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Page 1 of 1
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ENGINEERING TASK PLAN
for a
VAPOR TREATMENT SYSTEM
ON TANK 241-C-103

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Characterization Equipment Development

R. B. Conrad

March 1995

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**ENGINEERING TASK PLAN FOR A
VAPOR TREATMENT SYSTEM ON
TANK 241-C-103**

1.0 INTRODUCTION

1.1 Purpose

The purpose of this Engineering Task Plan (ETP) is to obtain concurrence on the scope, tasks, and responsibilities necessary to design, fabricate, test, and install a vapor treatment system (mixing system) on tank 241-C-103 (C-103). The mixing system is to be installed downstream of the breather filter and will use a mixing blower to reduce the chemical concentrations to below allowable levels as identified by the Toxicology Review Panel (TRP) report (Mahlum, et al., 1994). This is related to Tri-Party Agreement (TPA) Milestone No. M-40-07 which is to install and operate the C-103 vapor treatment system by June 30, 1995.

1.2 Background

A number of people have reported ill effects, including headache, burning sensation in nose and throat, nausea, and impaired pulmonary function, while working around waste tanks on the Hanford project. As indicated in the "1993 Program Plan for the Resolution of Tank Vapor Issues," WHC-EP-0562, Rev. 1 (Osborne and Huckaby, 1994), musty and foul odors, including the smell of ammonia, have been reported to emanate from several single-shell tanks (SSTs). Several of these occurrences were attributed to C-103. C-103 is connected to 241-C-102 (C-102) which is connected to 241-C-101 (C-101) via underground cascade overflow lines (C-103 being the lowest or last tank in the cascade).

An attempt to address this problem was made in 1989. Two carbon adsorption canisters were installed downstream of the C-103 breather filter. Multiple failures of this passive system caused it to be valved out of service in 1993. The failures were all characterized by partial or total restriction of flow identified during periodic flow testing of the breather filter. An Engineering Evaluation of Alternatives evaluated this system and concluded that these failures were most likely due to accumulation of condensate inside the canisters until the inlet piping was covered (Conrad, 1994).

It was also determined that unfiltered leak paths were not adequately sealed which would result in fugitive emissions (emissions emanating from unfiltered leak paths). The pressure drop of the passive carbon system added to the tank pressure during rapid barometric pressure drops, which had to result in increased fugitive emissions. As the carbon adsorbers filled with condensate, the fugitive emission problem would get worse.

Characterization of C-103 vapors and gases has been completed (Huckaby and Story, 1994). The TRP has issued a report identifying the chemicals of concern (Mahlum, 1994). See Table 1 for information.

The Engineering Evaluation of Alternatives was performed to identify the best vapor treatment technologies to control vapor emissions from C-103 (Conrad, 1994). A review of the existing system concluded that, with some design and procedural improvements, it was a viable technology. Carbon adsorption with carbon adsorption/reactants and biofiltration were identified as the top two technologies for this application. Uncertainties associated with biofiltration initially resulted in the selection of a carbon based technology. A survey of carbon vendors using the latest tank vapor characterization, however, resulted in a much higher carbon usage rate than previously estimated. During initial design efforts, a simpler, safer, and more cost effective "mixing" method was identified that does not require the use of carbon.

The new concept has been approved by Westinghouse Hanford Company (WHC) Engineering and Program management, WHC safety and environmental organizations, and the Washington Department of Health. Efforts to gain approval from the Washington Department of Ecology (WDOE) are ongoing. A representative from WHC's Air and Water Permitting indicates that chances to obtain WDOE's approval are high.

2.0 SCOPE

2.1 Objective

The objective of this task is to provide a treatment system for C-103, which is TPA Milestone No. M-40-07 (Osborne & Huckaby, 1994). Completion of the field Acceptance Test Procedure (ATP) as described herein will satisfy the TPA milestone. The vapor and liquid characterization of tank C-103 indicates that it is definitely a source of vapors of concern. Tank C-102 is directly connected to C-103 and is believed to possibly be a source of vapors of concern. Tank C-101 has been pumped and is not considered a source of vapors of concern.

The installation of this mixing system will protect the facility worker from overexposure to passive vapors emanating from C-102 and C-103 during normal operation. When the mixing system is installed and its performance verified, it will allow Industrial Hygiene to relax the worker safety personal protective equipment requirements that are currently in place within the vicinity of C-102 and C-103.

The design objective will be to design a system that will keep tank emissions as close to passive as possible that will protect workers and minimize impact on the environment.

2.2 Deliverables

A mixing system will be provided to Tank Farms Operations. The deliverables consist of the following.

- 2.2.1 Project supporting documentation including an ETP, procurement specifications, drawings, test plan, plant forces work review, As Low As Reasonably Achievable (ALARA) Management Work Sheet, dose rate

calculations, unreviewed safety question (USQ) screening (where required), Acceptance for Beneficial Use (ABU), and as-built drawings.

- 2.2.2 Hardware to support the mixing system installation.
- 2.2.3 The mixing system may include a draw tube/venturi, mixer blower, and stack and be skid mounted. Instrumentation may consist of a mixer blower outlet flow or pressure switch that will interface with status lights. It will also have the capability to measure and totalize flow exiting the tank.
- 2.2.4 An evaluation of electrical power availability and condition at the installation site and design, procurement, and installation of additional or new electrical power if required.
- 2.2.5 Installation work plan and operating and maintenance procedures as required.

