer to Attachment C. The flares are continuously monitored with flow monitors and heat sensing thermocouples to ensure continuous operation as required by the respective NSPS and MACT rules (specifically §60.18 and §63.11) as applicable. In addition, OCI will utilize natural gas instead of nitrogen for sweep gas to ensure the vent stream is maintained with >200 Btu/scf.

Methanol reactor catalyst is not re-activated on site. There are no GHG emissions from catalyst reactivation from the site.

10. On page 4-1 of the permit application, it states that the North and South Steam Reformers are the primary reformers for the Methanol Plant. The steam reformers have the ability to operate in four different operating cases that are as follows:
    - Case A: Methanol Plant stand-alone operation (without CO2 addition)
    - Case B: Methanol Plant stand-alone operation (with CO2 addition)
    - Case C: Methanol and Ammonia Plant production (without CO2 addition)
    - Case D: Methanol and Ammonia Plant production (with CO2 addition)

    In order to determine the worst-case GHG emissions for the reformers operation, the emissions were calculated for each operating case and compared. The results of this analysis indicate Case D to be the worst-case for GHG emissions; therefore, OCI proposes to use Case D to establish the potential to emit allowable emissions for the reformers. It is not clear how the North and South Reformers are operated. Are the North and South Reformers operated in parallel, series or one at a time with the other serving as a spare? Do both Reformers vent through the same stack? Since your application indicates several operating cases for the North and South Reformers, please propose a BACT limit for each operating case. EPA typically will issue an output-based BACT emission limit (e.g., lb or ton CO2/ton methanol or Heat Required MMBtu) or a combination of an output- and input-based limit, where feasible and appropriate. For the individual reformers for this project, in addition to the proposed tons per year emission limit, please propose an output-based, combination of an output- and input-based limit or efficiency- based limit for the North and South Steam Reformers in each operating scenario. Please provide an analysis that substantiates any reasons for infeasibility of a numerical emission limitation or an efficiency based limit for individual emission units. For the emission sources where numerical emission limitations are infeasible, please propose an operating work practice standard that can be practically enforceable. For the emission sources where numerical emission limitations are infeasible, please propose an operating work practice standard that can be practically enforceable. For the emission sources where numerical emission limitations are infeasible, please propose an operating work practice standard that can be practically enforceable. For the emission sources where numerical emission limitations are infeasible, please propose an operating work practice standard that can be practically enforceable.

OCI – The OCI reformers are operated in parallel and simultaneous. Our plan is to utilize a single SCR and vent the reformer and pre-reformer heater combustion emissions through the common SCR and out a common stack. Please refer to Attachment D for the proposed BACT limits for each operating case.

11. On page 4-7 of the permit application, it is stated that Pre-Reformer Fired Heater will operate with different heat input from natural gas depending on the specific case that the steam reformers are operating. The four different operating cases of the steam reformers are summarized in Comment #9. In order to determine the worst-case GHG emissions for the heater's operation, the emissions were calculated for each operating case and compared. The results of this analysis indicate Case C to be the worst-case for GHG emissions; therefore, OCI proposes to use Case C to establish the potential to emit allowable emissions for the heater.

Please refer to Comment #9 and provide the same information that is requested for the North and South Reformers, for the Pre-Reformer Fired Heater.

OCI – The OCI reformers are operated in parallel and simultaneous. Our plan is to utilize a single SCR and vent the reformer and pre-reformer heater combustion emissions through the common SCR and out a common stack. Please refer to Attachment D for the proposed BACT limits for each operating case.

12. The case analysis submitted for the Pre-Reformer Fired Heater for Cases A and C appear to have identical chemical constituent profiles and fuel flow rates, however different GHG emission rates were calculated and presented for Cases A and Con page 4-9. Please explain the difference.

OCI – The fuel firing rates are slightly different for the two cases resulting in slightly different emission rates.

13. On page 4-1 of the permit application, it states that OCI proposes to use Case D to establish the potential to emit allowable emissions for the North and South Reformers. The design specification information presented in Table 6 entitled "Boilers and Heaters" for the North and South Reformers are not consistent with the case analysis submitted for Case D. The chemical constituent profile and fuel flow rates presented in Table 6 does not appear to match the chemical constituent profile and fuel flow rates submitted in the case analysis for Case D. Please explain.

OCI – The Table 6 provided in the application represents typical values. An updated Table 6 for Case D will be provided in the updated permit application.

14. On page 4-10 of the permit application, it states that as a part of this debottlenecking project, the DME Eductor's maintenance emissions are being routed to the Methanol Plant Flare rather than to the atmosphere. The project will also change the status of the Stripper Tails Tank to a process vessel and the vent will be routed to the flare. Will there be modifications made to the Stripper Tails Tank as a result of this change in status? If so, please provide supplemental information that details these modifications. Will there be piping modifications/additions to route the maintenance emissions from the DME Eductor and the Stripper Tails Tank to the flare? If so, will this create an increase in fugitive leak emissions? Please revise process flow diagram to reflect any changes. Also, on page 1-1 of the permit application, it is stated that this project will allow the recovery and recycle of two former waste water streams (Stripper Tails and Dehydrator Tails) and one atmospheric vent (CO_2 Stripper Vent) through the new Saturator Column for recovery of organics for feedstock and two atmospheric vent streams (DME Eductor and the Stripper Tails Tank Vent) that will be routed to the Methanol Unit Plant Flare for destruction. Please clarify if routing the DME Eductor emissions to the flare will be normal operations, as it reads on page 1-1, or only during MSS, as it reads on page 4-10. If the emissions from the DME Eductor are routed to the flare during normal operations, as well as during MSS, please revise the emission calculations and data provided for this vent stream on page 4-10?

OCI – The DME MSS vent will not be able to go to the flare due to inadequate pressure. The vent will remain as is currently permitted. There will be piping changes made to the Stripper Tails tank vent piping. These fugitive component changes are incorporated in the fugitive emissions found in the TCEQ permit application. The BFD and PFDs (Attachment A) have been updated to reflect this. We will be submitting an updated fugitive count in the revised permit application document to EPA. We are also changing the routing of the Stripper Tails tank vent from flare EPN 45 to flare EPN FL42. We are providing an updated permit application that includes these changes. The DME eductor will vent to fuel gas during normal operations and vent to atmosphere during MSS, as currently permitted.

15. On page 9 of 9 of the permit application on Table 2F entitled "Project Emission Increase" for GHG emissions; it appears as though Table 2F for GHG does not contain a complete list of emissions addressed in this application. Please ensure the table contains all emissions that are new, modified and affected. On page 4-1 of the application, OCI provided the following list of emission sources that are addressed in this application:

- North and South Reforming Furnaces (EPN: STK41)
- Pre-Reformer Fired Heater (EPN: PRFMHTR)
- Reformer MSS Flare (EPN: FL 42)
- Methanol Plant Flare (EPN: 45)
- Marine Vapor Control System Flare (EPN: 326)
- CO2 Stripper Vent (EPN: MET-STK44)
- Ammonia Plant Flare (EPN: FL321)

Please ensure that the emission sources identified in the list above are included in Table 2F for CO2e emissions and properly identified as new, modified or affect. In addition to the above list of emission sources, will there be an increase and/or decrease of GHG emissions due to the increase in methanol and ammonia production from the following emission sources?

- Ammonia Startup Heater (EPN: HTR 324)
- Methanol Process Fugitives (EPN: MET-FUG247)
- Methanol Cooling Tower (EPN: MET-CLT 246)
- Main Loading Dock Fugitives (EPN: 327)
- Scrubber Vent (EPN: 35)
- Scrubber Vent (EPN: 328)
- Refined Methanol Storage (EPN: MET-TFL50)
- Ammonia Tank Flare (EPN: TKFLARE)
- Oil/Water Separator (EPN: OWS325 Fugitive)

Please supplement Table 2F to include any of the above mentioned emission sources and Properly identify them as new, modified or affected. Typically CO2 emissions are associated with combustion pollutants and CH4 is associated with VOC pollutants, therefore if OCI feels that such emission sources do not have the potential to experience a change in the amount of GHG pollutants emitted as a result of this project, please provide an explanation. If any of the above emission sources do experience a change (i.e., new, modified or affected) in emissions because the project, please provide emission calculations including the baseline emissions calculations for these emission sources used to calculate the GHG emission increases and decreases attributed to the project.

OCI – OCI is updating the netting as requested for the sources impacted by the debottlenecking project. Please note the following sources are either not a source of GHG emissions or are not impacted by the project.

- Ammonia Startup Heater (EPN: HTR 324) – Not modified
- Methanol Process Fugitives (EPN: MET-FUG247) – Not modified
- Methanol Cooling Tower (EPN: MET-CLT 246) – Not modified
- Main Loading Dock Fugitives (EPN: 327) – Not modified
- Scrubber Vent (EPN: 35) – Not a source of GHGs
- Scrubber Vent (EPN: 328) – Not modified
- Refined Methanol Storage (EPN: MET-TFL50) – Not a source of GHGs
- Ammonia Tank Flare (EPN: TKFLARE) – Not modified
- Oil/Water Separator (EPN: OWS325 Fugitive) – Not a source of GHGs,

16. In Appendix B entitled "BACT Analysis" of the permit application, the 5-step BACT analysis is presented. Please address the following questions:

Reformer MSS Flare (New)

A. On page 6-1 of the permit application, it is stated that the top down BACT analysis has been performed for the Steam Reformers and Pre-Reformer Fired Heater. On page 1-1 of the permit application it is stated that this project includes the installation of a new flare to control MSS emissions from the reformer vent during emission events, startups, and shutdowns. Please supplement the 5-step BACT analysis with an evaluation of the proposed flare to be installed. Please include all technologies considered and the basis for elimination. Please include benchmark data that compares the proposed flare to similar and existing sources. If there are other new or modified emissions sources (equipment and piping), please supplement 5-step BACT analysis.

OCI – This flare is being installed to control emissions from several process PSV's that were routed to the atmosphere.

A 5-step BACT analysis with an evaluation of the proposed flare to be installed is included as Attachment E.

Pre-Reformer (New)

B. It is not clear why a 5-step BACT analysis was not included for the Pre-Reformer. Please provide supplemental information on this emission or provide an analysis, as necessary.

OCI – The pre-reformer is not an emission source. OCI has included a BACT analysis for the pre-reformer heater since it is the emission source.

Steam Methane Reformers (Modified)

C. On page D of the BACT analysis, it is stated that heat energy resulting from the combustion of fuel in the reformers is used as a heat source within the process and for various utility duties. This use of heat energy reduces the energy consumed by the overall process by utilizing the waste heat. The direct result of reducing the need for additional heaters/boilers reduces the use of fossil fuels and thus lowers emissions of GHGs. What is the proposed monitoring, recordkeeping, and compliance strategy to ensure maximum heat recovery from reformers to the process and utility fluids used internally in the unit? Also, the BACT analysis states that the current configuration utilizes heat recovery to greatly reduce the need for additional heaters/boilers for steam production, feedstock preheating, boiler water preheating, and other process heat needs. Please provide supplemental data that support this assertion. Please provide a comprehensive list of areas in the plant where heat recovery from the reformers is to be utilized for steam production, feedstock preheating and other process needs which reduces the need for an additional heater/boiler. If possible, please provide supporting data that compares the amount of fossil fuel usage or the amount of heater/boilers utilized in the other methanol production facilities that do not employ the same reformer design technology as OCI and provide the percent reduction.

OCI – The plant utilizes a Digital Control System (DCS) where data is viewed and recorded for live conditions and historical purposes. The DCS system is set up with alarm values that indicate when the process is out of normal. The operators will make a change or changes to bring the process back into the normal value. Periodic checking is done with Engineering to check the system for optimization and provide feedback to the operators for any adjustments. As explained in OCI's reply to Item 16.F, a key performance indicator (KPI) of energy efficiency (MMBtu/MT) is used by operations personnel. A higher KPI would indicate a less efficient operation and the Operator would be able to investigate and take corrective action e.g. a very high value for excess oxygen would lower the over efficiency of operation.

The Reformers have a large heat duty to convert Natural gas and steam to Reformed gas. This process has a low efficiency and in order to recover this efficiency the utilization of the waste heat is used. For the Foster Wheeler furnace design heat is utilized in 2 streams the Flue gas and the process gas. If no heat recovery was used then a separate fired boiler would be needed for steam generation and a separate heater for process heating requirements.

The combined heater efficiency is calculated to be 92.11% on the basis of total heat absorbed over total fuel fired. This is considered as good as any state-of-the-art natural gas fired heaters and boilers, efficiency of which can range from 90%-93%, based on scopes of individual heat recovery scopes. The supplemental data is included as Attachment F.

The following is a comprehensive list of areas in the plant where heat recovery from the reformers is to be utilized for steam production, feedstock preheating and other process needs which reduces the need for an additional heater/boiler

FIRED HEATERS OF REFORMER SYSTEM

Equipment	Fuel Burned
Reformer Burners	Natural Gas + Offgases

Pre-Reformer Heater	Natural Gas
SCR Duct Burners	Natural Gas

HEAT ABSORBED/RECOVERED AT FLUE GAS SYSTEM

Equipment	Process Stream
Reformer Tubes	Process Feed (Syngas + Steam)
Steam Generation Coils	Boiler Feed Water + Steam
Steam Superheater Coils	HP Steam
BFW Preheat Coils	BFW
Pre-reformer Feed Coils	Natural Gas + Steam
NG Feed Coils	NG Feed + Pre-Reformed Gas + Steam
Saturator Water Heater Coils	Saturator Water

HEAT RECOVERED AT HOT PROCESS GAS COOLING SYSTEM

Equipment	Process Flow
Reformer WHBs (HP Steam)	Boiler Feed Water/Steam
NG/Reformed Gas Interchanger	NG/Reformed Gas
Mixed Feed/Reformed Gas Interchanger	Mixed Feed (syngas+steam)/syngas
Saturator Water Preheater	Saturator Water
25# Steam Boiler	Boiler Feed Water
Fuel Gas Preheater	Natural Gas + Offgases
BFW Heater	Boiler Feed Water
Process Condensate Heater	Process Condensate

Generally, modern methanol plants have a net overall efficiency in a broad range between 30 and 38 MMBTU/Ton of Methanol based on selected technology. According to the table submitted in Celanese GHG permit application submitted in August 2012, a modern state-of-the-art SMR (steam Methane Reforming) based methanol plant has an efficiency between 34 and 35 MMBTU/ton of methanol.

Reformer Design Process	Heat Required (MMBtu) per Methanol produced (tonne)
Design A: SMR Original Technology	36 – 38
Design B: SMR Current Technology	34 – 35
Design C: ATR	32 – 33
Design D: Combined Reforming	30 – 32

Calculated efficiency for the OCI Methanol plant is 34.1 MMBtu/ton for Case-A (Table below). For Cases-B & D, where CO2 can be added to increase capacity, this efficiency will improve and is estimated to be in the range of 32-33 MMBTU/ton

Comparison of Methanol Plant Energy Efficiencies between Original Design, Current Operating, and Upgraded Capacity (future) Conditions

Description	Improved Capacity Case (3000 MTPD)	Comments
Natural Gas to Feed (lb/hr)	161,981.4	From HMB Doc # OCI-PRC-HMB-0001, current operating material Balance
Natural Gas to fuel (lb/hr)	65,038.4	From HMB Doc # OCI-PRC-HMB-0001, current operating material Balance
Total NG Consumed (lb/hr)	227,019.8	Feed + Makeup Fuel
LHV Natural Gas (Btu/lb)	20,700.5	NG compositions per original PFD/current plant data/upgraded plant design basis
Total Energy Consumed (MMBtu/hr)	4,699.4	
Hydrogen Export to NH3 Plant (lb/hr)	11,529.3	From current plant data and HMB Doc # OCI-PRC-HMB-0001, current operating material Balance
LHV H2 (Btu/lb)	51,542.0	
H2 Heating Value (MMBtu/hr)	594.2	
Methanol Produced (lb/hr)	267,285.9	Per original PFD/current plant data/new HMB
Methanol Produced MT/hr	120.3	1 MT = 100 kg = 2204 lb
Gross Efficiency (MMBtu/MT of MeOH)	39.1	Gross Efficiency = Total NG (feed+fuel) LHV/Total MeOH product
Net Efficiency (MMBtu/MT of MeOH)	34.1	Net Efficiency = (Total NG LHV - H2 LHV to NH3 Plant)/Total MeOH product

D. On page E of BACT analysis, it states that OCI proposes to replace the existing reformer tubes with tubes that are larger in diameter and that have a smaller wall thickness. These tubes would contain more catalyst than the existing tubes, resulting in increased production efficiency. Please provide the supporting data and calculation that details the design decision to increase the reformer tube size. On page E of BACT analysis, it states that OCI proposes to replace the existing reformer tubes Please provide the supporting production efficiency calculations. If possible, please provide benchmark data that compares the reformers to an existing and/or similar source.

OCI – Attachment G contains the supporting data and calculation that details the design decision to increase the reformer tube size.

E. Please provide details on the operating parameters OCI is proposing to monitor and control to ensure maximum heat recovery for the reformers (i.e., flue gas stack temperature, feedstock/steam ratios, steam pressures and temperatures). What is OCIs proposed monitoring approach?

OCI – OCI will monitor the above streams in 16 part "C" plus in addition OCI will monitor the following to ensure optimization of heat recovery from the reformers.

Flue gas stack temperature	150°C-210°C, with 190°C Nominal
Oxygen values in the Flue gas stream	To be set after Stack testing
Fuel gas firing rates to the Reformer	In accordance with MMBtu/MT

CEMS (NOx, O2, CO & NH3)	***EPA application limits***
NOx	0.01lb/mmbtu,
O2	to be set with stack testing, nominal should be 2 - 4%
CO	100 ppm hourly and 50 ppm average
NH3	<10ppm

Continuous data is feed to the DCS from instrumentation installed in the process. The flue gas is monitored with a continuous analysis of this steam that allows for any operation corrections for Nox, CO and NH3.

F. What operating parameters will OCI monitor and control to minimize the amount of natural gas fed (fossil fuel) to the reformer for a given methanol capacity.

OCI – The calorific value (MMBtu) of the natural gas fuel is calculated from the plant's on-line mass spectrometer. The methanol plant production (Metric Tons, MT) is metered by a coriolis mass flow meter. A key performance indicator (KPI) of energy efficiency (MMBtu/MT) is used. A higher KPI would indicate a less efficient operation and the Operator would be able to investigate and take corrective action e.g. a very high value for excess oxygen would lower the over efficiency of operation.

Reformer visual conditions and CEMS Carbon Monoxide (CO) limits are used to adjust burner operation and minimize fuel gas to the heater. Additionally, higher flue gas and coil outlet temperatures would be an indicator of excess fuel usage (for a constant excess oxygen percentage).

OCIB will use best operating practices with regards to the Reformer firing rates and excess air. OCI will monitor the stack O2 with oxygen trim control used to keep the O2 as low as possible but still keep CO from being formed. This will ensure efficient combustion of the Reformer fuel.

G. What will be the operating parameters that will ensure minimum excess air? Please include a discussion on how O2 analyzers will be utilized to determine optimum excess air to provide proper combustion.

OCI – Continuous oxygen monitoring of the flue gas will be done with indication on the DCS. Oxygen trim control will be used to reduce the excess Oxygen. It should be kept in the 2-4% range.

H. The BACT analysis states that periodic tuning serves to maximize combustion efficiency by reducing CO and unburned carbon, thus reducing GHG emissions. Please provide details on the periodic tuning to be conducted and the scheduling and recordkeeping of maintenance done on the reformer burners. How will the need for maintenance be ascertained for the reformer burners? What alerts will be instituted to warn on-site personnel when the reformers are operating below design efficiency?

OCI – OCI will comply with the maintenance requirements within the Boiler MACT (40 CFR Part 63, Subpart DDDDD).

As explained in OCI's reply to Item 16.F, a key performance indicator (KPI) of energy efficiency (MMBtu/MT) is used by operations personnel. A higher KPI would indicate a less efficient operation and the Operator would be able to investigate and take corrective action e.g. a very high value for excess oxygen would lower the over efficiency of operation.

Saturator Column (New)

I. On page E of the BACT analysis, it states that the Saturator Column serves to eliminate the atmospheric CO2 stripper emission point in the current process by processing the vent stream through the Saturator Column, reducing CO2 emissions by 612.6 tons per year and methane emissions by 6.8 tons per year. Also, on page 4 of the "OCI Process Energy Efficiency Improvement Study" located in the Appendix of the application, it is stated that the operation of the Saturator Column will allow the recovery of 100 tons per hour of water as steam. Please provide technical data and calculations to support these assertions. Were different designs evaluated for the Saturator Column? Please provide benchmark data that compares the proposed Saturator Column to an existing and/or similar source. If possible, please provide the technical resources used to evaluate different designs and to support design choice. What is the proposed compliance monitoring method for the Saturator Column? What operating parameters will be monitored and used to alert on site personnel to operating problems or the Saturator Column operating below design efficiency?

OCI – The Saturator was chosen because it is a proven technology for reduction of waste water streams from the process. It recovers waste heat energy and helps to improve the plant efficiency with reduction of steam production. The option of a process gas stripper column was evaluated but found to be in adequate.

OCI will monitor the Steam pickup, water circulation rates, temperature and column pressure delta. Of these the steam pickup is the most important as it indicates if the system is operating at design. The steam pickup consists of measuring the Dry natural gas inlet flow and the outlet wet gas flow with the difference indicating the amount of water (steam) pickup. Each indication will have hi and lo alarms to indicate potential problems to operation and engineering personnel. Please see Attachment H for further explanation along with additional calculations in the tables labeled "Emission Reduction by Saturator" and "MB Around Saturator".

Pre-Reformer Fired Heater (New)

J. OCI proposes the use of efficient combustion measures, routine maintenance practices/operational monitoring, and heat recovery from the fired heater flue gas in order to maximize heater efficiency and minimize greenhouse gas emissions. Since efficient heater designs vary among heaters, please provide supplemental data to the BACT analysis that explains if other heaters were evaluated for this project and why they were eliminated. Please provide supplemental information that includes the comparison data that was used to assess the operation, performance and efficiency of the chosen equipment. If a more efficient design was evaluated and eliminated, please explain why. Also, please provide supplemental data that explains why the heater selected is the most efficient for this source. Please provide manufacturer's data for the Pre-Reformer Fired Heater.

OCI – A step-by-step technical bid evaluation was performed for three fired heater suppliers for the pre-reformer fired heater quotation. Among the three quotations, only one quotation (designed and supplied by OnQuest Engineering Inc.) was accepted as complete and per acceptable design criteria. Therefore, a separate evaluation was not necessary. However, OnQuest Engineering Inc. has designed and supplied fired heaters and reformer furnaces for many industrial plants requiring efficient and state-of-the-art design. The data sheets are included as Attachment I.

K. What is OCI's proposed monitoring methodology for the Pre-Reformer Fired Heater? Please provide details on the operating parameters you are proposing to monitor and control to ensure that proper combustion and heat transfer is occurring.

OCI – OCI will monitor O2 and set ranges during the performance test.

L. The BACT analysis states that periodic tuning serves to maximize combustion efficiency by reducing CO and unburned carbon, thus reducing GHG emissions. Please provide details on the periodic tuning to be conducted and the scheduling and recordkeeping of maintenance done on the Pre Reformer fired heater burners. How will the need for maintenance be ascertained for the Pre Reformer fired heater burners? What alerts will be instituted to warn on-site personnel when the Pre Reformer fired heater is operating below design efficiency?

OCI – OCI will comply with the maintenance requirements within the Boiler MACT (40 CFR Part 63, Subpart DDDDD).

As explained in OCI's reply to Item 16.F, a key performance indicator (KPI) of energy efficiency (MMBtu/MT) is used by operations personnel. A higher KPI would indicate a less efficient operation and the Operator would be able to investigate and take corrective action e.g. a very high value for excess oxygen would lower the over efficiency of operation.

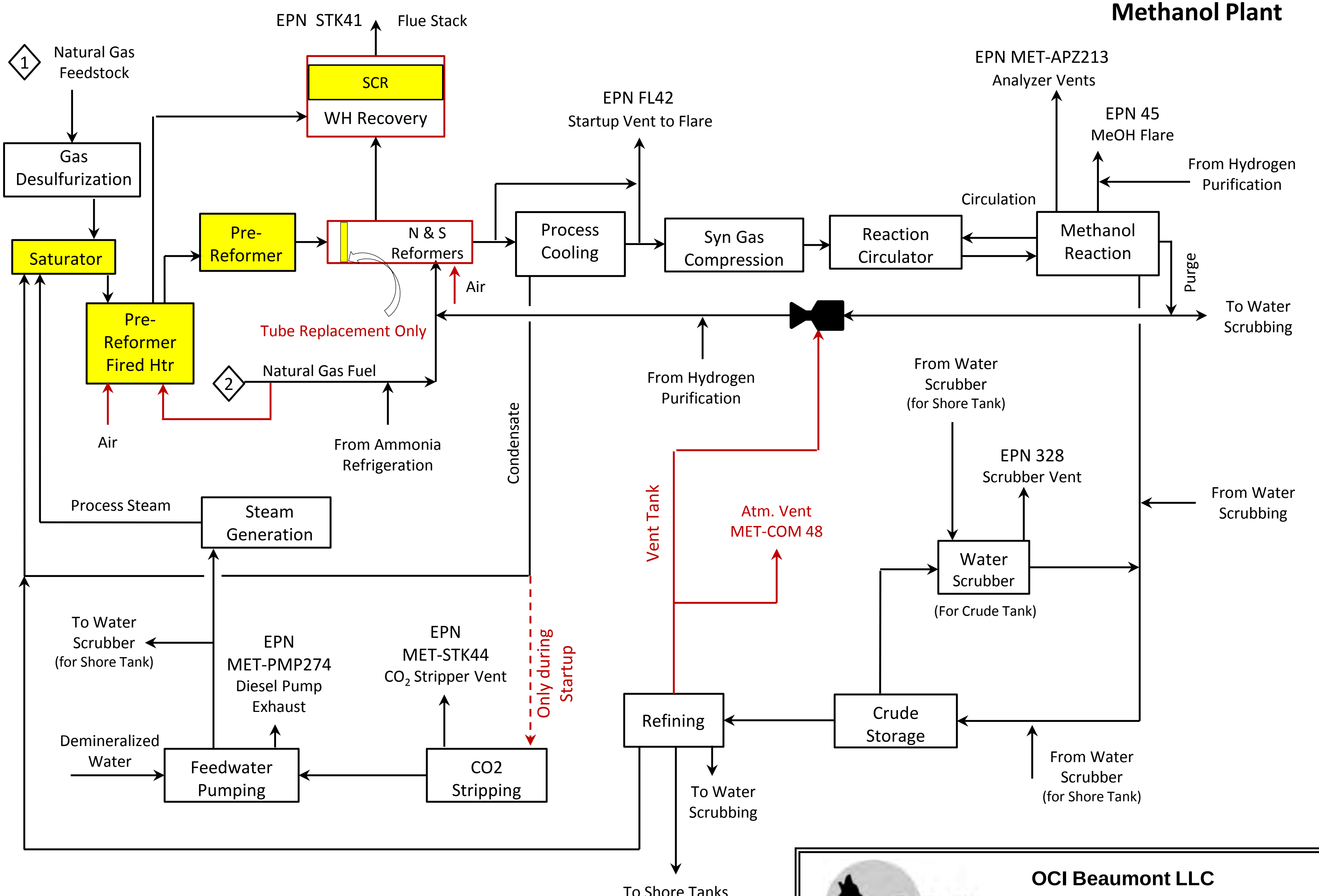
Carbon Capture and Storage (CCS)

M. On page F of the BACT analysis, it is stated that CCS is economically infeasible for OCI Reformers because of the following reasons: low CO2 concentration, low pressure, high temperature and high volume. The BACT analysis includes an approximate cost to install, operate and maintain CCS of $106.2 million per year at the OCI facility. The supporting calculations were not included in the application. Please provide the site- specific parameters that were used to evaluate and eliminate CCS from consideration. This material should contain detailed information on the quantity and concentration of CO2 that is in the waste stream and the equipment for capture, storage and transportation. Please include cost of construction, operation and maintenance, cost per pound of CO2 removed by the technologies evaluated and include the feasibility and cost analysis for storage or transportation for these options. Please discuss in detail any site specific safety or environmental impacts associated with such a removal system.

OCI – Please refer to Attachment J.

