MON RULE BATCH PROCESS VENT REQUIREMENTS

Presented by Michael R. Dixon, P.E.

Dixon Environmental

November 2003

PROCESS VENT REQUIREMENTS

Chemical Manufacturing Subpart FFFF	**For Existing Facilities:**	**For New and Reconstructed Facilities:**
1. Process Vents – Continuous See Table 1 of FFFF	Either reduce OHAP by ≥ 98%, closed vent system to a flare, ≤ 20 ppmv outlet from a control device, or maintain TRE > 1.9.	Either reduce OHAP by ≥ 98%, closed vent system to a flare, ≤ 20 ppmv outlet from a control device, or maintain TRE > 5.0.
2. Process Vents – Batch **See Table 2 of FFFF**	**For total batch vent emissions ≥ 10,000 lb/yr, reduce OHAP by ≥ 98%, closed vent system to a flare, or ≤ 20 ppmv outlet from control device. Alternatively, reduce OHAP by ≥ 95% using a recovery device.**	**For total batch vent emissions ≥3,000 lb/yr, reduce OHAP by ≥ 98%, closed vent system to a flare, or ≤ 20 ppmv outlet from control device. Alternatively, reduce OHAP by ≥ 95% using a recovery device.**
3. Process Vents – Hydrogen Halide/Halogen HAP & PM HAP See Table 3 of FFFF.	For total process uncontrolled HCl/HF/Cl_2 emissions >1,000 lb/yr reduce by ≥ 99% or ≤ 20 ppmv outlet from control device.	[Same as existing for HCl/HF/Cl_2] Plus, if a new source with uncontrolled PM HAP emission ≥ 400 lb/yr reduce by ≥ 97%.

BATCH OPERATIONS

- Noncontinuous – involving intermittent or discontinuous feed.
- Generally involves emptying of equipment after batch.
- Raw materials and product transfers do not occur simultaneously.

REMEMBER THAT PROCESS VENTS FROM BATCH OPERATIONS EXCLUDED FROM HON MUST COMPLY WITH MON BATCH VENT REQUIREMENTS.

BATCH PROCESS VENT

- From single unit operation or from manifolded vent.
- HAP-containing gas stream released, or potential to be released, to the atmosphere.
- Examples:
  - Vents on product recovery condensers
  - Reactors
  - Filters
  - Centrifuges
  - Process Tanks

WHAT IS NOT A BATCH VENT?

- Continuous Vent
  - Air oxidation reactor
  - Distillation unit
  - Other reactor
- Surge Control Vessel – Immediately preceding a continuous reactor, air-oxidation reactor, or distillation unit.
- Bottoms Receiver – Following a continuous distillation unit.

WHAT IS NOT A BATCH VENT? - CONTINUED

- Gases vented to a fuel gas system.
- Vents on storage tanks, wastewater sources and equipment leaks.
- Drums, pails and totes.
- Elephant trunk systems.
- Vents containing < 50 ppmv or < 200 lb/yr HAP.

OTHER VENT EXEMPTIONS

- Venting during startup, shutdown and malfunction (SSM).
- Opening a “safety device” to avoid unsafe conditions.

GROUP 1 BATCH PROCESS VENT

- *Group 1 batch process vent* means each of the batch process vents in a process for which the collective **uncontrolled** organic HAP emissions from all of the batch process vents are
- ≥ to **10,000 lb/yr** at an existing source

  or
- ≥ 3,000 lb/yr at a new source.

UNCONTROLLED EMISSIONS

- *Uncontrolled HAP emissions* means a gas stream containing HAP which has **exited the process (or process condenser, if any)**, but which has not yet been introduced into an air pollution control device to reduce the mass of HAP in the stream.

- If the process vent is not routed to an air pollution control device, uncontrolled emissions are those HAP emissions released to the atmosphere.

- Reference 40 CFR 2550(g) and 40 CFR 63.1251.

DEFINITIONS

- *Process tank* means a tank or vessel that is used within a process to **collect material discharged from a feedstock storage tank or equipment within the process** before the material is transferred to other equipment within the process or a product storage tank.

- A process tank has emissions that are related to the characteristics of the batch cycle, and it **does not accumulate product over multiple batches**.

- Surge control vessels and bottoms receivers are not process tanks.

- Not a *storage tank* per the definition of storage tank.

