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USACE / NAVFAC / AFCEC | **UFGS-31 23 01 (February 2021)**
Change 1 - 11/21

Preparing Activity: USACE | **New**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2025

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02/21; CHG 1: 11/21

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SECTION 31 23 01

UNDERWATER BLASTING
02/21; CHG 1: 11/21

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NOTE: This guide specification covers the requirements for underwater (from overwater vessels and platforms) blasting and blasting near a water body with adverse impacts for any use of blasting, most commonly submerged rock excavation and/or submerged structural demolition. If any of the materials being blasted and excavated are known to be, or during the contract period may possibly be, above water, also use Section 31 23 06.00 BLASTING - SURFACE. For projects on a naval facility, consult with local NAVFAC office, Naval Ordinance Safety and Security Activity (NOSSA), and NAVSEA on requirements. NAVSEA OP5 Ammunition and Explosive Safety Ashore manual dictates many of the requirements and NOSSA has the final determination on any blasting on a Navy installation above or underwater. Reference NAVSEA OP5 manual and contact local Explosives Safety Officer and Planner for the base prior to revising the specification. Overall NOSSA approval process can take 12-18 months depending on the level of approval required.

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).

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PART 1 GENERAL

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NOTE: Consult with an office that has most recently completed a similar type of underwater or near-water blasting, while editing this section, to be appraised of recent, specific requirements, guidance, blasting developments or understandings for the subject project. Consult with, or have the specifications reviewed by, a subject matter expert in blasting for projects where blasting issues are particularly challenging or where protections to the public, structures/facilities, and/or natural resources will require project-specific designs or activities.

There are likely decisions and/or requirements of other agencies, the Safety Manual, and/or internal departments, which could have an influence upon a project's blasting specs. Some of these issues may be: navigational concerns and dealing with federal, state, and local jurisdictions and agencies; public use of nearby federal, state and/or local properties near the project; evaluations of acceptable vibrations and/or pressures affecting individuals or reaching nearby structures; natural resource (environmental) impact reviews, negotiations and/or requirements; cultural resource impact reviews for their considerations and/or requirements; constraints on the drilling or blasting procedures; pre-blast inspections; special studies to facilitate lower cost of the bids or to encourage more bid submissions; the acquisition strategy for the payment; and, other concerns specific to the project. If there are required natural resource protections, there will need to be resolutions concerning specialty firms or professions, including all of the appropriate references, designing the activity(-ies) for the project, and the Contractor's conduct of the activity(-ies), in full or part, or the Contractor's coordination with a government agency(-ies) or external office(s) conducting the activity(-ies).

The following information will be indicated on the project drawings:

1. Surface elevations, existing and new; Applicable datum for elevations and spatial coordinates will be stated clearly for reference.

2. All utilities, whether trenched, buried, at the surface or overhead to distances well beyond the project's limits;

3. Location and record of all soil and rock borings and test pits, including soil and rock

classifications and their properties, weathered rock, bit drops and voids, ground water observations, and topsoil thickness encountered in boring;

4. Location and limits of hard material, whether rock or concrete, or other building materials; with caveats as to uncertainty as appropriate;

5. Excavation or demolition limits with tolerances;

6. Details of any special limits that may require line drilling, presplitting, reduced subdrilling, and/or specialty blasting practices;

7. Location of borrow and disposal area, if located on Government property;

8. Hydrological, hydraulic and impoundment data, where applicable; and,

9. Details of all rights-of-way within the project boundaries.

****

1.1 SCOPE

The breakage of rock and hard/unyielding materials may be conducted by any means, unless otherwise stated herein. If the contractor elects to use drilling and blasting for breakage or displacement of any units, this entire section is applicable and covers activities associated with drilling and blasting for rock excavation at the surface. Contained herein are procedures for all activities relating to drilling; blasting and the transportation, storage and use of explosives; breakage and displacement of rock. The Contractor's blasting program and methods are those necessary to accomplish the excavation shown on the Contract drawings in accordance with the provisions specified herein. Control the quantity of explosives fired in all blasting to prevent injuries to persons and to avoid damage to all structures, properties, governmental and nonprofit entities, commerce and businesses, and natural resources and their habitat.

1.2 RELATED WORK SPECIFIED ELSEWHERE

****

NOTE: List any specifications that are related, such as Excavation, Earthwork, Demolition, Temporary Environmental Controls, Natural Resources, Shotcrete are typical specs related, depending on the project.

****

Section [_____]

1.3 REFERENCES

****

NOTE: Add and remove references as needed for the project. Reference the appropriate state and local laws, regulations and ordinances concerning blasting

where the project is to occur.

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 paragraph 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.

INTERNATIONAL SOCIETY OF AUTOMATION (ISA)

ISEE PSBS	(2017) ISEE Performance Specification for Blasting Seismographs

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 495	(2018) Explosives Materials Code

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2024) Safety -- Safety and Occupational Health (SOH) Requirements
EM 1110-2-3800	(2018) Engineering and Design -- Blasting for Rock Excavations

U.S. Code (USC)

16 USC 470	National Historic Preservation Act
16 USC 668	Bald and Golden Eagle Protection Act
16 USC 1361	Marine Mammal Protection Act
16 USC 1531	Endangered Species Act
16 USC 1801	Magnuson-Stevens Act
33 USC 1251	Clean Water Act
33 USC 1401	Marine Protection, Research and Sanctuaries Act

42 USC 4321 National Environmental Policy Act

42 USC 7401 Clean Air Act

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

49 CFR 177 Carriage by Public Highway

1.4 DEFINITIONS

****
NOTE: Delete definitions that will not be used in the specification text for a specific project. A complete list of blasting definitions can be found in the GLOSSARY of the EM 1110-2-3800. Recommend only using definitions not already in GLOSSARY in the EM and those definitions to further stipulate the work on the specific project in the specification. It may be necessary to add definitions depending on what the Earthwork and/or Excavation specifications for the project have terms for Rock, Weathered Rock, Sound Rock, Voids, Sediment, etc.
****

1.4.1 Controlled Blasting

Controlled blasting refers to blasting techniques used to better distribute the explosive charge to minimize adverse impacts. For underwater blasting, adverse impacts may be cited for the public's and contracted personnel's safety, lessening the fracturing of the rock being blasted, surrounding facilities' protection, and the avoidance of impacting natural resources or their habitats. Controlled blasting techniques must be deployed, such as careful loading to the pattern's design using the drilling log for each shot hole, stemming effectively the top of firm rock and any soft zones or voids, carefully observing maximum charge weight per delay, using delays between holes and rows of 25 milliseconds or greater, and avoiding rifling plumes by proper blasting techniques.

1.4.2 Flyrock

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NOTE: Choose the distances for the project, the typical values are listed. Edit definition as needed for project site.
****

Flyrock is one of the three primary adverse impacts from blasting. Flyrock is defined as any airborne projectile flying the lesser distance of either 60 m 200 ft horizontally from the shot pattern or one-half the distance between the shot pattern and the Contractor work limits, whichever distance is the lesser.

1.4.3 Green Concrete

****
NOTE: If no concrete placement is expected on the

project then delete this definition. If concrete placements will occur when blasting operation is ongoing, further define green concrete here and include appropriate thresholds and monitoring for the green concrete in Part 3. There needs to be limits on vibrations when there is green concrete because of the strength loss due to vibrations while curing. Involve the Structural Engineer project development team members in these determinations.

****

Green concrete is recently placed concrete that has initiated setting but may have substantial strength reduction from strong vibrations before the concrete has fully cured. Green concrete also includes the materials of shotcrete or cementitious grouts. Each Individual Shot Plan is required to consider vibrations emanating from its blast pattern reaching the location of the reported newly placed concrete to remain below allowable vibration levels depending upon the age of the concrete. Note the paragraph GREEN CONCRETE.

1.4.4 Pressure Waves

Pressure Waves, both Airblast (or noise) and Underwater Pressure Waves, are one of the three, primary adverse impacts from blasting. Airblast and Underwater Pressure Waves are solely compression waves passing through the air or water, respectively. Their units of measure may be in terms of pressure, Pascals (Pa) or pounds per square inch (psi), or in terms of the logarithmic scale, Decibels (dB). Note that pressures in dB have different reference values for Airblast and Underwater Pressure Waves, so the pressure waves through air are of a lower magnitude than pressure waves through water with the same numeric dB value.

1.4.5 Rock, Hard/Unyielding Material, Weathered Rock, Voids (Bit Drops), Sediment

1.4.5.1 Rock

Rock is natural solid, interlocking material with firmly cemented, laminated, and crystalline fabric, foliated masses or conglomerate deposits, none of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of high-energy mechanical devices; and, so classified for this project as submerged large boulders, [masonry, or concrete other than pavement exceeding the capacity of the awarded contractor's underwater excavation capacity,] which may be the minimum volume of 0.38 cubic meter 0.50 cubic yard.

1.4.5.2 Hard/Unyielding Material

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NOTE: Depending upon the acquisition strategy and measurement and payment, hard materials should typically be included in lump sum payment.

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Hard/Unyielding materials comprise weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" with stones greater than 25.4 mm 1.0 inch in any dimension. These materials usually require the use of heavy excavation

equipment or high-energy mechanical devices for breakage or displacement to remove the materials .

1.4.5.3 Weathered Rock

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NOTE: Weather rock and voids are particularly important for the percussion drilling's logging to properly stem the zone where the weather rock and bit-drops are encountered.

****

Weathered rock, for underwater percussion-drilling logging, is any original rock unit that has been altered to a weaker state that will not retain stemming when explosives are loaded into that material.

1.4.5.4 Voids

Voids, for underwater percussion-drilling logging, is any rapid bit drop with little or no resistance to the downward drilling pressure. Voids may be water or sediment filled, which may possibly determine that the original rock unit has been altered to a weaker state that will not retain the gaseous detonation products when the explosives are shot.

1.4.5.5 Sediment

Sediment is both: the loose to firm material that may be dredged above the surface of weathered or firm rock, which cannot be easily dredged; and the infill of voids as solid particles.

1.4.6 Unstable Material

Unstable materials are loose, submerged sediment that are easily displaced by water flow or turbulence and by vibrations or incidental impact.

