Oil and Gas Emissions Spreadsheet Changes Made From May 2011 to January 2012
Version

Notes
This is a list of changes made between the two-spreadsheet versions listed above. It should be inclusive of all changes; however, there may be some changes inadvertently left out. The changes are grouped into General/Major Changes and Specific/Minor Changes. The Specific/Minor Changes are ordered by spreadsheet tab; some changes apply to multiple tabs and are listed as such. It should be noted that the term “Old” refers to non-Barnett Shale area requirements and the term “New” refers to Barnett Shale area requirements. When the emissions summary table or tab is referred to, if it does not have either “Old” or “New” in front of it, it is associated with both.

General/Major Changes

• The emission summary table pulls in the emission rate values from the individual unit/source calculation tabs.
  • An emissions summary population macro has been created for the Old and New Emissions Summary tabs.
  • VOC Type and Emission Type drop-down menus are added to multiple unit/source calculation tabs (to be visible for New requirements only); the choice selected from each menu determines where in the emissions summary table the emission rate values get pulled into.
  • Changes are made to multiple tabs including the Tanks, Glycol Units, Amine Units, Loading, MSS, and Other tabs to facilitate population of the emissions summary table.
  • Instructions and explanations are added throughout the spreadsheet, both as text and comments in order to guide the user and make the spreadsheet as easy as possible to use.
  • Tab titles and instructions are added to provide a consistent format and provide useful information at the top of each tab.
  • The spreadsheet has been made better for printing through the use of page breaks.
  • Some changes are made to the pop-up boxes related to the macros to make them more logical.
  • “Next Tab” buttons are added to each tab, which may be used to navigate from tab to tab, or the user could navigate by clicking on whichever tab the user wishes to view. There is no specific order in which each tab has to be accessed, but in general, the order in which the tabs should be filled out is the order they appear in, with the exception that the unit/source calculation tabs can filled out in a different order as needed.
Specific/Minor Changes

- A space for emission point number (EPN) and emission point name to be entered is added to each unit/source calculation tab.

- A space is added for the company name and site name (as entered on the Facility Information tab) to be automatically pulled to the top of each tab.

- On multiple tabs, a spot is added asking the user to select how a stream is controlled. This information is used for the emissions summary table to be populated correctly by the macro.

- On multiple tabs, notes and comments have been added to explain how the spreadsheet works and why certain information is asked for in the way that it is. For example, the application of control efficiencies is done slightly differently for different tabs. It is also done slightly differently depending on how a stream is controlled. This is explained on each tab that represents a source that could possibly be sent to a control device.

- On multiple tabs, macros are utilized to change the required inputs shown on the tab, which are triggered by certain user inputs. Explanations are also added about what is happening and why.

- On multiple tabs, there used to be a comment for the cell with the note “VOC and H₂S control efficiencies may be entered.”

- The comment said:
  - “IMPORTANT NOTES:
    - The spreadsheet tabs for flares, vapor combustors, and thermal oxidizers ask for the total vapors sent to the control device to be inputted.
    - If this unit is controlled by a flare, vapor combustor, or thermal oxidizer, make sure to consider that the vapor rates entered into the control device tab need to NOT have a control device destruction efficiency already applied.
    - It is up to the user to choose how to handle this, but one suggestion is to NOT apply a control efficiency here on this spreadsheet tab so that the values shown on this sheet will be uncontrolled emissions, which can be inputted into the control device tab.
    - Two important things to avoid are:
      - (1) Double applying a control efficiency by applying it once here and then once again on the control device tab. (This will cause emissions to appear lower than they should.)
      - (2) Double counting emissions when entering them onto the emissions summary table. (This will cause emissions to appear higher than they should.)”

- Now the two “things to avoid” have been eliminated because now the user does not choose where to account for controlled emissions, instead there is only one way to handle it. This was necessary for the emissions summary table to be populated correctly by the macro. Before it was not necessary when the user had to populate the emissions summary table.
• On multiple tabs, the H₂S weight percent default is changed from 3% to 0.001%.

