

Documenting, Evaluating and Sustaining Compliance with the Benzene Waste Operations NESHAP

Paper # 69567

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ABSTRACT

The Benzene Waste Operations NESHAP (BWON) was promulgated under 40 CFR Part 61, Subpart FF. This rule was unique in that it blended ideals of waste and water quality management into an air rule that was designed to reduce benzene emissions from facility waste. The rule has had a storied past, the Environmental Protection Agency (EPA) issued a stay of effectiveness on the rule after initial promulgation which lasted until promulgation of the January 7, 1993 amendments that removed the stay and finalized the rule. The stay of effectiveness was largely due to the great deal of confusion regarding interpretation of the rule and the amendments were designed to clarify provisions of the rule that had been widely misunderstood. Even today, over a decade after initial promulgation of the rule, regulated facilities routinely misapply the rule. This may be due to the progression of changes in interpretation of the rule by regulators and regulated facilities. Regardless, EPA has made the BWON an enforcement initiative. In fact, each of the refinery Consent Decrees over the past several years has had stipulations for evaluating and upgrading the BWON program at the refinery.

This paper provides a brief history of the rule, a summary of the rule requirements, common misinterpretations of the rule, and recommendations for the development of a sustainable BWON implementation and compliance program.

INTRODUCTION

The regulatory burden for refineries and chemical plants has increased since the passage of the 1990 Clean Air Act amendments. The passage of Title V of the Clean Air Act Amendments placed greater emphasis on tracking and certifying compliance with existing regulations. In addition, the emergence of refinery consent decrees has highlighted regulations with changing interpretations that make tracking and certifying historical compliance nearly impossible. One of these regulations, originally promulgated less than a year before the 1990 Amendments, is Title 40 Code of Federal Regulations Part 61, Subpart FF – The National Emission Standard for Benzene Waste Operations (commonly called the Benzene Waste Operations NESHAP or “BWON”.)

The BWON is a unique rule in that it is a mosaic of waste and water quality management provisions built into an air rule designed to be a risk based standard to reduce benzene

emissions from facility waste. The BWON rule is an exceedingly complex rule even by EPA standards. The complexity of the rule was recognized by EPA to such a degree that a Frequently Asked Questions (FAQ) document¹ was published as interpretative guidance five years after final rule promulgation and nine years after the rule proposal.

On March 7, 1990 the EPA promulgated Subpart FF. Then, pursuant to regulated community and agency concerns with the rule as written, the EPA issued a “stay of effectiveness” on March 5, 1992. The stay was ultimately removed with the promulgation of rule amendments on January 7, 1993.

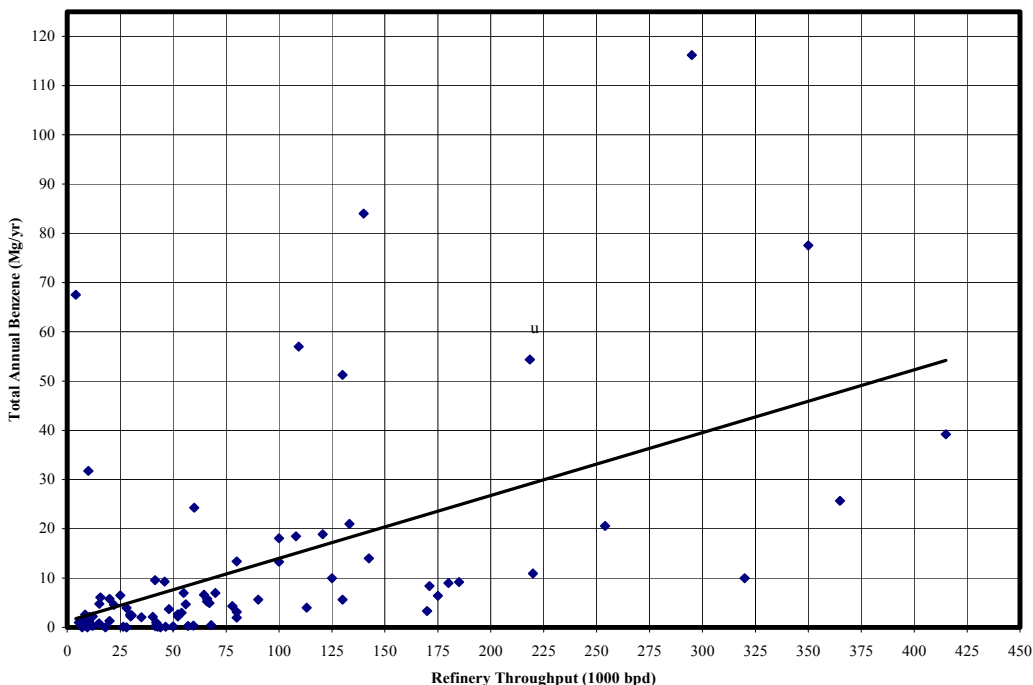
The stay of effectiveness was largely due to the great deal of confusion regarding interpretations of the rule. The amendments were designed to clarify provisions that had been widely misunderstood by affected sources². Because of this confusion and because EPA and industry interpretations have changed since rule promulgation, it is important for a facility to document the bases used in the preparation and development of reports such as the Total Annual Benzene (TAB) report.

