Navy Closure Task Force – Red Hill
Revised Tank Cleaning Verification Plan
April 12, 2024

Section 1. INTRODUCTION

The Navy Closure Task Force – Red Hill (NCTF-RH) is submitting this revised proposed tank cleaning verification plan in response to General Comment No. 1 in the Hawaii Department of Health (DOH) letter dated November 15, 2023. NCTF-RH submitted a Tank Cleaning Verification Plan on January 10, 2024, which was not accepted by DOH and the Environmental Protection Agency (EPA). This second submission of a revised Tank Cleaning Verification Plan incorporates findings from in-depth Navy research and in-person communications held with both DOH and EPA at DOH on March 20, 2024. In order to prevent delays in the tank cleaning process, NCTF-RH is requesting concurrence from DOH and EPA to proceed with this tank cleaning verification plan no later than May 6, 2024.

The NCTF-RH definition of clean is a direct quote from API 2015: "the removal of all product, vapor, sludge, and residue from a tank, and washing, rinsing, and drying a tank so that no product or residue remains on any tank surfaces (shell, bottom, piping, appurtenances)." It should be noted: there are no criterion listed in any of the aforementioned regulations (API 2015, UFGS 33.0150.55, API 1604) regarding level of cleanliness. NCTF-RH assumes both EPA and DOH agree with this definition based on past discussions and correspondence.

Recognizing the absence of prescribed tank cleaning standards in both EPA and DOH regulations, NCTF-RH is proposing to augment the visual inspection by utilizing a multiple-lines-of-evidence (MLOE) approach that incorporates both documented qualitative and quantitative methods to demonstrate sufficient cleanliness of tank interior surfaces, protection of the aquifer, and support closure-in-place of Red Hill Bulk Fuel Storage Facility's (RHBFSF) 20 underground fuel storage tanks and 4 surge tanks. The MLOE quality methods described within this plan have multiple layers of quality oversight and review that include cleaning contractor quality control (QC), NCTF-RH quality assurance (QA), independent third-party quality verification (QV), and regulatory inspection from DOH and EPA to ensure transparency and ensure agreement amongst all involved parties that tanks are sufficiently cleaned to effectively eliminate further risk to human health and the environment. Additionally, NCTF-RH proposes to include a quantitative means of demonstrating each tank has achieved the necessary level of cleanliness.

The NCTF-RH intends to comply with the following prescribed cleaning standards when cleaning the tanks:

1. National Fire Protection Association 326, "Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair"
2. United Facilities Guide Specifications 33 0150.55 "Cleaning of Petroleum Storage Tanks"
3. American Petroleum Institute Publication (API) 1604 "Removal and Disposal of Used Underground Petroleum Storage Tanks"

4. American Petroleum Institute Publication 2015 "Cleaning Petroleum Storage Tanks"

Section 1.0.1. Past Proposed Efforts for Tank Cleaning Verification

Prior to submitting the initial Tank Cleaning Verification Plan on January 10, 2024, the Navy had proposed a different approach for tank cleaning validation. In late 2023, the Navy began exploring the use of ultra-violet (UV) light to detect the presence of fuel on the interior surfaces of Red Hill underground storage tanks. The Navy had also previously considered a method that analyzes the effluent rinsate from the tank. However, the Navy eventually concluded these methods were ineffective for the following reasons:

1. UV: When exposed to UV light, JP-5 could only be detected using a UV-bandpass camera, making it impractical to use in the field. JP-5 could not be observed within the visible light spectrum (i.e. using only the naked eye).
2. UV: The intent of using the UV light process was to confirm any remaining fuel on the interior surface of the tank was less than 1 mil in thickness. However, the thickness threshold for using UV light generally only worked for a thickness of 5 mils or greater.
3. Rinsate: The NCTF-RH elected not to pursue rinsate sampling due to the inability to pinpoint locations inside each tank that required further cleaning. If a rinsate sample from the tank sample line did exceed the EALs, it is not possible to pinpoint the area that must be cleaned again. Thus, requiring the entire tank to be cleaned again.

NCTF-RH is submitting this revised plan with the hope that both EPA and DOH will agree with the proposed approach as outlined below.

Section 2. TANK CLEANING VERIFICATION METHODS

The contractor, NCTF-RH, and an independent third-party will use a combination of both qualitative and quantitative evidence to demonstrate the interior of each tank has achieved the required level of cleanliness.

