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Evaluation of Application for Approval of Alternative Methodology for Compliance with the NESHAP for Shipbuilding and Ship Repair and Recommended Requirements for Compliance

(Application Submitted by Metro Machine Corporation, Norfolk, Virginia)

Office of Air Quality Planning and Standards
Clean Air
OAQPS

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CHAPTER 1

Summary of Conclusions, Conditions, and Requirements

The Environmental Protection Agency (EPA) is providing background information that supports the use of Metro Machine Corporation's (MMC) compliant all position enclosure (CAPE) plus air management system and regenerative thermal oxidizer (RTO) (CAPE+RTO System) as an alternative means of limiting the emissions of volatile organic hazardous air pollutants (VOHAP) per volume of applied solids (nonvolatiles). This document also explains how we arrived at the operating, recordkeeping, and reporting conditions that MMC must meet for approval. The add-on control system they used consists of a pollution capture unit operation (CAPE) plus air management system and a destruction unit operation (RTO). When operated according to the specified procedures, it will control emissions to a level no greater than that from using coatings which comply with the limits in Table 2 of 40 CFR Part 63, Subpart II. Our approval to use it depends on the requirements outlined below and explained in Chapters 2 and 3.

1.1 Overview of Requirements Metro Machine Corporation Must Meet for Approval

MMC must operate properly the permanent total enclosure (and air management system) and oxidizer and meet the following:

(a) an overall control efficiency (considering both the capture efficiency of the enclosure and the destruction efficiency of the add-on control unit operation) of at least 95 percent, and

(b) the amount of time (t_2), in hours, the RTO needs to be operated after the application of coatings ceases, presented in Table 1.1.

Table 1.1 Additional Hours of RTO Operation for Compliance with Subpart II

CAPE Air Temperature	32°C 90°F	27°C 80°F	20°C 68°F	18°C 60°F	14°C 55°F	10°C 50°F
Hours of RTO Operation (t_2) after Coating Ceases	0 hr	2 hr	3 hr	4 hr	5 hr	6 hr

Note: For temperatures between 4.5°C (40 °F) and 10°C (50 °F), t_2 = 6 hours. Do not operate the CAPE+RTO System if the CAPE air temperature is below 4.5 ° C (40 °F).

1. To satisfy the first requirement MMC must:

- Operate the CAPE at a vacuum equal to or greater than 0.013 mm Hg (0.007 in. of water), the value presented in EPA Method 204,
- Operate RTO with an air flow between 284 and 397 standard m^3/min (10,000 and 14,000 standard ft^3/min),
- Operate RTO with a combustion temperature greater than 760°C (1400°F), and
- Measure the VOHAP concentration at the exit to the RTO after assembling the CAPE.

2. To meet our requirements for compliance, MMC must:

- Submit a revised implementation plan within 3 months of our approval date,
- Include copies of forms used to show compliance,
- Cover quality assurance and quality control (QA/QC) requirements and how MMC will carry out proper operation at the facility,
- Maintain equipment as specified in the approval,
- Monitor emission after assembling CAPE sections,
- Submit reports every 6 months, and
- Maintain records for 5 years.

1.2 Overview of Information Provided in this Document

Chapter 2 is divided into three main sections, based on Section 63.783(c) of 40 CFR Part 63, Subpart II. Each section addresses one of the points raised in the shipbuilding and ship repair regulation. First, we present the requirements in Section 2.1. They include requirements for QA/QC. They offer MMC a level of flexibility for choosing operating conditions without exceeding the VOHAP limits in 40 CFR Part 63, Subpart II, presented in Table 1.2. Section 2.2 discusses briefly aspects of MMC's submittal for the CAPE+RTO System used in their 1996 emission test (performance test) to explain how we evaluate their approach to determine the CAPE and RTO operating time. We also explain in Section 2.2, the importance when determining operating time of not averaging emissions from the applied coatings that would exceed the individual limits of the 23 categories of coatings. The second part of Section 2.2 evaluates in detail the results of the 1996 Emission Test which includes operating parameter values for the CAPE+RTO System and the values monitored. Although the enclosure allows MMC to discharge all emissions from an applied coating, that would need to be captured and sent to the oxidizer, the procedure followed by MMC during the 1996 Emission Test falls short of doing that. The section also lists the EPA test methods that were used by MMC and the equations they used to determine the destruction efficiency of the oxidizer, following the requirements of EPA Method 25A. In Section 2.3 we discuss certain aspects of the material balance information submitted by MMC to explain why their application was not complete and to make a number of points that have application beyond their submittal that is being evaluated here. Chapter 3 discusses how volatiles evolve from coating and aspects related to drying of a coating. It also shows how volatile materials (solvents) evolve from applying coatings to a ship's hull inside an enclosure (CAPE). It introduces two key terms used in this evaluation--dry- to-touch time and the dry-to-hard time--and shows how the common (implicit) assumption that all the volatiles flash-off instantaneously, affects the calculations of the emission levels. The descriptions and calculations in this chapter support our conclusions in Chapter 2. Chapters 4.0 provides a chronology of events leading to the approval. It also describes the capture and destruction unit operations and highlights important design, construction, start up, and operational features.

TABLE 1.2 VOLATILE ORGANIC HAP (VOHAP) LIMITS FOR MARINE COATINGS

	VOHAP limits[a,b,c]		
	grams/liter coating (minus water and exempt compounds)	grams/liter solids[d]	
Coating Category		t ≥ 4.5°C	t < 4.5°C[e]
General use	340	571	728
Specialty	--	--	--
Air flask	340	571	728
Antenna	530	1,439	--
Antifoulant	400	765	971
Heat resistant	420	841	1,069
High-gloss	420	841	1,069
High-temperature	500	1,237	1,597
Inorganic zinc high-build	340	571	728
Military exterior	340	571	728
Mist	610	2,235	--
Navigational aids	550	1,597	--
Nonskid	340	571	728
Nuclear	420	841	1,069
Organic zinc	360	630	802
Pretreatment wash primer	780	11,095	--
Repair and maintenance. of thermoplastics	550	1,597	--
Rubber camouflage	340	571	728
Sealant for thermal spray aluminum	610	2,235	--
Special marking	490	1.178	--
Specialty interior	340	571	728
Tack coat	610	2,235	--
Undersea weapons systems	340	571	728
Weld-through precon. primer	650	2,885	--

[a]The limits are expressed in two sets of equivalent units. Either set of limits may be used for the compliance procedure described in §63.785(c)(1), but only the limits expressed in units of g/L solids (nonvolatiles) shall be used for the compliance procedures described §63.785(c)(2)-(4).

[b]VOC (including exempt compounds listed as HAP) shall be used as a surrogate for VOHAP for those compliance procedures described in §63.785(c)(1) (3).

[c]To convert from g/L to lb/gal, multiply by (3.785 L/gal)(1/453.6 lb/g) or 1/120. For compliance purposes, metric units define the standards.

[d]VOHAP limits expressed in units of mass of VOHAP per volume of solids were derived from the VOHAP limits expressed in units of mass of VOHAP per volume of coating assuming the coatings contain no water or exempt compounds and that the volumes of all components within a coating are additive.

[e]These limits apply during cold-weather time periods, as defined in §63.782. Cold-weather allowances are not given to coatings in categories that permit over a 40 percent VOHAP content by volume. Such coatings are subject to the same limits regardless of weather conditions.

REFERENCES

1. *Application for Approval of Alternative Methodology for Compliance with The NESHAP for Shipbuilding and Ship Repair*; submitted by Metro Machine Corporation, Norfolk, VA, June 12, 1996 (Revised October 31, 1996); prepared with Pacific Environmental Services, Inc., Herndon, VA.

2. *Implementation Plan for Compliance with the NESHAP for Shipbuilding and Ship Repair Metro machine Corporation*; prepared by Eric Lasalle, November 1, 1996; Metro Machine Corporation, Norfolk, VA.

3. *Air Emission Evaluation Total Gaseous Organic Compounds and Filterable Particulate Emissions Compliant All Position Enclosure (CAPE) System USS SCOTT DDG-995 Metro Machine Corporation*; prepared by Pacific Environmental Services, Inc., Herndon, VA, September 1996 for Metro Machine Corporation, Norfolk, VA.

CHAPTER 2

Evaluation of Request for Approval of an Alternative Technology

As an owner or operator of a new or existing major source affected by the shipbuilding and ship repair national emission standards for hazardous air pollutants (NESHAP), you must only apply complying coatings. This is stated under Section 63.783 of Subpart II [1]. This means that you must apply to a "ship" only coatings with an as-applied volatile organic hazardous air pollutant (VOHAP) content (including cure volatile) that do not exceed the applicable VOHAP limits in Table 2 of 40 CFR Part 63, Subpart II (standard), Table 2.1, unless you apply for and receive approval to use an alternative technology.

Metro Machine Corporation (MMC) applied to the Environmental Protection Agency (EPA), for permission to use non-complying coatings within an enclosure (CAPE) and to direct all the exhaust air from the enclosure to a regenerative thermal oxidizer (RTO) as an alternative technology.

An alternative technology must meet three requirements under §63.783(c) of the standard :

C(1) "The owner or operator of an affected source may apply to the Administrator for permission to use an alternative means such as (an add-on control system) of limiting emissions from coating operations."

C(2) ***"The Administrator shall approve the alternative means of limiting emissions if, in the Administrator's judgment, post control emissions of VOHAP per volume applied solids will be no greater than those from the use of coatings that comply with the limits in Table 2 of this subpart."***

C(3)*"The Administrator may condition approval on operation, maintenance, and monitoring requirements to ensure that emissions from the source are no greater than those that would otherwise result from this subpart."*

We will discuss each of these elements in the following chapters, starting with Element C(3) in Section 2.1 which provides context to the subsequent discussion. Section 2.1 represents the requirements for meeting the limits in the regulation and for quality assurance and quality control. It will also include recordkeeping and reporting requirements. Section 2.2 will deal with Element C(1) and Section 2.3 will deal with Element C(2). The requirements and operating conditions stated in Section 2.1 will ensure that "post control emissions of VOHAP per volume applied solids will be no greater than those from the use of coatings that comply with the limits in Table 2 of this subpart," as required under Element C(2).

Section 2.1

Element C(3)

"The Administrator may condition approval on operation, maintenance, and monitoring requirements to ensure that emissions from the source are no greater than those that would otherwise result from this subpart."

2.1. A Overview

If you use an air pollution control unit (device) or equipment not listed in 40 CFR Part 63, Subpart II you must submit a description of the add-on control unit (device) or equipment, test data verifying the performance of the add-on control unit (device) or equipment in controlling VOHAP and/or volatile organic compound (VOC) emissions, as appropriate, specific operating parameters that will be monitored to establish compliance with the standards, and the recordkeeping and reporting requirements as discussed in Section 2.1(C). An applicant may reference data previously submitted by that applicant or a previous applicant when applicable.

The following operating parameters will need to be defined to link monitoring information to determination of alternative compliance with the VOHAP limits for this subpart.

(1) The capture efficiency of the enclosure.

(2) The destruction efficiency of the add-on control unit operation. The unit operation shall only receive pollutants generated within the CAPE (enclosure).

(3) The amount of time, in hours, the capture (CAPE) and destruction (RTO) unit operations need to be operational after the application of each coating cycle.

A new performance test will be required if volatile emissions from other operations are also directed to the RTO. During the 1996 Emission Test [2] the only emissions directed to the RTO were those generated from coating the portion of the hull enclosed within the CAPE.

Because the limits in the shipbuilding and ship repair regulation are specified on a not to be exceeded basis, emissions from a painting phase involving non complying coatings must not be averaged over time to determine the amount of time the RTO must be operated as indicated in Chapter 3. Since time-averaging is not permitted in this regulation the operator is not permitted to shut down the RTO, under normal operating conditions, during application of a non-complying coating. Since the number of hours the incinerator is operated after each non-complying coating layer is applied to the hull surface may under certain conditions affect compliance with the VOHAP limit, the owner or operator shall not turn off the RTO before a lapse of time equal to the time defined by the application of each coatings cycle, time (t_1) plus the time (t_2) indicated in Table 1.1 (in hours). The cycle time begins when the coating begins to be applied.

$$\text{Total RTO Time} = t_1 + t_2; \text{ hours} \qquad \text{(Equation 2.1)}$$

Operations during periods of start-up, shut down, and malfunction shall not constitute representative conditions (normal operating conditions). The operating, monitoring, and recordkeeping requirements presented below were developed to satisfy the above requirements.

2.1.B Details of Requirements (Quality Assurance/Quality Control Plan)

This document provides details on the maintenance, monitoring, recordkeeping and operating requirements necessary for the CAPE+RTO System to qualify as an "alternative means of limiting emissions" under §63.783(c) of 40 CFR Part 63, Subpart II. The CAPE+RTO System consists of two main unit operations, an enclosure (the CAPE) plus air management system and a regenerative thermal oxidizer (RTO). In brief, when a coating is applied within the CAPE, the system must be operated at a minimum of 95 percent overall control efficiency. In addition, the CAPE must be operated at a vacuum equal to or greater than 0.013 mm Hg (0.007 in. of water), the value presented in EPA Method 204. The RTO must operate with an air flow between 284 and 397 standard m^3/min. (10,000 and 14,000 standard ft^3/min) and a combustion temperature greater than 760°C (1400°F). In addition, the CAPE+RTO System must be operated for the required amount of time. When the conditions and requirements contained in this document are met, the control system qualifies as "an alternative means of limiting emissions."

The requirements in this attachment apply when the CAPE+RTO System is operated . If coatings are applied when the System is not operated, then the compliance procedures of §63.785 and all relevant monitoring, recordkeeping, and reporting requirements of 40 CFR Part 63, Subpart II apply.

1. Overview of requirements

The EPA establishes the following operational parameters in approving the alternative means of compliance with the VOHAP limits for 40 CFR Part 63, Subpart II:

(a) An overall control efficiency (considering both the capture efficiency of the enclosure and the destruction efficiency of the add-on control unit) of at least 95 percent, and

(b) The amount of time (t_2), in hours, the RTO needs to be operated after application of coating ceases, presented in Table 1.1 (above).

The facility must also meet the detailed operating, monitoring, and recordkeeping requirements presented in Sections 2.1.C. In addition, the RTO shall only receive pollutants generated within the CAPE enclosure. New performance test data will be required if volatile emissions from other operations outside the CAPE are also directed to the RTO. Furthermore, the owner or operator shall provide to the implementing agency a plan based on the recommended maintenance practices provided by the manufacturers for the CAPE+RTO System.

2. Considerations in establishing requirements

The format of the standard is an important consideration in establishing equivalency and, specifically, the amount of time the CAPE+RTO System needs to be operated after the application of coatings ceases (Item 2 above). The VOHAP limits in the shipbuilding and ship repair regulation are specified in grams per liter of solids (nonvolatiles) and the regulation prohibits an owner or operator from allowing application of any coating with an as-applied VOHAP limit exceeding the value of a complying coating. Furthermore, a coating continues to emit while it is drying. Since the VOHAP limits are on a not-to-be-exceeded basis, the coating cycle was examined.

It takes several days to complete the coating of the portion of the hull surface area enclosed in the CAPE. Generally, a coating cycle, regardless of the number of painters involved, may take 2 or more hours to complete. Figure 2-1 contains a plot of the data points presented by MMC in the (June) 1996 Emission Test report [2]. The first complete curve reflects the results for a coating cycle that lasted over 3.0 hours. The time it takes to reach the maximum concentration point provides a measure of the time it takes to apply the coating (coating application time (t_1)), which was around 2 hours in this case. Some of the coating cycles overlap if more than one coater was involved. The concentration is high when the solvent is evaporating while the coating dries. It will take several days to complete coating the portion of the hulls's surface area enclosed by the CAPE.

One issue in this analysis was determining that amount of time (t_2) after coating ceases that the CAPE+RTO System must continue to operate. Operating parameters and environmental conditions such as temperature, humidity, and pollutant concentration in the enclosure determine the length of time it takes for the necessary mass of pollutants released from the enclosure environment to reach the RTO inlet. The operator must not shut down the flow to the RTO or the RTO before the emissions from the enclosure, referenced on a solids basis, are equal to or are below those for a complying coating which occurs at t_2 (Figure 2.2 and Equation 2.1). Should the enclosure be instantaneously removed at or after this point-in-time (t_2), the grams of VOHAP on the hull plus those in the enclosure atmosphere divided by the solids deposited from a coating on the hull would not exceed the value resulting from applying a complying coating. As a result, the owner or operator shall not turn off the RTO before the completion of each coatings cycle, time (t_1) plus the time (t_2) indicated in Table 1 (in hours). The coating cycle time begins when application begins.

Hence, the length of operation of the air flow and RTO for a coating application period is not based on the time it takes to oxidize a given mass of VOHAP from a coating. Instead, it is based on ensuring that the emission value (in g VOHAP inside the enclosure/L solids on the hull) does not exceed at any time the limits for a complying coating before the flow to the RTO or the RTO itself is turned off.

Figure 2.1 Change of Concentration of Volatiles at the Exit of the CAPE (data used was from 1996 Emission Test, Ref. 2)

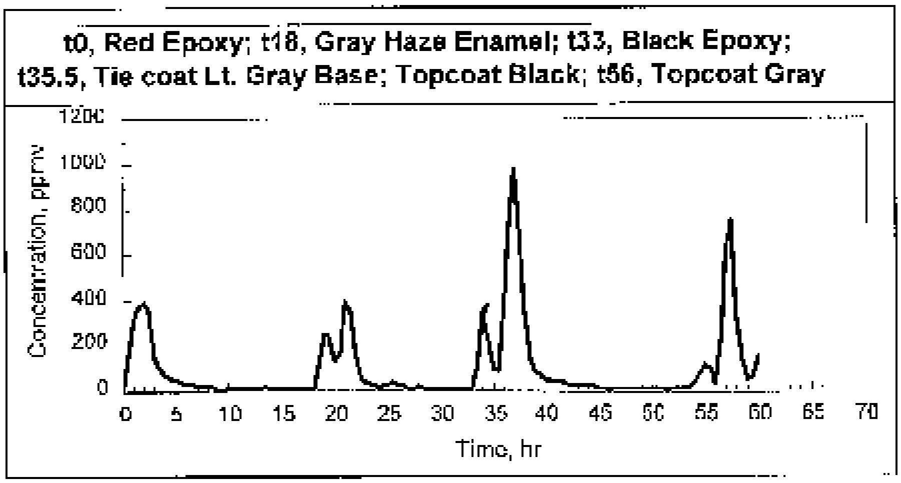
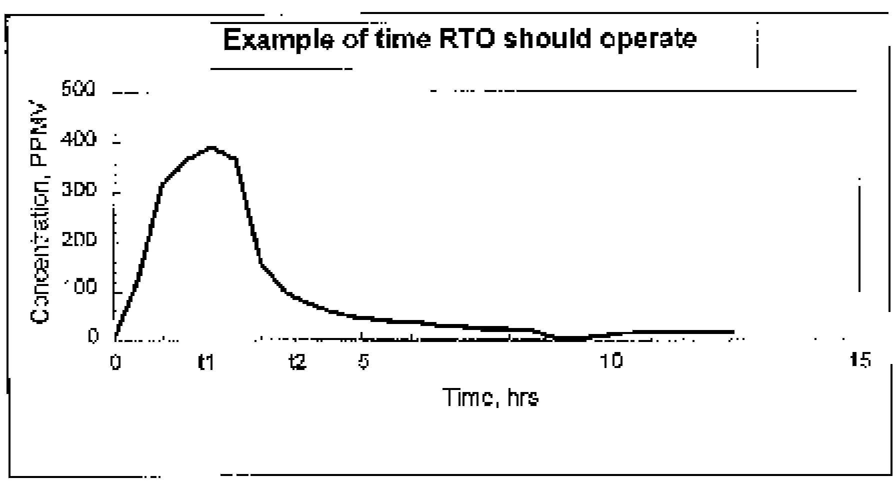


Figure 2.2 Illustration of a Coating Cycle



2.1.C Detailed Requirements

This section includes the detailed requirements, including quality assurance/quality control provisions, from the General Provisions and Subpart II.