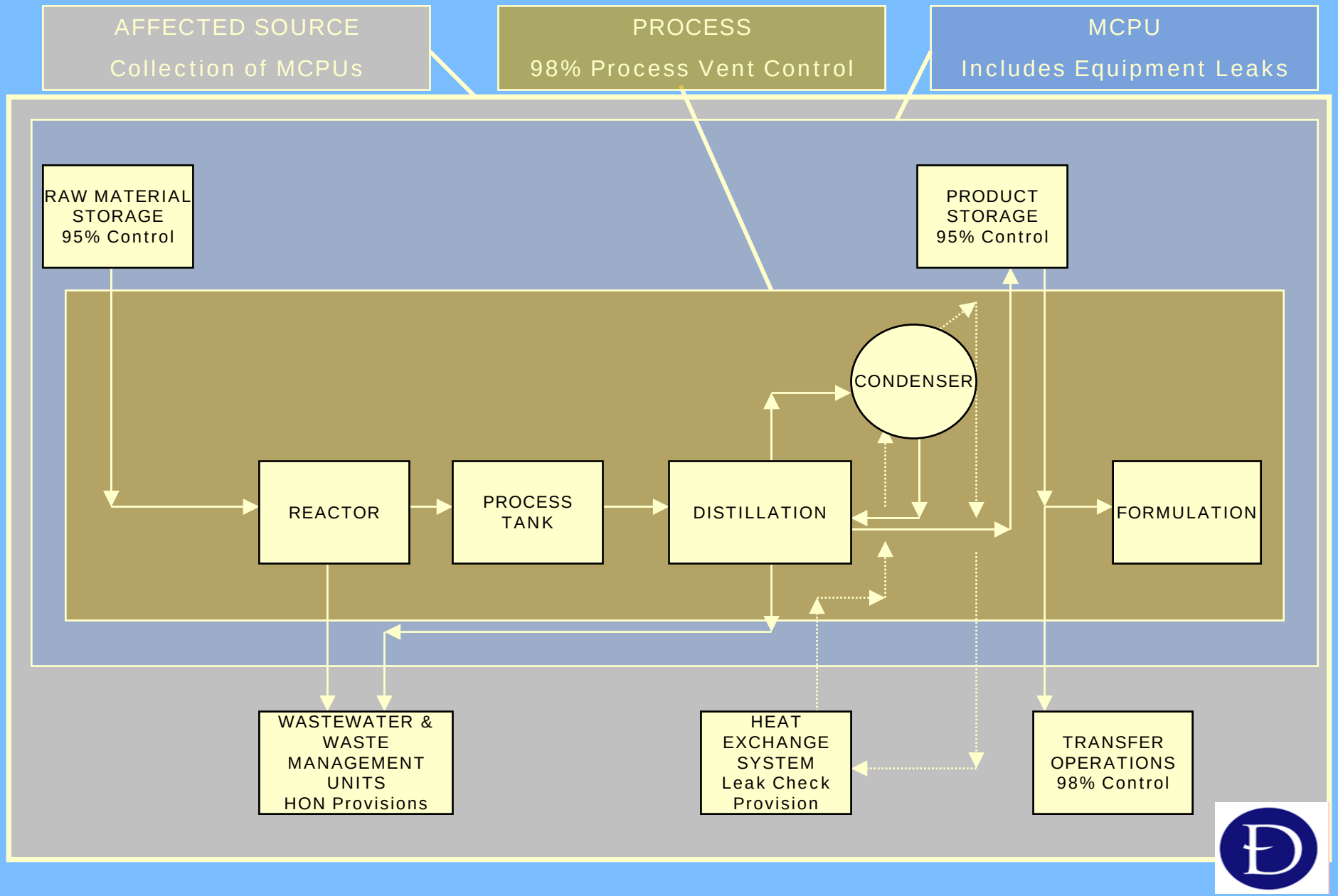
DEFINITIONS - CONTINUED

- *Surge control vessel* means feed drums, recycle drums, and intermediate vessels **immediately preceding continuous reactors, air-oxidation reactors, or distillation operations**. Surge control vessels are used within an MCPU when in-process storage, mixing, or management of flowrates or volumes is needed to introduce material into continuous reactors, air-oxidation reactors, or distillation operations.