1.4.7 Vibrations

Vibrations are one of the three, primary adverse impacts from blasting. Vibrations are the result of various wave forms emanating from the detonation or deflagration of ignited materials from a shot pattern. Peak particle velocity (PPV) is defined as the maximum absolute value among the three ground vibration velocities measured in the vertical, longitudinal, and transverse directions over a time of a record. Peak, total vector-sum particle velocity is the peak value over the full, time history of each time-unit's value of the square-root sum of the squared, component velocities. Velocity units are expressed in centimeters per second (cps) or inches per second (ips).

1.5 SYSTEM DESCRIPTION

Boring logs are [shown on the drawings] [appended to the SPECIAL CONTRACT REQUIREMENTS or GDR]. Bottom-sounding surveys are provided as contoured maps, as precise to the vertical and lateral tolerance on the date of the survey.

The subsoil investigation report and samples of materials taken from subsurface investigations may be examined at [_____]. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.5.1 Classification of Excavation

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NOTE: Inapplicable portions will be deleted. Other classifications of excavation may be utilized as required. For underwater blasting, resolve whether there is any potential for anthropogenic materials, such as concrete or pavement, or lost shipping debris that must be included in paragraph DEFINITIONS above and paragraph CLASSIFICATIONS herein.

If no consideration will be given to the nature of the materials, then all excavation will be designated as unclassified excavation. Otherwise, finish the specified excavation on a classified basis, in accordance with the following designations and classifications.

****

1.5.1.1 Common Submerged Excavation

Include common excavation with the satisfactory removal and disposal of all materials not classified as rock or hard/unyielding materials. Include the removal of any concrete or masonry structures or pavements that may be encountered in the submerged excavation zone under this classification.

1.5.1.2 Rock Excavation

Submit notification of encountering rock and/ or hard/unyielding materials in the project. Include rock excavation with blasting, excavating, grading, disposing of material classified as rock, and the satisfactory removal and disposal of boulders 1/2 cubic meter yard or more in volume; solid rock; rock material that is in ledges, bedded deposits, and unstratified masses, which cannot be removed without systematic drilling and blasting; firmly cemented conglomerate deposits possessing the characteristics of solid rock impossible to remove without systematic drilling and blasting; and hard materials as defined herein [requires inclusion of appropriate definition of hard materials for the project].

If at any time during excavation, including excavation from borrow areas, the Contractor encounters material that may not be classified as rock excavation, uncover such material, and notify the Contracting Officer. Do not proceed with the excavation of this material until the Contracting Officer has classified the materials as common excavation or rock excavation and has taken cross sections as required. Failure on the part of the Contractor to uncover such material, notify the Contracting Officer, and allow ample time for classification and cross sectioning of the undisturbed surface of such material will cause the forfeiture of the Contractor's right of claim to any classification or volume of material to be paid for other than that allowed by the Contracting Officer for the areas of work in which such deposits occur.

1.5.2 Blasting

Drilling and blasting are not required activities for breakage of materials to allow excavation. Should the Contractor elect to conduct

drilling and blasting, the Contractor must perform the blasting in accordance with this section. The Contractor is responsible for all claims for damages and injuries caused by, or arising out of, blasting activities and its adverse impacts, as noted in the FAR.

Perform blasting in accordance with EM 385-1-1 and in conformance with all Federal, State, and local laws, regulations, and ordinances. Submit notice 30 days prior to starting work. Submit a Master Blasting Plan for approval, prepared and signed by the Blasting Specialist that includes: a listing of all federal, state and local regulations and ordinances to conduct blasting at the project; the support documentation and certifications for all proposed blasting personnel; information and data sheets for all the explosives to be used at the project; the design approach to blasting; outlines of all required reports and formats for all the forms of the respective reports; and, the procedures to control all the adverse effects of blasting. Use the non-electric blasting caps for all underwater blasting. Obtain written approval prior to performing any blasting and notify the Contracting Officer 24 hours prior to blasting. Include provisions for storing, handling, and transporting explosives as well as for the blasting operations in the plan.

1.6 SUBMITTALS

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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.

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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

Master Blasting Plan; G, SO

Blasting Safety Plan; G, SO

Navigation Control Plan; G, AO

Test-Blast Plan; G, AO

Certified Marine Survey; G, AO

Pre-Blast Surveys; G, [_____]

Blasting Consultant's Qualifications; G, [_____]

Blasting Specialist's Qualifications; G, [_____]

Blaster-In-Charge Qualifications; G, [_____]

Blaster Qualifications; G, [_____]

Blasting Administrator's Qualifications; G, [_____]

Vibration Monitoring Specialty Firm; G, [_____]

Public Notice Of Blasting Operations; G, [_____]

Structural Inspection/Evaluation Specialist; G, [_____]

Natural Resource Subcontractor; G, [_____]

SD-03 Product Data

Explosives and Blasting Equipment; G, [_____]

Lightning Detection Device; G, [_____]

Seismographs; G, [_____]

SD-05 Design Data

Individual Shot Plan

SD-06 Test Reports

Test-Blast Evaluation Report

Individual Shot Reports; G, [_____]

Drilling Logs

Individual Shot Vibration Monitoring Report

Individual Shot Videos

Daily Blasting And Removal Log

Blasting Consultant's Report

Post-Blast Surveys; G, [_____]

Reports of Required Safety, Protective, and Natural Resource Programs

SD-07 Certificates

Blasting Licenses and Credentials; G, [_____]

Seismic Specialist; G, [_____]

Seismograph Technicians; G, [_____]

Magazine Keeper; G, [_____]

1.7 COORDINATION

****
NOTE: The following paragraph can be used if working with multiple stakeholders/owners.
****

Blasting will be in the vicinity of the [existing lock, railroad, and highway, and river barge, train, highway traffic, utilities and businesses] and their operation will not be impeded or delayed beyond that which has been coordinated with [TVA, U.S. Coast Guard, U.S. Army Corps of Engineers - [_____] District, [_____] environmental or natural resources offices, [_state_] Department of Transportation, [_____], [_____] Railroad, regional or local utilities, and/private businesses]. A coordination plan, with the appropriate authorities that mitigates [navigation and traffic delays], in the Master Blasting Plan.

Coordinate, through the Contracting Officer, with other Contractors working onsite to minimize work stoppages during blasting.

1.8 LIABILITY

Compliance with provisions in the contract will not relieve the Contractor of their responsibility for any damages or injuries caused by, related to, or arising out of blasting or associated blasting activities. Notwithstanding federal, state, and local laws, regulations and ordinances, the Contractor assumes all liability and hold and save the Government, its agents, officers, and employees harmless for any and all claims for personal injuries, property damage, or other claims arising out of or in connection with the handling of explosives or blasting under this contract.

PART 2 PRODUCTS

2.1 TRANSPORTATION, STORAGE AND USE OF EXPLOSIVES

****
NOTE: Confirm and follow federal, state, and local

regulations and guidance on the transport, storage and use of all Explosives. State and local agencies and/or authorities may not easily allow the receipt of Explosives in a timely manner. State and local agencies and/or authorities may have specific reporting, certifications, adverse impact concerns, or distance regulations from the blast zone to private properties governing the use of Explosives. The Agency/Service may wish to allow storage of Explosives on federal premises. The winning contractor should independently assess and cite in the Master Blasting Plan all federal, state, and local laws, regulations, ordinances, or authorities that impact the transportation and storage of Explosives. Consider requiring cartridge explosives for water sensitive explosive materials or allowing the use of those bulk explosive that are not water sensitive, i.e., "Bulk explosives such as ammonium nitrate and fuel oil (ANFO) or bulk emulsion or emulsion blends will not be permitted."

****

2.1.1 General

Store, transport, handle, use, and otherwise secure explosives in accordance with best practices as approved by the Contracting Officer and in accordance with all Federal, State and Local laws and regulations. Comply with all special rules and regulations that may be made by the authorities having jurisdiction, or by the Contracting Officer, regarding construction of, and storage in magazines and precautions in blasting. Times and imposed restrictions concerning the use of explosives must be conducted in accordance with local, State, and Federal regulations. The Contracting Officer reserves the right to establish restrictions or time windows when blasting will not be allowed.

2.1.2 Blasting Products

2.1.2.1 Requirements

All explosive materials to be used on site must be proposed for approval in the Master Blasting Plan. Cartridged and bulk explosives may be used in different sections of the project. All explosive materials used on the project must be six months or less of age or no older than one half the shelf life shown on the explosives manufacturer's technical data sheet for that product. Millisecond delay, shock-tube initiators, must be used as the initiation system. To ensure the accuracy of firing times of blasting caps, it is required that each cap period come from one lot number. Mixing of lot numbers for any single cap delay period within a shot pattern is strictly prohibited. For underwater blasting's ability to displace rock against the water load, the minimum delay both between shot holes and shot rows will be 25 milliseconds.

2.1.2.2 Prohibited Explosive Materials

Explosives that do not meet the manufacturer's specifications must not be used. When, in the opinion of the Contracting Officer, any explosive materials is either of excessive age or appears to be in a deteriorated condition, all work must cease until the products age and quality can be determined. Blasting products without date batch codes will not be

permitted on site. The Contracting Officer may require any explosive materials to be tested by an independent organization to determine its performance as compared to the manufacturer's data sheet. If explosive materials' performance or composition deviates by more than 10 percent in any manner from the manufacturer's data sheet, that lot number will be rejected. The Contractor is responsible for any required testing and no additional compensation will be made for any product testing directed by the Contracting Officer.

Bulk explosives, which are water sensitive, are strictly prohibited.

Detonation Cord is strictly prohibited for initiation transmission through the air and water to the shot holes. An approved non-electric shock tubing, proposed in the Master Blasting Plan, must be used to transmit the firing initiation to each shot hole. Detonation cord may be used within the shot hole by proper connection to the shock tubing beneath the highest elevation of firm-rock stemming.

2.1.3 Magazines

****

NOTE: Determine whether not allowing onsite explosive storage magazines will be an adverse impact that will limit bidders. If the project has sufficient area of restricted open property, explosive magazines may be allowed onsite. For example, a rural federal project may have sufficient property to accommodate the stand-off distances from the magazine to other residential or essential structures to easily allow an onsite magazine, especially if the adjacent non-federal property owners might not wish to have a magazine on their property. Recognize that there will be at least two daily trips with appropriate explosive-transport vehicles between the magazine and the coming shot pattern. Delete the first paragraph, "No explosives … explosive magazines.", if onsite magazines will be allowed.