Section 2.1. Qualitative Methods

The contractor, NCTF-RH, and the independent third-party contractor will use a series of qualitative methods to verify tank cleanliness. These methods include visual inspection, gas-free tank inspection and certification, and the water break test.

Section 2.1.1: Gas Free Tank Inspection and Certification

The Gas Free Tank Inspection and Certification is a critical safety measure in the tank cleaning verification process for the RHBFSF. This critical step ensures that the tank atmosphere is free from hazardous vapors, thereby guaranteeing a secure environment for personnel entry and subsequent cleaning operations.

Section 2.1.1.1: Certification Process: The inspection involves a comprehensive evaluation of the tank's internal atmosphere, conducted by a certified Industrial Hygienist/Marine Chemist. The

specialist assesses the levels of various vapors and gases using calibrated detection instruments, ensuring they fall below the threshold limits for occupational exposure and flammability. The key elements checked include the concentration of hydrocarbons, oxygen levels, the presence of toxic gases, and the Lower Explosive Limit (LEL).

Section 2.1.1.2: Safety Confirmation: The certification affirms that the tank contains less than 10 percent of the LEL, oxygen content is within safe breathing ranges (generally between 19.5 percent to 23.5 percent), and noxious fumes such as benzene, hydrogen sulfide, carbon monoxide, and other hydrocarbons are within permissible exposure limits set by regulatory agencies like OSHA.

Section 2.1.1.3: Documentation: Upon successful inspection, the chemist issues a Gas Free Certificate, which is a formal document that declares the tank as safe for personnel entry and work. This certificate is an essential document and must be presented before any personnel can enter the tank for cleaning or inspection.

Section 2.1.1.4: Quality Assurance: As part of the quality assurance protocols, NCTF-RH ensures that the certification procedure is conducted with the utmost diligence and the results are thoroughly documented. The documentation is reviewed as part of the third-party quality validation (QV) program and is retained for records, serving as proof of compliance with safety and health regulations.

Section 2.1.1.5: Regulatory Compliance: The gas-free certification is not only a fundamental aspect of worker safety but also a compliance requirement per API 2015 and UFGS 33.01.50.55. By adhering to this protocol, NCTF-RH demonstrates its adherence to regulatory standards and its commitment to providing a safe working environment. This procedure underpins the integrity of the subsequent steps in the tank cleaning and verification process.

Section 2.1.2: Visual Inspection for Presence of Product and Sludge

The primary qualitative method of verifying tank cleanliness is through the use of visual inspection.

As part of the NCTF-RH quality assurance, NCTF-RH will observe and document the following through the use of photographs:

- Visual inspection to ensure all liquids have been removed.
- Visual inspection to ensure all sludge has been removed.
- Visual inspection to ensure that the tanks have been cleaned in accordance with the contractor's plan.

Visual confirmation is evidence to support tank cleaning verification, designed to ensure that all surfaces within a tank are free from product residues and sludge post-cleaning. The water break test is a tied to the visual inspection. The QC, QA, and QV will observe if water wets the surface rather than beading up; if the water flows uniformly over the entire surface, the surface can be assumed to be clean but if the surface beads-up or does not wet an area, that area will be pressure

washed until clean. This step is crucial for both QC, QA, and QV, and it requires meticulous documentation.

Section 2.1.2.1: Documentation Practices: The comprehensive documentation process captures all facets of visual inspection. Written records detail each inspection's date, exact location within the tank, and the findings of the inspection. Photo documentation supplements written records, providing a visual account that showcases the condition of the tank surfaces during each phase of the cleaning operation.

Section 2.1.2.2: QC Protocols: The cleaning contractor, in accordance with their QC plan will visually inspect and document throughout the cleaning process. These inspections are a critical element of their QC program, ensuring that no residual product or sludge remains. Cleaning contractor personnel are trained to meticulously inspect every area of the tank's interior and to verify that all surfaces are devoid of visual detection of fuel and sludge.

Section 2.1.2.3: Post-Cleaning Inspections: Once the tank cleaning is complete and the interior is dry, the NCTF-RH QA team conducts a thorough inspection to verify the absence of any product or sludge. This step confirms the effectiveness of the cleaning contractor's cleaning efforts and is essential before the tank can be certified as clean.

Section 2.1.2.4: Quality Validation: The independent third-party quality validation (QV) contractor will perform an independent review of the cleaning process. This includes examining plate layout diagrams that record the date each section was cleaned, rinsed, and visually inspected by QC and QA personnel. The QV process confirms that the cleaning contractor’s methods have been thorough and up to the prescribed standards.