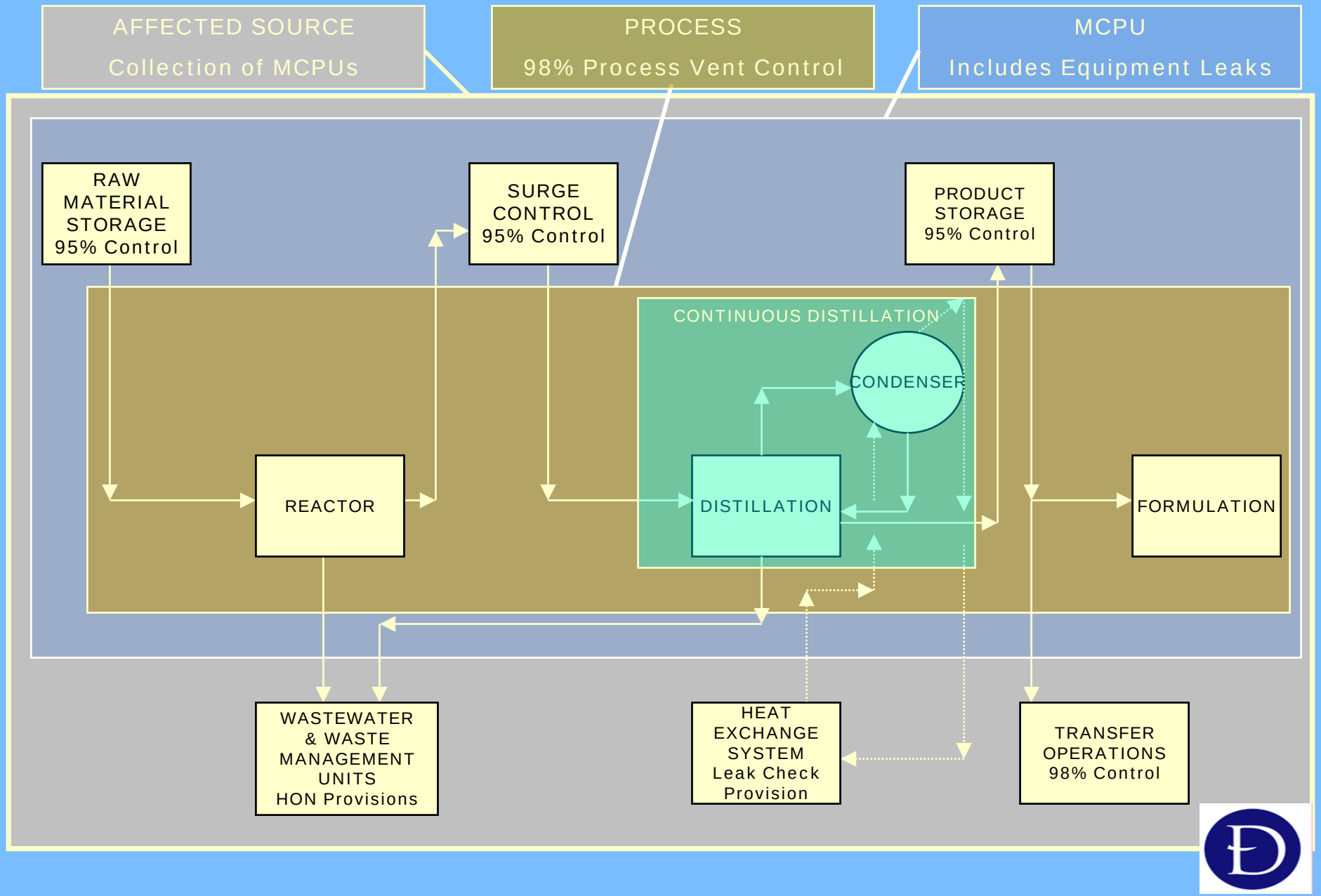
- *Bottoms receiver* means a tank that collects bottoms **from continuous distillation** before the stream is sent for storage or for further downstream processing.

- Not s*torage tanks* per the definition of storage tank.