****

[No explosives will be stored onsite. There must be no permanent explosive storage or overnight explosive storage onsite. The Contractor will either obtain daily deliveries of the explosives to the site from a manufacturer or supplier or secure offsite explosive magazines.

] When the Contractor will maintain the explosive magazines, obtain all necessary Federal and State magazine permits for the magazines. Magazines must be located at safe distances as defined by the Bureau of Alcohol, Tobacco and Firearms (ATF), in addition to the State of [_____]'s requirements. Procure off-site explosive storage and expect to transport the daily volume of explosives to the site. Secure a permit to transport explosives from the State of [_____]'s Highway Patrol when and if required, and transport explosives in accordance with 49 CFR 177 when carried on public highways.

The Contractor must have two temporary magazines on board the drilling and loading barge of sufficient volume to hold the largest day's use of explosives and initiators separately. These temporary magazines must meet all ATF requirements and all regulations and ordinances of state and local

government. No explosives may remain overnight in the temporary magazines. A daily-use log of explosives delivered, loaded by shot hole through the day, and removed at the last shift must account for the use of all explosives.

2.1.4 Magazine Keeper

Each magazine keeper must be experienced and familiar with the laws and general practices concerning the handling, care, use, and storage of explosives and detonators. The magazine keeper is responsible for maintaining a cleared area around each magazine. The magazine keeper will not be required to perform any duties that will in any way interfere with their duties as magazine keeper and being physically present at the magazines for every entry to the magazines for delivery, disbursement, and review of explosives at the magazines.

If explosives are delivered and returned daily from the manufacturer or supplier to the project, the driver of the truck will serve as the magazine keeper.

PART 3 EXECUTION

3.1 GENERAL EXCAVATION AND REMOVAL

****

NOTE: Delete inapplicable sections. The coordination with other federal, state, and local jurisdictions and agencies, the public, and private entities must be completely resolved before finalizing the specifications.

While it is not typical to have low tolerances for the horizontal variation of submerged walls or for the vertical variation of submerged pay grades, some projects may require limited control of the walls and grades in underwater blasting. Before resolving the project's underwater tolerances, determine an easy and effective means to survey the submerged walls and grades, and further assess to what precision such surveys may accurately estimate horizontal and vertical variations over short distances.

Presplitting would be an unusual requirement for underwater blasting, even in shallow water, because of the accuracy of knowing the exact horizontal location of the Top of Firm Rock. In projects where controlled blasting techniques are required to produce final walls which require presplit blasting, only explosives designed for this application must be allowed.

Specific underwater blasting impacts' requirements, negotiated or specified with environmental agencies and offices, must be fully determined, and in some cases designed, for the project before the specs may be finalized. Some requirements, like seasonal restrictions on underwater blasting or the prohibition of detonation cord in the open air and

water, may easily be included. Other requirements, such as the required use of a bubble curtain, should be avoided if possible, because of its difficulty in its proper use, maintenance, and storage, but when required will need to be designed by an appropriate experienced professional for inclusion of the designed element in the specifications.

****

Perform the excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Dredging, breakage, displacement, and excavation of all the materials will be accomplished by appropriate techniques and with special care, such that no individuals, cited natural resources, structures, navigation and other sensitive features, and activities suffer any adverse effects from blasting. Perform the submerged removal in accordance with the typical sections shown and the tolerances specified in paragraph SUBMERGED MATERIAL DISPOSAL.

The Contractor's blasting program and methods will be those controlled blasting techniques necessary to accomplish the excavation shown on the contract drawings in accordance with the procedures specified in this section. Make necessary plans, examinations, surveys, and test blasts to determine the quantity of explosives that can be fired to accomplish the breakage (or displacement) and removal of materials without injuries to persons, and aquatic wildlife (or other natural resources), or damage to personal or public property. Test blasts will be performed to slowly build to acceptable loading and timing of production shot patterns, to verify that the monitoring network performs as designed, to begin to assemble monitoring data collection, and to resolve that the submerged material is adequately broken or displaced for removal. Use the test blasting results to optimize remainder of work. The blasting program must abide by all applicable Federal, state, and local laws, regulations, and ordinances established for the project's location.

Process any and all claims of public entities, companies and private citizens arising from the transportation, storage, and use of explosives promptly in an acceptable time period set by the Contracting Officer Representative (COR); in particular, all injury and property damage claims must be acknowledged by the Contractor, or their representative, and be submitted immediately as directed by the COR to the Contracting Officer providing name of claimant, location, time and description of alleged injury, and damage, and estimated value. The claimed injury or damage will be evaluated and inspected by an appropriate specialist within 48 hours following initial notification, and processed to a conclusion (honored, denied, or compromised) within 90 days after cessation of all blasting on the contract; but, in no case will the claims remain unresolved for a period exceeding 6 months (180 calendar days). Submit evaluation and inspection results and actions taken to the Contracting Officer on a weekly basis.

3.1.1 Removal of Submerged Materials

****

NOTE: Determine whether varied submerged materials being excavated may be placed in other submerged low-elevation zones that allows undifferentiated placement of the excavated volumes to the pay grade. There may be requirements to place certain

materials in specific locations by the submerged material's type. Different projects may require disposal only above water or only below water.

****

3.1.1.1 Sediment Within the Project Limits for Removal Displacement

Sediment vertically above the project limits for removal may be excavated, removed, or displaced by any means, including dredging, prior to action upon deeper materials. Sediment may be left in place for removal by mechanical means after the breakage of deeper materials allows those materials to be removed. Unless the Disposal of Materials requires differentiation of materials below or above the water surface, the sediment may be removed and placed in the disposal zone before or after the excavation of deeper materials.

3.1.1.2 Breakage of Rock and Hard/Unyielding Materials for Excavation and Disposal

****

NOTE: Determine whether the sentence below, "The lateral dimensions … azimuthal direction." is required. If it is necessary for specific project, determine the lateral distances the azimuthal directions that meet the project's needs. If it is not necessary for specific project, delete the sentence.

****

Blasting may be conducted to break or displace the rock and hard/underlying materials into sizes that may be removed by dredging or excavation equipment. Test blasting will be conducted to determine the parameters for the following production blasting. Care must be taken to prevent damage to any of the remaining specified materials, features or structures noted in the drawings; and avoid adverse effects from blasting to personnel, the public, natural resources, structures, and features. The lateral dimensions of any blast plan must not exceed [_____] m [_____] ft horizontally in any azimuthal direction. The Contractor must curtail blasting activities in designated areas when, in the opinion of the Contracting Officer, damage to in-place units or adverse impacts may have occurred. Blasting will be curtailed in these designated areas until both remediation, as directed by the Contracting Officer, has been completed, and the Contractor has resolved a means to conduct the blasting without the damage or adverse impacts.

3.1.2 Disposal of Materials Within the Project Limits

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NOTE: The Guide Spec presumes that all dredged and/or excavated materials below the water surface may be placed below a specified elevation(s) in submerged, low-elevation zones already surveyed and provided in drawings. If any materials must be removed from the project area and/or will be placed by material type and/or within certain tolerances, compaction requirements and/or by having been dewatered, additional disposal sections and references to those locations of placement or disposal will be required to be added.

****

Transport and place all dredged, displaced, or excavated materials within the limits of the disposal zones below the specified elevations, according to the requirements specified in paragraph SUBMERGED MATERIAL DISPOSAL.

3.2 SAFETY PROCEDURES

3.2.1 General

Ensure all work completed under this Contract is executed safely. Follow the safety procedures outlined in EM 385-1-1. EM 385-1-1 will govern all activity unless more stringent safety requirements are specified in other applicable Federal, State, and local laws, regulations, and ordinances.

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NOTE: Additional narrative may need to be added on coordination with other federal, state, or local entities before acceptance of the Master Blasting Plan for critical items and required limitations, which have been included within paragraphs SAFETY PROCEDURES, OPERATIONAL REQUIREMENTS, and IMPACT MONITORING. There may be compliance obligations for the Contractor, the Contracting Officer and/or other entities regarding those critical items and required limitations. For example, if a Marine Mammal Watch Program is required to avoid blasting while marine mammals are near the loaded, underwater shot array, then the CO, the Contractor and the entity requiring the watch program should schedule and meet both to discuss and to have a mutual understanding relative to project of the Marine Mammal Protection Plan.

****

3.2.2 Weekly Coordination Meeting

Coordinate all blasting schedules with the Resident Engineer's Office and Contracting Officer at least one week in advance and hold a weekly blasting coordination meeting with the Resident Office. Provide an agenda for the blasting coordination meeting that lists project's prior week's shots, the forecasted shot schedule, and displays a scale site plan showing the locations of the schedule shots. The Blasting Specialist, Blaster in Charge, and Seismic Specialist are required to participate in discussion of agenda items and lessons learned.

3.2.3 Public Notice of Blasting Operations

Thirty days, prior to any blasting operations, prepare and submit to the Contracting Officer a public government notification letter of the proposed blasting activities. The Government will distribute copies of this notification letter by certified mail to local governments, law enforcement, public utilities, public users of project recreational facilities, and residents and commercial interests located within 0.8 kilometers one half mile of the blast site. This notification letter must contain at minimum:

a. Name, address, telephone number and e-mail address of the Contractor;

b. Plan maps identifying the specific areas in which blasting will take

place, and major and secondary roads, geographic features and auxiliary features;

c. Duration of blasting activities, and on which days of the week and hours of the day that blasts can be expected to occur;

d. Vehicular and pedestrian traffic control measures to be taken;

e. Methods to limit access to the blasting area; and,

f. Types, patterns and duration of audible warning and all-clear signals to be used before and after blasting.

3.2.4 Public Meetings

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NOTE: Communicate with the project manager and all stakeholders about whether specific requirements for a meeting or multiple meetings are needed. It may be necessary to advertise the meeting in a local newspaper and specify the meeting room capacity.