As mentioned earlier, EPA has made refineries an enforcement initiative over recent years with the BWON debatably the second high priority behind New Source Review. In the agency’s evaluation of the BWON program at a refinery, certain rules of thumb are used to determine, at a high level, whether there may be deficiencies in a facility’s BWON program. (Note that the problems common to refineries also exist at chemical plants. EPA has recently started auditing chemical plants as the refinery enforcement initiative winds down.)

The first is how many waste streams are in the total annual benzene report for a facility. It is generally accepted that there should be no less than one stream per 1000 barrels per day of charge. For example, an 80,000 barrel per day refinery should have, at a minimum, eighty streams identified in their TAB report. Note that depending on the detail in how streams are identified, this number could easily be ten times that value.

The second rule of thumb is that very few, if any, refineries should have a TAB less than 1 Megagram per year (Mg/yr) and it is generally accepted that refineries with a charge rate of greater than 70,000 barrels per day have a TAB of greater than 10 Megagrams per year³. Figure 1 graphically represents this relationship using actual refinery TAB data. The 1 Mg/yr and 10 Mg/yr are key applicability thresholds within the rule. A more detailed discussion of rule applicability is provided in subsequent sections of this paper.

Figure 1. Refinery Throughput versus TAB Relationship³



This paper is broken the following sections:

- An overview of the risk based regulation where the confusion surrounding many of the widely misunderstood terms is discussed and the compliance options of the rule are summarized.
- A discussion on the development of a BWON compliance program and the economic integration of a sustainable BWON program into the operation of a facility.
- A summary of common misinterpretations and misapplications of the rule along with discussions of commonly missed waste streams at a facility.

Please note that, while it will be clearly stated how the rule can be applied from an engineering and implementation standpoint, it should be made clear that no legal advice has been provided in association with this paper.

REGULATORY SUMMARY

The applicability of the Benzene Waste Operations NESHAPs to a facility is based on the total annual benzene quantity (TAB) at the facility. The TAB for a facility, as defined in the §61.342(a), is the “sum of the annual benzene quantity for each waste stream at the facility that has a flow-weighted annual average water content greater than 10 percent or that is mixed with water, or other wastes, at any time and the mixture has an annual average water content greater than 10 percent.” There are three TAB ranges that relate to one of three tiers of requirements under the rule follows:

- Facilities with a TAB of greater than 10 Megagram per year (Mg/yr) are required to install controls on their waste streams and waste management units and submit certain quarterly and annual reports. A detailed description of the compliance options for facilities with a TAB of greater than 10 Mg/yr is provided in following sections of this paper.
- Facilities with a TAB of less than 10 Mg/yr but greater than 1 Mg/yr are not required to install controls; however, annually, and whenever a change occurs that may increase the facility TAB above 10 Mg/yr, the facility must submit an updated TAB report.
- Facilities with a TAB of less than 1 Mg/yr were/are required to submit an initial TAB report and an update to the TAB whenever a change occurs that may increase the facility TAB above 1 Mg/yr.

Waste Stream Determination and Stream Classification

The BWON requires that affected facilities determine their TAB at the point of waste generation for each waste stream. The point of waste generation is defined in the rule as:

“the location where the waste stream exits the process unit component or storage tank prior to handling or treatment in an operation that is not an integral part of the production process, or in the case of waste management units that generate new wastes after treatment, the location where the waste stream exits the waste management unit component.”

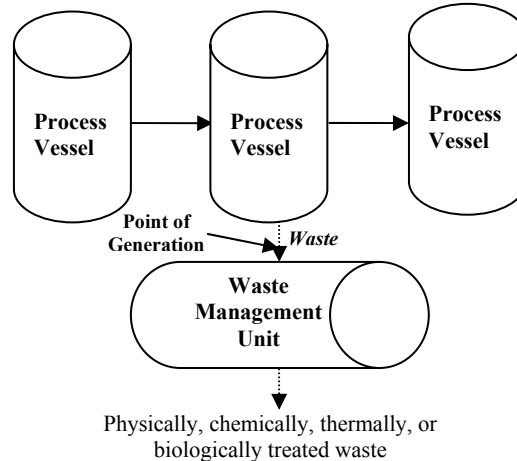
There are certain exclusions to this definition of point of waste generation. The exclusion that is typically found in a refinery setting is that the point of waste generation for waste streams that are routed to a sour water stripper are counted at the sour water stripper outlet. The one qualification to this exception is that the stream must be “sour” by definition. In other words, it must have a sulfur and/or ammonia content of greater than 10 parts per million by weight (ppmw).

The term “point of waste generation” in and of itself was a point of confusion in the original rule and, in turn, EPA provided clarifications to the definition of point of waste generation in the preamble to the January 7, 1993 amendment where it was stated that the intent of the “point of waste generation is to establish the true emission potential of a stream”⁴. Therefore, the point of waste generation of a stream was defined as the point after a waste has left a process and prior to handling or management in a unit that is not integral to the process, including prior to processes that promote resource recovery⁵.

