Red Hill Bulk Fuel Storage Facility

Standard Operating Procedures for Visual Monitoring to Verify Tank Cleaning Completion

I. General Provisions

i. The tank cleaning contractor will complete visual monitoring and verification of successful tank cleaning by ultraviolet fluorescence as described in this Standard Operating Procedure (SOP). The contractor will incorporate this SOP into its Quality Control (QC) program.

ii. This SOP establishes visual monitoring requirements to verify completeness of tank cleaning operations, which includes a written record that specifies visual inspection tools, the location(s) from which inspection will be made, the name(s) and title(s) of the person(s) responsible for inspection, and the reporting format.

iii. This SOP is modeled after "California Code of Regulations Title 23 § 2642 – Visual Monitoring" (Cal. Code Regs. Tit. 23, § 2642) which describes procedures for visual inspection of underground storage tank for hazardous substances.

iv. Application of ultraviolet light to induce fluorescence and identify petroleum products during visual monitoring is based upon approved field screening procedures accepted by State of Hawaii Department of Health's (HDOH) Hazard Evaluation and Emergency Response (HEER). Utilization of fluorescence to identify presence of petroleum products is cited in multiple documents prepared by HDOH HEER including: Technical Guidance Manual (TGM) Section 8 (Subsection 8.5.4 Other CPT instruments), Section 3 (Subsection 3.4.4 Subsurface Decision Units), LNAPL Guide Companion Document (HDOH 2018), and Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater (HDOH 2017).

v. This visual monitoring process provides a presence/absence verification of petroleum contamination within the tanks. Under this procedure, the absence of fluorescence indicates cleaning has been completed, but the observation of fluorescence indicates the continued presence of petroleum contamination. In the event petroleum is identified, follow up corrective action will occur to clean identified and documented area(s) of residual contamination.

II. Inspection & Enforcement Overview

i. During cleaning operations of RHBFSF tanks, inspection personnel with the tank cleaning contractor will perform visual monitoring as described in this SOP to identify and document presence of petroleum products within the tanks and verify completion of tank cleaning.

ii. Tanks will be cleared for entry by a qualified industrial hygienist or equivalent to ensure tanks are safe for entry by inspection personnel.

iii. Inspection personnel will abide by all safety procedures outline in RHBFSF's Environmental Health and Safety (EHS) requirements for entry and movement within the tanks.

iv. Utilizing scaffolding and fall protection devices available within the tanks, inspection personnel will survey the entirety of the internal surface within the tanks

using ultraviolet light to visually identify and document presence and location of fluorescence of petroleum products.

v. Inspection personnel will use the Visual Monitoring Requirements Field Form (included below) to document findings.

vi. If standing liquid is observed at the base of the tank, inspection personnel will use a bailer to collect enough of the a sample into an open, clear container to get a good identification of color, clarity, odor, and other parameters on the Visual Monitoring Requirements Field Form.

vi. If inspection personnel observe fluorescence, the tank cleaning contractor will perform additional cleaning as a corrective action. If the inspection personnel identify fluorescence during ultraviolet monitoring, they will note the location and size on the Tank Visual Monitoring Field Form, with sufficient graphical detail (photo evidence and/or drawings) to aid in follow-on corrective action measures to clean localized areas. Inspection personnel will use this ultraviolet fluorescence procedure to verify the follow-on cleaning. Cleaning will repeated as necessary until fluorescence is not observed.

vii. Inspection personnel will complete and submit to the Navy the Visual Monitoring Report.

III. Visual Monitoring Program

The visual monitoring program shall incorporate of the following:

i. Visual monitoring will utilize ultraviolet (UV) light to induce fluorescence of petroleum products to aid in the identification and mitigation of residual contamination.

ii. Prior to use, UV light instruments must be demonstrated to be capable of producing fluorescence on a fuel contaminated surface from a distance of 25 feet.

iii. Visual monitoring will be used to inspect the tank interior surface.

iv. Inspection personnel shall receive documented training for the operation of mobility and safety equipment, the monitoring equipment, and emergency procedures.

v. Visual monitoring shall be performed within 15 days following completion of tank cleaning operations and following approval for safe entry of inspection personnel by a qualified industrial hygienist (or equivalent).