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Fifteen calendar days prior to any blasting operations, provide the approved Blasting Specialist, Blasting Consultant, and Seismic Specialist to attend a public-relations meeting to be conducted on an evening to be determined by the Contracting Officer. This meeting will inform the public about the anticipated blasting operations. The Blasting Specialist, Blasting Consultant, and Seismic Specialist must each make a short presentation of blasting operations and answer any questions pertaining to public concerns dealing with the blasting operations, the magnitude of vibrations, airblast and potential for flyrock that may impact the public, and the project's required natural resource activities. Distribute points of contact should the public and local entities have an event of concern related to the blasting program.

3.2.5 Warnings and Signals

Establish a method of warning all employees on the job site of an impending blast following the guidance of EM 385-1-1. The signals must consist of a five-minute warning signal to notify all in the area that a blast will be initiated in five minutes. A second warning signal must be sounded one-minute before the blast. After the blast is over, sound an all-clear signal, once the blast site has been inspected for misfires by the Blaster in Charge to notify all in the area that the blasting operation is finished. No personnel other than the Blaster in Charge must enter the blast area, until it has been determined to be all clear.

3.2.6 Notification to Navigation

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NOTE: Use the following paragraphs when working in or near navigable waters or navigation lock. The notice may need to be coordinated with multiple federal, state, or local agencies, which could include the U.S. Coast Guard, a Corps of Engineers' District Office, an entity of a District Office (e.g., a Lock), a state agency, a local agency for a harbor or its police or fire department, and other

offices.
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Notify the [_____] a minimum of [14] [_____] calendar days prior to the commencement of blasting operations to allow for sufficient time to send out navigation notices. The information to be supplied will include the dates and time window of blasting operations.

3.2.7 Navigation Control During Drilling, Loading, and Blasting Operations

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NOTE: Determine the number of patrol vessels required for the specific project. At least one patrol vessel should be required unless the AO totally controls the water surface far beyond the size of the excavation zone. Correct the second and third paragraphs with such determination for the specific project.

Placement of buoys in the third paragraph is also project specific. Resolve whether buoys are required and the distance beyond the shot pattern or excavation zone that the buoys should be positioned.
****

Notify the Coast Guard 24 hours prior to a scheduled blast and 2 hours prior to the actual blast's initiation. Contact should be made with: US Coast Guard's contact, whose name and an alternate's name will be provided at time of contract award.

Operate [two] patrol vessel[s] during blasting operations equipped with a visible yellow flashing light, audible horn, and radio with a hailer, whose sole function will be to monitor and maintain security in the blast area. Use patrol vessels during all blasting operations. Inspect and insure there is no vessel traffic within the work area prior to the firing of the blasting caps and until such time as the Contractor has sounded the "All-Clear Signal".

Establish and maintain a warning system as required by EM 385-1-1 and as stated in paragraph WARNINGS AND SIGNALS. Equip and maintain the floating plant with radio equipment capable of communications with the Coast Guard. The Contractor, after each blast, upon inspecting the area, notify the Coast Guard and Contracting Officer if all clear or misfire is noted. Buoy the area with warning signs. The warning signs are to be legible from a distance of [_____] m [_____] ft and contain the message "DANGER - EXPLOSIVES IN USE" visible on either side of the sign. Station patrol vessels at the drill barge and remain in the blasting area during all blasting operations. Land oriented access control and visual observation locations will be determined and approved by the Contracting Officer.

3.2.8 Lightning Detection Device

Furnish, maintain, and operate lightning detection equipment during the entire period of blasting operations and during the periods that explosives are used at the site. Equipment must provide real time audio and visual alarm/signal and detection based on combined detection of electromagnetic, electrostatic, light wave spectral and audio disturbances, or a commercial service based on these, as a minimum for approved. Equipment must be capable of detecting lightning within 40

kilometers 25 miles as a minimum of the blast area. Provide the equipment after approval. When and where the lightning detection device indicates a blasting hazard potential, immediately evacuate personnel from all areas where drilling is being conducted or explosives are present. When a lightning detector indicates a blasting hazard, perform the following actions.

a. Clear the blasting area of all personnel. Place guards at all access points to the blast area.

b. Immediately notify the Contracting Officer of the potential hazards and precautions being taken.

c. Terminate the loading of holes and secure the unused explosives to an approved location.

d. When the hazard dissipates, inform the Contracting Officer that the drilling and loading of holes will continue.

3.2.9 Drill-Boat or Barge Safety

All onboard day magazines must be permanently secured to the deck as required by the Coast Guard. No high explosives will be stored on the boat or barge deck in the open except for the one case that is to be loaded immediately into the shot holes. Any explosives remaining on deck must be returned to the day magazine prior to the firing of any blast. The firing line reel or spool will be mounted on the rig in a manner that it cannot be lost overboard. An approved blasting machine will be used for detonation regardless of the number of caps used. No electric blasting system can be used. The amount of explosives permitted aboard the drill boat or barge at any one time will be subject to the approval of the Contracting Officer, but in no case will such amount exceed the amount permitted by appropriate codes and regulations.

Make necessary arrangements to prevent damage to any vessel, moored or underway, building or structure and to preserve the crew or occupants thereon from exposure to injury because of the Contractor's operations. Automatic fire extinguishers of an appropriate type must be installed on air compressors and in all engine compartments abroad vessels (drill boats, barges) where explosives are stored, handled, and used. The Contracting Officer may require additional arrangements. Have a Certified Marine Survey of all floating plant proposed for underwater blasting work on this contract performed prior to starting any work and provide the results to the Contracting Officer. Remote fuel shut-offs and fire-signaling devices must be provided aboard the drill boat.

3.2.10 Inspection for the All-Clear Signal

The Blaster in Charge must thoroughly inspect the entire blast area for a minimum of five minutes following a blast. The five-minute delay between blasting and commencing work is needed to ensure that no misfires have occurred. Details of the misfire procedures were provided in the Blasting Safety Plan, including the distance of the restricted area when a misfire is discovered.

3.2.10.1 Check for Misfires

During the five-minute delay, it is the responsibility of the Blaster in Charge to enter and inspect the shot-pattern area and verify for all

loaded shot holes that all explosives have been detonated.

3.2.10.2 Misfire-Handling Procedures

Should an inspection indicate that complete detonation of all charges did not occur, only critical personnel involved in the blasting operation or excavation of the unexploded material are allowed within the established shot-pattern area. Restrict the site until the Blaster in Charge or the Blasting Specialist indicate the site is safe. If the misfire poses problems that cannot be safely corrected by the Blaster in Charge or the Blasting Specialist, a consultant, or an explosives company representative skilled in correcting misfires must be called to resolve the problem. Provide within 60 minutes of the recognition of a misfire, a notice to the Contracting Officer and all applicable agencies and offices for public safety. Compliance with this or any other provision in the Contract will not relieve the Contractor of responsibility for any damages or injuries caused by, related to, or arising out of blasting or associated blasting activities.

Provide the details of the misfire and the correction measures in the Individual Shot Report for shot with the misfire to the Contracting Officer and the emailed addressees the next business day.

3.2.11 Natural Resource Protection (Environmental Resource Protection)

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NOTE: During the planning process for projects requiring underwater blasting, the agency/Service responsible for construction would have conducted an environmental impact analysis of the project, including blasting impacts, and coordinated with applicable Federal and state Natural Resource agencies, under the authorities of a number of environmental laws. For example, an Environmental Assessment (EA) or Environmental Impact Statement (EIS) would have been completed per the requirements of the National Environmental Policy Act. Often mitigation is suggested or required by the reviewing agencies. These mitigation techniques could be as simple as the design of well stemmed shot-holes to reduce pressure entering the water column or the use of small repelling charges to scare fish from the blasting zone. The responsible, reviewing agencies could also require extensive planning and design for such mitigation techniques as post-blast monitoring studies or the design and use of an effective bubble curtain system to reduce blast pressures. If marine mammals are in the project area, the Marine Mammal Act comes into play. Depending on the project, the National Marine Fisheries Service (NMFS) has required the use of Marine Mammal Watch Programs to ensure that marine mammals are not within a specified distance from the blast prior to detonation. These distances (in the form of pressure limits) are often provided by the NMFS and the monitoring is conducted by specialized companies with specialists in the identification of marine mammals. The NMFS has also required near-field pressure monitoring to confirm Watch Program

distances and far-field acoustic monitoring to ensure that sound levels are below levels causing auditory damage. The major environmental laws that may require mitigation or place restrictions on project blasting are listed under paragraph REFERENCES. (If there are no requirements under an environmental law, then the no mitigation would be required under that law and the reference should be deleted). However, additional Federal and state laws may also apply, depending on the project. Coordination with other federal, state, and local agencies and jurisdictions, the public, and private entities must be completely resolved before finalizing the Specifications. It is essential that the agency/service person, using these Guide Specifications to prepare Plans and Specifications. coordinate with the planners and environmental compliance specialists within their agency/Service to ensure that all the blasting restrictions and mitigation measures are incorporated into the Plans and Specifications. Failure to comply with the requirements of Federal or state laws and regulations could result in project delays or stoppages.

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The Contractor is required to utilize the following to avoid and minimize techniques designed to mitigate the impacts of underwater blasting that have been developed, in coordination with other Federal agencies, in compliance with the federal, state, and local environmental laws and regulations and with applicable regulations and requirements of Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS. All activities requiring the Contractors' action or coordination are included in paragraph NATURAL RESOURCE ASSESSMENTS, Mitigation and Monitoring. The Contractor has full responsibility for not violating all the mitigation requirements. Associated fines for violations will be borne by the Contractor.

[3.2.11.1 National Environmental Policy Act

Write detailed description of work to be performed by the Contractor here. If there is no required work under 42 USC 4321 then the section should be deleted and renumbered.

][3.2.11.2 Endangered Species Act

Write detailed description of work to be performed by the Contractor here. If there is no required work under 16 USC 1531 then the section should be deleted and renumbered.

][3.2.11.3 Marine Mammal Protection Act

Write detailed description of work to be performed by the Contractor here. If there is no required work under 16 USC 1361 then the section should be deleted and renumbered.

][3.2.11.4 Bald and Golden Eagle Protection Act

Write detailed description of work to be performed by the Contractor here. If there is no required work under 16 USC 668 then the section

should be deleted and renumbered.