Even after clarification there was still a question of how to determine when the waste has left the process and has begun to be handled in or managed in a unit that is not integral to the process. EPA further addressed this in the final stay of the final rule where they expressed that a waste management unit is distinguished from a process unit based on the material managed in the unit. Therefore, if the material meets the definition of waste in the rule, then the unit handling the waste is a waste management unit and the point of

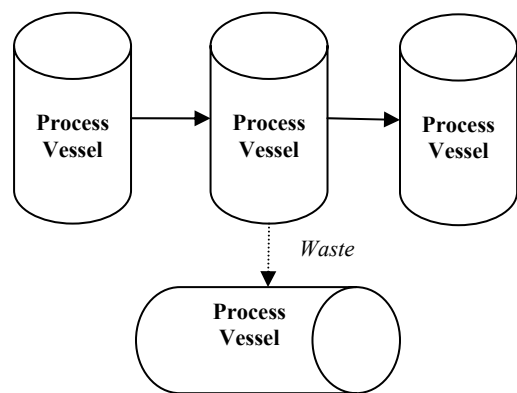
waste generation would be at a location prior to where the waste enters this unit⁶. This is represented graphically in Figure 2.

Figure 2. Waste Stream and Point of Waste Generation



To further complicate the idea, in some cases, a material may meet the definition of a waste even though it never leaves a process. In this case there may not be a point for that material that technically meets the definition of point of waste generation in the rule. This situation is referred to as “recycle without point of generation” and is graphically represented in Figure 3. Material that never leaves a process is not covered by the rule, even though it may meet the definition of waste. The burden, however, will be on owners and operators to demonstrate that the material does not leave the process, and that units claimed to be process units are, in fact, integral to the process⁷. This is where it is critical to supply documentation for each determination of whether a material meets the definition of a waste and/or whether a point of generation has been created.

Figure 3. Recycle Without Point of Waste Generation



To summarize, there are five classifications of waste streams that must be understood with regard to the BWON and TAB calculation. These classifications are waste streams,

recycle streams, in-process recycle streams, recycle streams without a point of generation and excluded waste streams. Each of these are described in Table 1 and further illustrated in Figures 2 through 5. For statutory reference, the Federal Register or Regulatory citation that corresponds to each stream classification is identified.

Table 1. Stream Descriptions

Is Stream Included in TAB	Description/Definition	Characteristics	Citations and Figure
Yes	Waste Stream	Material that is discarded or is being accumulated, stored, or physically, chemically, thermally, or biologically treated	§61.342(a) <i>Figure 2</i>
No	Recycle without a POG	A material otherwise discarded or not integral to the process, but hard piped back to the process with no potential emissions prior to reentering the process. The material may not be accumulated, stored, or physically, chemically, thermally, or biologically treated.	58 FR 3076 Col 3 P 5 <i>Figure 3</i>
Yes	Recycle	The stream is being accumulated, stored, or physically, chemically, thermally, or biologically treated prior to recycle back to the process.	58 FR 3078 Col 3 P 1-4 <i>Figure 4</i>
No	In-Process Recycle	The vessel generating the stream, the vessel receiving the stream, and the stream itself are integral to the process.	58 FR 3076 Col 3 P 5 <i>Figure 5</i>
No	Excluded Waste	Remedial activities, excavated contaminated soil, pumping and treating of groundwater, recovery of product from soil or groundwater, organic waste (<10% water)	§61.342(a)(3)

Figure 4. Recycled Waste Stream

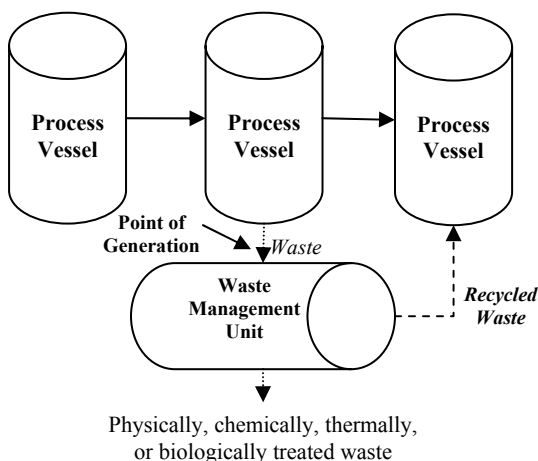
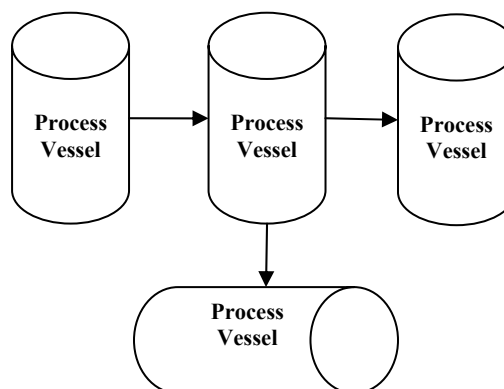


Figure 5. In-Process Recycle



The mini-process flow diagrams for in-process recycle, recycle, recycle with no point of generation, and waste streams attempt to demonstrate each stream type more clearly.