vi. The liquid level in the tank shall be recorded at the time of each inspection.

vii. If any liquid is observed around or beneath the tank, a sample will be collected within a clear container to identify color, clarity, odor, and other parameters on the Visual Monitoring Requirements Field Form.

viii. All completed visual monitoring events shall include a Visual Monitoring Report which includes the following:
   a. Completion of the Visual Monitoring Requirements Field Form;
   b. Date(s) and duration of monitoring event;
   c. The methods and equipment (such as make/model of UV light, type of mobile equipment used), identified by name and model, used for performing the monitoring.

d. The location(s), as identified on a plot plan, where the monitoring was performed;
e. The name(s), title(s), and company of the person(s) who conducted the monitoring and maintained the equipment;
f. Documented findings and any necessary corrective actions.

IV. Written Procedures and Schedule

A written statement of monitoring procedures shall be available at the facility and the record shall include schedule for visual inspections, the location(s) for which the inspections will be made, the name(s) and title(s) of the person(s) responsible for inspection along with their contact details, and the reporting format.

V. Completed Visual Monitoring Reports

Submitted copies of Visual Monitoring Reports and follow-up reports following necessary corrective actions will be held at the facility as a hard copy and stored within cloud based server.

VI. Supplemental Material: Theory of Operation for Fluorescence Screening

Crude petroleum oils are complex mixtures of different compounds (mainly organic), which are obtained from an extensive range of different geological sources. The fluorescence of crude petroleum oils derives largely from the aromatic hydrocarbon fraction, and this fluorescence emission is strongly influenced by the chemical composition (e.g., fluorophore and quencher concentrations) and physical characteristics (e.g., viscosity and optical density) of the oil. The fluorescence spectroscopy is increasingly used in petroleum technology due the availability of better optical detection techniques, because as this tool offers high sensitivity, good diagnostic potential, and relatively simple instrumentation (Steffens et. al., 2010). As evident in the widely used screening tool, laser-induced fluorescence (LIF) technology, to identify petroleum products in the subsurface, which is heavily cited by HDOH HEER guidance documents (Technical Guidance Manual (TGM) Section 8; TGM Section 3; HDOH, 2018; and HDOH, 2017).

In the presence of ultraviolet light, petroleum oils become electronically excited which results in the process of fluorescence emission, primarily in the visible region of the spectrum (Brown and Fingas, 2003). Under ultraviolet light, all petroleum products and crude oils exhibit fluorescence which varies in intensity and hue (Ricker, 1962; Bujewski and Ruthford, 1997). As a screening tool, fluorescence induced by ultraviolet light is one of the only visual tools that can positively discriminate petroleum-based products on most backgrounds (Fingas and Brown, 2014). The high sensitivity of this tool allows for detection of petroleum products ranging from below 100 ppm to more than 10,000 ppm (Löhmannsröben and Roch, 2000). Given the proven application and scientific study of fluorescence screening to identify petroleum-based contamination in the field of environmental restoration and within the state of Hawaii, this tool is well supported for its application as visual monitoring tool to verify completion of tank cleaning.

REFERENCES

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Red Hill Tank Visual Monitoring Field Form

Operator In Responsible Charge (ORC)		**Phone:**	
Company:		**Address:**	
Visual Monitoring Surveyor(s) (if different than ORC):		**Phone:**	
Company:		**Address:**	
Tank Name:		**Date Completed:**	
Tools Used During Visual Monitoring:			

Questions	Yes/No	Description
1. Are walls of the tank tank dry?		
2. Is there liquid present at the bottom of the tank? *If YES, what is the approximate depth and volume? Provide a description of liquid properties (color, clarity, odor).*		
3. Was fluoresense observed on tank walls? *If YES, provide sufficient detail to locate (location, approximate site). Utilize drawing sheet to aid in locating residual petroleum.*		
4. Is there visual evidence of wall damage? *If YES, provide sufficient detail to locate (location, approximate site). Utilize drawing sheet to aid in locating structural damage.*		
5. Is there visual evidence of residual petroelum within the tank (staining, fuel, odor)?		

Prepared by: _____ **Date:** _____ **Signature:** _____

Red Hill Tank Visual Monitoring Form (Contin)

DRAWING No: