This document is a compilation of previous presentations regarding MSS for petroleum refineries and chemical plants. Some of the guidance and examples included may not be relevant for MSS from terminals or miscellaneous facilities.

For questions on this guidance and whether it applies to your specific case, please contact the Chemical Section of the Air Permits Division at 512-239-1250.

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I Maintenance, Startup, and Shutdown (MSS) Identification, Best Available Control Technology (BACT), and Emission Estimates

1. Identifying Planned MSS

A. Only planned MSS activities can be authorized.

B. To determine whether MSS activity is planned, consider the definition of unplanned MSS in 30 TAC 101:

C. Unplanned maintenance, startup, or shutdown activity--For activities with unauthorized emissions that are expected to exceed a reportable quantity or with excess opacity, an unplanned maintenance, startup, or shutdown activity is:

(1) a startup or shutdown that was not part of normal or routine facility operations, is unpredictable as to timing, and is not the type of event normally authorized by permit; or

(2) a maintenance activity that arises from sudden and unforeseeable events beyond the control of the operator that requires the immediate corrective action to minimize or avoid an upset or malfunction.

D. Upset is defined in 101.1 as follows:

E. Upset event--an unplanned and unavoidable breakdown or excursion of a process or operation that results in unauthorized emissions.

F. Planned maintenance arises from events that do not require immediate corrective action to minimize or avoid a breakdown or excursion of a process where the action or excursion results in (additional) air emissions.

G. Planned shutdowns are those that are part of normal or routine facility operations, including planned maintenance. They do not include process unit shutdowns due to sudden breakdown or excursion of a process or operation requiring immediate action, or unplanned maintenance.

H. Planned startups would follow planned shutdowns.

I. Clarification: Redundant Control Devices.

(1) Redundant control devices have been historically authorized before there was a requirement to authorize MSS emissions.

(2) Redundant control device must be immediately available and satisfy BACT.

(3) If both control devices have the same control efficiency, the control devices can be combined into one emission point.

(4) If the control efficiencies are different, the use of the less effective control device is limited.

(5) The control device and backup control device are reviewed as a control system meeting BACT, so if either device is available there are no MSS emissions when one control device is down.

J. When identifying MSS emissions, consider all activities that may result in emissions, such as:

catalyst activation and deactivation; catalyst charging; use of portable frac tanks; use of vacuum trucks; meter proving; abrasive blasting; decoking; acid and caustic washing; use of aerosol cans; blowdowns of natural gas or liquid hydrocarbons, compressed air, and steam lines; calibration of analytical equipment including CEMS; chemical cleaning; combustion shutoff devices; facility/building maintenance including roof repair (tar asphalt); insulation addition or removal; pneumatic starts on reciprocating engines, turbines, compressors; machine blowdowns; pipeline pigging; sampling; ultrasonic cleaning; water washing empty drums or totes; tank and vessel degassing; landing of floating roofs in tanks; use of temporary control devices; or any other activity that might result in air emissions.

K. Types of MSS Emissions

(1) Startup and shutdown with emissions from normal emission points and control devices may be less than allowable emission rates but may not meet all performance standards.

(2) Startup and shutdown with no control or an alternate control may result in high short term emissions from the process unit.

(3) Venting and degassing of facilities to prepare for maintenance.

(4) Emissions from maintenance activities.

2. BACT

A. There are two aspects to minimizing emissions from MSS activities.

(1) Minimize MSS activities that result in emissions, limit their duration, and minimize the emissions (Pollution Prevention - P2).

(2) Use Add-on Control.

B. Type 1 MSS emissions from routine Emission Point Number (EPN) and control device.

(1) New add-on control is generally not required.

(2) Existing control is operational but may be less efficient during startup and shutdown so may not satisfy all requirements in the permit conditions (example: Selective Catalytic Reduction may take time during startup to heat up to required operating temperature so limits on lb/MM Btu basis in permit conditions may not be achievable.)

(3) Control as well as possible during these times and minimize operating time in this condition.

(4) Limit emissions to less than operating allowable emission rates.

(5) Startup may be limited (example to less than eight hours with operating rate less than 75 percent of design).

(6) Shutdown may be limited (example four hours).

(7) Control device must be started prior to venting a waste gas stream if possible, otherwise as soon as possible.

C. BACT - P2.

(1) Justify number of activities used to make up proposed allowable.

(2) Provide basis for frequency.

(3) Compare to industry norm.

(4) Provide actual number for the past several years.

(5) Use methods that minimize air emissions.

(6) Methods used to set up for and perform maintenance.

(7) Design to minimize emissions from MSS.

D. Type 2 MSS emissions (no control or alternate control.

(1) Generally occurs when process parameters no longer support production at the process unit.

(2) Alternate control strongly encouraged. In refineries, this is generally a flare.

(3) Potential for significant emissions.

(4) If control problematic, should focus on need for SS, method of shutdown, and the design and operation of unit.

(5) More likely to be an issue for chemical plants. Limited to vents containing sulfur at refineries.

E. BACT - Add-on Control

(1) Control emissions if vapor pressure (vp) > 0.50 pounds per square inch (psi) at operating or ambient temperature.

(2) Maintain control until volatile organic compound (VOC) concentration < 10,000 ppmv.

(3) Keep all liquids covered.

(4) Consider controlling emissions if forced ventilation is used with standing liquid present with vp > 0.10 psi.

F. Type 3 MSS emissions - Vent and Degas.

(1) Equipment involved can range from major process units to valves and detectors.

(2) Depressurize to control if vp > 0.50, use knockout pot or equivalent for 2-phase streams.

(3) Drain all liquid from low point drains.

(4) Setup purge/degas to ensure entire equipment volume is included.

G. Type 4 MSS emissions - Maintenance Emissions.

(1) Solvents used in cleaning.

(2) Painting and abrasive blasting. Recommend using permit by rule (PBR) authorization.

3. Estimating Emissions

A. Best estimates will likely be based upon process knowledge and parameters. Very little standard guidance is available (exception - tank roof landings).

B. Typical tools may include:

(1) Gases - Ideal gas law

(2) Liquids - AP-42 loading equation for bulk transfers

(3) Residual/clingage - explain numbers greater than in AP-42 for tanks

(4) Standing liquid exposed to air/ventilation, use correlation.