1. General Provisions, 40 CFR Part 63, Subpart A

The following requirements of the General Provisions (40 CFR Part 63, Subpart A) apply to this approval:

Table 2.1 Applicability of the General Provisions to this Approval

Reference	Applies	Comment
63.1(a)(1)-(3)	Yes	
63.1(a)(4)	Yes	Subpart II clarifies the applicability of each paragraph in Subpart A to sources subject to Subpart II.
63.1(a)(5)-(7)	Yes	
63.1(a)(8)	No	Discusses State programs.
63.1(a)(9)-(14)	Yes	
63.1(b)(1)	Yes	§63.781 specifies applicability in more detail.
63.1(b)(2)-(3)	Yes	
63.1(c)-(e)	Yes	
63.2	Yes	Additional terms are defined in §63.782; when overlap between Subparts A and II occurs, Subpart II takes precedence.
63.3	Yes	Other units used in Subpart II are defined in that subpart.
63.4	Yes	
63.5(a)-(c)	Yes	
63.5(d)	Yes	Information on add-on control devices and control efficiencies should be included in the application to comply with Subpart II in accordance with §63.783(c).
63.5(e)-(f)	Yes	
63.6(a)-(b)	Yes	
63.6(c)-(d)	Yes	Except §63.784(a) specifies the compliance date for existing affected sources.
63.6(e)-(f)	Yes	These paragraphs are applicable because an alternative means of limiting emissions is used to comply with Subpart II in accordance with §63.783(c).
63.6(g)	No	§63.783(c) specifies procedures for application and approval of alternative means of limiting emissions.
63.6(h)	No	Subpart II does not contain any opacity or visible emission standards.
63.6(i)-(j)	Yes	
63.7	Yes	This section is applicable because an alternative means of limiting emissions is used to comply with Subpart II in accordance with §63.783(c).
63.8	Yes	This section is applicable because an alternative means of limiting emissions is used to comply with Subpart II in accordance with §63.783(c).
63.9(a)-(d)	Yes	§63.787(a) extends the initial notification deadline to 180 days. §63.787(b) requires an implementation plan to be submitted.

Reference	Applies	Comment
63.9(e)	Yes	This paragraph is applicable because an alternative means of limiting emissions is used to comply with Subpart II in accordance with §63.783(c).
63.9(f)	No	Subpart II does not contain any opacity or visible emission standards.
63.9(g)-(h)	Yes	This paragraph is applicable because an alternative means of limiting emissions is used to comply with Subpart II in accordance with §63.783(c).
63.9(i)-(j)	Yes	
63.10(a)-(b)	Yes	§63.788(b)-(c) list additional recordkeeping and reporting requirements.
63.10(c)	Yes	This section is applicable because an alternative means of limiting emissions is used to comply with Subpart II in accordance with §63.783(c).
63.10(d)	Yes	
63.10(e)	Yes	This paragraph is applicable because an alternative means of limiting emissions is used to comply with Subpart II in accordance with §63.783(c).
63.10(f)	Yes	
63.11	Yes	This section is applicable because an alternative means of limiting emissions is used to comply with Subpart II in accordance with §63.783(c).
63.12--63.15	Yes	

2. <u>40 CFR 63, Subpart II</u>

The following requirements of 40 CFR 63, Subpart II apply:

Table 2.2 Applicability of 40 CFR Part 63, Subpart II to this Approval

Reference	Applies to Subpart II	Comment
63.781	Yes	Applicability.
63.782	Yes	Definitions.
63.783 (a)	No	Except if a coating is applied when the alternative means of limiting emissions is not operating, then this paragraph applies.
63.783 (b)	Yes	Work practice requirements for reducing emissions.
63.783 (c)	Yes	No owner or operator of an exisiting or newly affected source shall exceed the applicable limits given in Table 2 of Subpart II, as determined by the procedures described in Table 2.3 of this section.
63.784	Yes	Compliance dates.
63.785	No	Except if a coating is applied when the alternative means of limiting emissions is not operating, then this section applies.
63.786	No	Except if a coating is applied when the alternative means of limiting emissions is not operating, then this section applies.
63.787 (a)	Yes	Notification Requirements.
63.787 (b)	Yes	
63.787 (b)(1)	Yes	

Reference	Applies to Subpart II	Comment
63.787 (b)(3)	Yes	The implementation plan shall address the subject areas indicated in this section, especially Table 2.3 in addition to those listed in the regulation, as indicated below. The implementation plan will serve to provide guidance and will assist in enforcement of the regulation. It is not the mechanism for enforcing the regulation.
63.787 (b)(3)(i)	No	Except if a coating is applied when the alternative means of limiting emissions is not operating, then this section applies.
63.787 (b)(3)(ii)	Yes	The implementation plan shall include the procedures for maintaining the records required under Table 2.4 of this section. as well as the procedures for maintaining the records required under the applicable sections of §63.788.
63.787(b)(3)(iii)	Yes	Transfer, handling, and storage procedures.
63.788 (a)	Yes	Applicable recordkeeping and reporting requirements.
63.788 (b)(1)	No	Except if a coating is applied when the alternative means of limiting emissions is not operating, then this section applies.
63.788 (b)(2)	Yes	Only paragraphs (b)(2) (i) through (iii), and paragraph (b)(2)(vi) apply except if a coating is applied when the alternative means of limiting emissions is not operating, then all of paragraph (b)(2) applies.
63.788 (b)(3)	No	Except if a coating is applied when the alternative means of limiting emissions is not operating, then this section applies.
63.788 (b)(4)	Yes	
63.788 (c)	Yes	When the alternative means of limiting emissions is operating with the compliance procedures presented in Table 2.3 of this section pursuant to §63.783(c), the applicable reporting requirements, for each 6-month period, are those that are relevant to the compliance procedure in Table 2.3. The reporting requirements also include those stated in Table 2.4 of this section. When the alternative means of limiting emissions is not operating, the compliance procedures under §63.785 are applicable and the applicable reporting requirements in Subpart II should be used.

3. Operating and monitoring requirements

Table 2.3 identifies the operating and monitoring requirements that apply when using the CAPE+RTO System as an alternative means of emission limitation to satisfy the VOHAP limits requirements of 40 CFR Part 63, Subpart II. Note that for all five of the operating and monitoring specifications, no averages shall be calculated (except for Item 5 in Table 2.3, VOHAP concentration at exit to RTO). In addition, the instructions contained in the operator's manual of the manufacturer shall be observed.

A flow diagram representing the control system shall be provided to the implementing agency identifying the positions of all temperature and flow measuring instruments. The measurements shall be carried out in such a way that the results are representative, accurate, and within the precision defined below.

Table 2.3 Operating and Monitoring Requirements for the CAPE+RTO System (parameters were selected to achieve 95 percent overall control)

Operating Requirements	Operating Parameters	Monitoring Specifications		Excursions or Exceedences
1. Assembly of (CAPE) The enclosure shall be inspected following assembly of the sections.	Visual inspection	Inspect for tears and goodness of fit around the contour of the portion of the ship hull.		Not Applicable. (Make necessary repair and adjustments)
2. Vacuum in Enclosure (CAPE) The vacuum in the enclosure shall be equal to or greater than 0.013 mm Hg (0.007 in. of H_2O) gauge. The door shall normally be kept closed. Any air passing through seams or openings must be going into the enclosure.	Enclosure vacuum.	Instrument	Indicating differential manometer.	Upon excursion from the minimum required vacuum, stop applying coatings. Resume application of coatings after the required minumum vacuum is reestablished. A vacuum measurement of less than 0.013 mm Hg due to normal opening of the access door to allow entry and exit of personnel and equipment does not constitute an excursion. Report an excursion as specified in Table 2.4.
		Location	The internal sensing probe shall be toward the mid-point of the enclosure away from any direct draft, air flow, or doors that might interfere with the reading.	
		Performance specifications	The manometer must include the range of -0.557 to 0.0 mm Hg (-0.030 to 0.0 in. H_2O), and shall be readable to the nearest 0.002 mm Hg (0.001 in. H_2O).	
		QA/QC	The manometer shall be zeroed each quarter. Conduct a daily check for plugging or other interferences by verifying that the pressure reading is typical and fluctuating in a typical manner.	
		Monitoring frequency	The pressure within the enclosure shall be recorded at two hour intervals. This may be done manually.	
3. Chamber Temperature The RTO combustion chamber temperature shall operate at 760°C (1400°F) or higher.	The RTO combustion chamber temperature shall be monitored with a thermocouple.	Instrument	The thermocouple shall be connected to an alarm set at 760°C (1400°F).	Upon excursion fom the range (i.e., sounding of the alarm), stop applying coatings. Do not apply coatings until the problem is fixed. Report an excursion as specified in Table 2.4.
		Location	In the combustion chamber. The thermocouple is an integral part of the RTO design.	
		Performance specification	The thermocouple sensitivity shall be ± 0.1%. The minimum chart division shall be 10°C or 20°F.	
		QA/QC Practices	Automatic self-check of the thermocouple is part of the RTO internal auditing process. A periodic electrical continuity check shall be made according to manufacturer's instructions but no less frequently than once each year.	
		Monitoring frequency	Continuous	

Operating Requirements	Operating Parameters	Monitoring Specifications		Excursions or Exceedences
[1]4. Flow rate to the RTO The flow rate during RTO operation shall be between 284 and 397 standard* m^3/min (10,000 - 14,000 standard ft^3/min). The CAPE+RTO System shall be visually inspected prior to start up after each assembly to ensure it is properly assembled and that no damage has occured.	The flow rate to the RTO.	Instrument	A flow measuring instrument.	Upon excursion from the range stop applying coatings. Do not resume the application of coatings before the flow is brought within the allowed range. Report an excursion as specified in Table 4. Report any repair or adjustments of the CAPE + RTO System as specified in Table 2.4.
		Location	The instrument shall be positioned near the inlet of the RTO such that flow disturbances do not influence the readings.	
		Performance Specification	The flow sensor shall be within ± 0.5 % and the indicating instrument shall be within ± 2% of full scale. The indicating instrument must be calibrated to measure a range of flow, from 0 to 426 actual m^3/min (0 to 15,000 actual cfm).	
		QA/QC	A periodic electrical calibrations check shall be made according the manufacturer's instructions, but no less frequently than once each year. After the CAPE+RTO System is assembled, the reading from the flow measuring instrument shall be compared with the fan speed reading measured within the first 2 hours. A difference of more than 10 percent requires re-calibration of the flow measuring instrument.	
		Monitoring frequency	Flow reading shall be recorded every 2 hours.	

*Note: Standard Conditions = 20° C and 101 kPa(68 ° F and 29.92 in Hg).

Operating Requirements	Operating Parameters	Monitoring Specifications		Excursions or Exceedences
5. VOHAP Concentration at exit to RTO. After assembling the CAPE the concentration of VOHAPs from the RTO outlet shall be less than 30 ppmv, measured as propane, while the concentration of VOHAPs to the RTO is greater than 120 ppmv.	RTO inlet and exit concentrations	Instrument	Portable flame ionization detector.	Upon excursion from the range, application of coatings shall cease. Do not apply coatings until the operating requirements are satisfied. Report an excursion as specified in Table 2.4.
		Location	At the inlet and outlet of the RTO.	
		Performance specification	Instrument range from zero to 500 ppmv, readable to within 5 ppmv. The maximum calibration value of the instrument should exceed that of the maximum output concentration reading (ppmv) by at least 15 percent.	
		QA/QC	The instrument shall be zeroed and calibrated using zero, 250, and 500 ppmv standard gases the day of the use of the instrument.	
		Monitoring frequency	The inlet and exit concentrations shall each be measured 3 times during the first coating cycle after each assembly of the CAPE+RTO System, between 45 minutes after the beginning of the first coating cycle and 30 minutes after completion of the coating cycle. The triplicate measures of a concentration shall be arithmetically averaged to calculate a single inlet and a single outlet concentration.	
6. RTO Operating Time /Air Temperature The time of RTO operation after coating application ceases shall be t_2. This time t_2 shall be determined according to Table 1 from the enclosure air temperature.	The RTO time, t_2, is based on the temperature in the enclosure or duct work.	Instrument	An air temperature measuring instrument.	Turning off the RTO before the required time will result in an exceedance of the standard. Report all exceedences in accordance with Table 4 and §63.788, paragraphs (b)(4) and (e).
		Location	The instrument shall be located in the middle of the enclosure or in the duct work near the recirculation exhaust, away from flow disturbances.	
		Performance specifications	The temperature measurement instrument range shall include values from -1.1 °C to 43.3 °C (30°F to 110°F). Sensitivity of the instrument shall be within 0.1%. The instrument must be readable in increments of 0.5 °C (1°F).	
		QA/QC	A periodic check shall be conducted according to the manufacturer's instructions but no less frequently than annually.	
		Monitoring frequency	The temperatue shall be measured within 2 hours after the start of the last coating- cycle.	

Operating Requirements	Operating Parameters	Monitoring Specifications	Excursions or Exceedences
7. The CAPE+RTO shall operate during the time a coating is applied (t_1) plus the additional time (t_2) determined from Table 1 above.	t_1 and t_2	Properly operating a watch or clock.	Turning off the flow from the CAPE to the RTO or the RTO itself before the required time will result in an exceedance of the standard. (See recordkeeping and reporting requirements below.)
8. All monitoring instruments shall operate according to the monitoring specifications.			Stop application of coatings until the problem is fixed.

4. Recordkeeping and reporting requirements

Tables 2. 2 and 2. 4 identify the recordkeeping and reporting requirements that apply when using the CAPE+RTO System as an alternative means of emission limitation to meet the requirements of 40 CFR Part 63, Subpart II.

Table 2.4 Recordkeeping and Reporting Requirements for the CAPE+RTO System (in addition to applicable requirements in Section 63.788 identified in Table 2.2)

Recordkeeping	Semiannual Reporting
1. Dates of visual inspection following assembly of CAPE sections to fit contour of a portion of a ship hull.	Any repair or adjustments made.
2. Values of the measured vacuum inside enclosure, every 2 hours. Record the time and date of each measurement .	Times and dates that vacuum of the enclosure are less than the minimum vacuum required; action taken.
3. Values of RTO combustion chamber temperature measurements . Record the date of the of the measurements.	Times and dates that the RTO temperature was not operating at or above the minimum temperature; action taken.
4. Values of the air flow rate to the RTO every 2 hours. Record the time and date of each measurement.	Times and dates that the flow to the RTO falls outside of the operating range of 284 and 397 standard m^3/min (10,000 - 14,000 standard ft^3/min); reasons and action taken.
5. Values of the VOHAP concentrations at RTO inlet and outlet , following assembly of CAPE sections and connection to RTO; and date and time of each measurement.	Times and dates the RTO average concentration of VOHAPs from the RTO was above minimum vacuum required; reasons and actions taken. Dates the measuring instruments were not operating properly; actions taken
6. *Operating Time/Air temperature in the CAPE:* Record the date, start time (t_a) and end time (t_1) for the coating period; CAPE air temperature reading within two hours after the start of the last coating-cycle and the extra time (t_2) needed to run the RTO after application of the last coating.	Time and dates that the RTO was turned off before the extra time, t_2; the reasons and action taken.
7. Value of required CAPE + RTO operating time, $t_1 + t_2$	Time and dates that the RTO was turned off before the required operating time, $t_1 + t_2$; reasons and action taken.
8. Start and end times and dates of RTO operation.	Start and end times and dates of RTO operation.
9. A copy of the manufacturer's QA/QC recommendation and procedures for the instruments and units applicable to Table 3 of this appendix. Dates of each QA/QC check.	N/A

Recordkeeping	Semiannual Reporting
10. A copy of the operation and maintenance procedures to be followed in relation to Table 3 of this appendix to minimize operational problems.	N/A
11. A copy of the application for approval including supporting documentation.	N/A
12. Records shall be compiled on a monthly basis and shall be maintained on-site for at least 5 years.	Applicable records or reports may be submitted in paper or electronic format.

N/A Not applicable

Section 2.2

Element C(1), Part 1

"The owner or operator of an affected source may apply to the Administrator for permission to use an alternative means such as (an add-on control system) of limiting emissions from coating operations."

Section: 63.783(c) also specifies that an application for alternative means of limiting emissions must include:

(i) ***"An engineering material balance evaluation that provides a comparison of the emissions that would be achieved using the alternative means to those that would result from using coatings that comply with the limits in Table 2 of this subpart, or the results from an emission test that accurately measure the capture efficiency and control device efficiency achieved by the control system and the composition of the associated coatings so that the emissions comparison can be made..."***

When you use both capture and destruction unit operations you need to perform an emission test. The test should define the following three values:

(1) The capture efficiency of the enclosure.
(2) The destruction efficiency of the add-on control unit operation.
(3) The amount of time (in hours) the destruction unit needs to be operating after each coating cycle. This parameter is especially important for air-cured (dried) coatings and when "time averaging" of emissions from coatings is not permitted. You cannot use time averaging of emissions when it results in exceedence of an individual coating limit on a solids (nonvolatiles) basis.

2.2.A Capture Efficiency of CAPE (enclosure)

MMC contracted with Pacific Environmental Services (the Contractor) to perform air emission tests on a ship, the USS Scott DDG-995, during the period August 19-23, 1996 at MMC shipyards in Norfolk Virginia. A copy of the 1996 Emissions Test [2] report was submitted together with the 1996 Application for Approval [3] and the 1996 Implementation Plan [4]. The MMC followed, as will be shown later, an operational protocol that would satisfy all but one of the requirements for 100 percent capture efficiency.

MMC also investigated the effectiveness of the CAPE (enclosure) for controlling emissions associated with abrasive blasting of ships in dry dock and the results were discussed in the1996 Emission Test report. MMC identified, in the report, other environmental benefits that may be achieved by using the CAPE (enclosure) during ship repair operations.

