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USACE / NAVFAC / AFCEC **UFGS-02 51 19 (February 2025)**

Preparing Activity: USACE **Superseding**
UFGS-02 51 19 (February 2021)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2025

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SECTION 02 51 19

SOLIDIFICATION AND STABILIZATION DECONTAMINATION

02/25

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SECTION 02 51 19

SOLIDIFICATION AND STABILIZATION DECONTAMINATION
02/25

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NOTE: This guide specification covers the requirements for solidification/stabilization (S/S) of contaminated materials.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

****

PART 1 GENERAL

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NOTE: This guide specification provides the framework for developing a project-specific S/S specification. This guide specification is not intended for in situ applications of the S/S technology, specifically when contaminated materials are present at depth and specialized equipment is required for reagent delivery and mixing. This guide specification should be modified as necessary for a given site, to incorporate the conditions, mix design, mixing method, and regulatory requirements which are specific to the site. This guide specification specifically considers S/S

applications using ex-situ mixing of contaminated materials and reagents in a dedicated mixing system such as a pug mill. This guide specification can also be modified to accommodate other applications of the S/S technology such as mixing reagents into contaminated materials at the surface or at shallow in-situ depths (e.g. using an excavator bucket or soil tiller for mixing). For these relatively simple applications, many elements of this guide specification will be un-necessary and should be deleted.

The S/S treatment considered in this guide specification starts with the raw contaminated material; continues through preparation, feeding, and mixing reagents into the contaminated material. Other specification sections would provide requirements for handling, stockpiling, and final disposition of the treated material (either left in-place, moved to an on-site designated permanent storage unit, or transported off-site for final disposal). As applicable, refer to Section 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL for requirements related to excavation and stockpiling of the contaminated materials; Section 31 00 00 EARTHWORK for placement of treated materials in on-site permanent storage; and Section 02 81 00 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS for requirements relevant to offsite transportation and disposal.

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1.1 MEASUREMENT AND PAYMENT

1.1.1 Unit Prices

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NOTE: Edit this paragraph based on whether the Contract will use a single job price or unit prices. If Section 01 20 00 PRICE AND PAYMENT PROCEDURES is in the project, move these paragraphs to that Section for editing.

If the project includes Section 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIALS, coordinate measurement and payment methods and contaminated material handling and stockpiling between this Section and Section 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIALS.

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1.1.1.1 Contaminated Materials

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Use the first bracketed paragraph for measurement by volume. Use the second bracketed paragraph for measurement by weight. Batch processing is likely to use weight as the method of measurement. In situ processes are more likely to use volume as the

method of measurement.
****

[Measure contaminated materials by the cubic meter cubic yard of contaminated material that is treated by solidification and stabilization (S/S). Compute volume by[the average end area method from cross sections taken before and after excavation of contaminated material][the surficial area and treatment depth when treating contaminated material in-situ].

][Measure contaminated materials by the metric ton ton of contaminated material treated by S/S. Use a properly calibrated weighing system to accurately measure the gross (bulk) weight of the contaminated material. Convert the measured gross (bulk) weight of the contaminated materials to be treated to dry weight based on the[percent moisture content of representative contaminated material samples. Determine the percent moisture content in accordance with[ASTM D2216][ASTM D4643][ASTM D4959][_____]. Determine moisture content[daily][for every[500][_____] metric tons tons of contaminated material that is treated]][_____].

] Unit price must include costs for materials, labor[, moisture reduction][, hauling][, stockpiling], processing and treatment, testing and analyzing,[and] operation and maintenance[, and wastes (solid, liquid and/or gaseous) treatment and disposal].

1.1.2 Single Job Prices

[1.1.2.1 Bench-Scale Treatability Studies

****
NOTE: Delete this paragraph if bench-scale treatability studies have already been performed.
****

If the Government requires the Contractor to perform bench-scale treatability studies, the studies will be[included as part of base bid items][measured at a single job price][_____]. The price must include costs for labor and materials for:

a. Preparing plans.

b. Collecting representative contaminated materials.

c. Conducting the studies (including sampling and analysis).

d. Evaluating results.

e. Report preparation.

f. Treating and disposing of study-derived wastes.

]1.1.2.2 Field Demonstration

Payment for field demonstrations will be[included as part of base bid items][based on a single job price for each field demonstration requested by the Contracting Officer and properly completed]. The price will include costs for labor and materials for:

[a. Moisture reduction.

][b. Hauling.

][c. Stockpiling.

] d. Processing and treating.

e. Testing and analyzing.

f. Preparing reports.

g. Treating and disposing of wastes (solid liquid and/or gaseous) generated during field demonstrations.

h. Other incidental work (such as manufacturers' field services, health and safety monitoring and controls, and utilities).

1.1.2.3 Other Work Items

****
NOTE: Coordinate this paragraph with Section 01 50 00 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS. Temporary utility connections are covered in Section 01 50 00 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS.
****

Include work items related to the work of this Section, but not included in the above paragraphs, in the base bid for treatment of the contaminated materials. Such work items include:

a. Submittals related to operation of the S/S treatment system.

b. Mobilization and demobilization.

c. Site preparation in the treatment area.

d. Configuration and installation of the treatment system.

e. Manufacturers' field services.

f. Environmental compliance monitoring.

g. Health and safety monitoring and controls.

h. Utilities required for the S/S treatment, if approved by the Government as necessary for the project.

1.2 REFERENCES

****
NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this aragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of

the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D1632	(2007) Standard Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory
ASTM D1633	(2000; R 2007) Standard Test Methods for Compressive Strength of Molded Soil-Cement Cylinders
ASTM D2216	(2019) Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D4643	(2017) Standard Test Method for Determination of Water Content of Soil and Rock by Microwave Oven Heating
ASTM D4959	(2016) Determination of Water (Moisture) Content of Soil by Direct Heating
ASTM D5084	(2016a) Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(2018) Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 505-B-04-900A	(2005) Intergovernmental Data Quality Task Force - Uniform Federal Policy for Quality Assurance Project Plans: Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs Part 1: UFP-QAPP Manual
EPA 600/2-85/028	(1985) Guide For Decontaminating Buildings, Structures, and Equipment At Superfund Sites

EPA SW-846	(Third Edition; Update VII) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods
UFP-QAPP WKSTS	(2012) Intergovernmental Data Quality Task Force - Uniform Federal Policy for Quality Assurance Project Plans, Optimized UFP-QAPP Worksheets

1.3 PRE-INSTALLATION MEETINGS

****
NOTE: Delete this paragraph if the requirements are included in Section 01 30 00 ADMINISTRATIVE REQUIREMENTS, Section 01 32 01.00 10 PROJECT SCHEDULE, or other Specification Section.

Appropriate facility personnel should be present at the pre-installation meeting if siting of the treatment facility and other associated work areas will be discussed.
****

Conduct a pre-installation meeting at the jobsite at least[five business days prior to the start of operations on the project][_____]. Arrange the pre-installation meeting and follow the written pre-installation meeting agenda submitted prior to the meeting. The purpose of this meeting is to review the requirements of this Section and the associated plans. The following individuals must be in attendance at this meeting: Contractor's Project Manager and Site Foreman and [Contracting Officer][_____].

Record pre-installation meeting minutes and publish via email within 48 hours to all attendees. Re-publish the minutes within 48 hours via email pending any subsequent comments from the attendees.

1.4 SYSTEM DESCRIPTION

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NOTE: Indicate if the Government knows/assumes that there are multiple dissimilar types of contaminated materials that will require different S/S treatment processes. This may be based on site investigations and/or previously completed treatability studies.
****

The work consists of S/S treatment of approximately [_____][cubic meters cubic yards][metric tonstons] of contaminated material.

1.4.1 Design Requirements

****
NOTE: The complexity of S/S treatment processes can vary. Examples of simplistic applications would be spreading reagents onto contaminated materials and mixing with an excavator bucket or tow-behind tractor tiller. Examples of more complex applications would be multi-step processes of separating oversize material, blending/homogenizing

contaminated materials, feeding contaminated materials and reagents into a mixing unit, and conveying treated materials to a stockpile location or load-out area. The design requirements below are written for a complex S/S application. Edit as necessary for a simplistic S/S application.

Omit the third- and fourth-to-last sentences of this paragraph ("The Contractor may propose … must be addressed in detail…") if a specific method of treatment (in situ or ex-situ) is desired.

****

Configure the treatment plant based on the contaminated material characteristics data, [the Contractor's own interpretation of the previously conducted treatability study results][_____], and [the bench-scale [and][or] pilot-scale treatability studies performed by the Contractor][_____] to ensure the treated material conforms to paragraph PERFORMANCE REQUIREMENTS.[The treatment plant must be transportable.] The materials, components, accessories, and equipment used to fabricate the treatment plant must meet their functional requirements and must be compatible with the contaminants of concern, the reagents used in the treatment processes, and the operating conditions of each unit operation.[The Contractor may propose a treatment plant different from the treatment plant specified. Government approval of a Contractor-proposed treatment plant does not relieve the Contractor of responsibility for meeting specified requirements for safety, reliability, and performance.] Provide a safe and reliable treatment plant in compliance with the applicable codes and regulations and specified requirements. The treatment plant must consist of the following:

1.4.1.1 Contaminated Material Preparation and Feed System

****

NOTE: Since heterogeneity and inconsistent feed conditions can impact S/S treatment efficiency, if appropriate, pre-processing steps to maintain homogenization for optimal treatment efficiency should be specified. Alternatively, contaminated materials may need to be segregated by order of magnitude concentrations and treated using different process conditions to optimize treatment throughput and minimize treatment costs, which should be determined during the treatability/design steps.

Oversize material will likely need to be removed when S/S is performed ex-situ. Edward Bates and Colin Hills' Stabilization and Solidification of Contaminated Soil and Waste: A Manual of Practice (2015) indicates that most ex-situ S/S mixers require feed material to be less than 2.5 cm 1 in.

Bates & Hills "Stabilization and Solidification of Contaminated Soil and Waste: A Manual of Practice" is available at: https://clu-in.org/download/techfocus/stabilization/S-S-Manual-of-Practice.p

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Provide a contaminated material preparation and feed system which

includes, but is not limited to:

a. Oversize material separation.

b. Blending or separation of different materials to provide a consistent feedstock(if needed).

c. Stockpiling of oversize and feed contaminated materials.

d. Conveying, feeding, treatment [and][or] disposal of oversize material.

e. [Dust][emission] controls.

f. Measurement of oversize and feed contaminated materials.

Base the capacity of this system on the downstream treatment system operations. Refer to Section 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL for requirements related to excavation and stockpiling of the contaminated materials.

1.4.1.2 Reagent Feed and Mixing System

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NOTE: The suggested mixing equipment production rates provided below are average values from the Edward Bates' and Colin Hills' 2015 Stabilization and Solidification of Contaminated Soil and Waste: A Manual of Practice. When specifying minimum production rates, the designer should also be aware of potential production rate limitations associated with the available storage area for stockpiling treated materials and turnaround times for testing of treated materials for performance requirement verification.

****

Provide satisfactory means, incorporating weighing, metering, or volumetric measurement to deliver the required quantity of each reagent. Equip and operate silos and feeders to prevent caking of reagent and variation in feed. Ensure that each reagent can be easily sampled. Provide mixing equipment [with a minimum capacity adequate to meet performance and schedule requirements] [capable of treating[515][_____] cubic meters/day[675][_____] cubic yards/day] and with positive means for controlling the mix proportions, maintaining the time of mixing constant, and maintaining the appropriate rotation speed of the mixer.

1.4.1.3 Plant Supporting System

Include a supporting system in the treatment plant for water storage and distribution, reagents storage and distribution, power generation and distribution, and fire safety. Provide these supporting facilities with adequate capacities to deliver water, reagents, power,[_____], and fire protection necessary for operation of the S/S system. Refer to [Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS][_____] for requirements related to spill containment structures and stormwater pollution prevention.

1.4.1.4 Utilities

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NOTE: The locations and details (such as utility point of contact, sizes, capacities, and flows) of the utility hookups should be provided on the drawings for the Contractor's use. Verify the utilities are available on-site before including the second sentence.

****

In accordance with Section 01 50 00 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS, provide the utilities associated with the installation and operation of the treatment plant including, but not limited to:[telecommunications,][electricity,][water,][gas,][_____,][sanitary,] and solid waste facilities.[The[telecommunications][electricity][water][gas][sanitary] and[solid waste facilities][_____] are available at the site.]

1.4.1.5 Material Measurement

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NOTE: This paragraph is primarily intended to ensure that calibrated scales are being used to weigh materials when weight is being used as the basis for measurement and payment.

****

Provide scales, meters, and volumetric measuring devices for measuring oversize materials, feed contaminated materials, reagents, and water which conform to the applicable requirements of NIST HB 44, except that the accuracy must be plus or minus[0.1][_____] percent of the quantity being measured. For scales used to measure weight of material in vehicles, provide scales of sufficient length to permit simultaneous weighing of all axle loads. For scales used to make measurement for payment, ensure the scale is certified[by an acceptable scales company representative][by an inspector of the State Inspection Bureau charged with scales inspection] prior to weighing any materials. Perform a check of calibration of measuring equipment prior to initial use, and once every [seven][_____] calendar days. The requirements of this paragraph do not apply to measurement of chemical or physical data for purposes of demonstrating compliance with paragraph PERFORMANCE REQUIREMENTS.

[1.4.1.6 Bench-Scale Treatability Study Work Plan

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NOTE: Typically, a bench-scale treatability study will have been performed prior to development of this specification; however, the Contractor is sometimes required to complete a bench-scale treatability study prior to performing full-scale work at the site. Bench-scale treatability study test results should include the proposed reagents and mix ratios to be used during full scale treatment. The test results submitted should verify that the mix design proposed meets the post-treatment criteria listed in paragraph PERFORMANCE REQUIREMENTS. Consideration should also be given to the need to monitor off-gas and dust emissions during the bench-scale treatability study.

Further guidance on conducting treatability studies

for S/S treatment can be found in the Interstate Technology and Regulatory Council's July 2011 Development of Performance Specifications for Solidification/Stabilization and Edward Bates' and Colin Hills' 2015 Stabilization and Solidification of Contaminated Soil and Waste: A Manual of Practice.

ITRC "Development of Performance Specifications for Solidification/Stabilization" (2011) is available at: https://itrcweb.org/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFil

****

Submit a Bench-Scale Treatability Study Work Plan within[60][_____] calendar days after notice to proceed. Do not perform the treatability study until the work plan is approved. Prepare [draft for Government review] [draft-final for [regulatory][_____] review] and final versions of the Bench-Scale Treatability Study Work Plan. Allow [30][_____] calendar days for [Government] review [and [30][_____] calendar days for regulatory review]. Allow [45][_____] days for comment resolution following each review and preparing the next version of the document. Address the technical requirements, listed below and in paragraph BENCH-SCALE TREATABILITY STUDY, in the work plan. The technical requirements include, but are not limited to:

1.4.1.6.1 Conceptual Implementation Plan

Describe the proposed means of meeting the S/S treatment requirements in paragraph PERFORMANCE REQUIREMENTS for the contaminated materials, including reagent delivery and mixing methods, anticipated cure times for treated materials, and methods for transporting contaminated and treated materials between various stages of the treatment process.

1.4.1.6.2 Proposed Mixes

Submit multiple proposed mixes of contaminated soil and reagents to be included in the bench-scale treatability study designed to optimize the treatment effectiveness. At a minimum, include the following reagents in the proposed mixes:[Portland cement,][fly ash,][activated carbon,][_____].

1.4.1.6.3 Laboratory Procedures

Describe how the parent contaminated material sample will be processed to remove oversize materials, homogenized, and subdivided into aliquots for testing of different proposed mixes. Describe how reagents will be mixed with contaminated materials. Identify and justify deviations between the Conceptual Implementation Plan and Laboratory Procedures (e.g., the Conceptual Implementation Plan is to mix dry reagents into contaminated materials, but the Laboratory Procedure proposes mixing reagents as slurries).

[1.4.1.6.4 Testing Approach

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NOTE: If a UFP-QAPP is prepared and covers testing during the Bench-Scale Treatability Study, this paragraph should be deleted or replaced with a reference to the UFP-QAPP.

****

Describe the testing approach which will be used to assess performance of the different proposed mixes.

]]1.4.1.7 S/S Treatment Work Plan

****

NOTE: The Designer may wish to require the S/S Treatment Work Plan, UFP-QAPP, and other preconstruction submittals required under this section to be completed concurrently or with the other plans being appendices of one primary plan. This Section should be edited to reflect such a requirement if applicable.

****

Submit an S/S Treatment Work Plan[within[200][_____] calendar days after notice to proceed][not less than[60][_____] calendar days prior to the anticipated start of full-scale S/S operations]. Do not perform S/S of contaminated material until the work plan is approved. Prepare [draft for Government review] [draft-final for [regulatory][_____] review] and final versions of the S/S Treatment Work Plan. Allow [30][_____] calendar days for [Government] review [and [30][_____] calendar days for regulatory review]. Allow [45][_____] days for comment resolution following each review and preparing the next version of the document. Address the technical requirements, below, in the work plan. The technical requirements include, but are not limited to:

a. Schedule. Specify dates for the start and completion of design documentation, mobilization, installation, field demonstrations, treatment of contaminated materials, disposal of treated materials and wastes, and demobilization. Include details such as intended hours of operation, scheduled downtime, and routine maintenance downtime.

b. Project Organization. Propose a project organization for carrying out the S/S treatment. Provide an organization chart including subcontractors. Clearly define the project responsibilities of each individual, including, but not limited to:

(1) Project management and coordination.

(2) Scheduling and schedule control.

(3) Quality control.

(4) Sampling, measurement, analysis, and data management.

(5) Operation and maintenance of the treatment plant.

c. Mix Design: Propose the mix design and method of mixing to be used in treating the contaminated material. Indicate if different mix designs will be needed for dissimilar types of contaminated materials based on Contractor interpretation of existing conditions. Document that sufficient quantities of reagents are available to complete the project. Identify the proposed source of water for the S/S process.

d. Equipment: Propose the homogenization and mixing equipment, batching equipment, and process control instrumentation. Include process flow diagrams, mixing times, and processing rates. Identify anticipated

pretreatment of the contaminated material and indicate if there is a maximum allowable particle size for the S/S mixing equipment. Identify equipment foundation requirements to ensure a stable and safe area for S/S treatment equipment.

e. Drawings: Provide drawings indicating dimensions and layout of the S/S system, material laydown areas, and haul routes on the site. Drawings must be to scale.

f. Quality Control: Provide a quality control plan as required in Section 01 45 00 QUALITY CONTROL which addresses control and documentation of batch proportions, mixing time, mixing speed, sample collection, sample curing, and post-treatment testing. This program must ensure that the Contractor's operations comply with the Contract requirements with respect to quality of materials, workmanship, construction, finish, functional performance, and accuracy of data.

g. Mobilization and Demobilization: Include a mobilization plan and a post-treatment demobilization plan detailing the cleanup and sampling plan for the treatment area. Address the requirements in paragraphs MOBILIZATION and DEMOBILIZATION.

h. Outline the planned Field Demonstration and evaluation activities. This plan must address, but not be limited to:

(1) Contaminated materials characterization.

(2) Proposed demonstration testing runs (including specification of mix design and testing/operating conditions of the unit processes/operations for each run).

[(3) Sampling locations.

][(4) Analyses and analytical methods.

] (5) Mass balance calculation and performance evaluation [for each major piece of equipment].

(6) Treated materials and waste characterization.

(7) Health and safety monitoring and control.

(8) Waste treatment and disposal.

i. Oversize Material Surface Cleaning Decontamination (if needed): If the S/S project has the potential to generate oversize material that cannot be treated via S/S, develop a surface cleaning decontamination plan. Consult EPA 600/2-85/028 when preparing the surface cleaning decontamination plan.

j. Process Material Tracking Schedule. Provide a Process Material Tracking Schedule for recording and managing the quantities of the contaminated materials processed,[other waste streams requiring disposal such as [_____]][reprocessing of treated materials that fail to meet post treatment criteria][_____], and the treated materials to be re-deposited on-site (e.g., use as backfill) or materials requiring off-site disposal. Track each material from the original source, continue through various stages of handling and treatment, and end at the ultimate disposal.

k. Permits, permit equivalents, and certifications in accordance with paragraph REGULATORY REQUIREMENTS. For items requiring a longer time frame, submit copies of applications and scheduled dates for receiving final approval.

[

l. Bench-Scale Treatability Study Test Report: After completion of testing, compile the data from the bench-scale treatability study and prepare a Bench-Scale Treatability Study Test Report that includes but is not limited to, the materials, procedures, and methods used in the study; tests performed; sampling and analysis results; conclusions with supporting dialog; and proposed conditions to be tested in the Field Demonstration. Submit the Bench-Scale Treatability Study Test Report as an attachment to the S/S Treatment Work Plan.]

1.4.1.8 Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP)

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NOTE: This section may reference a separate specification section requiring preparation of a quality assurance project plan or may be excluded entirely if the requirements are part of another specification section.

****

Prepare a Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) in accordance with the requirements set forth in EPA 505-B-04-900A and using the UFP-QAPP WKSTS. Incorporate sampling and analysis requirements from this Section into the UFP-QAPP. Prepare [draft for Government review] [draft-final for [regulatory][_____] review] and final versions of the UFP-QAPP. Allow [30][_____] calendar days for [Government] review [and [30][_____] calendar days for regulatory review]. Allow [45][_____] days for comment resolution following each review and preparing the next version of the document. Submit the UFP-QAPP [within [30][_____] calendar days after notice to proceed] [at the same time the S/S Treatment Work Plan is submitted][_____]. Do not perform work at the site, with the exception of site inspection and surveys, until the UFP-QAPP is approved. Tailor the content to the requirements of the project and the site conditions.

1.4.2 Performance Requirements

1.4.2.1 Treated Material

****

NOTE: The table in this paragraph should be developed on a site specific basis considering the purpose of S/S treatment in the overall strategy for managing the contaminated material. Ideally, post-treatment testing criteria will be defined in a site-specific decision document. Post-treatment testing depends on the purpose of the S/S treatment. In general, S/S treatment is either completed as on-site pre-treatment prior to disposing the treated material off-site, or S/S treatment is performed to reduce chemical leachability and improve strength properties for material that will remain on-site (either in-situ or in a designated permanent storage unit).

The Toxicity Characteristic Leaching Procedure (TCLP) by EPA Method 1311 is usually the definitive test for contaminated materials that are pre-treated via S/S prior to off-site disposal. TCLP test results are used to determine if a contaminated material must be managed as a hazardous waste. In some instances, such as when a contaminated material is considered a listed hazardous waste, "total" chemical testing data may be needed in addition to or instead of TCLP data.