II <u>Maintenance, Startup, and Shutdown (MSS) Update for Process Vessels</u>

1. What is a Process Vessel?

A. A process vessel is a piece of process equipment that contains gas or liquid that needs to be cleared for maintenance, startup, or shutdown operations.

B. Examples of process vessels:

(1) Columns - distillation, absorbers, etc.

(2) Reactors

(3) Other vessels or pieces of equipment

(4) Piping

C. Basic permitting and calculation methods are the same for large and small vessels.

2. MSS Emissions from Clearing Process Vessels

A. Break activity into component parts.

B. Use reasonable and consistent assumptions for each part.

C. Document assumptions and calculation methods.

D. Apply appropriate control factors.

3. Steps to Clearing Vessels

A. Route fluids to other parts of process as much as possible.

B. Route fluids to knockout-drum for phase separation, if necessary. If VOC partial pressure > 0.5 psi, route any vents to control device or controlled recovery system.

C. Drain liquids to covered vessels if possible. Control loading emissions if vapor pressure > 0.5 psia. If physical configuration of the equipment prevents draining to a covered vessel, can drain to open pan but cover liquid or transfer liquid to covered vessel within one hour of being drained.

D. Generally, if liquid had vapor pressure ≥ 0.5 psia, degas vessel to control until VOC concentration < 10,000 ppmv.

E. Account for emissions from every step.

4. Use Consistent Authorization Mechanism

A. All aspects of each MSS activity must be authorized by the same mechanism. For example, if vessel liquid is transferred to a frac tank, loading emissions are routed to the plant flare, and the vessel is degassed to a temporary control device, each activity must be authorized under the permit unless all are authorized by permit by rule (PBR).

B. Cannot authorize vessel degassing under permit, and frac tank under PBR.

C. Partial permitting is not allowed.

5. Calculating Emissions from Clearing Process Vessels

A. When fluids are routed back to other parts of the process, emissions are accounted for in process emissions already authorized (working loss emissions from storage tanks, for example). Therefore, there are no additional MSS emissions.

B. When draining liquids to temporary storage, pans, etc., use the AP-42 loading loss equation from Section 5.2.2.1.1: LL = 12.46 SPM/T.

(1) Use the proper control factors if loading is controlled.

(2) Use the proper saturation factors to account for bottom fill or splash loading.

(3) Use the proper material temperature, vapor pressure, and concentration.

C. After the liquid has been drained, the vessel is not empty.

(1) Air contaminants are still present in the vapor space (assumed to be saturated with the liquid previously contained unless applicant can justify lower saturation level).

(2) Residual liquid will cling to the surfaces of the vessel and be emitted when the vessel is opened to the atmosphere. Assume clingage from a layer of material 0.0004 inches thick. Multiply thickness by the vessel surface area to get volume of liquid, and then multiply by the liquid density to get mass of clingage. Be sure to use consistent units for volume and density.

(3) If the VOC vapor pressure of the material was 0.1 psi or less, vapor space emissions can be neglected for small vessels or piping because calculations show they would be small compared to clingage emissions. For large vessels, vapor space emissions may be significant.

(4) If the VOC vapor pressure of the material was greater than 0.1 psi, clingage emissions can be neglected because calculations show they would be small compared to vapor space emissions.

D. To calculate emissions from the vapor space of a vessel that had stored liquid, or from a vessel that had stored a gas, use the Ideal Gas Law with appropriate volume, pressure, and concentration.

(1) Ideal Gas Law: The number of moles of a material contained in a defined volume is equal to the pressure times the volume divided by the Universal Gas Constant and the absolute temperature:

$$n = PV/RT$$

(2) When the vessel is opened to the atmosphere or routed to control, the total mass of contaminant that could be vented or routed to control would be equal to the number of moles of gas contained in the vessel volume multiplied by the contaminant concentration and the contaminant molecular weight:

$$\frac{(\text{vessel pressure})(\text{vessel volume})*MW*Conc.}{(10.73\ \text{psia-ft}^3/\text{lb-mol-R})(460+T)} = \text{lbs per event}$$

(3) Multiply the pounds per event by the total number of events per year to get total annual emissions. If the degassing emissions are routed to a control device, apply the appropriate control device efficiency. (See G. for guidance on short-term emissions.)

E. Use Correct Parameter Values for All Variables

(1) For pressurized vessel, use total vessel pressure to calculate amount routed to control.

(2) For degassing to atmosphere, use the correct residual pressure and concentration. For example, if the flare header pressure is 5 psig and the vessel is degassed until the VOC concentration is less than 10,000 ppmv, P = 14.7 + 5 = 19.7 psia and concentration is 10,000/1,000,000 = 0.01.

(3) For volume, the preference is to use the actual volumes of actual vessels with the actual historical frequency of MSS activities.

(4) Reasonable simplifying assumptions (equivalent of X vessels with Y volume) may be accepted in special cases. Need basis and documentation for assumption.

(5) For piping, estimates of volume as a fraction of vessel volume may be acceptable.

(6) The use of purge flow rate and duration instead of volume may be an option, but use appropriate concentration. The concentration would not be at the maximum for the entire duration of the event.

F. Pipe Clearing

(1) Calculate clearing and degassing emissions using the same methods as for vessels.

(2) The open-ended line fugitive factor is not appropriate for estimating emissions for opening or clearing lines.

(3) Fugitive emissions from open-ended lines created during maintenance will generally be minimal due to the permit condition requiring them to be monitored for leaks or equipped with a cap, blind flange, plug, or second valve within 72 hours.

G. Short-Term Emissions

(1) May need to show different scenarios to find realistic worst case.

(2) Assuming that all emissions from an event occur in one hour is worst case, but may not be realistic (and may not pass impacts review).

(3) Calculating hourly emissions as the total emissions per event divided by the hours per event may not be the maximum hourly rate.

(4) Consider factors such as ventilation rates, time to complete task, variable concentration over time, etc. Use of decay equations may be appropriate.

(5) Consider which activities could occur during the same hour.