• The 0.001 H₂S weight percent default is chosen as the highest weight percent that would not correspond to a sour gas stream. The way in which the specific value of 0.001 wt% was chosen is as follows:

• A sour gas stream is defined in 30 TAC, Chapter 101 (101.1 - Definitions) as "any natural gas containing more than 1.5 grains of hydrogen sulfide per 100 cubic feet, or more than 30 grains of total sulfur per 100 cubic feet,” and 1.5 grains of hydrogen sulfide per 100 cubic feet equals 24 ppmv H₂S or 0.0024 mol% H₂S. In order to go from mol% to weight% of H₂S, the total gas stream molecular weight must be known. To go from 24 ppmv (0.0024 mol%) H₂S to wt% H₂S, the calculation boils down to: (mol% H₂S)*(H₂S MW/total MW)=(wt% H₂S), in which we know the mol% we want to convert from is 0.0024 mol%, the H₂S MW is a constant, the total MW is variable, and the wt% H₂S is what is being solved for. Since total MW is the only variable value, the range of possible values was looked at and the highest total MW value was specifically looked at because it corresponds to the lowest H₂S wt% that could correspond to a 0.0024 mol%. A small sample of gas stream data provided in air permitting applications and also listed in E&P Tanks Geographical Database was looked at to see what the total gas sample molecular weights were. The gas stream data looked at are of the following types: separator gas, inlet gas to dehydrator, gas evolved from hydrocarbon liquid flashed, gas evolved from water flashed, and calculated tank working, breathing, and flash losses. The maximum molecular weight found with a plus 5% increase was 57 g/mol, which corresponds to a 0.001 wt% H₂S. It is also noted that even using a maximum MW of 160 g/mol, the calculated value would still round to 0.001 wt% H₂S; since 160 g/mol is an incredibly high unrealistic molecular weight for a natural gas stream or a stream of gas generated from oil/condensate, it is safe to assume that if the H₂S wt% is less than 0.001, the stream is not sour.

• On multiple tabs, some calculations have been changed so that a continuous operating schedule is not assumed, instead the operating schedule can be entered by the user. For example, on some of the Tanks tabs, a continuous operating schedule was assumed. This has been changed because, although most tanks are expected to be continuous potential emission sources, the emission calculation may need to be done separately for two different operating scenarios, for example, one in which the tanks are uncontrolled for some small amount of time during the year.

• On the Facility Information tab:
  • The TCEQ logo is added to the top of the tab.
  • The revision date is added to the top of the tab.
  • An “Enable Macro Link” and “Trusted Location Link” are added to provide information on those topics.
• A comment is added on the **Facility Information tab** which says:

  • “The impacts review that is built into this spreadsheet is the impacts review for the Barnett Shale area rule requirements using the modeling tables from the rules.

  • The other types of impacts review for showing NAAQS compliance or compliance with the PBR 106.261/262 emission limits need to be done separately and provided separately. Modeling reports and any necessary calculations need to be provided.”

• A note is added titled “Planned Maintenance, Start-up, and Shutdown (MSS) versus Alternate Operating Scenarios” and a comment with further explanation is also added.

• A spot for fugitives to be entered as an “Equipment/Process Type” is added. A spot for fugitive emission rates to be created on the **Emissions Summary tab** if needed is added.

• “Other” is added as a choice of “Equipment/Process Type” to be used for emissions that do not fit into any of the other “Equipment/Process Types” listed on the **Facility Information tab**. A spot for these other emission rates to be created on the **Emissions Summary tab** if needed is added.

• Changes are made to the layout of the tables to better separate the different areas.

• The format of the tanks pop-up box which appears when the “Run” button is pressed on the **Facility Information tab** (if any number of tanks are entered on the **Facility Information tab**) is changed and some information is added.

  • The calculation methods are grouped according to the loss type.

  • An explanation is added which lets the user know that if they are not sure which method(s) to use, all methods can be selected and an explanation of each method will be visible.

  • A link to a TCEQ flash guidance document is added.

• On the **Lab Analyses tab**:

  • Multiple changes in content and format are made.

  • The purpose of the tab is explained.

  • Notes and comments have been added to the top and throughout the tab.

  • More comments are added to explain what needs to be entered from the sample and where the information needs to be entered.

  • More information about each sample is asked for.