][3.2.11.5 Marine Protection, Research and Sanctuaries Act

Write detailed description of work to be performed by the Contractor here. If there is no required work under 33 USC 1401 then the section should be deleted and renumbered.

][3.2.11.6 Magnuson-Stevens Act

Write detailed description of work to be performed by the Contractor here. If there is no required work under 16 USC 1801 then the section should be deleted and renumbered.

][3.2.11.7 Clean Air Act

Write detailed description of work to be performed by the Contractor here. If there is no required work under 42 USC 7401 then the section should be deleted and renumbered.

][3.2.11.8 Clean Water Act

Write detailed description of work to be performed by the Contractor here. If there is no required work under 33 USC 1251 then the section should be deleted and renumbered.

][3.2.11.9 National Historic Preservation Act

Write detailed description of work to be performed by the Contractor here. If there is no required work under 16 USC 470 then the section should be deleted and renumbered.

][3.2.11.10 Additional Federal Environmental Laws

Write detailed description of work to be performed under Federal environmental laws by the Contractor that are not listed in paragraph REFERENCES. If there is no required work under this Federal law, then the section should be deleted and renumbered.

][3.2.11.11 State and Local Environmental Laws and Regulations

Write detailed description of work to be performed by the Contractor here. If there is no required work under an applicable state and local laws and regulations, then the section should be deleted and renumbered.

]3.3 OPERATIONAL REQUIREMENTS

****

NOTE: The coordination with other federal, state, and local jurisdictions and agencies, the public, and private entities must be completely resolved before finalizing the specifications. A project's excavation and/or foundation requirements, for which submerged, dense materials are being removed, may require navigation, highway, structural and/or other regulations and codes to be followed. Depending upon the proximity of public-use areas, private residences or businesses, and the project's location within a county or township, various accommodations

will need to be required for the protection of the public, and the safety of private entities regarding local laws, regulations, and ordinances. Avoiding natural-resource impacts may overlay other measures and require seasonal or daily time limitations of the initiation of the individual blast patterns; special observers for some or all the blasting; special studies or monitoring while the blasting is being conducted; and other potential considerations.

Agency coordination will vary by project. Be certain that all government stakeholders have been involved with planning of the project and approved of all requirements for the specifications. List those important navigation or safety stakeholders in 3.3.2. When there are navigable waters near the excavation zone, list in 3.3.2 the controlled navigation perimeter's distance during the warning period of a shot. While the distance is project specific, the minimum distance is typically 300 m 1,000 ft.

****

3.3.1 Coordination

3.3.1.1 Schedules

Coordinate schedules for blasting with the proper authorities, federal, state, local. No blasting will be conducted unless the Contractor is notified by the appropriate parties that blasting may proceed. In addition, if channel restrictions of navigable waters are required for drilling and blasting, the Contractor will coordinate with the U.S. Coast Guard.

3.3.1.2 Permits

Obtain all necessary permits from the state and local authorities to transport explosives and all blasting agents necessary, and to perform blasting operations on site. The Contracting Officer will be notified in writing that all permits have been obtained and will be furnished copies of all permits.

3.3.2 Navigational, Lock or Vessel Control During Excavation and Removal

Various agencies and offices, [_____], must be notified of the scheduled blasting times for coordination. The Contractor must assure that no vessels are within, nor on a heading and speed to be within, [_____] m [_____] ft of the shot pattern during the 5-minute warning.

3.3.3 Work Restrictions

****

NOTE: While it is not typical to have low tolerances for the horizontal variation of submerged walls or for the vertical variation of submerged pay grades, some projects may require limited control of the walls and grades in underwater blasting. Before resolving the project's underwater tolerances, determine an easy and effective means to survey the

submerged walls and grades, and further assess to what precision such surveys may estimate horizontal and vertical variations over short distances. Presplitting would be an unusual requirement for underwater blasting, even in shallow water, because of the precision of knowing the horizontal location and vertical relief of the presplit walls. In projects where controlled blasting techniques are required to produce final walls which require presplit blasting, only explosives designed for this application must be allowed.

List all the restrictions for blasting agreed to by various agencies and offices in the sentence of the first paragraph, "The restrictions include: [_____]." Such restrictions may need to be detailed elsewhere in the specs, and may include any or all or the following: public notices; vessel traffic control by patrolling and through the Coast Guard; blast initiation only during daylight hours; prohibiting the use of bulk explosives; assuring confined detonations within sound rock; limiting the maximum charge weight of explosives per delay; assuring that airblast and vibration remain below acceptable levels; recording all shots with videography and blast seismographs; seasonal restrictions to lessen the likelihood of a species in the blasting area; and, the use of fish-repelling noise immediately preceding every shot. Some specialty requirements will require careful consideration for their need and will require the design input of experienced specialists. These specialty requirements include, but are not limited to, underwater pressure wave monitoring or mitigation by use of an air curtain. The design or limitation of the action is stated in these paragraphs. The Contractor's actions or coordination of required Natural Resource activities are listed in paragraph NATURAL RESOURCE ASSESSMENTS, MITIGATION AND MONITORING.

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There are a variety of restrictions upon blasting to assure that there are no adverse impacts to the public and upon commerce, and to avoid harm to surrounding structures and to the natural resources and their habitats. The restrictions include: [_____]. Several restrictions that are not fully detailed elsewhere within this chapter are noted in this paragraph.

3.3.3.1 Confined Detonations

The rock excavation after blasting will be more effective if each loaded drill hole is well confined by stemming within sound rock. The intent is to confine the gaseous detonation products of each shot hole, such that no rifling plumes, the visual result, are produced in any shot patterns. The premature release of the gaseous products reduces or eliminates effective fracturing and displacement and causes large water-borne pressures potentially damaging to natural resources. Drill-hole logging is required to recognize the depth of firm rock and voids, and to adjust the designed Individual Shot Plan loading of each shot hole with

explosives and stemming according to the position of sound rock relative to the paid elevation of removal. Video recording of each blast will detail the effectiveness of avoiding rifling plumes.

3.3.3.2 Temporal, Weekly and Seasonal Restrictions for Blasting

****

NOTE: Determine the times, days, and dates that blasting is permitted. Typically, blasting is only allowed during business hours on business days and Saturdays, particularly when there may be vibratory blasting impacts at residential, business and/or commercial structures. Specialty or critical facilities may require other temporal and vibratory restrictions. Usually, blasting is restricted from being conducted on Sundays and federal holidays. There may need to be date restrictions for specific local or regional events. In coordination with state and local entities, revise the paragraphs for your specific project.

****

Blast initiation is permitted: during daylight, business hours on business days; on Saturdays to [_____]; and, on Sundays and federal holidays to [_____]. Regardless of the season, blast initiation is only permitted, during the period from one-hour after sunrise to one-hour before sunset. The Contractor will not be constrained by weather conditions, except for lightning, for underwater blasting in depths of water greater than 0.9 m 3.0 ft for which airblast is often negligible. Drilling and blasting will not be permitted during the following seasonal periods: [_____].

3.3.3.3 Allowable Vibration

****

NOTE: Vibration monitoring is required for every blasting project. The paragraph's narrative is a generic description for most projects, where the nearest structure/facility is: Standard Construction Timber Frame, Brick, and Concrete Buildings; Lock Monoliths; Powerhouse Switchyard; Highway and Railroad Bridges; Buried Utilities; and Wells and Aquifers. Some projects may require assessment by a trained experienced blasting specialist or structural engineer of lower allowable vibration criteria at critical or historic or special structures or facilities or structures with continuous occupants. Vibrations can cause the occupants of structures to become physically uncomfortable at levels well below the allowable vibration levels to avoid damage to the structure itself. Projects a with a Powerhouse and Electrical Power Relay Equipment or Pipelines, besides those with continuous occupants, should be evaluated for lower allowable vibration criteria. Some projects could utilize the assessment by a trained experienced blasting specialist or structural engineer to include higher allowable vibration criteria for those projects where typical structures/facilities are more than twice the

distance of the closest approach of blasting to: Steel and Reinforced-Concrete Structures; Mass Concrete Monoliths; and Cured Shotcrete.

Alternate language and charts for this section:

TABLE 1 below gives standards for allowable peak particle velocities as they relate to a variety of common construction materials. Do not exceed these vibration limits.

These vibration limits must not be incorporated in the blast design. Many projects have been constructed utilizing a fraction of these allowable values. Properly design the blasts, set allowable vibration limits, and maintain proper control throughout the duration of construction. The Contractor is responsible for all damages caused directly by, or as a result of the blasting operations. Compliance with this or any other provisions in the Contract must not relieve the Contractor of responsibility for any damages or injuries caused by, related to, or arising out of blasting or associated blasting activities.

Here are two examples of vibration tables. The first is more generic and should be used the section shows for a specific project also requiring an initial peak particle velocity for test blasting ramp up.

TABLE 1: VIBRATION LIMITS FOR STRUCTURES		
STRUCTURE TYPE	ALLOWABLE PPV (ips)	ALLOWABLE PPV (cps)
Standard Construction Timber Frame, Brick, and Concrete Buildings	2.0	5.0
Reinforced Concrete Structures (not Mass Concrete)	4.0	10.0
Steel Structures	4.0	10.0
Buried Utilities	2.0	5.0
Wells and Aquifers	2.0	5.0
Steel Pipelines	5.0	12.7
Mass Concrete Monoliths (Cured Concrete) Shotcrete	10.0	25.4

Or similar, adjust these for projects:

Features	Initial	Initial	Product	Product
Lock Control Room	0.5	1.2	2.0	5.0
Powerhouse Lower Level	0.2	0.6	1.0	2.5
Powerhouse Control Room 69kV Relay	0.4	1.0	1.0	2.5
Powerhouse Switchyard	2.0	5.0	2.0	5.0
Transmission Tower	3.0	7.6	3.0	7.6
Existing Lock Monoliths	2.0	5.0	2.0	5.0
Segmental and Cellular Cofferdam	2.0	5.0	4.0	10.0
Downstream Highway and Railroad Bridges	1.0	2.5	2.0	5.0

Note that older deteriorated structures or utilities and structures housing computers or other sensitive equipment may require lower peak particle velocity limits than those provided in Table 1. Also, buried pipelines owned by private utility companies or bridge structures owned by other agencies may be subject to lower limiting values imposed by the owner. The safe vibration limits and charge weights per delay to achieve these vibration limits must be established by the Seismic Specialist and the Blasting Consultant. Vibration limits for all non-government owned structures must conform to the laws of the State of [_____]. The text below can be used referring to the graph in NFPA 495 in lieu of site specific developed for the project.