Attachment A

Methanol Plant

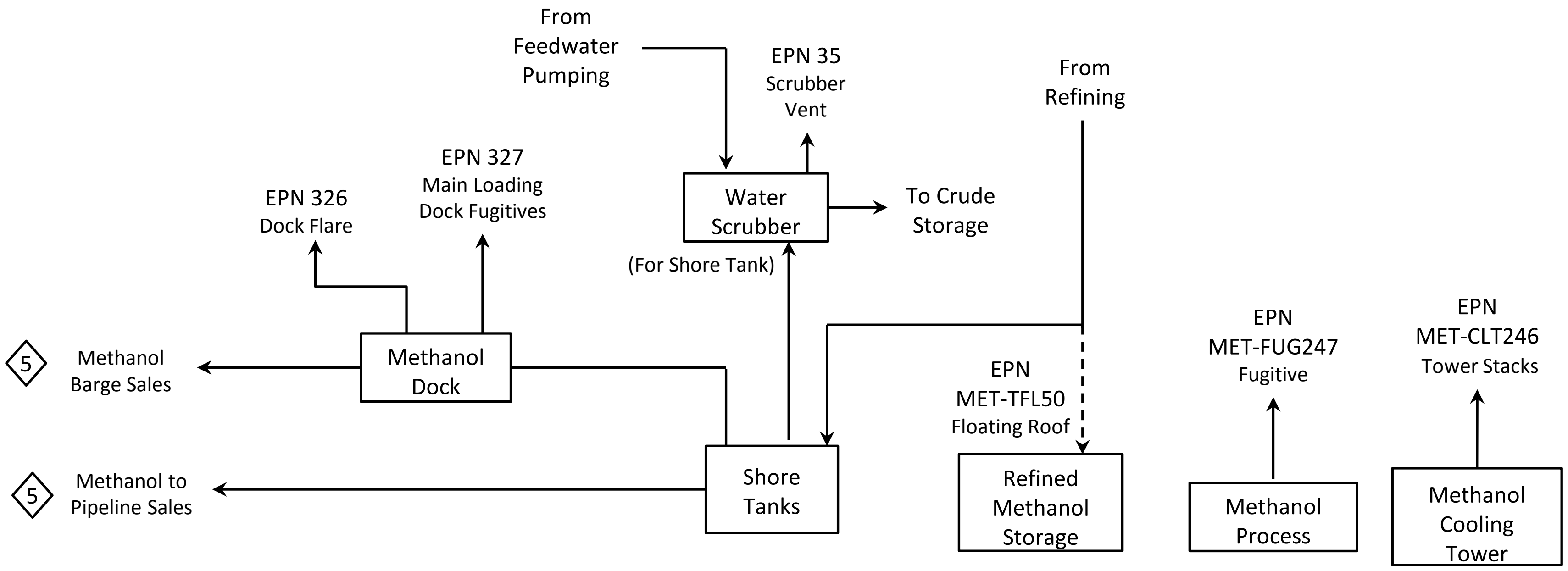


OCI Beaumont LLC

NSR Permit #901 - Block Flow Diagram

De-Bottleneck Project, 3rd Qtr 2014

Methanol Plant (Cont.)

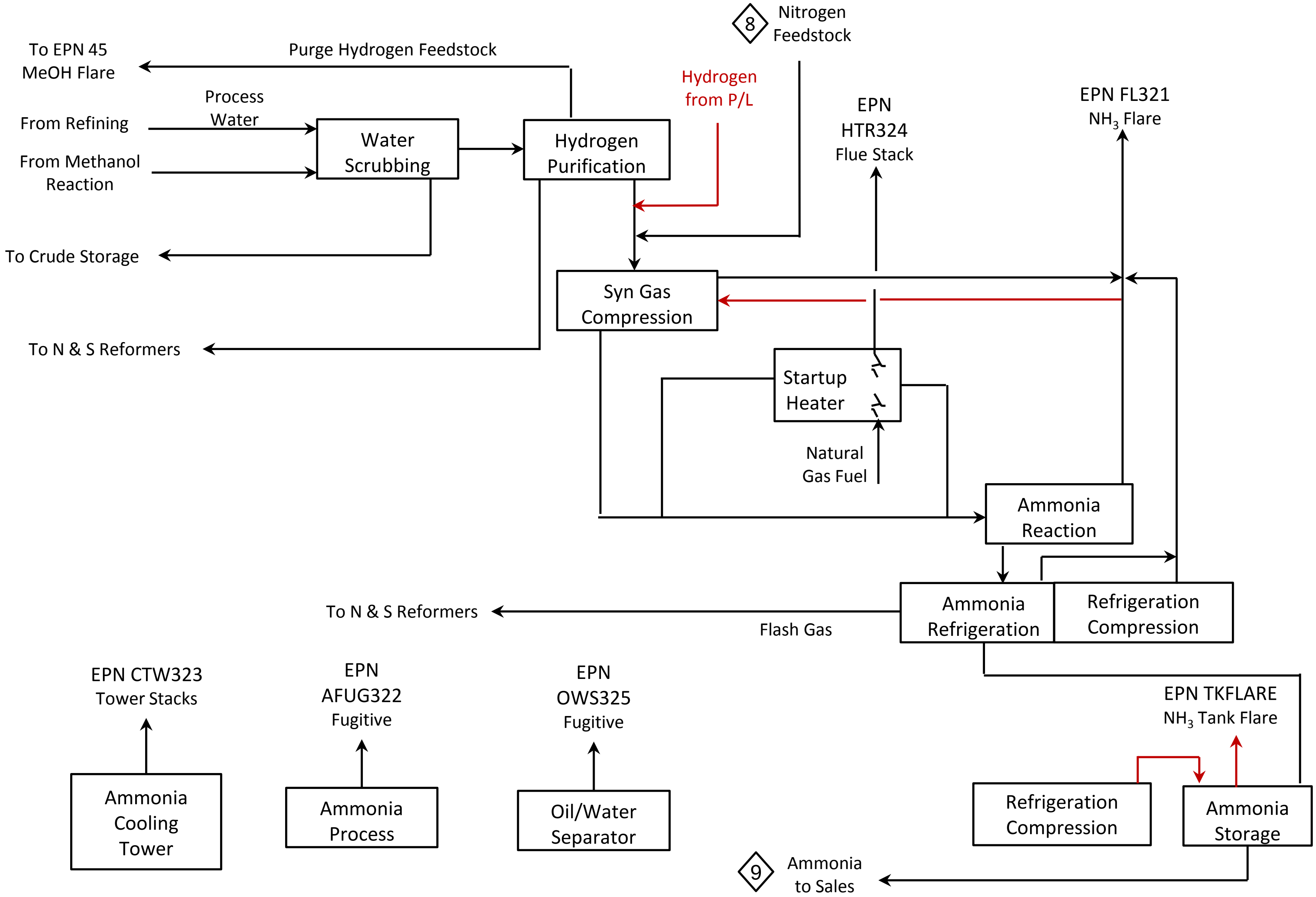


OCI Beaumont LLC

NSR Permit #901 - Block Flow Diagram

De-Bottleneck Project, 3rd Qtr 2014

Ammonia Plant

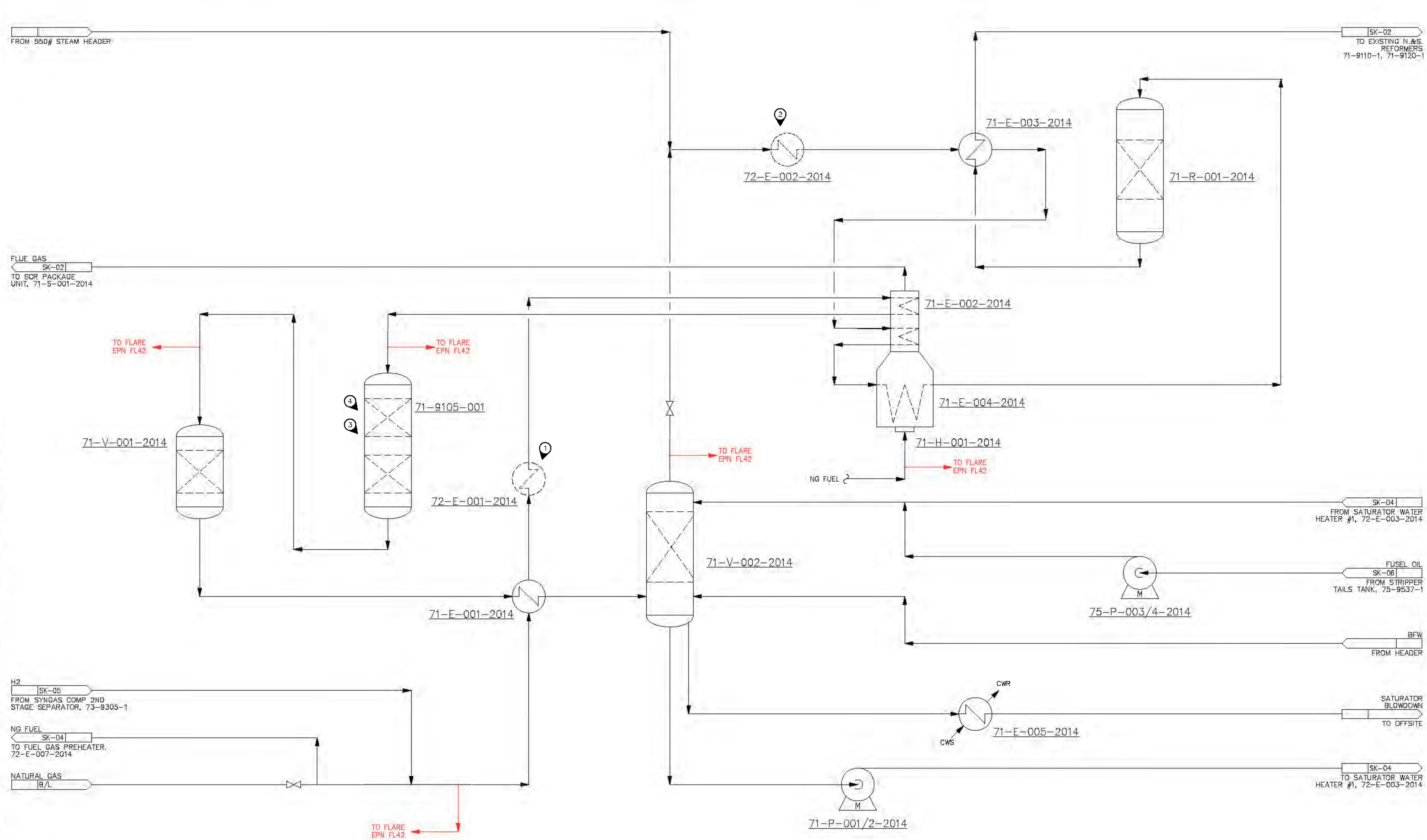


OCI Beaumont LLC

NSR Permit #901 - Block Flow Diagram

De-Bottleneck Project, 3rd Qtr 2014

71–V–001–2014 ULTRAPURIFICATION VESSEL	71–E–001–2014 HDS INTERCHANGER	71–V–002–2014 SATURATOR	71–P–001/2–2014 SATURATOR CIRCULATION PUMPS	72–E–002–2014 MIXED FEED/REFORMED GAS INTERCHANGER	71–E–003–2014 PREREFORMER INTERCHANGER	71–R–001–2014 PREREFORMER
71–9105–001 MIXED BED DESULFURIZER (4)	72–E–001–2014 NATURAL GAS/REFORMED GAS INTERCHANGER	71–E–002–2014 NATURAL GAS FEED PREHEATER	71–H–001–2014 PREREFORMER FIRED HEATER	71–E–004–2014 PREREFORMER FEED HEATER	71–E–005–2014 SATURATOR BLOWDOWN COOLER	75–P–003/4–2014 FUSEL OIL PUMPS



NOTES

1. REFORMED GAS ON SHELL SIDE; SHOWN ON SK–04.
2. REFORMED GAS ON SHELL SIDE; SHOWN ON SK–04.
3. EXISTING HYDRODESULFURIZATION VESSEL IS TO BE RERATED TO 570 PSIG AND 425°C DESIGN CONDITIONS.
4. EXISTING EQUIPMENT.

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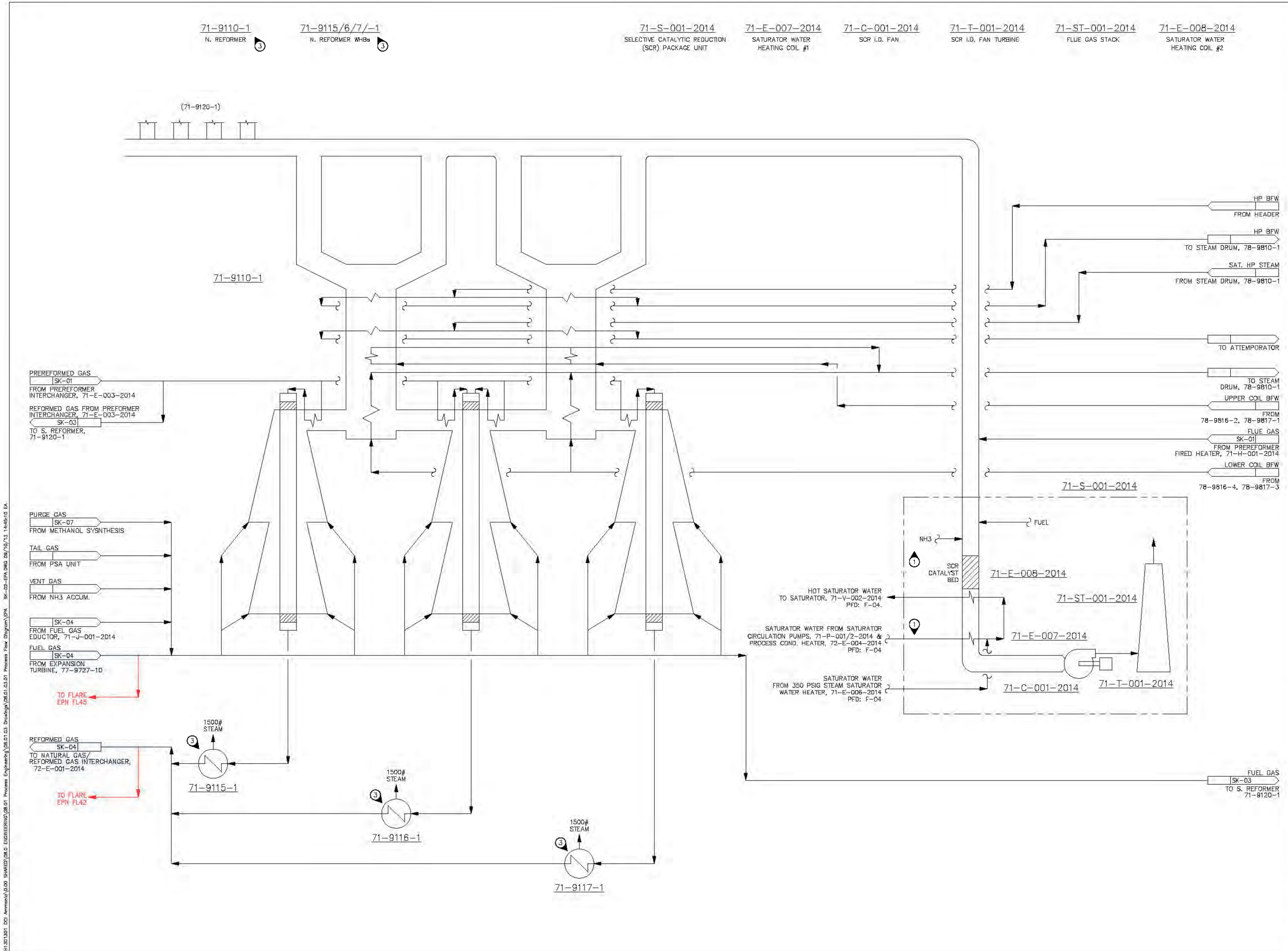
PROCESS FLOW DIAGRAM
METHANOL PROCESS UNIT
DESULFURIZATION AND PREREFORMING

DRAWN: | SCALE: NONE

DWG. NO. SK–01 | REV. A



P:\H1301301 OCI Ammonia\0.00 SHARED\08.0 ENGINEERING\08.01 Process Engineering\08.01.03 Drawings\08.01.03.01 Process Flow Diagram\EPA SK-02-EPA.DWG 09/10/13 14:45:10 EA

NOTES

1. REFER SK-04 FOR DETAILS ON LOCATION OF HEATING COILS IN SATURATOR WATER CIRCUIT.
2. DUAL DRIVE: STEAM TURBINE AND MOTOR.
3. EXISTING EQUIPMENT.

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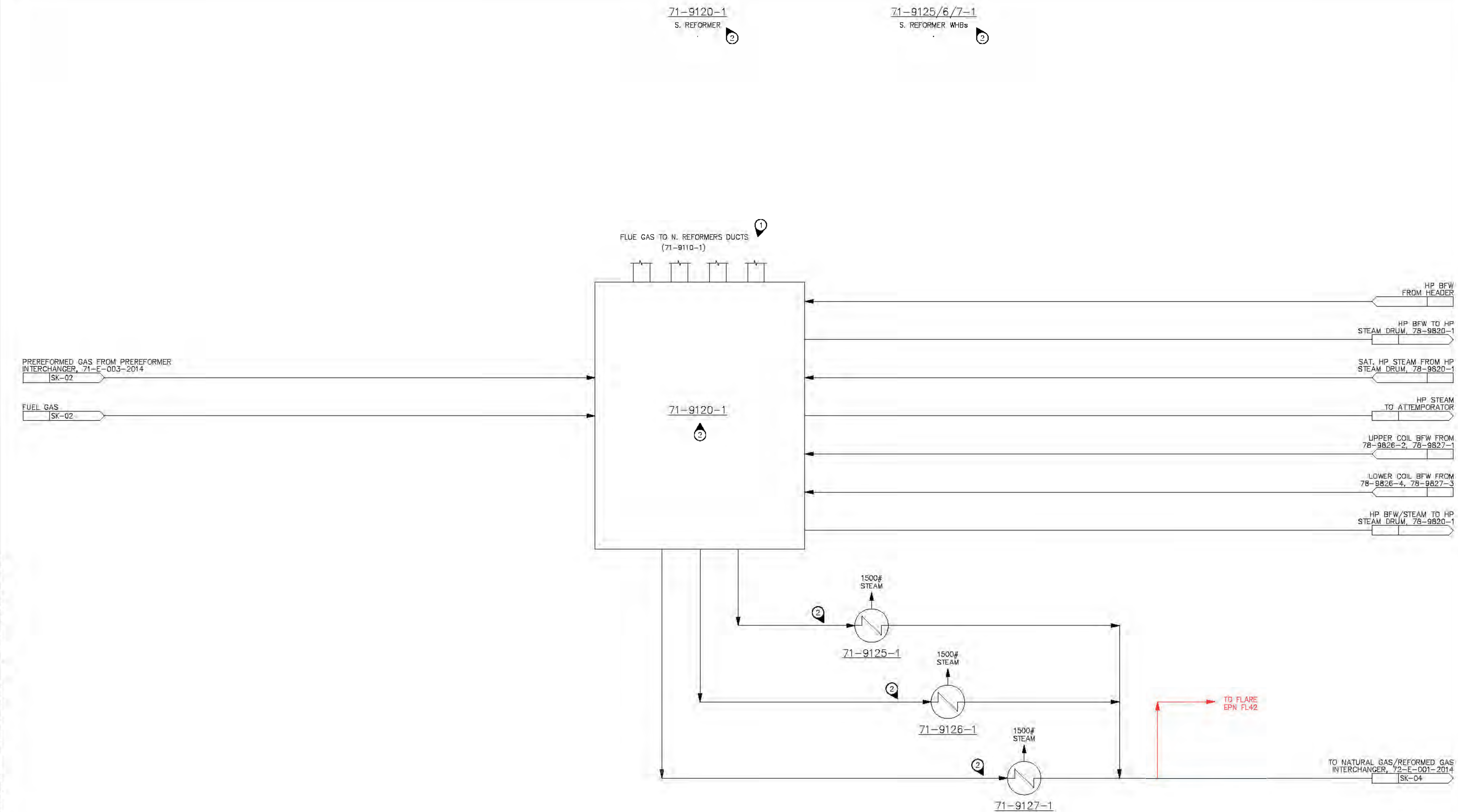
PROCESS FLOW DIAGRAM
METHANOL PROCESS UNIT
No. 1 REFORMER & SELECTIVE CATALYTIC REDUCTION (SCR) UNIT

DRAWN: | SCALE: NONE

DWG. NO. SK-02 | REV. A



NOTES

1. FUEL GAS FROM 4 DUCTS OF N. REFORMER (71-9110-1), 4 DUCTS OF S. REFORMER (71-9120-1) AND 1 DUCT FROM PREREFORMER FIRED HEATER (71-H-001-2014)TIE INTO A COMMON DUCT TO THE SCR PACKAGE. REFER TO SK-02 FOR DETAILS.
2. EXISTING EQUIPMENT.

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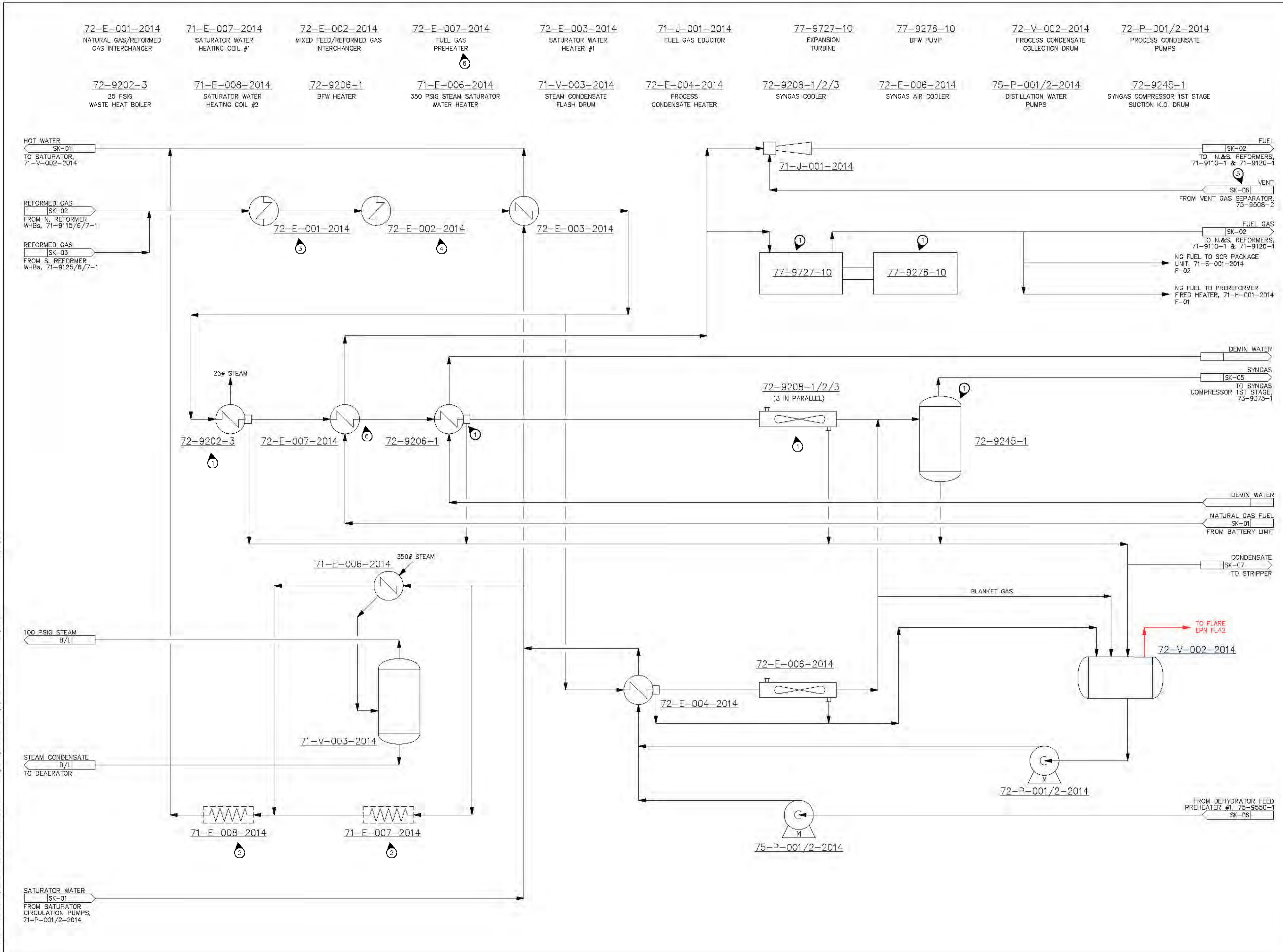
PROCESS FLOW DIAGRAM
METHANOL PROCESS UNIT
No. 2 REFORMER

DRAWN: | SCALE: NONE

DWG. NO. SK-03 | REV. A



NOTES

1. EXISTING EQUIPMENT.
2. HEATING COILS ARE LOCATED DOWNSTREAM OF SCR.
3. NATURAL GAS ON TUBESIDE, SHOWN ON SK-01.
4. MIXED FEED ON TUBESIDE, SHOWN ON SK-01.
5. VENT FROM SPLITTER VENT CONDENSER, 75-9502-2 IS SENT TO VENT GAS SEPARATOR (NO. SHOWN ON PFD-6452).
6. 72-9204-1 WILL BE REPLACED IN KIND WITH 72-E-007-2014 WITH INCREASED SHELL DESIGN PRESSURE OF 570 PSIG..

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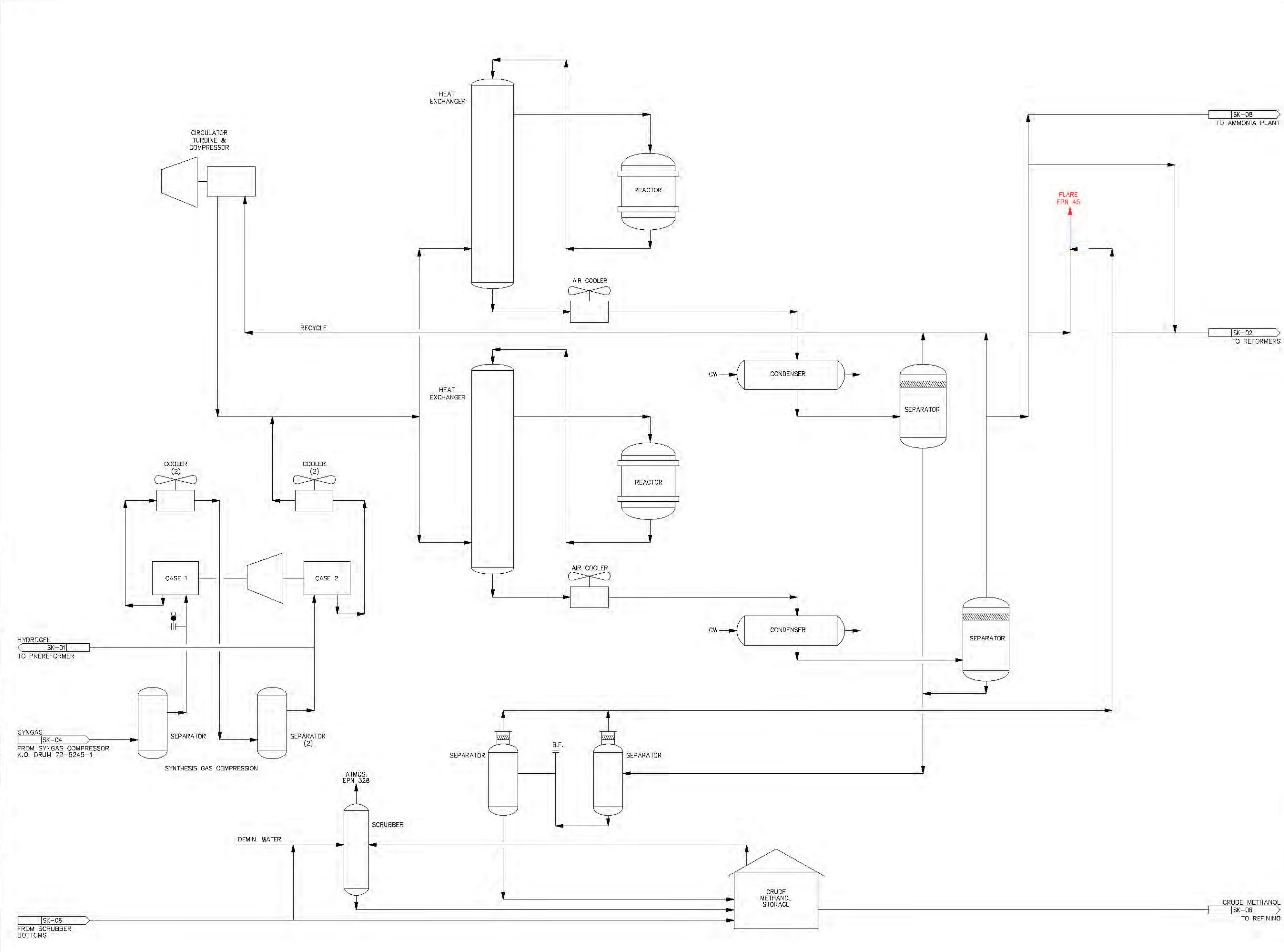
PROCESS FLOW DIAGRAM
METHANOL PROCESS UNIT
SYNGAS HEAT RECOVERY