3.0 DESCRIPTION

3.1 Physical Description

This mixing system concept will utilize a blower that will force approximately 22.6 m³/min (800 cfm) of fresh air up through a nominal 4.6 m (15-foot) stack. See Figure 1 for the current design concept. This relatively large flow rate of fresh air will pass around a smaller beveled draw tube positioned perpendicular to the main flow. This will create a low pressure in the smaller tube which will be connected to the tank via a new 2-inch diameter three-way valve installed on the existing breather filter. By adjusting the position of the beveled tube in the larger flow stream, the low pressure, and therefore the tank flow rate, can be adjusted. The turbulence in the stack will ensure full mixing of the two streams.

An evaluation of potential unfiltered leak paths concluded that fugitive emissions can be eliminated or at least reduced to an acceptable level by "sealing" unfiltered leak paths (Conrad, 1994). The mixing system will have the capability to measure tank exhaust flow rate.

The mixing system will be capable of being passively operated. That is, the tank flow after turning on the fresh air blower will have the capability to be set to equal the average natural breathing rate. The system will "track" with barometric pressure fluctuations. To illustrate, during a decrease in barometric pressure, the pressure inside the tank, and thus the pressure in the small tube, will increase relative to that of ambient. The pressure difference at the beveled tube/main flow interface must increase resulting in a higher flow out of the tank. As soon as the tank pressure equalizes with the barometric pressure, the flow will return to normal. The system flow rate will also be adjustable if field conditions require a higher tank flow. Although very desirable, it is not a requirement that a measurable negative pressure be attained in the three tanks.

The three tanks will be configured as follows: 1) the mixing system will be installed downstream of the C-103 breather filter; 2) the breather valve on C-101 and C-102 will be closed; and 3) the above ground unfiltered leak paths will be sealed as required. In this configuration, the only predominant point of emission is via the mixing system on C-103. The system will be turned on and, by measuring the pressure in the three tanks, the optimum flow rate will be obtained. If the tanks are sufficiently "leak tight," a negative pressure should be measurable. If they are not and cannot be made so, the system will be set at $0.4 \text{ m}^3/\text{min}$ (15 cfm) above the average natural breathing rate. This is the estimated peak flow rate due to barometric pressure fluctuations. In essence this flow will simulate the highest estimated combined flow from all factors that would create a condition where the tank pressure is greater than the atmosphere causing tank vapor to exit a tank. These factors include the Food Instrument Corporation purge air, temperature buoyancy effects, and barometric pressure fluctuations. The argument is that by doing so these factors are negated and the predominant point of emission is through the mixing system.

The minimum average flow rate allowed is 56 l/min (2 cfm) as identified by a safety analysis performed on the exothermic reaction hazards of the organic liquid layer in C-103 (Postma, 1994).

3.2 Procurement

All material procurement will be identified and accomplished in accordance with WHC-CM-2-1, Procurement Manual and Procedures. Emergency procurements will be used only if time constraints on the item will exceed scheduled commitments that may prolong an unsafe condition.

3.3 Testing

Preliminary tests on individual components shall be performed to optimize design configuration. Formal testing will include a shop ATP, a field ATP after installation, and an Operational Test Procedure (OTP). These formal tests will be accomplished in accordance with approved test procedures (see Section 9.0).

After installation a field ATP will be performed. This ATP will verify the operation of the system and that the concentrations at the stack exit are below the Consensus Exposure Standard (CES) as identified by the TRP report (Mahlum, 1994). Successful completion of this ATP will satisfy the TPA milestone.

After completion of the field ATP, an OTP will be performed which may take one to two months to complete. During this OTP, Industrial Hygiene personnel will perform additional source, area, and personnel monitoring to further monitor the system's performance before relaxing safety requirements. Barometric pressure, flow rate, tank pressures, etc., will also be monitored to verify performance characteristics. The OTP will also attempt to establish a system curve (i.e., negative pressure of each tank versus mixing system tank flow rate from 0 to 40 cfm).

After completion of the OTP, the system will be formally turned over to Operations.

3.4 Special Reviews

Special reviews required include review by Safety Analysis and a final Operational Readiness Review (ORR) prior to installation. An ORR will also be required prior to final turnover to Operations after completion of the performance evaluation phase. This task is less than a Hazard Category 3 and, as such, the readiness review will be via a plant generated checklist. In addition, a USQ determination will be performed in accordance with WHC-CM-1-3, Management Requirements and Procedures, MRP 5.12.

3.5 Installation

Installation will be completed by appropriate bargaining unit staff. Installation will be performed via work package documentation in accordance the Job Control System (JCS).

3.6 Maintenance/Operation

Operation and maintenance of the system will be performed through approved tank farm preventive maintenance and operation/maintenance documents.

3.7 Training

Installation training will be performed prior to installation. Maintenance and operation training will be performed prior to final turnover to Operations.

3.8 Tank Flow Rate Range

The WDOE must approve of the operating range of $0.4 \text{ m}^3/\text{min}$ (0-15 cfm) above average natural breathing rate. Air and Water Permitting has indicated confidence is high that this approval will be obtained.

3.9 Metric Units

All drawings, documents, and procedures will utilize metric units in their development. Soft conversions from English units to metric units (also known as standard international system of units (SI)) shall be implemented on this project where practical. For example, pipes, tubing, fittings, plate sizes, wiring, panels, etc., will be true English dimensioned components, but will be called out with its equivalent metric dimension. English unit callouts, in parentheses, will only follow those SI units which are at critical locations, interfaces with English components, or where confusion may occur with them. Bills of material will utilize both units where practical. Equipment that is routinely labelled, sold, and installed by other than metric callouts will be detailed on the drawings and specifications by the common trade size (i.e., wire size, motor size, English sized fasteners, etc.).