TCLP testing should generally not be used to demonstrate performance when contaminated materials are left on-site after S/S treatment. The Synthetic Precipitation Leaching Procedure (SPLP) by EPA Method 1312 is an alternative testing method that can be used to determine the mobility of both organic and inorganic contaminants. Note that the SPLP method involves mechanically reducing the particle size of samples if greater than 9.5 mm 0.375 inch, so if the S/S treatment process creates a monolithic solid material, the SPLP method may overestimate the leachability of contaminants by artificially creating a greater surficial area for leaching than actually exists. For monolithic materials, EPA's Leaching Environmental Assessment Framework (LEAF) Methods 1313 - 1316 provide a testing method which may be more applicable.

Physical testing methods may also be appropriate when S/S-treated contaminated materials are left on-site. Physical tests such as unconfined compressive strength represent the treated materials capacity to support loads placed on the treated material and can also serve as a surrogate measure of durability and chemical reaction success between the treatment reagent and contaminated material. Permeability testing indicates the degree to which liquids can move through treated material and cause contaminants to leach.

The excessive addition of reagents during treatment can result in a greater than anticipated volume increase. Limiting volume increase is important if the treated material is to be placed in an onsite permanent storage unit with limited storage space. For this reason, monitoring of volume increase is often done during the treatability study, field demonstration, and/or full-scale treatment. A volume increase performance requirement may not be necessary if there is abundant space available for disposal of treated contaminated material. A volume increase performance requirement is also not appropriate if the plans and specifications require specific treatment mixtures and application methods, in which case the Contractor would have little control over volume increase.

Two approaches are provided for attaining performance criteria: meeting performance criteria for every sample of treated material (conservative approach) or meeting performance criteria on the average for all samples of treated material. The averaging approach would not be appropriate if S/S treated materials are to be sent off-site for disposal, because averaging of sample results cannot be used for waste characterization to determine if a material is or is not a hazardous waste.

****

Conduct the work in a manner that will ensure that treated material is a homogenous mixture of contaminated materials and reagents[with no clumps of intact contaminated material larger than the size specified in Table 1 that have not been mixed].[Each sample of treated material must meet the criteria shown in Table 1.][An average of all samples of treated material must meet the performance criteria in Table 1; for chemical properties no individual sample can be greater than [_____][110 percent] of the criteria in Table 1 with no more than [_____][20 percent] of the samples exceeding; for physical properties other than maximum clump size no individual sample can be less than [_____][90 percent] of the criteria in Table 1 with no more than [_____][20 percent] of the samples falling short.]

Table 1 - POST-TREATMENT PERFORMANCE CRITERIA

PROPERTY	TEST VALUE	TEST METHOD
Chemical Properties		
pH	[_____]	[_____]
[_____]	[_____]	[_____]
Physical Properties		
Paint Filter Liquids Test	No Free Liquids	EPA SW-846 9095B
Min. Unconfined Compressive Strength	[_____] kPa[_____] psi	ASTM D1633
Hydraulic Conductivity	[_____] centimeters per second (cm/s) [_____] feet per second (f/s)	ASTM D5084
Maximum Volume Increase (1)	[_____] percent	
Maximum Clump Size	[10][_____] cm [4][_____] inches	Visual
[_____]	[_____]	[_____]

Note (1): Determine the volume increase by comparing the volume of in situ contaminated material to be treated to the volume of treated material

using the following formula:

B= 100 x [(1+R) x (D in situ/D treated) - 1], where

B= Volume increase in percent.
R= Dry weight ratio of solidifying agent to contaminated material.
D in situ = Dry unit weight of in-situ contaminated material.
D treated = Dry unit weight of compacted treated material.

1.4.2.2 Emission and Dust Controls

****
NOTE: Specifications for emission and dust controls should be provided in Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS. The remaining text in this note discusses S/S technology-specific emission and dust control considerations to incorporate into Section 01 57 19. An air pathways analysis should be performed during design in accordance with EP 200-1-24 Air Pathway Analysis for the Design of Hazardous, Toxic and Radioactive Waste (HTRW) Remedial Action Projects. Depending upon the contaminants of concern in the contaminated materials, the unit processes/operations employed in the treatment plant, the amount of pollutants emitted, and the geographical location of the site, the emission standards and limitations for certain contaminants and dust control can be identified from the following regulations including, but not limited to, National Primary and Secondary Ambient Air Quality Standards, National Emission Standards for Hazardous Air Quality Pollutants, and state and local regulations.

Based on the regulatory requirements, the proper technologies or apparatus for the emissions control if required can be determined. Upon completion of the design of the treatment plant, these emission requirements and control technologies should be defined by the design engineer.

If a performance specification is prepared, the emissions, dust sources, and contaminants of concern should meet specified requirements based on applicable regulations. Section 01 57 19 should list the emissions criteria for the contaminants of concern for each emission and dust source, and if applicable, monitoring requirements should be specified. The applicable federal, state, and local regulations should also be identified. If the specification is prepared based on detailed design, the technologies or apparatus for controlling the emissions and dust sources should also be specified.
****

Provide an S/S treatment system which meets the emissions and dust control requirements in accordance with[Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS][_____].

1.4.2.3 Noise Control

****

NOTE: Specifications for noise controls should be covered in Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS. The remaining text in this note discusses S/S technology-specific emission and dust control considerations to incorporate into Section 01 57 19. Based on the geographical location of the site, and the land uses and environment surrounding the site, the site-specific noise level requirements for the day and night operations and monitoring requirements can be identified from state and local regulations and/or developed by interacting with the state and local agencies.

****

Provide an S/S treatment system which meets the noise control requirements in accordance with[Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS][_____].

1.5 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy and Air Force projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S"

classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Pre-Installation Meeting Agenda

Pre-Installation Meeting Minutes; G, [_____]

S/S Treatment Work Plan; G, [_____]

Bench-Scale Treatability Study Work Plan; G, [_____]

Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP); G, [_____]

Pre-Installation Equipment Examination

Pre-Installation Examination Report

SD-05 Design Data

Adjusted Mix Design; G, [_____]

SD-06 Test Reports

Field Demonstration Report; G, [_____]

Operations Reports

Water Supply Analysis

SD-07 Certificates

Qualifications; G, [_____]

Reagent Certificates Of Analysis

1.6 QUALITY CONTROL

1.6.1 Regulatory Requirements

****

NOTE: Include Federal, state, and local regulatory requirements; utility company regulations; and applicable codes and standards published by scientific and engineering institutions where appropriate in the body of this Section. Some of the potentially applicable Federal regulations are listed as follows:

Toxicity Characteristic Leaching Procedure (TCLP)

Recording and Reporting Occupational Injuries and Illnesses

Occupational Safety and Health Standards

Safety and Health Regulations for Construction

Permitting

National Primary and Secondary Ambient Air Quality Standards

National Emission Standards for Hazardous Air Quality Pollutants

State and Local Air Quality Standards

National Pollution Discharge Elimination System (NPDES) Discharge Limitations and Permit Procedures

Hazardous Waste Identification and Standards Applicable to Generators, Transporters, and Owners and Operators of Treatment, Storage and Disposal Facilities (TSDF)

Land Disposal Restrictions (LDRs)

Department of Transportation Hazardous Materials Program Procedures

Hazardous Materials Transportation Regulations

Standards for Protection Against Radiation

Land Disposal of Low-Level Radioactive Waste

Packaging and Transportation of Radioactive Materials

For sites addressed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), administrative permit requirements for on-site activities are not required, though the substantive requirements may need to be met. Permitting requirements known to have substantive requirements should be listed here. If permit requirements are covered in other specifications, delete this section.