DRAWN: | SCALE: NONE

DWG. NO. SK-04 | REV. A



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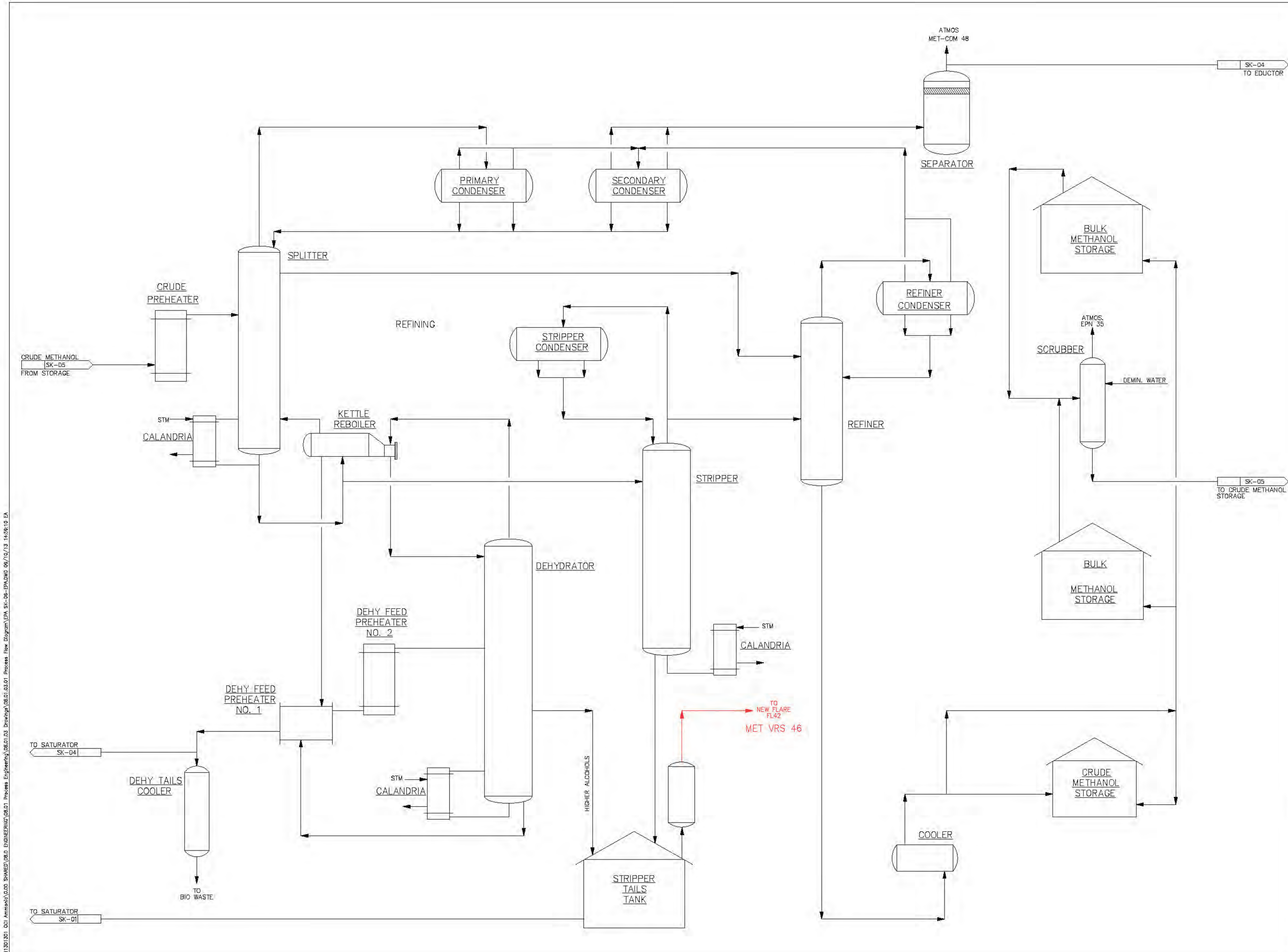
PROCESS FLOW DIAGRAM
METHANOL PROCESS UNIT
COMPRESSION-REACTION

DRAWN: SCALE: NONE

DWG. NO. SK-05 REV. A



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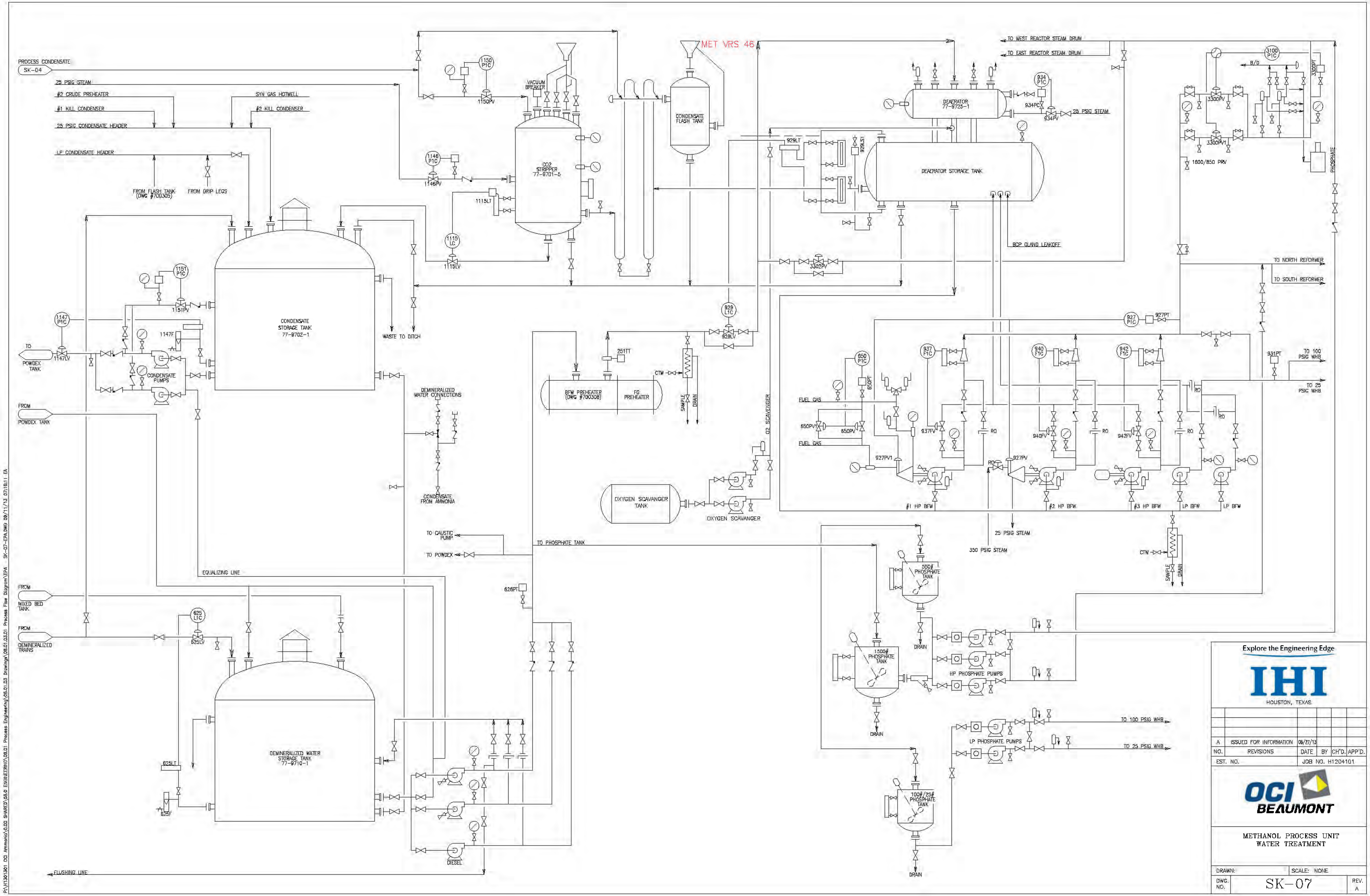
PROCESS FLOW DIAGRAM
METHANOL PROCESS UNIT
REFINING–STORAGE

DRAWN: | SCALE: NONE

DWG. NO. SK–06 | REV. A



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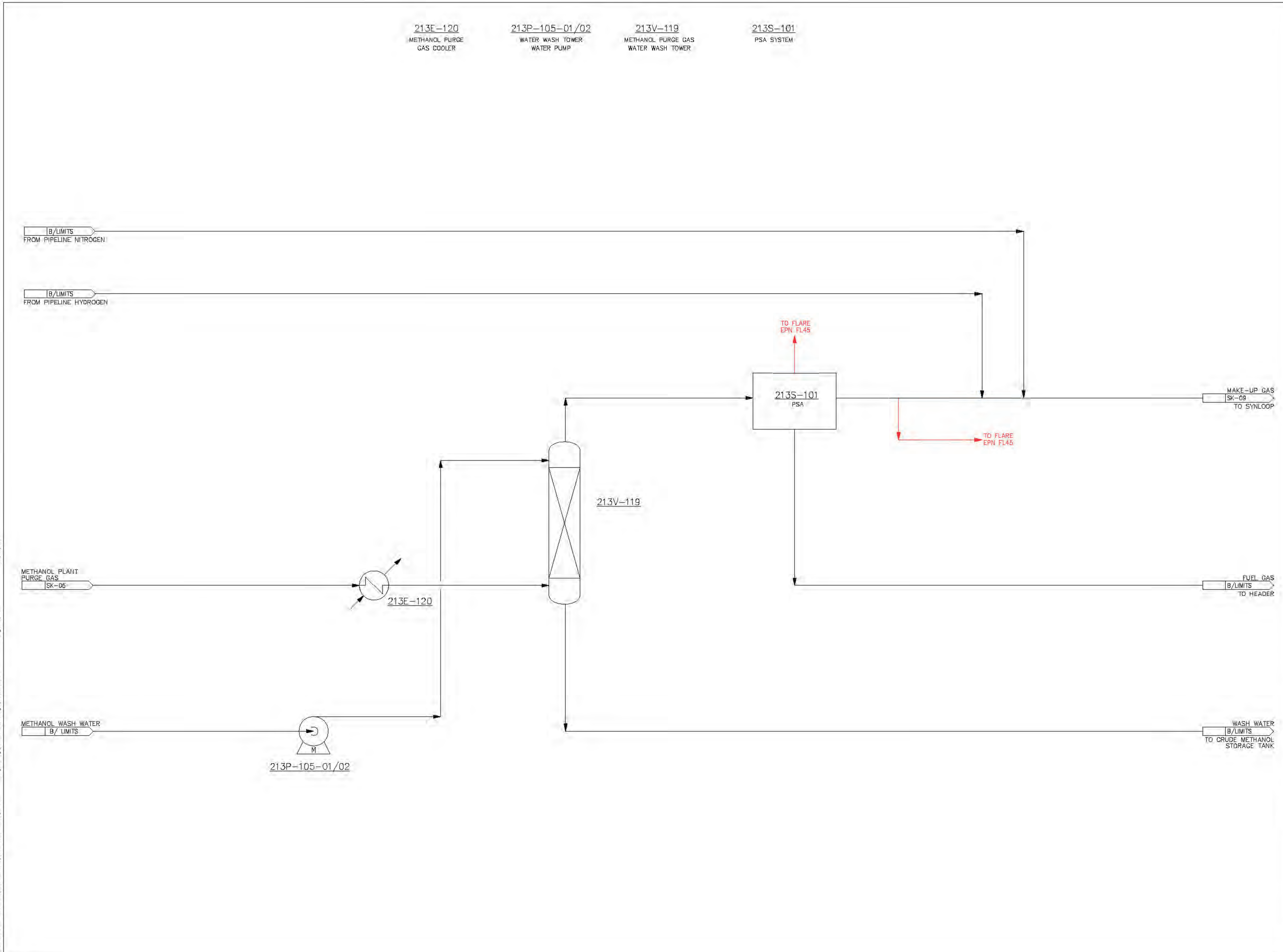

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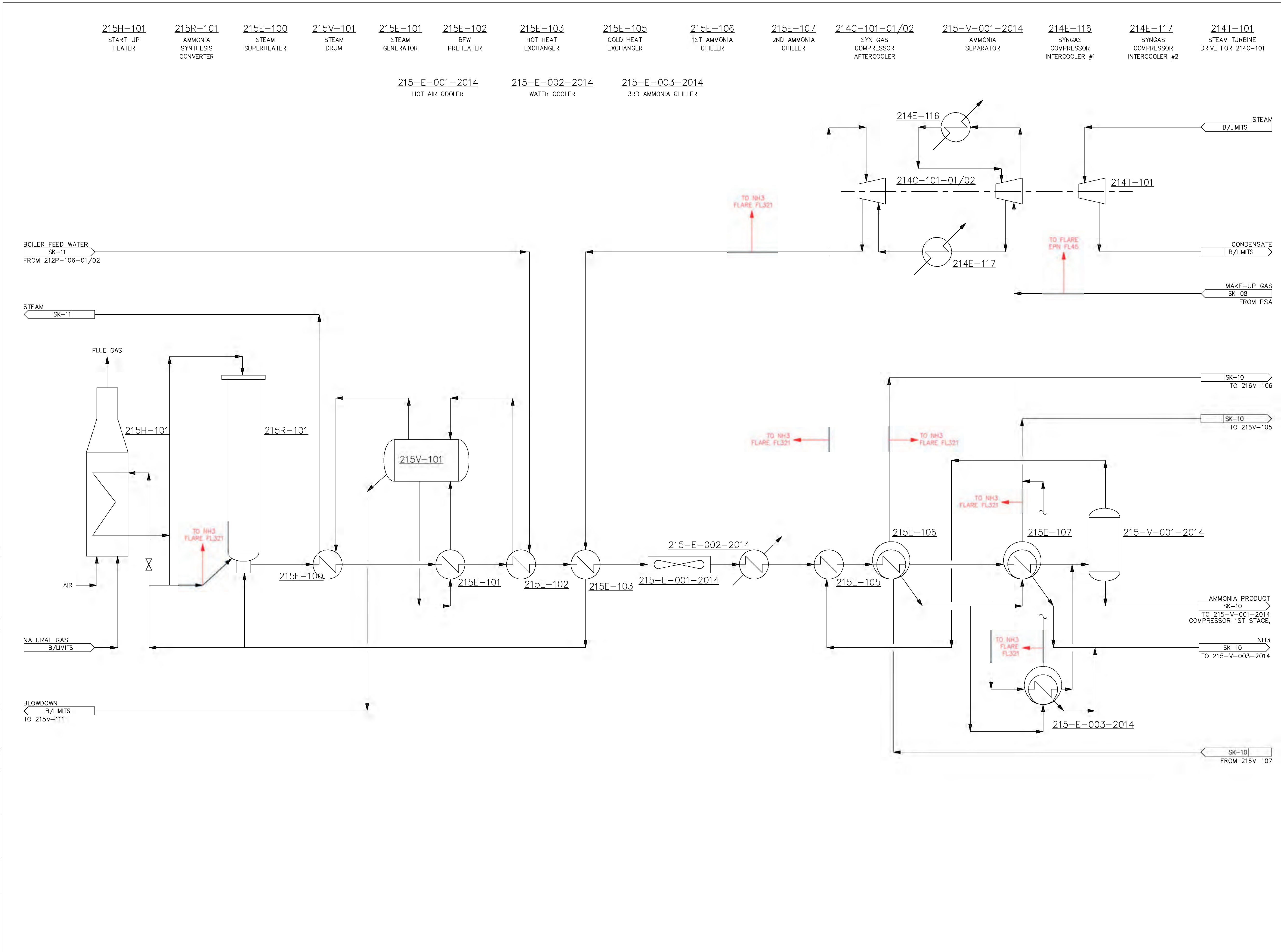
PROCESS FLOW DIAGRAM
1,000 STPD AMMONIA PLANT
MEOH PURGE GAS

DRAWN: | SCALE: NONE

DWG. NO. SK-08 | REV. A



NOTES

1. NO GAS LOOSES FORSEEN FOR SYNSTHESIS GAS COMPRESSOR. 214C-101-01/02

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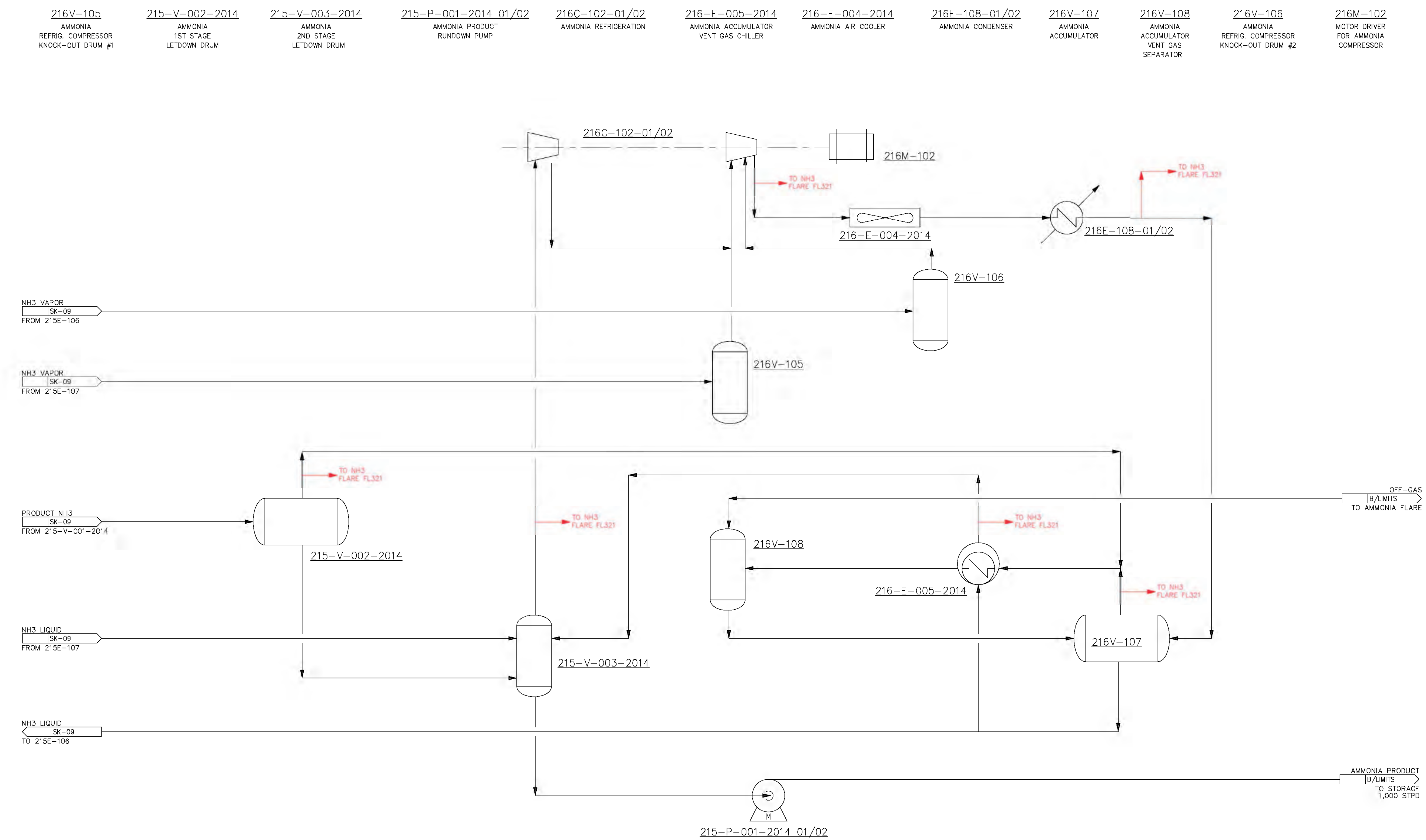
PROCESS FLOW DIAGRAM
1,000 STPD AMMONIA PLANT
AMMONIA SYNTHESIS LOOP

DRAWN: | SCALE: NONE

DWG. NO. SK-09 | REV. A



NOTES

1. IF VALVES DIFFER IN COLD PRODUCT AND WARM PRODUCT CASES, THE COLD PRODUCT VALVES ARE THE BOTTOM OF THE STACKED VALUES.

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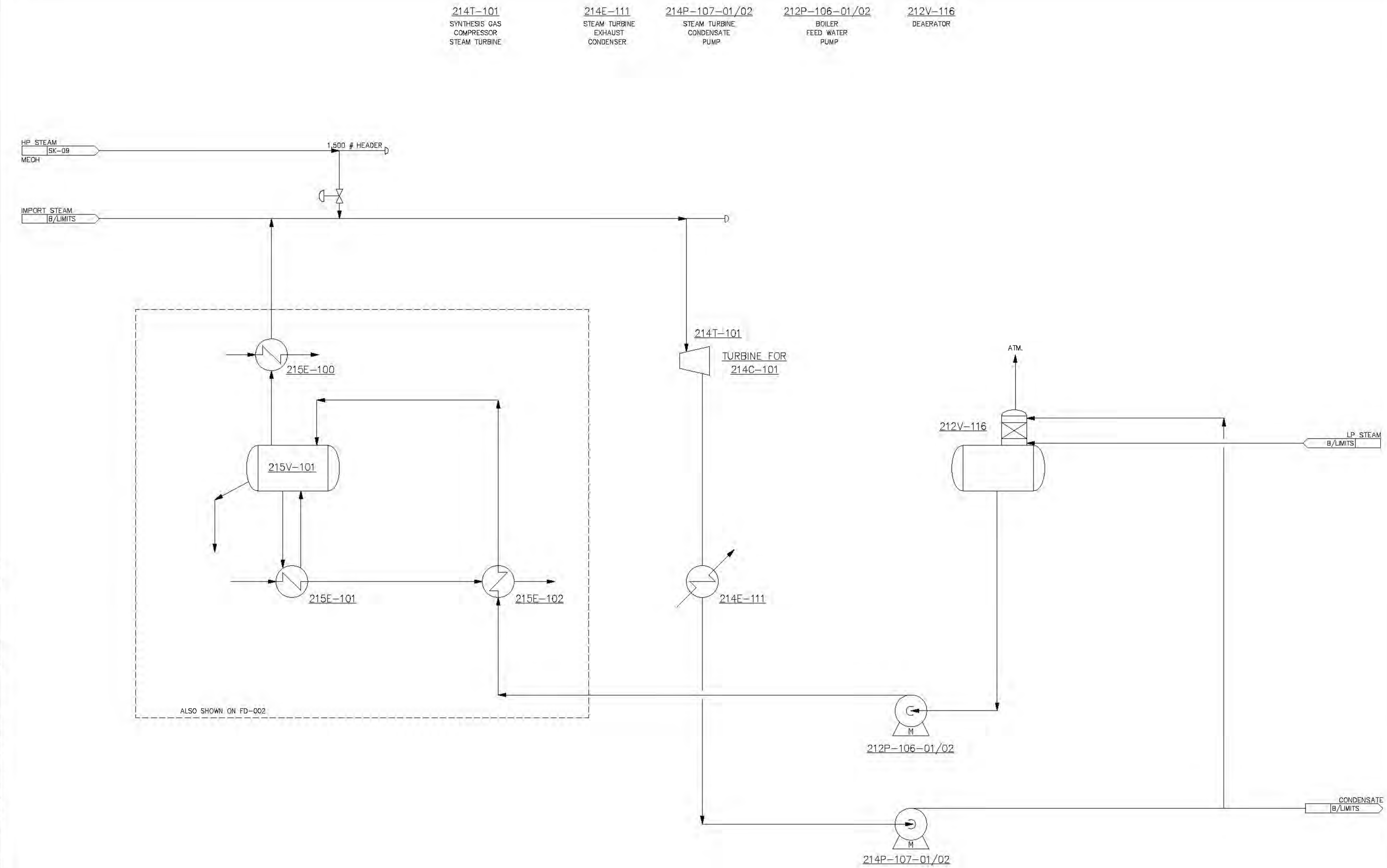
PROCESS FLOW DIAGRAM
1,000 STPD AMMONIA PLANT
AMMONIA REFRIGERATION

DRAWN: SCALE: NONE

DWG. NO. SK-10 REV. A

P:\H1301301 OCI Ammonia\0.00 SHARED\08.0 ENGINEERING\08.01 Process Engineering\08.01.03 Drawings\08.01.03.01 Process Flow Diagram\EPA SK-10-EPA.DWG 09/17/13 14:51:17 CHL



NOTES

1. IF VALVES DIFFER IN COLD PRODUCT AND WARM PRODUCT CASES, THE COLD PRODUCT VALVES ARE THE BOTTOM OF THE STACKED VALVES.

* STEAM RATE TO BE COMFIRMED BY SUPPLIER.

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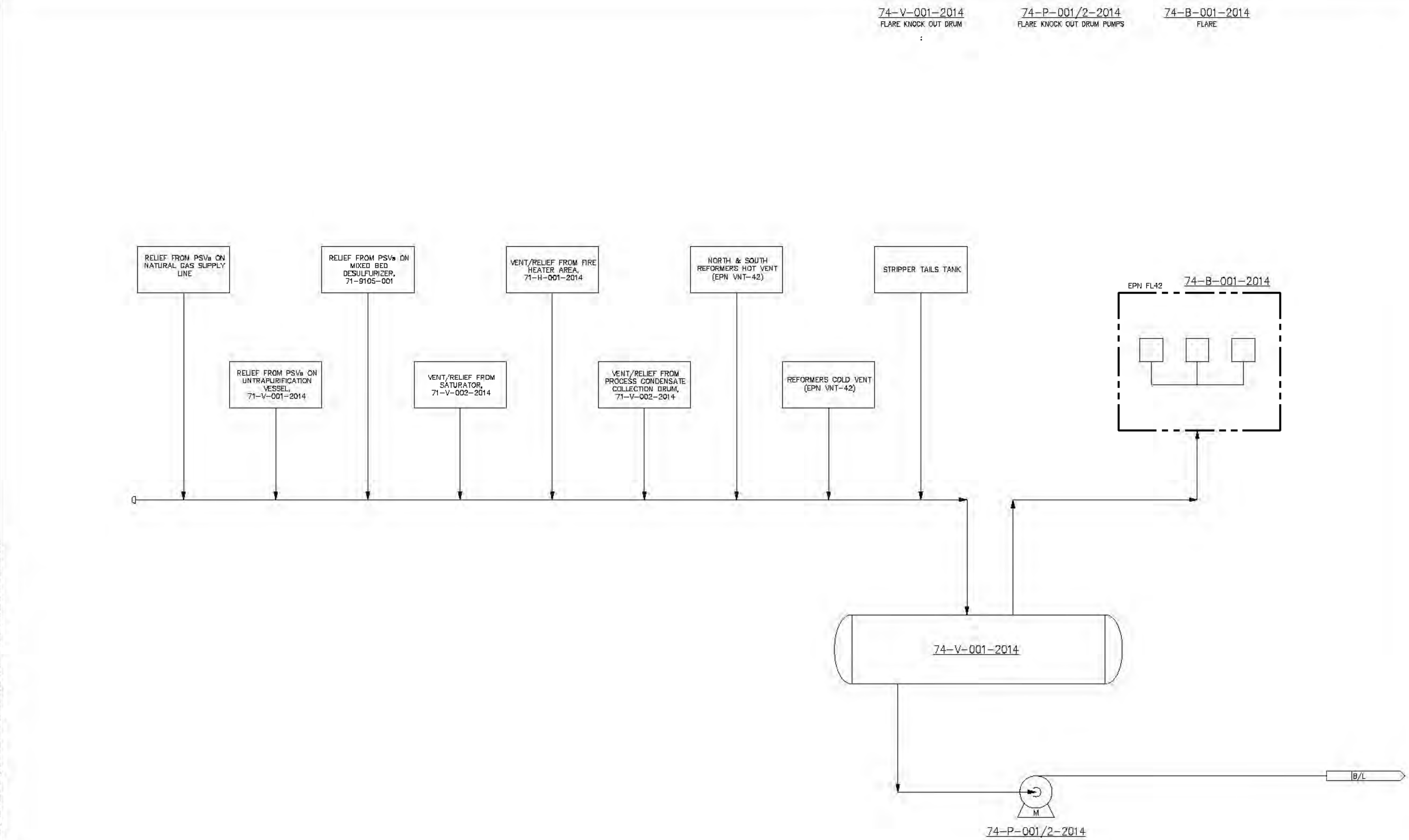
PROCESS FLOW DIAGRAM
1,000 STPD AMMONIA PLANT
STEAM BALANCE

DRAWN: | SCALE: NONE

DWG. NO. SK-11 | REV. A



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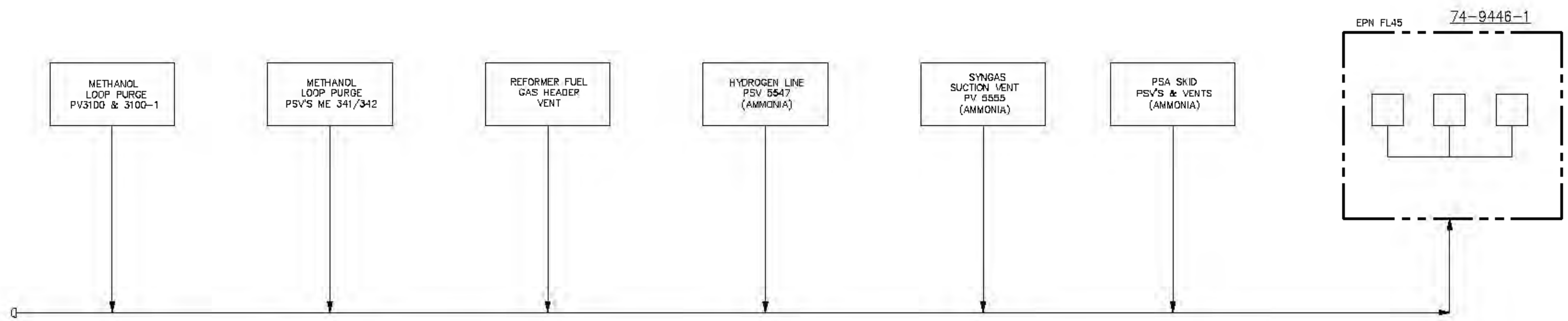
PROCESS FLOW DIAGRAM
METHANOL PROCESS UNIT
FLARE SYSTEM (NEW)

DRAWN: CHL — SCALE: NONE

DWG. NO. SK-12 — REV. A

74-9446-1
FLARE (FL45)