2.2.B Destruction Efficiency of the RTO

MMC meets all requirements for destruction efficiency based on detailed and well documented performance test data involving gaseous organic compounds, using EPA Method 25A [5]. The 1996 Air Emission Test results show that RTO can achieve:

- Destruction efficiencies greater than 98 percent, when the concentration of VOC pollutants is greater than 100 ppmv.
- Efficiency of 90 percent when the concentration is 50 ppmv (propane equivalent).
- Output concentration from the RTO much below the 50 ppmv value, which represents the cut-off value for using EPA Method 25A.

In Table 5 of the 1996 Application for Approval MMC says that they will operate the RTO to produce a destruction efficiency of 95 percent, determined using EPA Method 25A, the level they will want to take credit for in future operation. We have explained the conditions under which you can use EPA Method 25A in a 1995 memo [5].

2.2.C Operating Time for the RTO

MMC tried to develop a simple procedure to relate the time it would need to run the RTO when they apply coatings with different assumed solids (nonvolatiles) content. In their calculations, they

- Assumed that coatings released the volatiles instantaneously.
- Average the emissions from coating over time, concluding that they could turn off the RTO while still applying coatings.

However, we have concerns about the reliability of MMC's predicted RTO operating values because under certain conditions the assumptions may not be valid. For example, they did not consider the effect of temperature or season on evolution of volatiles. Considering all these factors, we identified the appropriate operating time for the RTO in Table 1.1 above.

Also, an operator must not turn off the air to the RTO or the RTO itself when applying a coating. We cannot assume when you stop applying a coating that all the necessary mass of volatiles was swept out of the enclosure and directed to the thermal oxidizer. Under certain application temperatures and coating VOHAP content, you will need to operate the RTO beyond the time it takes to complete the application of a coating (Chapter 3). The necessary time is defined at the point when the total emissions inside the CAPE System divided by the total solids (nonvolatiles) on the hull is at the level or below that of each complying coating. If we accepted the argument that the higher destruction efficiency achieved during certain painting cycles should balance any time-period of noncompliance resulting from the application of coatings in the enclosure--we would inadvertently be granting those that have elected to use add-on controls in lieu of using complying coatings a compliance-related advantage. The requirements are given in Section 2.1.

2.2.D Coating Limits Never-to-be-Exceeded Form of the Standard

The NESHAP specifies under Section 63.783(c)(iii)(2) that the post-control emissions of VOHAP per volume of applied solids (nonvolatiles) must be no greater than those from the use of coatings that comply with the limits in Table 2 of Subpart II (Table 1.2), meaning that the post-control emissions at any time should not exceed the mass of VOHAP per volume of nonvolatiles (solids) applied. Since the limitations in Table 2 of the standard are specified on a never-to-be-exceeded basis, the use of non-complying coatings is not permitted and constitutes a violation of the standard, unless the emissions released are being controlled to the level of the compliant coatings--referenced on a solids or nonvolatiles basis.

When we developed the regulation in 1993, we had evaluated several approaches for determining maximum achievable control technology (MACT) options. All were based on coatings with inherently low pollutant contents [6]. Two options were evaluated during the development of the rule:

(1) The first type of limit is based on maximum or never-to-be-exceeded values for each coating category. The facility and paint manufacturer would know that by using or producing a coating that, as applied, meets the MACT limit, he or she is complying with the regulation. You are not allowed to apply in uncontrolled environment, coatings that emit VOHAPs above these limits.

(2) The second type of limit is based on averaging. Average limits allow the shipyard to use any coating, but they must do extensive planning, calculating, and recordkeeping to make certain they meet the average limit. Use of any high-HAP coating must be offset by use of one with low-HAP content within the designated averaging period.

Of the options evaluated for selecting the "floor," the never-to-be-exceeded basis was the option adopted in the final regulation based on the comments received from the stakeholders [7 - 9]. As a result, certain existing coatings which are non-complying cannot be used, once the regulation was in place, without first installing add-on controls. The never-to-be-exceeded limits were the basis for calculating the MACT floor and the emission reduction achievable resulting from this regulatory action. Any form of time-averaging that resulted in exceeding a limit is therefore not permitted.

Time-averaging of emissions would, thus, allow a source to use low or zero VOHAP/VOC coatings during certain painting cycles and non-compliant coatings during other coating cycles. You would be in compliance, as long as the total emissions released during the averaging period did not exceed the total emissions produced had only complying coatings been used throughout that time period. However, this is not permitted. When you are using the CAPE+RTO System you are allowed to use non-complying coatings and the emissions from coating cycles may mix inside the CAPE. You will need to operate until the mass of VOHAP's within the CAPE divided by the solids applied to the hull is less or equal to that of the complying coating.

2.2.E VOC as Surrogate for VOHAP

MMC indicated in its application that it has selected the option allowed in the NESHAP of using VOC content as a surrogate for VOHAP content. The term VOHAP *content* as used in this standard includes any volatile emitted during air curing of the coating. However, any 'exempt' compound that is an organic HAP (non-VOC HAP) will need to be counted when determining the total mass of VOC material that would be emitted from a coating.

Section 2.3

Element C(1), Part 2

(ii) "A proposed monitoring protocol that includes operating parameter values to be monitored for compliance and an explanation of how the operating parameter values will be established through a performance test..."

In this section we will evaluate the 1996 Emissions Test (performance test) [2] results for the CAPE+RTO System. In the first part we discuss the extent MMC satisfied the 100 percent capture efficiency requirements defined in EPA Method 204 (62 FR 32500, June 16, 1997) [10]. In the second part we evaluate the procedure followed by MMC for setting the value of the destruction efficiency of the RTO.

2.3.A CAPE (enclosure)

The Unit Operation System (UOS), the ensemble on which the material balance should be set to determine the change in the VOHAP concentration resulting from application of a coating, is the CAPE (enclosure) volume plus the air volume in pipes of the air management system (Figure 2.3). If the CAPE system captures in-time the necessary amount of VOHAPs and passes these VOHAPs to the RTO, the CAPE system will be considered to have 100 percent capture efficiency.

The requirements of a Permanent Total Enclosure and for ensuring that the flow is into the enclosure are specified in EPA Method 204. If the following four requirements (Requirements 1 to 4) are met and if all the exhaust gases from the enclosure are ducted to the add-on control device (Requirement 5), then the VOHAP capture efficiency is assumed to be 100 percent, and capture efficiency need not be measured. If part of the VOHAP laden gas stream is not ducted to the add-on control device, capture efficiency must be determined. The following paragraphs present each requirement (total five) and discusses whether the CAPE met or was not able to meet the requirement during the 1996 Emission Test in Norfolk, Virginia.

(1) *"Any [natural draft opening] NDO shall be at least four equivalent opening diameters from each VOHAP emitting point unless otherwise specified by the Administrator."*

MMC indicated on page 2-14 of the 1996 Emission Test report [2] that CAPE design contains no windows. It has no NDOs such as those that allow raw materials to enter and products to leave and the doors were normally closed during coating operation (Appendix, Exhibit 2.1).

An NDO according to Section 3.1 of EPA Method 204 is "[A]ny permanent opening in the enclosure that remains open during operation of the facility and is not connected to a duct in which a fan is installed."

MMC determined the equivalent diameter on each side of the CAPE to be 5.2 cm (0.17 ft). This value comes from worst case assumption that a gap 2.54 cm by 16.5 m (1 in. by 54 ft) existed between the CAPE and the ship hull, on each side of the curtain touching the ship hull (Appendix, Exhibit 2.2). Four equivalent diameters would be 21 cm (0.68 ft). This means that the CAPE would meet requirement 1. Under operating conditions the nozzle of a paint gun would normally be positioned at a distance greater than 21 cm from either sides of the canvas edges touching the hull, to avoid painting the walls of the enclosure.

To evaluate the Capture efficiency of the CAPE, MMC estimated the areas through which the air infiltrates into the CAPE. They referred to these areas as NDOs. These areas (NDOs) are located mainly along the sides of the enclosure where the curtains come in contact with the hull of a ship. Although the contour of a ship makes it difficult to obtain a good seal, a visual inspection during the test performed by MMC indicated no visible cracks or openings at the seam of the total enclosure and the hull.

(2) *"The total area of all NDOs shall not exceed 5 percent of the surface area of the enclosure's walls, floor, and ceiling."*

MMC established the enclosure area ratio (NEAR) for the CAPE at 0.005 using Equation 2.2 below. This value is below the limit of 0.05 set in EPA Method 204. They arrive at this value by estimating the following:

(a) A_N, the NDO total area as 23.9 m^2 (257 ft^2), (Appendix, Exhibit 2.2), assuming that a 2.54 cm (1 in.) gap existed along every seam of the enclosure.

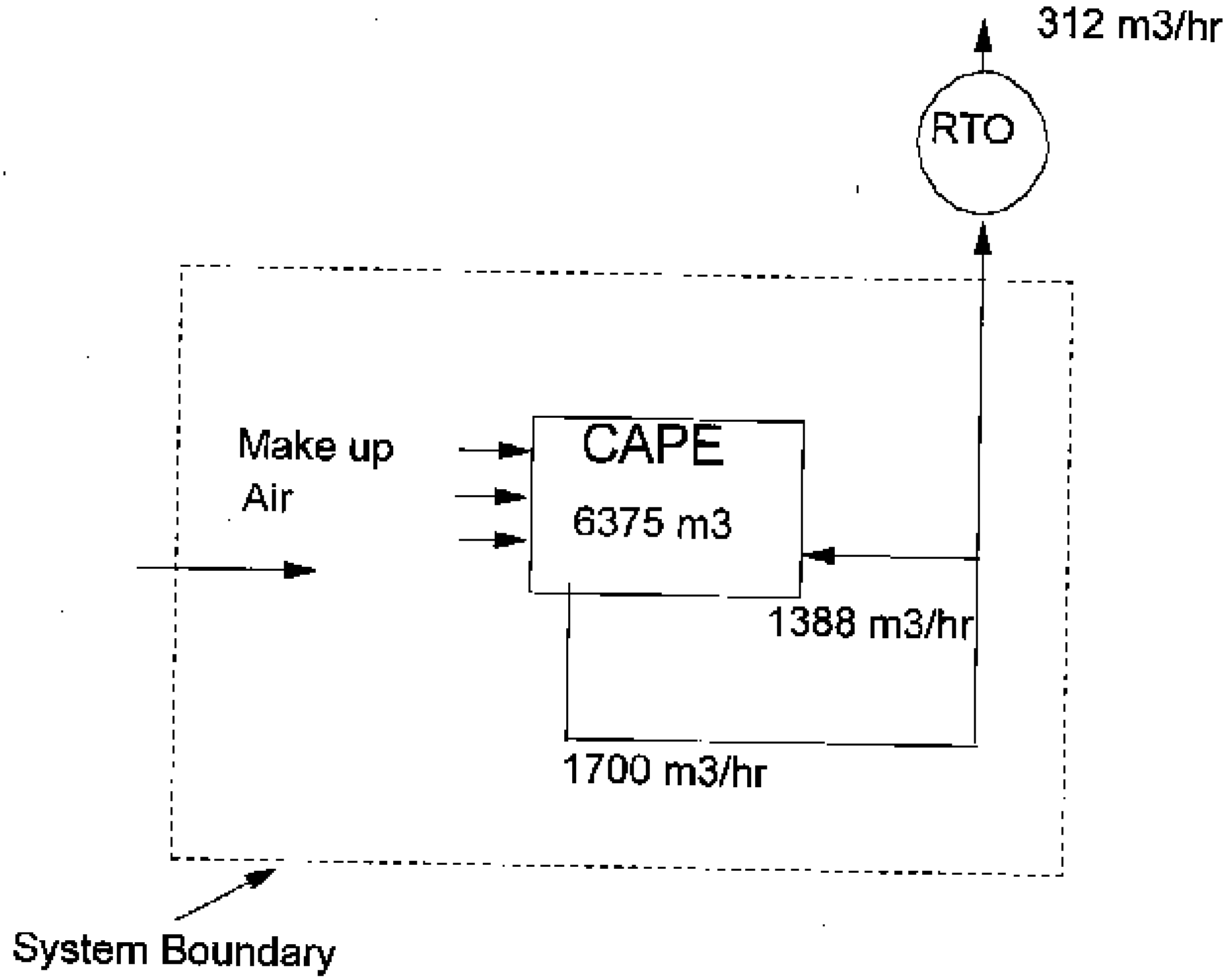
(b) A_T, the total enclosure surface area as 5082 m^2 (54, 825 ft^2). Five percent of this area is 100 m^2 (2, 741 ft^2). Hence,

$$\begin{aligned} NEAR &= (A_N) / (A_T) \\ &= (23.9) / (5082) \\ &= .005 \text{ (or 0.5 \%)} \end{aligned} \qquad \text{(Equation 2.2)}$$

Therefore, the enclosure meets requirement.

(3) *"The average facial velocity (FV) of air through all NDOs shall be at least 3,600 m/hr (200 ft/min). The direction of air flow through all NDOs shall be into the enclosure."* A vacuum (negative pressure drop) of 0.013 mm Hg (0.007 in. H_2O) corresponds to an FV of 3,600 m/hr (200 ft/min). (NOTE: 0.13 mm Hg (.007 H_2O) vacuum is the value in the latest version of EPA Method 204.)

Figure 2.3 CAPE and Air Management System Unit Operation System (boundary for material balance)



The requirement here can be satisfied in two ways: (1) if the average FV for a permanent enclosure is at least 3,600 m/hr or alternatively, or (2) the vacuum inside the enclosure is greater than 0.013 mm Hg. (.007 in. H_20).

MMC satisfied the alternative option (2). It continuously monitored the pressure drop (static pressure) along four centrally located positions in the CAPE (Appendix, Exhibit 2.3). Each of the probe locations was: 9.15 m (30 ft) high; 1.53 m (5 ft) from the outer wall of the enclosure; and 18.3 m (60 ft) between either air plenum. The positions were equally spaced, 18.3 m (60 ft) from one another. Location number 1 is about 73.2 m (240 ft) from the exhaust point, and location number 4 was the closest at 18.3 m (60 ft). The static pressure was always above the required minimum of -0.013 mm Hg (-0.007 in H_20) throughout the four days of the monitoring period: The average static pressure for the four positions along the CAPE was -0 .035 mm Hg (-0.019 in. H_20). Requirement 3 is, therefore, met.

In the following section we will show you the results we obtained when we tried to use the equation in Method 204 shown below to calculate FV:

$$FV = (Q_o - Q_I) / A_N \qquad \text{(Equation 2.3)}$$

where:

Q_o = the sum of the volumetric flow from gas streams exiting the enclosure through the exhaust duct or hood, corrected to standard conditions. [Q_o = 1700 m^3/min]

Q_I = the sum of the volumetric flow, corrected to standard conditions, from all gas streams into the enclosure through a forced makeup air duct; zero, if there is no forced makeup air into the enclosure. [Q_I = 1388 m^3/min]

A_N = total area of all NDOs in enclosure. [A_N = 23.9 m^2]

The value of FV for the CAPE is equal to [60 (1700 - 1388)] / 23.9 = 780 m/hr (43 ft/min). This value is lower than the 3600 m/hr (200 ft/min) minimum value specified in EPA Method 204. Since MMC, in its 1996 Emissions Test, indicated that when the seal between the CAPE and hull was inspected visually, there were no visible cracks or openings, one can conclude the worst case assumption that a one-inch gap existed at every seam of the total enclosure which overstimated the total area A_t of all NDOs . MMC did not perform this calculation as it did not select this option. It met instead the negative pressure drop requirement. We expect the air flow through the CAPE to be inwards when we operate the enclosure at this minimum vacuum. [10]

(4) *"All access doors whose areas are not included in Criterion Number 2 and are not included in the calculation in Criterion Number 3 shall be closed during routine operation of the process."*

This criteria is met. In this set up, there are two doors positioned, one at each end of the CAPE. They are used to access or depart the enclosure. The criterion is met because the doors are normally closed. There are no windows to the enclosure.

(5) *"All VOC emissions must be captured and contained for discharge through a control device."*

This criterion was not met. MMC is able to discharge using this setup all emissions from an *as-applied* coatings that would need to be captured and sent to the oxidizer. However, MMC's procedure presented in the 1996 Emission Test (performance test) and which it indicated in its Application for Approval would not do that. We explain in Section 4.2 why the approach used by MMC for determining RTO operating time would not guarantee that the necessary amount of VOC emissions are captured and contained for discharge.

2.3.B Regenerative Thermal Oxidizer (RTO)

If we use an add-on control unit such as an oxidizer, the owner or operator needs to do an initial performance test to show that the required emission reduction is achieved. Another purpose of the test is to identify and validate the monitoring protocol that includes operating parameter values to be monitored for compliance. MMC provided detailed results of a test undertaken in Norfolk, Virginia, in 1996 [2]. They used several test methods:.

- EPA Method 1 of Appendix A of 40 CFR Part 60 was used for sample and velocity traverses.
- EPA Method 2 of Appendix A of CFR Part 60 was used for velocity and volumetric flow rates.
- EPA Method 3 of Appendix A of CFR Part 60 was used for gas analysis.
- EPA Method 4 of Appendix A of CFR Part 60 was used for stack gas moisture.
- MMC proposed using EPA Method 25A to measure VOC concentration in the inlet duct to the RTO, and in the outlet of the RTO. It conducted three 1-hour test runs using one flame ionization (total) analyzer (FIA) at the inlet, and one FIA at the outlet of the RTO. It also indicated that during a test, the coating application rates reflected near maximum operating condition.
- MMC determined the destruction efficiency of the incinerator. Equation 2.4 below identifies the parameters that were measured in the demonstration test.

$$DE = (C_i Q_i - C_o Q_o) / C_i Q_i \qquad \text{(Equation 2.4)}$$

where:

DE = destruction efficiency, %
C_i = inlet VOHAP concentration, ppmv propane, dry basis
C_o = outlet VOHAP concentration from incinerator, ppmv Propane, dry basis
Q_i = inlet flow rate, m^3/minute at STP
Q_o = outlet flow rate, m^3/minute at STP

MMC conducted a system bias check prior to conducting the coating test runs to verify that each entire sampling system was leak tight. It also conducted a calibration error test within 2 hours of initiating a test run. Zero and span drift checks were performed at the completion of each sampling run. These tests are not required in EPA Method 25A. It shows that MMC was paying attention to quality control.

On page13 of the Application for Approval [3] MMC indicated that it will use the approach in the 1996 Emission Test to demonstrate compliance with the NESHAP using the CAPE+RTO System (Appendix, Exhibit 2.4). However, EPA will allow MMC to use the 1996 Emission Test [2] in lieu of a new performance test if they are using the same CAPE+RTO System in the new locations and operating as explained in Section 2.1.

(iii) *"Details of appropriate recordkeeping and reporting procedures"*.