  • Weight percents or mole percents of the samples can now be entered, instead of only mole percents.

  • If mole percents are being entered, there is a spot for component molecular weights to be entered as needed.
• If weight percents are being entered, there is a spot which also asks for the gas molecular weight (molecular weight of the total sample) and the gas and liquid H₂S content in parts per million by volume (H₂S ppmv).

• A drop down menu has been added to select whether weight percents or mole percents are being entered for each sample so that the correct values will be pulled forward correctly to other unit/source calculation tabs.

• The order of compounds is changed so that the compounds are grouped by the number of carbon atoms.

• The butanes are grouped together because all isomers have the same molecular weight. There is also a comment added listing the isomers.

• The pentanes are grouped together because all isomers have the same molecular weight. There is also a comment added listing the isomers and specifically explaining that neo-pentane, also called 2,2-dimethlypropane, is a pentane isomer (previously when each isomer of butane and pentane were listed separately, there was no spot to enter neo-pentane/2,2 dimethlypropane, which may have led to mistakes of grouping it with propane.)

• The nitrogen molecular weight is changed from 14.00674 to 28.0134 g/mol to reflect the fact that nitrogen exists as a diatomic molecule.

• The hydrogen molecular weight is changed from 1.00794 to 2.01588 g/mol to reflect the fact that hydrogen exists as a diatomic molecule.

• On the Fugitives tab:
  • Changes are made to the format for consistency in the macro code, which includes moving the totals to the bottom instead of the right side and reordering them.
  • A comment is added explaining that 100% VOC content should almost always be used for water/oil service fugitive components because the emission factors already take into account the fact that the stream is mostly water with a small percentage of hydrocarbon liquid present.
  • The comment is added:
    • “If the VOC type is a mixture of different VOC types, pick the choice with the lowest emission limit (lowest ESL). Crude Oil or Condensate VOC has a lower emission limit than Natural Gas VOC. If there are fugitive emissions from a condensate tank and from piping containing natural gas, then pick Crude Oil or Condensate VOC.
    • If this causes a problem, provide an explanation on the Emissions Summary tab. The emissions can be broken up manually into the appropriate VOC types if needed and the split-up values can be reflected in the emission totals.”

• On the Engines, Turbines, and Heaters/Boilers tabs:
  • The instructions are changed and added to provide more useful information and also to be consistent with the types of instructions on the other unit/source calculation tabs.
• The particulate matter (PM) compounds or emission factors are changed to make sure PM$_{10}$ and PM$_{2.5}$ emission factors are appropriate and there is only one possible one to use, which will get pulled into the emissions summary table.

• On the **Engines and Turbines tabs**:
  - The question and comment below is added and the formula is changed as described.
    - Question: “Does the VOC emission factor being used below include formaldehyde? (pick Yes or No from list)”
    - Comment: “If No, the formaldehyde emissions will be added into the VOC emissions. If Yes, the formaldehyde emissions will not be added into the VOC emissions. If this question is left blank, the formaldehyde emissions will be added into the VOC emissions.”

• The NO$_2$ NAAQS Compliance Demonstration part is removed because it should not be done on a unit by unit basis. A note was added on the **Facility Information tab** which says:
  - “The impacts review that is built into this spreadsheet is the impacts review for the Barnett Shale area rule requirements using the modeling tables from the rules.
  - The other types of impacts review for showing NAAQS compliance or compliance with the PBR 106.261/262 emission limits need to be done separately and provided separately. Modeling reports and any necessary calculations need to be provided.”

• On the **IC Engines tab**:
  - Some of the fuel type choices are removed, so that the choices are natural gas, field gas, and propane.
  - A comment is added that the emission factors for natural gas as shown below in the sheet will be used for natural gas, field gas, and propane.

• On the **Turbines tab**:
  - Some of the fuel type choices are removed, so that the choices are natural gas and field gas.
  - The PM$_{10}$ and PM$_{2.5}$ factors are updated.
    - The PM total factor (from AP-42 table 3.1-2a) is used for PM$_{10}$.
    - The PM condensable factor (from AP-42 table 3.1-2a) is used for PM$_{2.5}$.