Analog pressure gauges as well as flow measuring and sensing devices will have combination measurement units called out, with the primary numbers

in SI units. The pressure units will be in centimeters of water (inches of water) and/or kilopascals (psi) as required. Digital meters will be set to read in SI units.

3.10 Design Control

The mixing system design shall be controlled per WHC-CM-6-1, Standard Engineering Practices, EP-2.4, Rev. 3. The system has facility use potential. This document will serve as the engineering work plan for the mixing system assembly.

The drawings will be identified as "development control." The drawings will identify any restrictions or special conditions attached to the fabrication. Material requirements and inspection criteria will be called out on the drawings.

Changes to fabrication drawings will be made only by the cognizant design engineer or designated representative (see engineering tasks). Changes shall be made in red ink on drawings and then signed and dated by the individual making the change. If a drawing becomes illegible or confusing due to the number of changes, that drawing shall be replaced with an updated version containing all modifications to that point.

4.0 SYSTEM FUNCTIONAL PERFORMANCE DESCRIPTION

The mixing system will consist of a skid mounted mixing blower, draw tube/venturi, and stack. See Figure 1 for a design concept which is provided for reference only.

4.1 Environmental Conditions

<u>Condition</u>	<u>Range</u>	<u>Rate of Change</u>
Ambient Air Temperature	-31°C to 46°C (-23°F to 115°F)	3°C (5.4°F) decrease in 20 minutes 4°C (7.2°F) increase in 60 minutes
Relative Humidity	15% to 90%	Negligible
Rain	1.5 cm (.60 inch) per hour maximum	
Snow, Sleet, Hail	20 cm (8 inches) of snow maximum in 24 hours with 36 cm (14 inches) of snow maximum accumulation. Sleet and hail account for less than 1 percent of frozen precipitation. Maximum hailstone diameter is 1 cm (3/8 inches). The site is subject to blowing and drifting snow. Glaze occurs approximately six days a year.	

Blowing Dust (dust picked locally from surface and blown about in clouds or sheets)	Restricts visibility up to 10 km (6 miles) or less. May completely obscure sky. Occurs approximately 10 times a year. Approximately 24-hour duration for each occurrence.
Solar Radiation	300 plus days direct sunlight per year
Wind	129 km/hr (80 mph) (American National Standards Institute A58.1)

4.2 Vapor Mixing System Inlet Conditions (from tank)

See Table 1 for a listing of the chemical compounds of concern, reported concentrations, and CES as identified by the TRP (Mahlum, et al., 1994).

Temperature, 27°C to 38°C (80°F to 100°F)

Relative humidity, 100%

Average natural breathing rate estimate, 141 l/min (5 cfm) (Claybrook, 1991)

Maximum flow rate out of C-103 is calculated to be about 0.4 m³/min (15 cfm) above natural breathing flow rate (due to rapid decreases in barometric pressure).

Ammonia and nitrous oxide are generated in the waste at a fixed rate. Therefore, at higher flow rates the concentration of these chemicals decrease proportionally. The organic chemicals, however, are evaporated from the organic layer and at these low flow rates are conservatively assumed to remain constant.

4.3 Vapor Mixing System Outlet Conditions

Each chemical compound of concern shall be reduced in concentration to at or below its CES as identified by the TRP report (Mahlum, et al., 1994). Analysis will only be performed for those chemicals listed in the TRP report as being above the CES. This will satisfy the TPA milestone. However, to address odor concerns the concentrations shall be reduced even more to as low as reasonably achievable.

The minimum required fresh air flow is determined by identifying the chemicals that have the highest ratio of reported concentration to its CES. For the generated inorganic gases, ammonia and nitrous oxide are reported to be present at essentially equal concentrations (304 ppm) and both have the same CES (25 ppm). A conservative goal is to reduce chemicals to one-half the CES. The minimum required mixing ratio for these gases then is $304 / (.5 \times 25) = 24$. A conservative assumption is that the reported concentration was obtained at a natural breathing rate of 141 l/min (5 cfm). Therefore a conservative minimum required fresh air flow rate for these gases is 141 l/min (5 cfm) times the minimum required mixing ratio, or $141 \times 24 = 3.4 \text{ m}^3/\text{min}$ (120 cfm). This is true for any flow rate from the tank since ammonia and nitrous oxide are generated at a constant rate.

For the organic chemicals, the highest concentration to CES ratio is for Benzene (0.3 ppm : 0.1 ppm). The minimum required mixing ratio is $0.3/(0.5 \times 0.1) = 6$. But since the concentration for organic chemicals is assumed to remain constant, the minimum required fresh air flow rate must be calculated at the maximum expected tank flow rate. The maximum flow is estimated at 424 l/min (15 cfm) + 141 l/min (5 cfm) = 565 l/min (20 cfm). Therefore the minimum required fresh air flow rate is 565 l/min (20 cfm) $\times 6 = 3.4 \text{ m}^3/\text{min}$ (120 cfm).

To address odor concerns, a blower capable of producing $22.6 \text{ m}^3/\text{min}$ (800 cfm) of fresh air has been selected based on physical size and electrical power requirements. See Table 1 for resulting mixed concentrations and comparisons to CES and odor thresholds assuming a tank flow of 141 l/min (5 cfm). For the organic chemicals of concern, the mixed concentrations are all less than 2% of the CES. The ammonia and nitrous oxide are both at 8% of the CES.

See Table 2 for the same comparisons assuming a tank flow of $0.57 \text{ m}^3/\text{min}$ (20 cfm). For the organics, the mixed concentrations are all less than 8% of the CES. Since ammonia and nitrous oxide are generated at a fixed rate, the concentrations remain the same as the 141 l/min (5 cfm) case or at 8% of the CES.