6. Other Helpful Hints

A. Document the basis for all assumptions.

B. Use consistent assumptions: for example, don't say the flare header pressure is five psig in one calculation and seven psig in another, unless they are separate sections with different pressures.

C. Show speciated emissions.

D. Show your work and give example calculations so the permit reviewer can follow them.

III <u>Authorizing Storage Tank Maintenance, Startup, and Shutdown (MSS) Activities in New Source Review (NSR) Permits</u>

1. Topics

A. Storage tank review - a short review of the types of storage tanks that will be addressed in the MSS activities presentation

B. Storage tank MSS activities – a listing of the MSS activities associated with the various types of storage tanks

C. Best Available Control Technology (BACT) for storage tank MSS activities – listing and discussion of BACT requirements for the common storage MSS activities

D. Estimating emissions from storage tank MSS activities – discussion of calculation methodologies for emissions from storage tank MSS activities

2. Storage Tank Review

A. Fixed Roof Tanks

(1) Vertical fixed roof (VFR) tanks consist of a cylindrical steel shell with a permanently fixed roof.

(2) VFR tanks may be either freely vented or may be equipped with a pressure/vacuum vent.

(3) Horizontal fixed roof (HFR) tanks are generally small storage tanks with capacities less than 40,000 gallons.

(4) HFR tanks are usually equipped with pressure/vacuum vents, gauge hatches, and manways.

B. Floating Roof Tanks

(1) Internal floating roof (IFR) tank can be described as a vertical fixed roof with a floating roof inside.

(2) The floating roof consists of a deck, deck fittings, either fixed or adjustable legs, and a rim seal system.

(3) The fixed roof may be self-supported or may be supported by vertical columns in the tank, which also penetrate the floating roof.

(4) External floating roof (EFR) tank consists of an open-topped cylindrical shell with a roof that floats on the surface of the stored liquid.

(5) The floating roof in an EFR is similar to that of an IFR, except that there are no vertical support columns that penetrate the floating roof.

3. Storage Tank MSS Activities

A. Change of Service With Tank Cleaning

(1) Floating roof tanks (external and internal).

(a) Empty the tank.

(b) Degas vapor space under roof.

(c) Remove heel, if not a drain dry tank.

(d) Enter and clean.

(e) Refill the tank.

(2) Fixed roof tanks.

(a) Empty the tank.

(b) Degas vapor space.

(c) Remove heel.

(d) Enter and clean.

(e) Refill the tank.

B. Change of Service Without Tank Cleaning

(1) Floating roof tanks.

(a) Empty the tank.

(b) Degas vapor space under roof.

(c) Open tank to remove heel if there is concern for contamination of new product.

(d) Refill the tank.

(2) Fixed roof tanks.

(a) Empty the tank.

(b) Degas vapor space if entry of tank is needed to remove heel.

(c) Open tank to remove heel.

(d) Refill the tank.

C. Seal Inspections

(1) External floating roof tanks.

(a) Empty the tank.

(b) Degas vapor space under roof.

(c) Remove heel, if not a drain dry tank.

(d) Enter and clean.

(e) Inspect seals.

(f) Refill the tank.

(2) Internal floating roof tanks – same as EFR tanks.

D. Common Tasks for All Tank Maintenance Activities

(1) Emptying the tank.

(2) Landing the roof (floating roof tanks).

(3) Degassing the tank.

(4) Post degas, removing the heel.

(5) Entering and cleaning the tank.

(6) Refilling the tank, refloating the roof (floating roof tanks only).

4. BACT for Storage Tank MSS Activities

A. General Guidelines - floating roof tanks storing liquids with VP > 0.5 psia may have their roof landed to perform seal inspections, maintenance, or a change of service.

(1) Minimize change of service and convenience floating roof landings.

(2) Convenience landings may be authorized if emissions are controlled and off-site impacts are acceptable.

B. Emptying the Tank

(1) Floating roof tanks.

(a) Liquid must be withdrawn continuously from the tank once the floating roof has landed on its legs. Once the floating roof has landed, the vapor control achieved by the roof rim seals and deck fittings is ineffective. Any pause in the emptying process can result in significant emissions. The emptying process may be paused in order to switch from larger to smaller diameter piping if the tank is so equipped in order to remove as much heel as possible.

(b) The degassing of the tank vapor space must commence or the roof re-floated within 24 hours of the roof being landed (the liquid level has dropped below the floating roof). A floating roof tank with a landed roof and residual liquid acts as a mini-fixed roof tank. Breathing (standing) losses will occur due to diurnal temperature changes.

(2) Fixed roof tanks – emptying the tank will not produce any additional emissions from routine operating emissions, therefore no additional controls of this activity is considered BACT.

C. Degassing the tank

(1) Gas or vapor removed from the vapor space under the landed floating roof must be routed to a control device achieving destruction and removal efficiency (DRE) of at least 98%.

(2) Control must be maintained on vapors removed from the tank until the volatile organic compound (VOC) concentration is less than 10,000 ppmv.

(3) If low vapor pressure liquid is added in order to lower the vapor pressure of the residual liquid in the tank, it should be done during tank degassing in order to minimize additional working losses.

D. Post Degas - If the vapor pressure of the residual VOC (heel) in the tank is > 0.5 psia, perform degassing at least once per day, until residual liquid is removed or diluted with low VP liquid.

E. Cleaning and Entry

(1) If the VP of the residual liquid is >0.02 psi, forced ventilation must be exhausted through a control device.

(2) Additional control may be required for removal of sludge.

F. Filling the Tank

(1) Emissions for filling a clean tank are lower than for a tank with a heel due to the lower saturation factor.

(2) If total site-wide refilling losses are less than or equal to ten tons per year (TPY), no control of refilling is necessary if off-site impacts are acceptable.

(3) If tank is not being cleaned, control of refilling may need to be evaluated on a cost per ton basis.

5. Estimating Emissions for Storage Tank MSS Activities

A. Fixed Roof Tanks

(1) Use of a cleaning solvent requires authorization for change of service since different chemical compounds would be emitted.

(2) Emissions from working and standing losses are calculated using Equations 1-29 and 1-4 from Section 7.1.3.1 Total Losses From Fixed Roof Tanks of Chapter 7, AP-42.

B. Floating Roof Tanks

(1) Emptying the tank – no emissions above routine are expected.