****

The Contractor must conduct all the required monitoring as noted in paragraph IMPACT MONITORING. The Contractor must conduct all blasting by controlled blasting methods to avoid exceeding the allowable vibration in applicable federal, state, and local laws, regulations and ordinances at all structures and facilities, as monitored by blast seismographs.

The allowable vibration at any structure or facility must not exceed the maximum PPV of 5.0 centimeters/second (cm/s) 2.0 inches/second (ips), nor exceed the PPV amplitude in the Frequency versus Particle Velocity Graph Figure in NFPA 495 (Figure 11.2.1) for the frequency of the half-cycle amplitude.

****

NOTE: The section pertaining to Green Concrete may be removed and its definition removed, if the concern for newly placed concrete, shotcrete and/or cementitious grouts is not applicable. The period of hours is broad, because neither the exact time of the blast nor of the material placement will be known exactly. Values of allowable PPV have not

been included greater than 2.0 ips, because above 2.0 ips will adversely affect ordinary structures and individuals within those structures. Further, most concrete structures should be limited to allowable PPV at or below 4.0 ips.

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3.3.3.4 Limiting Blast-Induced Vibrations at Green Concrete

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NOTE: Some guidelines for peak particle velocities related to time intervals after placing mass concrete/shotcrete/grout curtains are given in Tables 2 and 3 should be considered when designing a blast. The specification writer must include a limitation of the allowable vibration when there is green concrete expected on the project. Table 2 has two option, one is more conservative, designer should make engineering decision which to use or adjust based on data. There are other potential charts that can be used:

TABLE 2: VIBRATION LEVELS FOR GREEN MASS CONCRETE/SHOTCRETE/GROUT

TIME AFTER PLACEMENT	ALLOWABLE PPV (ips)	ALLOWABLE PPV (cps)
0 - 4 Hours	2.0	5.0
4 - 24 Hours	3.0	7.6
1 - 3 Days	5.0	12.7
4 - 7 Days	7.0	17.7
8 - 10 Days	9.0	22.8
Over 10 Days	10.0	25.4

TABLE 3: VIBRATION LEVELS FOR GREEN CONCRETE/SHOTCRETE

TIME AFTER PLACEMENT	ALLOWABLE PPV (ips)	ALLOWABLE PPV (cps)
0 - 10 Hours	0.1	0.2
10 - 24 Hours	2.0	5.0
24 - 48 Hours	3.0	7.6
2 - 3 Days	4.0	10.0
4 - 7 Days	6.0	15.2
8 - 10 Days	8.0	20.3
Over 10 Days	10.0	25.4

****

During the performance period, other construction activities may be placing concrete at varied locations on or near the project. The Contractor will coordinate with other project contractors or will be informed on the prior business day by the Contracting Officer concerning the likely placement of concrete near the project.

a. The Contractor will assure that a seismograph is monitoring vibrations

from blasting at a location, which is closer to the blast pattern than the Green Concrete. Seismic monitoring must be conducted near the concrete placement from prior to placement until 72 hours after placement.

b. The table below indicates that maximum allowable peak particle velocity (PPV) permitted, relative to the age of the recently-place concrete, as measured at an acceptable location or within 15 m 50 ft of the most recently placed concrete on the side of closest approach to the blast.

Age of Concrete (hours)	less than 12	12 to 24	24 to 72
PPV (inch/second)	0.1	1.0	2.0

c. Adjust all blasting to conform to the table's maximum allowable PPV at the seismograph near the Green Concrete. See paragraph IMPACT MONITORING.

3.3.3.5 Allowable Airblast

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NOTE: Airblast is rarely a concern with underwater blasting. Some provision for allowable airblast should be provided within this paragraph. Air blast limits should follow most stringent regulation as some states have a threshold more stringent than some agencies.

****

The Contractor must conduct all the required monitoring as noted in paragraph IMPACT MONITORING. The Contractor must conduct all blasting by controlled blasting methods to avoid exceeding the allowable airblast in applicable federal, state, and local laws, regulations and ordinances at all structures and facilities, as monitored by blast seismographs. Peak airblast overpressure must be held below [133 dB (linear peak scale), 100. Pascals (Pa) 0.015 pounds/square inch (psi)] at the nearest residential or inhabited structure or other designated location.

3.4 BLASTING PERSONNEL

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NOTE: Depending on the scope and duration of the project, it may be prudent to require the Contractor to provide a named and approved alternate for some positions. Several positions are required to continuously perform blasting responsibilities, even when one individual is not available onsite for that role's responsibilities.

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3.4.1 Blasting Consultant

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NOTE: Depending on the scope of the project, it may not be necessary to require a Blasting Consultant. This will be determined during design, a USACE Blasting SME should be consulted to discuss this.

Projects with few critical blasting limitations, far from sensitive structures or from heavily used public areas, or with few Natural Resource issues may not need a Blasting Consultant. One option is to still require a blasting consultant to be engaged, but only for reviewing the Master Blasting Plan and engaged on serious blasting issues with the blasting (misfires, shot hole rifling loss of confinement, exceedance of vibration and/or airblast limits, approaching Natural Resource limitations without being able to properly break and displace rock) as and if the issues develop.

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The Blasting Consultant, Blasting Specialist, Blasting Administrator, Blaster in Charge, and Vibration Specialist cannot be the same person. Retain a recognized Blasting Consultant to assist both with the project's blast design and with the resolution of any blasting issues for the project. The Contractor must submit the Blasting Consultant's expertise submission within [15] [_____] days of the Notice to Proceed. The Blasting Consultant must be approved by the Contracting Officer's Representative two weeks prior to the submission of the Master Blasting Plan.

3.4.1.1 Blasting Consultant's Responsibilities

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NOTE: The paragraph below should be used when controlled blasting techniques are required.

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The Contractor's Blasting Consultant must be available to review the Master Blasting Plan, assist with controlled blasting techniques, and resolve difficult or complex issues with blasting for the project. The Blasting Consultant will recommend controlled blasting methods, as necessary, to meet safety and natural resource requirements, retain airblast and vibration within the allowable limits, and protect the rock foundation. Proposed controlled blasting methods must be submitted in the Master Blasting Plan.

The Blasting Consultant must provide advice for, and review, the Master Blasting Plan, attend the public meeting(s), and be available for consultation on an "as needed" basis, as determined separately by the Contractor or by the Contracting Officer. The Blasting Consultant is not required to be at the project site for review of the Master Blasting Plan or of any specific shot plans or records. The Blasting Consultant must be present at the project site for any required shot issue or, if requested, for the subsequent shot following a misfire or significant exceedance of any onsite blasting issues.

The Blasting Consultant must provide a written summary of all site visits and special assignments within [2] [_____] business days of performing such actions to both the Contractor and the Contracting Officer's representative.

The Blasting Consultant must submit a short, signed Blasting Consultant's Report each month stating that he/she has briefly reviewed the individual shot documents, including blast videos, and has collaborated with the Contractor on all issues, concerns, or errors in the individual shot

documents. This report is due within [3] [_____] business days after the end of the month.

If problems with vibration, airblast, rifling of a shot hole producing a water column plume, or production blasting occur, the Contracting Officer will require the Contractor to immediately summon the approved Blasting Consultant and have their presence on site within 10 days after the problem develops to:

a. Approve each Individual Shot Plan;

b. Observe in person shot-hole drilling, logging, revision to that hole's plan, and loading with the full authority to stop or delay any blast he/she considers unsafe;

c. Review and sign each Individual Shot Record at no additional cost to the Government; and,

d. Submit and sign a written checklist that all necessary precautions were reviewed and followed by the drilling and blasting crews.

The checklist must be as defined under the section on Individual Shot Reports. The signed checklist must be attached to each Individual Shot Report.

3.4.1.2 Blasting Consultant's Expertise

The consultant must be able to demonstrate involvement in at least 15 projects with controlled blasting. The consultant must provide, as a minimum, the credentials and experience for each outlined following items:

a. The consultant must have at least 10 years of experience in construction blasting within 75 m 250 ft of protected structures, and had consultation on three underwater blasting programs;

b. The consultant must be able to demonstrate that he has attended at least 15 short courses, seminars, or conferences on blasting technology, or university engineering class studies on blast design during the past 20 years, including a complete understanding of blasting seismology with emphasis on vibration frequency, acceleration, and displacement (ground strain);

c. For the past 10 years the consultant must have derived their primary source of income from providing specialized blasting consulting services;

d. A list of recent projects containing a description of the projects' details, summarize the blasting plans, and any modifications made during the projects from your consulting;

e. Provide the names and telephone numbers of contacts, who have sufficient stature with, and knowledge of, their individual project to verify the submitted information in competency and ability, for at least three recent projects;

f. Hands-on experience as a blaster for at least 3 years; and,

g. The Blasting Consultant, Blasting Specialist, Blaster in Charge, and Seismic Specialist cannot be the same person.

3.4.1.3 Blasting Consultant's Qualifications Submissions

Submit the resume, education, experience, current blasting licenses and credentials, and training of the proposed Blasting Consultant, and a formal letter of commitment from the consultant verifying their availability on an "as needed" basis for the duration of the Contract. The consultant must be a drilling and blasting expert, who has derived their primary source of income by providing specialized blasting and blasting consulting services. The provided consultation must have included at least three, large underwater blasting projects. The consultant must not be an employee of the Contractor, an explosives manufacturer, an explosives distributor, or any other sub-contractor. There must be no additional cost to the Government for the Blasting Consultant's duties, even when required by the Government.

3.4.2 Blasting Specialist

The Blasting Specialist is the Contractor's employee most responsible for the project's blasting and conducting all coordination and providing all documentation for the underwater blasting. The Blasting Specialist must coordinate with the Contracting Officer on all issues dealing with blasting. The Blasting Specialist must be on the job site each day. The Contractor must submit the Blasting Specialist's expertise submission within [15] [_____] days of the Notice to Proceed. The Blasting Specialist must be approved by the Contracting Officer's Representative two weeks prior to the submission of the Master Blasting Plan.