4.4 Design Interface

The design interfaces identified for the mixing system are of the following categories: hardware, functional, human factors engineering, and safety.

Hardware interfaces include those between the mixing system and the existing breather filter and the existing electrical power supply.

Functional interfaces:

Maintenance - Includes duct connection to the existing breather filter outlet (Flanders¹ G1 housing), and to site electrical power supply.

Operation - Will consist of mixing blower on/off switch and tank flow rate/totalizer local indication and status lights. Operations will be able to visually determine from a distance if the fresh air flow has decreased below a set point for some reason.

Sampling - Includes vapor stream sample ports to allow Industrial Hygiene and Health Physics personnel to perform periodic confirmatory sampling if required.

Human factors engineering shall be applied to the functional interfaces identified above. The system shall be designed so as to minimize the

¹Flanders Filters, Inc., Washington, North Carolina.

number of personnel and time required to perform operational, maintenance, and periodic sampling functions.

Safety interfaces include those for the worker such as high temperature, pinch points, surface radioactive contamination, and overexposure to gaseous emissions from the mixing system. Also of concern is the impact on the tanks due to loss of power or reduction in fresh air flow.

Industrial Hygiene has performed source monitoring on all potential leak paths in the past. A few leak paths have been identified on the central pump pit of both C-102 and C-103. Operations and engineering will decide on a reliable sealing method for all potential leak paths and attempt to eliminate these leaks.

4.4.1 Breather Filter

The mixing system will be designed to connect with the breather filter exit flange (4-inch diameter, 150 lb.).

4.4.2 Electrical

Sufficient power to supply a 2 horsepower, 230/460 volt motor is required. Electrical and equipment grounding will be required.

The design and construction of this equipment shall comply with the requirements of National Fire Protection Agency (NFPA) 70. The specific application of this equipment requires that it be designed to function and to be serviced in an exposed environment as previously defined. All equipment shall be suitable for the application and shall be listed by an approved, nationally recognized testing laboratory.

4.4.3 System Performance

System performance can be verified in several ways: by calculation, by field sampling of stack, by source sweeps of potential fugitive leak paths, and by monitoring pressure in the three tanks. However, it is not a requirement that a measurable negative pressure be attained in the tanks.

Determining the concentration of chemicals of concern after mixing is a simple calculation. The reported concentration (C) in the tank is divided by the mixing ratio. The mixing ratio is the fresh air flow rate (Q_f) divided by the tank flow rate (Q_t). The equation is $C/(Q_f/Q_t)$. To illustrate, the concentration of ammonia after mixing, given a tank flow of 141 l/min (5 cfm) and fresh air flow of 22.6 m³/min (800 cfm), would be 1.9 ppm [304 ppm/(800/5)]. The CES of ammonia is 25 ppm and the odor detection level is 17 ppm (see Table 1).

A confirmation of the mixed concentration can be obtained by collecting field samples from the stack downstream of the drawtube/venturi. This will require limits of detection in the ppm range and can be obtained using hand-held real time instruments. Grab samples for laboratory analysis can also be

taken. A sample port will be provided with a 1/4" Swagelok² tube fitting and cap on the outlet.

How well fugitive leak paths can be sealed can be evaluated by:
1) performance of industrial hygiene source monitoring (source sweeps) during a falling barometer, 2) monitoring tank pressures of the three tanks, and/or
3) comparison of the mixing system tank flow rate (flow out) with inlet flow.

4.4.4 Radioactive Particulate Sampling

Periodic confirmatory sampling (about once per year) will be performed via a new three-way valve on the breather filter. An existing mobile sampler will be used to pull samples from a normally capped 2-inch diameter male threaded connection. Mobile samplers are available on site but a 4-inch filter holder will have to be procured. This sampling can be performed without interruption of the mixing system.

4.5 Instrumentation and Control

Instrumentation will consist of a fresh air flow or pressure switch that will interface with the mixing system status lights in the following manner.

- Red light - Fresh air flow is above the set point (normal condition).
- Green light - Fresh air flow is below the set point (abnormal condition).
- No light - Power is off.

Local indication of tank exhaust flow rate and a tank flow totalizer will be required. Extra contacts will be provided for remote monitoring if required in the future.

Instrumentation shall be traceable to National Institute of Standards and Technology.

Control of the system will be simply an on/off switch of the mixing blower.

4.6 Material Selection

All materials will be selected appropriate for the intended application and environment. Design life is 10 years.

4.7 Tank Vapor Condensate

Consideration shall be given to the potential for tank vapor to condense prior to entering the mixing stack. The stack velocity of approximately 2,500 fpm will most likely prevent any significant accumulation of condensate

²Swagelok® is a registered trademark of Crawford Fitting Company.

in the bottom of the stack or skid. The main concern if vapors were to condense is that the condensate may accumulate on the skid and cause an odor incident.

4.8 Transportability

The stack shall be capable of being disassembled to facilitate transporting. It shall also be capable of being moved by forklift or crane.

4.9 Design Verification

Verification of the design of the mixing system will be documented accordingly per WHC-CM-6-1, EP-4.1. Approval designator will be ESQ.

5.0 ORGANIZATIONAL RESPONSIBILITIES

Listed below are tasks assigned to each organization involved in the project. The items listed are the major activities for each group and may not include all areas of responsibilities that may be implied by the specific task.

5.1 Customer

Customer: JW Osborne (Tank Vapor Issue Resolution)
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The Customer for this project is Jerry Osborne who is the program manager for the Vapor Issues Resolution Safety Program. The Customer will have overall input on the requirements and direction for the mixing system. The Customer will provide funding and scheduling requirements for the activities and perform the ORR before installation and before turnover to Operations.