****

Obtain the permits, permit equivalents, and certifications; and meet the regulatory requirements necessary for the installation, operation, and closure of the project.[Correspondence from regulatory agencies, and other relevant information, is attached to the specifications to indicate the level of effort necessary to obtain finalized permits, permit equivalents, certifications and to meet substantive regulatory requirements.]

1.6.2 Qualifications

****

NOTE: Requirements for the Contractor's experience should be determined and specified based on the experience, availability, and state of the S/S

treatment technology industry and the site-specific requirements. If S/S treatment is being used for unique contaminants, consider specifically identifying contractor S/S experience requirement for those contaminants in the optional bracket at the end of paragraph CONTRACTOR EXPERIENCE.

****

1.6.2.1 Contractor Experience

Submit evidence of successful completion of[at least one S/S project][[_____] S/S projects of comparable size and scope][at least[three][_____] S/S pilot scale treatability studies, demonstration studies, or full scale remediation projects that required handling and transportation of materials contaminated with[RCRA hazardous wastes][CERCLA hazardous material][_____]] using the proposed system or a similar system.

1.6.2.2 Key Personnel

Provide key personnel who have a minimum of[three][_____] years of S/S field experience. Include system operators, quality control personnel, and supervisory engineering and technical staff involved with the S/S system operation in key personnel. Submit a list of these personnel with their qualifications.

1.6.2.3 Lab Validation

Perform testing by a DoD Environmental Laboratory Accreditation Program (DoD ELAP) accredited commercial testing laboratory meeting the requirements of[Section 01 45 00 QUALITY CONTROL][_____] and approved by the Contracting Officer. Submit testing laboratory validation for the testing to be performed. Do not permit work requiring testing until the Contracting Officer approves use of the testing laboratory.

1.7 DELIVERY, STORAGE, AND HANDLING

Safely transport, store, and handle equipment and raw materials (including reagents). Package and ship these items in compliance with United States Department of Transportation requirements. Store and handle these items onsite in accordance with the manufacturer's recommendations and in compliance with applicable regulatory requirements.

1.8 PROJECT/SITE CONDITIONS

1.8.1 Environmental Requirements

****

NOTE: Consider the site-specific conditions when determining allowable ambient temperatures at which S/S and curing may take place. Low temperatures near or below freezing can be very detrimental due to inability to adequately mix frozen material and limiting of chemical reactions which occur in the aqueous phase. Very high temperatures above 32 degrees C 90 degrees F can also have a negative effect on S/S performance when curing of cementitious materials is important; however high temperatures are overall less likely to be

detrimental compared to low temperatures. Treatability studies can be used to address the situation of high temperatures during curing.

****

Do not perform S/S in an ambient temperature below[4][_____] degrees C[40][_____] degrees F without approval from the Contracting Officer. Ensure the temperature of the treated material remains above freezing while curing. Do not treat contaminated material if it contains any frozen material. Do not perform S/S during periods of heavy rainfall as this will result in the addition of excess water to the mixture.

1.8.2 Existing Conditions

****

NOTE: Place the site characterization data in an appendix to the Specifications or on the Drawings. Include:
- Available information about the extent and characterization of significant quantities of debris.
- The detail to which site characterization has been performed and indicate where obvious data gaps exist.
- Construction limits.
- Property utilities.
- Chemical data.
- Geotechnical data.
- Sampling locations.
- Boring logs.
- Locations and details (such as utility point of contact, sizes, capacities, and flows) of the utility hookups.

Indicate if there are multiple dissimilar types of contaminated materials that will require different S/S treatment processes. Materials may be considered dissimilar due to different types or relative concentrations of contaminants. Determination of dissimilar materials may be based on site investigations and/or previously completed treatability studies.

****

The existing site conditions are presented[in Appendix [_____]][and][on the Drawings]. These include[physical configuration,][utilities,][topography,][land uses,][geotechnical characteristics of the contaminated materials (including[grain size analysis,][total organic content,][cation exchange capacity,][pH,][moisture content,][bulk density,][porosity,]),][hydrogeology,][treatability study results,] and[nature and extent of contamination]. The existing conditions presented are the result of site investigations at specific locations; variations in the existing site conditions could occur. Perform an independent interpretation of the site characterization data. Notify the Contracting Officer within[48 hours][_____] of discrepancies between the data provided and actual field conditions.

PART 2 PRODUCTS

2.1 WATER

****

NOTE: Two options are provided. The first option is to only allow the Contractor to use potable water. The second option allows the Contractor to use non-potable water, but includes a testing requirement to limit the chance that the Contractor supplies a water that could introduce contaminants into the treated materials. The first option is simpler, but could lead to higher project costs if the volume of water needed is significant and/or potable water sources are not readily available. When specifying the chemical contaminant criterion to be met for water, the Designer should consider if there are other standards which are more appropriate for the specific project (e.g. state groundwater cleanup criteria).

Maximum concentrations for potential chemical interferences from water used with cementitious binders are available in ASTM C1602/C1602M Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete. Requiring testing for these chemicals may not be considered necessary given that the specification requires using the water in a bench-scale treatability study, which would demonstrate performance.

****

Supply the water used to facilitate S/S treatment.[Use only potable water from a regulated public water system.][If non-potable water is to be used, provide water that does not contain oils, acids, salts, alkalis, organic matter, solids, or other substances at concentrations that could be detrimental to the successful treatment of the contaminated materials. If non-potable water is to be used, the proposed water must be used during a Bench-Scale Treatability Study conducted in accordance with the requirements of this Section to demonstrate that the water is acceptable for use. Also characterize non-potable water prior to its use by collecting a sample from the water source and analyzing according to Table 2. Submit a Water Supply Analysis demonstrating that water meets requirements.

TABLE 2 - TREATMENT WATER CRITERIA		
ANALYTICAL METHOD NUMBER (From EPA SW-846)	ANALYSIS TYPE	CRITERION TO BE MET

TABLE 2 - TREATMENT WATER CRITERIA		
6010[and 7470A]	Metals[and Mercury]	[Less than Maximum Contaminant Level (MCL)] [_____]
8260	Volatile Organics	
8270	Semi-volatile Organics	
8082	PCBs	
1633	PFAS	
8081	Pesticides	

Within each Analytical Method, only analyze for analytes which have a [MCL] [_____].]

2.2 REAGENTS

Provide reagents which are free of chemicals which could result in secondary contamination of the material being treated. Provide a Reagent Certificates of Analysis with each shipping unit of reagent. A confidentiality agreement may be requested if proprietary reagents are being used.

[2.3 SAMPLES OF CONTAMINATED MATERIAL FOR TREATABILITY STUDIES

****

NOTE: This paragraph should be included if bench-scale treatability studies are to be performed by the Contractor. Action level criteria should be specified for the purpose of collecting representative samples for bench-scale treatability studies. Table 3 should be edited based on site-specific contaminants of concern and their corresponding action levels. Additional testing may be needed to verify that physical properties (e.g. grain size, total organic content, density, porosity, moisture content) of the samples are also representative of site conditions.

To reduce the overall risk to the Government, it is strongly advised that the project team should require the Contractor to collect samples for the bench-scale treatability study unless the nature of the site prevents the Contractor from doing so. Depending on site conditions and project needs (e.g. site security, access issue, etc.), the government may provide samples to the Contractor to conduct bench-scale treatability studies.