(2) Landing the floating roof – calculation of standing losses.

(3) Internal floating roof tank with heel - use Equation 2-16 from Section 7.1.3.2.2 Roof Landings of Ch 7, AP-42.

(4) External floating roof tank with heel - use Equation 2-19 from Section 7.1.3.2.2 Roof Landings of Ch 7, AP-42.

(5) Degassing/post degassing (consideration of presence or absence of heel, how and when heel is removed).

(6) Use the Ideal Gas Law (see below), vapor pressure at 95° F or actual temperature if higher, and vapor molecular weight of compound in the tank. Assume a concentration based on whether the tank contains a full heel (60% saturated) or a partial heel (50% saturated).

(7) Ideal Gas Law: n = PV/RT

Total Emissions = **(PV/RT)** * MW * Concentration

P = vapor pressure of material stored pressure (psia) at t

V = vessel volume (ft^3)

MW = molecular weight (lb/lb-mole)

Concentration = 50 or 60% of full saturation

R = (10.73 psia-ft3/lb-mol-R)

T = 460 + t (deg R)

t = 95° F or actual, whichever is higher

(8) Ventilation/cleaning.

(9) If the tank is to be ventilated prior to entry for cleaning, use correlation equation below to estimate emissions resulting from forced ventilation.

$ER = 4.14(10^{-5}U_s^{0.78}P_vM_w^{0.67}A_p^{0.94})$

Where ER = emission rate, lb/hr

U = surface wind speed, m/s

P_v = VOC vapor pressure, Pa

M_w = VOC vapor molecular weight

A_p = liquid surface area, m2

(a) SOURCE: Ajay Kumar, N.S. Vatcha, and John Schmelzle, "Estimate Emissions from Atmospheric Releases of Hazardous Substances," Environmental Engineering World, November-December 1996.

(b) Refer to API Technical Report 2568 "Evaporative Loss from the Cleaning of Storage Tanks" for estimation methods to be used for various cleaning scenarios.

(10) Filling the tank – total emissions from refloating the floating roof.

(11) Internal floating roof tank with heel - use Equation 2-26 of Section 7.1.3.2.2 Roof Landings of Ch 7, AP-42.

(12) External floating roof tank with heel - use Equation 2-27 of Section 7.1.3.2.2 Roof Landings of Ch 7, AP-42.

(13) Use one of the following saturation factors -

Full Heel S = 0.6

Partial Heel S = 0.5

Drain Dry S = 0.15

(14) Maximum short-term emissions – refloating the floating roof.

(15) Maximum short-term emission rate (lbs/hr) is the total mass of vapor (lbs) emitted when the floating roof is refloated as the tank is refilled divided by the time it takes to refloat the roof.

(16) Time to refloat the roof is determined by dividing the volume of the vapor space (gallons) by the filling rate (gal per hr).

(17) It is important not to represent the maximum short term as the total mass of emissions during a tank landing event divided by 24 hours or the length of the event.

(18) Maximum short-term emission rate while refloating the roof may be on the order of 800-1000 lb/hr from a tank that has not been cleaned depending on the material stored and the refill rate.

(19) SOURCE: Draft Memo "Calculating Short Term Emissions from Tank Roof Landings" dated 1/18/07.

6. References

A. Undated internal TCEQ document entitled "Tank MSS"

B. Section 7.1.3.1, "Total Losses From Fixed Roof Tanks," Chapter 7, AP-42

C. Section 7.1.3.2.2, "Floating Roof Landing Losses," Chapter 7, AP-42

D. Draft Memo "Calculating Short Term Emissions from Tank Roof Landings" dated 1/18/07

E. API Technical Report 2568, "Evaporative Loss from the Cleaning of Storage Tanks" dated 11/07

F. API Technical Report 2567, "Evaporative Loss from Storage Tank Floating Roof Landings" dated 4/05

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IV <u>Vacuum Trucks and Frac Tanks</u>

1. Definitions and Modes of Operation

A. Vacuum trucks are used for removal of liquids from storage tanks; other vessels and equipment; and spills.

B. Vacuum truck operation options:

(1) Vacuum is drawn on vacuum truck tank and then pump is turned off; liquid is drawn into the tank using the vacuum in the tank; and then the tank is emptied prior to drawing another vacuum (no emissions generated during vacuuming operations).

(2) Positive displacement pump is used to move liquids into the vacuum truck.

(3) Air mover is used to move liquids into the vacuum truck.

C. Frac Tanks are used to temporarily store liquid material.

2. Emission Calculations

A. Vacuum Trucks

Loading Loss Equation in AP-42 is used for estimating emissions using air blowers and positive displacement pumps. If using positive displacement pump use 1 X loading loss equation. If using air blowers, 2 X loading loss equation.

LL = 12.46 SPM/T

LL = Loading loss (lb/1000 gal of liquid loaded)

S = Saturation factor from AP-42, Table 5.2-1

P = True vapor pressure of liquid loaded (psia)

M = Molecular weight of vapors (lb/lb-mol)

T = Temperature of bulk liquid loaded (deg R)

B. Frac Tanks

C. Emissions from frac tanks should be estimated using EPA Tanks Program.

3. BACT

A. Vacuum Trucks

(1) Use “duck bill” attachment if the hose end cannot be submerged in the liquid being collected. Minimize air transfer.

(2) No controls are required if 1) vacuum is drawn on vacuum truck; 2) positive displacement pumps are used; or 3) if air movers are used where the vapor pressure of material is less than 0.5 psia.

(3) If material cleaned utilizing air movers has a vapor pressure greater than 0.5 psia, the vacuum truck must be routed to control device. Emissions must be controlled down to 100 ppmv.

B. Frac Tanks

(1) Exterior surfaces exposed to the sun shall be white or aluminum effective May 1, 2013.

(2) Submerged fill pipes and emissions vented to a control device when filling if the vapor pressure of the liquid stored is greater than 0.50 psia at 95° F.

V <u>Miscellaneous Maintenance, Startup, and Shutdown (MSS) Emission Sources, Permit Attachments, and Impacts Review</u>

1. Miscellaneous Activities

A. Surface coating: generally authorized under PBR 106.263

B. Abrasive blasting: generally authorized under PBR 106.452 if done in a dedicated area or booth or 106.263 for outdoor abrasive blasting.