5.2 Responsible Manager and Engineer

Responsible Manager: TL Moore (Characterization Equipment Development)
Responsible Engineer: RB Conrad (Characterization Equipment Development)

The Responsible Manager has overall responsibility in implementing the design and installation of the mixing system. All other organizations will be responsible to the Responsible Manager and Engineer. The following are the major tasks of the Responsible Manager and Engineer.

- 5.2.1 Provide project management, coordination, and direction on the mixing system.
- 5.2.2 Overall project scheduling and budget development.
- 5.2.3 Overall design review of the mixing system and site work.

- 5.2.4 Prepare the ETP.
- 5.2.5 Support and provide input to the environmental and safety assessment individuals with their tasks.
- 5.2.6 Provide lead on design review of the mixing system.
- 5.2.7 Assist in system ATPs and system turnover ABU.
- 5.2.8 Provide input on site work design, as required.
- 5.2.9 Provide coordination with other tank activities tied to the mixing system.
- 5.2.10 Provide mechanical support on the program.
- 5.2.11 Provide comment resolution, input, and support during design reviews on the mixing system.
- 5.2.12 Provide lead coordination and direction during testing and final turnover of the mixing system. Provide and lead ATP documentation.
- 5.2.13 Provide functional design criteria for the mixing system to the ETP.
- 5.2.14 Provide required documentation as identified in the ABU checklist.

5.3 Lead Design and Test Engineer

Lead Design and Test Engineer: GA Barnes (Characterization Equipment Development)
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The Lead Design and Test Engineer is responsible for the detail design fabrication and test of the mixing system and shall provide comment resolution, input, and support during design reviews on the mixing system. He is also responsible to perform development control as described in Section 3.10.

5.4 Electrical Support Engineer

Electrical Support Engineer: RE Merriman (Electrical Engineering)
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The Electrical Support Engineer will provide electrical support on the skid mounted mixing system and site electrical power supply design.

- 5.4.1 Assist in identifying appropriate electrical design codes.
- 5.4.2 Provide electrical design support on the project.
- 5.4.3 Responsible for interfacing with associated activities and organizations.

- 5.4.4 Provide comment resolution, input, and support during design reviews on the mixing system and site electrical systems.
- 5.4.5 Provide design, guidance, and direction on site work design and installations as required. Develop Engineering Change Notices (ECNs) as needed.
- 5.4.6 Coordinate testing and final turnover of electrical systems.
- 5.5 Equipment Testing Engineer

Equipment Testing Engineer: PV Meeuwsen (Equipment Testing Laboratory)

The Equipment Testing Engineer shall be responsible to provide facilities (305 Building), technicians, and fabrication support as required for preliminary testing, fabrication, and functional shop tests. He will also prepare both the shop and field ATP's.

5.6 East Tank Farms Ventilation Systems Engineer

East Tank Farms Ventilation Systems Engineer: SR Pierce
(East Systems Engineering)

The East Tank Farms Ventilation Systems Engineer will provide all required support on the task.

- 5.6.1 Responsible for interfacing with associated activities and organizations.
- 5.6.2 Provide comment resolution, input, and support during design reviews on the mixing system if required.
- 5.6.3 Will be the cognizant engineer for the system after the evaluation phase is complete and the system has been turned over to Operations.

5.7 Installation/Acceptance Engineer

Installation/Acceptance Engineer: RW Reed (Manager, Installation/
Acceptance Engineering)

The Installation/Acceptance Engineer will be responsible for the field work plans and/or JCS documentation for installation of the mixing system in the tank farm. The following are the major responsibilities of this engineer and may not be all inclusive.

- 5.7.1 Provide all required procedures for maintenance, craft personnel, and operators for installation and operation of the mixing system in the tank farm. Characterization Equipment Development will provide

operation and preventative maintenance requirements, and recommended spare parts list and funding.

- 5.7.2 Provide input, reviews, and approval on such activities as the design, training, operating, maintenance, and safety documents for the mixing system.
- 5.7.3 Act as the cognizant engineer, on behalf of East Systems Engineering, as the design authority, and customer for Plant Engineering for all structures, systems, and equipment provided by this project.
- 5.7.4 Responsible for providing engineering input to the preparation, planning, scheduling, and performance of the JCS work packages in the tank farms.
- 5.7.5 Will help define what is required for partial and final ABU forms.
- 5.7.6 Will accept primary engineering responsibility for the mixing system provided by this project after installation and during performance of the OTP. After completion of the OTP, the system will be turned over to East Tank Farms Ventilation Cognizant Engineer.

5.8 Quality Control Engineer

Quality Control Engineer: HK Ananda (Tank Waste Remediation System (TWRS) Programs Quality Assurance)
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The Quality Control Engineer will ensure compliance.

- 5.8.1 Review and approve documentation provided by this work including this ETP, design, ATP, etc.
- 5.8.2 Provide design review, comment resolution, input, and support during design reviews on the mixing system.

5.9 Industrial Safety Engineer

Industrial Safety Engineer: JA Harvey (TWRS Industrial Health/Safety)
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The Industrial Safety Engineer will be the main safety contact and is responsible for ensuring that the mixing system meets all applicable safety codes and standards. This position will interface with other safety organizations such as Industrial Hygiene, Fire Protection, Nuclear, and Radiation Control as required.

- 5.9.1 Provide input to documentation such as design and ATP as required, including applicable safety codes and standards.
- 5.9.2 Review and approve documentation provided by this work including the this ETP, design, ATP, etc.