Section 2.1.2.5: Regulatory Review: All documentation for each tank is systematically reviewed and then forwarded to EPA and DOH in the finalization of each tank and the final tank cleaning report for final review and concurrence. The thoroughness of this documentation ensures that the regulatory bodies have all the information they need to assess the tank cleaning's compliance with environmental and safety regulations.

Section 2.1.3: Water Break Test

Section 2.1.3.1: Process: The third-party independent contractor will spray atomized mist of distilled water onto surfaces in various locations throughout the interior of the tank and observe for water beading. If water “wets” the surface rather than beading up, the surface can be considered free of petroleum, oil and lubricant (POL) contamination. Beading of water (i.e. water forming droplets) is evidence of POL contamination.

Section 2.1.3.2: Documentation Practices: The comprehensive documentation process will capture all details of the water break test. Written records detail the inspection's date, exact location within the tank, and the findings of the inspection. Photo documentation supplements written records, providing a visual account that showcases the condition of the tank surfaces after successful cleaning has been completed.

Section 2.2. Quantitative Sampling Methods (TPH-DRO Wipe Test)

NCTF-RH is incorporating the Total Petroleum Hydrocarbon Diesel Range Organics (TPH-DRO) Wipe Test, as substantiated by research conducted by Naval Facilities Engineering and Expeditionary Warfare Center (EXWC), development, testing, and evaluation (RDT&E) into RHBFSF tank cleaning verification process. This method offers a quantitative metric for tank surface cleanliness by measuring the mass of diesel range organics per surface area. As demonstrated by the Navy's RDT&E efforts, TPH-DRO has been identified as the dominant risk driver that accounts for the majority (greater than 95%) of total TPH in residual fuels within the Red Hill tanks. Total Petroleum Hydrocarbon Gasoline Range Organics (TPH-GRO) was below detection limits in rinsate samples. The Navy research also evaluated other parameters associated with the fuels stored within the Red Hill Tanks; such as presence of ultra-violet fluorescence of residual fuels, presence of Polycyclic aromatic hydrocarbons (PAHs), middle distillates, and benzene, toluene, ethylbenzene and xylene (BTEX) compounds in rinse samples, and presence of volatile vapors after cleaning, all of which were found to not be present in post-cleaned samples. Given the data from Navy's research, the TPH-DRO Wipe Test is the most appropriate and direct measure for verification purposes to target evidence of residual fuel contamination that can be tied to relevant regulatory standard environmental action levels (EALs) to ensure protection of the aquifer, the environment, and human health. The TPH-DRO Wipe Test can be effectively used on all three types of fuels previously stored in the RHBFSF.

Section 2.2.1: ASTM D6661 Method Modification

The TPH-DRO Wipe Test introduced in the Revised Tank Cleaning Verification Plan is a slight modification of ASTM D6661, the Standard Practice for Field Collection of Organic Compounds from Surfaces Using Wipe Sampling. While ASTM D6661 is a method specifically devised for assessing surfaces for polychlorinated biphenyls (PCBs), its foundational approach is versatile and can be adapted for a broad spectrum of organic compounds. The essence of the method's adaptation lies in its application of different extraction methods used in a laboratory to target specific organic compounds, including TPH-DRO.

This method is simple in its application as materials are limited to a hexane-soaked cotton gauze to collect the wipe sample, a 100 square centimeter border (4"x4") to define the sample area, and a collection vial to store and ship the collected sample for lab analysis. Although the wipe sample collection mirrors that of PCBs, the extraction and analysis of TPH-DRO diverge to accommodate the chemical nature of diesel range organics. This distinction is addressed by employing EPA Method 8015D, which is the established protocol for the extraction of hydrocarbons in the diesel range. Method 8015D ensures the accurate identification and quantification of TPH-DRO.

All collected samples will be sent to a Third-Party Environmental Laboratory Accreditation Program (ELAP) certified by both EPA and DOH for TPH-DRO sample analysis using EPA Method 8015D.