C. Degreasers

(1) Generally authorized by PBR 106.454. Requirements for permit will be similar to these.

(2) Generally determine emissions using mass balance - the difference between initial solvent and recovered solvent sent back to vendor.

D. Transfers of solids - PM emissions

(1) Examples - catalyst change out, bag filter replacement, maintenance on baghouses. This review is still largely case-by-case.

(2) Must estimate the amount of solids exposed during activity and the fraction of that which could be transferred (or "dropped"). These need to be engineering estimates; there is not yet a generally accepted method for estimating these.

(3) AP-42 drop equation may be used to estimate losses from solids transfers. From AP-42 (5th Edition), Section 13.2.4:

$E = k(0.0032)(U/5)^{1.3}/(M/2)^{1.4}$

U is wind speed in mph

M is moisture in percent

Particle size multipliers (k) from AP-42, Section 13.2.4

for TSP	0.74
for PM_{10}	0.35
for $PM_{2.5}$	0.11

(4) Make reasonable assumptions and emission estimates. Practices must be consistent with BACT; assuming all is released into air is not consistent with BACT.

(5) BACT

(a) Control generally not necessary for infrequent activities.

(b) Identify Best Management Practice (BMP), such as

(i) limiting transfers during high winds or establishing wind breaks;

(ii) vacuuming PM out of housing using vacuum with High Efficiency Particulate Air (HEPA) filter; and

(iii) removing filters or bags with care and placing them in enclosed containers.

2. Attachments to MSS Model Permit

A. These may not necessarily be attachments to most MSS permits but the concepts/requirements should be in permits authorizing MSS

(1) Attachment C identifies the MSS activities authorized by the permit.

(2) Attachment D identifies the facilities on which the MSS is authorized to occur and those temporary facilities that may support the performance of MSS.

(3) Attachments A and B identify activities that are eligible for streamlined recordkeeping. Attachment A activities only require an annual validation. Attachment B activities may be tracked through work orders or equivalent.

(4) These designations (A through D) reflect the development of the MSS model permit.

B. Attachment C - Authorized MSS Activities

A comprehensive list of the MSS activities and emission points authorized by the permit.

(1) If an activity is not on the list, it is not authorized by the permit.

(2) The listing clarifies the final result of a complex permit review.

(3) Identify what the startup or shutdown involves in terms of what causes air emissions - not what might be repaired or why the shutdown is necessary.

(4) Very few maintenance emissions have been identified in reviews completed thus far - tank cleaning solvents, abrasive blasting, welding, and painting.

(5) Can be a reasonably concise list - See the example attachment. This table might also be incorporated into the body of the permit.

(6) The Emission Point Numbers (EPNs) identified in Attachment C are generally designated as MSS on the MAERT. Exception - facilities may typically have startup and shutdown emissions from routine emission points that are compliant with the routine allowables elsewhere in the permit, and the permit authorizing the facilities may be referenced to avoid duplicating emissions accounted for elsewhere. See attached permit conditions.

C. Attachment D - Facilities Covered

(1) Identifies two groups of facilities.

(a) Currently permitted (must be authorized by a permit, not a PBR), permanent facilities with MSS emissions.

(b) Temporary facilities (by category) used to support the performance of MSS on the currently permitted, permanent facilities.

(2) If MSS only on facilities authorized by the permit, listing the first category is not necessary. If no attachment, generally place temporary facility language in the condition identifying MSS and summarizing recordkeeping.

(3) If used to support MSS, temporary facilities must be identified (and emissions estimated).

D. Attachments A and B - Streamlined Records

(1) These allow for reduced recordkeeping for numerous activities with minor emissions. Must balance the need for reasonable tracking of actual emissions against administrative burden.

(2) Attachment B lists activities that meet the criteria above and the performance of the activity is already tracked in some manner. Typical example - work orders. Permit application assigns an emission rate to MSS activity (pump repair, for example). Use data from pump repair records maintained by the applicable group each month with emission rate from the permit application to determine emissions due to that activity for that month.

(3) Attachment A lists activities that meet the above criteria but do not generally have records generated. These activities are typically not controlled, and might include: gauge calibrations, blowdowns of air lines. Emissions are based on estimated PTE, which means emissions per activity as well as activities per hour and year must be estimated. Must validate accuracy annually.

(4) For significant sites (refineries), Attachment A activities have generally been two to three tons per year (tpy), Attachment B activities from five to ten tpy.

E. Emission Tracking/Enforceability

(1) Focus of permit is on MSS emissions, not number of activities on a facility or facility type.

(2) MSS emissions may be shown in emission caps. The cap and types of activities are enforceable, not the number of activities that may have been assumed to construct the cap.

(3) Permit focuses on what is authorized; it does not list what is not authorized.

3. Impacts Review

A. Methodology/Recommendations

(1) Try to streamline review.

(2) Separate MSS emissions from routine operating emissions. The Modeling and Effects Review Applicability (MERA) document is written to allow for this.

(3) Treat MSS emissions on a permit basis rather than a project basis.

(4) Facilities in Air Pollutant Watch List (APWL) areas will have to be reviewed by TCEQ Toxicology Section.

(5) If toxicology review is required, identify any significant actual emission reductions that may occur due to control of emissions for MSS activities.

B. If reviewing emissions of any of the 22 compounds listed below, will need toxicology review if modeled GLCmax for MSS emissions is greater than the ESL for the compound: Acrolein, Acrylonitrile, Benzene, Bromine, 1,3-butadiene, Carbon disulfide, Chlorine, Chloroform, Chloroprene, Epichlorohydrin, Fluorine, Formaldehyde, HCI, HF, Hydrazine, Mercaptans, Methyl bromide, MDI, Phosgene, Phosphine, Styrene (odor), TDI

C. Other compounds under review are eligible to be evaluated under MERA Step 9.D. Once this point is reached, it will probably be necessary to do refined modeling to obtain number of exceedances.