3.4.2.1 Blasting Specialist's Responsibilities

The Blasting Specialist is responsible for the project's blast design, preparing and submitting all necessary blasting documentation, and conducting quality control. The Contractor may employee a documentation assistant to aid the Blasting Specialist with all the blasting documentation creation and submissions. The Blasting Specialist is solely responsible for the accuracy and timely submission of all blast documentation.

3.4.2.2 Blasting Specialist's Expertise

The Blasting Specialist must be able to demonstrate involvement in at least three projects with underwater blasting. The Blasting Specialist must provide, as a minimum, the credentials and experience for each outlined following items:

a. The proposed individual must have at least 10 years of verifiable experience utilizing controlled blasting techniques and have had conducted controlled blasting on three underwater projects;

b. Within the last five years, the proposed individual must have completed at least five days of classroom training that has familiarized the person with the most current drilling and controlled blasting methods;

c. The proposed individual must be a licensed blaster in the State of [_____] and hold all credentials that may be required by local jurisdictions;

d. In the last five years the proposed individual must have been

responsible for the blast design or execution of underwater rock excavation projects, similar in scope and complexity as this project;

e. The names and telephone numbers of contacts, who have sufficient stature with, and knowledge of, their individual project to verify the submitted information in competency and ability, for at least three underwater blasting projects; and,

f. The Blasting Consultant, Blasting Specialist, Blaster in Charge, and Seismic Specialist cannot be the same person.

3.4.2.3 Blasting Specialist's Qualifications Submission

Submit the resume, education, experience, current blasting licenses and credentials, and training of the proposed Blasting Specialist. Their credentials must include a list of the projects, including the location, duration, scope, description, geologic conditions, and the challenges that developed though the course of the projects and how the challenges were resolved.

3.4.3 Blaster in Charge

The Blaster in Charge may create the Individual Shot Plan for approval by the Blasting Specialist. The Blaster in Charge, in the absence of the Blasting Specialist, is the Contractor's employee responsible for on-deck supervision of all underwater blasting activities and its documentation. The Contractor must submit the Blaster-in-Charge's expertise submission within [15] [_____] days of the Notice to Proceed. The Blaster in Charge must be approved by the Contracting Officer's Representative two weeks prior to the submission of the Master Blasting Plan.

3.4.3.1 Blaster-in-Charge's Responsibilities

The Blaster in Charge, in the absence of the Blasting Specialist, is responsible for on-deck supervision of the drilling, shot-hole logging, possible revisions of the Individual Shot Plan, loading or abandoning of individual shot holes, and firing the blast. The Blaster in Charge is responsible for: the accurate placement of the shot holes' locations for drilling; conducting the drilling and shot-hole logging accurately; accounting for the relevant geology within each shot-hole's log; assuring the careful recording of every shot-hole's log and their submission with the Individual Shot Report; loading the blastholes according to the Individual Shot Plan or the revision thereto based on the shot-hole's log; coordinating the likely time of the blast pattern's initiation; coordinating all notices of imminent blasting and providing the signaling before and after the shot; initiating the blast; performing the post-blast inspection; providing the All-Clear signal or instituting the notices and actions for a misfire; and, providing the documentation for, and signing, the Individual Shot Report.

3.4.3.2 Blaster-in-Charge's Expertise

The Blaster in Charge must be able to demonstrate involvement in at least two projects with underwater blasting. The Blaster in Charge must provide, as a minimum, the credentials and experience for each outlined following items:

a. The proposed individual must have verifiable experience in equivalently responsible roles for controlled blasting projects for at

least 3 years and with underwater projects;

b. Within the last 5 years, the proposed individual must have completed at least five days of classroom training that has familiarized the person with the most current drilling and controlled blasting methods;

c. The proposed individual must be a licensed blaster in the State of [_____] and hold all credentials that may be required by local jurisdictions; and,

d. The Blasting Consultant, Blasting Specialist, Blaster-in-Charge, and Seismic Specialist cannot be the same person.

3.4.3.3 Blaster-in-Charge Qualifications Submission

Submit the resume, experience, current blasting licenses and credentials, and training of the proposed Blaster-in-Charge. Their credentials must include a list of the projects, including the location, duration, scope, description, geologic conditions, and the challenges that developed though the course of the projects and how the challenges were resolved.

3.4.4 Blasters

The Contractor may elect to employ multiple Blasters. Each Blaster is a Contractor's employee responsible for on-deck, underwater drilling and blasting activities under the supervision of the on-deck, Blasting Specialist or Blaster in Charge, whoever is present. The Blaster in Charge or a Blaster will log each shot hole, as the hole is being drilled. Each Blaster must be approved by the Contracting Officer's Representative after the submission of the Master Blasting Plan.

Blaster qualifications require each Blaster must be able to demonstrate prior experience with drilling and blasting. The proposed individuals must be a licensed or certified blaster in the State of [_____] and hold all credentials that may be required by local jurisdictions. Submit the resume, experience, current blasting licenses and credentials, and training of each proposed Blaster with the Master Blasting Plan.

3.4.5 Blasting Administrator

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NOTE: For smaller projects this position may not be necessary. The Blasting Administrator was added for large projects to aid the Blasting Specialist with paperwork.

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The duties of the Blasting Administrator are to be the direct assistant of the Blasting Specialist in preparing all necessary paperwork, and in performing quality control on all issues dealing with blasting. The primary function is to assist the Blasting Specialist in the preparation and completion of submittals, prepare the detailed post blast report, and the individual shot videos for submittal to the Contracting Officer, and submit the drilling logs with the post blast report. The Blasting Administrator cannot sign any paperwork. The Blasting Administrator must be approved by the Contracting Officer.

Blasting Administrator's qualifications require the Blasting Administrator to possess the following minimum qualifications and experience:

a. Holds a current Blaster's license;

b. Have prior experience in underwater blasting;

c. Must have completed at least five days of classroom training within the last five years that has equipped the person with the most current knowledge in blasting procedures; and the software to be used on the project; and,

d. Have proven proficiency with blasting software and spreadsheets.

3.4.6 Vibration Monitoring Specialty Firm

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NOTE: This is requirement is a new format from previous specifications. The firm is submitted for approval, having the appropriate experience and the firm must have on staff the Seismic Specialists and Seismograph Technicians, typically a firm is subcontracted by the Contractor and having multiple experienced people approved allows them to have flexibility on supporting the site work. The people coming to the project or responding to the work must be within the group approved but does not need to be a single person anymore.

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Retain the services of a vibration monitoring specialty firm that specializes in the prediction, monitoring, and control of ground vibration and airblasts. The firm must have experience conducting installation of seismographs for vibration monitoring, communicating vibration and airblast results, and developing and maintaining a site attenuation curve. The firm must have on staff at least two Seismic Specialists that specialize in vibration monitoring and analysis. The firm must have on staff at least four Seismograph Technicians that have five years or more experience with seismograph installation and vibration monitoring. Submit resumes for all personnel and for the firm for approval citing, in additional to other pertinent data, experience, training, and education, at least 60 days prior to the commencement of blasting. The Seismograph Technicians must be persons capable of setting up the seismographs at designated locations, effectively recording the blast, and appropriately interpreting results. The Seismic Specialists must interpret the seismograph records to ensure that the seismic data must be effectively utilized in the control of the blasting operations with respect to the existing structures. The Seismograph Technicians must supervise the placement, operation, and maintenance of the seismographs. The Seismic Specialists must conduct the airblast and particle velocity regression analysis as described in this Section. The Contracting Officer may require the Seismic Specialists and Seismograph Technicians to be present during the test blast program, production blasting, or both.

3.4.7 Seismic Specialist

The Contractor will retain the services of an independent, seismic-monitoring firm with employees capable of monitoring, assessing, and predicting vibrations and airblast due to blasting. The Seismic Specialist must be an employee of the independent, seismic-monitoring firm, and must not be an employee of the Contractor. The Seismic

Specialist will conduct, or assure the actions are being taken to obtain, the required blast seismograph monitoring for the project. The Seismic Specialist will supervise all Seismograph Technicians deployed to the project to deploy and maintain all the seismographs for recording vibrations and airblast, and to properly retain, store and submit all seismic records of the blasting. The Contractor must submit the independent, seismic-monitoring firm's, Seismic Specialist's expertise submission within [15] days of the Notice to Proceed. The firm and Seismic Specialist must be approved by the Contracting Officer's Representative two weeks prior to the submission of the Master Blasting Plan.

3.4.7.1 Seismic Specialist's Responsibilities

The Seismic Specialist must be a person able to deploy blast seismographs, effectively record and transmit the seismic data, comprehensively assess, and interpret seismic data regarding the monitored blast's parameters, and remotely supervise the firm's Seismograph Technicians. The Seismic Specialist must also interpret the seismic records to ensure that the seismic data will be effectively utilized in the control of the blasting operations with respect to the existing structures and conduct of an optimized blasting program.

3.4.7.2 Seismic Specialist's Expertise

The Seismic Specialist must be able to demonstrate monitoring deployment, seismic data assessment and interpretation, prediction of vibration and airblast from blasting, and remote supervision of field personnel for five blasting projects. The Seismic Specialist must provide, as a minimum, the credentials and experience for each outlined following items:

a. The proposed individual must have verifiable experience in equivalently responsible roles for controlled blasting projects for at least 3 years;

b. Within the last five years, the proposed individual must have completed at least five days of classroom training concerning seismic monitoring equipment, data telemetry, and seismic data interpretation;

c. The Blasting Consultant, Blasting Specialist, Blaster in Charge, and Seismic Specialist cannot be the same person. The proposed Seismic Specialist and Structural Inspection/Evaluation Specialist may be the same person.

3.4.7.3 Seismic Specialist Qualifications' Submission

Submit the credentials of the proposed seismic-monitoring firm with documentation for the Seismic Specialist. Submit the firm's history for this office, if there are multiple offices, years under the present office's leadership, the regional extent of clients, the approximate number of projects in the past year, and the number of present employees at this office. Submit the resume, education, experience, credentials, and training of the proposed Seismic Specialist. Their credentials must include a list of the projects, including the location, duration, scope, description, and the monitoring challenges that developed though the course of the projects and how the challenges were resolved. The documentation must provide experience and capability for the proposed Seismic Specialist to provide remote blast monitoring and supervision of support personnel while the individual is not on site.