Each piece of equipment identified as a Process Vessel (PV) is integral to the process unit in the drawings. An “in-process recycle” stream is a stream that was never a waste, one that has always been integral to the process. Streams that were once “waste” (i.e., directed to the sewer, picked-up by a vacuum truck, drained to a sump) are addressed in the following two paragraphs.

Waste means any material resulting from industrial, commercial, mining or agricultural operations, or from community activities that is discarded or is being accumulated, stored, or physically, chemically, thermally, or biologically treated.

The EPA chose not to clarify the definition of waste in the January 7, 1993 amendments⁸. Rather, the EPA chose to refer back to the previous definition and to provide specific exclusions for those streams that have little or no emission potential⁹.

Certain waste streams that are hard piped directly back to a process vessel may not have a point of waste generation although they may have been historically “wasted”. A physical change rerouting the stream directly to a crude feed tank rather than being routed to an oil water separator and then to a crude feed tank may eliminate the point of waste generation at the oil water separator. These streams have no point of waste generation as long as they are not accumulated, stored, or physically, chemically, thermally or biologically treated.

Waste management unit means a piece of equipment, structure, or transport mechanism used in handling, storage, treatment, or disposal of waste. Examples of a waste management unit include a tank, surface impoundment, container, oil-water separator, individual drain unit, thin-film evaporation unit, waste incinerator, and landfill.

If a waste is “discarded or is being accumulated, stored, or physically, chemically, thermally, or biologically treated.” then the vessel performing these functions is a waste management unit. Each vessel on the mini-flow diagrams has been referred to as either a waste management unit (WMU) or a Process Vessel (PV).

Waste stream means the waste generated by a particular process unit, product tank, or waste management unit. The characteristics of the waste stream (e.g., flow rate, benzene concentration, water content) are determined at the point of waste generation. Examples of a waste stream include process wastewater, product tank drawdown, sludge and slop oil removed from waste management units, and landfill leachate.

Streams with less than 10% water are considered organic waste and are not included in the TAB (see additional discussion below.) However, if an organic waste is mixed with an aqueous waste, then the contribution of benzene in the organic stream must be included in the TAB.

As can be seen from the previous discussion, identifying and documenting the classification determinations for each stream in a facility can be a convoluted process. This makes it even more important to have documentation to provide for sustainable

compliance. The suggested methodologies for documenting stream classification and the development of a sustainable compliance program are discussed in more detail in following sections.

TAB Calculation

A rigorous discussion describing the types of streams and that are to be included in a facility TAB has just been presented. However, identifying the streams in the TAB is just half of the TAB equation, the “n” as shown below in the mathematic representation of a facility TAB.

$$TAB = \sum_{i=1}^n (Q_i \times C_{\text{benzene},i})$$

TAB = total annual benzene (Mg/yr)

Q = annual waste quantity (Mg/yr)

C_{benzene} = flow weighted annual average benzene concentration (weight fraction)

n = number of benzene streams “containing” > 10% water

The other half of the TAB equation is determine the benzene quantity from each applicable waste stream or point of waste generation. This is determined by estimating the annual waste quantity of the stream and associating it with a benzene concentration representative of that waste stream over the course of a year.

The determination of the annual waste quantity for inclusion in the TAB calculation is explicitly required by the rule to be on a potential-to-emit basis. This can be determined one of three ways:

- By determining the highest waste generation rate of the past five years,
- Using the maximum design capacity of the waste management unit, or
- By measurements that are representative of maximum waste generation rates.

Oftentimes, the waste quantity from a source may not be known. In these instances, measurements, engineering calculations, or operational experience will have to be used to determine waste quantities. The key is to ensure that the determined waste quantity is representative of the maximum waste generation rate. Note that when determining a waste quantity the fraction oil and water of the waste must be determined.

The BWON defines two ways that the benzene concentration for a waste stream can be determined, either by process knowledge or through measurement. The rule in fact specifies a certain methodology for taking measurements of the benzene concentration in the waste. The rule requires that for each sample location, (or waste stream) three representative samples be taken at a point prior to the waste being exposed to the atmosphere and that the sample be cooled to 10 degrees Celsius or less when taken. The rule specifies certain other details for waste stream sampling in §61.355(c)(3) that are not described in detail in this paper. Therefore, in order to document compliance with the

sampling methodology, it is important that a sampling plan be developed that incorporates the sampling provisions of the rule and documents the quality assurance and quality control procedures that will be used. As shown in the equation above, the benzene concentration is supposed to be a flow weighted annual benzene concentration in the waste stream. In order for this to be calculated, the benzene analysis from the oil and water phases of the wastes sampled and a waste quantity or flow rate for each phase of each sample event must be determined. Mathematically, the equation for determining the flow weighted average benzene concentration is as follows:

$$C_{\text{benzene,FWA}} = 1 / Q_T \times \sum_{i=1}^n (Q_i \times C_{\text{benzene,i}})$$

$C_{\text{benzene,FWA}}$ = flow weight average benzene concentration (ppmw)

Q_T = annual waste quantity (kg/yr)

Q_i = annual waste quantity for stream represented by $C_{\text{benzene,i}}$ (kg/yr)

$C_{\text{benzene,i}}$ = benzene concentration (ppmw)

n = number of waste samples

When a stream is a constant flow waste stream, the flow weighted average equation simply becomes the mathematical mean of the sampling results.