(1) Model only the reasonable worst case MSS emissions. This is likely to be due to emptying and degassing a large process unit or refilling a landed floating roof tank. The worst case scenario for any compound should be identified through a limited amount of modeling and engineering judgment (this should be explained in detail). Note that if the results are anywhere near the limits allowed in Step 9.D, the assumptions made in setting up the modeling run are likely to be included in a permit condition.

(2) Permit reviewer can pass results that meet the following criteria at the GLCmax:

No more than two hours per year > ten times the ESL.

No more than 12 hours per year > four times the ESL,

No more than 24 hours per year > two times the ESL, and

No more than 48 hours per year > one times the ESL.

D. If toxicology review is necessary

(1) Clearly identify any real emission reductions that result from new MSS control requirements.

(2) Ensure the emission estimates and modeling assumptions are reasonable.

(3) Be prepared to add emission controls.

VI Maintenance, Startup, and Shutdown (MSS) New Monitoring

1. Why MSS Monitoring?

   A. Required for decision making associated with operations.

   B. Required to document activities.

   C. Required for records and reporting.

2. Example Monitoring Efforts

   A. Monitoring of volatile organic compounds (VOCs) with an Environmental Protection Agency (EPA) Method 21 type instrument.

   B. Monitoring with a Lower Explosive Level (LEL) type instrument.

   C. Monitoring with stain tubes or detector tubes.

   D. Other methods pre-approved on case-by-case basis.

3. Monitor Issues

   A. Concern expressed that an appropriate detector is not available or that a Flame Ionization Detector (FID) will not work.

   B. Many have identified concerns that Method 21 is too prescriptive and is not appropriate.

   C. Others stated that air in-leakage should be allowed because the FID requires air/oxygen to function and without air in-leakage the detector will not operate. The Air Permits Division believes that an appropriate detector will work in most cases, and that Method 21 does not require only an FID.

   D. Leak level has been established at 10,000 ppmv VOC (or 1 vol. %).

   E. Response factor (RF) is inappropriate for MSS. MSS requires RF of 2, though Method 21 allows RF of 10.

   F. Others have asked that on-site established monitoring procedures be accepted for monitoring.

4. VOC Monitor

   A. Leak level or decision level generally 10,000 ppmv VOC (or 1 vol. %) unless specified differently.

B. Initial condition specified EPA Method 21 with specific accuracy, calibration gas, and response time requirements and noted that it was prepared for FID but that other detectors could be used. With input from the Texas Oil and Gas Association (TxOGA), the condition no longer requires a specific detector type.

C. Recognized safety concern with FID.

D. Recognized concern that FID may need supplied air for measurements.

E. Three exceptions to Method 21:

(1) Calibrate once every 24 hours.

(2) Response factor of VOC to be sampled must be < 2X cal gas used. Though Method 21 allows RF < 10 for monitoring small fugitives, it is not reasonable for large volumes of uncontrolled VOC emissions.

(3) Method is used to measure concentration in a gas stream and not for fugitive emissions leaking from components.

F. Period equal to 2X the response time of the instrument should be met prior to recording data.

G. Monitor should operate to collect five minutes of VOC data with operational decision based on the highest one-minute value recorded.

5. LEL Monitor

A. LEL provision provides for an optional monitoring approach.

B. Target level established at 10% of Lower Explosive Limit (Must be less than 10,000 ppmv equivalent).

C. Establish a calibration monthly with certified gas standard (Generally pentane for refineries, major constituent of gas to be monitored for other applications).

D. Must perform a daily functionality test or calibration check.

E. Use of an alternative gas standard may be permissible if it can be demonstrated that it is appropriate and that there are documented or demonstrated response factors for each and a means to measure constituent X when calibrated with Y. Requires pre-approval and inclusion in permit condition.

6. LEL Monitor Issues

A. The appropriate calibration gas has been debated. Originally pentane was chosen because it appeared to have a good response factor relationship between compounds in refinery application. However, chemical plants have a wider range of chemicals. Therefore, close review should be done to ensure the compound chosen to calibrate the instrument is appropriate.

B. Response factors differ from compound to compound and must be considered, just like the compound's LEL.

C. Ease of calibration versus bump test has been questioned by industry. Current requirement is to perform a functionality test (or calibration check) to ensure the instrument is reading correctly in lieu of the industry desired bump check to indicate that the unit will go into alarm mode when it hits a specific concentration level.

7. LEL Examples

Compound	LEL	Control to 10% LEL
Methane	5.0%	5000 ppmv
Propane	2.1%	2100 ppmv
Pentane	1.5%	1500 ppmv
Methanol	6.0%	6000 ppmv
Ethanol	3.3%	3300 ppmv
Benzene	1.2%	1200 ppmv

8. LEL Response Factors

A. Issue - LEL calibration with one compound and measurement of another.

B. Ex: calibrate with C1 and use in C5 environment.

C. Assume measured LEL value of 10% as C1.

D. To determine LEL of pentane must use correction or correlation factor of 1.9.

E. Consequently, LEL = 10% x 1.9 = 19% for pentane.

F. Must know correlation factor between calibration compound and the measured environment.

9. Detector Tube Measurements

   A. Option to monitor VOC added per TxOGA request.

   B. Use in accordance with guidelines from manufacturer.

   C. Attempts to ensure that concentration to be measured may be accurately determined with tube selected.

   D. May not have specificity required (i.e., interference).

   E. Need a minimum of two samples, five minutes apart.

   F. The measured contaminant level should be below the release concentration (RC).

   G. RC is defined as 10,000 times the mole fraction of total air contaminants detected by the tube.

10. Detector Tube Example

   A. Assume the ethylene concentration is 2000 ppmv.

   B. Assume the total VOC concentration is 10% or 100,000 ppmv.

   C. The mole fraction of ethylene is 2000/100,000 or 0.02.

   D. Then the release level is 10,000 x 0.02 = 200 ppmv ethylene.

   E. In this instance, the level is significantly lower than the VOC decision concentration, since the measurement tool cannot define the Total VOC.

   F. Critical in the assessment is knowledge or data to define the mole fraction.

11. Other Case-By-Case Methods

   A. Assume that some sites will have well established procedures.

   B. Example is site with gas chromatograph (GC) instrumentation and ability of staff to obtain representative samples.

   C. For sample representativeness, TCEQ has identified that Tedlar bag is appropriate for sample collection and transport to lab. May require protection from sunlight to minimize degradation.

   D. Prefer that lab use an established reference method with defined procedure.

E. Requires pre-approval and inclusion in permit condition.

12. MSS Control Decisions

A. MSS conditions identify various scenarios where control must meet a specific condition.

B. Uncontrolled venting of tanks vessels - cannot occur until a specific VOC level is achieved. In many cases, the level is 10,000 ppmv VOC.

C. Open ended lines - condition.

D. Carbon adsorption system (CAS) - breakthrough of first canister of dual canister CAS at 100 ppmv VOC above background. Replacement of cans in four hours.

E. Thermal Oxidizer - measured temperature > 1400 degrees F.

F. Internal Combustion (IC) Engine - MSS activity must cease if outlet VOC > 100 ppmv by VOC monitor.

G. Liquid scrubber - MSS activity must cease if outlet VOC > 100 ppmv by VOC monitor.

H. Closed-loop refrigerated vapor recovery system (VRS) - recirculated vapor sampled with VOC monitor every four hours in condenser inlet.

I. Other controls - an attempt has been made to determine and list potential controls, with assurance industry will come up with additional, more effective measures to control emissions. Therefore, additional systems will be assessed on a case-by-case basis.

13. Records

A. Records are required and necessary to document decision making.

B. Records also important to document emissions.

C. Records will assist with MSS reporting as appropriate.

VII <u>Federal Applicability Related to Planned Maintenance, Startup, and Shutdown (MSS)</u>

1. Federal New Source Review (FNSR) Concepts

A. Major Source

(1) Prevention of Significant Deterioration (PSD):

Named Source: 100 tons/year

Unnamed Source: 250 tons/year

(2) Nonattainment:

Marginal and Moderate Designations: 100 tons/year

Serious Designation: 50 tons/year

Severe Designation: 25 tons/year

B. Significant Increase (Major Project)

A project whose emission increases (without consideration of any decreases) exceeds the de minimis value for the pollutant involved.

(1) PSD

100 tons/year	Carbon monoxide (CO)
40 tons/year	Nitrogen oxides (NO_x), sulfur dioxide (SO_2), and volatile organic compounds (VOC)
25 tons/year	Particulate matter (PM)
15 tons/year	Particulate matter less than or equal to ten microns in diameter (PM10)
0.6 tons/year	Lead
3 tons/year	Fluorides
7 tons/year	Sulfuric acid mist
10 tons/year	Hydrogen sulfide, total reduced sulfur, reduced sulfur compounds

(2) Nonattainment

40 tons/year	NO_x and VOC
100 tons/year	CO (El Paso - Partial)
15 tons/year	PM10 (El Paso - Partial)

The significant increase levels described above for nonattainment are based on the nonattainment areas being designated as either Marginal or Moderate for ozone. The significance level falls to 25 tons/year for Serious and Severe nonattainment designations.

C. Contemporaneous Net

Comparison of the baseline actual emission rates to the Potential To Emit (PTE), or the projected actual emission rate, over the contemporaneous period.

(1) Baseline: The rate, in tons/year, at which the facility emitted the pollutant during any consecutive 24-month period selected by the owner or operator within a ten-year period immediately preceding either the date the owner or operator begins actual construction of the project, or the date a complete permit application is received by the TCEQ.

(2) Projected Actual Emissions (for existing facilities only): The maximum annual rate, in tons/year, at which an existing facility is projected to emit a federally regulated new source review pollutant in any rolling 12-month period during the five years following the date the facility resumes regular operation after the project, or in any one of the ten years following the date, if the project involves increasing the facilities design capacity or its potential to emit for that federally regulated pollutant.

(3) Contemporaneous Period: The contemporaneous period extents back 60 months prior to the start of construction of the proposed project through the start of operation of the new or modified facilities.

Baseline emissions are used when determining emission increases and decreases for all projects in the contemporaneous period. Projected actual emissions are only used to determine the project emissions increase for the current project.

D. Major Modification

If the value obtained from the netting calculation exceeds the significance threshold for the pollutant under evaluation, FNSR is triggered. The significance levels are the same values as described in (B) above.

2. MSS before FNSR

If the MSS emissions occurred before FNSR came into existence, the project emission increase may be assumed to be zero for each facility if the following can be verified:

A. The facility existed prior to the applicability of the FNSR program

(1) August 7, 1977 for SO_2 and particulate matter (PM).

(2) March 1, 1978 for all other criteria pollutants.

B. The facility has not been modified since FNSR applicability such that MSS emissions were increased.

3. Inclusion of MSS Emissions into the Emissions Inventory

MSS emissions that have been reported into the Emissions Inventory in a timely (not several years later) manner under 30 Texas Administrative Code (TAC) Chapter 101 may be included into the site's baseline emission rate. These emissions must take both of the following into account:

A. The application of Best Available Control Technology (BACT)

B. The application of all applicable rule requirements (Chapters 115, 117, etc)

4. MSS Contained Under Existing Allowable Emission Rates (Tons/Year)

MSS activities may be authorized without triggering FNSR applicability if the emissions resulting from the MSS activity can be accommodated within the authorized emission rate for the facility undergoing evaluation/review.

5. MSS Emissions/Activities as a New Project

All MSS emissions and/or activities may be treated as a new project. All MSS emissions must be added up and the resulting value compared to the appropriate significance level for the air pollutant being evaluated.

A. If the source is currently a minor source and the MSS emissions are a major source in and of themselves, the appropriate FNSR review (PSD and/or nonattainment) must be conducted. The applicant will need to demonstrate that MSS would not have made any previous project a major source.

B. At an existing major source, if the MSS emissions exceed the appropriate significance level determining that a project is major:

(1) Full contemporaneous netting must be conducted.

(2) If full contemporaneous netting indicates that the project is a major modification, the appropriate FNSR review (PSD and/or nonattainment) must be conducted. The review would not be limited to MSS alone, and would most likely lead to a retrospective analysis.

6. Retrospective Analysis for MSS

MSS emissions must be evaluated to determine their impact on federal applicability for all projects completed since FNSR came into being. If the retrospective analysis indicates that FNSR (PSD and/or nonattainment) would have been triggered, the appropriate FNSR review shall be conducted using today's BACT and/or Lowest Achievable Emission Rate (LAER), modeling techniques, etc.