5.10 Environmental Compliance Engineer

Environmental Compliance Engineer: LA Garner (Tank Farm Environmental Compliance)
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The Environmental Compliance Engineer will ensure compliance with environmental regulations.

- 5.10.1 Review and approve documentation provided by this work including the design, ATP, etc.
- 5.10.2 Provide design review, comment resolution, input, and support during design reviews on the mixing system.
- 5.10.3 Provide appropriate environmental documentation. This includes preparing a documented plan and conducting an independent assessment of operational readiness, with respect to environmental protection, and verifying that all required environmental documentation is in place relative to this task in accordance with WHC-CM-1-5, Standard Operating Practices, Section 1.2, "Operational Readiness Reviews."

5.11 Environmental Permit Engineer

Environmental Permit Engineer: CE Sowa (Air & Water Permitting)
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The Environmental Permit Engineer will provide support in obtaining the necessary permit documentation. This approach has been presented to the Washington State Department of Health who approved the concept and a tank flow range between 0 and 425 l/m (15 cfm) above the average natural breathing rate as required. The Washington State Department of Health directed that periodic confirmatory measurement of radioactive particulate emissions is required only if a constant flow above the average breathing rate is pulled from the tank. A continuous record sampler is not required. Air & Water Permitting will submit a request to the WDOE to allow an operating range of 425 l/m (15 cfm) above the average natural breathing rate. This request is being made in case unforeseen field conditions make it desirable to operate at a constant flow rate above the natural breathing rate.

- 5.11.1 Prepare appropriate documentation and interface with appropriate regulators.
- 5.11.2 Provide comment resolution, input, and support during design reviews on the mixing system if required.

5.12 National Environmental Policy Act (NEPA)

NEPA: MT Jansky (NEPA Services)

NEPA Services has reviewed the concept and has issued a letter indicating that it does not require additional NEPA review. This letter is still valid although the concept described in this ETP is slightly different than that described in the letter.

5.13 Safety Assessments Engineer

Safety Assessments Engineer: WG Farley (SST Safety Analysis)

The Safety Assessments Engineer will perform a USQ Safety Evaluation.

5.14 Operational Readiness Review Engineer

Operational Readiness Review Engineer: SJ Dechter (TWRS Plant)

Preliminary direction is that the ORR will consist of a memorandum of understanding to the U.S. Department of Energy, Richland Operations Office, stating that the hazards will have been evaluated per the USQ and appropriate approvals from regulators are being obtained. Preliminary indications are that this task is less than hazard category 3 and as such the readiness assessment will be via a plant generated checklist.

5.15 TWRS Operations Support

TWRS Operations Support: DL Sparks (ETF Field Support)

TWRS Operations Support will provide Operations support on the mixing system during installation and will be the end user of the system.

- 5.15.1 Provide input and reviews on the mixing system designs to determine site adequacy and interface problems in the tank farms.
- 5.15.2 Responsible for installation of the mixing system. This may include installation of all ancillary components as well as wiring and piping needs.
- 5.15.3 Provide resources to complete the work packages and field installations, as required.
- 5.15.4 Will assume ownership of the mixing system at turnover.
- 5.15.5 With engineering's assistance, will identify a sealing method and seal unfiltered leak paths in C-101, C-102, and C-103.

5.15.6 Will add to operators routines a regular check of the mixing system to ensure proper operation.

5.16 TWRS Industrial Hygienist

Industrial Hygienist Scientist: ER Hewitt (TWRS Industrial Health/Safety)
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Senior Industrial Hygienist assesses employee exposure by interpreting monitoring results, makes decisions on ability of engineering controls to control worker exposures, and makes recommendations to management on need for engineering controls and personal protective equipment.

5.17 ABU Requirements

This section will describe the turnover requirements on this program prior to final acceptance of the mixing system. The following table from the ABU document is included to identify tasks to be completed and responsible individuals. A final ABU will be prepared upon final turnover to Operations.

6.0 SCHEDULE

The mixing system will be available for installation by April 30, 1995, and installation will be completed by May 15, 1995. The ATP will be performed after installation, followed by the OTP. Completion of the ATP will serve as meeting the requirements of TPA Milestone No. M-40-07. See separate schedule for details.