BATCH OPERATIONS

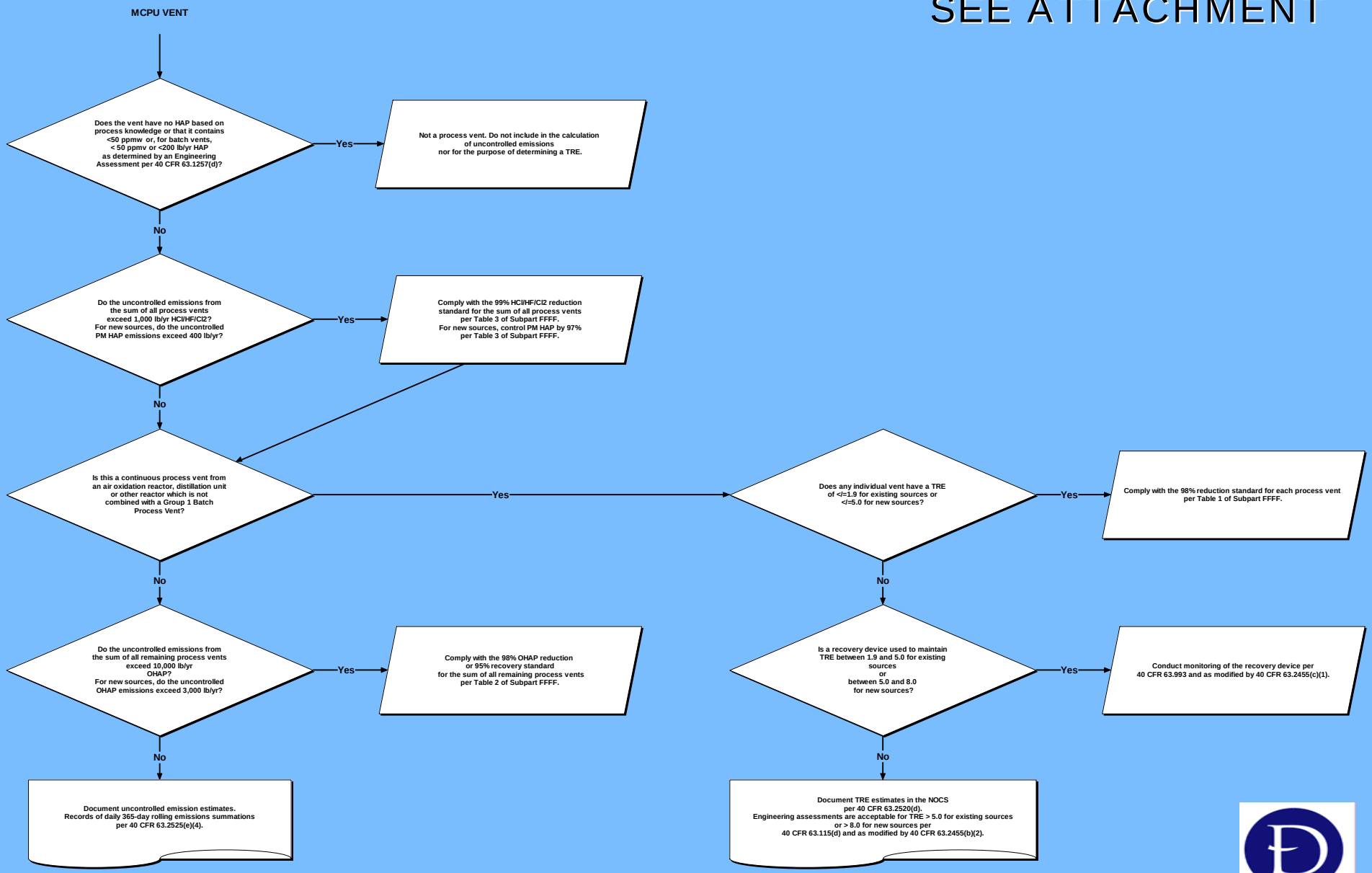


CONTINUOUS & BATCH OPERATIONS

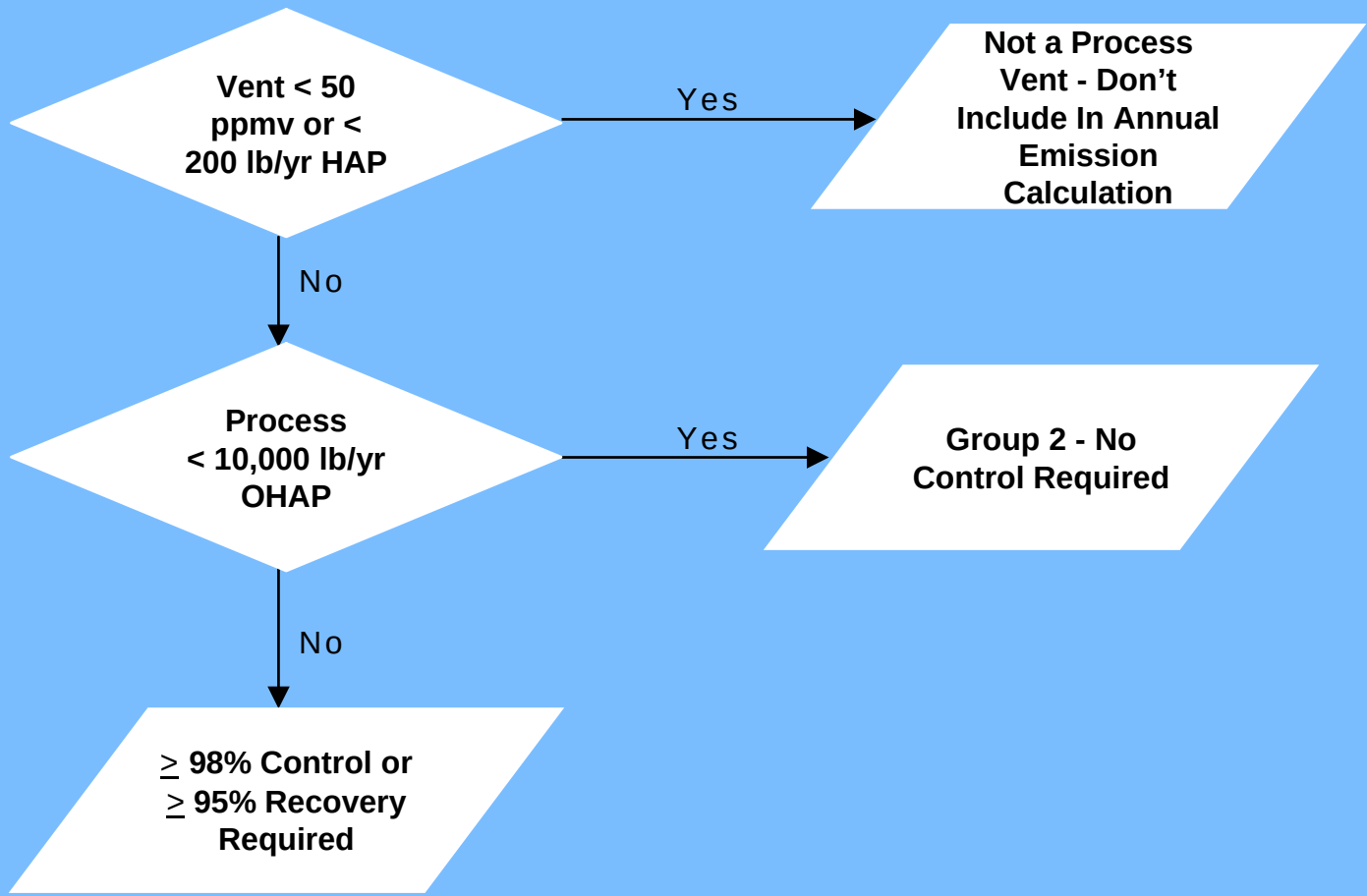


PROCESS VENT REQUIREMENTS

SEE ATTACHMENT



BATCH VENT OHAP THRESHOLDS – EXISTING SOURCES



PROCESS VS. CONTROL CONDENSERS

- Process condensers defined in Pharma MACT
  - Primary purpose is to recover material as internal part of process.
  - Must support a vapor-to-liquid phase change for periods of equipment operation that are at or above boiling/bubble point of the substance(s) at the liquid surface.
  - Examples include: distillation, reflux and condensers used in stripping/flashing operations.
  - Condensers in line prior to vacuum source.