Section 2.2.2: Conversion of TPH-Wipe Test Results to TPH-DRO EALs

The TPH-DRO wipe test results, which are measured in mass per surface area, will be converted into concentration values for comparison against EALs for TPH-DRO. This conversion assumes complete diffusion of TPH-DRO from the interior tank surfaces in contact with water. This highly conservative approach will ensure the utmost protection of the environment and public health. The TPH-DRO Wipe Test results will be evaluated against the prevailing EALs at the time of sampling. Although the EALs vary for TPH-DRO amongst the different fuels, the Navy will work with regulatory partners to determine an applicable EAL to use for TPH-DRO based on type of fuel. Although DOH EALs are a cumulative total of TPH to include TPH-D, G, and O, as previously mentioned the majority of residual fuel (>95%) is composed of TPH-D which is the leading risk driver for closure. Therefore, only TPH-DRO will be the focus of quantitative analysis against the prevailing EAL for TPH at the time of sampling.

To convert TPH-wipe results, which are typically expressed as mass per surface area (mg/cm^2), to a concentration (µg/L), we must relate the mass of TPH-DRO captured by the wipe to the volume of water that would be in contact with the surface of the tank. Here's a step-by-step breakdown of the math:

1. **Estimate Volume of Water:**
    - Estimate the volume of water in the tank that would enter the tank. This involves assuming a depth of water in the tank and calculating the corresponding volume. Understanding that water depth will determine the degree of residual TPH diffusing into the water, as a conservative measure a full tank was evaluated to ensure the total tank surface area is captured (200 feet depth of water). At lower depths (<2 feet) there is negligible amounts of TPH mass (<2 grams) that doesn't warrant risk evaluation.

2. **Determine Submerged Surface Area in Contact with Water:**
    - Identify the total surface area of the tank that would be in contact with any water present. As previously mentioned, this could assume a tank full of water to capture the total tank surface area (200 feet depth of water) or be restricted to a certain depth of water expected (i.e. 2 feet depth of water).

3. **Determine the Mass of TPH-DRO per Surface Area:**
    - Use the TPH-DRO wipe test results to determine a statistically supported mass of TPH-DRO per unit area. A sufficient sample size will be used to develop a statistically supported mass of TPH-DRO per unit area for each tank.

4. **Convert Mass/Surface Area to Mass/Volume:**
    - Multiply the mass of TPH-DRO per unit area (from step 3) by the total surface area in contact with water (from step 2) to get the total mass of TPH-DRO that would potentially dissolve in the water.
    - Then, divide this total mass by the volume of water in the tank (from step 1) to convert it to a concentration.

The formula for determining TPH-DRO concentration is shown below:

$$\text{TPH-DRO Concentration } (\mu g/L) = \frac{Total\ Mass\ of\ TPH{-}DRO\ (\mu g)}{Volume\ of\ Water\ (L)}$$

Where:

$$Total\ Mass\ of\ TPH-DRO\ (\mu g) = \text{TPH-DRO Wipe Test Results } (\tfrac{mg}{cm^2}) \text{ x } 1000\ (\tfrac{\mu g}{mg}) \text{ x } 1000\ (\tfrac{cm^2}{m^2}) \text{ x Submerged Surface Area } (m^2)$$

This calculation assumes 100% transfer of TPH-DRO from the tank surface to the water which is a conservative approach. In reality, not all residues may dissolve or disperse into the water, so this method will conservatively overestimate the concentration.

Section 2.2.3: Statistically Supported Sample Size

In determining the appropriate sample size for the TPH-DRO Wipe Test in this Revised Tank Cleaning Verification Plan, NCTF-RH has adopted the requirements set forth by EPA Method SW-846 Chapter 9, ensuring the scientific credibility of the process. NCTF-RH's statistically supported sample size aligns with the guidelines outlined in Interstate Technology Regulatory Council (ITRC), Soil Background and Risk Assessment, Section 11 Statistics, Subsection 11.1.3. Minimum Sample Size (ITRC Web-Document), which states, "The minimum sample size is the number of individual samples required to conduct a specific statistical test or to calculate a specific statistical parameter with an acceptable level of uncertainty. Generally, a minimum sample size of 8–10 samples is required to do this ((USEPA 2009), (USEPA 2015)). This recommendation is applied in many state agency guidance documents ((IDEM 2012), (IDEQ 2014), (KDHE 2010)). However, depending on site characteristics and conditions or desired statistical power, more samples may be required. Some state agencies require a minimum sample size of 20 samples ((KEEC 2004), (MTDEQ 2005)), due to the typical heterogeneity of soils (MTDEQ 2005))." It's important to note that the ITRC is a state-led environmental coalition that is made up of regulators, state/federal agency partners, academic experts, and industry professionals that represent all 50 states to provide technical documentation to improve regulatory decision-making while protecting human health and the environment. While this ITRC document recommends a sample size of 20 to account for the high heterogeneity typically found in soil profiles, NCTF-RH proposes to collect 30 samples, to provide well-supported statistically-based results beyond ITRC's minimum range that will suffice for the comparatively homogeneous surfaces of the interior of the underground storage tanks.