The facility indicated that it will maintain separate records for the coatings applied to a substrate within the CAPE system, including the amount of each coating, the volatile content (including cure volatiles), and volume solids (nonvolatiles) of the coating applied to the ship hull. This will not be required when the CAPE+RTO System is used as indicated in Section 2.1.

When a coating is thinned, the thinning allowance should be calculated to meet the limits on a solids basis. That should be the basis for the as-supplied and the as-applied certifications. This is explained in Section 63.785 (c)(2) & (c)(3) of the regulation. MMC recognized that Equation 1 in the standard [1] needs to be used to determine thinning allowances. However, they are checking compliance using g/liter of coating units in the certification sheet for "noncomplying coatings" (page19 of their 1996 Implementation Plan). They should have used g/l solids limits instead. Their statements in Section V(c)(2), page 8 of the Application for Approval indicates that compliance be based on "g/l of coating or g/l of solids." They need to indicate that g/L solids (nonvolatiles) shall be used whenever thinning solvents are added to coatings. MMC indicated that it will make the indicated revisions.

Lastly, MMC put much thought into planning the work and reporting the test information in the 1996 emission test performed in Norfolk, Virginia. They documented well how they measured emissions of VOC material and particulates. The test report contains supporting details, including essential quality control logs and data tables (e.g., Appendix, Exhibits 2.5 and 2.6). However, I found it difficult at times to match pieces of data together. Such issues were later clarified (Appendix, Exhibit 2.7).

Section 2.3

Element C(2)

"The Administrator shall approve the alternative means of limiting emissions if, in the Administrator's judgment, postcontrol emissions of VOHAP per volume applied solids will be no greater than those from the use of coatings that comply with the limits in Table 2 of this subpart."

We will discuss some of the material balance related information submitted by MMC. The purpose is also to clarify a number of important points that have application beyond the MMC's submittal.

2.4.A Material Balance Calculations of Theoretical Minimum VOHAP Reduction 76

MMC used a material balance to calculate, for a representative number of coatings applied to ships, the *minimum reduction* of emissions, referenced on a solids (nonvolatiles) basis, that is needed to meet the coating limitations in the regulations. They did the calculations for two coatings with assumed solids (nonvolatiles) content from 20 to 80 percent by volume. The results are shown in Table 5 of their 1996 Application for Approval [2], (Appendix, Exhibit 2.8). MMC concluded, for example, that if the calculated reduction necessary was 77 percent for a given coating mixture, using an RTO with a destruction efficiency of 95 percent would achieve a higher reduction than is required by the regulation. MMC referred to this minimum reduction as an "overall control efficiency required."

<u>EPA Comments</u>

We disagree with their conclusions.

- The calculated minimum reduction of VOHAPs on a nonvolatiles basis (solids) is a useful number. It does not however, indicate the overall control efficiency achieved at a given RTO setting, unless we can assume that

  > "all the paint emissions <u>evolve at once</u> and all the air flow directed from the enclosure (CAPE) into the RTO occurs instantaneously."

- The above scenario is unlikely and MMC will need to factor in the amount of time needed for the necessary amount of volatiles to reach the RTO from the enclosure.

2.4.B Material Balance as an Alternative to Emission Testing (Model 1)

MMC used another material balance approach (Model 1) to estimate the VOC build-up within the CAPE during application of a coating. They calculated the hours of RTO operating time required for compliance for coating application periods varying between 2 and 8 hours (Appendix, Exhibit 2.9). The calculations were performed for two types of coatings, in nonvolatiles (solids) content from 20 - 80 percent and presented in a table, which was to be used as an alternative to emission testing. They also calculated another table to illustrate the time needed to achieve concentrations of less than 908 g (2000 Lbs) (Appendix, Exhibit 2.10).

1. EPA comments (Model 1)

We believe that MMC started with a good idea, however, the model they used does not represent the situation under study. Our reasons are explained below:

- An implicit assumption in the model used is that all VOHAPs (or VOCs) are flashed off instantaneously when the paint is applied. This would lead to a higher rate of evolution of VOHAP material. It would also result in predicting a shorter time for reaching the maximum VOHAP concentration than might occur in an actual coating cycle.

- The Company did not restrict the use of Table 2 in the 1996 Application for Approval (Appendix, Exhibit 2.9) to one temperature and one would conclude that the table was going to be used throughout the year. A coating will take much more time to dry in winter than in summer.

- Table 2 in Exhibit 2.9 shows that for antifoulant coatings with 40 percent solids (nonvolatiles) by volume, applied for 8 hours, the RTO would need to operate for only 5 hours to bring down the emissions to the level of compliant coatings. This implies that MMC can turn off the RTO while they are still applying coatings; however, we disagree as explained in Section 2.2.

- MMC assumed that the NESHAP permitted the time-averaging of emissions to meet the limitations in Table 2 of this NESHAP. This explains why they indicated that the RTO could be turned off before they completed painting and still be in compliance. The NESHAP does not allow averaging of emissions. In Table 2 of the regulation (Subpart II) the limits are specified as never-to-be-exceeded.

- Although MMC did not provide details about the model, it was possible to duplicate some of the results by assuming, as a starting point in the analysis, that the mass of volatiles removed and the mass of volatiles recirculated were proportional to the flow. That assumption did not lead to the conclusion reached by EPA using a more robust model (Model 2). Hence, MMC should not use Table 2 in Exhibit 2.9 of the Appendix to meet the standard.

2. EPA comment (reduction to background level, Appendix. Exhibit 2.10)
   (Table 4 of the 1996 Application for Approval)

- An owner or operator of the RTO is only required to ensure that the "postcontrol VOHAP emissions" per volume of applied solids be no greater than those from the use of coatings that comply with the limits in Table 2 of the NESHAP (Table 2.1) and not the destruction of all the applied VOHAPs.

- An owner or operator of the RTO is not required to reduce emissions to background level. Therefore, MMC's did not need to develop their Table 4 (Appendix, Exhibit 2.10). The table, however, provides a reference point for the maximum achievable reduction--background level.

- MMC showed that the RTO would need to operate14 hours–6 additional hours after painting ceases to achieve VOHAP background level. At this point the coating should be at a minimum dry-to-touch, but it will still retain a small percentage of the solvent. This can range from 5-15 percent by mass volatiles (Appendix, Exhibit 2.11). It may take between 4 to 36 hours from the time a coating is applied to be dry, i.e., dry-to-touch (near zero emissions). The drying times depend on temperature and type of coating and other operating parameters. The terms dry-to-touch and dry-to-hard are explained in some detail in Chapter 3.0.

2.4.C Determining Operating Time for the RTO

The values in Tables 2 and 4 of the Application presented by MMC underestimate the operating time for the RTO for reasons explained in Chapter 3.0 and, therefore, should not be used. MMC must modify the CAPE supervisor log, the CAPE+RTO System operator log, and the CAPE air compressor operating log, to include the total planned hours of coatings, which ends with each volume of non complying coating applied.

The RTO operating time for compliance $= t_1 + t_2$, hours are indicated in Equation 2.1, where, t_1 = coating cycle time (hours) plus t_2 = additional time to ensure that RTO is not stopped before the emissions in the CAPE from the coating cycle are equal to or below that of a complying coating.

Ideally, an owner or operator should determine the value of t_2 at the recommended dry film thickness and temperature as explained in Chapter 3.0. MMC is already collecting this type of information as part of the Quality Assurance Record for Critical Coated Areas (Appendix, Exhibit 2.5) for the batch of coating. However, MMC will be required to follow a simple approach for determining t_2. It will first need to measure temperature inside the CAPE and use this value to determine the extra time from Table 1.1. The operator will have to choose between one of two locations:

- Inside the air conduit exiting the CAPE.
- At some height in the middle of the CAPE.

The specific requirements are explained in Section 2.1 Element C(3).

REFERENCES

1. 40 CFR Part 63, Subpart II--National Emission Standards for Shipbuilding and Ship Repair (Surface Coating).

2. *Air Emission Evaluation Total Gaseous Organic Compounds and Filterable Particulate Emissions Compliant All Position Enclosure (CAPE) System USS SCOTT DDG-995 Metro Machine Corporation*; prepared by Pacific Environmental Services, Inc., Herndon, VA, September 1996 for Metro Machine Corporation, Norfolk, VA.

3. *Application for Approval of Alternative Methodology for Compliance with The NESHAP for Shipbuilding and Ship Repair*; submitted by Metro Machine Corporation, Norfolk, VA, June 12, 1996 (Revised October 31, 1996); prepared with Pacific Environmental Services, Inc., Herndon, VA.

4. *Implementation Plan for Compliance with the NESHAP for Shipbuilding and Ship Repair Metro Machine Corporation*; prepared by Eric Lasalle, November 1, 1996; Metro Machine Corporation, Norfolk, VA.

5 . Memo from John B. Rasnick, April 4, 1995, "*EPA's VOC Test Methods 25 and 25A*," EMC GD-033, URL: http://www.epa.gov/emc.

6. NESHAP for Shipbuilding and Ship Repair; Docket No. A-92-11; Documents No. II-C-014.

7. NESHAP for Shipbuilding and Ship Repair; Docket No. A-92-11; Document No. II-D-065.

8. NESHAP for Shipbuilding and Ship Repair; Docket No. A-92-11; Documents No. II-D-067.

9. NESHAP for Shipbuilding and Ship Repair; Docket No. A-92-11; Documents No. II-D-069.

10. *Preparation, Adoption, and Submittal of State Implementation Plans; Appendix M, Test Methods, 204 A-204 F*; 62 FR 32500 (Monday, June 16, 1997).

CHAPTER 3

EVOLUTION OF VOLATILES DURING PAINTING

This chapter will look at typical phases that a coating undergoes after it is applied to a substrate and that produce emissions and explains why MMC's methods of calculating emission levels must change to meet our conditions for approval.

3.1 Application and Drying Phases of a Coating

Protective coatings are usually applied as a system, which may include a primer, a middle coat, and a topcoat. Coatings must reach the right conditions before another coat goes on; otherwise, the new layer will affect the rate of solvent evolution resulting in problems such as blisters. The coating manufacturer provides guidance to avoid such problems.

When a coating is applied to a substrate, a part of the volatile material flashes off during application or spraying. We do not know how much evaporates in the first phase because it depends on the operation. The rest of the volatile material evaporates in two distinct drying phases. The first is the "dry-to-touch" or "dry-to-tack" time, which can vary from 2 hours to much more than 10 hours. The second is the "dry-to- hard" time, which may vary from 4 to 72 hours. These relatively long drying (curing) times occur when a drying oven is not used or the air is much below oven level temperatures . (Oven temperatures are usually greater than 90°C or 194°F). A paint needs more time to dry completely (dry hard), but we do not need to know the time referred to as the dry-to-hard time, because little solvent emits during that period.

<u>Dry-to-Touch Time</u>

We can define the dry-to-touch time (drying time), as the time until the paint is still soft when touched but does not stick to one's finger. A Material Safety Data Sheet (MSDS) will state the "dry-to-touch" time as the recommended film thickness. As the ambient temperature decreases, drying time markedly increases (Appendix, Exhibit 3.1). This drying time is important because it marks the point at which the coating on the substrate contains no more than 3-20 percent by mass volatile material (Appendix, Exhibit 2.11). More forgiving paints can receive a second coat at that point. Usually, operators recoat such coatings while the paint on the substrate is much more moist (contains more solvent) than at the dry-to-touch point. That is why the EPA's model focuses on the dry-to-touch time. During operations, a coating's drying time depends on a number of factors, including the resin used in the coating, the thickness of applied coating, the substrate's temperature, and the air flow.

3.2 How Long Volatiles Take to Emit from an Enclosure

The regulation on shipbuilding and ship repair identifies 23 categories of (marine) coatings that serve the different applications and functional needs of the industry. They include alkyds, inorganic zincs, and epoxies. Painters apply coatings to large surface areas by spraying, brushing, or using rollers. When they paint a ship's hull, they normally leave the coating to dry in the open. Ducting the emissions from the hull of a ship to an abatement unit operation has not been practical until recently.

The CAPE+RTO System (Appendix, Exhibit 3.2) includes an enclosure that captures and releases volatiles from coatings applied in cycles usually lasting from 1 to several hours. Appendix, Figure 2.3 of Section 2.3 (shows a schematic of an enclosure with recirculation. A certain mass of air leaves the top of the enclosure so the system pulls in the same amount of make-up air (fresh air) through the cracks between the ship's hull and the CAPE's walls. When painting begins, the make-up air mixes with the volatile material and the recirculated air. The volume of make-up air pulled in is likely to be affected by the amount of volatiles evolved. Air should recirculate fast enough to allow rapid mixing of the VOHAPs evolving within the CAPE system. Otherwise, we cannot assume the concentration inside the CAPE and that leaving in the flow to the RTO are the same.

The solvent loss from a coating film depends on the temperature, air velocity and turbulence over the surface, ratio of surface to volume, and other factors that determine rate of evaporation from a coating film [1]. For most of the coatings discussed here evaporation controls the emissions of volatiles. After a film forms on the coating there comes a point where the rate of solvent loss from the coating film becomes dependent on how quickly the solvent can reach the surface of the film to evaporate. The amount evaporated is determined by diffusion of volatiles between particles in the film (the diffusion-control regime) [2]. Sometimes, people refer to this period as the dry stage because the coating film on a substrate feels dry-to-touch. We are not interested in that second phase.

Figure 2.1 of Section 2.1 shows the concentration profile (build up and decay curves) for VOC material during several coating cycles in a coating period that lasted for several days. In some cases the curves overlap, showing that several coating application cycles were occurring at the same time. It also includes intervals when paint was not applied. For example, a large time gap between the first two coating cycles exceeded the time-to-dry for the first coating.

3.3 Determining the Concentration of Volatiles Inside a Coating Enclosure

In the following sections we will describe two ways to predict the concentration of volatiles inside the enclosure while applying a coating: MMC's method and our method. Once we know the likely concentration, we can determine how long the regenerative thermal oxidizer (RTO) needs to run in order to comply with the limit 571 g/L (4.76 lb/gal) for a general use coating. Both methods assume that there are no concentration gradients inside the enclosure and that volatiles do not re-enter the enclosure. As discussed later, we can keep volatiles from leaking out by maintaining a minimum vacuum inside the CAPE. For this discussion we assume that all volatiles in the coatings are VOC material.

1. Calculation by MMC (Model 1)

Exhibit 3.3 in the Appendix summarizes MMC's results. On the same page you will find variables for a maximum application rate of 72,640 g/hr (160 1b/hr). MMC determined they had to run the RTO for several hours beyond the coating cycle time to reach compliance. (They did not commit to run the RTO beyond that long.)

They did not describe the procedure exactly, but we were able to duplicate the initial 15-minute intervals. To do so, we assumed the mass of pollutants resulting during each interval split according to the same ratio as the flow going to the incinerator and the flow returned to the CAPE. MMC assumed that volatiles (VOC) material evaporated instantaneously once sprayed. Also, they did not factor in their calculations how temperature or season affects volatiles' rates of evolution from a coating. Ideally, to determine the volatiles concentration or change in VOC concentration within the enclosure (CAPE), MMC should have used the total air volume in the CAPE plus piping. They did not report this value, but they told us the inside volume of the piping from the incinerator to the CAPE was less than 425 m^3 (15, 000 ft^3), which, in this case, is negligible compared to the CAPE volume. We credit MMC for having considered the need to run the RTO beyond the coating cycle, but their approach cannot be used to predict the effect of temperature or coating thickness on the volatiles rate of evolution from an applied coating.

2. Model used by EPA to calculate rate of evaporation (Model 2)

We calculated emissions using a spreadsheet (Model 2) that was developed by EPA [3]. Model 2 is a combination of two published models. The first provides exact solutions to the indoor concentration during and after the application of a coating [1] The second describes a method to estimate the source decay rate constant which is calculated on the basis that 90-percent of the solvent mass has been emitted at the end of the drying time [4]. We mentioned some of the limiting conditions and explain other details in the cited paper. Table 3.1 gives the variables that we must define to determine the volatiles rate of build-up inside the CAPE. They include the air-exchange rate (exhaust-flow rate and booth volume), an important parameter that affects the volatile's maximum peak concentration. We will assume in the following example that all volatiles are VOC material. We determine the application rate and hull area painted from the Appendix, Exhibit 3.4, as MMC recommended in a recent communication [5]. We also assumed the dry coating thickness was 127 micron (5 mil) to determine volume solids (nonvolatiles) as was indicated in the Appendix, Exhibit 3.4.

We used the conditions in Table 3.1 to generate the tabular results in Table 3.2. We can deduce from these results that, after one hour, the VOC in the CAPE's air is 3.9 g/m^3 and the VOC on the hull's surface is 51,674 g. The total VOC inside the booth is 76,280 g (75 percent of content of the as-applied coating). At this point, the total VOC per liter of solids on the hull is 683 g/L solids (Table 3.2). If we add the amount that is still in the booth air, we get 1009 g/L solids (on the hull).

If the coating were an antifoulant, the complying limit is 765 g/L solids. The ratio of total VOC inside the CAPE divided by solids (nonvolatiles) on the hull would reach that limit about 1.7 hours into the coating cycle of 2 hours. Hence, if workers suddenly removed the enclosure, the emission rate would never exceed 765 g/ L solids on the ship's hull.

However, a general-use coating with a complying limit of 571 g/L solids would need close to 2.3 hours or about 20 minutes above the time for completing the coating cycle represented here.

Table 3.1 Input Parameters Used in Model 2

Parameters	**Values**	
CAPE * (enclosure) Volume	6,371 cubic meters	225,000 cubic feet
Exhaust flow rate	21,420 cubic meters/hour	755,700 cubic feet/hour
Surface Area	1,208 square meter	13,000 square feet
Volatiles density	840 g/L	7.0 lb/gal.
Nonvolatiles (solids) content	42.2 % V/V	42.2 % V/V
Paint 90 % drying time	2 hours	2 hours
Spraying Period	2 hours	2 hours
Spraying (application) rate**	256 L/h	67.5 gal/hr
Overspray	30 %	30 %

* Neglecting 425 m^3 (15,000 ft^3) of piping will slightly underestimate VOC evolution time.
** Rounded to three significant figures.

In Table 3.1 we used 2 hours instead of 2.75 hours, the value recommended by MMC [5]. A value of 2 hours agrees better with their 1996 test results plotted in Figure 2.1 in Chapter 2. MMC did not clearly specify the nonvolatiles content of the as-applied coating. We derived the value in three steps as follows:

- First, we calculated an overall coverage based on the coating that was applied inside the CAPE (including the overspray): 1209 m^2/511 liter = 2.37 m^2/liter. The values we used are from Appendix, Exhibit 3.5.

- Second, we adjusted the value determined in Step 1 above for 30 percent overspray: 2.37/ (1-0.3) = 3.38 m^2/liter. This value is the practical (effective) coverage of the ship hull.