PROCESS VS CONTROL CONDENSERS - CONTINUED

- While boiling or anytime not followed by a control device must demonstrate that process condensers are properly operating:
  - Initial demonstration;
  - Measure exhaust gas, or liquid receiver temperature; or
  - 99% via material balance.

    [63.1257(d)(3)(iii)(B)]
- All Other Condensers are Control or Recovery Devices.

DETERMINING BATCH VENT UNCONTROLLED EMISSIONS

- Calculate Based Upon Pharma MACT Equations;

  Or

- Request Use of Engineering Assessment;

  Or

- Designate as Group 1 if:
  - Complying with Alternative Standard, Or
  - All Group 1 Batch Process Vents are Controlled and Tested Under Hypothetical Worst Case Conditions.

ESTIMATING UNCONTROLLED HAP EMISSIONS FROM BATCH PROCESSES

- Calculation specified in 40 CFR 63.1257(d)(2):
  - Purging
  - Heating
  - Depressurization
  - Vacuum operations
  - Gas evolution
  - Air drying
  - Empty vessel purging
- Equations rely on Raoult's Law.
  (Henry's Law for dilute aqueous mixtures)
- Often done with commercially available software.

RAOULT'S LAW

- Vapor/Liquid Equilibrium.
- Ideal Liquid/Vapor to determine OHAP concentration.
- Displacement/Purge gas rate determines OHAP mass rate.

$$y_i = \frac{x_i P_i^*}{P_t}$$

BATCH VENT ORGANIC HAP CONTROL OPTIONS

- ≥ 98% Process-Wide Reduction, Closed Vent System to a Flare, or ≤ 20 ppmv outlet from control device.
- ≥ 95% Process-Wide Recovery.
- Alternative Standard:

  ≤ 20 ppmv Combustion Outlet or ≤ 50 ppmv Non-Combustion Outlet – REQUIRES CEMS.
- Remember that Table 3 requires ≥ 99% Control of HF/HCl/Cl_2 if Uncontrolled (HF/HCl/Cl_2) Emissions ≥ 1,000 lb/yr.

PROCESS-WIDE 98% ORGANIC HAP REDUCTION

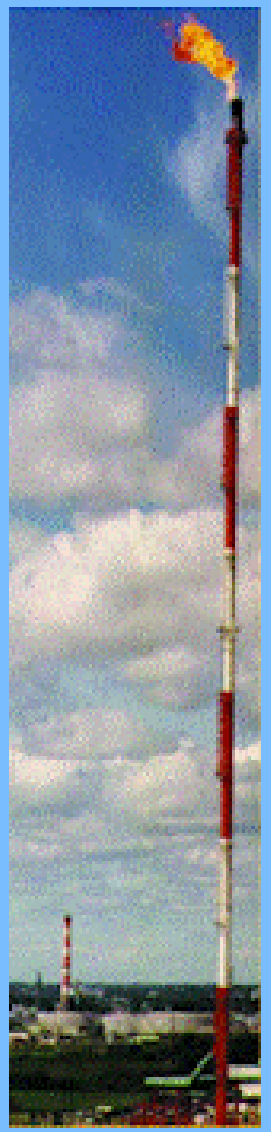
- Test inlet/outlet during worst (absolute or hypothetical) case conditions.

- Outlet during worst case conditions
  ≤ 20 ppmv OHAP outlet from control device.

- Condensers do not require performance testing, rather continuous process gas outlet temperature monitoring.

NOTE: Flow indicator required to identify periods of no flow.

- Flares must comply with 63.987



HALOGENATED PROCESS VENT

- Halogenated vent stream means a vent stream determined to have a mass emission rate of halogen atoms contained in organic compounds of ≥0.45 kilograms per hour.
- If you do not designate the PV as halogenated you must determine if it is using 63.115(d)(2)(v), which provides for use of process knowledge that no halogen is present, or use of an engineering assessment or measurement where halogen is present.

HALOGENATED PROCESS VENT (CONTINUED)

- If you use a halogen reduction device to reduce hydrogen halide and halogen HAP emissions from halogenated vent streams, you must meet the requirements of §63.994.
- If you use a halogen reduction device before a combustion device, you must determine the halogen atom emission rate prior to the combustion device according to the procedures in §63.115(d)(2)(v).