A sample size of 30 is statistically significant, conservatively-biased and robust enough to yield reliable TPH-DRO Wipe Test results. Moreover, NCTF-RH proposes a focused and conservatively-biased sampling strategy, targeting the bottom 20 feet of the tank with 20 of the 30 samples. This decision is rooted in the understanding that the bottom section of the tank presents the highest potential for retaining residual hydrocarbons, having been perennially submerged in fuel and subjected to decades of sludge accumulation.

By concentrating the majority of wipe samples in this area, NCTF-RH ensures that the data is collected from the most severe areas of the tank, thereby adopting a conservative stance in the verification process. The remaining 10 samples will be dispersed across the vertical walls of the

tank, providing a comprehensive representation of the tank's overall cleanliness. Through this strategic sampling distribution, NCTF-RH underscores its commitment to a methodical and scientifically sound approach to environmental stewardship and regulatory compliance.

Section 2.2.4: Pre-Cleaning Inspection Using TPH-DRO Wipes

TPH-DRO wipes will be collected before cleaning and used to establish a baseline of residual petroleum on the tank walls at the RHBFSF (10 TPH-DRO wipe samples per tank). This initial assessment quantifies the amount of TPH-DRO present before the commencement of cleaning activities, serving as a crucial reference point for the Navy to evaluate the effectiveness of the tank cleaning process. Wipes collected before cleaning will be compared to those collected after cleaning to determine the effectiveness of the cleaning method and will not be compared to EALs. Only wipes collected after cleaning will be compared to EALs.

2.2.4.1: Documentation and Analysis: Each pre-cleaning wipe test is thoroughly documented, including details such as the date, specific location within the tank, and the measured TPH-DRO levels. This documentation provides a detailed map of contamination hotspots and general tank condition, facilitating a focused and strategic cleaning plan.

2.2.4.2: QA Verification Activities: QA will be present throughout the cleaning process. The government QA team take photos of the cleaning tank procedures. The QA team will document the procedures executed by the contractor. The QA team will spot check the contractor throughout the process. The QA team will take 30 samples and have an independent 3rd party lab perform analysis on the TPH-DRO wipes More importantly, post-cleaning samples will confirm the level of contamination on the interior surfaces of the tank is less than the EALs.

Section 2.2.5: Integration into QC, QA, and QV Phases

The TPH-DRO Wipe Test will be systematically integrated into all phases of the tank cleaning process. The NCTF-RH will implement this test as part of its pre-cleaning procedure (10 TPH-wipe samples). The NCTF-RH will take (30 TPH-DRO wipe samples, post cleaning. NCTF-RH will employ it in quality assurance evaluations (30 TPH-DRO wipe samples). The data collected will be summarized by the 3rd party QV team. EPA and DOH will have access to the data during the collecting of samples, inspections, and results.

Documentation will include detailed records of the wipe tests, the calculated concentrations of TPH-DRO, and the specific methodologies used. Upon completion of tank cleaning and validation through TPH-DRO Wipe Test results, the NCTF-RH will send all results to DOH and EPA for regulatory review, ensuring a swift and transparent transition to the next stages of tank closure.

As previously stated, TPH-DRO levels will be taken before cleaning. Post-cleaning TPH-DRO samples will compared to EALs to clearly demonstrate the tanks are within the required standard of cleanliness, or to inform whether additional cleaning is needed. Additionally, wipe tests will serve to manage residual risk and to serve as a line of evidence to support closure-in-place.

Section 2.3: Process Overview

In the following Figure 1, a step-by-step process describes a high-level overview of the MLOE used for verifying tank cleanliness.