****

[The Contracting Officer will provide the required samples to conduct the bench-scale treatability studies.][Select sampling locations and collect representative samples to conduct the bench-scale treatability studies. Consider the existing site conditions presented in paragraph EXISTING

CONDITIONS when selecting sampling locations. Coordinate the sampling protocol with the Contracting Officer before obtaining the samples.] The collected bench-scale treatability study samples must have contaminant concentration levels [representative of the average concentration of the contaminants identified][and][meeting than the action level criteria presented in Table 3]. Otherwise, repeat sampling until the contaminant concentration levels exceed the action level criteria. Test samples of contaminated materials intended to be used in the bench-scale treatability studies in accordance with procedures in the[Bench-scale Treatability Study Work Plan][and][UFP-QAPP]. Do not commence bench-scale treatability studies until contaminated material sample results meet the aforementioned concentration criteria.

TABLE 3 - ACTION LEVEL CRITERIA	
PARAMETER	ACTION LEVEL CRITERIA
pH	[<][>] [_____]
[_____]	[_____]

]2.4 MIX DESIGN

****
NOTE: In most instances, the Government will have conducted treatability studies prior to advertisement for bids. Results of these treatability studies are generally provided to bidders and included in the contract documents. In some limited circumstances, the designer may elect to specify the exact reagent mix to be used by the Contractor; modify the paragraph below if using this approach. This is generally not recommended because it places project performance risk on the Government.
****

Select a mix design which is capable of producing treated materials meeting the performance criteria listed in paragraph PERFORMANCE REQUIREMENTS for use during full scale treatment.

PART 3 EXECUTION

3.1 EXAMINATION

[3.1.1 Bench-Scale Treatability Study

****
NOTE: If a Treatability Study has previously been performed or is otherwise not needed, delete this paragraph. To reduce the chances of using soil samples that are not representative of site conditions, a minimum volume of 4 liters 1 gallon is recommended for each condition to be tested at the bench scale.
****

Perform at least [three][_____] replicate tests simultaneously for each selected mix from the approved Bench-Scale Treatability Study Workplan. Homogenize and divide the contaminated soil into replicate volumes prior

to initiating testing. Do not use less than less than [4][_____] liters [1][_____] gallon of contaminated soil in each mix. Test samples of curing treated materials in accordance with procedures in the [Bench-Scale Treatability Study Work Plan][and][UFP-QAPP] and at a frequency of no less than every [7][_____] days. Cure treated material for a period of not less than [28 days][_____] or until target levels identified in paragraph PERFORMANCE REQUIREMENTS are reached, whichever is shorter.

]3.1.2 Pre-Installation Equipment Examination

Conduct a pre-installation examination of the S/S treatment equipment for damage, defects, and dilapidation. Submit the results of the pre-installation examination to the Contracting Officer for review and information. The Contracting Officer may conduct an independent examination to ascertain the condition and functionality of the equipment. Based on this examination, the Contracting Officer has the right to reject the entire system or damaged, defective, or dilapidated equipment. The cost associated with equipment or control replacement or repair, and delays caused by the rejection must be borne by the Contractor. Routinely and properly inspect and maintain the equipment to provide the operation of the treatment plant as required by the Contract schedule. Schedule delays and costs due to lack of inspections and maintenance are the responsibility of the Contractor. Provide alternate/auxiliary power source if sufficiently reliable sources are not available.

3.1.3 Infrastructure Conditions

Conduct a pre-installation examination of the on-site infrastructure, utility conduits, monitoring points, and site access constraints. Photographically document, with identifying labels, the existing condition of infrastructure and utilities, particularly for comparison to post-operation conditions. Verify locations of critical utilities that cannot be disrupted and those utilities that would potentially have significant impacts on operations and public safety. Submit a Pre-Installation Examination Report documenting the examination activity. Obtain all necessary utility clearances before initiation of subsurface work.

3.2 PREPARATION

3.2.1 Mobilization

****
NOTE: Section 01 35 29.13 HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES includes requirements for decontaminating equipment that has been used in contaminated zones. Modify that Section to extend decontamination/cleaning requirements to equipment being brought on-site to cover the requirements of this paragraph.
****

Follow the approved mobilization and demobilization plans submitted as part of the S/S Treatment Work Plan. Do not mobilize the treatment plant to the site until the [S/S Treatment Work Plan][UFP-QAPP] has been approved by the Contracting Officer and the Contractor has received written confirmation. Delays caused by the Contractor's failure to meet regulatory requirements must result in no additional cost to the

Government. In accordance with[Section 01 35 29.13 HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES][_____], the equipment which is rented and/or previously used for other site remediation must be decontaminated and tested for contaminants of concern before being brought to the site.

3.2.2 Stockpiles

****

NOTE: Sufficient area should be prepared for stockpiling untreated and treated contaminated materials based on consideration of equipment production rates, allowable stockpile sizes, and overall project schedule. Background sampling under the stockpiles of contaminated materials should be performed before their construction, unless previous information is adequate. Coordinate with Section 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL. If Section 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL is not in the project, copy stockpiling information from paragraphs EXCAVATION WORK PLAN, GEOMEMBRANE, CONTAMINATED MATERIAL STORAGE, and SAMPLING BENEATH STORAGE UNITS into this section.

****

Prepare areas that will be used to stockpile untreated and treated contaminated materials in accordance with Section 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL. Provide sufficient area to stockpile [_____] [cubic meters][metric tons][cubic yards][tons] of untreated contaminated material and[six][_____] stockpiles of[500][_____][cubic meters][metric tons][cubic yards][tons] of treated contaminated material.

[3.2.3 Foundations

****

NOTE: Delete this paragraph if the S/S treatment does not involve erecting/installing a fixed S/S system (e.g. treating contaminated materials in-situ). Minimum requirements should be specified for the foundation/containment area of the treatment plant. An option is provided at the end of the paragraph to require installing a liner and berm in the location where the S/S treatment plant will be constructed; this option addresses cross-contamination risk if the treatment plant is located on non-contaminated ground.

****

Construct equipment foundations in accordance with the approved S/S Treatment Work Plan and this paragraph. Grade the area around the S/S treatment plant so that the water drains away from the work area adjacent to the treatment area.[Construct a liner and berm surrounding the S/S treatment plant. Construct the liner and berm[in accordance with the stockpile liner and berm requirements in Section 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL][_____]].

][3.3 ERECTION, INSTALLATION, AND DEMOBILIZATION

****
NOTE: Delete this paragraph if the S/S treatment does not involve erecting/installing a fixed S/S system (e.g. treating contaminated materials in-place). Referenced UFGS should be edited to include only the minimum requirements applicable to a temporary installation.
****

Erect and install the treatment plant on a temporary basis so that it can be readily removed from the site after completion of the Contract work. Perform the erection and installation to incur minimal damage to the existing site environment.[Complete mechanical work in accordance with the requirements of Section 23 30 00 HVAC AIR DISTRIBUTION.][Complete electrical work in accordance with Sections[33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION,][33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION,][and][26 20 00 INTERIOR DISTRIBUTION SYSTEM][and [_____]].][Complete plumbing work in accordance with[Section 22 00 00 PLUMBING, GENERAL PURPOSE][Section 40 05 13 PIPELINES, LIQUID PROCESS PIPING][_____]].

]3.4 FIELD DEMONSTRATION

****
NOTE: The need for a formal Field Demonstration should be discussed with the Contracting Officer and would be a function of the uncertainty of the materials to be treated. For well-defined contaminants and contaminated material compositions that are known to be amenable to S/S treatment, data obtained from the bench-scale treatability or full-scale system startup should be adequate to negate the need for a formal Field Demonstration. If the contaminants/contaminated material is not known to be amenable to S/S treatment, then a formal Field Demonstration in accordance with the following requirements will need to be performed. If a formal Field Demonstration is not required, sufficient startup testing should be done to validate performance prior to ramping up to full-scale operation.