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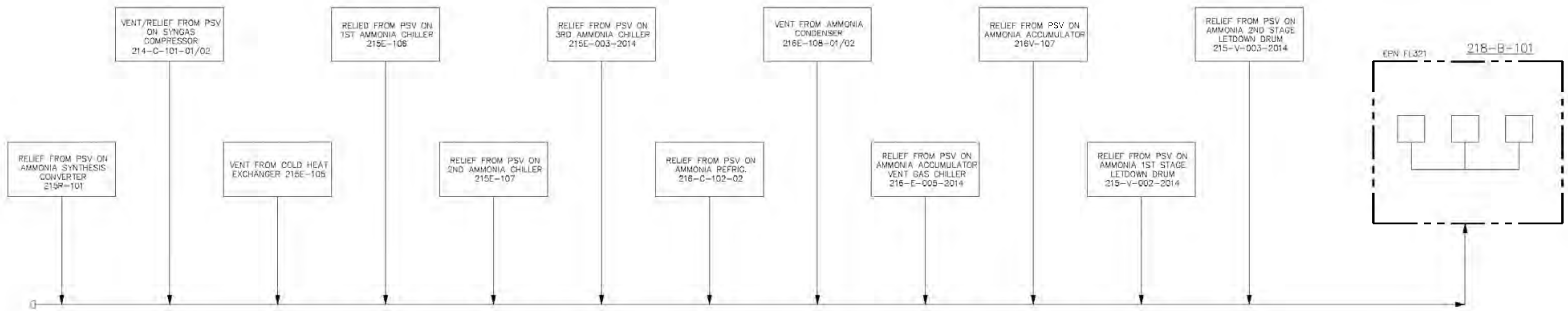
PROCESS FLOW DIAGRAM
METHANOL PROCESS UNIT
FLARE SYSTEM (EXISTING)

DRAWN: CHL | SCALE: NONE

DWG. NO. SK-13 | REV. A

218-B-101
AMMONIA FLARE



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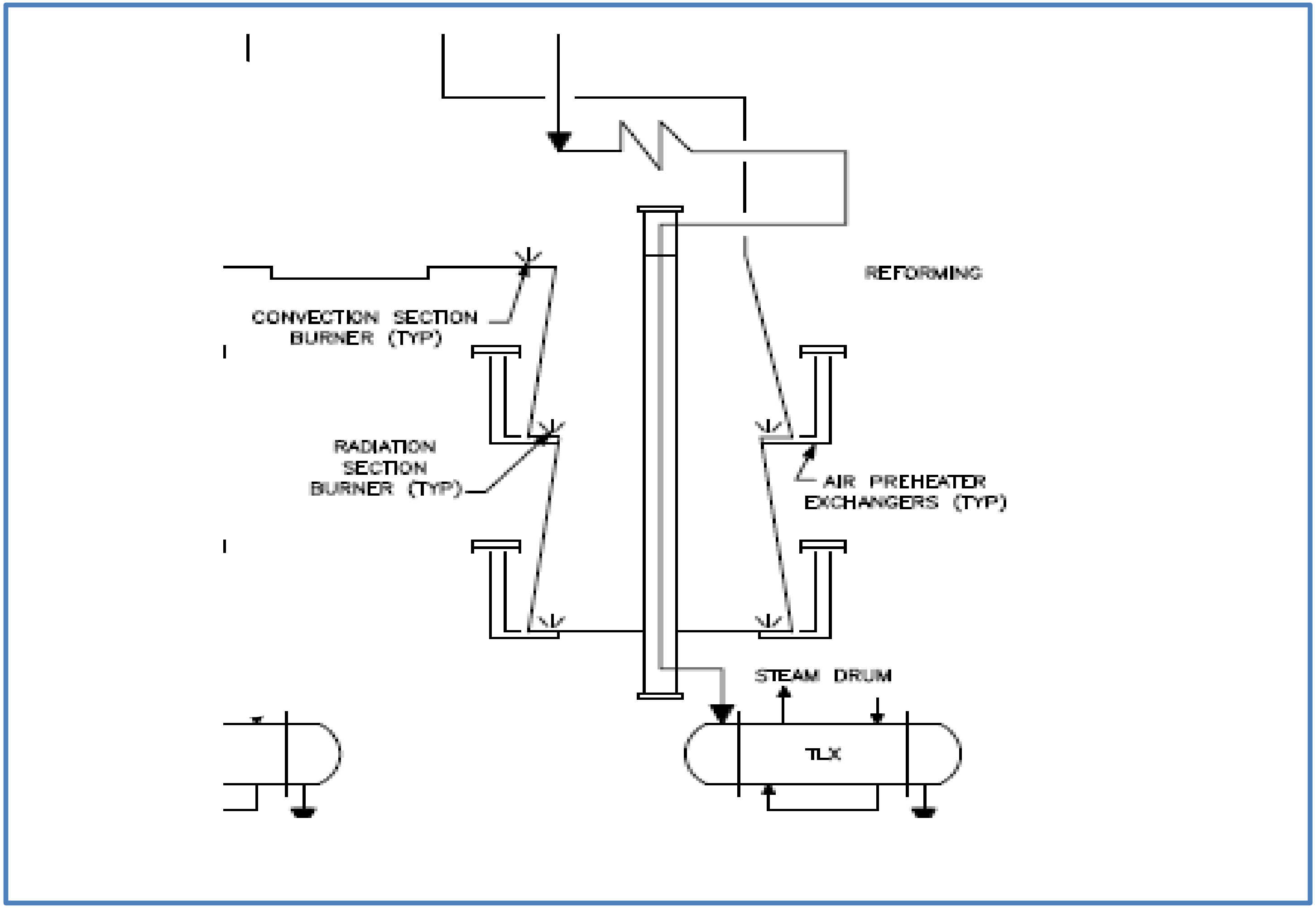
OCI BEAUMONT

PROCESS FLOW DIAGRAM
1,000 STPD AMMONIA PLANT
AMMONIA FLARE SYSTEM (EXISTING)

DRAWN: CHL | SCALE: NONE

DWG. NO. SK-14 | REV. A

Attachment B



Sketch A: Burner and Combustion air System for side-fired Reformers

Attachment C

Attachment C-1

OCI VENTS TO NEW METHANOL FLARE EPN FL42

	Vent from Saturator	Vent/Relief from Process Condenstae Collection Drum (6)	Vent Pre-Reformer	North & South Reformers Hot Vent (5)		Reformers Cold Vent (Two cold vents located at different areas; hence different composition)		Vent from Stripper Tails Tank Continous	Sweep Gas Continuos (4)
	PV-4251		**PV-4303**			**PV-4509**	**PV-252/252-1**		
Component	Mole%	Mole%	Mole%	Mole%	Mole%	Mole%	Mole%	Mole%	Mole%
H2	0.70		0.54	58.5	58.5	73.3	68.40	0.00	0.00
CO	0.50		0.11	12.39	12.39	15.3	14.30	0.00	0.00
CO2	0.10		0.37	5.57	5.57	7.4	6.90	0.00	1.19
N2	0.10		0.06	0.04	0.04	0.1	0.10	0.00	0.23
CH4	32.20		24.68	1.62	1.62	3.7	3.40	0.00	96.19
C2H6	0.70		0.52					0.00	2.04
C3H8	0.10		0.06					0.00	0.25
C4H10			0.05					0.96	0.00
C5H12+								0.30	0.00
H2O	65.50	100	73.6	21.87	21.87	0.3	7.00	21.31	0.00
Methanol	0.10		0.06					77.42	0.00
Total	100	100		100	100	100	100	100	100
LHV (Btu/lb)	6,746.99	0	5,111.95	7,199.60	7,199.60	11,091.37	9,769.81	7,967.15	20,436.66
HHV (Btu/lb)	7,487.44	0	5,674.42	8,243.35	8,243.35	12,683.00	11,171.98	9,010.36	22,674.69
lb/hr	523,052	4,292	685,788	288,519	288,519	94,900	323,205	239.84	19.00
SIMULTANEOUS VENTING SOURCES AND SCENARIO MATRIX									
MeOH Plant Planned Shutdown	X					X	X	X	X
MeOH Plant Planned Start-Up	X		X				X		X

Attachment C-2

OCI VENTS TO EXISTING METHANOL FLARE EPN-45

	Methanol Loop Purge	Reformer Fuel Gas Header Start-Up Vent	Syngas suction vent	PSA Inlet Vent	PSA HYDROGEN Vent	PSA TAIL GAS Vent	Sweep Gas (3)
	PV-3100/3100-1	PV-650-2	PV-5555	PV-5328	PV-5358	PV-5368	CONTINUOUS
Component	Mole%	Mole%	Mole%	Mole%	Mole%	Mole %	Mole %
H2	87.09	0.00	75.00	87.09	100.00	60.05	0.00
CO	1.12	0.92	0.00	1.12	0.00	0.64	0.00
CO2	2.09	1.23	0.00	2.09	0.00	1.53	1.19
N2	0.25	0.23	25.00	0.25	0.00	0.60	0.23
CH4	8.75	96.43	0.00	8.75	0.00	36.07	96.19
C2H6	0.00	1.74	0.00	0.00	0.00	0.00	2.04
C3H8	0.00	0.25	0.00	0.00	0.00	0.00	0.25
C4H10	0.00	0.08	0.00	0.00	0.00	0.00	0.00
C5H12+	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H2O	0.04	0.00	0.00	0.04	0.00	0.09	0.00
Methanol	0.71	0.00	0.00	0.71	0.00	0.03	0.00
Ethanol	0.00	0.00	0.00	0.00	0.00	1.00	0.00
Total	100	101	100	100	100	100	100
LHV (Btu/lb)	26,458	20,437	9,152	26,458	51,542	22,750	14,760
HHV (Btu/lb)	30,779	22,675	10,836	30,779	61,030	25,796	16,376
lb/hr	57,520	7,700	83,700	70,000	12,000	35,175	19
SIMULTANEOUS VENTING SOURCES AND SCENARIOS							
MeOH Plant Planned Shutdown		X	X				X
NH3 Plant Planned Shutdown	X				X	X	X
MeOH Plant Planned Start-Up	X	X					X
NH3 Plant Planned Start-Up			X	X	X	X	X

Attachment C-3

OCI VENTS TO AMMONIA FLARE EPN: FL321

	Purge from NH3 loop PV-5777	Syngas loop purge HV5690	Sweep Gas (1)
	PV-5777	HV-5690	CONTINUOUS
Component	Mole%	Mole%	Mole%
H2	59.29	71.25	100.00
CO	0	0.00	0.00
CO2	0	0.00	0.00
N2	28.14	23.71	0.00
CH4	2.01	0.35	0.00
C2H6	0	0.00	0.00
C3H8	0	0.00	0.00
C4H10	0	0.00	0.00
C5H12+	0	0.00	0.00
Argon	0.67	0.35	0.00
Ammonia	9.89	4.44	0.00
Total	100	100	100
LHV (Btu/lb)	6,221	9,199	51,542
HHV (Btu/lb)	7,357	10,893	61,030
lb/hr	444	30,874	2.50

Notes:

(1) A continuous hydrogen flow at 445 SCFH will be added to the flare (as sweep gas) during normal operation and during all venting scenarios.

(2) In case ammonia loop trip, refer to EPN-45 vent case

4.2 Methanol Plant Flare (EPN: 45)

The methanol plant flare combusts gases during upset and MSS periods. Both the methanol and ammonia production units can use this flare. Process purge gas from normal operations may also be used as fuel gas for the reformers. The flare is equipped with continuous burning pilots. Additionally, the flare will operate with a continuous sweep of natural gas. Emissions for this flare are calculated per the methods in 40 CFR Part 98, Subpart Y. The basis for the emission calculations is defined as follows:

Emissions Basis

Pilot Gas Combustion:

Fuel Usage: 80 scf/hr-pilot
Number of Pilots: 3 pilots
Typical Nat Gas Heating value: 985.44 Btu/scf
Annual Operating Hours: 8,760 hrs/yr

Normal Operations

Natural Gas Sweep

- 3.83 MMscf/yr (68 deg. F and 14.7 psia)
- Typical Nat Gas Heating value: 985.44 Btu/scf
- Annual Operating Hours: 8,760 hrs/yr

MSS Operations

Ammonia and Methanol Plant Startups and Shutdowns

- Vent gas from multiple vents during startup and shutdown operations (Refer to enclosed vent stream data for stream compositions and properties.
- 1 Ammonia Plant startup and shutdown / yr
- 1 Methanol Plant startup and shutdown / yr
- 8 hours per startup event, 4 hours per shutdown event

CO_2:

CO_2 emissions are calculated utilizing the following equation:

$$CO_2 = 0.98 \times 0.001 \times \left(\left(\sum Flare_{Norm} \times HHV \times EmF\right) + \sum \left[\frac{44}{12} \times (Flare_{ssm}) \times \frac{MW}{MVC} \times CC\right] \right)$$ (Equation Y-3, 40 CFR Part 98.253)

Where: CO_2 = Carbon dioxide emissions in metric tons per year;
0.98 = Assumed combustion efficiency of the flare;
0.001 = Conversion factor from Kg to metric tons;
$Flare_{Norm}$ = Annual volume of flare gas combusted during normal operations (Pilot Gas), MMscf/yr;
HHV = Higher heating value for fuel gas or flare gas, MMBtu/MMscf;
EmF = Default CO_2 emission factor for flare gas, 60 Kg CO_2 / MMBtu (high heat basis);
44 = molecular weight of CO_2, Kg/Kg-mol;
12 = atomic weight of C, Kg/Kg-mol;
$Flare_{ssm}$ = Volume of gas combusted during start-up or shutdown event from engineering calculations (startups/shutdowns), scf/event;
MW = Average molecular weight of the flare gas from engineering calculations for each event, kg/kg-mol,
MVC = Molar conversion factor, 849.5 scf/Kg-mol (@ 68°F);
CC = Average carbon content of the flare gas from engineering calculations for each event, Kg C / Kg flare gas;

CH_4:

CH_4 emissions are calculated utilizing the following equation:

$$CH_4 = \left(CO_2 \times \frac{EmF_{CH_4}}{EmF}\right) + CO_2 \times \frac{0.02}{98} \times \frac{16}{44} \times f_{CH_{4(1-6)}}$$ (Equation Y-4, 40 CFR Part 98.253)

Where: CH_4 = Annual methane emissions from flared gas, MT CH_4/yr;
CO_2 = Carbon dioxide emissions from equation Y-3 above, MT/yr;
EmF_{CH4} = Default CH_4 emission factor for "Petroleum Products" from Table C-2 of Subpart C, Kg CH_4 / MMBtu;
EmF = Default CO_2 emission factor for flare gas, 60 Kg CO_2 / MMBtu (high heat basis);
0.02/0.98 = Correction factor for flare combustion efficiency;
16/44 = Correction factor ratio of the molecular weight of CH_4 to CO_2;
$f_{CH4(1-6)}$ = Weight fraction of carbon in the flare gas prior to combustion that is contributed by methane from engineering calculations, Kg C from methane / Kg C in flare gas;

N_2O:

N_2O emissions are calculated utilizing the following equation:

$$N_2O = \left(CO_2 \times \frac{EmF_{N2O}}{EmF}\right)$$ (Equation Y-6, 40 CFR Part 98.253)

Where: N_2O = Annual nitrous oxide emissions from flared gas, MT N_2O/yr;
CO_2 = Carbon dioxide emissions from equation Y-3 above, MT/yr;
EmF_{N2O} = Default N_2O emission factor for "Petroleum Products" from Table C-2 of Subpart C, Kg N_2O / MMBtu;
EmF = Default CO_2 emission factor for flare gas, 60 Kg CO_2 / MMBtu (high heat basis);

The following table summarizes the greenhouse gas emissions for the Methanol Plant Flare. TCEQ Table 8 and detailed emissions calculations for the flare are included on the following pages.

	EPN: 45
CO_2 (tpy)	8,586
CH_4 (tpy)	228.8
N_2O (tpy)	0.1

OCI Beaumont LLC
Existing Methanol Plant Flare (45)
Continuous, Startup, and Shutdown Vents
September 2013

Component	Mol Wt	Carbon Content	Methanol Loop Purge PV-3100/3100-1 NH3 Plant SD/MeOH Plant SU Mole%	wt%	Fuel Gas Header Start PV-650-2 MeOH Plant SU/SD Mole%	wt%	Syngas suction vent PV-5555 MeOH Plant SD/NH3 Plant SU Mole%	wt%	PSA Inlet Vent PV-5328 NH3 Plant SU Mole%	wt%
H2	2.016	0	87.0850	0.3738	0.0000	0.0000	75.0000	0.1776	87.0850	0.3738
CO	28.01	0.428775437	1.1230	0.0670	0.9200	0.0152	0.0000	0.0000	1.1230	0.0670
CO2	44.01	0.272892524	2.0930	0.1961	1.2300	0.0318	0.0000	0.0000	2.0930	0.1961
N2	28.01	0	0.2480	0.0148	0.2300	0.0038	25.0000	0.8224	0.2480	0.0148
CH4	16.04	0.748753117	8.7470	0.2987	96.4300	0.9094	0.0000	0.0000	8.7470	0.2987
C2H6	30	0.800666667	0.0000	0.0000	1.7400	0.0307	0.0000	0.0000	0.0000	0.0000
C3H8	44	0.818863636	0.0000	0.0000	0.2500	0.0065	0.0000	0.0000	0.0000	0.0000
C4H10	58	0.828275862	0.0000	0.0000	0.0800	0.0027	0.0000	0.0000	0.0000	0.0000
C5H12+	72	0.834027778	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
H2O	18	0	0.0400	0.0015	0.0000	0.0000	0.0000	0.0000	0.0400	0.0015
Methanol	32	0.3753125	0.7050	0.0480	0.0000	0.0000	0.0000	0.0000	0.7050	0.0480
Ethanol	46.07	0.521380508	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Avg MW	4.70		17.01		8.51		4.70	
LHV (Btu/lb)	26458		20437		9152		26458	
HHV (Btu/lb)	30779		22675		10836		30779	
MMBtu/hr	1521.88		157.36		765.98		1852.08	
VOC Wt %								
lb/hr	57520		7700		83700		70000	
hr/yr (startup)	8		8		8		8	
hr/yr (shutdown)	4		4		4		0	
hr/yr (continuous)	0		0		0		0	
MMscf comb/yr (startup)	37.74		1.39		30.29		45.92	
MMscf comb/yr (shutdown)	18.87		0.70		15.14		0	
MMscf comb/yr (continuous)	0		0		0		0	
HHV (MMBtu/MMscf)	375.32		1001.35		239.55		375.32	
Carbon Content (Kg C/Kg Flare Gas)	0.32		0.73		0.00		0.32	
Carbon fraction contributed from CH4	0.690		0.935		0.000		0.690	

OCI Beaumont LLC
Existing Methanol Plant Flare (45)
Continuous, Startup, and Shutdown Ve
September 2013

Component	Mol Wt	Carbon Content	PSA Hydrogen Vent PV-5358 NH3 Plant SU/SD Mole%	wt%	PSA TAIL GAS Vent PV-5368 NH3 Plant SU/SD Mole %	wt%	Natural Gas Sweep Continuous Mole %	wt%
H2	2.016	0	100.0000	1.0000	60.0500	0.1424	0.0000	0.0000
CO	28.01	0.428775437	0.0000	0.0000	0.6400	0.0211	0.0000	0.0000
CO2	44.01	0.272892524	0.0000	0.0000	1.5300	0.0792	1.1900	0.0313
N2	28.01	0	0.0000	0.0000	0.6000	0.0198	0.2300	0.0038
CH4	16.04	0.748753117	0.0000	0.0000	36.0700	0.6804	96.1900	0.9217
C2H6	30	0.800666667	0.0000	0.0000	0.0000	0.0000	2.0400	0.0366
C3H8	44	0.818863636	0.0000	0.0000	0.0000	0.0000	0.2500	0.0066
C4H10	58	0.828275862	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
C5H12+	72	0.834027778	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
H2O	18	0	0.0000	0.0000	0.0900	0.0019	0.0000	0.0000
Methanol	32	0.3753125	0.0000	0.0000	0.0300	0.0011	0.0000	0.0000
Ethanol	46.07	0.521380508	0.0000	0.0000	1.0000	0.0542	0.0000	0.0000

Avg MW	2.02		8.50		16.74	
LHV (Btu/lb)	51623		22750		20436.66	
HHV (Btu/lb)	61030		25796		22674.69	
MMBtu/hr	619.48		800.22		0.388297	
VOC Wt %						
lb/hr	12000		35175		19	
hr/yr (startup)	8		8		0	
hr/yr (shutdown)	4		4		0	
hr/yr (continuous)	0		0		8760	
MMscf comb/yr (startup)	18.34		12.75		0	
MMscf comb/yr (shutdown)	9.17		6.37		0	
MMscf comb/yr (continuous)	0		0		3.83	
HHV (MMBtu/MMscf)	319.44		569.52		985.44	
Carbon Content (Kg C/Kg Flare Gas)	0.00		0.57		0.73	
Carbon fraction contributed from CH4	0.000		0.896		0.941	

OCI Beaumont LLC
NSR Permit No. 901 Amendment
Revised 09-2013

Methanol Plant Flare GHG Emissions (EPN: 45)

Pilots (Normal Operations)

80	Pilot Gas Flow, scfh per pilot
3	# of pilots
14400	Total Pilot Gas Flow, scf/hr
126.14	Total Pilot Gas Flow, MMscf/yr

Flared Streams (Normal Operations)

	Natural Gas Sweep Continuous
Avg MW	16.74
hr/yr (startup)	0
hr/yr (shutdown)	0
hr/yr (continuous)	8760
MMscf comb/yr (startup)	0
MMscf comb/yr (shutdown)	0
MMscf comb/yr (continuous)	3.83
HHV (MMBtu/MMscf)	985.44
Carbon Content (Kg C/Kg Flare Gas)	0.73
Carbon fraction contributed from CH4	0.941

Startup and Shutdown Waste Gas

	Methanol Loop Purge PV-3100/3100-1 NH3 Plant SD/MeOH Plant	Reformer Fuel Gas Header Start-Up Vent PV-650-2 MeOH Plant SU/SD	Syngas suction vent PV-5555 OH Plant SD/NH3 Plan
Avg MW	4.70	17.01	8.51
hr/yr (startup)	8	8	8
hr/yr (shutdown)	4	4	4
hr/yr (continuous)	0	0	0
MMscf comb/yr (startup)	37.74	1.39	30.29
MMscf comb/yr (shutdown)	18.87	0.70	15.14
MMscf comb/yr (continuous)	0	0	0
HHV (MMBtu/MMscf)	375.32	1001.35	239.55
Carbon Content (Kg C/Kg Flare Gas)	0.32	0.73	0.00
Carbon fraction contributed from CH4	0.690	0.935	0.000

	PSA Inlet Vent PV-5328 NH3 Plant SU	PSA Hydrogen Vent PV-5358 NH3 Plant SU/SD	PSA TAIL GAS Vent PV-5368 NH3 Plant SU/SD
Avg MW	4.70	2.02	8.50
hr/yr (startup)	8	8	8
hr/yr (shutdown)	0	4	4
hr/yr (continuous)	0	0	0
MMscf comb/yr (startup)	45.92	18.34	12.75
MMscf comb/yr (shutdown)	0.00	9.17	6.37
MMscf comb/yr (continuous)	0	0	0
HHV (MMBtu/MMscf)	375.32	319.44	569.52
Carbon Content (Kg C/Kg Flare Gas)	0.32	0.00	0.57
Carbon fraction contributed from CH4	0.690	0.000	0.896

EMISSION CALCULATIONS

CO2 Emissions

129.97 MMscf/yr, $FLARE_{norm}$ (Pilot Gas + Sweep Nat Gas)
985.44 HHV (Nat Gas, MMBtu/MMscf)
60 Kg/MMBtu, EmF
849.5 scf/Kg-mol, MVC

8,692 MT/YR, CO2 Emissions (Eqn Y-3, 40 CFR Part 98)
9,581 Ton/yr, CO2

CH4 Emissions

0.003 EmFch4, Emission factor from Table C-2 (40 CFR Part 98)

207.60 MT/YR, CH4 Emissions (Eqn Y-4, 40 CFR Part 98)
228.8 Ton/yr, CH4

N2O Emissions

0.0006 EmFn2o, Emission factor from Table C-2 (40 CFR Part 98)

0.0869 MT/YR, N2O Emissions (Eqn Y-5, 40 CFR Part 98)
0.10 Ton/yr, N2O

CO2e Emissions

	Global Warming Potential	CO2e, MT/yr	CO2e, ton/yr
CO2	1	8,692	9,581
CH4	21	4,360	4,806
N2O	310	27	30
		13,078.3	**14,416.3**

TABLE 8

FLARE SYSTEMS

Number from flow diagram: EPN: 45	Manufacturer & Model No. (if available): NAO, Inc. - 24" NFF-CG (Equip. #14-9446-001)

CHARACTERISTICS OF INPUT

Waste Gas Stream	Material	Min. Value Expected	Ave. Value Expected (NH3 Plant SU)	Ave. Value Expected (MeOH Plant SU)
Reactor Purge Gas		lb/hr	lb/hr	lb/hr
	H2	0	58038	21502
	CO	0	5430	3969
	CO2	0	16514	11526
	N2	0	70567	880
	CH4	0	44844	24185
	C2H6	0	0	236
	C3H8	0	0	50
	C4H10	0	0	21
	C5H12+	0	0	0
	H2O	0	174	88
	Methanol	0	3402	2763
	Ethanol	0	1906	0
% of time this condition occurs		~98	~1	~1

	Flow Rate (scfm [68°F, 14.7 psia])		Temperature °F	Pressure (psig)
	Minimum Expected	Design Maximum		
Waste Gas Stream	0	78,333.33	100	9.5 psia
Fuel Added to Gas Stream (NG)	240			

	Number of Pilots	Type Fuel	Fuel Flow Rate (scfm [70°F & 14.7 psia]) per pilot
	3	Natural Gas	1.33

For Stream Injection	Stream Pressure (psig)		Total Stream Flow	Temperature °F	Velocity (ft/sec)
	Min. Expected	Design Max.	Rate (lb/hr)		

	Number of Jet Streams	Diameter of Steam Jets (inches)	Design basis for steam injected (lb steam/lb hydrocarbon)

For Water Injection	Water Pressure (psig) Min. Expected Design Max.	Total Water Flow Rate (gpm) Min. Expected Design Max.	No. of Water Jets	Diameter of Water Jets (inches)

Flare Height (ft): 217	Flare tip inside diameter (ft): 2
Capital Installed Cost $________	Annual Operating Cost $_____________

Supply an assembly drawing, dimensioned and to scale, to show clearly the operation of the flare system. Show interior dimensions and features of the equipment necessary to calculate its performance. Also describe the type of ignition system and its method of operation. Provide an explanation of the control system for steam flow rate and other operating variables.

4.4 Reformer Flare (EPN: FL42)

The Reformer Flare will be constructed as part of the debottlenecking project in order to combust the off-gas from various vents during startups and shutdowns. The primary reformers have previously vented to atmosphere during MSS operations. These emissions are being routed to a flare as BACT for this MSS source. During MSS operations, process gases consisting of carbon monoxide, methane, hydrogen, nitrogen and water must be slowly introduced into or taken out of the synthesis gas compressor. This slow loading of the compressor during MSS results in the need for this vent. The vent is also needed during malfunctions to prevent equipment damage. As part of this debottlenecking project, the status of the stripper tails tank will be changed from a tank to a process vessel and the vent will be routed to the flare. No upset / malfunction emissions are being permitted in this application. The flare emissions are calculated below.

BASIS AND ASSUMPTIONS:

Pilot Gas Combustion:

Fuel Usage: 71 scf/hr-pilot
Number of Pilots: 4 pilots
Typical Nat Gas Heating value: 985.44 Btu/scf
Annual Operating Hours: 8,760 hrs/yr

Normal Operations

Natural Gas Sweep

- 3.83 MMscf/yr (68 deg. F and 14.7 psia)
- Typical Nat Gas Heating value: 985.44 Btu/scf
- Annual Operating Hours: 8,760 hrs/yr

Stripper Tails Vent

- From Methanol Plant – average flow to flare = 48 lb/hr

MSS Operations

Methanol Plant Startups and Shutdowns

- Vent gas from multiple vents during startup and shutdown operations (Refer to enclosed vent stream data for stream compositions and properties.
- 1 methanol plant startup and shutdown / yr
- 8 hours per startup event, 4 hours per shutdown event

Calculation Methodology

CO_2:

CO_2 emissions are calculated utilizing the following equation:

$$CO_2 = 0.98 \times 0.001 \times \left(Flare_{Norm} \times HHV \times EmF + \sum \left[\frac{44}{12} \times (Flare_{ssm}) \times \frac{MW}{MVC} \times CC\right]\right)$$ (Equation Y-3, 40 CFR Part 98.253)

Where:

CO_2 = Carbon dioxide emissions in metric tons per year;
0.98 = Assumed combustion efficiency of the flare;
0.001 = Conversion factor from Kg to metric tons;
$Flare_{Norm}$ = Annual volume of flare gas combusted during normal operations (Pilot Gas and Stripper Tails Tank Vent), MMscf/yr;
HHV = Higher heating value for fuel gas or flare gas, MMBtu/MMscf;
EmF = Default CO_2 emission factor for flare gas, 60 Kg CO_2 / MMBtu (high heat basis);
44 = molecular weight of CO_2, Kg/Kg-mol;
12 = atomic weight of C, Kg/Kg-mol;
$Flare_{ssm}$ = Volume of gas combusted during start-up or shutdown event from engineering calculations, scf/event;
MW = Average molecular weight of the flare gas from engineering calculations for each event, kg/kg-mol,
MVC = Molar conversion factor, 849.5 scf/Kg-mol (@ 68°F);
CC = Average carbon content of the flare gas from engineering calculations for each event, Kg C / Kg flare gas;

CH_4:

CH_4 emissions are calculated utilizing the following equation:

$$CH_4 = \left(CO_2 \times \frac{EmF_{CH_4}}{EmF}\right) + CO_2 \times \frac{0.02}{98} \times \frac{16}{44} \times f_{CH_{4(1-4)}}$$ (Equation Y-4, 40 CFR Part 98.253)

Where:

CH_4 = Annual methane emissions from flared gas, MT CH_4/yr;
CO_2 = Carbon dioxide emissions from equation Y-3 above, MT/yr;

EmF_{CH4} = Default CH_4 emission factor for “Petroleum Products” from Table C-2 of Subpart C, Kg CH_4 / MMBtu;
EmF = Default CO_2 emission factor for flare gas, 60 Kg CO_2 / MMBtu (high heat basis);
0.02/0.98 = Correction factor for flare combustion efficiency;
16/44 = Correction factor ratio of the molecular weight of CH_4 to CO_2;
$f_{CH4(1\text{-}4)}$ = Weight fraction of carbon in each of the startup and shutdown streams prior to combustion that is contributed by methane from engineering calculations, Kg C from methane / Kg C in flare gas;

<u>N_2O:</u>

N_2O emissions are calculated utilizing the following equation:

$$N_2O = \left(CO_2 \times \frac{EmF_{N2O}}{EmF}\right)$$ (Equation Y-6, 40 CFR Part 98.253)

Where: N_2O = Annual nitrous oxide emissions from flared gas, MT N_2O/yr;
CO_2 = Carbon dioxide emissions from equation Y-3 above, MT/yr;
EmF_{N2O} = Default N_2O emission factor for “Petroleum Products” from Table C-2 of Subpart C, Kg N_2O / MMBtu;
EmF = Default CO_2 emission factor for flare gas, 60 Kg CO_2 / MMBtu (high heat basis);

The following table summarizes the greenhouse gas emissions for the Reformer MSS Flare. TCEQ Table 8 and detailed emissions calculations for the flare are included on the following pages.