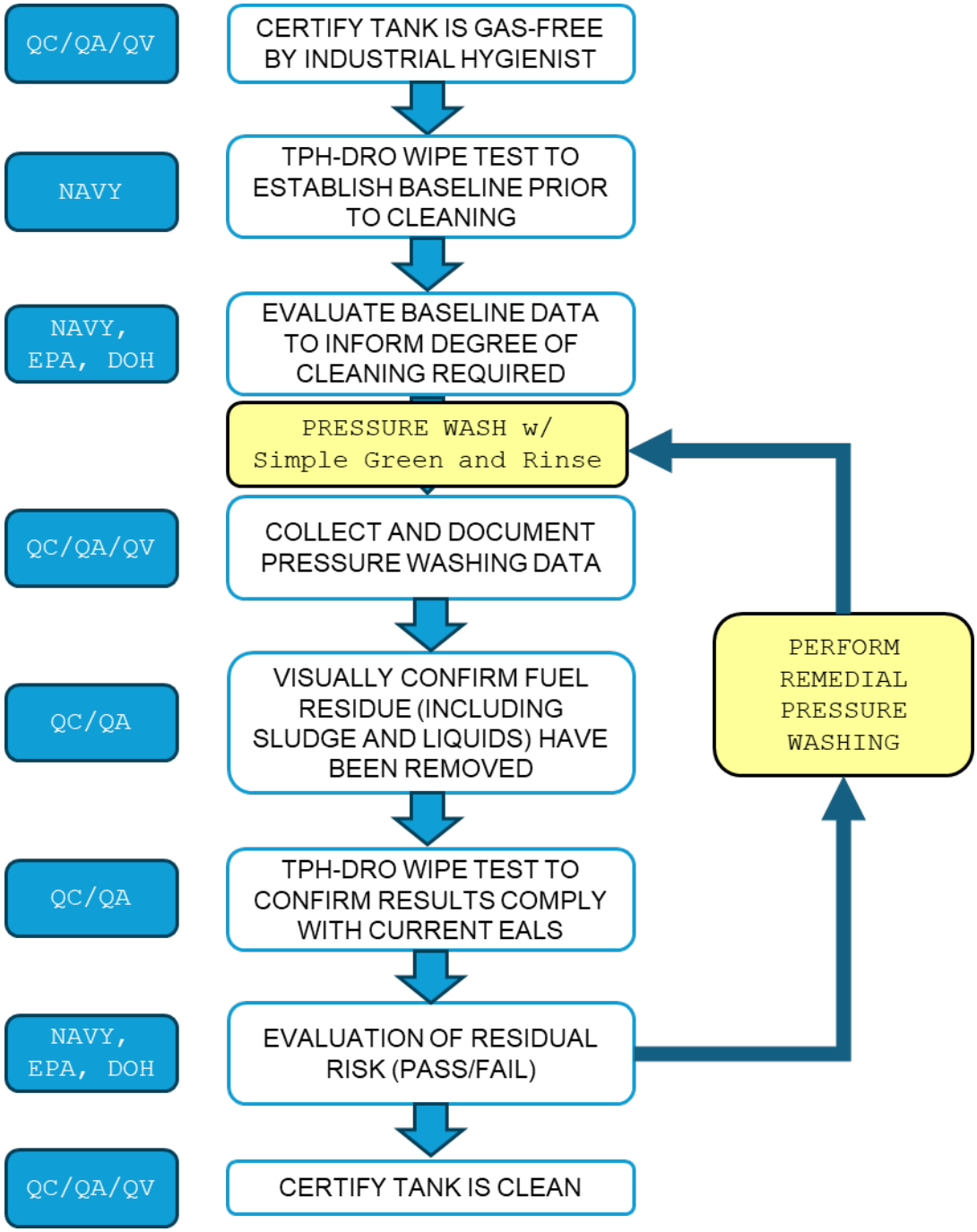

Figure 1: Tank Cleaning Verification Process

Step 1 - Gas Free Tank Certification:

Before any wipe testing is conducted, it is imperative to obtain a Gas Free Tank Certification. This step involves an industrial hygienist or marine chemist certifying that harmful vapors are no longer present, rendering the tank safe for personnel occupancy. This certification is a prerequisite to ensure safety during the subsequent testing phases. This step will be initiated for both pre-cleaning and post-cleaning inspections.

Step 2 – Pre-Cleaning Inspection using TPH-DRO Wipe Testing:

Prior to cleaning, NCTF-RH will complete a baseline survey of the tank's interior surfaces using TPH-DRO wipes (10 samples) to quantify the initial levels of residual petroleum, which aids in tailoring the subsequent cleaning efforts. This strategy establishes a quantifiable measure against which the effectiveness of the cleaning process can be assessed, ensuring a thorough removal of petroleum residues and verifying the tank's readiness for the next phase of quality assurance and validation.