Applying the discussion above for a theoretical waste stream the calculations would work as shown below.

Table 2. Example TAB Calculation

Sample Number	Phase	Annual Waste Quantity Contribution (10 ³ gal/yr)	Specific Gravity	Waste Quantity (kg/yr) {Q}	Benzene Concentration (ppmv) {C}	Annual Benzene Quantity {Q x C}
1	Water	550	1	4,587,000	98	450
	Oil	0.25	0.75	1,564	6,550	10
2	Water	475	1	3,961,500	115	456
	Oil	1.5	0.75	9,383	6,300	59
3	Water	620	1	5,170,800	106	548
	Oil	0.75	0.75	4,691	6,425	30
$\Sigma Q \times C =$						1,553

$$Q_T = \Sigma Q = 13,734,938 \text{ kg/yr}$$

$$C_{\text{FWA}} = 1/Q_T \times (\Sigma Q \times C) = 113 \text{ ppmw}$$

$$\text{TAB} = Q_T \times C_{\text{FWA}} = 1.55 \text{ Mg/yr}$$

Compliance Options

As mentioned in a previous section, facilities with a TAB of greater than 10 Mg/yr are subject to the control requirements of the BWON meaning that all waste management units handling each waste stream with a water content of greater than 10%, a benzene concentration of greater than 10 ppmw and a flow rate of greater than 0.02 liters per

minute must be controlled. The specific control requirements are fairly straightforward in the rule; therefore they are not outlined in detail in this paper. However, in summary, waste management units such as containers, individual drain systems, oil-water separators, tanks, and waste treatment processes may require floating roofs, closed vent systems venting to control, or redesign in the case of junction boxes and wastewater system drains. EPA understood that these controls could be costly, thus they outlined three compliance methods in the rule that allowed facilities to “selectively” choose the streams controlled. This uncontrolled benzene quantity is normally called the “BQ” and the three compliance options are the “1 BQ”, “2 BQ”, and “6BQ”. The annual report for the facility operating under each of these compliance options will include, in addition to the TAB, a table of the facility BQ.

Basic Control (2 BQ)

Under the “basic control” or “2 BQ” compliance option, a facility may exempt from control certain waste management units as long as the benzene quantity in the streams managed by those units are less than 2 Mg/yr. However, the low flow exemption cannot be used under the 2 BQ compliance option. In addition, uncontrolled organic streams (streams with a water content less than 10%) must be included in the 2 BQ. What this means is that a stream that is not included in a facility TAB may be included in the 2 BQ. Other streams that are not included in the TAB but may be included in the 2 BQ are “excluded wastes” such as uncontrolled remediation waste. Another item of note for the 2 BQ option is that uncontrolled turnaround waste must be counted in the 2 BQ for the year generated in lieu of averaging as allowed for the TAB.

The benefits of the 2 BQ control option are that the facility may exclude any streams from control, stream with less than 10 ppmw benzene do not count toward the 2 Mg/yr, and the 2 BQ is not a cumulative number therefore compliance can be reestablished if necessary. The problems associated with the 2 BQ option include that it may have a higher initial cost to implement and require more wastewater controls. Even so, the 2 BQ is generally the preferred compliance option because it allows a facility to only control portions or streams with high concentrations of benzene.

1 Mg/yr Benzene Target for Process Wastewater (1 BQ)

Under the 1 Mg/yr benzene target for process wastewater, the facility can choose which process wastewater streams they control as long as the sum of the benzene quantity from all uncontrolled process wastewater streams and the benzene quantity from controlled wastewater streams where they leave the treatment process is less than 1 Mg/yr total. However, all other waste streams, including tank drawdown, landfill leachate, and turnaround must be controlled.

Treat to Target (6 BQ)

The 6 BQ “treat to target” compliance option is similar to the 2 BQ in that the facility can choose which streams to exclude from control, up to 6 Mg/yr. However, under the 6 BQ

option all streams with greater than 10% water are included in the 6 Mg/yr ledger, including those that are less than 10 ppmw, and organic streams must be controlled.

The 6 BQ is counted differently than the other BQs. Each uncontrolled waste stream is counted at the point of generation in manner similar to TAB calculation. However, waste streams managed in units equipped with Subpart FF controls are counted at the entrance to the first uncontrolled management unit and waste streams never managed in uncontrolled units are counted at the facility discharge. The 6 BQ is similar to the 2 BQ compliance option for uncontrolled turnaround waste in that it must be counted in the 6 BQ for the year generated in lieu of averaging as allowed for the TAB.

The problems associated with the 6 BQ are that it is a calendar year cumulative compliance demonstration, it is subject to end-of-line verification on a mass basis, and spill, upsets, and maintenance may create recurring compliance problems. In the recent refinery consent decrees this is the compliance option that has typically been required by the BWON enhancement portions of the decree along with the development of an end-of-line (EOL) sampling program to verify the BQ.

DEVELOPMENT OF A COMPLIANCE PROGRAM

There are five key elements to creating a comprehensive and sustainable compliance program for BWON.