DOCUMENTATION REQUIRED for ACCEPTANCE FOR BENEFICIAL USE

DESCRIPTION	RESPONSIBILITY	DESCRIPTION	RESPONSIBILITY
<u>ENGINEERING</u>		<u>ENGINEERING cont'd</u>	
• Engineering Task Plan (ETP)	[X] Conrad	• Incorporate outstanding project generated ECNs	[]
• Activity Schedule	[X] Conrad	• Software Configuration Management Plan	[]
• Final Safety Analysis Report (FSAR)	[]	• System Requirements Specs.	[]
• Interim Safety Basis - update	[]	• Software Design Description	[]
• Safety Assessment (USQ)	[X] Farley	• Validation & Verification Records	[]
• Safety Equipment List (SEL)	[]	<u>TRAINING</u>	
• Operational Safety Requirements (OSR) - or update existing	[]	• Training Plan	[]
• Operational Safety Document(s) (OSD) - or update existing	[]	• Training Manuals	[]
• Functional Design Criteria (FDC)	[]	• Training to Operating Crews	[X] Reed
• Conceptual Design Report (CDR)	[]	• Training to Maintenance Crews	[X] Reed
• Supplemental Design Requirements Document (SDRD)	[]	• Training Mock-up	[]
• System Design Description (SDD)	[]	<u>OPERATIONS/ MAINTENANCE</u>	
• Test Plan/Specifications	[]	• Operating and Maintenance Manuals	[]
• Acceptance Test Procedures (ATPs) and Final Test Report	[X] Meeuwsen	• Operating Procedures	[X] Reed
• Operational Test Procedures (OTPs) and Final Test Report	[X] Strickler	• Surveillance Procedures	[X] Reed
• Environmental Impact Statement	[]	• Calibration Procedures	[X] Reed
• Environmental Report	[]	• Preventative Maintenance Procedures	[X] Reed
• Environmental Permit	[X] Sowa	• Repair/Maintenance Procedures	[X] Reed
• Hazardous Waste Disposal Plan/Procedures	[]	• Functional Check Procedures	[]
• Solid Waste Disposal Plan/Procedures	[]	• CBRS (PM/S) Data Sheets	[]
• Stress/Seismic Analysis	[]	<u>QUALITY ASSURANCE</u>	
• Stress/Design Report	[]	• Inspection Plan	[]
• Design Specifications/Report	[]	• QAPP	[]
• Equipment Specifications	[]	• QAP _J P	[]
• Procurement Specifications	[X] Barnes	<u>PROCUREMENT ACTIVITIES</u>	
• Construction Specifications	[]	• Vendor Information Files	[X] Conrad
• Essential Material Specifications	[]	• Comprehensive Equip. List	[]
• Final Design Drawing(s)	[X] Barnes	• Spare Parts List	[X] Conrad
• Installation Drawing(s)	[X] Barnes/Merriman	• Spare Parts in Stock	[]
• Installation Work Plan	[]	• _____	[]
• As-built Drawing(s)	[X] Barnes	• _____	[]
• Interface Control Drawing(s)	[]	• _____	[]
• IEFD Drawing(s)	[]		
• Systems Drawing(s)	[]		
• Drawing Tree	[]		

7.0 COST ESTIMATE

Task	Responsible Organization	Funding Req'mts
1. Project Lead	Responsible Manager and Engineer	\$80,000.00
2. Mixing System Design/Analysis	Characterization Equipment Development	50,000.00
3. Mixing System Fabrication	306 Building	30,000.00
4. Electrical Design	Electrical Support Engineer	10,000.00
5. Installation	Crafts, Operations, etc.	20,000.00
6. Safety/Environmental Assessments	Safety and Environmental Organizations	10,000.00
7. Environmental Permit	Environmental Permits	10,000.00
8. Industrial Safety Support	Industrial Safety	10,000.00
9. Industrial Hygiene Support	Industrial Hygiene	50,000.00
10. Quality Assurance	Quality Assurance	10,000.00
11. JCS Support	Test Engineering	30,000.00
TOTAL		310,000.00

8.0 QUALITY ASSURANCE

Quality Assurance requirements for activities defined within the defined scope of work shall be in accordance with the U.S. Department of Energy, Richland Operations Office Order 5700.6C, and WHC-CM-4-2, Quality Assurance Manual. These documents meet the American Society of Mechanical Engineers (ASME), Quality Assurance Program Requirements for Nuclear Facilities (ASME NQA-1) as the quality standard for this work. The overall system being Safety Class 3, a graded approach towards the Quality Assurance shall be implemented to be cost effective. The main intent is to provide assurance that the facility and equipment are adequate to meet task requirements; the prepared plans and specifications adequately state Quality Assurance requirements; fabrication and construction are performed in accordance with the design; and tests confirm the adequacy of design and the quality of construction and manufactured components, where appropriate.

The final assembled system will be tested to the requirements of its approval designator and safety class. Therefore, for the individual components, if purchased as commercial grade, the ATP can be treated as dedicating them for the system, although such dedication is not mandatory for Safety Class 3 systems.

9.0 APPROVAL DESIGNATOR

Approval Designator ESQ applies to the mixing system design, with Designator SQ for overall work scope of the mixing system installation on C-103. ECNs or drawings related to the electrical power supply requirements will have approval designator SQ. The shop ATP will have a Q designator. Preliminary testing designator is not applicable.

10.0 SAFETY CLASS

The overall safety class of this system is Safety Class 3.

The safety function performed by this system is to protect the facility worker from being overexposed to passive emissions from tank C-103 which is a passively ventilated tank. It is to be installed downstream of the existing passive breather filter. Failure of this system to provide this function may result in a facility worker within the immediate vicinity to be overexposed to passive emissions. The status lights will provide visual indication from a safe distance that the system is functioning properly. Therefore, the flow switch/status light circuit is Safety Class 3. All other components are Safety Class 4.

C-101 is not a watch list tank.

C-102 is on the organic watch list tank and is currently being pumped.

C-103 is on the organic watch list. It is no longer a USQ tank. It has been determined to be NFPA Class IIIB, which is the least flammable class (Postma, 1994).

11.0 REFERENCES

Claybrook, S. W., and T. M. Burke, "Evaporation Modeling for Tank C-103," WHC-SD-WM-ER-127, Rev. 0, dated 1991. Numerical Applications, Inc., and Westinghouse Hanford Company, both of Richland, Washington.

Conrad, R. B., "Engineering Evaluation of Alternatives for Treatment of Tank 241-C-103 Vapor Space," WHC-SD-WM-ES-281, Rev. 0, dated June 1994. Westinghouse Hanford Company, Richland, Washington.

Huckaby, J. L., and M. S. Story, "Vapor Characterization of Tank 241-C-103," WHC-EP-0780, Rev. 0, dated June 1994. Westinghouse Hanford Company, Richland, Washington.