Step 3 - Visual Confirmation of Lack of Presence of Product and Sludge:

After ensuring the tank is gas-free, a visual inspection is performed to detect the absence of product and sludge during all phases of cleaning including, pre-cleaning inspection, during cleaning operations, and after cleaning activities have been completed. Visual documentation will include photography during all phases of cleaning operation described above to serve as evidence to support written records. This meticulous approach to visual confirmation and documentation ensures accountability at each step of the tank cleaning process. The detailed records and photographic evidence not only demonstrate compliance with the established procedures but also serve as a reliable reference for future inspections and maintenance activities. Documented results from the visual inspection will provide qualitative evidence to augment the quantitative results from TPH-DRO wipe test results.

Step 4 – QA (and QC) TPH-DRO Wipe Testing:

The wipe testing is conducted in accordance with the outlined sampling plan. The gauze pads, soaked in an appropriate solvent, are used to wipe specified areas of the tank interior surfaces systematically. The sampling strategy involves:

- Selection of up to 30 random locations for QC at the discretion of the cleaning contractor.
- Selection of 30 random locations for QA, with a focus on the bottom 20 feet.
- Send samples to a 3rd Party ELAP-accredited laboratory to conduct EPA Method 8015D.
- Assuming complete diffusion of measured residual mass for conservative risk assessment using a full tank scenario (water depth 200 feet).

Step 5 - Analysis and Documentation:

Post-collection, the samples are analyzed for TPH-DRO content, results are documented and analyzed against prevailing EALs at the time of sampling. This documentation includes the location, conditions of the sampled area, and TPH-DRO wipe test results.

Step 6 - Quality Validation:

The final step is a comprehensive quality validation (QV) of all gathered documentation and collected data. This QV is integral to the verification plan, ensuring that the tanks meet the established cleanliness criteria and supportive lines of evidence to support tank closure.

By implementing this method, the NCTF-RH can provide a scientifically supported, quantitative assessment of tank cleanliness, aligning with environmental safety objectives and regulatory requirements. The inclusion of TPH-DRO wipe tests during the tank cleaning process fosters a rigorous, transparent, and thorough verification process.

Section 3: TANK CLEANING QUALITY VERIFICATION TIERS

The comprehensive approach to verify tank cleanliness at the Red Hill Bulk Fuel Storage Facility is delineated into four independent, yet interconnected tiers. Each tier serves a specific function in the quality assurance process, ensuring that the tank cleaning meets stringent standards of safety and environmental protection. These tiers represent a collaborative, multilayered effort between various entities, each with a defined role in the tank cleaning verification plan.

Tier 1: Contractor Quality Control by the cleaning contractor

The initial tier of verification is undertaken by the tank cleaning contractor responsible for the Quality Control (QC) over its cleaning operations. The cleaning contractor's QC team continuously monitors and verifies that all cleaning procedures are effectively removing product, sludge, and residue from the interior surfaces of the tanks. The QC process includes comprehensive checks and balances to ensure that each cleaning step is executed to the highest standards and is thoroughly documented for subsequent review. Specific data for inclusion of the QC documentation process may include records of cleaning solution used and relative percentages in detergent rinse (i.e. 3% Simple Green), pressure readings from pressure washer during soap and pressure rinse cycles (if applicable), water flow rates, time spent cleaning each section or vertical transect of the tank, and volume of waste extracted from the FOR line.

Tier 2: Quality Assurance by NCTF-RH

NCTF-RH provides the second tier of verification through its Quality Assurance (QA) program. NCTF-RH QA team inspects the work completed by the cleaning contractor, corroborating that the tanks are devoid of product, sludge, and residue. Further, NCTF-RH will collect the TPH-DRO wipe samples as part of its QA evaluation in combination with continuous visual inspection to confirm the cleanliness of every tank interior surface.

Tier 3: Quality Validation by Third-Party Contractor

The third tier involves hiring an independent third-party contractor to perform Quality Validation (QV) of the tank cleaning. This contractor will review and validate the cumulated document and data collected from all utilized methods such as visual inspection, wipe testing, and any additional necessary assessments. The QV process mirrors the protocols established by the Joint Task Force – Red Hill (JTF-RH) and serves as an impartial assessment to ensure unbiased verification of the tank cleaning quality.