	EPN: FL42
CO_2 (tpy)	16,721
CH_4 (tpy)	265.8
N_2O (tpy)	0.2

OCI Beaumont LLC
Proposed Reformer Flare (FL42)
Continuous, Startup, and Shutdown Vents
September 2013

			Vent from Saturator PV-4251 MeOH Plant SU/SD		Vent Pre-Reformer PV-4303 MeOH Plant SU		Reformers Cold Vent PV-4509 MeOH Plant SD	
Component	Mol Wt	Carbon Content	Mole%	wt frac	Mole%	wt frac	Mole%	wt frac
H2	2.016	0.0000	0.7000	0.0008	0.5400	0.0006	73.3000	0.1524
CO	28.01	0.4288	0.5000	0.0080	0.1100	0.0017	15.3000	0.4420
CO2	44.01	0.2729	0.1000	0.0025	0.3700	0.0092	7.4000	0.3359
N2	28.01	0.0000	0.1000	0.0016	0.0600	0.0010	0.1000	0.0029
CH4	16.04	0.7488	32.2000	0.2957	24.6800	0.2242	3.7000	0.0612
C2H6	30	0.8007	0.7000	0.0120	0.5200	0.0088		0.0000
C3H8	44	0.8189	0.1000	0.0025	0.0600	0.0015		0.0000
C4H10	58	0.8283		0.0000	0.0500	0.0016		0.0000
C5H12+	72	0.8340		0.0000		0.0000		0.0000
H2O	18	0.0000	65.5000	0.6750	73.6000	0.7502	0.3000	0.0056
Methanol	32	0.3753	0.1000	0.0018	0.0600	0.0011		0.0000

Avg MW	17.47		17.66		9.70	
LHV (Btu/lb)	6746.99		5111.95		11091.37	
HHV (Btu/lb)	7487.44		5674.42		12683.00	
MMBtu/hr	3529.024		3505.714		1052.576	
VOC Wt %						
lb/hr	523052		685788		94900	
hr/yr (startup)	8		8		0	
hr/yr (shutdown)	4		0		4	
hr/yr (continuous)	0		0		0	
MMscf comb/yr (startup)	92.27		119.66		0	
MMscf comb/yr (shutdown)	46.13		0		15.08	
MMscf comb/yr (continuous)	0		0		0	
HHV (MMBtu/MMscf)	339.56		260.16		319.26	
Carbon Content (Kg C/Kg Flare Gas)	0.238		0.181		0.327	
Carbon fraction contributed from CH4	0.931		0.926		0.140	

OCI Beaumont LLC
Proposed Reformer Flare (FL42)
Continuous, Startup, and Shutdown Vents
September 2013

			Reformers Cold Vent PV-252/252-1 MeOH Plant SU/SD		Stripper Tails Tank Vent Continuous		Natural Gas Sweep Continuous	
Component	Mol Wt	Carbon Content	Mole%	wt frac	Mole%	wt frac	Mole %	wt%
H2	2.016	0.0000	68.4000	0.1345	0.0000	0.0000	0.0000	0.0000
CO	28.01	0.4288	14.3000	0.3906	0.0000	0.0000	0.0000	0.0000
CO2	44.01	0.2729	6.9000	0.2961	0.0000	0.0000	1.1900	0.0313
N2	28.01	0.0000	0.1000	0.0027	0.0000	0.0000	0.2300	0.0038
CH4	16.04	0.7488	3.4000	0.0532	0.0000	0.0000	96.1900	0.9217
C2H6	30	0.8007		0.0000	0.0000	0.0000	2.0400	0.0366
C3H8	44	0.8189		0.0000	0.0000	0.0000	0.2500	0.0066
C4H10	58	0.8283		0.0000	0.9600	0.0189	0.0000	0.0000
C5H12+	72	0.8340		0.0000	0.3000	0.0074	0.0000	0.0000
H2O	18	0.0000	7.0000	0.1229	21.3100	0.1305	0.0000	0.0000
Methanol	32	0.3753		0.0000	77.4200	0.8432	0.0000	0.0000

Avg MW	10.25		29.38		16.74	
LHV (Btu/lb)	9769.81		7967.15		20436.66	
HHV (Btu/lb)	11171.98		9010.36		22674.69	
MMBtu/hr	3157.653		0.3824232		0.388297	
VOC Wt %						
lb/hr	323205		48		19	
hr/yr (startup)	8		0		0	
hr/yr (shutdown)	4		0		0	
hr/yr (continuous)	0		8760		8760	
MMscf comb/yr (startup)	97.12		0		0	
MMscf comb/yr (shutdown)	48.56		0		0	
MMscf comb/yr (continuous)	0		5.51		3.83	
HHV (MMBtu/MMscf)	297.44		687.38		985.44	
Carbon Content (Kg C/Kg Flare Gas)	0.288		0.338		0.733	
Carbon fraction contributed from CH4	0.138		0.000		0.941	

OCI Beaumont LLC
NSR Permit No. 901 Amendment
Revised 09-2013

Reformer MSS Flare GHG Emissions (EPN: FL42)

Pilots (Normal Operations)

71 Pilot Gas Flow, scfh per pilot
4 # of pilots
17040 Total Pilot Gas Flow, scf/hr
149.27 Total Pilot Gas Flow, MMscf/yr

Flared Streams (Normal Operations)

	Stripper Tails Tank Vent	Natural Gas Sweep
	Continuous	Continuous
Avg MW	29.383	16.739018
hr/yr (startup)	0	0
hr/yr (shutdown)	0	0
hr/yr (continuous)	8760	8760
MMscf comb/yr (startup)	0	0
MMscf comb/yr (shutdown)	0	0
MMscf comb/yr (continuous)	5.51	3.83
HHV (MMBtu/MMscf)	687.38	985.44
Carbon Content (Kg C/Kg Flare Gas)	0.34	0.73
Carbon fraction contributed from CH4	0	0.941

Startup and Shutdown Waste Gas

	Vent from Saturator	Vent Pre-Reformer	Reformers Cold Ven	Reformers Cold Vent
	PV-4251	PV-4303	PV-4509	PV-252/252-1
	MeOH Plant SU/SD	MeOH Plant SU	MeOH Plant SD	MeOH Plant SU/SD
Avg MW	17.467062	17.6586124	9.695488	10.25443
hr/yr (startup)	8	8	0	8
hr/yr (shutdown)	4	0	4	4
hr/yr (continuous)	0	0	0	0
MMscf comb/yr (startup)	92.268998	119.6642636	0	97.11756
MMscf comb/yr (shutdown)	46.134499	0	15.07994	48.55878
MMscf comb/yr (continuous)	0	0	0	0
HHV (MMBtu/MMscf)	339.55649	260.1578133	319.2644	297.4409
Carbon Content (Kg C/Kg Flare Gas)	0.2379026	0.181184338	0.327022	0.288115
Carbon fraction contributed from CH4	0.9306358	0.926426426	0.140152	0.138211

CO2 Emissions

153.10	MMscf/yr, $FLARE_{norm}$ (Pilot Gas + Sweep Gas)
985.44	HHV (Nat Gas, MMBtu/MMscf)
5.51	MMscf/yr, $FLARE_{norm}$ (Stripper Tails Tk Vt)
687.38	HHV (Stripper Tails Tk Vt, MMBtu/MMscf)
60	Kg/MMBtu, EmF
849.5	scf/Kg-mol, MVC
15,169	MT/YR, CO2 Emissions (Eqn Y-3, 40 CFR Part 98)
16,721	Ton/yr, CO2

CH4 Emissions

0.003	EmFch4, Emission factor from Table C-2 (40 CFR Part 98)
241.15	MT/YR, CH4 Emissions (Eqn Y-4, 40 CFR Part 98) - From Waste Gas)
265.8	Ton/yr, CH4

N2O Emissions

0.0006	EmFn2o, Emission factor from Table C-2 (40 CFR Part 98)
0.1517	MT/YR, N2O Emissions (Eqn Y-5, 40 CFR Part 98)
0.2	Ton/yr, N2O

CO2e Emissions

	Global Warming Potential	CO2e, MT/yr	CO2e, ton/yr
CO2	1	15,169	16,721
CH4	21	5,064	5,582
N2O	310	47	52
		20,280.1	**22,355.0**

TABLE 8

FLARE SYSTEMS

Number from flow diagram: EPN: FL42	Manufacturer & Model No. (if available): Zeeco Flare Systems

CHARACTERISTICS OF INPUT

Waste Gas Stream	Material	Min. Value Expected	Ave. Value Expected (Shutdowns)	Avg. Value Expected (Startups)
		lb/hr	lb/hr	lb/hr
Process Gas	H_2		58349	44308
	CO		172386	131636
	CO_2		128907	103354
	N_2		1996	2374
	CH_4		177660	325590
	C_2H_6		6288	12347
	C_3H_8		1318	2343
	C_4H_{10}		0	1126
	C_5H_{12}+		0	0
	H_2O		393294	907263
	Methanol		958	1704
% of time this condition occurs		Varies	Varies	Varies

	Flow Rate (scfm [68°F, 14.7 psia])		Temperature °F	Pressure (psig)
	Minimum Expected	Design Maximum		
Waste Gas Stream	0		630	6
Fuel Added to Gas Stream (NG)	445			

	Number of Pilots	Type Fuel	Fuel Flow Rate (scfm [70°F & 14.7 psia]) per pilot
	4	Natural Gas	1.2

For Stream Injection NA	Stream Pressure (psig)		Total Stream Flow Rate (lb/hr)	Temperature °F	Velocity (ft/sec)
	Min. Expected	Design Max.			

	Number of Jet Streams	Diameter of Steam Jets (inches)	Design basis for steam injected (lb steam/lb hydrocarbon)

For Water Injection NA	Water Pressure (psig) Min. Expected Design Max.	Total Water Flow Rate (gpm) Min. Expected Design Max.	No. of Water Jets	Diameter of Water Jets (inches)

Flare Height (ft): 215	Flare tip inside diameter (ft): 3.5
Capital Installed Cost $ TBD	Annual Operating Cost $ TBD

Supply an assembly drawing, dimensioned and to scale, to show clearly the operation of the flare system. Show interior dimensions and features of the equipment necessary to calculate its performance. Also describe the type of ignition system and its method of operation. Provide an explanation of the control system for steam flow rate and other operating variables.

Attachment D

Attachment D

BACT Limits at MMBTU Fired /MT of Methanol Produced

Fired Unit	Description	Case A: Methanol Plant Stand Alone Operation (W/O CO2 Addition)	Case B: Methanol Plant Stand Alone Operation (With CO2 Addition)	Case C: Methanol and Ammonia Plant in Operation (W/O CO2 Addition)	Case D: Methanol and Ammonia Plant in Operation (With CO2 Addition)
Reformer	Total Fired Duty for Reformer in MMBtu/hr	2,095.5	1,684.1	2,200.0	1,750.3
	Methanol Produced in MT/hr	120.3	120.3	120.3	120.3
	BACT Limit in MMBtu/MT of MeOH	**120.3**	**14.0**	**18.3**	**14.5**
Pre-reformer	Total Fired Duty for Pre-reformer Fired Heater in MMBtu/hr	196.9	153.1	197.0	153.1
	Methanol Produced in MT/hr	120.3	120.3	120.3	120.3
	BACT Limit in MMBtu/MT of MeOH	**1.6**	**1.3**	**1.6**	**1.3**
SCR Duct Burner	Total Fired Duty for SCR Duct Burner in MMBtu/hr	145.0	145.0	145.0	145.0
	Methanol Produced in MT/hr	120.3	120.3	120.3	120.3
	BACT Limit in MMBtu/MT of MeOH	**1.2**	**1.2**	**1.2**	**1.2**
Combined BACT Limit in MMBtu Fired / MT of Methanol Produced		**123.1**	**16.5**	**21.1**	**17.0**

Attachment E

5-Step GHG BACT Analysis of New Flare (EPN FL42)

OCI is proposing to install a flare to primarily control MSS emissions from startup and shutdown of the reformers. The flare will also control minor emissions from the stripper tails tank vent. This reformer MSS vent and small tank vent are currently vented to atmosphere without control. This BACT analysis is focused on the significantly larger MSS vent stream. OCI has reviewed the EPA RACT/BACT/LAER Clearinghouse (RBLC for similar streams with no results found for this type of MSS). A review of recently available methanol unit permits and applications revealed similar MSS streams. The Equistar and Celanese Methanol Unit permits were reviewed as yet un-entered RBLC data.

CO2 and N2O emissions from flaring process gas are produced from the combustion of carbon containing compounds (e.g., CO, VOCs, CH4) present in the process gas streams and the pilot fuel. GHG emissions from the flare are based on calculation methodologies found in 40 CFR Part 98 for flares. The emission estimates are based on the carbon content and flow rate of the waste gas streams. The primary pollutant to control for GHGs from the MSS sources is CH4 found in the process gas. Flares are an example of control devices which the control of certain pollutants causes the formation of GHG emissions. Specifically, the control of CH4 in the process gas at the flare results in the creation of additional CO2 emissions via the combustion reaction mechanism. However, given the relative global warming potential (GWP) of CO2 and CH4. OCI believes it is appropriate to apply combustion controls to the CH4 emissions even though it will form additional CO2 emissions.

Step 1 – Identification of Potential GHG Control Techniques

The following potential GHG control strategies for the flare were considered as part of this BACT analysis:

Good Process Design;

Best Operational Practices

Good Flare Design; and

Flare Gas Recovery (FGR)

1. Good Process Design

The process is designed with reliability in mind; redundant transmitters are installed key process parameters. The heaters are also designed with automatic controls to ensure the process remains within control limits. This design helps to eliminate upsets from operational errors or instrument failure. The proposed flare is being installed to control emissions from several process PSV's that were routed to the atmosphere which will greatly reduce the CH4 emissions. The proposed flare for this project is intended to control only intermittent vent streams from maintenance, start-up and shutdown activities and malfunctions.

2. Best Operational Practices

Best Operational Practices for the flare include pilot flame monitoring, flow measurement, and minimum BTU values maintained for complete combustion. These practices will ensure flame stability in accordance with 40 CFR §60.18.

3. Good Flare Design

Good flare design can be employed to destroy large fractions of the flare gas. Much work has been done by flare and flare tip manufacturers to assure high reliability and destruction efficiencies. The flare will be designed to achieve 99% destruction efficiency for compounds with one to three carbons and 98% for compounds with four or more carbons.

4. Flare Gas Recovery (FGR)

FGR is a technology that emerged from the drive to conserve flared gas streams at large integrated refineries. A FGR system utilizes water seal drums to prevent recoverable gas flow from going to the flare while allowing the flare to function in the event of an emergency. A compressor located on the downstream end of the main flare header is used to increase the pressure of a constant volumetric flow of flare gas, allowing it to reach a facility that can beneficially use the flare gas as fuel. For applications suited to flare gas recovery the use of the flare is minimized and hence GHG emissions from the flare are also minimized. Flare gas recovery is not practical for OCI as the primary MSS waste gas stream is intermittent and has a very high flow rate.

Step 2 – Elimination of Technically Infeasible Control Options

All control technologies identified in Step 1 are considered technically feasible for this project, except the use of FGR. Use of FGR is not suited to the proposed project because the system would not receive a constant volumetric flow of recoverable gases. The vent streams that will be routed to the flare will result from intermittent MSS events. Furthermore, the reformer would be the most likely recipient of the recovered gas, which is not a viable scenario since the reformer would be in start-up or shutdown mode when the gas is available. FGR is feasible at some refineries with existing fuel gas systems that distribute to a large number of combustion units that constantly need fuel, but is not feasible for the proposed project.

Step 3 – Rank Remaining Control Options by Effectiveness

Use of a good flare design, good process design, and best operational practices is the most effective option for control. Natural gas-fired pilots and good flare design will be applied as $CO2$ GHG BACT for the flare in order to minimize emissions from the flare.

Step 4 – Top-Down Evaluation of Control Option

No energy or environmental impacts (that would influence the GHG BACT selection process) would eliminate any of the remaining control options.

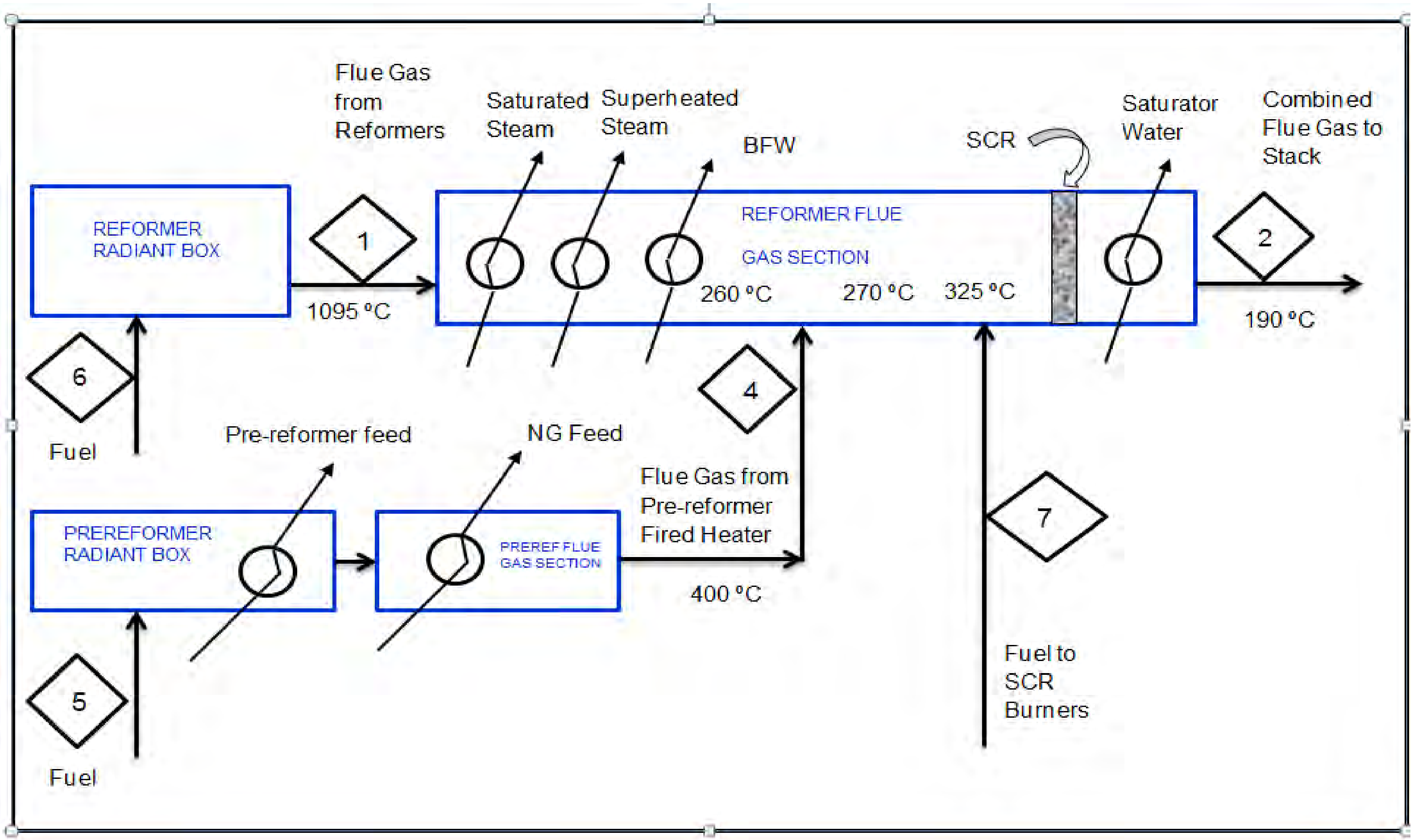
Step 5 – Selection of GHG BACT for Flare

OCIB will use good flare design with appropriate instrumentation and control in addition to good process design, and best operational practices will be used as best available control options for reducing GHGs.

Attachment F

Thermal Efficiency - OCI Methanol Plant Reforming Units

The reforming unit consists of three different firing area with a combined flue gas section and a common stack as shown in Sketch-C. Overall thermal efficiency of the unit is calculated as shown on TABLE-C:



SKETCH-C

TABLE-C

Process Parameter	Revised Value	Unit	Comments
Reformer Heat Duty/Heat absorbed	1,123.72	MMBTU/hr	From Aspen Output file - estimated for 3ktpd
Heat duty Prereformer Feed Heater	108.53	MMBtu/hr	From PFD data
Heat duty NG Feed Preheater	13.18	MMBtu/hr	From PFD data
Enthalpy Hot Flue gas from reformer	1,603.94	MMBTU/hr	Stream No. 1 (Value from Heat & Material Balance)
Enthalpy Flue gas to Stack	557.91	MMBTU/hr	Stream No. 2 (Value from Heat & Material Balance)
Enthalpy Flue gas from fired heater	47.76	MMBTU/hr	Stream No. 4 (Value from Heat & Material Balance)
Flue Gas Enthalpy Change	1,093.80	MMBTU/hr	Heat out from reformer flue gas section
Total Heat Out	**2,339.23**	**MMBTU/hr**	
Reformer Fuel	93,587.81	Lb/hr	Stream No. 6 (Value from Heat & Material Balance)
Reformer fuel HHV	23,507.34	Btu/lb	Estimated from HMB Composition
Total Heat In to Reformer	2,200.00	MMBTU/hr	Fuel Mass Flow x HHV
Reformer Radiant Efficiency	51.08	%	Heat Absorbed (HHV)/ Reformer Fuel (HHV)
Prereformer Fuel	8,612.43	lb/hr	Stream No. 5 (Value from Heat & Material Balance)
Prereformer Fuel HHV	22,873.91	Btu/lb	NG Fuel (Estimated from HMB Composition)
Heat Input	197.00	MMBtu/hr	Fuel Mass Flow x HHV
Fuel to SCR burners	6,310.08	lb/hr	Stream No. 7 (Value from Heat & Material Balance)
SCR burners fuel HHV	22,979.12	Btu/lb	Estimated from composition
Heat duty to SCR	145.00	MMBtu/hr	Fuel Mass Flow x HHV
Total Heat In (total Fuel)	**2,542.00**	**MMBtu/hr**	
Net Efficiency	**92.02**	**%**	**Total Heat Out (Recovered) / Total Heat In (Fuel)**

Attachment G

Attachment G
Reformer Tube Size Calculations

Selection of higher grade alloy material allowed designing thinner wall thickness for the reformer catalyst tubes (Please see attached Foster Wheeler Catalyst Tube Design Summary). The tube wall thickness design has been validated by Schmidt & Clemens (S&C), who is well-known in industry for designing and supplying state-of-the-art reformer tubes for modern steam methane reformers around the world. Detail calculations for thickness, thermal stress and life of the tubes performed by S&C per API-530 are attached.

Keeping same outside diameter and decreasing wall thickness meant increased inside diameter for the tubes, allowing increased catalyst and higher feed flow rate. However, since the reforming reaction is endothermic, heat flux rate to the tubes must also be increased in order to achieve higher production. According to basic heat conduction theory (Fourier Law) heat flux rate can be increased by increasing firing rate (Q) and decreasing tube wall thickness (t) for constant heat transfer coefficient (**λ**) and constant temperature gradient (ΔT):

$$\frac{Q}{A} = q = \frac{\lambda}{t}\Delta T$$

The overall efficiency of the plant has been calculated based on total heat input (Q), which would have been higher if thickness (t) remained unchanged. A quantitative impact of wall thickness on heat requirement could be equivalent to about 37% reduction in fuel requirement[NOTE1]. This equates to an efficiency improvement of about 6.4 MMBTU/MT of Methanol. If tube wall thickness remained unchanged, the overall efficiency of the plant (34.1 MMBTU/MT of Methanol) would have been worse (40.5 MMBTU/MT Methanol[NOTE2]) due to increased fuel requirement (Q) for higher flux requirement.

[NOTE1] Details:

$$\frac{Q1}{Q2} = \frac{t2}{t1}$$

$$\frac{Q1 - Q2}{Q1} = \frac{t2 - t1}{t2}$$

$$\frac{Q1 - Q2}{Q1} = \frac{0.67'' - 0.92''}{0.67''} = -0.373$$

[NOTE2] Details:

Reformer Fuel	93,587.81	Lb/hr
Reformer fuel HHV	23,507.34	Btu/lb
Total Heat In to Reformer	2,200.00	MMBTU/hr

If tube thickness remained unchanged (t1), total fuel to reformer would have been increased by 2,200 x 0.373 = 820.6 MMBTU/hr

Description	**Case: Decreased Tube Thickness**	**Case: Original Tube Thickness**
Total Energy Consumed (MMBtu/hr)	4,699.4	5,469.0
Hydrogen Export to NH3 Plant (lb/hr)	11,529.3	11,529.3
HHV H2 (Btu/lb)	60,962.1	60,962.1
H2 Heating Value (MMBtu/hr)	702.8	702.8
Methanol Produced (lb/hr)	267,285.9	267,285.9
Methanol Produced MT/hr	120.3	120.3
Gross Efficiency (MMBtu/MT of MeOH)	39.1	45.5
Net Efficiency (MMBtu/MT of MeOH)	33.2	40.5

FOSTER WHEELER

Foster Wheeler USA Corporation Fired Heater Division

FWFHD Project Number: 5-56-08060587

Engineering Study for OCI Beaumont

Catalyst Tube Design Summary

Original Tube Inside Diameter = 4.25"; Original Tube Outside Diameter = 6.09"

Original Wall Thickness = 0.92"

Proposed New Tube Inside Diameter = 4.75"; Proposed Tube Outside Diameter = 6.09"

Proposed New Wall Thickness = 0.67"

Increase in Internal (Catalyst) Volume per Reformer = 330 ft^3 (24.91%)

Increase in Heat Transfer Surface (Based on I.D.) per Reformer = 1759 ft^3 (11.77%)

Calculated Maximum Tube Metal Temperature = 1799°F

Design Tube Metal Temperature = 1850°F

Design Pressure = 330 psig

Notes:

1. The use of thinner wall (0.67") is possible due to the use of micro-alloys which have superior rupture stress characteristics. The catalyst tube vendor chosen by OCI will need to confirm the proposed micro-alloy material will meet the design conditions specified.
2. Calculated maximum tube metal temperature is based on Foster Wheeler's in-house computer program. A minimum margin of 50°F is added to determine the design tube metal temperature.
3. Design pressure is based on inlet pressure into the catalyst tubes.
4. As this is a catalytic reaction more catalyst volume means more ability to produce syn gas (H_2 + CO).

Prepared by: **Darren Koon**
Manager, Proposals
Foster Wheeler Fired Heater Division

Darren Koon

Dated: September 12, 2013

Schmidt + Clemens
Centrifugal Casting Division

Calculation of tube minimum thickness according to API-530 Standard

Customer: Orascom E&C USA, Inc
S+C Ref: 38095
Drawing: OD 5,05"

Design data

Pressure (Pr)	**330,0**	*psi*
Temperature (T)	**1850,0**	*ºF*
Outside Diameter (Do)	**6,09**	*inches*
Material:	**Centralloy® G 4852 Micro R**	
Design Time	**100000**	*hours*
95% of Minimum Stress to Rupture at 100000 h (Sr)	**1896,5**	*psi*
Corrosion Allowance (CA)	**0,0**	*inches*
Corrosion Fraction (f)	**0,0**	
Outside Roughness (Ro)	**0,03125**	*inches*

Calculation of Stress Thickness (ts)

$$ts = \frac{Pr \ Do}{2Sr + Pr} =$$ **0,489** *inches*

Calculation of Minimum Thickness (tm)

$tm = ts + f \cdot CA =$ **0,489** *inches*

Calculation of Inside Diameter (Di)

$Di = Do - 2 \cdot ts - 2 \cdot Ro - 2 \cdot f \cdot CA =$ **5,050** *inches*

Notice

The calculations above stated can only be used as reference. Only the Engineering Company can give valid information in what dimensions and materials of the Plant components is concerned.

The properties of the materials supplied by us will be in accordance with those used in above calculations.