If processing of contaminated material must stop pending field demonstration results, the Contract must provide for issuing a second notice (or third notice in a project where treatability studies are performed) to proceed by Contracting Officer upon approval of the field demonstration.
****

Prior to full-scale operations, perform a field demonstration. Process at least [500][_____][cubic meters][metric tons][cubic yards][tons] of contaminated material. Perform a field demonstration on each dissimilar type of contaminated material and reagent mix to be treated. During the field demonstration, handle dissimilar materials in accordance with paragraph DISSIMILAR MATERIALS, and follow paragraph CHANGE OF OPERATING CONDITIONS as needed.

3.4.1 Full-Scale Processing Equipment

Use the full-scale processing equipment, reagents, mix ratios, and mixing procedures proposed for full scale S/S treatment.

3.4.2 Contaminated Material Sourcing

****

NOTE: Prior to implementing the field demonstration, chemical testing should generally be performed to verify that the materials to be used for the test run contain the contaminants of concern at high enough concentrations to adequately test the system. Additional testing may be warranted to verify that the physical properties of the materials are also representative of site conditions.

****

Obtain contaminated material used for the field demonstration from [the location specified by the Contracting Officer][_____]. Prior to performing the field demonstration, test each dissimilar type of contaminated material to be used for the field demonstration. Consider the existing site conditions presented in paragraph EXISTING CONDITIONS when selecting sampling locations. The contaminated material samples must have contaminant concentration levels [representative of the average concentration of the contaminants identified][and][meeting the action level criteria presented in Table 4]. Otherwise, repeat sampling until the contaminant concentration levels exceed the action level criteria. Test samples of contaminated materials intended to be used in the field demonstration in accordance with procedures in the [Bench-Scale Treatability Study Work Plan][and][UFP-QAPP].

TABLE 4 - ACTION LEVEL CRITERIA

PARAMETER	ACTION LEVEL CRITERIA
pH	[<][>] [_____]
[_____]	[_____]

3.4.3 Field Demonstration Treated Material Testing

****

NOTE: Consideration should be given to the need for monitoring off-gas, dust, and noise generation during the field demonstration to ensure compliance with local, state, and federal regulations.

****

Once the field demonstration has generated the required quantity of treated material, perform the tests identified in paragraph POST TREATMENT TESTING on on[five][_____] representative samples of the treated material. If the treated materials produced during the field demonstration do not meet the criteria in the paragraph PERFORMANCE REQUIREMENTS, process an equal quantity of the same type of material using properly modified operating conditions and/or incorporation of reagents that have been proven effective as part of the treatability testing, until

satisfactory results are obtained. Return the treated materials that failed the demonstration testing to the contaminated materials stockpile for re-processing during full-scale treatment.

3.4.4 Field Demonstration Test Results

****
NOTE: Two options are provided for the next step after the field demonstration. The first option (halting processing contaminated soils until results from the field demonstration testing indicate the Contractor's proposed operating conditions can successfully treat the contaminated soils) would generally only be appropriate if the S/S treatment process has yet to be demonstrated on a large scale for the specific contaminants and soil composition.
****

Submit a Field Demonstration Report including pre-treatment and post-treatment test results. Document other relevant field demonstration data including but not limited to: batch proportions, mixing time, and mixing speed. Include off-gas, dust, and noise test results. After completion of the field demonstration,[do not process additional contaminated material until test results from the field demonstration verify that the treated material meets the criteria listed in paragraph PERFORMANCE REQUIREMENTS. Allow[14][_____] calendar days in the schedule for Government review and approval of the field demonstration report.][contaminated material may continue to be processed. However, if test results from the field demonstration do not pass the criteria in paragraph PERFORMANCE REQUIREMENTS, reprocess the contaminated material treated with the failing mix design in accordance with paragraph RETESTING AND REPROCESSING].

3.5 OPERATION

3.5.1 Dissimilar Materials

****
NOTE: Delete the bracketed text item if dissimilar materials are not known to be present at time of preparing project specifications.
****

Do not mix together dissimilar materials that either prior testing or field quality control observations during S/S operations have indicated need different mix formulations.[Materials known to be dissimilar at the site are defined in[paragraph EXISTING CONDITIONS][_____].]

3.5.2 Oversize Material

****
NOTE: This paragraph can be deleted if S/S is performed in-situ unless there is large debris that needs to be removed to facilitate mixing and/or protect mixing equipment from damage. An optional requirement is included if oversize material must be decontaminated before it is transported off-site for disposal.
****

Reduce the size of oversize contaminated material to less than [2.5 cm one inch][the maximum allowable particle size of the S/S mixing unit as defined in the S/S Treatment Work Plan][_____]. Treat oversize contaminated material which can be reduced to an allowable size for the S/S process. Remove oversize material that cannot be reduced to an allowable size for the S/S unit process.[Decontaminate oversize materials in accordance with the procedure developed in the S/S Treatment Workplan]. Dispose oversize material off-site in accordance with [Section 02 81 00 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIAL][_____].

3.5.3 Treated Materials

3.5.3.1 Temporary Storage of Treated Materials

****

NOTE: The second option in the paragraph below applies only to S/S treatment when the treated material is placed into permanent on-site storage. To prevent double handling it is preferable to place treated material directly into the permanent storage area rather than stockpiling until post-treatment testing is completed.

****

[Separate treated material into units (stockpiles) for post-treatment testing. Keep dissimilar materials in separate stockpiles pending test results. Unit size greater than the quantity pertaining to the most frequent quality control test is prohibited. If the test results indicate the treated materials of a stockpile meet the post treatment criteria presented in paragraph PERFORMANCE REQUIREMENTS, this stockpile of treated materials[may][must][_____] be combined with other stockpiled material which has also met the post treatment criteria.]

[Place treated material directly into the permanent storage unit after treatment. Place treated material such that the material from specific batches/runs can be defined and removed if it fails post-treatment testing.]

3.5.3.2 Final Disposal of Treated Materials

Dispose treated materials which meet the treatment performance requirements in paragraph PERFORMANCE REQUIREMENTS[off-site in accordance with Section 02 81 00 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS][in the designated permanent storage unit. Place treated materials in accordance with Section 31 00 00 EARTHWORK].

3.5.4 Change of Operating Conditions

****

NOTE: If adjustment to the mix design is required due to change in contaminated material characteristics, then the Contractor's adjusted mix design should be evaluated by the Contracting Officer for the extent of changes from the previous mix design. Further, price negotiation may be required based on the extent of changes from the previous mix design.

****

The following two requirements must be met in order to be considered for change of operating conditions:

a. The physical and chemical characteristics of the contaminated materials are significantly different from the originally defined characteristics.

b. The treatment requirements cannot be met under the current S/S treatment plant design and related mix design/operating conditions.

When change of operating condition is necessary, notify the Contracting Officer before changes are made to the mix design and related operating conditions. The Contracting Officer may require the Contractor to perform a field demonstration for significant changes made to the mix design and related operating conditions in accordance with paragraph FIELD DEMONSTRATION, for approval. If adjustment to the mix design is required due to change in contaminated material characteristics, submit an adjusted mix design for the extent of changes from the previous mix design for approval. Further, price negotiation may be required based on the extent of changes from the previous mix design.

3.6 FIELD QUALITY CONTROL

****

NOTE: Leaching and hydraulic conductivity tests are not amenable to real time quality control because of the time required to perform the tests; therefore, it is preferable to minimize the number of leaching and hydraulic conductivity tests performed and to maintain quality control of the S/S process by verifying that the mix design works during the field demonstration and maintaining quality control by monitoring batch proportions and mixing time. Real time indicator tests such as pH, specific conductance, mix temperature, and water content can also be used as quality control tools.