- Third, we used the practical coverage and the dry film thickness (DFT) in the equation below to determine the volume fraction nonvolatiles (NV):

$$(1000/DFT) * NV = 3.38 \qquad \text{(Equation 3.1)}$$

The DFT was assumed to be 1.27 * 10^{-4} meters (5 mils). If we had used the total sprayed coating (as-applied basis) to calculate coverage (2.37 m^2/liter) we would have underestimated the content of nonvolatiles in the as-applied coating. However, if the actual overspray was less than the default value of 30 percent we used in Table 3.1, we would be underestimating the NV fraction of the coating. A decrease in the value of effective or practical coverage (for a given DFT) results in a lower value of NV content (fraction) and a higher as-applied VOC content which results in a higher VOC spray rate.

Table 3.2 Volatile to Solids Ratio, g/L (for a 2 hour coating application period)

VOC (g) / Solids (L)	On Surface / On Surface	In Booth / On Surface
Time (h)	**Ratio 1**	**Ratio 2**
0		
0.04	1124.4	1610.7
0.08	1099.1	1578.5
0.12	1074.6	1546.9
0.16	1050.8	1515.9
0.2	1027.7	1485.6
0.24	1005.3	1456.0
0.28	983.5	1426.9
0.32	962.4	1398.5
0.36	941.9	1370.9
0.4	922.0	1343.8
0.44	902.7	1317.4
0.48	883.9	1291.6
0.52	865.7	1266.4
0.56	848.0	1241.8
0.6	830.8	1217.9
0.64	814.1	1194.5
0.68	797.9	1171.7
0.72	782.1	1149.5
0.76	766.8	1127.8
0.8	751.9	1106.6
0.84	737.4	1086.0
0.88	723.3	1066.0
0.92	709.6	1046.4
0.96	696.3	1027.3
1	683.3	1008.7
1.04	670.7	990.6
1.08	658.4	972.9

1.12	646.5	955.7
1.16	634.9	938.9
1.2	623.6	922.5
1.24	612.6	906.5
1.28	601.9	891.0
1.32	591.4	875.8
1.36	581.3	861.0
1.4	571.4	846.6
1.44	561.7	832.5
1.48	552.4	818.8
1.52	543.2	805.4
1.56	534.3	792.4
1.6	525.6	779.7
1.64	517.1	767.3
1.68	508.9	755.1
1.72	500.8	743.3
1.76	493.0	731.8
1.8	485.3	720.5
1.84	477.8	709.5
1.88	470.5	698.8
1.92	463.4	688.3
1.96	456.5	678.1
2	449.7	668.1
2.02	439.5	653.6
2.04	429.5	639.3
2.06	419.7	625.4
2.08	410.1	611.7
2.1	400.8	598.3
2.12	391.7	585.1
2.14	382.8	572.2
2.16	374.0	559.6

NOTE: Limits for "general use" coatings is 571 g/L solids, t1 +t2 = 2.14 hours
Limits for "antifoulant" coatings is 765 g/L solids, t1 +t2 = 1.65 hours

Required time for CAPE+RTO System is 2 hours. No extra operating hours are required as shown in Table 1.1.

Table 3.3 below provides some interesting results calculated by our model: The wet film thickness (Ds in Table 3.3) based on total coating sprayed in the enclosure, is equal to $4.24 * 10^{-4}$ meters. When we correct this value for 30-percent overspray, we get the practical or actual WFT, which is equal to $2.48 * 10^{-4}$ meters (~ 10 mil). The Vst in Table 3.3 is the rate of surface (m^2)

coverage and Cw is the VOC content per cubic meter of coating multiplied by (1 minus percent overspray). The product Vst, Ds, and Cw is the effective VOC application (spray) rate--grams of VOC per hour that land on the hull per hour.

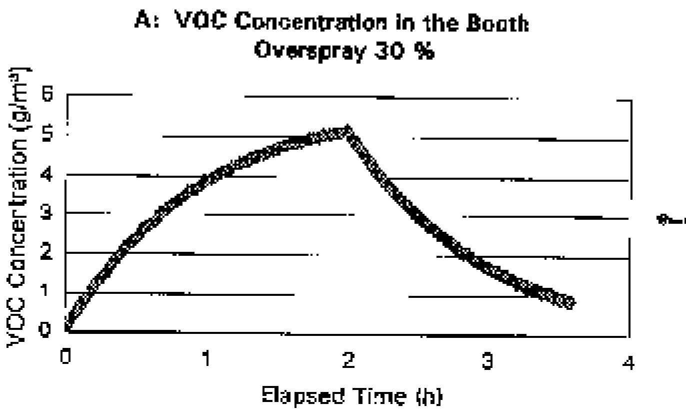
Table 3.3 Output Parameters from Model 2 (Reference 3) (input conditions in Table 3.1)

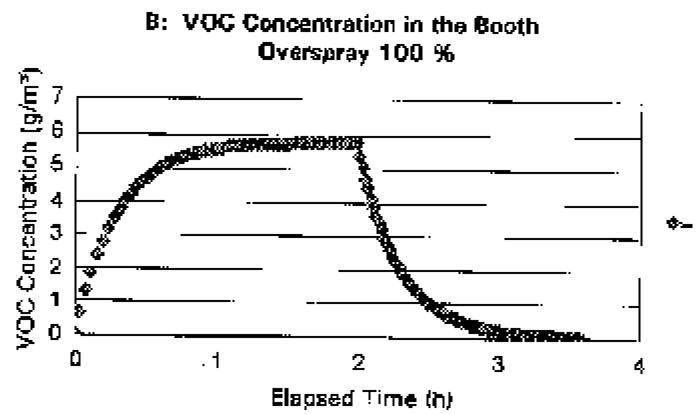
Effective paint spray rate	179 L/h (excluding overspray)		
Effective VOC spray rate	87006 g/h		
Paint overspray rate	76.8 L/h	N =	3.36 (air exchange rate, 1/h)
VOC overspray rate	44.3904 L/h	k =	1.151 (1st-order decay rate const., 1/h)
VOC overspray rate	37289 g/h		
No. of data points (1)	50.00	k1	0.00049 (1st-order constant, m/h)
Time interval (1)	0.04 h	k2	3.36 (air exchange rate, 1/h)
No. of data points (2)	100	Ds	4.24E-004 (film thickness, m)
Time interval (2)	0.02	Vst	604 (application rate, m^2/h)
		Cw	339864 (VOC conc. in coating, g/m^3)
Calculation of wet film thickness		B	2.21
paint volume	512 L	Vst Ds Cw	87005.18
paint volume	0.4238 L/m^2		
paint volume	4.24E-004 m^3/m^2		

3.4 Effect of Assuming that the Volatiles Flash-Off Instantaneously

If we assumed that all the volatiles/VOCs are flashed off instantaneously at application, they would evolve at a higher rate, and we would predict a shorter time to reach the maximum concentration than would occur in an actual coating cycle. To illustrate the point, compare the two curves shown in Figures 3.1 and 3.2, which we produced using our model (Model 2) [3]. The first curve (30 percent overspray) in each figure shows the time it takes for the concentration to peak inside the CAPE, assuming 30 percent of all volatiles evaporate instantaneously (flash-off) while the coating is being applied. The second curve shows the time to peak concentration assuming volatiles evaporate instantaneously. The first curve better represents an actual situation. When the overspray is assumed to be 100 percent we can simulate the situation where all solvent flashes off at application.

Figure 3.1 Effect of Percent Evaporation on Volatile Emissions Profile (input parameters are defined in Table 3.1, Temperature – 32 °C or 90 °F)





We compare in Table 3.4 the values of VOC in the enclosure at two critical RTO operating times: 1.7 hours and 2.3 hours, respectively, for antifoulant and general use coatings. We have also included in Table 3.4 the values of the VOC concentration in the enclosure .

Table 3.4 Mass of VOC Remaining In Enclosure (Model 2: input conditions in Table 3.1)

Critical RTO Operating Time (hours)	Mass of VOC Remaining in Enclosure (VOC Concentration in Enclosure Air)		Comments
	30 % overspray	100 % overspray	
1.7 hr (antifoulant coating)	96, 310 g (4.9 g/m^3)	17,4311 g (5.8 g/m^3)	1. The mass of VOC remaining when we assume 100 % flash-off is underestimated by a factor of more than 5.
2.3 hr (general use coating)	72,356 g (3.8 g/m^3)	13,511 g (2.1 g/m^3)	2. The mass of VOC in the enclosure is not directly related to concentration in the enclosure atmosphere. The VOC content on the painted surface changes with overspray level.

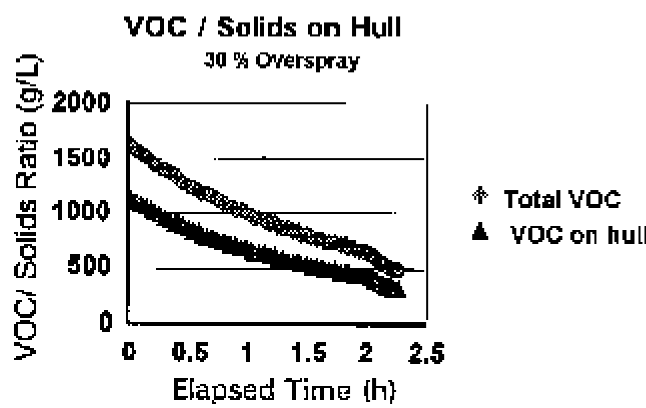
Model 2 calculates the concentration build-up of volatile material by taking into account the emission change as painting progresses per unit area of substrate. We assume the coating applies to the surface at a constant rate. One can visualize that our model divides the application area into many squares which begin to emit solvent as they are being covered with paint according to an infinitesimal or "microscopic" emission rate. The model then combines the effects on these squares to produce a "macroscopic" emission rate. This approach explains why our model above shows the build-up of volatile (VOC or VOHAP) material inside the CAPE taking a longer time to reach the peak concentration value: it adds the emissions from layers of drying coating to those from the newly applied coating. (The decay curves are similar for both models.) Of course, we are assuming that the room air in the enclosure does not cause feedback or back-pressure effect that would lower the microscopic emission rate as the concentration increases in the enclosure. In reality, such back-pressure effects may occur. Both Model 1 and Model 2 base their calculations on a coating that will dry to touch in 2 hours near around 32°C (90°F) and at that point it will still retain10-percent by mass volatiles. However, only Model (2) enables us to readily investigate the effect of ambient temperature and other parameters on the rate of evolution of volatiles in a coating in their 1996 Emission Test (performance test) shown in Figure 2.1. The effect of temperature is reflected in the value of k1, the first-order decay constant, 1/h. In our model we define k1 in terms of time-to-dry (t_d) in hours [3]:

$$k1 = -\ln(0.1)/t_d \qquad \text{(Equation 3.2)}$$

3.5 General Discussion

The model we used (Model 2) to predict the rate of emissions of volatiles from the application of coatings predicts the volatiles profile for Intergard Epoxy Red that matches reasonably well the emission data MMC recorded during their 1996 Performance Test. This provides a level of validation of our model. The experimental curve based on MMC's data is shown as the first curve on the left in Figure 2.1 and the predicted curve is shown in Figure 3.1(A). Model 2 is useful as it makes it possible for us to predict the effect of operating variables such as temperature and amount of coating sprayed on the VOC remaining inside the enclosure or on the painted surface. Figure 3.2 provides a time profile for the VOC on the coated surface (lower curve) and total VOC inside the enclosure (top curve). Total VOC includes the amount on the hull surface plus what is the enclosure air.

Figure 3.2 Effect of Percent Evaporation on Volatile Emissions/Solids on Hull Profile (input parameters are defined in Table 3.1, Temperature ~ 32 °C or 90 °F)



Lastly, most of our discussion dealt with conditions similar to the MMC's test conditions (Table 3.1) for Intergard Red Epoxy, shown as the first curve in Figure 2.1. However when we apply (spray) a coating at colder temperatures the drying time in Table 3.1 will need to be increased. This means that an operator will need to operate the RTO for a longer time to meet the standard as we indicated in Chapter 1. The total amount of coating applied in a coating cycle will also influence the amount of VOC remaining in the enclosure. In its application MMC had based its calculation on what they referred to as pertinent worst case data; maximum application rate of 72, 640 g/hr (60 lb/hr), Appendix A, Exhibit 3.6. This application rate is lower than in the simulation which used some of the actual data provided by MMC. We obtained a value 90, 218 g/h when we increased the value of the application period to 2.75 hrs, the value they asked us to use.

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1. H. Zeh, K. Kohljammer, and M. Krell; VOC-emission from Latex Paints and Plasters During Application, *Surface Coatings International*, Vol 4, 1994 pp142-151.

2. Z.W. Wicks, F.N. Jones, and S.P. Pappas; Film Formation, In *Organic Coatings: Science and Technology; (Vol. 1: Film Formation, Components, and Appearance)*; John Wiley and Sons, Inc., New York, 1992 pp 35-48.

3. The spreadsheet was developed for this project by Dr. Z. Guo, U.S. EPA/NRMRL/APPED/IEMB (MD-54), Research Triangle Park, NC 27711. The last version (September 22, 1998) was used.

4. W.C. Evans, Development of continuous-application source terms and analytical solutions for one- and two-compartment systems, In *Characterizing Sources of Indoor Pollution and Related Sink Effects*, ASTM STP 1287, Bruce A. Tichenor, Ed., American Society for Testing and Materials, pp. 279-293.

5. Communication from J. Berry, Environmental, to M. Serageldin, EPA/ESD, October 23, 1998, in response to questions regarding CAPE+RTO System, Fax from EPA dated October 19, 1998. This document will be added to Docket A-92-11.

Chapter 4

Background Information

4.1 Chronology of Events Leading to Approval

The shipbuilding and ship repair NESHAP (40 CFR 63, Subpart II) was promulgated on December 15, 1995 (60 FR 64330) and existing sources are required to be in compliance by December 16, 1997 (61 FR 30814). The NESHAP requires either use of coatings which do not exceed specified volatile organic HAP (VOHAP) limits, or use of an alternative means of reducing emissions. Any alternative means must be approved by the Administrator and approval is to be based on criteria listed in Section 63.783(c) of the NESHAP and any applicable requirement specified in Table 1 of Subpart II.

On June 12, 1996, MMC submitted to EPA Region III an Application for Approval to use an emission capture and destruction system in lieu of using compliant coatings to meet the requirements of the NESHAP. The 1996 Application for Approval, dated June 12, 1996, was first amended in October 1996 [1]. The submittal included an Implementation Plan dated November 1, 1996 [2] and an emission test performed in Summer 1996 [3]. A consultant was contracted by MMC in April 1997 to help bring the Application for Approval in line with the standard. Since April 1997, EPA has reviewed several corrected pages submitted by the consultant. An initial approval plan was defined requiring a performance test at every site the Compliant All Position Enclosure (CAPE) plus air management system and the Regenerative Thermal Oxidizer (RTO) unit operations (CAPE+RTO System) were to be used. MMC requested in March 1998 that it be granted a waiver from having to do a performance test at every site considering the cost burden. The elements for such an approach were worked out between MMC and EPA for several months. During that time MMC requested to revise the operating parameters in its original submittal, which was based on the 1996 Emission Test (performance test) results. The parameters changed included the flow to the thermal oxidizer and the minimum vacuum to be maintained in the enclosure. Consequently, MMC will not be required to meet the exact conditions of the 1996 Emission Test.

4.2 How the CAPE System and Thermal Oxidizer (CAPE+RTO System) Operate [2]

The control system consists of two unit operations: an enclosure (CAPE) unit with the air-management system (CAPE) and a regenerative thermal oxidizer (RTO). The CAPE capture unit consists of several modular sections (tower assemblies) linked to make up the enclosure which

[2] The documents Metro Machine Corporation (MMC) submitted contain the information.

conforms to sections of a ship's hull (Appendix, Exhibit 4.1) [3]. In its demonstration test, MMC used 15 tower assemblies to form a hull enclosure (CAPE) around the bow of the ship in Norfolk, Virginia, encompassing a volume of 6,372 m^3 (225,000 ft3). They need four set-ups to complete a ship of the size used in their demonstration test in 1996 on a military ship, dry-docked in MMC's shipyard location in Virginia. Workers must assemble and disassemble a CAPE (enclosure) several times before the hull area of a ship is painted or before transporting it to a new location (Figure 2.1).

The following description comes from MMC's 1996 Application for Approval and other material they have submitted [1-4]. The description helps explain some of the operating variables we have required MMC to monitor and record.

MMC's 1996 Application explains that a barge floating next to the ship that will be worked on, contains the incinerator and the air management system used to clean and circulate the air to the enclosure (Appendix A, Exhibit 4.1). The barge provides mobility to on-site locations and flexibility to adapt to various types and sizes of drydocks. It contains equipment to circulate, filter, dehumidify, and heat the air. Before MMC starts a coating operation (one or more coating cycles), it starts two blowers on the barge, combined they draw from the CAPE enclosure 1700 m^3/min (60, 000 ft^3/min) of air. The air passes through a dust collector that can filter out particles nearly 0.5 microns in size. From here 1400 m^3/min (49,000 ft^3/min) recirculate back to the CAPE enclosure, whereas the remainder of the air flow vents into the atmosphere at 312 m^3/min (11,000 ft^3/min). A volume of fresh air equal to the vented air leaks through the cracks between the enclosure and the hull or cracks between the modular sections (Figure 2.3 and Appendix, Exhibit 4.1).

During application of coatings and curing, the vented air laden with VOHAP material passes through the RTO. During the coating operation, the vented air is directed through the oxidizer and heats to 788°C (1450°F). A volume of fresh air equal to the air directed to the RTO leaks through the cracks between the enclosure and the hull, assuming the enclosure has no significant tears. The example discussed here represents a possible operating condition. The actual operating conditions used during the 1996 Emission Test are summarized in the Appendix, Exhibit 4.2 (Table 2.3 in Ref. 3.) The RTO destruction efficiency under the operating condition in the 1996 test was around 98 percent, when the pollution concentration was greater than 100 ppmv (measured as propane). The air in the CAPE (enclosure) recycles about four times in an hour (volume of air circulated through CAPE/volume of CAPE). The air turnover will be more frequent in smaller enclosures, if the volume of circulated air remains around 1700 m^3/min (the level during the 1996 Emission Test). This value is unlikely to change significantly unless MMC uses blowers having a capacity/rating or a CAPE volume with a very different volume.

MMC controls the modular enclosure's temperature and humidity by monitoring and regulating the conditions of the supply and return air stream from the equipment on the barge. During hot weather, the "Kathabar" dehumidifier controls humidity and helps lower the temperature. During cold weather, a hot water heater raises the air stream's temperature. Because the air supply is on a floating barge, MMC will use special ducts to compensate for tidal and wave motions. For example, slip joints and gimbals will keep ducts connecting the equipment barge and a floating or dry dock from breaking when the barge moves.

4.3 Benefits of Using the CAPE

No one tested this technology as a unit until 1996, so we did not recommend this technology as an option to control emissions of particulates and VOHAP or VOC materials while applying coatings when we developed the regulation on shipbuilding and ship repair or the document that discussed Alternative Control Techniques (EPA 453/R-94-03).

We see three main benefits. Using the CAPE+RTO System can:

- Reduce VOC and VOHAP materials resulting while applying coatings.
- Reduce particulate matter resulting from metal cleaning to remove old coatings from ship hulls.
- Provides a sheltered environment in which MMC can independently control temperature and humidity.

4.4 Design Features

An enclosure design determines the ventilation rate which in turn establishes the size of the heating, cooling, and other equipment, as well as the enclosure's operating cost usually expressed as dollars per volume of ventilation air [5].

An enclosure must contain the largest work piece and provide work space for the workers. (That explains the CAPE size.) A recirculation design requires the quantity of incoming fresh air and exhausted air to be the same. The fresh air must dilute the air in the enclosure below the 25 percent of lower explosion limit (LEL). National Fire Protection Association 33 requires this level to avoid explosions. The amount of coating applied during a coating period (one or more coating cycles) determines the rate of air removal and thus the enclosure's size [5].

In the 1996 Application [2] MMC said that they would limit the rate of coating application to 72,640 g/hr (160 lb/hr), so they would need to remove 312 m^3/min (11, 000 ft^3/min) of polluted air from the CAPE and direct it to the RTO to destroy the pollutants. The rate of air removed from the CAPE defines the rate of fresh air that infiltrates the CAPE through cracks and other such openings.

(When MMC applies a coating it reduces the air infiltration because of the emissions generated during the coating cycle.)

We have agreed not to hold MMC to their intended rate, however, because they subsequently asked to vary the exhaust flow from the CAPE between 284 to 397 standard m^3/min (10,000 to 14,000 standard ft^3/min). These values bracket the average actual flow rates used in the 1996 Emission Test (Appendix, Exhibit 4.2). We will require the facility to follow the equipment manufacturer's recommendations for the air flow to the RTO and for operations of the RTO.

4.5 Construction Features (observations during EPA's August 1998 site visit)

We could not see the gaps between each of the towers and between the ship's hull and the enclosure.

We had to open a large door at the CAPE's entrance to enter it. The exit was a flap at the other end of the CAPE. They marked it "emergency exit only" and they kept it closed. During the 1996 Performance Test the exit was another door they kept closed (Appendix, Exhibit 2.1).

4.6 Start-up Features

The Regenerative Thermal Oxidizer, or RTO, is an add-on control device manufactured by Durr. It has three towers and a "Programmable Logic Controller" (controller) that operates the system. The operator simply pushes the appropriate button to start it or shut it down.

The controller checks the RTO's operating requirements and verifies that all damper valves operate from fully-open to fully-closed. The controller also bars process air from entering until the combustion chamber achieves the set point temperature and lights the burner.

The RTO has a diagnostic program that can detect and display failures of the control system and failures of field equipment. The controller detects these failures and causes an alarm to sound and a rotating beacon to flash. The alarm continues until an operator pushes a "silence alarm" button. The beacon stays lit until the fault is corrected.

MMC is likely to move the CAPE+RTO System from one dock to another. After moving it to a new dry dock but before delivering process air to the RTO an operator must:

(a) Check for damage;
(b) Ensure that all piping, electrical, and duct connections have been properly assembled; and
(c) Maintain the minimum required vacuum.

4.7 Operational Aspects

Spray blasting (hull cleaning) and applying a coating can damage the flexible elements on the CAPE's curtains or towers, but following proper operational procedures should minimize such occurrences.

Moving the paint-mix containers inside the CAPE before applying a coating reduces the need to open the door during a coating cycle. With proper planning workers would only need to open it briefly while entering and exiting the CAPE.

Opening a door may drop the vacuum inside the CAPE below the minimum EPA Method 204 requires [6]. But MMC can make sure that doors to an enclosure stay closed while applying coatings.

For example, some spray booths have on the doors of the coating enclosure instruments that record the number of times the doors opened and how long a door is kept open. In other facilities alarms indicate when a door is open or when the vacuum inside the enclosure does not meet the minimum. MMC can use these options if necessary, but we will not require them.

After the RTO is fully operational and VOC or VOHAP-laden air is feeding into it, someone must verify that it is operating properly including burner's fuel-to-air ratio. Here is the procedure:

(a) Calibrate a portable, hand held, flame ionization detector using a gas standard with 0, 250, and 500 ppmv of propane.

(b) Use the detector to measure the VOC or VOHAP concentration at the outlet.

(c) Check to see that the outlet concentration is 30 ppmv (as propane), or more above background (5-20 ppmv).

(d) If the concentration is too high and there is no readily assignable cause, call a manufacturer's representative to correct the problem and restore the RTO's efficiency.

The RTO has a continuous recording device that monitors temperature in the combustion chamber to keep it near 788°C (1450°F)--the temperature at which it passed its last performance test. If the combustion temperature drops below 760°C (1400°F), the controller sounds a klaxon, triggers a flashing strobe light, and diverts air from the CAPE directly to the atmosphere. In this case, someone will tell painters within the CAPE to stop operations. MMC will keep a copy of this written procedure on file.

The RTO can foul its ceramic heat-transfer beds if material coming to it does not burn up, builds up on the beds, and causes the pressure drop across the bed to increase. If the operator lets the pressure drop to rise, it may choke the air flow and cause equipment problems upstream. Therefore, the operating procedures must address this issue, typically based on advice from the manufacturer who custom designed the RTO.

REFERENCES

1. *Application for Approval of Alternative Methodology for Compliance with The NESHAP for Shipbuilding and Ship Repair*; submitted by Metro Machine Corporation, Norfolk, VA, June 12, 1996 (Revised October 31, 1996); prepared with Pacific Environmental Services, Inc., Herndon, VA.

2. *Implementation Plan for Compliance with the NESHAP for Shipbuilding and Ship Repair Metro machine Corporation*; prepared by Eric Lasalle, November 1, 1996; Metro Machine Corporation, Norfolk, VA.

3. *Air Emission Evaluation Total Gaseous Organic Compounds and Filterable Particulate Emissions Compliant All Position Enclosure (CAPE) System USS SCOTT DDG-995 Metro Machine Corporation*; prepared by Pacific Environmental Services, Inc., Herndon, VA, September 1996 for Metro Machine Corporation, Norfolk, VA.

4. Clyde Smith, *Mobile Zone Designs for Ultra-Efficient Surface Coating Operations*, Technical Paper, Revised 11/89. Paper presented at the Air Pollution Control Association 1988 Congress and the 1988 Aerospace Symposium sponsored by EPA Region IX.

5. *Preparation, Adoption, and Submittal of State Implementation Plans; Appendix M, Test Methods, 204 A-204 F*; 62 FR 32500 (Monday, June 16, 1997).

Appendix

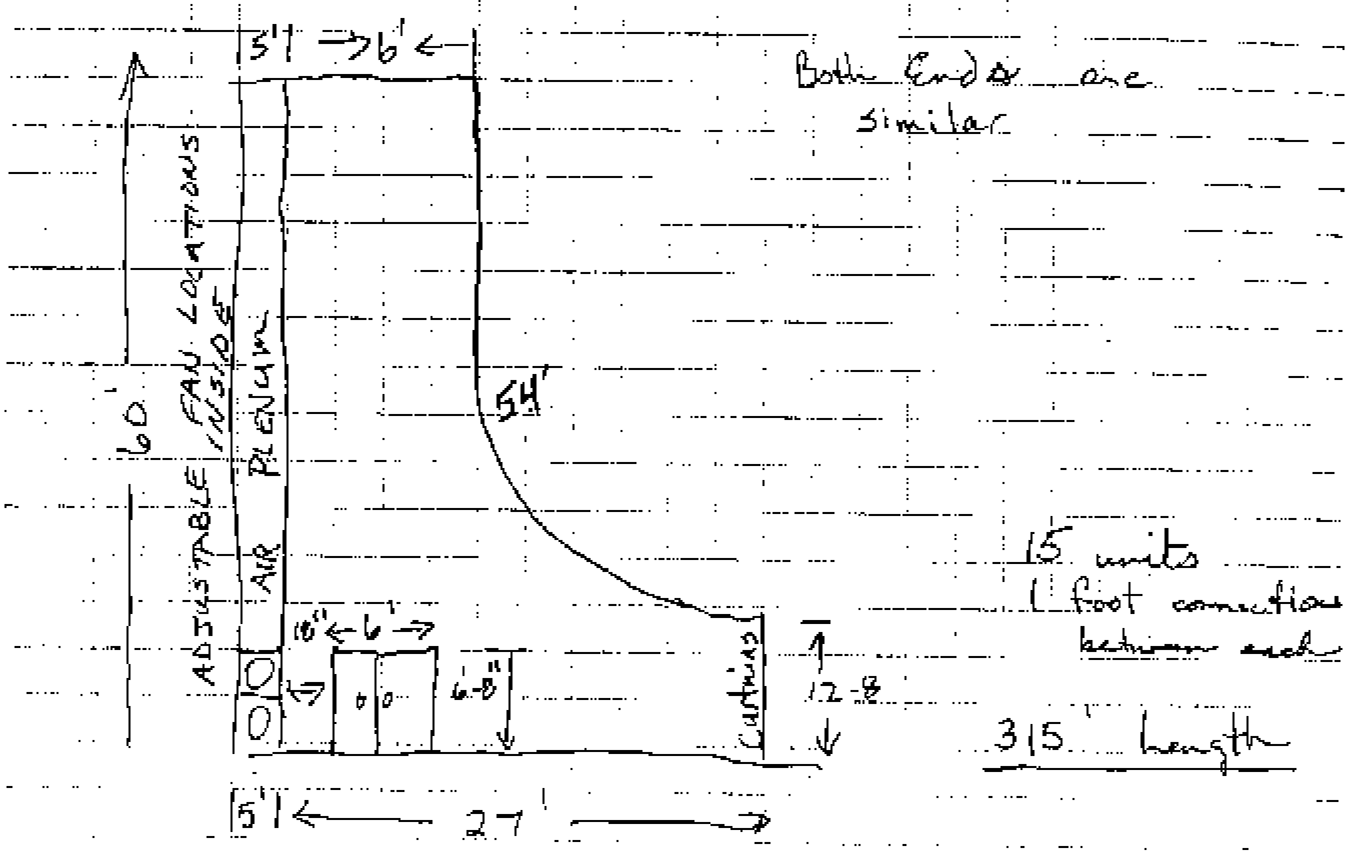
Exhibits

Exhibit 2.1 CAPE side view showing one door no other openings (MMC's 1996 Emission Test)

PACIFIC ENVIRONMENTAL SERVICES, INC.

Project No. 5187.001	Page 1 of 2
Client: METRO MACHINE CORP.	
Location: Norfolk, VA - DRYDOCK	

Prepared By	Date	Checked By	Date	Sheet Title
P. Siegel	8-24			CAPE - USS Scott - Port SIDE



ΔP locations ~60 feet from (+) return air side
30 feet high
6 feet from outer wall

Curtains are rolled & clipped at the ends with alligator clips. These curtains are inspected every hour.

Exhibit 2.2 Dimensions of the CAPE sections (MMC's 1996 Emission Test)

PACIFIC ENVIRONMENTAL SERVICES, INC.

Client				
Metro Machine Corporation				
Location: Compliant All Positions Enclosure				
Prepared By	Date	Checked By	Date	Sheet Title
P. Siegel				Natural Draft Openings (NDOs)

Purpose:

To determine if the enclosure meets Criteria C specified in EPA Method 204; "The total area of all NDO's shall not exceed five percent of the surface area of the enclosures four walls, floor, and ceiling.

Enclosure Surface Areas:

Floor 315 × 32 = 10,080 ft²

Outer Wall 315 × 60 = 18,900

Ceiling 315 × 11 = 3,465

Hull 315 × 51 = 16,065

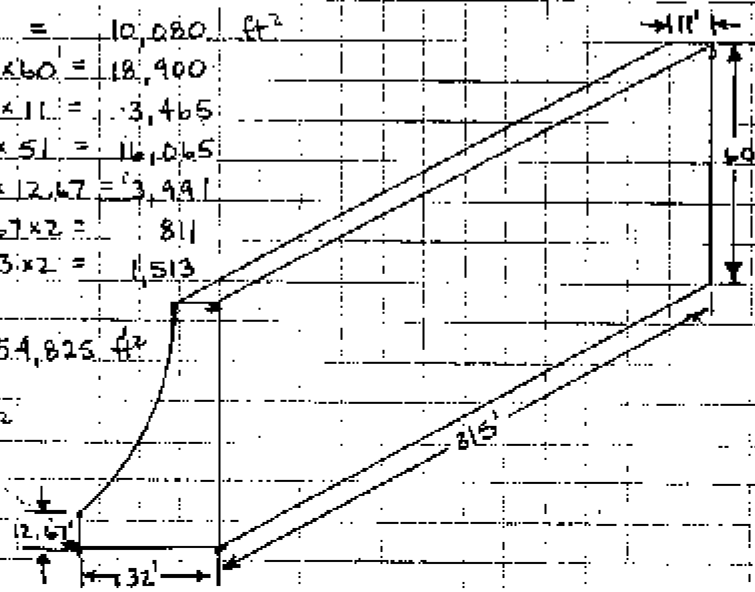
Inner Wall 315 × 12.67 = 3,991

Ends: 32 × 12.67 × 2 = 811

½ × 32 × 47.3 × 2 = 1,513

Total Area = 54,825 ft²

5% = 2,741 ft²



For Calculation Purposes Only:

Natural Draft Openings (NDOs) of 1 inch at every seam:

1/12 × 32 × 2 = 5.3 ft²

1/12' × 12.67' × 16 = 16.9

1/12' × 11' × 16 = 14.7

1/12' × 60' × 16 = 80.0

1/12' × 315' × 5 = 131.3

1/12' × 51' × 2 = 8.5

Total = 257 ft² < 2,741 ft²

**Exhibit 2.3 Static pressure sampling locations
(Fig. 3.3 in MMC's 1996 Emission Test)**

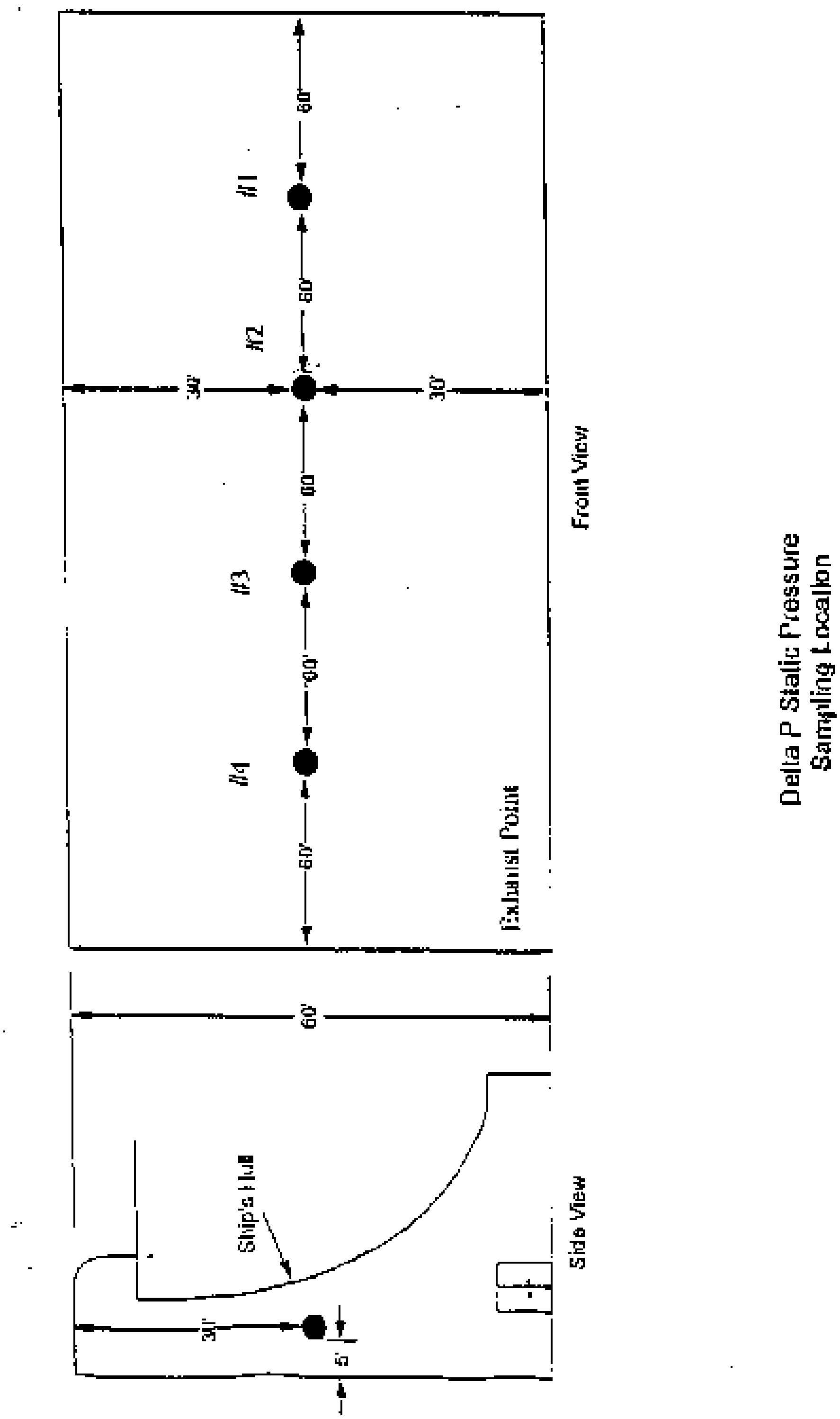


Exhibit 2.4 Proposed monitoring protocol (MMC's 1996 Application for Approval)

PROPOSED MONITORING PROTOCOL

MMC proposes to do the following to demonstrate compliance with the NESHAP using the CAPE® system.

1. Conduct a performance test to determine capture and destruction efficiencies of the proposed CAPE system. A performance test protocol is given in Attachment I. The capture verification will demonstrate 100 percent capture and the VOC destruction efficiency test will show a minimum of 95 percent destruction.

2. Using the material balance approach described earlier and an overall control efficiency of 95 percent, calculate the emission rate in grams of VOC per liter of solids for each application and compare with the standard for each category of coating used.

3. Maintain and monitor the RTO chamber temperature at or above the temperature required for 95 percent destruction efficiency. The desired minimum temperature will be established in consultation with the oxidizer manufacturer.

4. Ensure that all doors and windows to the enclosure are always kept closed to capture VOC emissions.

5. Perform periodic checks for any tears in the CAPE enclosure and repair as soon as possible.

6. Ensure that the RTO is on and operating properly for a period of time commensurate with the type of coating being used.