ALTERNATIVE PERFORMANCE STANDARDS

- Alternative Standard for Vents and Tanks
  - ≤ 20 ppmv OHAP Combustion Outlet
  - ≤ 50 ppmv OHAP Non – Combustion Outlet
- Pollution Prevention
  - Similar to Pharmaceutical Production MACT
  - Reduction of 65% in HAP Consumption
- Emission Averaging
  - Similar to the HON

ALTERNATIVE STANDARD DEMONSTRATION

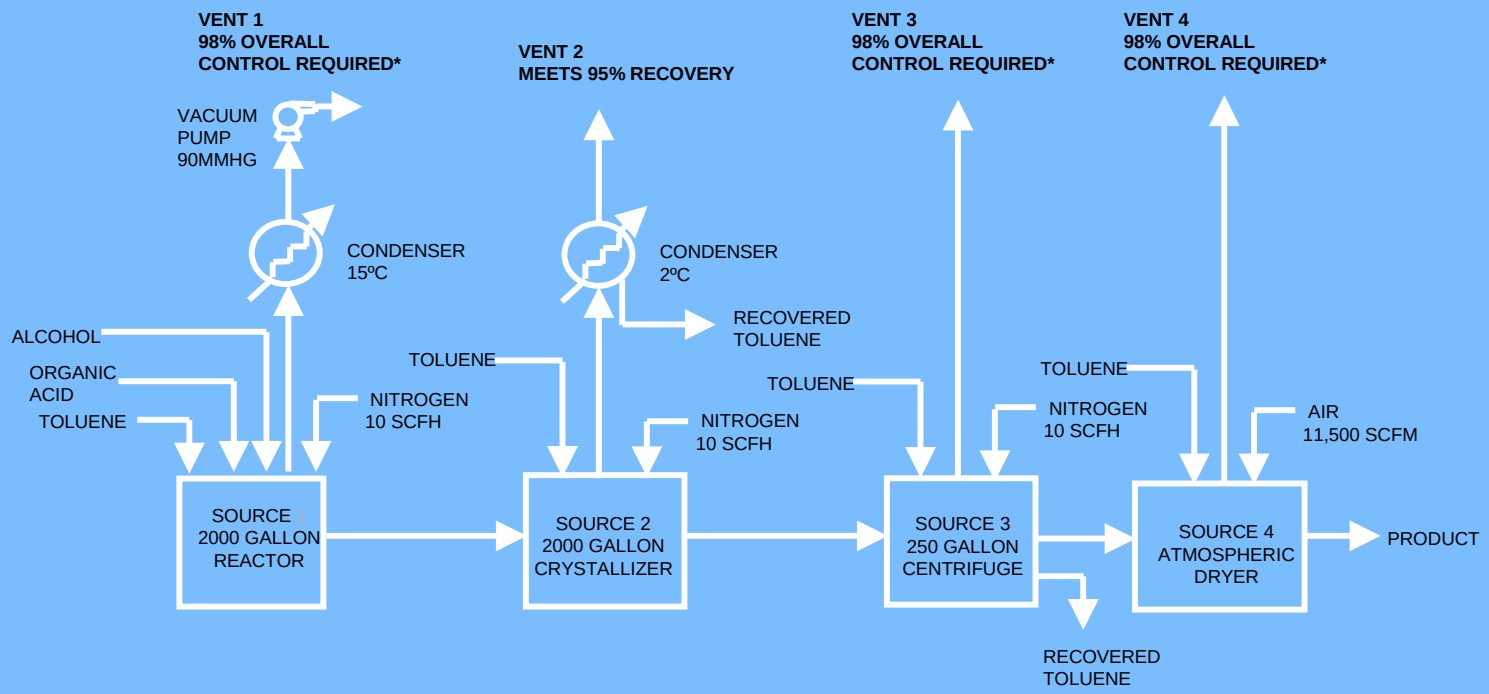
- Outlet CEMS to Continuously Monitor Compliance with Alternative Standard:
  - ≤ 20 ppmv for Combustion
  - ≤ 50 ppmv for Non- combustion
- All Group 1 Batch Process Vents Not Controlled by the Alternative Standard Must Meet the Emission Reduction Standard.
- Allows for Operational Flexibility:
  - No Compliance Demonstration (Worst Case Stack Testing) and
  - No Calculation of Uncontrolled Emissions.

BATCH VENT RECOVERY DEVICE DEMONSTRATION

- Process-Wide ≥ 95% Organic HAP Recovery.
- Recovery Device:
  - Reuse in a process at the source
  - Absorbers, Carbon Absorbers, Condensers, etc.
- Subject to Initial Performance Demonstrations, Setting Operating Limits and Continuous Compliance Requirements.

NOTE: Flow indicator required to identify periods of no flow.

95% RECOVERY AND 98% CONTROL EXAMPLE



31.2 LB/BATCH INTO CONDENSER
3.9 LB/BATCH OUT OF CONDENSER
87.6% EFFICIENT CONDENSER

28.8 LB/BATCH INTO CONDENSER
0.6 LB/BATCH OUT OF CONDENSER
97.8% EFFICIENT CONDENSER

•VENTS 1, 3 & 4 HAVE TOTAL UNCONTROLLED OHAP EMISSIONS GREATER THAN 10,000 LB/YR, THEREFORE THE PROCESS-WIDE OHAP EMISSIONS MUST BE REDUCED BY 98%.