- TAB Documentation and Regulatory Applicability Assessment
- Compliance Tools
- Self-Monitoring
- Forward Planning and Management of Change
- Roles and Responsibility

TAB Documentation and Regulatory Applicability Assessment

The cornerstone of a sustainable compliance program is to have thorough documentation of the basis for the facility TAB and BQ. The systematic process for identifying and quantifying facility wastes subject to the BWON suggested in this paper will not only assist a facility in sustaining compliance, but it may also prevent installation of unnecessary controls at the facility. Many facilities follow a back-to-front compliance approach versus the front-to-back compliance approach presented in this paper. The back-to-front methodology, or end-of-line analysis, is similar to the methodology that the EPA and NEIC use to verify a facility TAB and BQ. However, it is not an efficient manner of identifying the streams that actually require control, nor does it provide the value added that a front-to-back approach may provide by identifying streams that may have operational or process concerns within the facility.

For example, a facility performed end-of-line sampling at a point where the sewer systems from several uncontrolled streams or process units combine prior to entering the facility wastewater treatment system. The results of the benzene analysis at that point,

when associated with a waste flow, yielded a BQ higher than allowed under the rule. The next step in a back-to-front sampling regimen would be to continue sampling junction boxes following the sewer line back to the process units. In this approach, when a “hot” junction box is identified, the unit or units associated with that junction box may be controlled in full. However, the waste stream or streams and respective points of waste generation of concern have not been identified. It may have been that an organic stream was tied into the process sewer. This organic stream could have been identified in the front-to-back approach suggested below and then routed to the facility slop oil system, thus saving the expense of a potential retrofit of an entire unit’s sewer system.

The four steps in the suggested front-to-back compliance approach are stream identification, stream classification, determination stream waste quantity and determination of stream benzene content.

The starting point for the stream identification task is a complete set of refinery process and instrumentation diagrams (P&IDs.) The P&ID are reviewed to identify and highlight liquid streams from process vessels. Each stream identified is tabulated in a database or spreadsheet and associated with a P&ID number and a P&ID version date. Then, in order to assist in the stream classification process, other information for each stream is tabulated, including the source of the stream (process vessel or equipment number), the destination of the stream (waste management unit or process vessel number), and whether the destination of the stream is controlled.

At this point, the stream can be classified according to one of the five stream types discussed above: waste stream, recycle stream, in-process recycle stream, recycle without point of waste generation, or excluded waste stream. In some instances a waste stream may be a double count of a previous waste stream(s). For example a waste stream from a waste management unit may be a double count of each of the waste streams that are accumulated in the waste management unit. In these cases it is important to identify these streams as a double count so as not to over inflate the facility TAB or BQ.

After the streams have been identified and classified a cross-check to the P&ID review through interviews of operations personnel and process engineering is necessary. This will assist in identification of missed streams during the P&ID review and assist in the following step determining waste quantities. In addition, operation can provide insight into periodic maintenance wastes and how they are managed. These maintenance wastes, if managed in an uncontrolled manner, can quickly consume a facility BQ. Typical maintenance wastes to be aware of include filter change outs, pump drains, level gauge and level transmitter drains, and exchanger cleaning.

Finally, waste quantities and benzene concentrations must be associated with each of the waste streams identified. The waste quantity for the purposes of the TAB should be based on maximum facility design capacity, measurements representative of maximum waste generation rates, or the maximum quantity of waste generated in the past five years. An oil and water fraction for each waste quantity must also be identified. In many cases, a waste stream is expected to be entirely water; however, there may be an under

carry of oil following the water draw, water boot drain, or vessel dump. A common operation that results in oil under carry is when water draws are manually taken off of product tanks.

After the waste quantity is determined, the benzene concentration for each phase of the waste stream must be quantified either by analytical means or through process knowledge in the form of a range of concentration. Whatever the methodology used, it is important that the basis for each concentration be documented and reviewed on a periodic basis to ensure it is representative of current facility operations. In fact, the BWON in §61.342(c)(2) requires that streams that have been exempted from control due to a benzene concentration of less than 10 ppmw be reevaluated on an annual basis.

When the flow-weighted benzene concentration data is brought together with the waste quantity data for each stream, the TAB can be calculated for each waste stream and then summed for the facility TAB. Then, assuming the TAB is greater than 10 Mg/yr, the uncontrolled streams should be evaluated with respect to applicable exemptions and control requirements under each compliance option to strategically select a conceptual compliance approach and determine which control option makes sense for the facility.

At this point, waste management and treatment equipment must be identified and classified for each waste stream under the selected control option. The specific control requirements for each class of waste management unit and the associated monitoring, recordkeeping, and reporting must then be summarized. The BWON, although complex from an applicability and implementation standpoint, does not have extraordinarily complex control, monitoring, recordkeeping, reporting requirements for regulated equipment under the rule. In fact certain state and federal agencies have developed guidance to assist the regulated community in determining specific requirements for each waste management unit¹¹.

Compliance Tools

The second element of a sustainable BWON compliance program is the tools that guide users to fulfill the requirements of the regulation. These tools can include but are not limited to: written procedures, job aides, compliance schedules, and a comprehensive recordkeeping system.