• On the **Diesel Engines tab**:
  - “Diesel (or other fuel oil)” is made the only choice for fuel type since the tab is for diesel engines.
  - The SO$_2$ mass balance calculation for sour fuel is removed because the previous calculation relied on the ideal gas law, which is not appropriate for diesel fuel and also, based on TCEQ technical specialist experience, the AP-42 factor used is based on high sulfur diesel.
• The PM$_{2.5}$ emission factor is added in.

• Since there is no PM$_{2.5}$ factor listed in AP-42 table 3.3-1 (Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines), for PM$_{2.5}$, 76.4% of the PM$_{10}$ factor was used. The basis for using this percentage is that AP-42 table 1.3-7 (Cumulative Particle Size Distribution and Size-Specific Emission Factors Uncontrolled Commercial Boilers Burning Residual or Distillate Oil) shows that PM$_{2.5}$ emissions are 76.4% of PM$_{10}$ emissions.

• Table 1.3-7 (for boilers) was used a being representative of diesel engines because, based on TCEQ technical specialist experience, diesel engine emissions are expected to consist of a lower percentage of PM$_{2.5}$ than boilers are; therefore, this would provide a conservatively high estimate of PM$_{2.5}$ emissions from diesel engines.

• Table 1.3-7 (for commercial boilers) was used over table 1.3-6 (for industrial boilers) because it has a slightly better emission factor rating.

• There is a note under table 3.3-1, which states that all particulate is assumed to be less than or equal to 1 µm in size; however, based on TCEQ technical specialist experience, diesel emissions consist of a high percentage of particulate greater than 1 µm and 2.5 µm, meaning that using the same factor for PM$_{10}$ and PM$_{2.5}$ here is not appropriate.

• The SO$_2$ emission rate formula is changed on the **Heaters/Boilers tab** to put in the mass balance method result (instead of the result from using the AP-42 emission factor) if it has been calculated.

• On the **Tanks tabs**:

  • The tabs are modified so that there is only one set of results as opposed to having one set for controlled results and one set for uncontrolled results.

  • The tabs are modified so that they are easier to read and look better when printed on one landscape page and also for the purpose of simplification.

  • An explanation is added to the comment in the cell for “Percent Reduction for Produced Water Tank Calc. as Oil/Cond.” which says:

  • “This reduction will not be applied to the H$_2$S emissions because it is not appropriate. Due to the affinity of H$_2$S to water, the H$_2$S emissions from produced water cannot be assumed to be accurately represented by the same applied reduction used for VOC emissions calculated using condensate/oil properties and produced water throughput.”

• On the **Loading tab**,

  • The note is added:

  • “If vapor balancing is being performed and the tank is not being controlled, contact TCEQ about the appropriate tank working loss calculation.”
• Detailed notes are included about acceptable vapor VOC, benzene, and H₂S weight percents. The formulas are changed to allow a VOC weight percent to be applied to the calculation, with the note saying it has to be a justified value.

• A note is added about acceptable collection efficiencies for loading vapors being sent to a control device.

• Only one collection efficiency input is asked for, instead of two separate inputs for VOC and H₂S.

• On the **Glycol Units and Amine Units tabs**:
  
  • Changes are made to the information asked for.
  
  • The tables are broken up to separate the information to general unit information, flash tank, regenerator, results, and federal applicability. Specifically, the separation between flash tank and regenerator emissions is made to make it clear how each potential emission stream is controlled or not controlled.

• On the **Glycol Units tab**:
  
  • A spot is added for condenser efficiency to be entered and it is factored into the results.
  
  • The Rich/Low Sampling Calculation Method is removed.
    
    • This was done because it is understood that there may need to be some corrections from measured values that need to be made due to the issues related to the sampling. GLYCalc has two Calculation Methods built in that factor in Rich/Low sampling:
      
      1. The R/L+Gas calculation method requires process data, gas analysis, and rich/lean glycol compositions; the gas analysis is used to calculate light hydrocarbons and the glycol data is used for the heavier hydrocarbons.
      
      2. The GRI ARL calculation method requires rich/lean glycol composition inputs; the glycol data is used for emissions estimates, with correction factors for light hydrocarbons (to account for losses that occur when sampling high pressure glycol).