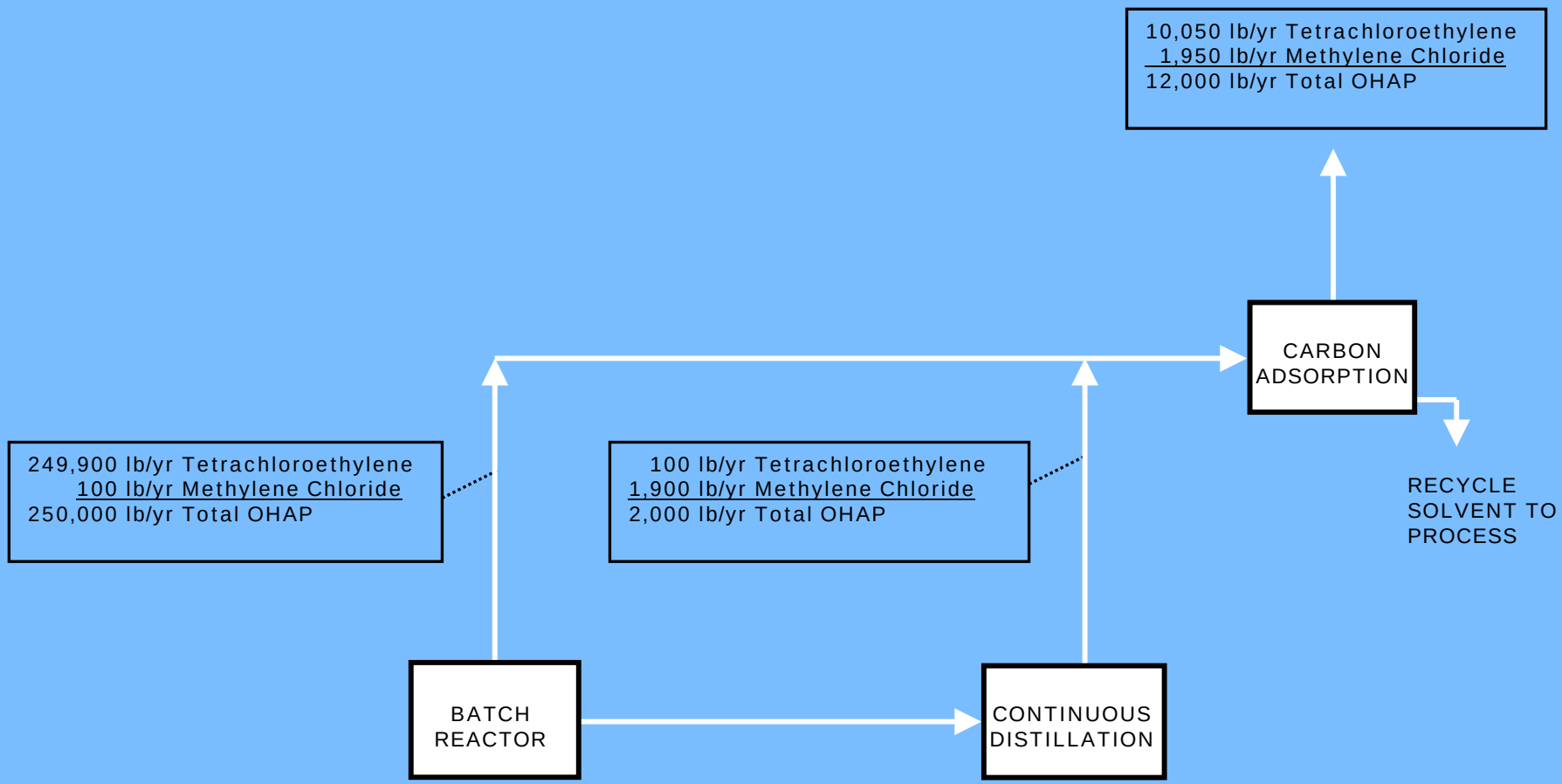
BATCH VENT CONTINUOUS COMPLIANCE

- Comply with Operating Limits As Determined By Performance Demonstration.
- Maintain records of whether each batch is considered a “standard batch”.
- Estimate Uncontrolled and Controlled Emissions From Non-Standard Batches.
- For Group 2 Batch Process Vents
  - <10,000 lb/yr process OHAP
  - <1,000 lb/yr process HF/HCl/Cl_2
  - 365-day rolling summations of emissions
  - Calculated at least monthly