Written Procedures

It is often necessary to document compliance procedures in order to maintain seamless compliance during personnel transitions and operational changes at a facility. In addition, written procedures provide a prescribed and consistent method for completing a specific job. Some of the written procedures that should be developed for a BWON compliance program include procedures for waste stream sampling, procedure for writing reports required by the regulation, and standard operating procedures to ensure that operations facilitates the compliance process.

Stream sampling procedures should be detailed enough to alert samplers of health hazards associated with benzene sampling and provide instructions to ensure that samples are collected and handled in accordance with regular requirements. Since sampling events do not always occur during regular business hours (e.g. turnaround or upset events), detailed procedures will provide step-by-step instructions for identifying sample points, proper collection methods, and sample handling information such as laboratory contacts and shipping procedures.

Reporting procedures should include details regarding locations of the data that is needed to fulfill reporting requirements. Reporting procedures can include references to specific documents that are generated during inspections or developed to summarize monitoring results. Alternatively, the procedures can direct the report writer to a contact person that can provide the necessary information. The procedure should detail information required by the regulation so that a duplicate rule interpretation is not required during each reporting period.

Standard operating procedures can provide operating personnel with steps to aide environmental staff in tracking and quantifying wastewater. Written operating procedures can also be used to alert non-environmental personnel of actions that will require notification or action in order to maintain regulatory compliance. It is unreasonable to expect all members of a facility's staff to know and understand the methods of determining whether a stream is subject to the requirements of BWON. However, properly written and readily accessible procedures can be used to inform staff members of activities and events that warrant notification of environmental personnel. Written procedures should also provide guidance for the proper operation and maintenance of treatment and control devices.

Job Aides

Job aides are tools that simplify certain processes and task and provide proximity of data. Some helpful types of job aides include equipment lists, inspection forms and logs, check sheets, and a compliance calendar.

A complete and descriptive equipment list provides both historic and on-going methods of documenting points of generation, control options, as well as an inventory of equipment that will be required to meet the standards outlined by BWON.

Well developed, detailed inspection forms and logs can be used to aide inspectors in completing thorough inspections and making proper notifications in case of equipment failures or malfunctions. Inspection forms and logs also provide inspectors with instructions on where completed forms are to be submitted or filed.

Check sheets can be used to verify that tasks are completed in a timely manner and also provide a venue for documenting decisions about equipment and stream changes.

A compliance calendar can be used to alert users of pending compliance dates as well as internal deadlines. Compliance dates include report due dates, inspection dates, and monitoring deadlines as outlined by the regulation. To ensure that information is being collected, reviewed, and filed in a timely fashion, the compliance calendar can also include key dates for beginning data review for quarterly and annual reports and necessary sampling events.

Document Management

Document management is an integral part of a successful compliance program. BWON is a recordkeeping intensive regulation and documents must be well-organized and accessible in order to maintain compliance. In fact, one of the best ways to document compliance with the rule to regulatory agencies is to be well organized, and thus able to provide requested reports promptly at an inspector's request.

A successful recordkeeping system should have a detailed index that facilitates efficient location and retrieval of required records. The index can provide regulatory citations and a brief summary of information being maintained. Additionally, the index can contain required retention times, file locations and responsible party for each document.

Self-Monitoring

The purpose of self-monitoring is to minimize incidents and liabilities associated with a poorly managed BWON program. Self-monitoring is accomplished using job specific checklists, document management as mentioned in the previous section, and BWON specific compliance checklists. Existing job specific checklists can usually be updated to incorporate BWON specific items so as not to further complicate jobs by incorporating additional checklists

Forward Planning And Management Of Change

One of the most critical areas to sustaining compliance is management of change. The Management of Change (MOC) process provides for the identification, communication and review of changes and their impact on operations, safety, and environmental compliance. In most cases a facility MOC procedures need to be revised to better incorporate environmental review of changes to facility processes, equipment, and operating procedures. Changes to any one of these areas should trigger a review by trained personnel to identify how the event will affect the current TAB calculation and control option as well as the definition of controlled equipment and points of generation. The tabulation of the relationships between waste streams, P&ID numbers and versions dates, and equipment numbers during the TAB documentation step mentioned above makes for an efficient cross-check when a certain piece of equipment or P&ID is affected by a proposed change.

Roles and Responsibilities

The final element in the design of a compliance program is the assignment of roles and responsibilities and the integration of the plan into the organization. First, facility management must champion the goals of the program and commit the resources necessary for its success. How the roles and responsibilities are allocated in each facility is specific to that facility. However, it is usually necessary to share the burden between environmental and operations personnel because in most situations it is unreasonable to assume that one person can be all knowing with regard to events affecting wastewater generation for an entire facility. Proper training should be used to clarify each individual's role for maintaining compliance. In addition, personnel should be trained in the purpose, use and upkeep of each element of a facility BWON compliance program. Subsequent training, including initial training of new or reassigned employees and refresher training of existing employees, should also be performed.