RECORDKEEPING AND REPORTING

To determine and demonstrate compliance with the NESHAP, MMC will keep records of usage of all coatings, thinners, reactors and solvents for each application. For each application of non-compliant coating, the beginning and ending time of the coating application and the RTO operation will be recorded. These records will be used to compile a monthly compliance record. The compliance record will show the type of coatings used for each application during the month, the duration of each application and the number of hours of operation of the RTO for each application. The records of monthly compliance determination will be retained for a period of five years and made available to the regulatory agencies upon request.

Exhibit 2.5 Example of protective coating quality assurance record for critical coated areas, Sheet 3 (MMC's 1996 Emission Test)

Sheet 3

Metro Machine Corp.
Protective Coatings Quality Assurance Record
For Critical Coated Areas

Location: U/W Hull Seachest Port Fr100-415

☐ Pre-Coat (Stripe) ☐ Disturbed Areas / Touch-Up Application Method / Equipment: 45:1 Airless

Start date / Time: 8/20/96 1815 Finish Date / Time: 8-20-96 9:00 P.M. Time Between Coats Of Paint: N/A

V Coating Application Coat # 1ST CT

Ambient Condition		Date / Time 8/20/96 1815	Date / Time 8/20/96 8:00	Date / Time 8-20-96 10:00 P.M.	Date / Time 8-21-96 12:15	Date / Time 8-21-96 7:00 A.M.	Date / Time 8-21-96 4:00 A.M.
Dry Bulb	°F	93°	85°F	84°F	82°F	82°F	83°F
Wet Bulb	°F	75°	70°F	67°F	67°F	67°F	66°F
Relative Humidity	%	42%	46%	40%	49%	49%	41%
Surface Temperature	°F	92°	82°F	80°F	78°F	78°F	78°F
Dew Point	°F	67°	62°F	57°F	58°F	59°F	57°F

VI Instrument Data

	Manufacturer	Serial #	Cal. Date	Due Date
Psychrometer	Bacharach	K27858	11-11-95	11-11-96
Surface Temp. Gage	PTC	14715-1	11-14-95	11-14-96
DFT. Gage	Elcometer	02304 01833	6-7-96 4-4-96	6-7-97 4-4-97
Profile Gage	Tester	92680	5-2-96	5-2-97

VII Coating Inspection Coat # 1ST CT

		Sat	Unsat
(1) Cleanliness		✓	
(2) Visual Appearance / Workmanship		✓	
(3) Holidays		✓	
(4) Correction Of Defects		✓	
(5) WFT	Required 3-7.5 Actual 5+	✓	
(6) DFT	Required 4-6 mils Actual 6.4 mils	✓ *	
(7) Total Average DFT	Required 4-6 mils Actual 6.4 mils	✓ *	
(8) Drying And Curing Times Prior To Service		✓	

* Notes:

1. Std Item 009-32 environmental readings to be taken at a minimum of every 2 Hrs.
2. Painting on surface temperature below 35°F or above 95°F requires the specific approval of the Supervisor.
3. Ambient and surface temperature must be at least 5°F above dew point.
4. Relative humidity must not exceed 85%.

*SAT LOW MILS IN ONE SEA CHEST. BUILT UP SECOND COAT.

Remarks / Comments:

Inspector Signature [signature] Date 8-21-96

Exhibit 2.6 Example of enclosure log
(MMC's 1996 Emission Test)

Enclosure Log

Date 8/20/96
Time 1950

Manometer Readings (Base)	.02	.02	.02	.01
Manometer Readings (Top)				
Dry Bulb Temp (Outside)	71			
Wet Bulb Temp (Outside)	70			
Dry Bulb Temp (Inside-Near middle of enclosure)	N/A			
Wet Bulb Temp (Inside-Near middle of enclosure)	N/A			
Estimate of % of enclosure at Negative Pressure	100			
Are inflatable seals properly sealing?	(yes) no			
Non inflated seals				
Are there leaks/perforations in the containment top?	yes (no)	NO SMELL OF VOC TOP		
Is there a buildup of water on the ship's deck?	yes (no)			
Is the blast/paint foreman aware of any problems with the CAPE Towers?	yes no			
Are all of the towers functioning properly?	(yes) no			
Is each manlift functioning properly?	yes (no)	PRIME REPAIR CALL		
Is water leaking from the ship?	yes (no)			
Is there evidence of water leaking into the enclosure?	yes (no)			
Is there evidence of water on the dock floor?	yes (no)			

C:\OPERATE\LOGS\ENCLOSURE.DOC
RCG
08/16/96 10:40 AM

Exhibit 2.7 Fax letter dated October 10, 1998 from Berry Environmental to U.S. EPA/OAQPS, in response to questions from EPA (2 pages)

BERRY ENVIRONMENTAL

P.O. Box 20634
Raleigh, N.C. 27619
Phone/Fax 919 785 9631

Dr. Mohamed Serageldin
Emission Standards Division, MD 13
Office of Air Quality Planning and Standards
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

Fax: 541 5689

Dear Mohamed

This is in response to the questions that you asked in your Fax of October 19th regarding the statistics of the first "paint cycle" on October 20th, 1996 during the Performance Test of the CAPE System. Based on a discussion Jim McMichael of Metro Machine, some of the values should be changed.

1. Amount of Paint Applied: 135 gallons

Reference: The third page (with "Sheet 2" in upper right corner) of the several Operator log-sheets titled "Protective Coatings Quality Assurance Record for Critical Coated Areas" located in Appendix D of the Test Report. Notice on the log sheet that the mixing ratio is 4:1 with a maximum thinning of 5%. I am told that it is unusual for the coating to require thinning so we cannot be certain that any was added.

The reference that I believe you used, a computer-generated log-sheet located much later in Appendix D, is confusing to me. Since it: 1) appears to have been created by PES as part of the Performance Test data and 2) does not reflect the appropriate 4:1 mixing ratio, we think it is an inferior reference.

1A. Time and length of paint cycle: 2 hours and 45 minutes, from 1815 hours to 2100 hours

Reference: The fifth page (with "Sheet 3" in upper right corner) of the several pages referenced in item 1. above. That page is improperly dated at the bottom of the page (8-22-96) but properly dated at the top where the start and stop dates and times are entered.)

Note that the starting date of 1815 hours is at least 15 minutes earlier than the first inlet concentration data that is recorded on the first page of Appendix B-2 (EPA Method 25A Data).

2. Booth volume: Approximately 225,000 cubic feet or 6,371 cubic meters

Reference: Letter[1] dated July 26, 1996 from Charles Garland, Vice President of Metro Machine to James Cashel. As you know, the ship's hull, which constitutes one wall of the enclosure, is of complex curvature, so the calculation is an estimate of the actual volume. Using the conversion factor of 0.0281[2] cubic meters per cubic foot, that calculates to a volume of 6,371 cubic meters.

3. Actual flow rate to the RTO: About 12,595 cubic feet per minute or 21,420 cubic meters per hour.

Reference: Calculated as the average of the first two entries of Table 2.3 on page 2-5 of the Performance Test Report. Page 2-4 of the Test Report notes the average flow rate during the test was

[1] This letter provides another interesting statistic, noting that a typical hull will require 1,500 gallons of paint compared to less than 200 for the superstructure area. Clearly the CAPE System will dramatically reduce the total emissions from ship repainting operations.

[2] Actually, 0.028316847 according to the "Environmental Pocket Reference" by Mostardi-Platt Associates.

Exhibit 2.7 (Page 2/2)

12,755 cubic feet per minute or 21,660 cubic meters per hour. The maximum flow rate during the performance test was 13,278[3] cubic feet per minute (22,560 cubic meters per hour).

Mohamed, based on this data, (which I had previously overlooked), please change Section C(3) of your final report. Under the part titled "Flow through the RTO", please change the "Indicator Range" so that the upper limit is 14,000 cfm (ten percent greater than the average flow during the performance test). The lower limit should remain at 9,000 cfm.

4. **Spraying Rate:** 49.1 gallons or 185.81[4] liters per hour.
   Reference: See items 1 and 1A above.

5. **Surface area coated:** Approximately 13,000 square feet or 1,208[5] square meters.
   Reference: See upper right corner of references for items 1. and 1A. above. This first paint cycle is applied to a hull that has just been grit blasted. Because the entire hull uses a common prime coat, during the first paint cycle, paint is applied to the entire portion of the hull within the CAPE. This is indicated by the note in the Remarks section of the reference for item 1A which states that the 135 gallons were used to paint the "sides, underwater hull and seachest."

Mohamed, I hope this information is helpful to you.

Best Wishes

Jim

Jim

cc: Rick Colyer

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[3] As you know, the RTO has a design flow of 11,000 cfm. This test demonstrated the excellent "turndown" (or "turnup"?) ratio flexibility of this RTO design. Its efficiency averaged 99 percent even with when the inlet flow averaged 16 percent above design (which, of course, decreased residence time in the combustion chamber a like amount).

[4] A conversion factor of 3.785 liters per gallon was used.

[5] A conversion factor of 0.0929 was used.

Exhibit 2.8 Calculation of required control efficiency (Table 5 of MMC's 1996 Application for Approval)

TABLE 5

CALCULATIONS FOR REQUIRED CONTROL EFFICIENCY TO DEMONSTRATE COMPLIANCE WITH THE NESHAP

No.	Item												
1	Coating Type	ANTIFOULANT						GENERAL USE MILITARY EXTERIOR & INORGANIC ZINC					
2	Solids Content by volume (%)	20	30	40	50	60	80	20	30	40	50	60	80
3	VOC content by volume of coating as applied (%)	80	70	60	50	40	20	80	70	60	50	40	20
4	VOHAP$_s$ = VOC content of coating as applied [lb/gal (g/L)]	5.6 (672)	4.9 (588)	4.2 (504)	3.5 (420)	2.8 (336)	1.4 (168)	5.6 (672)	4.9 (588)	4.2 (504)	3.5 (420)	2.8 (336)	1.4 (168)
5	VS$_s$ = Volume ratio of solids to applied coating	0.20	0.30	0.40	0.50	0.60	0.80	0.20	0.30	0.40	0.50	0.60	0.80
6	VOHAP$_s$/VS$_s$ & unit (lb/gal solids) (g/L solids)	6.38 (765)	6.38 (765)	6.38 (765)	6.38 (765)	6.38 (765)	6.38 (765)	4.72 (571)	4.72 (571)	4.72 (571)	4.72 (571)	4.72 (571)	4.72 (571)
7	VOHAP$_s$/VS$_s$ (lb/gal) (g/L)	28.0 (3360)	16.33 (1960)	10.5 (1260)	7.0 (840)	4.7 (564)	1.8 (216)	28.0 (3360)	16.33 (1960)	10.5 (1260)	7.0 (840)	4.7 (564)	1.8 (216)
8	OCE = Overall Control Efficiency Required (%)	77.2	60.9	39.2	8.9	0.0	0.0	83.1	71.1	55.1	32.6	0.0	0.0
9	CAPE[a] Overall Control Efficiency (%)	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0

Minimum reduction required on a solids basis

Exhibit 2.9 Number of RTO hours for compliance with the NESHAP (Table 2 of MMC's 1996 Application for Approval)

TABLE 2

NUMBER OF RTO HOURS REQUIRED FOR COMPLIANCE

TYPE OF COATING (STANDARD)	SOLIDS CONTENT OF COATING AS APPLIED (% volume)	HOURS OF RTO OPERATION FOR COMPLIANCE[6]			
		2 Hours	4 Hours	6 Hours	8 Hours
ANTIFOULANT [6.38 lb VOHAP/gal (765 g VOHAP/L)solids]	20	4	5	7	8
	30	3	4	6	7
	40	2	3	4	5
	50	1	2	2	2
	60	0	0	0	0
	80	0	0	0	0
GENERAL USE - Inorganic Zinc, Military Exterior [4.76 lb VOHAP /gal (571 g VOHAP/L solids)]	20	4	6	7	9
	30	3	5	6	8
	40	2	4	5	6
	50	2	3	4	5
	60	0	0	0	0
	80	0	0	0	0

[4]CAPE SYSTEM EVALUATION AND EMISSION TEST REPORT at MMC Compliance Engineering, Inc., Philadelphia, PA, December 14-21, 1995, Durr Project No. 2996-1021

[5]AIR EMISSION EVALUATION TOTAL GASEOUS ORGANIC COMPOUNDS AND FILTERABLE PARTICULATE EMISSIONS at Metro Machine Corporation, Norfolk, VA, August 19-23, 1996, PES Report 5187-001.

[6]Rounded up to the next integer number.

Exhibit 2.10 Minimum number of hours of RTO operation required to achieve background level (Table 4 of MMC's 1996 Application for Approval)

TABLE 4

MINIMUM NUMBER OF HOURS OF RTO OPERATION REQUIRED TO ACHIEVE CONCENTRATIONS OF LESS THAN 908 g (2.00 lbs)[a] FOR VOHAP APPLICATION RATE OF 160 LBS/HOUR (72,640 g/HOUR)

COATING TYPE	SOLIDS CONTENT OF COATING AS APPLIED (% by volume)	TOTAL HOURS OF RTO OPERATION TO ACHIEVE BACKGROUND CONCENTRATION			
		2 Hours Coating	4 Hours Coating	6 Hours Coating	8 Hours Coating
ANTIFOULANT HIGH VOHAP CONTENT [6.38lb/gal (765 g/L) solids]	20	8	10	12	14
	30	8	10	12	14
	40	8	10	12	14
	60	8	10	12	14
	50	8	10	12	14
	80	8	10	12	14
GENERAL USE - Inorganic Zinc, Military Exterior LOW VOHAP CONTENT [4.76 lb/gal (571 g/L) solids]	20	8	10	12	14
	30	8	10	12	14
	40	8	10	12	14
	50	8	10	12	14
	60	8	10	12	14
	80	8	10	12	14

Exhibit 2.11 Fax letter dated November 6, 1997 from Berry Environmental to U.S. EPA/OAQPS, in response to questions from EPA regarding dry to touch time (1 page)

BERRY ENVIRONMENTAL

P.O. Box 20634
Raleigh, N.C. 27619
Phone/Fax 919 785 9631

Date: November 6, 1997

FAX COVER SHEET

To: Mohamed Serageldin

Dear Mohamed

Last week you asked for estimates of the amount of VOC remaining in a marine coating wh becomes dry to touch. In response you received estimates from two analytical chemists:

Hiro Fujimoto, formerly of BASF	About 3 percent
William Golton, formerly of DuPont	Less than 10 percent

The additional information that we discussed earlier today is presented below. It was obtain by visiting booths of several exhibitors at the International Coating Exhibition earlier this week in tl Atlanta convention center. At each booth I asked for the most knowledgeable epoxy formulation chemist available. Each was then asked for an estimate of the percent of VOC remaining when a sp applied, thick film (3 to 4 mils), air-dried, epoxy-amine coating has "dried to touch". None was anxious to answer, noting that there were a lot of variables (solvent type, mix, oligomer length and r type were named) that could affect the rate of evolution. When it was explained that no single coati was involved, rather the quest was for a reasonable guesstimate for a variety of marine hull coatings following values were given.

Richard Martorano, Rohm and Haas,	5 to 6 weight percent
Larry Wang, Reichhold	Less than 10 percent
Andy Wang, Ciba	15 to 20 percent

Neil Wassburg (409 238 4420), was identified as best qualified to answer the question at Do booth, but he was never there when I was.

If all of the estimates are averaged with ~~the~~ "less than 10" scored as a full 10 percent, the average is 9.1 weight percent. If we score this like in ice figure skating, throw out the high and low, average would be something even less than 9 weight percent.

Mohamed, I hope this helps in your decision-making. I look forward to seeing you next weel

Best Wishes

Jim

Exhibit 3.1 MSDS for Intergard FP showing drying time (hours)

Intergard® FP

International
Marine Coatings

Polyamine Epoxy

Intended Uses

A universal anticorrosive for use on underwater hulls, above water areas, internal areas including ballast tanks, marine vessels, barges and offshore structures.

Product Description

A two component, self priming, surface tolerant epoxy with semi-gloss finish. Exhibits excellent chemical and abrasion resistance. A high build formulation capable of low temperature cure. Low VOC.

Product Information

Color	White - FPD052; Light Gray - FPJ034; Red - FPL274. Special colors can be **matched to meet customer specifications.**
Finish/Sheen	Semi-Gloss (ASTM D-523)
Converter	FPA327 for normal applications/FCA321 for low temperature
Volume Solids	80.0% ± 2% (ASTM D-2697) at 77°F (25°C) and 7 days cure
Mix Ratio	4:1 by volume
Flash Point	Part A, 117°F (47°C); Part B, 124°F (51°C); Mixed, 117°F (47°C) (Setaflash) (ASTM D-3278)
Film Thickness (SSPC-PA2)	4.0 mils dry specified equivalent to 5.0 mils wet 4.0-6.0 mils dry practical range equivalent to 5.0-7.5 mils wet
Theoretical Coverage	320 sq. ft./gal (4.0 mils DFT) **Allow appropriate loss factors**

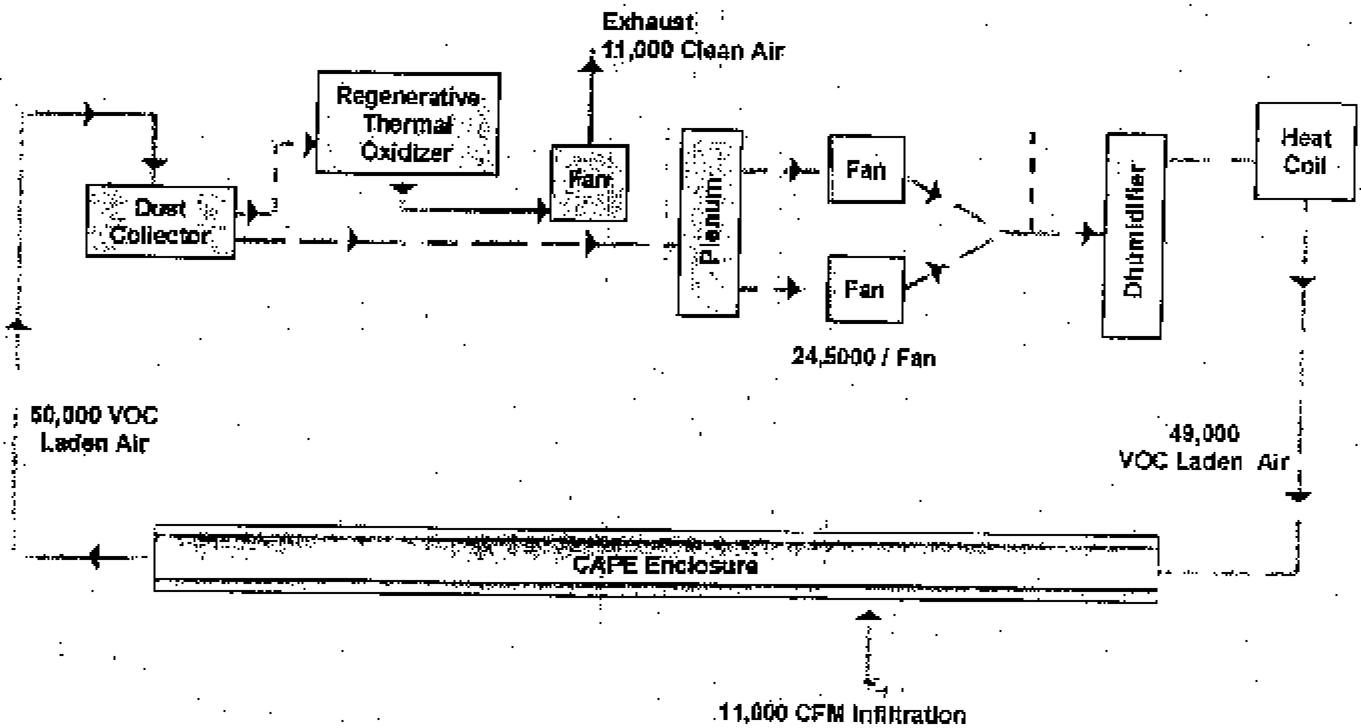
Application Details

Method	Conventional or airless spray
Induction/Sweat-in Time	15 minutes at temperatures below 70°F (21°C)
Thinner	GTA415 See Regulatory Data
Cleaner	GTA415
Pot Life	8 hrs @ 50°F (10°C), 4 hrs @ 75°F (24°C), 2 hrs @ 90°F (32°C)

Drying Time *(hours)** Substrate Temperature	[illegible] Touch	[illegible] Handle	Overcoating Interval By Specified Epoxies and Polyurethanes [illegible] *Minimum*	*Maximum*
50°F (10°C)	10	24	24	3 months
75°F (24°C)	4	8	10	2 months
90°F (32°C)	2	4	7	1 month

**Times listed above are for normal recoating situations of Intergard® FP with itself or other polyamine epoxies at specified temperatures within a relative humidity of 40-60%. Stated drying times are for FPA327 converter only. For low temperature application information with FCA321 low temperature converter see low temperature properties on page 4.*

Exhibit 3.2 CAPE and RTO layout (MMC 1998 Communication)



C.A.P.E. PAINT MODE

Reference

C.Gatland and M. Lukey; *An Innovative Permanent Total Enclosure for Blast Cleaning and Painting of Ships in Drydock*, MMC Compliance Engineering, Inc.