Schmidt+Clemens
Metallurgical Services

Rev: 0 01/01/2006

Schmidt + Clemens
Centrifugal Casting Division

S|C

Calculation of tube minimum thickness according to API-530 Standard

Customer: Orascom E&C USA, Inc
S+C Ref: 38095
Drawing:

Design data

Pressure (Pr)	**330,0**	*psi*
Temperature (T)	**1850,0**	*ºF*
Outside Diameter (Do)	**6,09**	*inches*
Material:	**Centralloy® G 4852 Micro R**	
Design Time	**100000**	*hours*
Minimum Stress to Rupture at 100000 h (Sr)	**1996,3**	*psi*
Corrosion Allowance (CA)	**0,0**	*inches*
Corrosion Fraction (f)	**0,0**	
Outside Roughness (Ro)	**0,03125**	*inches*

Calculation of Stress Thickness (ts)

$$ts = \frac{Pr\ \ Do}{2Sr + Pr} =$$ **0,465** *inches*

Calculation of Minimum Thickness (tm)

tm = ts + f·CA = **0,465** *inches*

Calculation of Inside Diameter (Di)

Di = Do - 2·ts - 2·Ro - 2·f·CA = **5,098** *inches*

Notice

The calculations above stated can only be used as reference. Only the Engineering Company can give valid information in what dimensions and materials of the Plant components is concerned.

The properties of the materials supplied by us will be in accordance with those used in above calculations.

Schmidt+Clemens
Metallurgical Services

Rev: 0 01/01/2006

Schmidt + Clemens

Centralloy® G 4852 Micro R

MATERIAL DATA SHEET

Designation: GX45NiCrSiNbTi35-25

Schmidt + Clemens GmbH + Co. KG · Edelstahlwerk Kaiserau · P.O. Box 1140 · 51779 Lindlar, Germany

Contents:

Chemical Composition

	mass percentage (*)
Carbon	0.45
Silicon	0.80
Manganese	1.00
Chromium	25.00
Nickel	35.00
Niobium	1.00
Titanium	Additions
Iron	Balance

(*) This is a typical composition which may be slightly modified according to the application.

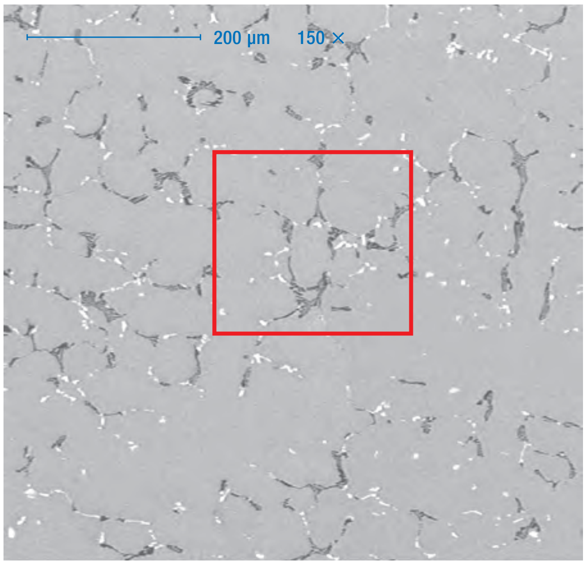
Features

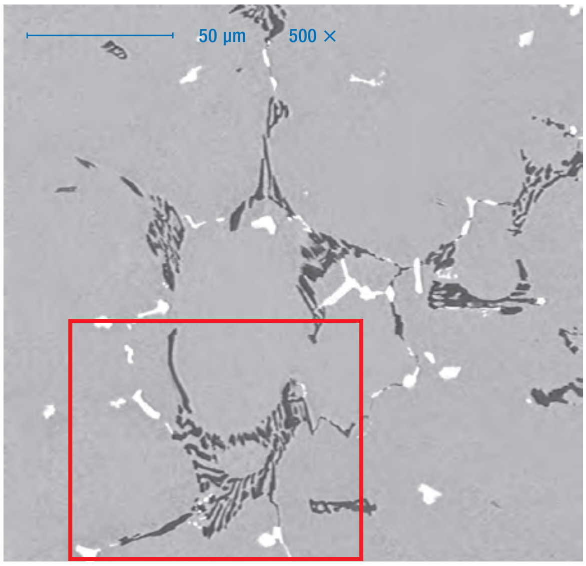
Centralloy® G 4852 Micro R is a cast austenitic steel 35% nickel 25% chromium alloy plus niobium, titanium and others. The alloy possesses excellent structural stability, very good high temperature stress rupture strength and good oxidation resistance.

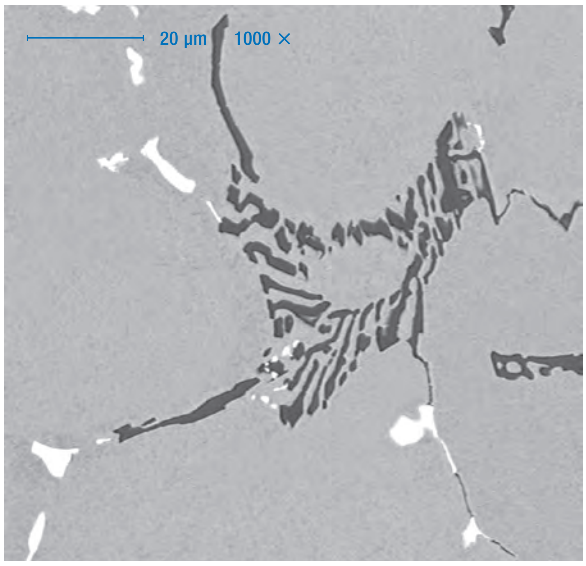
The presence of Carbon leads to the formation of a series of carbides:

a) During solidification (“as cast” condition)

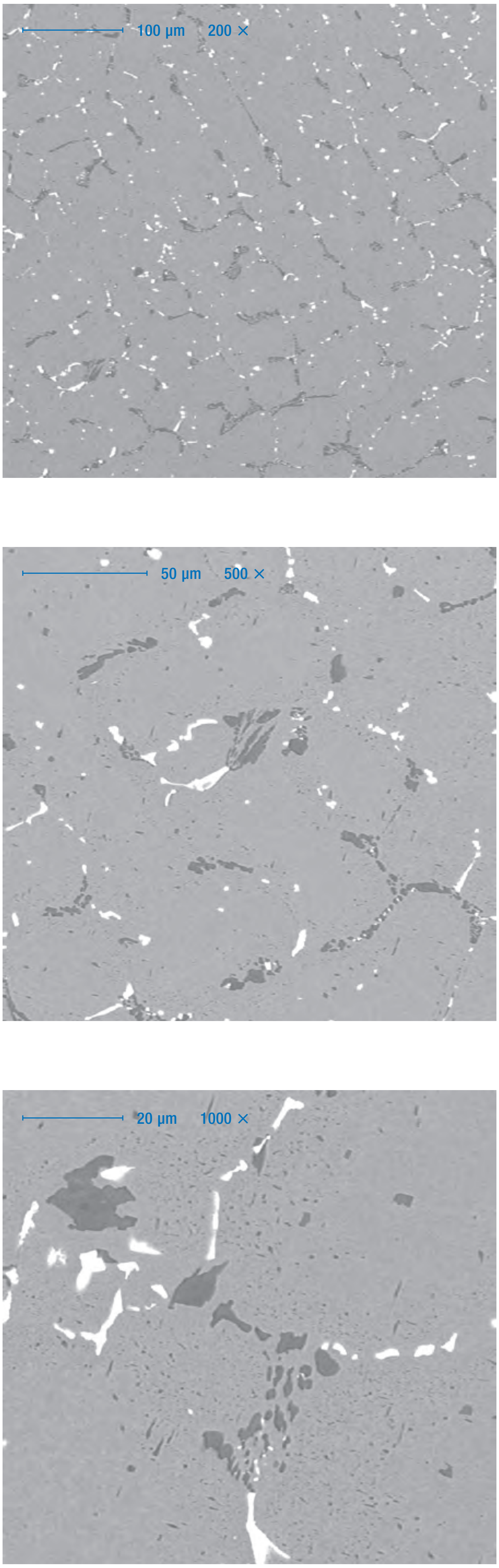
Intergranular carbides of the M_7C_3 type (where M is mainly Cr) and carbides/carbonitrides of the M(C,N) type where M is mainly Nb. These primary precipitates are visible in unetched micro specimens – see SEM Images – its colouring varying from light grey (MC-carbides) to dark grey (M_7C_3-carbides) and some smaller orange/yellow cubic MC-carbonitrides (M being mainly Ti).



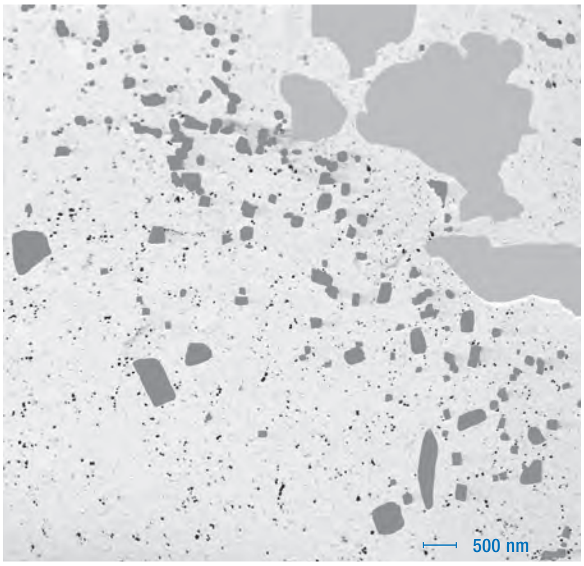




a) SEM Images of Centralloy® G 4852 Micro R as Cast Condition



b) SEM Images of Centralloy® G 4852 Micro R Aged Condition



TEM Image of Centralloy® G 4852 Micro R

b) After exposure to operational conditions
("aged" condition)

The primary M_7C_3 carbides are transformed to $M_{23}C_6$ carbides and small intragranular secondary $M_{23}C_6$ carbides are precipitated. Due to the balance of niobium and micro alloying elements secondary nano particles are precipitated intragranularly. The uniform dispersion and size of such particles leads to a hindered mechanism of dislocation movement with the result of significant strengthening of the material (see SEM Images). The secondary precipitates are visible in unetched micro specimens (see SEM Images) of dark grey colour, and the size of the nano particles can be detected in very high magnification by TEM examination (see TEM Image, black colour).

Product Forms

Centralloy® G 4852 Micro R was designed as centrispun tube material to meet specific design criteria in terms of creep rupture strength, oxidation resistance, and weldability. It is available as centrispun tubes, statically cast and investment cast product forms.

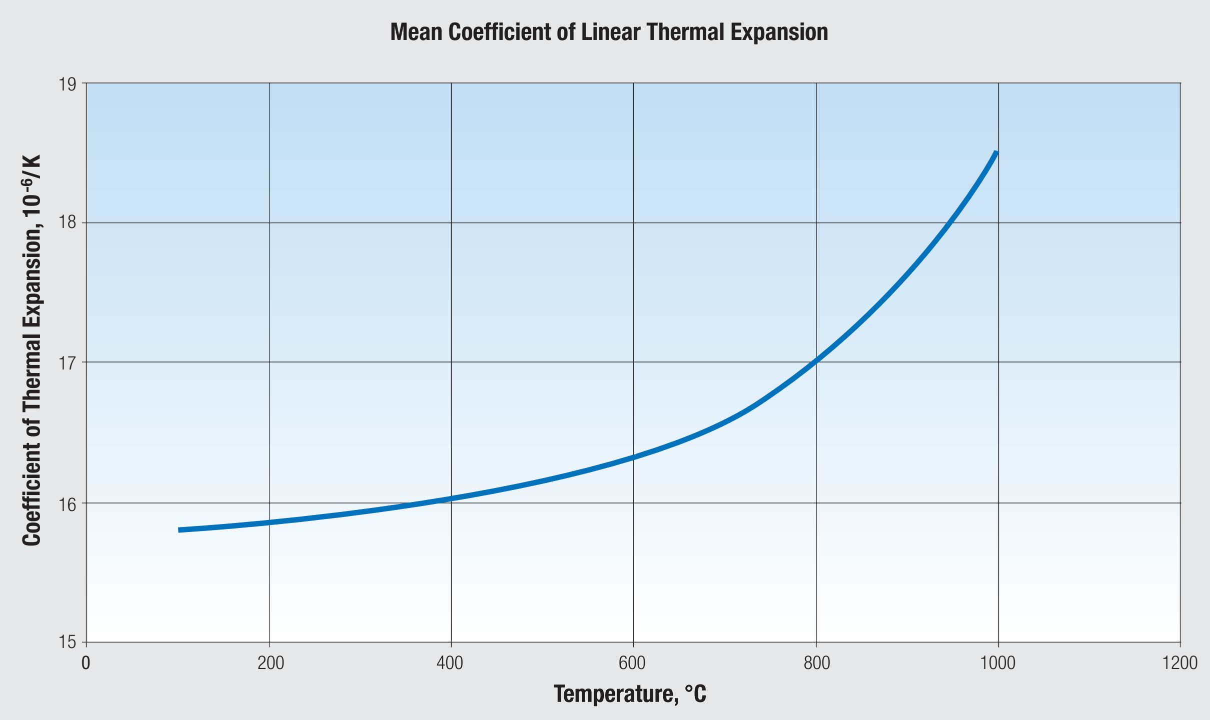
Other forms may be supplied upon request. Further information regarding these topics, and maximum and minimum sizes, may be obtained from the sales department.

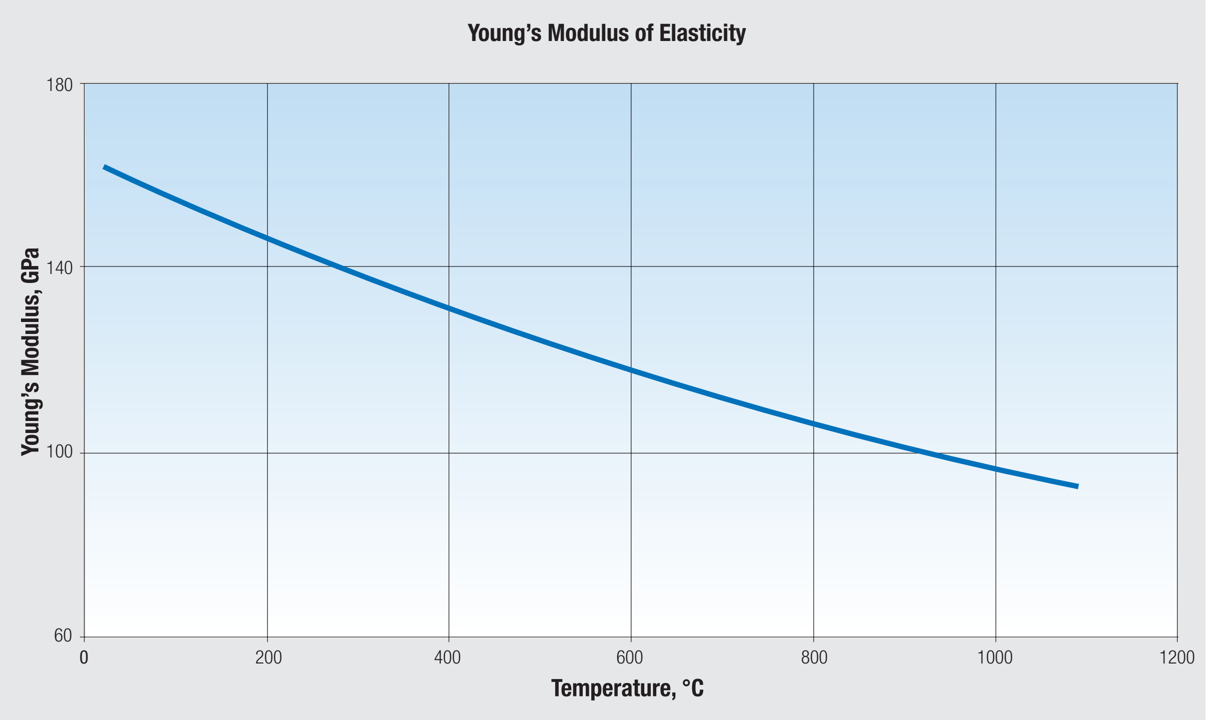
Applications

Tubular systems requiring excellent stress rupture strength combined with good oxidation resistance. The main application for the material Centralloy® G 4852 Micro R is the steam reformer (max. operating temperature: 1050°C).

Physical Properties

Density: 7.9 g/cm³
Thermal conductivity at 20°C: 11.2 W/mK

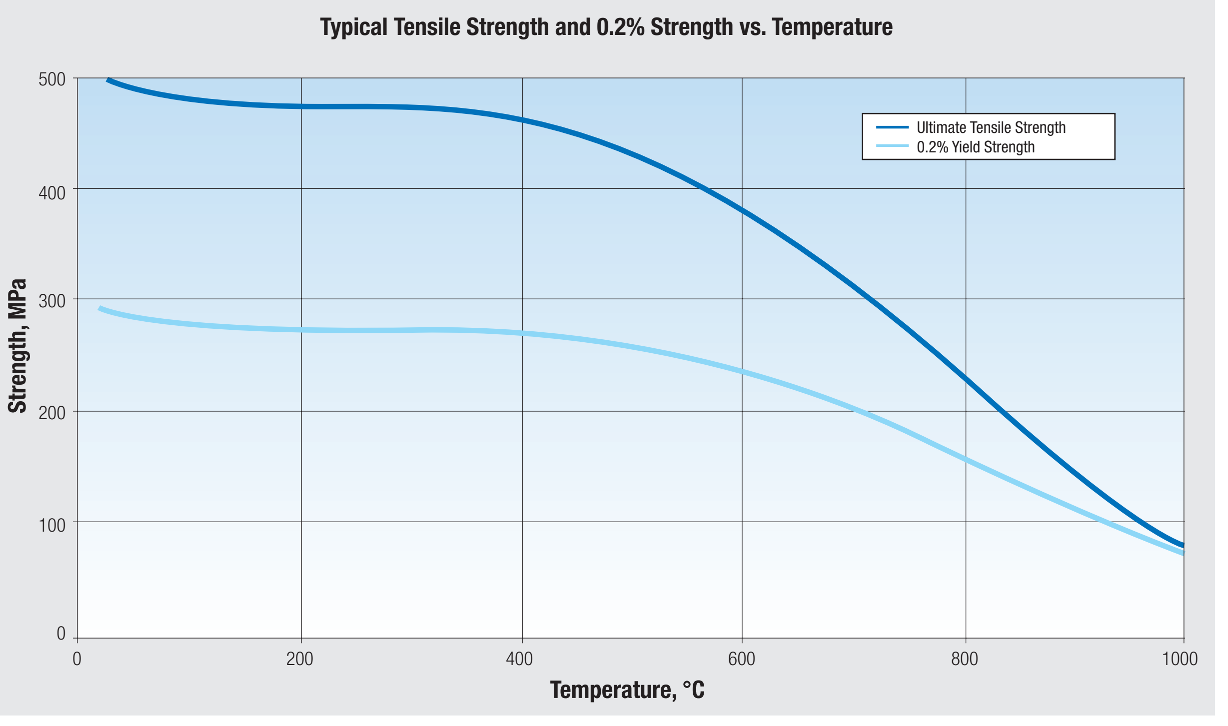


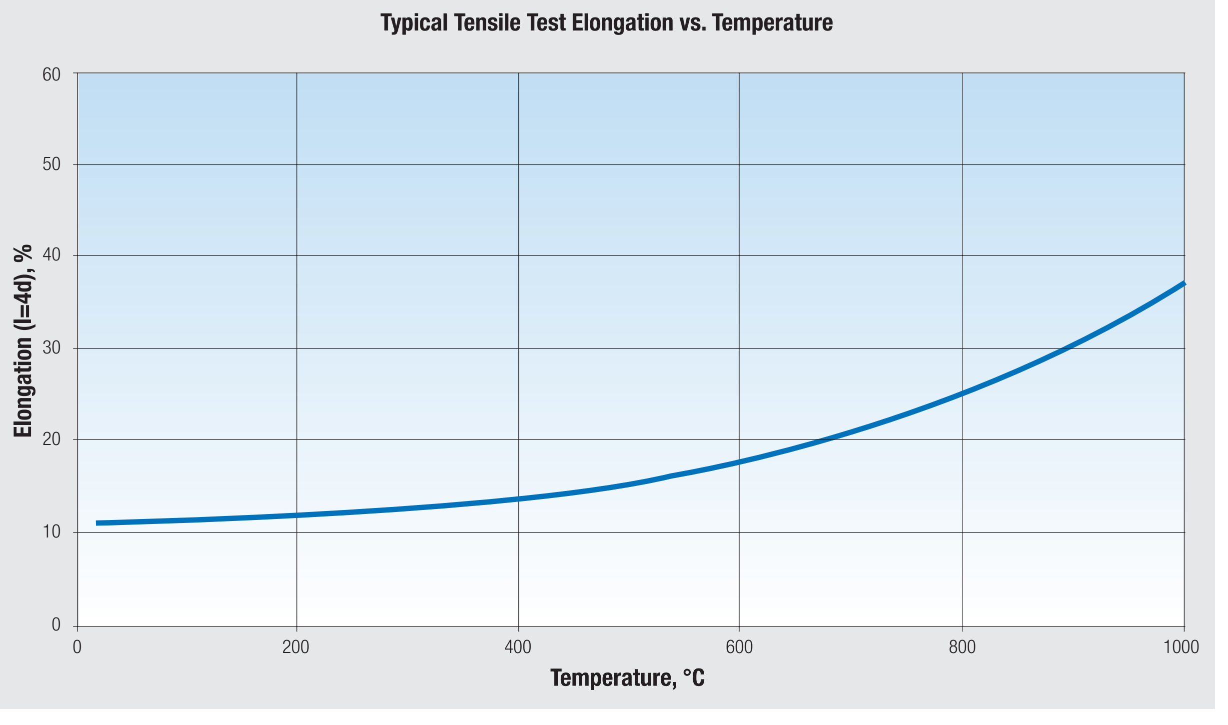


Mechanical Properties
(only for wall thickness less than 25 mm, in the cast conditions)

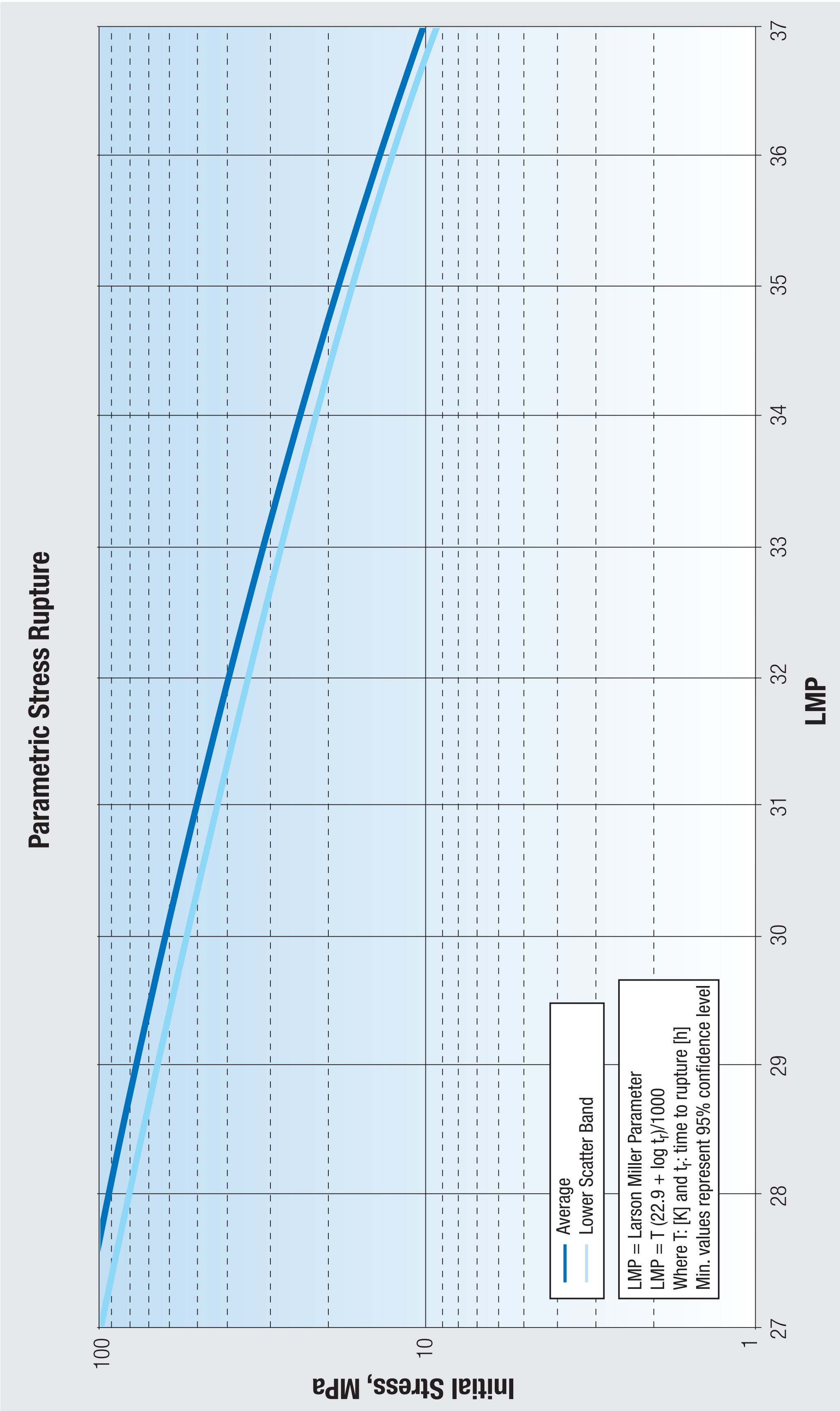
Tensile properties

Minimum tensile properties at 20°C:	0.2% Yield strength:	230 MPa
	Ultimate tensile strength:	450 MPa
	Elongation, (l = 5d):	8% for centricast tubes
		6% for static castings

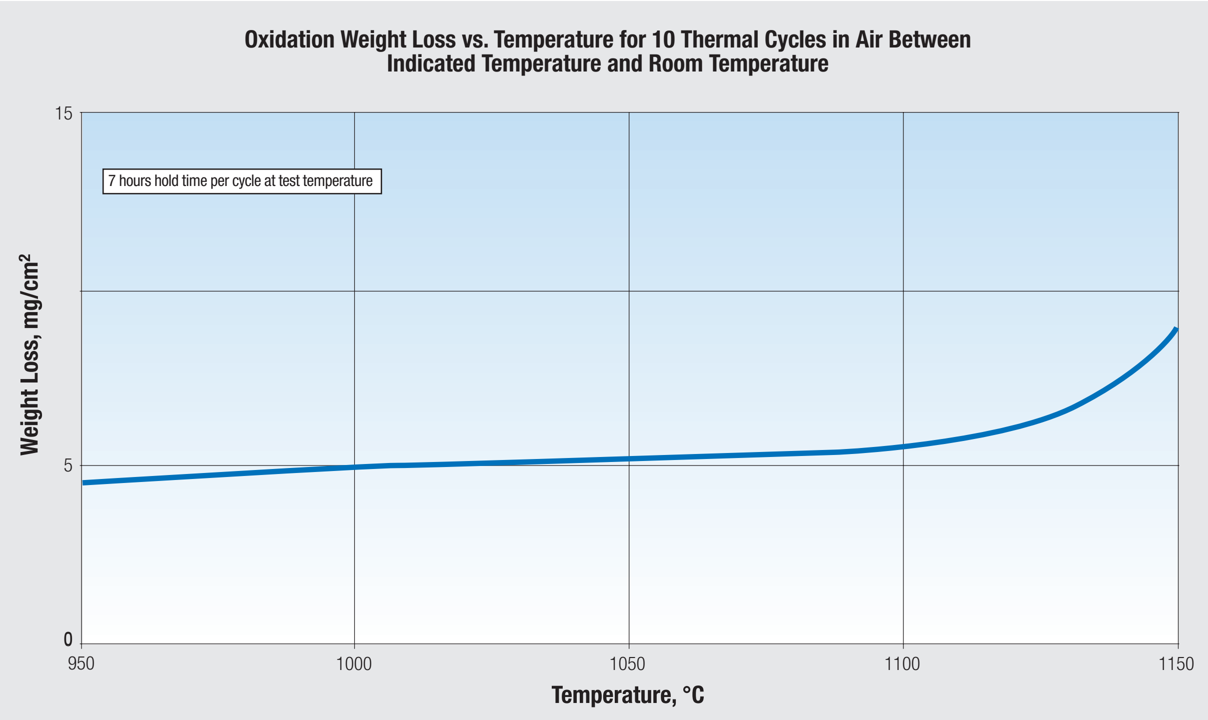




Parametric Stress Rupture Strength



Oxidation Resistance



Manufacturing Characteristics

Machining

In general terms the machinability of Centralloy® G 4852 Micro R is similar to that of other heat resistant alloys.

Welding

For critical, highly stressed and corrosion resistant joints coated electrodes, flux cored wire and non-coated filler material are commercially available. These welding consumables have high strength properties at elevated temperatures with good retained ductilities.

Besides fillerless PAW, SMAW, TIG and GMAW have been used satisfactorily for component fabrication or repair welding. Preheating and postweld heat treatment of the joint is not necessary.

For dissimilar weld joints to austenitic materials the same filler materials are recommended. Further information will be supplied upon request.

Health and Safety Information

The operation and maintenance of welding equipment should conform to the provisions of relevant national standards for the protection of personnel.

Mechanical ventilation is advisable, and under certain conditions in confined spaces, is necessary during welding operations in order to prevent possible exposure to hazardous fumes, gases, or dust that may occur.