COMMON BWON AREAS OF CONFUSION AND PROGRAMMATIC DEFICIENCIES

As mentioned in the introduction to this paper, the BWON is one of the first tier regulations that the EPA and NEIC have concentrated on in recent enforcement initiatives. Thus, this section of paper discusses some of the common areas of confusion and programmatic deficiencies that are found at facilities subject to the BWON. Many of these areas of confusion are also areas of focus for regulators; others are areas that have been identified through consulting experience within the regulated community. Some of the items below are self explanatory and therefore are not discussed at length for the purpose of this paper. Others have been discussed in previous sections of this paper but are reiterated here because of their importance.

- Deficient TAB Documentation – Very often the true identify of a waste stream cannot be determined from a TAB report and the information that has been used to determine the waste quantity or benzene concentration is not defensible.
- Incorrectly classified streams – Some of the streams that are often incorrectly classified include streams routed to a sour water stripper that do not meet the definition of sour water (i.e., sulfur or ammonia contents are not greater than 10 ppm.)
- Waste management units vs. process vessels – A detailed discussion of the difference between waste management units and process vessels was provided in the regulatory summary of this portion of the report. However, this is again noted because if a vessel that has been previously called a process vessel could potentially be viewed as a waste management unit, the facility must have thorough documentation for the process vessel basis.
- Annual waste quantity (maximum vs. actual) – Annual waste quantities should be determined by one of three ways – maximum of the past five years, maximum design basis, or measurement representative of maximum operations – not by past actual information.

- Controlled vs. uncontrolled waste management units – Waste streams that are ultimately managed in an uncontrolled waste management unit are uncontrolled waste streams even if the first waste management unit after the point of generation is controlled. It is important that for each waste stream the entire wastewater system is evaluated from point of generation to final treatment when evaluating controls.
- Missed streams – Missed waste streams are the most common deficiency in a facility BWON program and the one that EPA and NEIC focus on the most. NEIC findings reports and consent decrees systematically identify certain waste streams that are missed by facilities in their TAB and/or BQ. These waste stream include but are not limited to the following:
 - *Off-site wastes* – This includes both wastes shipped off-site and those received and managed. A waste that is sold is still a waste.
 - *Organic waste streams* – A stream that is organic when generated and ultimately combines with water to create a waste with a flow-weighted annual average water content of greater than 10% is considered an aqueous waste and must be included in the TAB and BQ. In many instances facility slop oil system are operated “wet”. In this case all slop generated at the facility may be a TAB stream.
 - *Multiple phase waste streams* – The BWON specifically requires that both the organic and water phase be identified for each waste stream. Very often the oil portion is discounted; however, even at low fractional content of the total waste, the high benzene concentrations in the organic phases can quickly create waste streams with concentrations greater than 10 ppm and create streams with large BQs. Organic under carry for a waste that is expected to be primarily water is also often missed.
 - *Maintenance streams* – Maintenance streams such as pump drains, filter change outs, and level gauge and transmitter drains are often missed as waste streams. These organic streams can be large contributors to the TAB and BQ when they ultimately combine with water to create a flow-weighted water content of greater than 10%.
 - *Upsets and spills*
 - *Spent Caustic* – Spent caustic is often excluded from TAB and BQ determinations. Although this aqueous stream may only contain small amounts of benzene in the dissolved phase, it is a waste stream and the oil carry over that is common with spent caustic can be a large benzene contributor.
 - *Sampling Waste* – Waste generated by sample purges prior to taking routine samples throughout the refinery are organic wastes that may be managed in an uncontrolled manner through disposal in open drains or grates in units not equipped with closed-loop samplers (i.e., those subject to HON or Refinery MACT.) Although small quantities, the respectively high benzene concentration in this waste can quickly add up in the facility TAB and BQ.
 - *Desalter Rag Layer Checks (Swing Arm Sampling)* – This is waste that is generated when operators check the depth of the emulsion layer (also

known as the cuff or rag layer) in desalters. This stream is very often missed in facility TAB and BQ reports, is often handled in an uncontrolled manner, and most importantly is one of the streams that regulators look for at a refinery.

- *Blowdowns* – Blowdowns are a subset of the spills and upsets listed above are when the contents of a process vessel may be sent to the wastewater treatment system or “blowdown system” during a process upset. Typical blowdown events are fluid catalytic cracking unit (FCCU) blowdowns and desalter rag layer dumps. Each of these instance can account for significant quantities of organic waste to the sewer or blowdown system. If either of these wastes are uncontrolled, these blowdown events can be a significant contributor to the facility BQ. These events are often missed as waste streams in both TAB and BQ reports.

CONCLUSIONS

The Benzene Waste Operations NESHAP is a complex regulation unlike any other regulation promulgated as a result of the Federal Clean Air Act. With its multi-tiered consolidation of waste management, water quality, and air control requirements, there is no wonder that it has often been misunderstood and misapplied since birth. Given the complexity of the rule, the necessity of developing a program to assist a facility in sustaining compliance is of paramount importance, but not without manpower and capital costs. However, a proper understanding of the regulation and an intimate understanding of the design of the benzene waste handling equipment at a facility can, in fact, promote resource and product recovery and identify process engineering opportunities that may provide for other cost savings at a facility. Compliance with the Benzene Waste Operations NESHAP is an attainable goal for any facility when a commitment to a programmatic approach to rule understanding and application is followed.

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