COMBINED VENTS

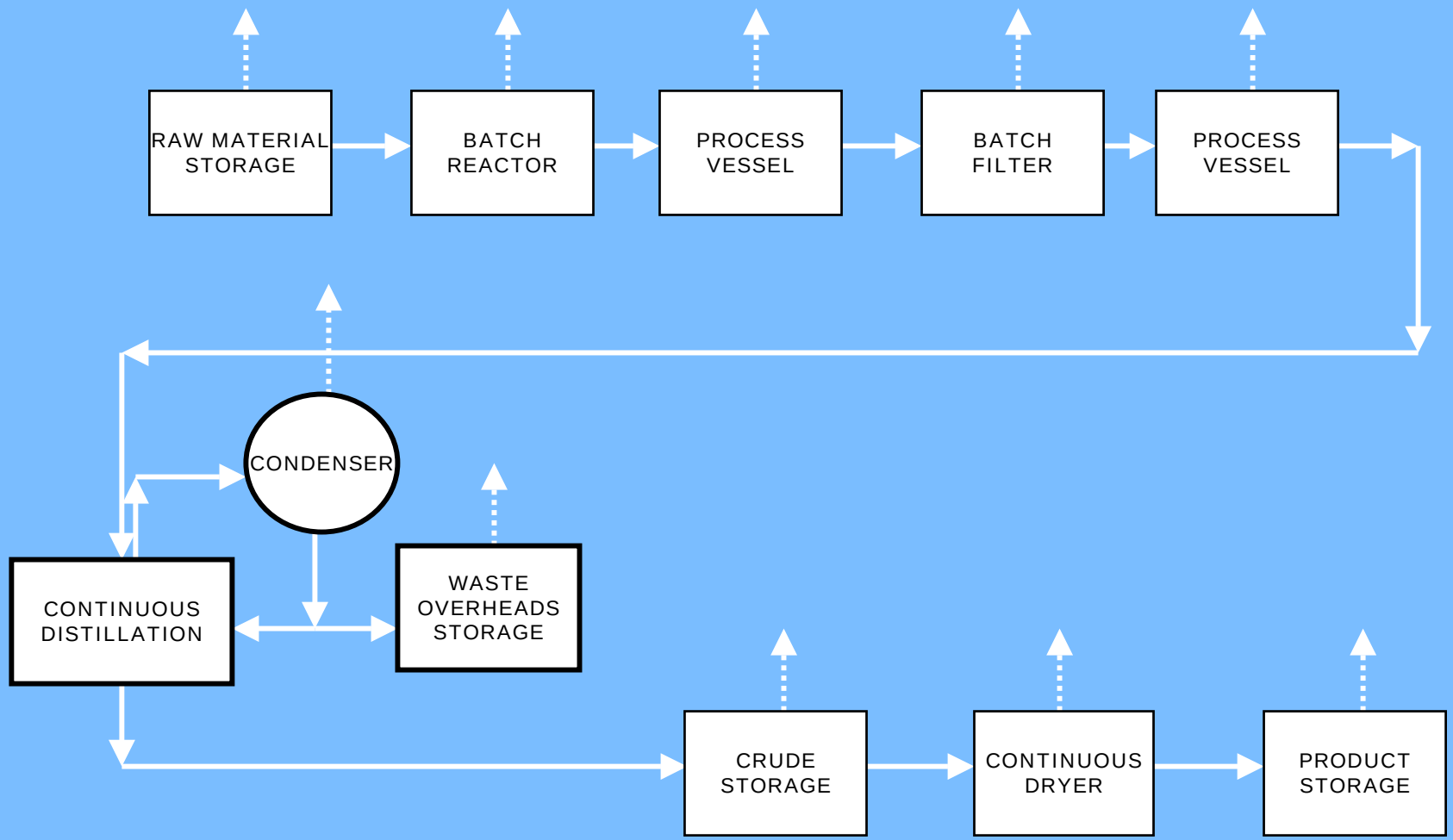
- Comply with each standard for each type of vent, Or
- Follow hierarchy:
  - Batch Vents
  - Continuous Vents Routed to Control Devices
  - Transfer Racks
  - Wastewater
  - Storage Tanks
  - Continuous Vents After a Recovery Device
- Must comply with HCl/HF/Cl_2 standard of Table 3.
- Must comply with Group 2 batch process vent recordkeeping requirements.

COMBINED PROCESS VENT EXAMPLE



$$\text{Recovery} = \frac{(250{,}000+2{,}000) - 12{,}000 \text{ OHAP}}{(250{,}000+2{,}000) \text{ OHAP}} = 95.2\%$$

WHAT STANDARD APPLIES TO EACH UNIT?



TOP TEN BATCH VENT CONSIDERATIONS

1) Properly identify boundaries of MCPU;
2) Properly categorize process tanks from surge control vessels/bottoms receivers and from storage tanks;
3) Properly characterize process from control condensers;
4) Know your uncontrolled/controlled batch process vent emissions;

TOP TEN BATCH VENT CONSIDERATIONS

5) Take advantage of 50 ppmv and 200 lb/yr vent threshold criteria;
6) Don’t allow 10,000 lb/yr exemption threshold to inadvertently limit your production capability and don’t underestimate the associated administrative burdens;
7) Remember that it’s a process-based standard and 98% control is not required for:
   - Each individual HAP, Nor
   - Each vent;

TOP TEN BATCH VENT CONSIDERATIONS - CONTINUED

8) Look for opportunities to leverage the 95% recovery option;
9) Properly document all estimates and assumptions; and
10) Plan testing/compliance demonstration to maximize on-going operational flexibility.