Mahlum, D. D., J. Y. Young, and R. E. Weller, "Toxicologic Evaluation of Analytes, from Tank 241-C-103," PNL-10189, dated 1994. Pacific Northwest Laboratory, Richland, Washington.

Osborne, J. W., and J. L. Huckaby, "Program Plan for the Resolution of Tank Vapor Issues," WHC-EP-0562, Rev. 1, dated May 1994. Westinghouse Hanford Company, Richland, Washington.

Postma, A. K., "Safety Analysis of Exothermic Reaction Hazards Associated with the Organic Liquid Layer in Tank 241-C-103," WHC-SD-WM-SARR-001, Rev. 0, dated March 1994. Westinghouse Hanford Company, Richland, Washington.

Figure 1 Mixing System Design Concept

TABLE 1
C-103 VAPOR TREATMENT SYSTEM
ENVIRONMENTAL AND WORKER IMPACTS

Quantity of Chemicals Emitted to Environment					Worker Exposure Allowables				Mixed Concentration		
									Fresh air (cfm) Ratio	800 160	
Chemical*	M	C (ppm)*	lb/hr	lb/yr	CES* ppm	Percent of CES	Odor* (ppm)		Mixed Concentration (ppm)	% of CES	
							I	D			
ORGANIC											
Acetonitrile (75-05-8)	41.05	13	4.09E-04	3.49E+00	20	65	0.400	1160.00	0.08	0	
Benzene (71-43-2)	78.12	0.3	1.80E-05	1.53E-01	0.1	300	0.780	61.00	0.00	2	
1,3-Butadiene (106-99-0)	54.09	0.06	2.49E-06	2.13E-02	0.19	32	0.099	0.45	0.00	0	
n-Butanol (71-36-3)	74.12	28	1.59E-03	1.36E+01	50	56	0.050	1.20	0.18	0	
n-Dodecane (112-40-3)	170.34	46	6.01E-03	5.13E+01	120	38			0.29	0	
2-Hexanone (591-78-6)	100.16	0.6	4.61E-05	3.94E-01	1	60	0.068		0.00	0	
Methylene chloride (75-09-2)	84.93	1.6	1.04E-04	8.90E-01	50	3	1.200	160.00	0.01	0	
Propane nitrile (107-12-0)	55	5.3	2.23E-04	1.91E+00	6	88	1.600	1.60	0.03	1	
Tributyl phosphate (126-73-8)	266	0.5	1.02E-04	8.71E-01	0.2	250			0.00	2	
n-Tridecane (629-50-5)	184.37	63	8.90E-03	7.61E+01	120	53			0.39	0	
Total Organics		158.36	1.74E-02	1.49E+02					0.99		
INORGANIC											
Ammonia (7664-41-7)	17	304	3.96E-03	3.38E+01	25	1216	0.043	17.00	1.90	8	
Nitrous oxide (10024-97-2)	44	305	1.03E-02	8.79E+01	25	1220			1.91	8	

*PNL-10189, Toxicologic Evaluation of Analytes from Tank 241-C-103, November 1994, Pacific Northwest Laboratory, Richland, Washington.

C = Concentration

CES = Consensus Exposure Standard

D = Detection

I = Inclusive Range (lowest number)

M = Molecular Weight

WHC-SD-MM-ETP-115
REV 0

TABLE 2
C-103 VAPOR TREATMENT SYSTEM
ENVIRONMENTAL AND WORKER IMPACTS

Quantity of Chemicals Emitted to Environment					Worker Exposure Allowables				Mixed Concentration		
									Fresh air (cfm) Ratio	800 40	
	Q(tank flow cfm)	20									
Chemical*	M	C (ppm)*	lb/hr	lb/yr	CES* ppm	Percent of CES	Odor* (ppm)		Mixed Concentration (ppm)	% of CES	
							I	D			
ORGANIC											
Acetonitrile (75–05–8)	41.05	13	1.64E–03	1.40E+01	20	65	0.400	1160.00	0.33	2	
Benzene (71–43–2)	78.12	0.3	7.19E–05	6.14E–01	0.1	300	0.780	61.00	0.01	8	
1,3–Butadiene (106–99–0)	54.09	0.06	9.95E–06	8.50E–02	0.19	32	0.099	0.45	0.00	1	
n–Butanol (71–36–3)	74.12	28	6.36E–03	5.44E+01	50	56	0.050	1.20	0.70	1	
n–Dodecane (112–40–3)	170.34	46	2.40E–02	2.05E+02	120	38			1.15	1	
2–Hexanone (591–78–6)	100.16	0.6	1.84E–04	1.57E+00	1	60	0.068		0.02	2	
Methylene chloride (75–09–2)	84.93	1.6	4.17E–04	3.56E+00	50	3	1.200	160.00	0.04	0	
Propane nitrile (107–12–0)	55	5.3	8.94E–04	7.64E+00	6	88	1.600	1.60	0.13	2	
Tributyl phosphate (126–73–8)	266	0.5	4.08E–04	3.48E+00	0.2	250			0.01	6	
n–Tridecane (629–50–5)	184.37	63	3.56E–02	3.04E+02	120	53			1.58	1	
Total Organics		158.36	6.96E–02	5.95E+02					3.96		
INORGANIC											
Ammonia (7664–41–7)	17	304	3.96E–03	3.38E+01	25	1216	0.043	17.00	1.90	8	
Nitrous oxide (10024–97–2)	44	305	1.03E–02	8.79E+01	25	1220			1.91	8	

*PNL-10189, Toxicologic Evaluation of Analytes from Tank 241-C-103, November 1994, Pacific Northwest Laboratory, Richland, Washington.

C = Concentration

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