Nickel-iron-base materials may contain, in varying concentrations, elemental constitutions of chromium, iron, manganese, molybdenum, cobalt, nickel, tungsten and aluminium. Inhalation of metal dust from welding, grinding, melting and dross handling of these alloy systems may cause adverse health effects.

Schmidt + Clemens Group

Centrifugal Casting – Petrochemicals

Industries
- Petrochemicals
- Iron-ore direct reduction

Services
- Business consulting
- Analysis of operational data
- Training of customer personnel
- Welding supervision

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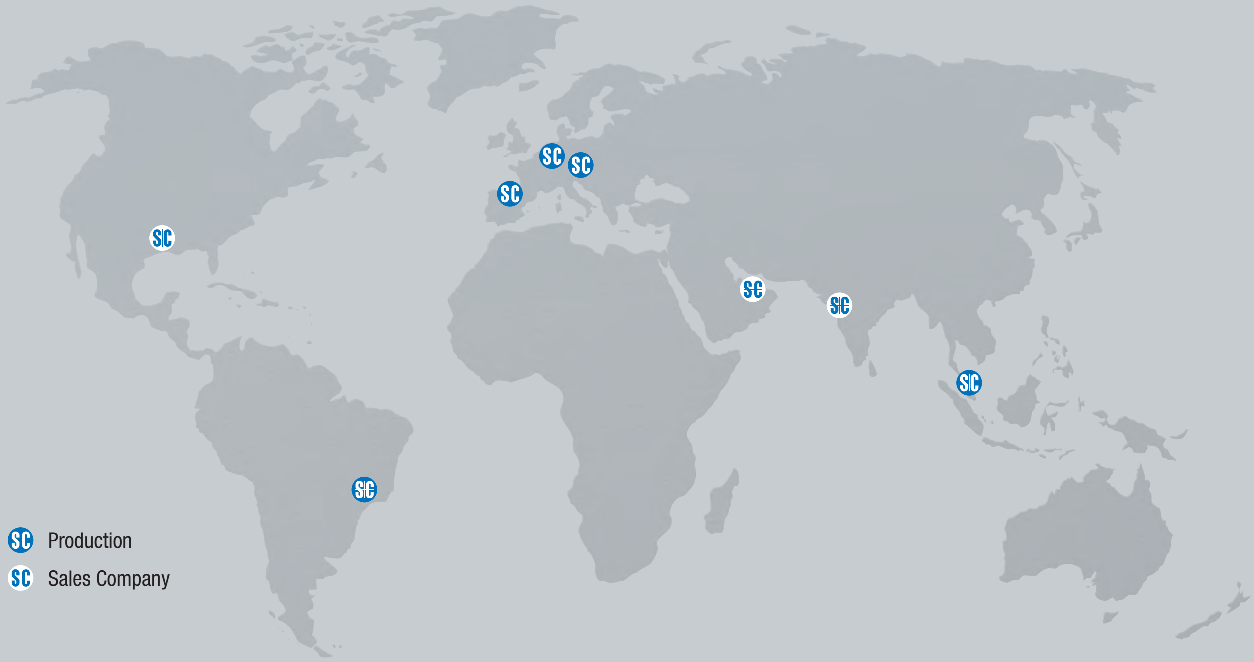


Attachment H

Response to EPA Information Request
OCI Beaumont LLC
Greenhouse Gas PSD Application

Attachment H
Saturator System

Process Description

Standard Methanol Plant designed with or without ATR technology uses what is called a Gas Saturator where the Natural Gas is saturated with a process water stream to be recovered as steam for the reformers, thus decreasing the demand of boiler generated steam to meet the steam to carbon ratio requirements for the reformer operation.

The advantage of a Saturator is that it can re-process the organic stream from distillation instead of firing it in the convection section of the reformers. The result is decreased NOx emissions and the recovery over 175 ton/hr of water as steam. This has a positive direct impact on the efficiency of the plant as well as reducing GHG emissions.

With the installation of a saturator column in the plant, the streams described above will be processed in a more efficient and environmental friendly way.

The stripper tails, dehydrator water stream and process condensate will be fed as a liquid stream to the top of this saturator packed column. The natural gas used as feedstock for the MeOH process will be sent as a gaseous stream to the bottom of the saturator column. The gas flows upward in the column and the liquid falls down in the packed column. This allows for effective mixing between these two phases. During this mixing process, the water and the organic components in the liquid stream will saturate the natural gas stream. This means that most of the organics will go to the natural gas stream and will be used as feedstock to the process instead of having to be treated as waste (hydrator water) or to be burned (stripper tails). Furthermore much of the steam that is needed to be mixed with the natural gas for the steam reforming is already transferred to the natural gas stream in the saturator column (i.e., the natural gas is already saturated with water). This gives the column its name.

The natural gas with water vapor and organics leaves the top of the saturator. The remaining liquid stream that exits the saturator column at the bottom is very small compared to the original flow of this stream. This strongly reduced liquid saturator bottoms stream is sent to the waste water treatment plant. This flow will be much less than the current dehydrator water stream sent to the waste water treatment plant.

To summarize: the saturator has the following environmental and energy efficiency advantages:

- The stripper tails will no longer will have to be “burned” in the reformer convection section. This will save natural gas, and will reduce the reformer flue gas emissions.
- The dehydrator water stream will be used effectively and the amount of purge water sent to the water treatment plant will be reduced.
- A major part of the organic components present in the stripper tail gas and the dehydrator water will be used as process feedstock reducing the need for natural gas feedstock.
- The process condensate will be recycled and the CO2 stripper will no longer be required during normal operations, thus decreasing GHG emissions.
- The amount of steam needed to be put into the natural gas for the steam reforming process will be reduced. This steam requirement reduction saves energy.

Process Control:

The saturator process is very stable during normal operation. There are certain key operational parameters that need to be controlled in the Saturator with two main objectives:

1. Maintain the required Steam Pick-Up flow
2. Maintain the quality of the Circulating Water to not jeopardize the integrity of the equipment included in the Saturator water circulation system and minimize blowdown purge.

Table 1 below shows the Saturator Column Key Operating parameters to be monitored and used to alert on site personnel to operating problems or the Saturator Column operating below design efficiency. The Maximum and Minimum ranges are action points for site personnel.

Table 1: Saturator Column Normal/Max/Min key Operating Parameters.

C. P.	TAG No	Description	Normal Value	Min-Max Range
1	TI-4258	Natural Gas Feedstock (°C)	84	80 - 90
2	TI-4252	Saturator Overhead Mixed Gas+Steam (°C)	208	201 - 215
3	PIC-4251	Saturator Column Pressure (psig)	422	410 - 435
4	TI-4271	Saturator Column Bottom (°C)	157	152 – 162
5	PDI-4262	Saturator Column Packing Delta P (psi)	0.08	0.05 – 1.0
6	FIC-4254	Saturator Water Circulation (PPH)	2,039,000	1,978,000- 2,100,000
7	FI-4290A	Saturator Calculated Steam Pick-Up (PPH)	353,128	343,000 – 365,000
8	AI-4270	Saturator Conductivity Analyzer (µS/cm)	<1000	< 1000
9	SC-4270	Saturator Manual Sampling Chlorides (ppm)	< 1	< 1
10	SC-4270	Saturator Manual Sampling pH	6.5	5.5 – 8.0
11	SC-4270	Saturator Manual Sampling TOC (ppm)	<1000	< 1000

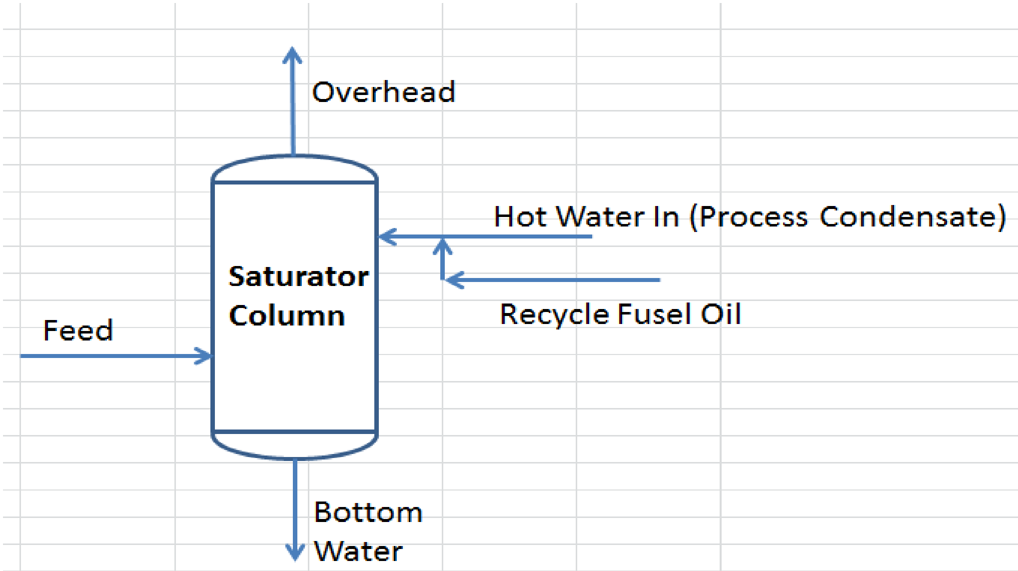
C.P. : Control Parameter

C.P. 1 to 8: are on-line monitoring parameters with continuous indication on main control room with corresponding high and low alarms setting used to alert personnel of problems on the operation of the Saturator Column.

C.P. 9 to 10: are periodical sampling monitoring of key water quality parameters to ensure the water circulating across the Saturator equipment system are not submitted to any corrosion and/or potential failure. These are used to setup the normal Saturator column blown down purge to minimize the flow to wastewater treatment.

EPA INFORMATION REQUEST: ITEM 16-I, SATURATOR COLUMN (NEW) -

Based on simplified mass balance around the saturator, the overhead stream that is 100% vapor contains x% of water. This equates to 351877 lb/hr of about 400# psig steam which is equates to 175 ton/hour.



Stream Description	Unit	Saturator Feed-Dry Gas	Saturator Ovhd-Sat. Gas	Recycle Fusel Oil	Hot Water In (Process Condensate)	Saturator Bottom Water
Phase		Vapor	Vapor	Liquid	Mixed	Liquid
Total Molar Rate	LB-MOL/HR	10,233.8038	29,801.9392	67.3490	133,060.8112	113,560.0248
Total Mass Rate	LB/HR	170,155.23	523,283.04	1,739.68	2,397,526.99	2,046,138.86
Temperature	C	83.8038	208.3696	93.4254	231.2401	156.3341
Pressure	PSIG	422.3000	412.3000	500.0000	440.0000	420.3000
Total Molecular Weight		16.6268	17.5587	25.8308	18.0183	18.0181
Total Enthalpy	MM BTU/HR	26.29	479.63	0.23	1,033.19	580.08
Vapor Mole Fraction		1.0000	1.0000	0.0000	0.0047	0.0000
Total Weight Comp. Rates	LB/HR					
H2		412.60	420.07	0.00	9.46	2.00
CO		1,197.33	1,213.98	0.00	21.71	5.06
CO2		6,113.88	6,334.54	0.00	455.31	234.66
N2		642.86	642.90	0.00	2.00	1.96
METHANE		153,781.81	153,781.95	0.00	809.66	809.51
ETHANE		6,097.08	6,096.98	0.00	28.36	28.46
PROPANE		960.84	960.83	0.00	3.39	3.40
n-BUTANE		436.24	436.23	0.00	2.11	2.12
n-PENTANE		152.26	152.26	0.00	0.20	0.21
n-HEXANE		350.85	350.85	0.00	0.54	0.54
NH3		0.00	0.00	0.00	0.00	0.00
MEOH		0.00	762.31	764.52	642.10	644.31
BUOH		0.00	253.24	253.24	0.00	0.00
H2O		9.48	351,876.91	721.92	2,395,552.15	2,044,406.64

EPA INFORMATION REQUEST: ITEM 16-I, SATURATOR COLUMN (NEW)

Based on existing plant PINK SHEET and simulations, the dissolved CO2 and CH4 concentrations in the process condensate are 0.00763% and 0.00063% respectively. Also, the CO2 stripper is designed for a maximum feed rate of 500 GPM of process condensate.

Therefore elimination of CO2 stripper by routing the process condensate to the new saturator would result in elimination of emissions of most of these dissolved gases except a few pounds that will slip with the saturator blowdown.

CO2 Stripper Data	**Composition wt%**	**Hourly Rate (lb/hr)**	**Yearly Rate (ton/yr)**	**Comments/Assumptions**
CO2 in condensate	0.05747	143.79	629.80	1 yr = 8760 hours; 8.34 lbs of water equivalent of 1 gallon of water; 1 ton = 2000 lbs
CH4 in condensate	0.00063	1.83	8.04	
Total Condensate (gpm)	500.00			
Total Condensate (lb/hr)	250200.00			

Saturator Data	**Composition mol frac**	**Hourly Rate (lb/hr)**	**Yearly Rate (ton/yr)**	**Comments/Assumptions**
CO2 with Blowdown	0.00030	6.28	27.52	Mol Wt CO2 = 44
CH4 with Blowdown	0.00011	0.84	3.67	Mol Wt CH4 = 16
Total Blowdown (lbmol/hr)	476.03	8568.59		Mol Wt Blowdown = 18
Net CO2 Emission Reduction			602.28	Blowdown ~2.9% per reference study[1]
Net CH4 Emission Reduction			4.37	Blowdown concentration per reference study[1]

[1]OCI provided data "Saturator Case Material and Heat Balance Pandora Methanol Plant"

NOTE: Calculations shown in permit application (page 4-22) must be corrected

Attachment I

PURCHASER / OWNER:	IHI / OCI Beaumont	**ITEM No.:**	71-H-001-2014
SERVICE:	Pre Reformer Fired Heater	**LOCATION:**	Beaumont, TX

FIRED HEATER DATA SHEET

API STD. 560

Pre Reformer Fired Heater
71-H-001-2014

A	8-Apr-13	For Proposal	TB	RP		
REV	**DATE**	**REVISION LOG**	**BY**	**CHECKED**	**APP'D**	**APP'D**

OnQuest

PROJECT NUMBER	DATA SHEET NUMBER	SHEET	REV
10-13-019	PDS-01-71H001-01	1 OF 7	A

OQ-30-DDS-001 SH1

FIRED HEATER DATA SHEET

PROJECT No.:	10-13-019
ITEM No.:	71-H-001-2014
REVISION No.:	A
SHEET No.:	2 of 7

1	**UNIT:** 71 - Reforming				**NUMBER REQUIRED:** One					
2	**SERVICE:** Pre Reformer Fired Heater				**MANUFACTURER:** OnQuest (Ref. No. 10-13-019)					
3	**TYPE OF HEATER:** Vertical cylindrical w/ Horizontal Convection Section									
4	**TOTAL HEATER ABSORBED DUTY, MM Btu/hr.:** 104.48 (Mixed Feed) + 11.35 (Natural Gas) = 115.83 MMBtu/hr (Design Case)									
5	**PROCESS DESIGN CONDITIONS**									**REV**
6	**OPERATING CASE**	Design				Normal				
7	**HEATER SECTION**	Rad./Conv.		Conv.		Rad./Conv.		Conv.		
8	**SERVICE**	Coil 1		Coil 2		Coil 1		Coil 2		
9	**HEAT ABSORPTION, MM Btu/hr.**	104.48		11.35		94.81		9.95		
10	**FLUID**	Mixed Feed		Natural Gas		Mixed Feed		Natural Gas		
11	**FLOW RATE, Lb/hr.**	589,440		146,195		589,440		146,195		
12	**FLOW RATE, B.P.D.**	-		-		-		-		
13	**PRESSURE DROP, ALLOW. (CLEAN | FOULED), psi.**	12	-	8	-	12	-	8	-	
14	**PRESSURE DROP, CALC. (CLEAN | FOULED), psi.**	12	-	8	-	12	-	8	-	
15	**AVG. RAD. SECT. FLUX DENSITY, ALLOW., Btu/hr-ft^2.**	-		-		-				
16	**AVG. RAD. SECT. FLUX DENSITY, CALC., Btu/hr-ft^2.**	10,125		-		9,330		-		
17	**MAX. RAD. SECT. FLUX DENSITY, Btu/hr-ft^2.**	18,225		-		16,795		-		
18	**CONV. SECT. FLUX DENSITY, (BARE TUBE), Btu/hr-ft^2.**	12,025		7,435		10,490		6,520		
19	**VELOCITY LIMITATION, ft/s.**	-		-		-		-		
20	**PROCESS FLUID MASS VELOCITY, Lb/sec-ft^2.**	45.2		51.0		45.2		51.0		
21	**MAX. INSIDE FILM TEMPERATURE: ALLOW. / CALC., ^{o}F.**	-	1160	-	800	-	1150	-	785	
22	**FOULING FACTOR, hr-ft^2-^{o}F/Btu.**	0.001		0.001		0.001		0.001		
23	**COKING ALLOWANCE, in.**	-		-		-		-		
24	**INLET CONDITIONS:**									
25	**TEMPERATURE, ^{o}F.**	734		641		761		641		
26	**PRESSURE, (psig).**	374.3		444.3		374.3		444.3		
27	**LIQUID FLOW, Lb/hr.**	-		-		-		-		
28	**VAPOR FLOW, Lb/hr.**	589,440		146,195		589,440		146,195		
29	**LIQUID GRAVITY, (DEG API) (SP. GR @ 60^{o}F.)**	-		-		-		-		
30	**VAPOR MOLECULAR WEIGHT**	17.66		16.63		17.66		16.63		
31	**VISCOSITY: LIQUID | VAPOR, cP.**	-	0.023	-	0.020	-	0.024	-	0.020	
32	**SPECIFIC HEAT: LIQUID | VAPOR, Btu/Lb-^{o}F.**	-	0.594	-	0.777	-	0.597	-	0.777	
33	**THERMAL COND.: LIQUID | VAPOR, Btu/hr-ft-^{o}F.**	-	0.037	-	0.050	-	0.039	-	0.050	
34	**OUTLET CONDITIONS:**									
35	**TEMPERATURE, ^{o}F.**	1022		739		1022		725		
36	**PRESSURE, (psig) (psia).**	362.3		436.3		362.3		436.3		
37	**LIQUID FLOW, Lb/hr.**	-		-		-		-		
38	**VAPOR FLOW, Lb/hr.**	589,440		146,195		589,440		146,195		
39	**LIQUID GRAVITY, (DEG API) (SP. GR @ 60^{o}F.)**	-		-		-		-		
40	**VAPOR MOLECULAR WEIGHT**	17.66		16.63		17.66		16.63		
41	**VISCOSITY: LIQUID | VAPOR, cP.**	-	0.029	-	0.021	-	0.029	-	0.021	
42	**SPECIFIC HEAT: LIQUID | VAPOR, Btu/Lb-^{o}F.**	-	0.633	-	0.820	-	0.633	-	0.814	
43	**THERMAL COND.: LIQUID | VAPOR, Btu/hr-ft-^{o}F.**	-	0.051	-	0.057	-	0.051	-	0.056	
44	**REMARKS AND SPECIAL REQUIREMENTS:**									
45	**DISTILLATION DATA OR FEED COMPOSITION:**									
46	**SHORT TERM OPERATING CONDITIONS:**									
47										
48	**NOTES:**									
49										
50										
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OnQuest

FIRED HEATER DATA SHEET

PROJECT No.:	10-13-019
ITEM No.:	71-H-001-2014
REVISION No.:	A
SHEET No.:	3 of 7

COMBUSTION DESIGN CONDITIONS

					REV
OPERATING CASE	Design	Normal			
TYPE OF FUEL	Natural Gas	Natural Gas			
EXCESS AIR, %	15	15			
CALCULATED HEAT RELEASE (LHV), MM Btu/hr.	148.0	133.0			
FUEL EFFICIENCY, CALCULATED, % (LHV).	78.3	78.8			
FUEL EFFICIENCY, GUARANTEED, % (LHV).	77.0	-			
HEAT LOSS, % OF HEAT RELEASE (LHV).	1.5	1.5			
FLUE GAS TEMPERATURE LVG: RADIANT SECTION, °F.	1700	1660			
COIL #1, °F.	1090	1070			
CONVECTION SECTION, °F.	825	810			
FLUE GAS QUANTITY, Lb/hr.	144,040	129,440			
FLUE GAS MASS VELOCITY THRU. CONV. SECTION, Lb/sec-ft^2.	0.400	0.359			
DRAFT: @ ARCH, in. H_2O.	0.1	0.1			
@ BURNERS, in. H_2O.	0.65	0.65			
AMBIENT AIR TEMPERATURE: EFFICIENCY CALCULATION, °F.	80	80			
STACK DESIGN, °F.	101	101			
ALTITUDE ABOVE SEA LEVEL, ft.	16	16			
VOLUMETRIC HEAT RELEASE (LHV), Btu/hr-ft^3.	4710	4235			

FUEL CHARACTERISTICS

GAS TYPE: Natural Gas		**LIQUID TYPE:** None		**OTHER TYPE:**	
LHV, Btu/(Lb).	20701	**LHV, Btu/Lb.**		**LHV, Btu/(Lb) (Scf).**	
HHV, Btu/(Lb).	22972	**HHV, Btu/Lb.**		**HHV, Btu/(Lb) (Scf).**	
PRESS. @ BURNER, psig.	45	**PRESS. @ BURNER, psig.**		**PRESS. @ BURNER, psig.**	
TEMP. @ BURNER, °F.	92	**TEMP. @ BURNER, °F.**		**TEMP. @ BURNER, °F.**	
MOL. WEIGHT	16.82	**VISCOSITY @ °F. SSU.**		**MOL. WEIGHT**	
		ATOMIZING: MEDIUM			
COMPOSITION	**MOLE %**	**PRESS., psig.**		**COMPOSITION**	**MOLE %**
H_2	-	**TEMP., °F.**		H_2	
N_2 / CO_2 / O_2	0.229 / 1.189 / -	**COMPOSITION**	**WT.%**	N_2 / CO	
CH_4 / C_2H_6	96.189 / 2.037			CH_4 / C_2H_6	
C_3H_8	0.219			C_3H_8	
C_2H_4	-			C_2H_4	
C_3H_6 / C_4H_8	- / -			C_3H_6 / C_4H_8	
iC_4H_{10} / nC_4H_{10}	- / 0.075	VANADIUM (ppm)		iC_4H_{10} / nC_4H_{10}	
C_5H_{12} / C_6H_{14}	0.021 / 0.041	SODIUM (ppm)		C_5H_{12}	
Sulfur	1 ppm (wt)	SULFUR		Sulfur	
TOTAL	100.0	ASH		TOTAL	100.00

BURNER DATA

MANUFACTURER: Callidus or equal		**SIZE & MODEL:** CUBL-12W		**NUMBER:** 12	
TYPE: Ultra Low NOx		**LOCATION:** Floor		**ORIENTATION:** Upfired	
HEAT RELEASE PER BURNER, MM Btu/hr.	**MAXIMUM:** 13.56		**NORMAL:** 12.33	**MINIMUM:** 3.39	
PRESSURE DROP ACROSS BURNER @ MAXIMUM HEAT RELEASE, in. H_2O.:			0.65		
DISTANCE BURNER CENTER LINE TO TUBE CENTER LINE, ft.			**HORIZONTAL:** 5'-4"	**VERTICAL:** -	
DISTANCE BURNER CENTER LINE TO UNSHIELDED REFRACTORY, ft.			**HORIZONTAL:** -	**VERTICAL:** 55'	
PILOT, TYPE & IGNITION METHOD: High Stability self inspirating pilot with flame rod				**CAPACITY, Btu/hr.:** 90,000	
FLAME SCANNERS, TYPE: 1" main flame scanner (connection only)					
LOCATION: On each burner			**NUMBER:** 12		
REQUIRED EMMISIONS:	**Lb/ MM Btu (HHV)**	**NOx:** 0.025		**CO:** 100 ppmv	
	@ 3% O_2 (dry)	**UHC:** -		**PARTICULATES:** -	

NOTES:

3

OQ-30-DDS-001 SH3

OnQuest

FIRED HEATER DATA SHEET

PROJECT No.:	10-13-019
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1	**MECHANICAL DESIGN CONDITIONS**					**REV**
2	**PLOT LIMITATIONS:** -		**STACK LIMITATIONS:** -			
3	**TUBE LIMITATIONS:** -		**NOISE LIMITATIONS:** 85 dBA @ 3 ft.			
4	**STRUCTURAL DESIGN DATA: WIND VELOCITY** -		**WIND OCCURANCE:** -			
5	**SNOW LOAD** -		**SEISMIC ZONE:** -			
6	**MIN. / NOR. / MAX. AMBIENT AIR TEMPERATURE, °F.:**	44 / 80 / 92	**RELATIVE HUMIDITY, %:** 60%			
7	**HEATER SECTION**	Radiant	Shield	Convection	Convection	
8	**SERVICE**	Mixed Feed	Mixed Feed	Mixed Feed	Natural Gas	
9	**COIL DESIGN:**					
10	**DESIGN BASIS: TUBE WALL THICKNESS (CODE / SPEC.)**	API 530	API 530	API 530	API 530	
11	**RUPTURE STRENGTH (MIN. OR AVG.)**	Minimum	Minimum	Minimum	Minimum	
12	**DESIGN LIFE, hr.**	100,000	100,000	100,000	100,000	
13	**DESIGN PRESSURE, ELASTIC | RUPTURE, psig.**	445 / 445	445 / 445	445 / 445	570 / 570	
14	**DESIGN FLUID TEMPERATURE, °F.**	1077	1077	1077	800	
15	**TEMPERATURE ALLOWANCE, °F.**	50	50	50	50	
16	**CORROSION ALLOWANCE, TUBES | FITTINGS, in.**	0.0625 / 0.0625	0.0625 / 0.0625	0.0625 / 0.0625	0.0625 / 0.0625	
17	**HYDROSTATIC TEST PRESSURE, psig.**	Per Code	Per Code	Per Code	Per Code	
18	**POST WELD HEAT TREATMENT (YES OR NO)**	Yes	Yes	Yes	Yes	
19	**PERCENT OF WELDS FULLY RADIOGRAPHED**	100%	100%	100%	100%	
20	**MAXIMUM (CLEAN) TUBE METAL TEMPERATURE, °F.**	1235	1205	1095	815	
21	**DESIGN TUBE METAL TEMPERATURE, °F.**	1300	1300	1115	865	
22	**INSIDE FILM COEFFICIENT, Btu/hr-ft^2-°F.**	141.7	128.6	127.1	227.7	
23	**COIL ARRANGEMENT:**					
24	**TUBE ORIENTATION: VERTICAL OR HORIZONTAL**	Vertical	Horizontal	Horizontal	Horizontal	
25	**TUBE MATERIAL (ASTM SPECIFICATION AND GRADE)**	A312 TP304H	A312 TP304H	A335 P22	A335 P11	
26	**TUBE OUTSIDE DIAMETER, in.**	6.625	6.625	6.625	4.5	
27	**TUBE WALL THICKNESS, (AVERAGE) , in.**	0.432	0.432	0.432	0.237	
28	**NUMBER OF FLOW PASSES**	20	20	20	9	
29	**NUMBER OF TUBES | NUMBER OF TUBE ROWS**	80 / -	30 / 3	50 / 5	72 / 4	
30	**NUMBER OF TUBES PER ROW (CONVECTION SECTION)**	-	10	10	18	
31	**OVERALL TUBE LENGTH, ft.**	51.5	19.75	19.75	19.75	
32	**EFFECTIVE TUBE LENGTH, ft.**	53.07	18.0	18.0	18.0	
33	**BARE TUBES: NUMBER**	80	30	-	-	
34	**TOTAL EXPOSED SURFACE, ft^2.**	7354	936	-	-	
35	**EXTENDED SURFACE TUBES: NUMBER**	-	-	50	72	
36	**TOTAL EXPOSED SURFACE, ft^2.**	-	-	14700	18505	
37	**TUBE LAYOUT (IN LINE OR STAGGERED)**	In Line	Staggered	Staggered	Staggered	
38	**TUBE SPACING, CENT. TO CENT.: HORIZ. | DIAG., in.**	12 / -	13.75 / 11.33	13.75 / 11.33	8 / 8	
39	**VERTICAL, in.**	-	9	9	6.93	
40	**SPACING TUBE CENT. TO FURNACE WALL, in.**	9	6.875	6.875	4	
41	**CORBELS (YES OR NO)**	No	Yes	Yes	Yes	
42	**CORBEL WIDTH, in.**	-	6.875	6.875	4	
43	**DESCRIPTION OF EXTENDED SURFACE:**					
44	**TYPE: (STUDS) (SERRATED FINS) (SOLID FINS)**	-	-	Solid	Solid	
45	**MATERIAL**	-	-	[1]	11% Cr	
46	**DIMENSIONS: HEIGHT, in. | THICKNESS, in.**	- / -	- /	0.75 / 0.06	1.0 / 0.06	
47	**SPACING (No. / in.)**	-	-	5	4.5	
48	**MAXIMUM TIP TEMPERATURE, (CALCULATED), °F.**	-	-	1205	925	
49	**EXTENSION RATIO (TOTAL AREA / BARE AREA)**	-	-	9.42	12.12	
50	**PLUG TYPE HEADERS:**					
51	**TYPE**	-	-	-	-	
52	**MATERIAL (ASTM SPECIFICATION AND GRADE)**	-	-	-	-	
53	**NOMINAL RATING**	-	-	-	-	
54	**LOCATION (ONE OR BOTH ENDS)**	-	-	-	-	
55	**WELDED OR ROLLED JOINT**	-	-	-	-	
56	**NOTES:**					
57	[1] Lower two rows shall be 18 Cr - 8 Ni. Remaining three rows shall be 11% Cr.					
58						
59						
60						