7. Case-by-case

The information identified above should be considered as examples of approaches for reviewing FNSR requirements in association with MSS emissions. The TCEQ's Air Permits Division will consider other approaches on a case-by-case basis.

VIII Identification of Maintenance, Startup, and Shutdown (MSS) Activities and Estimation of MSS Emissions - Examples

1. Tanks Example 1

An 80,000 barrel internal floating roof tank in motor gasoline service will be taken out of service for inspection, cleaning, and any required maintenance.

Tank Characteristics: Diameter = 120 ft

Leg height = 5.8 ft

Landed volume = 65,605 ft3 = 11,684 bbls

Drain-dry bottom configuration

Gasoline Properties: RVP = 10.0 psia

TVP at 95°F = 9.7 psia

Vapor molecular weight = 66 lb/lb-mol

Degassing - Gasoline vapor to control device - no forced ventilation:

(0.25 sat. factor)(9.7 psia)(65,605 ft3)(66 lb/lb-mol) = 1,763 lb
10.73 psia-ft3/lb-mol-°R)(555°R)

Refilling (roof refloating) - equation (2-26) from AP-42:

LFL = (PVV/RT)MVS = (9.7 psia)(65,605 ft3)(66 lb/lb-mol)(0.15 sat)/10.73 psia-ft3/lb-mol-°R)(555°R)]

= 1,058 lb while filling - until roof is refloated

At tank refill rate of 4,000 bbl/hr:

11,684 bbl/(4,000 bbl/hr) = 2.92 hours to refloat roof

1,058 lb refilling loss/2.92 hr = 362 lb/hr while filling

If this tank had not been drain-dry but had a sump (partial or full liquid heel), and had not been cleaned within 24 hours, the standing losses occurring during idle days would be added to the above refilling emissions to arrive at total emissions for the entire roof landing/refilling and roof refloating operation. Similarly, if forced ventilation had been used while residual liquid remained in the tank, those emissions would also be included in the total. However, since these do not occur simultaneously, for health effects purposes, the refilling emissions (362 lb/hr for ~3 hours) would be the determining factor.

2. Tanks Example 2

110,000 barrel fixed roof tank in kerosene/jet fuel service will be taken out of service for inspection, cleaning, and any required maintenance.

Tank Characteristics: Diameter = 140 ft

Shell height = 40 ft

Tank capacity = 614,190 ft3

Flat bottom configuration

Kero/Jet Properties: TVP at 95°F = 0.025 psia

Vapor molecular weight = 130 lb/lb-mol

Liquid density = 7.0 lb/gal

Degassing - kero/jet vapor contained in tank:

$$\frac{(0.025\ \text{psia})(614{,}190\ \text{ft}^3)(130\ \text{lb/lb-mol})}{(10.73\ \text{psia-ft}^3/\text{lb-mol-°R})(555\text{°R})} = 335\ \text{lb}$$

If forced ventilation is utilized:

$$ER = 4.14(10^{-5}\ Us^{0.78}\ Pv\ Mw^{0.67}\ Ap^{0.94})$$

Where ER = emission rate, lb/hr

Us = surface wind speed, m/sec

Pv = VOC vapor pressure, Pa

Mw = VOC vapor molecular weight

Ap = liquid surface area, m2

$$Us = \frac{(20{,}000\ ft^3/min)(min)(m)}{(15{,}396\ ft^2)(60\ sec)(3.28\ ft)} = 0.007\ m/sec$$

Ap = 3.142(140 ft)2/4)(m2/10.76 ft2) = 1,431 m2

Pv = (0.025 psia)(6895 Pa/psia) = 172.4 Pa

ER = 4.14(10-5)(0.007)0.78(172.4)(130)0.67(1,431)0.94= 3.62 lb/hr to control device

It should be noted that if the above forced ventilation example were redone with the same tank and fan rate parameters but substituting gasoline at the 9.7 psia TVP and 66 MW from Example 1, this emission rate would be ~ 900 lb/hr.

3. Equipment Clearing Example

Below is a sample historical maintenance record for a refinery:

Historic Equipment Maintenance Counts					
Equipment Type	Year			Proposed Maximum	Refinery-wide Equipment Count
	2004	2005	2006		
Pumps	836	1268	1222	1268	830
Compressors	62	92	89	92	60
Vessels	270	414	397	414	269
Exchangers	556	839	810	839	549

Emissions should be estimated for each category/equipment type based upon a representative situation where possible (volume of vapor/liquid cleared, etc.) The maximum proposed/expected allows for a safety factor over and above the highest recorded number of activities.

Liquid clingage may be ignored if the vapor pressure is > 0.1 psia, since the mass in the gas phase will be more significant. Clingage is likely to be more significant than the mass in the gas phase if the liquid vapor pressure is < 0.1 psia. If emissions from clingage are determined, a layer of 0.40 mil (0.0004 inch) should

be assumed to be on the surface area of the equipment. This is illustrated in the following table:

Estimated Clingage vs. Vapor Mass @ 0.4 mil Layer for Diesel Fuel (7.1 lb/gal Liquid Density, TVP = 0.02 psia, MW = 130):

Line/Vessel ID, in	Line/Vessel Length, ft	Clingage Mass, lb	Saturated Vapor Mass, lb
4	100	0.1864	0.0038
6	100	0.2796	0.0087
8	100	0.3729	0.0154
10	100	0.4661	0.0240
12	100	0.5593	0.0346
24	10	0.1119	0.0138
36	20	0.3356	0.0623
48	30	0.6711	0.1661
60	40	1.1186	0.3461

The estimated emissions from each category/equipment type should then be added to arrive at short-term and annual caps.

Document Change Record

Version	Date	Author	Change Details	Change Rationale
01	Unknown	K. Kind	Original Issue	
02	08/15/12	K. Mills-Jurach	Update to current style template; remove example permit and boilerplate conditions	Preparing document for web; decoupled boilerplate from document since boilerplate is update more frequently.
03	09/07/12	T. Hurley	Revised to improve readability and update to more current guidance	