Tier 4: Inspection by DOH and EPA

The fourth and final tier of verification is the inspection by representatives from DOH and EPA. These regulatory bodies will have the opportunity to physically inspect the tank interiors and review documentation to confirm the cleanliness of the tanks. DOH and EPA inspections represent the ultimate validation of the cleaning process, ensuring that all standards are met and that the tanks pose no further risk to the environment or public health.

Integration and Documentation

Throughout each tier of the verification process, meticulous documentation is maintained to record the cleaning activities, results, and any corrective actions taken. This documentation serves as a transparent record for all stakeholders involved and is critical for regulatory review and concurrence. The multi-tiered approach allows for a robust and comprehensive verification of tank cleanliness, ensuring the integrity of the cleaning process and safeguarding environmental and public health interests.

Section 4: TANK CLEANING VERIFICATION DOCUMENTATION

The verification of tank cleaning at the Red Hill Bulk Fuel Storage Facility entails comprehensive documentation to ensure transparency, regulatory compliance, and the highest standards of environmental safety. The following components form the backbone of the documentation process:

1. Marine Chemist's Volatile Vapors Report

A crucial aspect of the verification process is the safety of personnel entering the tanks. A Marine Chemist or Industrial Hygienist provides a report certifying the absence of harmful volatile vapors, ensuring the tank is safe for human entry. This report includes measurements of hydrocarbon levels, oxygen content, and the presence of other potential hazards contributing to the comprehensive safety profile for the cleaning operations.

2. Photographic Evidence of Tank Conditions

A visual record is essential for capturing the tank conditions at various stages. Photo documentation includes images of:

- Pre-cleaning condition, showcasing the tank's initial state.
- The tank during cleaning activities, illustrating the cleaning in progress.
- Post-cleaning condition, demonstrating the cleanliness of tank surfaces after the procedure.
- All phases of the tank cleaning verification activities, including QC by the cleaning contractor, QA by NCTF-RH, and QV by an independent third-party contractor.

Photographs serve as a visual corroboration of the written records and offer a clear, indisputable account of the tank's cleanliness throughout the process.

3. TPH-DRO Wipe Results Analysis

To assess the effectiveness of cleaning and verify the reduction of diesel range organics, pre- and post-cleaning TPH-DRO wipe test results are meticulously recorded. These results offer a quantitative measure of TPH-DRO mass reduction and more importantly, serve as a primary indicator of the cleaning process' success by comparison to prevailing EAL risk-based y levels set for TPH in groundwater. Documentation includes detailed information on the mass/surface area of TPH-DRO before and after cleaning, providing an empirical basis for evaluating the efficiency of residue removal.

4. Verification Activity Log

A detailed log captures the frequency of all verification activities, annotated with the time, date, and specific location within the tank. This record includes:

- The nature of each verification activity, whether visual inspections or TPH-DRO wipe tests.
- The specific section of the tank being inspected or tested, providing spatial context to the cleaning and verification efforts.

This documentation ensures an auditable trail of the verification process, enhancing the reliability and integrity of the cleaning efforts.

Summary

The comprehensive documentation of tank cleaning verification is designed to uphold stringent environmental standards, ensure worker safety, and provide clear, quantifiable evidence of cleaning efficacy and alignment with relevant regulatory limits such as DOH EALs. The evaluation of multiple verification methods from Navy RDT&E efforts and the development of a novel approach stands as a testament to NCTF-RH’s commitment to providing a transparent, clear, and accountable process in response to unique environmental challenges and ensuring protection of public health and the environment.

REFERENCES

1. NCTF-RH Tank Cleaning Verification Plan dated January 10, 2024
2. Hawai'i Department of Health (HDOH), 2022; Recommended Risk-Based Drinking Water Action Levels for Total Petroleum Hydrocarbons (TPH) Associated with Releases of JP-5 Jet Fuel, HDOH, 2017
3. Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater – Hawaii Edition
4. National Fire Protection Association 326, "Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair"
5. United Facilities Guide Specifications 33 0150.55 "Cleaning of Petroleum Storage Tanks"
6. American Petroleum Institute Publication (API) 1604 "Removal and Disposal of Used Underground Petroleum Storage Tanks"
7. American Petroleum Institute Publication 2015 "Cleaning Petroleum Storage Tanks"
8. ASTM D6661 "Standard Practice for Field Collection of Organic Compounds from Surfaces Using Wipe Sampling"