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FIRED HEATER DATA SHEET

PROJECT No.:	10-13-019
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1	**MECHANICAL DESIGN CONDITIONS (Cont'd)**					**REV**
2	**HEATER SECTION**	Radiant	Shield	Convection	Convection	
3	**SERVICE**	Mixed Feed	Mixed Feed	Mixed Feed	Natural Gas	
4	**RETURN BENDS:**					
5	**TYPE**	SRRB	LRRB	LRRB	SRRB	
6	**MATERIAL (ASTM SPECIFICATION AND GRADE)**	A403 WP304H	A403 WP304H	A234 WP22	A234 WP11	
7	**NOMINAL RATING OR SCHEDULE**	Sch. 80	Sch. 80	Sch. 80	Sch. 40	
8	**LOCATION (F. B. = FIRE BOX, H. B. = HEADER BOX)**	F.B.	H.B.	H.B.	H.B	
9	**TERMINALS AND OR MANIFOLDS:**					
10	**TYPE: BEVELED, MANIFOLD OR FLANGED**	Manifold	-	Manifold	Manifold	
11	**INLET: MATERIAL (ASTM SPECIFICATION AND GRADE)**	-	-	A335 P22	A335 P11	
12	**SIZE (NPS OR O.D., in.)**	-	-	18" NPS	12"	
13	**SCHEDULE OR THICKNESS, in.**	-	-	Sch. 40	Sch. 40	
14	**NUMBER OF TERMINALS**	-	-	1 [1]	1	
15	**FLANGE SIZE AND RATING**	-	-	-	-	
16	**OUTLET: MATERIAL (ASTM SPECIFICATION AND GRADE)**	A335 P22	-	-	A335 P11	
17	**SIZE (NPS OR O.D., in.)**	18" NPS	-	-	12"	
18	**SCHEDULE OR THICKNESS, in.**	Sch. 120	-	-	Sch.40	
19	**NUMBER OF TERMINALS**	1 [1]	-	-	1	
20	**FLANGE SIZE AND RATING**	-	-	-	-	
21	**MANIFOLD TO TUBE CONN. (WELDED, EXTRUDED, ETC.)**	Welded	-	Welded	Welded	
22	**MANIFOLD LOCATION (INSIDE OR OUTSIDE HEADER BOX)**	Outside	-	Outside	Outside	
23	**CROSSOVERS:**					
24	**WELDED OR FLANGED**	Welded				
25	**PIPE MATERIAL (ASTM SPECIFICATION AND GRADE)**	A312 TP304H				
26	**PIPE SIZE / SCHEDULE OR THICKNESS, in.**	6" NPS Sch. 80				
27	**FLANGE MATERIAL (ASTM SPECIFICATION AND GRADE)**	-				
28	**FLANGE SIZE / RATING**	-				
29	**LOCATION (INTERNAL / EXTERNAL)**	External				
30	**FLUID TEMPERATURE, °F.**	833				
31	**TUBE SUPPORTS:**					
32	**LOCATION (ENDS, TOP, BOTTOM)**	Top	Ends	Ends	Ends	
33	**MATERIAL (ASTM SPECIFICATION AND GRADE)**	A351 HK40	CS	CS	CS	
34	**DESIGN METAL TEMPERATURE, °F.**	1900	750	750	750	
35	**THICKNESS, in.**	As Req'd	1/2"	1/2"	1/2"	
36	**INSULATION: THICKNESS, in.**	-	4"	4"	4"	
37	**MATERIAL**	-	Kaolite 2300LI	Kaolite 2300LI	Kaolite 2300LI	
38	**ANCHOR (MATERIAL AND TYPE)**	-	TP310 SS	TP304 SS	TP304 SS	
39	**INTERMEDIATE TUBE SUPPORTS:**					
40	**MATERIAL (ASTM SPECIFICATION AND GRADE)**	-	-	-	A240 TP304H	
41	**DESIGN METAL TEMPERATURE, °F.**	-	-	-	1200	
42	**THICKNESS, in.**	-	-	-	As. Req'd	
43	**SPACING, ft.**	-	-	-	9'-0"	
44	**TUBE GUIDES:**					
45	**LOCATION**	[2]	-	-	-	
46	**MATERIAL**	[2]	-	-	-	
47	**TYPE / SPACING**	[2]	-	-	-	
48	**HEADER BOXES:**					
49	**LOCATION:** Convection ends			**HINGED DOOR / BOLTED PANEL:**	Bolted	
50	**CASING MATERIAL:** CS			**THICKNESS, in.:**	3/16"	
51	**LINING MATERIAL:** 6 PCF Ceramic Fiber Blanket			**THICKNESS, in.:**	2	
52	**ANCHOR (MATERIAL AND TYPE):** TP304 SS Pins and clips					
53	**NOTES :**					
54	[1] Manifolds will have two 18" NPS "legs" with one 24" NPS beveled connection.					
55	[2] Each radiant tube will have a A351 HK40 guide at its midpoint and a TP310 SS bottom guide at each bend.					
56						
57						

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FIRED HEATER DATA SHEET

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							REV
1	**MECHANICAL DESIGN CONDITIONS (Cont'd)**						
2	**REFRACTORY DESIGN BASIS:**						
3	**AMBIENT, °F.:**	80	**WIND VELOCITY, mph.:**	0	**CASING TEMP., °F.:**	180	
4	**EXPOSED VERTICAL WALLS:**	**None**					
5	**LINING THICKNESS, in.:**		**HOT FACE TEMPERATURE, DESIGN, °F.:**		**CALCULATED, °F.:**		
6	**WALL CONSTRUCTION:**						
7							
8	**ANCHOR (MATERIAL & TYPE):**						
9	**CASING MATERIAL:**		**THICKNESS, in.:**		**TEMPERATURE, °F.:**		
10	**SHIELDED VERTICAL WALLS:**						
11	**LINING THICKNESS, in.:**	6	**HOT FACE TEMPERATURE, DESIGN, °F.:**	2300	**CALCULATED, °F.:**	1600	
12	**WALL CONSTRUCTION:**	(2 x 1") 8 PCF Ceramic fiber blanket (2300F) + (4") 6 PCF Ceramic Fiber Blanket (1900F)					
13							
14	**ANCHOR (MATERIAL & TYPE):**	TP310 SS Studs and washers with CF wraps					
15	**CASING MATERIAL:**	CS	**THICKNESS, in.:**	1/4"	**TEMPERATURE, °F.:**	180	
16	**ARCH:**						
17	**LINING THICKNESS, in.:**	6	**HOT FACE TEMPERATURE, DESIGN, °F.:**	2300	**CALCULATED, °F.:**	1700	
18	**WALL CONSTRUCTION:**	(2 x 1") 8 PCF Ceramic fiber blanket (2300F) + (4") 6 PCF Ceramic Fiber Blanket (1900F)					
19							
20	**ANCHOR (MATERIAL & TYPE):**	TP310 SS Studs and washers with CF wraps					
21	**CASING MATERIAL:**	CS	**THICKNESS, in.:**	1/4"	**TEMPERATURE, °F.:**	180	
22	**FLOOR:**						
23	**LINING THICKNESS, in.:**	11	**HOT FACE TEMPERATURE, DESIGN, °F.:**	2500	**CALCULATED, °F.:**	1550	
24	**FLOOR CONSTRUCTION:**	(3") Kaolite 2500HS (or equal) + (8") Kaolite 2000HS (or equal)					
25							
26	**CASING MATERIAL:**	CS	**THICKNESS, in.:**	1/4"	**TEMPERATURE, °F.:**	195	
27	**MINIMUM FLOOR ELEVATION, ft.:**		**FREE SPACE BELOW PLENUM, ft.:**				
28	**CONVECTION SECTION:**						
29	**LINING THICKNESS, in.:**	7 / 5 [1]	**HOT FACE TEMPERATURE, DESIGN, °F.:**	2300	**CALCULATED, °F.:**	1265	
30	**WALL CONSTRUCTION:**	(3") Kaolite 2300LI (or equal) + (4") Kaolite 1800 (or equal) through Mixed Feed Coil					
31		(3") Kaolite 2300LI (or equal) + (2") Kaolite 1800 (or equal) for NG Coil					
32	**ANCHOR (MATERIAL & TYPE):**	TP310 SS (Shield) / TP304 SS (Finned)					
33	**CASING MATERIAL:**	CS	**THICKNESS, in.:**	1/4"	**TEMPERATURE, °F.:**	180	
34	**INTERNAL WALL:**	**None**					
35	**TYPE:**		**MATERIAL:**				
36	**DIMENSIONS: HEIGHT / WIDTH, ft.:**						

							REV
37	**DUCTS :**	**FLUE GAS**			**COMBUSTION AIR**		
38	**LOCATION**	**BREECHING**					
39	**SIZE, ft. OR NET FREE AREA, ft².**	As Req'd					
40	**CASING MATERIAL**	CS					
41	**CASING THICKNESS, in.**	1/4"					
42	**LINING: INTERNAL / EXTERNAL**	Internal					
43	**THICKNESS, in.**	5"					
44	**MATERIAL**	Kaolite 2300LI					
45	**ANCHOR (MATERIAL & TYPE)**	CS "V"					
46	**CASING TEMPERATURE, °F.**	180					

							REV
47	**PLENUM CHAMBER (AIR):**						
48	**TYPE OF PLENUM (COMMON OR INTEGRAL):**	Integral					
49	**CASING MATERIAL:**	CS	**THICKNESS, in.:**	10 ga.	**SIZE, ft.:**		
50	**LINING MATERIAL:**	Mineral wool			**THICKNESS, in.:**	1"	
51	**ANCHOR (MATERIAL & TYPE):**	SS pins and keepers					
52	**NOTES :**						
53							
54							
55							
56							

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OnQuest	FIRED HEATER DATA SHEET	
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		REVISION No.: A
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						REV
1	**MECHANICAL DESIGN CONDITIONS (Cont'd)**					
2	**STACK OR STACK STUB:**					
3	**NUMBER:** One	**SELF-SUPPORTED OR GUYED:** Self-supported stub		**LOCATION:** Atop Convection		
4	**INSIDE METAL DIAMETER, ft.:** 7'-4"	**CASING MATERIAL:** CS		**MIN. THICKNESS, in.:** 1/4"		
5	**HEIGHT ABOVE GRADE, ft.:** 90'-0"	**STACK LENGTH, ft.:** 9		**EXTENT OF LINING:** Full length		
6	**LINING THICKNESS, in.:** 5"	**LINING MATERIAL:** Kaolite 2300LI (or equal)				
7	**ANCHOR (MATERIAL AND TYPE):** C.S. "V"	**INTERNAL OR EXTERNAL INSUL.:** Internal				
8	**DESIGN FLUE GAS VELOCITY, ft/s.:** 40	**FLUE GAS TEMPERATURE., °F.:** 825				
9	**DAMPERS:**					
10	**LOCATION**	Stack				
11	**TYPE (CONTROL, TIGHT SHUT-OFF, ETC.)**	Control				
12	**MATERIAL: BLADE**	TP304 SS				
13	**SHAFT**	TP304 SS				
14	**MULTIPLE / SINGLE LEAF**	Multiple				
15	**PROVISION FOR OPERATION (MANUAL OR AUTO.)**	Automatic				
16	**TYPE OF OPERATOR (CABLE OR PNEUMATIC)**	Pneumatic				
17	**PLATFORMS:**					
18	**LOCATION:**	**WIDTH**	**LENGTH / ARC**	**STAIRS/LADDER**	**ACCESS FROM**	
19	Hearth	3'-0"	360°	Stairs	Grade	
20	Convection	3'-0"	2 Ends / 1 Side	Ladder	Hearth	
21	Damper	3'-0"	360°	Ladder	Convection	
22						
23						
24	**TYPE OF FLOORING:** Grating					
25	**DOORS:**					
26	**TYPE**	**NUMBER**	**LOCATION**	**SIZE**	**BOLTED/HINGED**	
27	ACCESS	1	Floor	24" x 24"	Bolted	
28		1	Breech		Bolted	
29	OBSERVATION	12	Rad. Wall	5" x 9"	Hinged	
30		2	Convection Wall	5" x 9"	Hinged	
31	TUBE REMOVAL	1	Rad. Roof	24" x 24"	Bolted	
32						
33	**MISCELLANEOUS:**					
34	**INSTRUMENT CONNECTIONS**		**NUMBER**	**SIZE**	**TYPE**	
35	**COMBUSTION AIR: TEMPERATURE**		-	-	-	
36	**PRESSURE**		-	-	-	
37	**FLUE GAS: TEMPERATURE**		5	1-1/2"	3000# Cplg.	
38	**PRESSURE**		6	1-1/2"	3000# Cplg.	
39	**FLUE GAS SAMPLE**		1	4"	150# RFWN	
40	**SNUFFING STEAM / PURGE**		6	2"	3000# Cplg.	
41	**O_2 ANALYZER**		1	4"	150# RFWN	
42	**VENTS / DRAINS**		- / 2 (hdr. boxes)	3/4"	3000# Cplg.	
43	**PROCESS FLUID TEMPERATURE**		-	-	-	
44	**TUBESKIN THERMOCOUPLES**		10	1-1/2"	Mfg. Standard	
45						
46						
47	**PAINTING REQUIREMENTS:** Surface prep. to SSPC SA2-1/2 plus one coat IOZ primer + two coats of acrylic silicone.					
48						
49	**INTERNAL COATING:** -					
50	**GALVANIZING REQUIREMENTS:** -					
51	**ARE PAINTERS TROLLEY AND RAIL INCLUDED (YES OR NO):** No					
52	**SPECIAL EQUIPMENT:** **SOOTBLOWERS** -					
53	**AIR PREHEATER** -					
54	**FAN(S)** | **OTHER** -					
55	**NOTES:**					
56						
57						

OQ-30-DDS-001 SH7

PURCHASER / OWNER:	IHI / OCI Beaumont	ITEM No.:	71-H-001-2014
SERVICE:	Pre Reformer Fired Heater	LOCATION:	Beaumont, TX

BURNER DATA SHEET

API STD. 560

Pre Reformer Fired Heater
71-H-001-2014

A	8-Apr-13	For Proposal	TB	RP		
REV	DATE	REVISION LOG	BY	CHECKED	APP'D	APP'D

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PROJECT NUMBER	DATA SHEET NUMBER	SHEET	REV
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OQ-30-DDS-002 SH1

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BURNER DATA SHEET

PROJECT No.:	10-13-019
ITEM NO.:	71-H-001-2014
REVISION No.:	A
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			REV
1	**GENERAL DATA**		
2	**TYPE OF HEATER**	Vertical Cylindrical	
3	**ALTITUDE ABOVE SEA LEVEL, ft.**	16	
4	**AIR SUPPLY: AMBIENT / PREHEATED AIR / GAS TURBINE EXHAUST**	Ambient	
5	**TEMPERATURE, °F. (MIN. / MAX. / DESIGN)**	44 / 80 / 101	
6	**RELATIVE HUMIDITY, %.**	60 - 100%	
7	**DRAFT TYPE: FORCED / NATURAL / INDUCED**	Natural	
8	**DRAFT AVAILABLE: @ DESIGN HEAT RELEASE, in. H_2O.**	0.65	
9	**@ NORMAL HEAT RELEASE, in. H_2O.**	0.65	
10	**REQUIRED TURNDOWN**	4:1	
11	**BURNER WALL SETTING THICKNESS, in.**	11	
12	**HEATER CASING THICKNESS, in.**	1/4	
13	**FIREBOX: HEIGHT, FLOOR TO ARCH, ft.**	55	
14	**WIDTH, TUBE TO TUBE CENTERLINE, ft.**	-	
15	**LENGTH, WALL TO WALL, ft.**	-	
16	**V.C. HEATER: TUBE CIRCLE DIAMETER, ft.**	25'-6"	
17	**BURNER DATA**		
18	**MANUFACTURER**	Callidus or equal	
19	**TYPE OF BURNER**	Ultra Low-NOx	
20	**MODEL & SIZE**	CUBL-12W	
21	**DIRECTION OF FIRING**	Upfired	
22	**LOCATION (ROOF / FLOOR / SIDEWALL)**	Floor	
23	**NUMBER REQUIRED**	12	
24	**CENTERLINE DISTANCE: BURNER TO TUBE, ft.**	5'-4½"	
25	**BURNER TO BURNER, ft.**	45¾"	
26	**BURNER TO UNSHIELDED WALL, ft.**	-	
27	**BURNER CIRCLE DIAMETER, ft.**	14'-9"	
28	**PILOTS: TYPE**	High stability self inspirating with flame rod	
29	**NUMBER REQUIRED**	12	
30	**IGNITION METHOD**	Manual	
31	**FUEL**	Natural Gas	
32	**FUEL PRESSURE, psig.**	10-15	
33	**CAPACITY, Btu/hr.**	90,000	
34	**OPERATING DATA**		
35	**FUEL**	Natural Gas	
36	**HEAT RELEASE PER BURNER, MM Btu/hr. (LHV)**		
37	**DESIGN**	13.57	
38	**NORMAL**	12.33	
39	**MINIMUM**	3.39	
40	**EXCESS AIR @ DESIGN HEAT RELEASE, %.**	15	
41	**AIR TEMPERATURE, °F.**	101	
42	**DRAFT LOSS @ DESIGN HEAT RELEASE, in. H_2O.**	0.65	
43	**DRAFT LOSS @ NORMAL HEAT RELEASE, in. H_2O.**	0.54	
44	**FLAME: SHAPE (FLAT, ROUND)**	Round	
45	**LENGTH @ DESIGN HEAT RELEASE, ft.**	23	
46	**DIAMETER @ DESIGN HEAT RELEASE, ft.**	3.4	
47	**FUEL PRESSURE REQUIRED @ BURNER, psig.**	25	
48	**ATOMIZING MEDIUM**	-	
49	**ATOMIZING MEDIUM / OIL RATIO, Lb/Lb.**	-	
50	**NOTES:**		
51			
52			
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56			
57			

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BURNER DATA SHEET

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							REV
1	**GAS FUEL CHARACTERISTICS**						
2	**FUEL TYPE**		Natural Gas				
3	**HEATING VALUE (LHV),** (Btu/Lb).		20701				
4	**SPECIFIC GRAVITY (AIR = 1.0)**		0.58				
5	**MOLECULAR WEIGHT**		16.82				
6	**FUEL TEMPERATURE @ BURNER, °F.**		44 - 92				
7	**FUEL PRESSURE AVAILABLE @ BURNER, psig.**		45				
8	**FUEL GAS COMPOSITION, mole %.**						
9		CH4	96.189				
10		C2H6	2.037				
11		C3H8	0.219				
12		nC4H10	0.075				
13		C5H12	0.021				
14		C6H14	0.041				
15		CO2	1.189				
16		N2	0.229				
17		SULFUR	1 ppm (wt.)				
18		TOTAL	100				
19	**LIQUID FUEL CHARACTERISTICS**						
20	**FUEL TYPE**						
21	**HEATING VALUE (LHV), Btu/Lb.**						
22	**SPECIFIC GRAVITY | DEGREE API**						
23	**H / C RATIO (BY WEIGHT)**						
24	**VISCOSITY, @**	**°F. (SSU)**					
25	**@**	**°F. (SSU)**					
26	**VANADIUM, ppm.**	**SODIUM, ppm.**					
27	**POTASSIUM, ppm.**	**NICKEL, ppm.**					
28	**SULFUR, % wt.**	**ASH, % wt.**					
29	**FIXED NITROGEN, ppm.**						
30	**LIQUID: ASTM IBP, °F.**	**ASTM END POINT, °F.**					
31	**FUEL TEMPERATURE @ BURNER, °F.**						
32	**FUEL PRESSURE AVAILABLE | REQUIRED @ BURNER, psig.**						
33	**ATOMIZING MEDIUM:**	**AIR / STEAM / MECHANICAL**					
34		**PRESSURE, psig. | TEMP., °F.**					
35	**MISCELLANEOUS**						
36	**BURNER PLENUM:**	**COMMON / INTEGRAL**	Integral				
37		**MATERIAL**	CS				
38		**PLATE THICKNESS, in.**	10 ga.				
39		**INTERNAL INSULATION**	1" mineral wool				
40	**INLET AIR CONTROL:**	**DAMPER OR REGISTERS**	Damper				
41		**MODE OF OPERATION**	Manual				
42		**LEAKAGE, %.**	< 3%				
43	**BURNER TILE:**	**COMPOSITION**	60% Nominal Alumina				
44		**MIN. SERVICE TEMPERATURE, °F.**	3000				
45	**NOISE SPECIFICATION**		85 dBA @ 3 ft.				
46	**ATTENUATION METHOD**		Inlet Muffler				
47	**PAINTING REQUIREMENTS**		SSPC SA2-1/2 plus one coat IOZ primer + two coats of acrylic silicone				
48	**IGNITION PORT:**	**SIZE / NUMBER**	2"		1		
49	**SIGHT PORT:**	**SIZE / NUMBER**	2"		1		
50	**FLAME DETECTION:**	**TYPE**	Scanner for Main Flame & Flame Rods				
51		**NUMBER / LOCATION**	1 scanner connection per burner & 1 flame rod per pilot				
52		**CONNECTION SIZE / TYPE**	1" swivel mount				
53	**SAFETY INTERLOCK SYSTEM FOR ATOMIZING MEDIUM & OIL**		-				
54	**PERFORMANCE TEST REQUIRED (YES or NO)**		Yes (Optional)				
55	**NOTES:**						
56							
57							
58							

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BURNER DATA SHEET	
PROJECT No.:	10-13-019
ITEM No.:	71-H-001-2014
REVISION No.:	A
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EMISSION REQUIREMENTS

			REV
FIREBOX TEMPERATURE, ^{o}F.		1700	
NOx	* ~~ppmv(d) or~~ Lb/MM Btu (HHV)	0.025	
CO	* ppmv(d) ~~or Lb/MM Btu (HHV)~~	100	
UHC	* ppmv(d) or Lb/MM Btu (HHV)		
PARTICULATES	* ppmv(d) or Lb/MM Btu (HHV)		
SOx	* ppmv(d) or Lb/MM Btu (HHV)		
*** CORRECTED TO 3% O_2 (DRY BASIS @ DESIGN HEAT RELEASE)**			

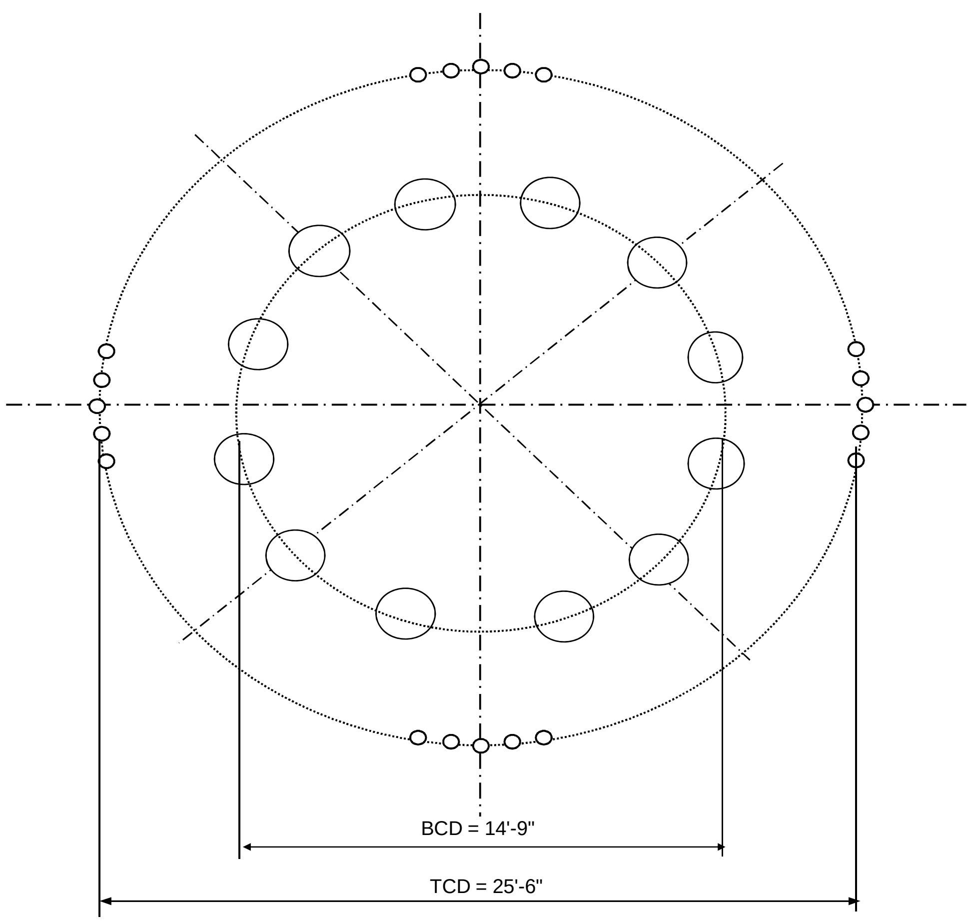
NOTES:

1] AT DESIGN CONDITIONS, MINIMUM OF 90% OF THE AVAILABLE DRAFT WITH AIR DAMPER FULLY OPEN SHALL BE UTILIZED ACROSS THE BURNER. IN ADDITION, A MINIMUM OF 75% OF THE AIR SIDE PRESSURE DROP WITH AIR DAMPER FULL OPEN SHALL BE UTILIZED ACROSS BURNER THROAT.

2] VENDOR TO GUARANTEE BURNER FLAME LENGTH.

3] VENDOR TO GUARANTEE EXCESS AIR, HEAT RELEASE AND DRAFT LOSS ACROSS BURNER.

Radiant Section (Burner/Tube Layout)
(Plan View)



Attachment J

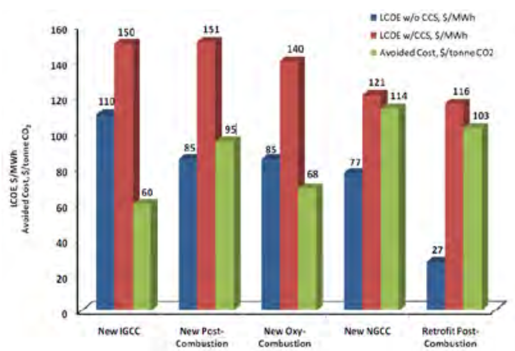
Attachment J

OCI Methanol CCS Project Cost Approximation

Purpose & Assumptions

1. The purpose is to estimate the cost of implementation of CCS under current economic and technological conditions for the OCI Methanol project
2. The reformer furnace and its waste heat recovery section are very similar from design and operation point of view to a natural gas combined cycle (NGCC) power plant
3. It is assumed that amine based acid gas recovery from flue gas (Post-combustion) is the best option for CO2 recovery for the plant.
4. Results of CCS study for a similar size NGCC Plant (3000 MTPD CO2) were used to derive numbers for the OCI Methanol plant (3100 MTPD CO2). The results of the authors' cost model were utilized where necessary.

Base Reference Plant : Politecnico di Milano (Italy) NGCC Plant, retrofitted with carbon capture plant of 3050 MTPD CO2[1]
Target Plant : OCI Methanol Plant, retrofitted with carbon capture plant of 3100 MTPD CO2

Data Description	Base Plant (No capture)[1]	Plant with capture Implemented[1]	Differential (Capture Plant)	OCI Capture Plant (estimated)[Note1]	Comments
Capital Cost, $/kW	531	807	276	N/A	
Net Power Output, MW	373.2	336.6	-36.6	N/A	Power consumed by capture equipment plus compressors for compressing CO2 to 1500 psig is 36.6 MW
CO2 Emitted, kg/kWh	0.374	0.037	90% Capture	90% Capture	
CAPEX, MM USD	198	272	73	109	OCI CAPEX derived by capacity adjustment and a flat 3.25 escalation/inflation. Capital cost seems to be in line with similar type plant costs.
MTPD CO2 Emitted	3350	299	90% Capture	3450	
MTPD CO2 Captured/Avoided	0	3051	90% Capture	3105	
Mitigation Cost in USD per MT of CO2 avoided in year 2000	49[2]			N/A	1. Composite cost data for all four NGCC plants including Milano is $49/MT per Reference 2 2. Reference data is per year 2000. A 3.25% flat escalation and inflation assumed to arrive at 2013 costs. 4. Reference plant cost data study assumed plant operating for 6570 hrs/year. OCI Methanol plant assumed 365 days operation for permit (8760 hrs). Adjustment made for higher operating time per year. 5. Estimated OCI Capture plant cost is in line with the cost presented in Reference 3. 
Total CCS Implementation cost in USD per year in 2013				**106**	
CO2 Transport & Storage Costs, USD/MT	Not Provided	Not Provided	Not Provided	Not Evaluated	Will drive total CCS cost higher. *[3] Recent estimates of storage costs derived from current commercial-scale projects are $11–17 per tonne (Sleipner); $20 per tonne (Weyburn) and $6 per tonne (In Salah)*

Conclusion

The cost of CCS will be than 106 USD/MT CO2 when costs of transport, pipeline, storage etc. are evaluated and added. Due to prohibitive costs, implementation of CCS is not a viable option under current economic and technological conditions for the OCI Methanol project.

REFERENCES

1. Jeremy David, "Economic Evaluation of Leading Technology Options for Sequestration of Carbon Dioxide", Massachusetts Institute of Technology (MIT)
2. Jeremy David and Howard Herzog, "The Cost of Carbon Capture", Massachusetts Institute of Technology (MIT), Cambridge, MA, USA
3. Report of the Interagency Task Force on Carbon Capture and Storage, August 2010