      • This is not a commonly used method (using rich/lean glycol sampling without using GLYCalc to make appropriate corrections) in Texas air permit applications (in fact, using rich/lean glycol sampling even in conjunction with GLYCalc is not a commonly used method either). If it is chosen to be used, the Other tab should be used to enter the emissions into the spreadsheet and detailed supplemental information should be provided. Sampling results and any other necessary supplemental information should be provided if rich/lean glycol sampling is used at all, regardless of whether GLYCalc is used.

• On the **Vapor Recovery Units tab**:
  
  • Changes are made to the information asked for.
  
  • An emissions calculator is added in based on inputs of the streams routed to the VRU and the VRU control efficiency.
• Changes are made so this tab can be used for mechanical VRUs (mVRUs) and liquid VRUs (lVRUs).

• On the Flare/Vapor Combustors and Thermal Oxidizers tabs:
  • Changes are made to the information asked for.
  • The tabs are modified so that they are easier read, look better when printed, are simplified, and are consistent with each other.
  • Some of the tables are re-formatted to separate the information and to make it more clear why certain information is asked for and what the result of making certain selections is.
  • Comments are added to highlight the differences between the different types of streams: waste gas, pilot streams, and supplemental fuel streams, including the differences in calculations.
  • The PM$_{2.5}$ emission factors are updated.
    • The PM total factor (from AP-42 table 1.4-2) is used for PM$_{10}$.
    • The PM condensable factor (from AP-42 table 1.4-2) is used for PM$_{2.5}$.

• On the Flare/Vapor Combustors tab:
  • The formula for the VOC hourly and annual emissions from pilot and added fuel streams is changed to not use the propane emission factor (AP-42 Table 1.4-3) for the propane fraction of the stream; instead the VOC emission factor (AP-42 Table 1.4-2) is used for the entire pilot and added fuel streams.

• On the MSS tab:
  • Significant changes are made to the way the calculation is done and information asked for.
  • Notes and comments are added to explain the calculation method including the limitations.

  • The Other tab is added to be used for emissions that do not fit into any of the other “Equipment/Process Types” listed on the Facility Information tab. A spot for these other emission rates to be created on the Emissions Summary tab if needed is added.

• On Both Old and New Emissions Summary tabs:
  • The TCEQ logo is added to the top of the tabs.
  • A spot for fugitive emission rates to be created on the Emissions Summary tab if needed is added. A spot for fugitives to be entered as an “Equipment/Process Type” on the Facility Information tab is added.
  • A spot for the Other emission rates to be created on the Emissions Summary tab if needed is added. “Other” is added as a choice of “Equipment/Process Type” to be used for emissions that do not fit into any of the other “Equipment/Process Types” listed on the Facility Information tab.
• Notes (5)-(7) are added under the table, which are as follows:

  “(5) If emissions from a source are:
   • (A) uncontrolled, then the uncontrolled emissions are reported in this table as being emitted from the source.
   • (B) controlled by a flare, vapor combustor, thermal oxidizer, or vapor recovery unit (VRU), then the controlled emissions are reported on this table as being emitted from the control device.
   • (C) controlled by another type of control device, then the controlled emissions are reported on this table for the source (even though emissions are actually being emitted at the control device).

  (6) For controlled tank, glycol/amine flash tank and regenerator, and MSS emissions, it is assumed that all vapors make it to the control device (100% collection efficiency). For controlled loading emissions, a 100% collection efficiency is not assumed.

  (7) A VRU itself is not actually considered an emission point; however, this table associates unrecovered (uncontrolled) emissions from sources controlled by a VRU at the VRU.”

• On the Old Emissions Summary tab, note (8) is added under the table, which is as follows:

  “(8) Benzene emissions are not required for sites not being registered under the new Barnett Shale area requirements; therefore, the benzene emissions reflected on this table will not be treated as emission limits (while it is not required, it is encouraged that benzene emissions are estimated.”

• On the Is Full Impacts Review Required tab, one of the three “outs” (the ways in which a full impacts review can be shown to be not required), the distance “out” is put first to make the order more logical.

• The benzene E max annual formula is corrected in the Full Benzene Impacts Review tab; a set of needed parenthesis was left out.