Exhibit 3.3 Sample calculation for 8 hour paint application (MMC's 1996 Application for Approval)

SAMPLE CALCULATION FOR 8 HOUR PAINT APPLICATION

Maximum duration of coating	8 hr	
VOC application rate	160 lb/hr	72,640 g/hr
VOC density	7.0 lb/gal	840 g/L
Solids content by volume	20 percent	
Solids volume as applied	5.71 gal/hr	21.6 L/hr
Total solids volume	45.7 gal	173 L
Total VOC applied	1280 lbs	581,120 g

Inside CAPE enclosure	96.9 lbs	44,011 g
VOC emitted	62.0 lbs	28,162 g
Total VOC emissions	159.0 lbs	72,172 g

Volume exhausted thru RTO	11,000 cfm	312 cmm
Volume circulated thru CAPE	60,000 cfm	1,700 cmm
Overall Control efficiency	95 %	

CALCULATION FOR COMPLIANCE WITH 4.76 lb/gal (571 g/L) solids "To meet the standard"

Hours	VOC added		VOC within CAPE		VOC to RTO		VOC Emitted		Status of CAPE
	(lbs)	(g)	(lbs)	(g)	(lbs)	(g)	(lbs)	(g)	
1	160	72,640	121	54,998	61.1	27,728	3.05	1,385	ON
2	160	72,640	175	79,464	116	52,659	5.80	2,633	ON
3	160	72,640	199	90,351	140	63,751	7.02	3,187	ON
4	160	72,640	210	95,190	151	68,686	7.56	3,432	ON
5	160	72,640	214	97,347	156	70,878	7.81	3,546	ON
6	160	72,640	217	98,305	158	71,859	7.91	3,591	ON
7	160	72,640	217	98,731	159	72,290	7.96	3,614	ON
8	160	72,640	218	98,922	160	72,488	7.98	3,623	ON
9	0.00	0.00	96.9	44,011	139	62,979	6.94	3,151	ON
TOTALS=	1,280	581,120			1,241	563,314	62.0	28,162	

VOC emitted 3.47 lb/gal (416 g/L) solids

Number of RTO hours for compliance = 9

CALCULATIONS TO ACHIEVE A CONCENTRATION OF LESS THAN 908 g (2.00 lbs) "Background Conc."

Hours	VOC added		VOC within CAPE		VOC to RTO		VOC Emitted		Status of CAPE
	(lbs)	(g)	(lbs)	(g)	(lbs)	(g)	(lbs)	(g)	
1	160.00	72,640	121	54,998	61.1	27,726	3.05	1,385	ON
2	160.00	72,640	175	79,464	116	52,659	5.80	2,633	ON
3	160.00	72,640	199	90,351	140	63,751	7.02	3,187	ON
4	160.00	72,640	210	95,190	151	68,686	7.56	3,432	ON
5	160.00	72,640	214	97,347	156	70,878	7.81	3,546	ON
6	160.00	72,640	217	98,305	158	71,859	7.91	3,591	ON
7	160.00	72,640	217	98,731	159	72,290	7.96	3,614	ON
8	160.00	72,640	218	98,922	160	72,488	7.98	3,623	ON
9	0.00	0.00	96.9	44,011	139	62,979	6.94	3,151	ON
10	0.00	0.00	43.1	19,561	44.0	19,953	2.20	998	ON
11	0.00	0.00	19.2	8,712	19.6	8,876	0.978	444	ON
12	0.00	0.00	8.54	3,877	8.70	3,950	0.435	197	ON
13	0.00	0.00	3.80	1,725	3.87	1,757	0.193	87.8	ON
14	0.00	0.00	1.69	767	1.72	781	0.086	39.0	ON

Number of RTO hours to achieve a concentration of less than 908 g (2.00 lbs) = 14

Exhibit 3.4 Paint system for Scott (DDG - 995)
(MMC's 1996 Emission Test)

1 m = 3.281 ft
3247 m²

PAINT SYSTEM for USS SCOTT (DDG-995) — Metro Machine Corporation Old Dominion Dry Dock

UNDERWATER HULL: USS SCOTT (DDG-995)

AREA (ft^2) = 35,000

Coat No.	Mil Spec	Manufacturer			Dry Film Thickness (Mils)	Loss Factor %	Spreading Rate (ft^2/Gal)	Volume (Gal)	VOC (lbs/Gal)	VOC (lbs)	VOC (Tons)
1		International	FPL274/FPA327	INTERGAURD EPOXY RED	5	30	180	194	1.62	315	0.16
2		International	FPY999/FPA327	INTERGAURD EPOXY BLACK	5	30	180	194	1.62	315	0.16
3		International	INTERSLEEK BXA386/390/391	TIE COAT LT GRAY	4	30	166	211	2.82	595	0.30
4		International	INTERSLEEK BXA816/821/822	FINISH HAZE GRAY	5	30	135	259	2.05	531	0.27
					TOTAL = 20 Mils		TOTAL = [illegible]		TOTAL = [illegible]		

BOOTTOP: USS SCOTT (DDG-995)

AREA (ft^2) = 3,000

Coat No.	Mil Spec	Manufacturer			Dry Film Thickness (Mils)	Loss Factor %	Spreading Rate (ft^2/Gal)	Volume (Gal)	VOC (lbs/Gal)	VOC (lbs)	VOC (Tons)
1		International	FPL274/FPA327	INTERGAURD EPOXY RED	5	30	180	17	1.62	27	0.01
2		International	FPY999/FPA327	INTERGAURD EPOXY BLACK	5	30	180	17	1.62	27	0.01
3		International	INTERSLEEK BXA386/390/391	TIE COAT LT GRAY	4	30	166	18	2.82	51	0.03
4		International	INTERSLEEK BXA819/821/822	FINISH BLACK	5	30	135	22	2.05	46	0.02
					TOTAL = 20 Mils		TOTAL = 74		TOTAL = [illegible]		

FREEBOARD: USS SCOTT (DDG-995)

AREA (ft^2) = 25,000

Coat No.	Mil Spec	Manufacturer			Dry Film Thickness (Mils)	Loss Factor %	Spreading Rate (ft^2/Gal)	Volume (Gal)	VOC (lbs/Gal)	VOC (lbs)	VOC (Tons)
1	MIL-P-24647	International	FPL274/FPA327	INTERGAURD EPOXY RED	6	30	180	139	1.62	225	0.11
2	MIL-P-24647	International	FPJ034/FPA327	INTERGAURD EPOXY GRAY	5	30	180	139	1.62	225	0.11
3	MIL-E-24635A	International	MIL-E-24635A	HAZE GRAY ENAMEL	3	30	320	74	2.4	210	0.11
					TOTAL = 13 Mils		TOTAL = 356		TOTAL = 0.33		

5/20/96

Exhibit 3.5 Example of protective coating quality assurance record for critical coated areas, Sheet 2 (MMC's 1996 Emission Test)

Sheet 2

METRO MACHINE

Metro Machine Corp.
Protective Coatings Quality Assurance Record
For Critical Coated Areas

Approx 13,000 sq ft

Location: UW Hull Port Mid ships Fr 100 - 415

☐ Pre-Coat (Stripe)   ☐ Disturbed Areas / Touch-Up

III Coating Material   Coat # 1 ST

	Sat.	Unsat
(1) Paint Manufacturer Name International	✓	
(2) Product Description FPL 274 / FPA 327	✓	
(3) Batch # UHN22066F / UKN51646F	✓	
(4) Date of Manufacture JUNE 96 / JUNE 96	✓	
(5) Mil-Spec. mil P 24647	✓	
(6) Color Red	✓	
(7) Thinner Name GTA 415	✓	
(8) Paint C.O.C.s / M.S.D.s	✓	
(9) Thinner C.O.C.s / M.S.D.s	✓	

IV Mixing   Coat # 1 ST

	Sat.	Unsat
(1) Storage 70°	✓	
(2) Mixing 4 to 1	✓	
(3) Thinning Max 5% by Volume	✓	
(4) Induction	✓	

Remarks / Comments: Gallons Used 135 gallons for Sides, UW Hull + Seachest

Inspector Signature [signature]   Date 8-20-96

Exhibit 4.1. Plan showing CAPE modular units and barge carrying the incinerator

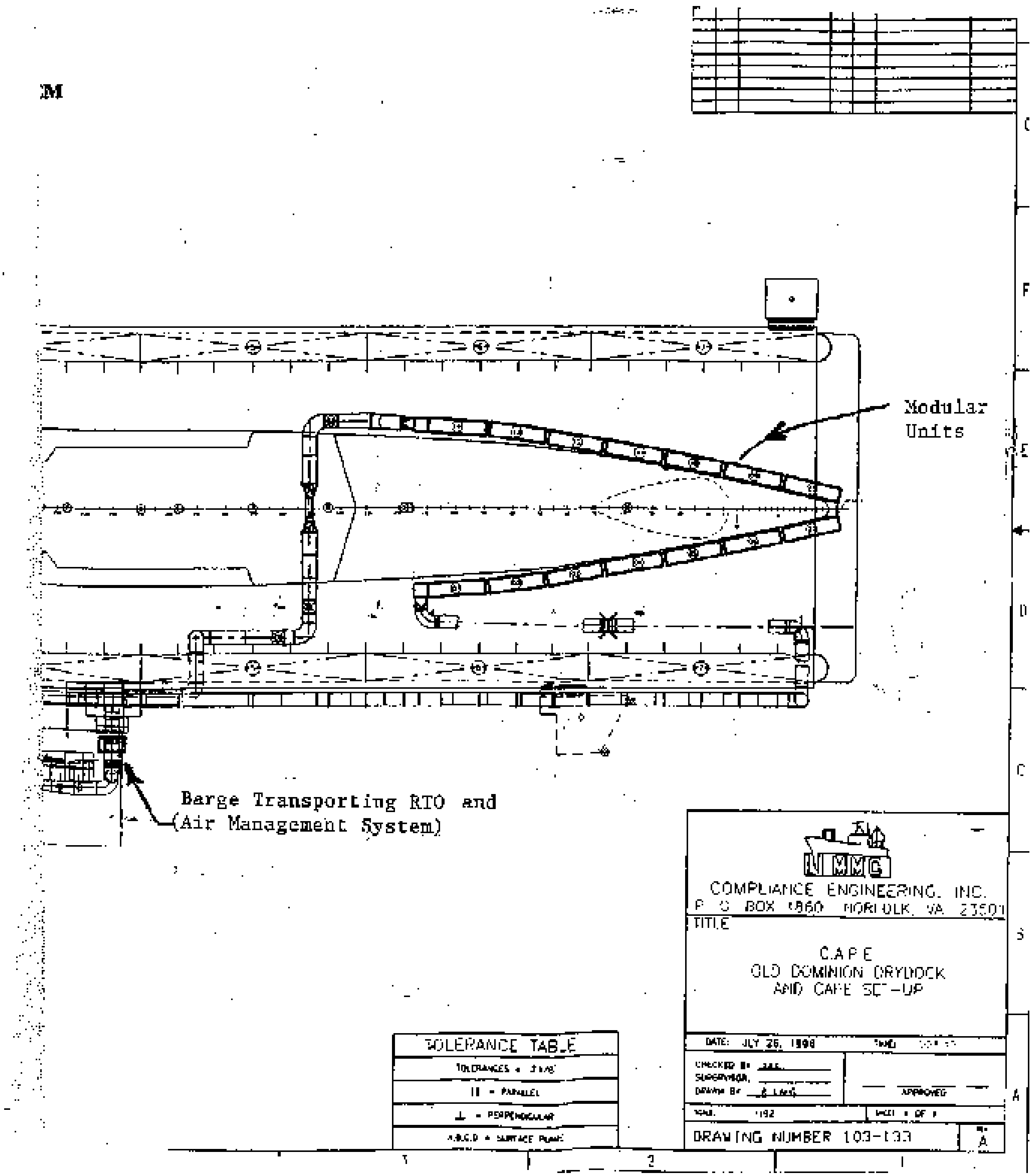


Exhibit 4.2 Summary of stack gas conditions (Table 2.3 in 1996 Emission Test)

TABLE 2.3

SUMMARY OF STACK GAS CONDITIONS REGENERATIVE THERMAL OXIDIZER INLET AND OUTLET CAPE® SYSTEM

Dates: 8/20/96 - 8/23/96 | Facility: MMC, Norfolk, VA

Run No.	Date/Time (1996)	Stack Gas Velocity, fps (mps)[a]	Stack Temperature, °F (°C)	Moisture, %	Volumetric Flow Rate		CO_2, %	O_2, %
					acfm (acmm)[b]	dscfm (dscmm)[c]		
RTO Inlet								
I-1A	8/20 - 1720	49.6 (15.3)	95 (35)	1.8	12,731 (361)	11,962 (339)	0.0	21.0
I-1B	8/20 - 2120	48.6 (14.8)	87 (31)	1.8	12,458 (353)	11,882 (336)	0.0	21.0
I-2	8/21 - 1030	49.4 (15.1)	94 (34)	1.3	12,679 (359)	11,991 (340)	0.0	21.0
I-3	8/21 - 1800	51.8 (15.8)	97 (36)	1.6	13,278 (376)	12,448 (353)	0.0	21.0
I-4A	8/22 - 0800	50.8 (15.5)	87 (31)	1.9	13,026 (369)	12,359 (350)	0.0	21.0
I-4B	8/22 - 1250	49.4 (15.1)	97 (36)	1.9	12,678 (359)	11,824 (335)	0.0	21.0
I-5	8/22 - 1600	48.8 (14.9)	101 (38)	2.3	12,512 (354)	11,534 (327)	0.0	21.0
I-6A	8/23 - 0900	51.4 (15.7)	91 (33)	2.6	13,178 (373)	12,349 (350)	0.0	21.0
I-6B	8/23 - 1350	51.6 (15.7)	98 (37)	2.6	13,251 (375)	12,264 (347)	0.0	21.0
Average		50.2 (15.3)	94 (34)	2.0	12,755 (361)	12,068 (342)	0.0	0.0
RTO Outlet								
O-1A	8/20 - 1800	51.4 (15.7)	242 (117)	1.8	16,668 (472)	12,430 (352)	0.9	19.8
O-1B	8/20 - 2112	52.5 (16.0)	238 (114)	1.8	17,051 (483)	12,785 (362)	0.9	19.8
O-2	8/21 - 1045	53.0 (16.2)	250 (121)	1.7	17,188 (487)	12,682 (359)	0.7	20.1
O-3	8/21 - 1800	53.1 (16.2)	247 (119)	1.9	17,230 (488)	12,741 (361)	0.8	20.0
O-4A	8/22 - 0830	52.9 (16.1)	246 (119)	2.3	17,178 (486)	12,627 (358)	0.7	20.2
O-4B	8/22 - 1230	50.6 (15.4)	245 (118)	2.3	16,412 (465)	12,085 (342)	0.7	20.2
O-5	8/22 - 1545	52.6 (15.8)	245 (118)	2.6	17,077 (484)	12,532 (355)	0.9	19.9
O-6A	8/23 - 0930	53.3 (16.2)	246 (119)	2.4	17,288 (490)	12,699 (360)	0.8	20.0
O-6B	8/23 - 1348	52.8 (16.1)	246 (119)	2.4	17,129 (485)	12,582 (356)	0.8	20.0
Average		52.5 (16.0)	245 (118)	2.1	17,025 (482)	12,574 (356)	0.8	20.0

[a] Feet per second (meter per second).
[b] Actual cubic feet per minute (actual cubic meter per minute).
[c] Dry standard cubic feet per minute (dry standard cubic meter per minute).

TECHNICAL REPORT DATA

(Please read Instructions on reverse before completing)

1. REPORT NO.
EPA-453/R-99-005

2.

3. RECIPIENT'S ACCESSION NO.

4. TITLE AND SUBTITLE
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5. REPORT DATE
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7. AUTHOR(S)
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Project Manager: Mohamed A. Serageldin, Ph.D., (919) 541-2379

16. ABSTRACT

The U.S. Environmental Protection Agency is providing background information that supports the use of Metro Machine Corporation's (MMC) compliant all position enclosure (CAPE) plus air management system and regenerative thermal oxidizer (RTO) (CAPE +RTO System) as an alternative means of limiting the emissions of volatile organic hazardous air pollutants per volume of applied solids (nonvolitiles). This document also explains how we arrived at the operating, recordkeeping, and reporting conditions that MMC must meet for approval. The add-on control system they used consists of a pollution capture unit operation (CAPE) plus air management system and a destruction unit operation (RTO). When operated according to the specified procedures, it will control emissions to a level no greater than that from using coatings which comply with the limits in Table 2 of 40 CFR Part 63, Subpart II.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air pollution, Equivalency, Shipbuilding and Ship Repair, NESHAP, Marine Coatings, Surface Coating, Ship Painting (Coating)	Air Pollution control	

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