****

The post treatment testing specified in this paragraph is needed by the Government to generate documentation that the S/S treatment has been accomplished in accordance with performance requirements approved by applicable authorities. The results of these tests may be used as part of the Contractor's QC program; however it is the contractor's sole responsibility to meet the performance requirements specified in this section. Therefore, it is expected that the Contractor will perform additional testing and measurements to assure that treated materials meet requirements without rejection of batches, retesting, and/or reprocessing.

3.6.1 Tests

3.6.1.1 Post Treatment Testing

****

NOTE: If cementitious reagents are used in treatment, a requirement is included to collect samples for post-treatment testing immediately after treatment. This eliminates the need to remove samples from the treated mass after it has cured.

The values shown in Table 5 for frequency of testing are only examples and need to be determined on a site specific basis. Coordinate the properties in this table with the properties in paragraph PERFORMANCE REQUIREMENTS. Edward Bates' and Colin Hills' 2015 Stabilization and Solidification of Contaminated Soil and Waste: A Manual of Practice includes discussion on sampling frequency (Section 6.2.1) and provides examples. It may be acceptable to change the number of samples during development of a UFP-QAPP, but attempt to establish a reasonable sampling frequency in the Specifications to provide a basis for the Contractor to bid the project.

****

Collect post treatment confirmation samples in accordance with the [UFP-QAPP][basewide QAPP][_____] and this paragraph. Collect confirmation samples at a minimum frequency [defined in Table 5][_____]. Collect samples as [discrete grabs][composites][incremental samples][_____]. Collect samples for quality control and quality assurance testing immediately after treatment and allow to cure as specified in ASTM D1632 or by another approved method. Analyze samples for the parameters identified in paragraph PERFORMANCE REQUIREMENTS. Complete all other sampling and analysis activities in accordance with the [UFP-QAPP][basewide QAPP][_____] (including but not limited to sample handling, preservation, transportation, collection/analysis of quality control samples, data validation, and data reporting). Any deviations to sampling frequency, number of samples, or sample collection methods must be [established in the approved [UFP-QAPP][basewide QAPP]][approved by the Contracting Officer].

Table 5 - POST-TREATMENT QUALITY CONTROL TESTING FREQUENCY

PROPERTY	FREQUENCY [Cubic Meters][Metric Tons] [Cubic Yards][Tons]
Chemical Properties	
pH	1 per [500][_____]
[_____]	1 per [500][_____]
Physical Properties	
Paint Filter Liquids Test	1 per [500][_____]
Min. Unconfined Compressive Strength	1 per [500][_____]
Hydraulic Conductivity	1 per [500][_____]
Maximum Volume Increase(1)	1 per [500][_____]
Maximum Clump Size	1 per [500][_____]

Table 5 - POST-TREATMENT QUALITY CONTROL TESTING FREQUENCY	
[_____]	1 per [500][_____]

3.6.1.2 Retesting and Reprocessing

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NOTE: An option is provided for retesting treated contaminated materials which fail to meet performance requirements. Retesting without first reprocessing treated contaminated materials should generally be prohibited unless there is reason to believe the original test result was inaccurate due to mislabeling/mishandling of the sample or analytical error discovered during validation of laboratory results (simply believing that a sample did not reflect the treatment is not sufficient to consider a result inaccurate).

If S/S treated material is being sent off-site for disposal, do not permit retesting unless there is reason to believe the original test result was inaccurate as described in the paragraph above. This is because waste characterization and disposal is based on grab sampling results, and averaging of sampling results cannot be used to determine that a waste meets regulatory disposal requirements.

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Reprocess and then retest units of treated contaminated materials that do not meet the post-treatment criteria in paragraph PERFORMANCE REQUIREMENTS[or quality assurance testing].[The Contractor may propose to retest failing units of treated contaminated soils prior to reprocessing. If the Contracting Officer approves retesting, collect and test two additional samples for the failed parameter(s). If both samples pass, re-processing the unit will not be required. If either sample fails, reprocess the unit.]

3.6.1.3 Government Quality Assurance Testing

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NOTE: Consider the need for quality assurance testing on a project-by-project basis. If QA testing is unnecessary, delete this paragraph. Factors to consider include whether the Government has access to a laboratory that can analyze quality assurance samples in a timely manner to not delay the project execution. Use of quality assurance testing data use also needs to be considered. A relatively straightforward data use is to compare quality assurance sample results to the project Performance Requirements, and failing result would be treated the same way as a failing Contractor test result. A more complicated data use is to compare results from quality assurance samples and contractor quality control samples for the purpose

of determining if there is meaningful disagreement between the results. In this case, procedures would need to be developed for determining when there is a meaningful disagreement between quality assurance and quality control sample results; corrective actions for when a meaningful disagreement was identified would also need to be developed. The process of defining procedures for identifying and correcting meaningful differences should be documented in a project-specific Quality Assurance Project Plan and referenced in this specification; the process is likely to complex to be adequately defined in this specification.

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Provide duplicate samples to the Government's quality assurance laboratory for Government quality assurance. Submit samples at a frequency of one set of samples per [10][_____] sets of quality control tests performed. Quality assurance samples will be tested for the same parameters as the parent quality control sample. Provide additional quality assurance samples upon request.

3.6.2 Inspection

3.6.2.1 Batch Proportions

Visually inspect treated materials to confirm that a homogeneous mixture has been created and maximum clump size is being met as defined in paragraph PERFORMANCE REQUIREMENTS. Record the mixing time, mixing speed, and quantities of contaminated material, reagents, and water added to each batch. Maintain mixing time, mixing speed, and batch proportions within the limits specified in the approved Work Plan and as modified during the field demonstration.

3.6.2.2 Government Inspection

The Government may conduct inspection of the system installation and perform periodic inspections during the S/S treatment operation to verify that the project activities are performed in accordance with the approved plans, specifications, and the regulatory requirements. Inspection findings must be addressed immediately and resolved to the Government's satisfaction.

3.6.2.3 Operations Reports

Submit operations reports [daily][weekly] for the first [10][_____] weeks, and at a frequency of [_____] thereafter. The operations reports must consist of a log of operating conditions including, but not limited to: hours of operation; staffing; weather conditions; process materials tracking schedule; sample shipment (include chain of custody documents); receipt of analytical results; changes in operating parameters; results of the testing and calibration activities; and inspection and maintenance activities. In addition, attach the physical and chemical test results generated onsite or received from offsite laboratories to the report. Include the following information with test results: time of sampling, location of sampling, and Contractor Quality Control (such as duplicate sample analysis, field and trip blank analysis, laboratory QC analysis, etc.) results. Perform data validation of the test results [in accordance with the project UFP-QAPP][before submittal].

3.7 DEMOBILIZATION

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NOTE: If there is a separate Specification Section which provides overall requirements for demobilization/site cleanup, such as 01 50 00 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS, move the requirements from this paragraph into that Section.

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Follow the approved mobilization and demobilization plans submitted as part of the S/S Treatment Work Plan. Demobilize to restore the site to its initial state, prior to the construction and operation of the S/S treatment facilities. Do not commence demobilization until written approval is received from the Contracting Officer. Demobilization must include, but must not be limited to:[disconnecting of utility service lines,][decontamination and removal of equipment and materials,][disposal of decontamination wastes,][disposal of any residual wastewater,] [removal of unused amendments and other materials,][removal of material overlying liners,][removal of liners,][regrading and removal of berms,][demolition and disposal of the treatment pad, other foundation slabs, and paved surfaces,][_____].[Perform post-treatment testing of soils below stockpile storage units and work area surfaces in accordance with Section 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL.]

-- End of Section --