3.4.8 Seismograph Technicians

The approved, independent, seismic-monitoring firm may provide Seismograph Technicians to assist the Seismic Specialist with the project's vibration and airblast monitoring. Each Seismograph Technician must be approved by the Contracting Officer's Representative after the submission of the Master Blasting Plan.

Each Seismograph Technician must be able to demonstrate prior experience with blast seismic monitoring on a prior project of equivalent size and similar telemetry requirements. The proposed individuals must have the required training and hold all credentials that may be required by local jurisdictions. Submit the resume, experience, credentials, and training of each proposed Seismograph Technician with the Master Blasting Plan.

3.4.9 Structural Inspection/Evaluation Specialist

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NOTE: Pre- and Post-Blast Inspections and the Structural Inspection/Evaluation Specialist would only be required if there are structures or facilities requiring such inspections. Eliminate the paragraphs referencing Pre- and Post-Blast Inspections and the Structural Inspection/Evaluation Specialist if the project does not have a requirement for these inspections. The Structural Inspection/Evaluation Specialist must be experienced in both pre- and post-blast inspections. While there may be an advantage to this person being a registered professional engineer, it is more important that the specialist have experience in evaluating potential blasting effects by post-blast inspections. Consider whether a registered professional engineer is a requirement, as the most experienced persons may not be registered professional engineers or may be difficult for a bidder to acquire for some projects

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Pre- and Post-Blast structural inspections must be performed by specialists with at least five years' experience in pre-blast and post-blast surveys.[The Structural Inspection/Evaluation Specialist must be a Registered Professional Engineer in the State of [_____], who is qualified to conduct structural evaluations.] Submit the resume, education, experience, credentials, and training of the proposed Structural Inspection/Evaluation Specialist to the Contracting Officer with the Master Blasting Plan. The proposed Seismic Specialist and Structural Inspection/Evaluation Specialist may be the same person.

3.4.10 Magazine Keeper

The Magazine Keeper and an Alternate are the Contractor's employees responsible for explosive magazines and its record keeping. The position of Magazine Keeper is required only if the Contractor elects to have explosives' magazines under his control. The Magazine Keeper must be approved by the Contracting Officer's Representative after the submission of the Master Blasting Plan.

The Magazine Keeper must be familiar with the laws and general practices concerning the handling, care, use, and storage of explosives and detonators. The Magazine Keeper must be responsible for maintaining a cleared area around each magazine, and accounting for by record the throughput of explosives and detonators. The Magazine Keeper must be present for any transfer of explosives and detonators into or out of the magazines. The Magazine Keeper must not be required to perform any duties that will in any way interfere with his or her duties as Magazine Keeper.

The Magazine Keeper must be able to demonstrate prior experience explosives' magazines. The proposed individual must hold all credentials that may be required by the State of [_____] and local jurisdictions. Submit the resume, experience, credentials, and training of the proposed Magazine Keeper with the Master Blasting Plan.

3.5 RECORD KEEPING

3.5.1 Pre-Blast Surveys

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NOTE: Pre- and Post-Blast Inspections and the Structural Inspection/Evaluation Specialist would only be required if there are structures or facilities requiring such inspections. Eliminate the paragraphs referencing Pre- and Post-Blast Inspections and the Structural Inspection/Evaluation Specialist if the project does not have a requirement for these inspections. The lateral distance to the nearest structures by azimuth may vary by project. Typically, only those nearest structures to the excavation zone requiring blasting in a general azimuthal direction are surveyed. Example, if there are many structures within 1,000 feet (if that is the resolved lateral distance) for a specific project, only the closest structures at ~700 feet to the south and at -850 feet to the east would need to be surveyed. For the example project those structures within 1,000 feet of the excavation zone are protected by the pre-blast surveys of the structures closer to the excavation zone on the same azimuth. If any of the structures or facilities are critical or sensitive features or if there is some public or governmental concern, it may be prudent to conduct the pre-blast surveys for all the structures within 1,000 ft, not just the closest by azimuth. The lateral distance also may need to be increased for certain projects. The Agency may seek rights-of-entry for these structures proposed for surveys with the announcement of the Public Meeting. Those owners, who decline the right-of-entry, miss their opportunity to document that there were no prior defects, so that Post-Blast Surveys could document the damage but would not have a Pre-Blast Survey to show there was no previously existing damage given the owner's claim of new blasting damage.

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Prior to the commencement of blasting, conduct a pre-blast survey of

nearest buildings, structures, and utilities within 300 m 1,000 ft from the blast area by azimuth about the blasting zone to document pre-existing conditions. The pre-blast surveys will be conducted by, or under the supervision of, the Structural Inspection/Evaluation Specialist, who will also sign and date each survey. The survey extent and method used must be acceptable to both the Contractor's insurance company and the Contracting Officer. Submit a copy of all pre-blast surveys at least two weeks prior to the first Test Blast. Provide owners of surveyed structures a copy of their Pre-Blast Survey before, or with the notice of, blasting commencement. Notify owners and occupants of local buildings 10 days prior to the commencement of blasting.

Perform the following when conducting pre-blast survey.

a. Provide methodology to be used in conducting the pre-blast survey and listing of structures, determined from the survey to be sensitive, with reasons for these structures being sensitive.

b. Each structure must be documented (including photography and video recordings) as to its construction, foundation type, condition, and closest distance to excavation blasting. The general condition and all observable defects of each structure must be documented.

c. The Commodity storage facilities that may be impacted by blasting must be addressed by the Contractor for safety and continued operation during the blasting program.

d. Freestanding structures (such as retaining walls) must be inspected on the exterior and on the interior as a room. All concrete walks, driveways, etc. must be inspected for cracks, level condition, holes, and defects.

e. Industrial structures, silo/elevators and special facilities, and office space must be described relative to their present conditions and tolerance to vibration. Besides the inspection of walls, columns and stairwells, the Contractor must survey the work areas and structures for distress.

f. An inspection of accessible structures must be made and a list of all structures, which could not be surveyed or refused to allow survey, must be completed. The dates of possible subsequent surveys and physical constraints prohibiting the survey must be documented.

g. Certify that the survey was prepared prior to the start of any blasting under this Contract.

3.5.2 Post-Blast Surveys

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NOTE: Pre- and Post-Blast Inspections and the Structural Inspection/Evaluation Specialist would only be required if there are structures or facilities requiring such inspections. Eliminate the paragraphs referencing Pre- and Post-Blast Inspections and the Structural Inspection/Evaluation Specialist if the project does not have a requirement for these inspections.

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Post-blast surveys are not typically required. Post-blast surveys must be conducted at any location, where a reasonable notice of damage from blasting has been provided. Post-blast surveys will be conducted by, or under the supervision of, the Structural Inspection/ Evaluation Specialist, who will also sign and date each survey. The survey extent and method used must be acceptable to both the Contractor's insurance company and the Contracting Officer. The post-blast surveys must be conducted within a week of the notice of damage from blasting. Submit a copy of all post-blast surveys within two business days of the on-premises surveys to both the structure's owner and the Contracting Officer.

3.5.3 Daily Explosives' Magazine Inventory and Daily Explosives' Accounting

Accurate daily records must be kept by the Magazine Keeper, who must account for each piece of explosive, detonator, and equipment from the time of delivery at the magazine until its discharge in use or return to the magazine. If explosive products will be delivered and returned daily, the records of the driver must agree with the amount used in the day and a copy of each driver's record must be provided with the Daily Blasting and Removal Log submission. No explosive can be accepted until it has been plainly labeled and delivered as new stock in sound condition. Dates of manufacture and lot numbers will be recorded for all explosives delivered to the site. No explosive material older than 1 year will be used. Containers for explosives must be approved in advance by the Contracting Officer. Remaining inventory must be checked each day and any discrepancies must be immediately reported, regardless of the potential of accounting error, loss, or theft of explosive material.

Should a loss or theft of explosives occur, all circumstances and details of the loss or theft must be immediately reported to the nearest office of Alcohol, Tobacco and Firearms, as well as to the local law enforcement authorities and the Contracting Officer's representative.

3.6 BLASTING DOCUMENTS

3.6.1 Master Blasting Plan

The Master Blasting Plan must be submitted for approval by the Contracting Officer 45 days before the first anticipated Test Blast. No blasting may be conducted prior to the approval of the Master Blasting Plan. No deviation from the Master Blasting Plan will be conducted by the Contractor. Any request for change or revision to the Master Blasting Plan must be provided in writing and approved by the Contracting Officer before such change or revision can be performed. The Contractor will submit a Test Blasting Plan within the Master Blasting Plan that includes calculations for all noted adverse impacts. Non-electric blasting caps must be used for all underwater shots. The Master Blasting Plan must contain provisions for storing, handling, and transporting explosives, as well as for the blasting operations. The means of surveying and locating the shot-hole positions horizontally and vertically must be described in detail within the Master Blasting Plan. Provide a signed statement by the Blasting Consultant that the plan represents a safe and efficient set of means and methods with which to achieve the goals of the work. The Master Blasting Plan must be submitted with the signature and date of the Blasting Specialist. The Contracting Officer will have a minimum of 30 calendar days review of the revised plan. The Contractor may elect, or may be required, to revise and resubmit the Master Blasting Plan or a portion thereof; additional time will be allotted for review by the Contracting Officer.

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NOTE: Add or delete sections of the Master Blasting Plan, as appropriate. Include within the Master Blasting Plan.
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3.6.1.1 Proposed Blasting Personnel

Submit all the approved and proposed blasting personnel and their required information from paragraph BLASTING PERSONNEL. List and copies of licenses, permits, and clearances required, including permit numbers, when applied for, and date of approval or anticipated approval by Federal, State, and local concerns. Provide their police records for every approved and proposed blasting individual. Submit the complete Project Team Organization with duties, responsibilities and authorities clearly defined. Identify the on-site Safety Officer and include a listing of all personnel authorized to sign for, receive and use explosives on this contract.

3.6.1.2 Explosives and Blasting Equipment

Submit all the explosives, their use, and their data sheets for the project. Data sheets, which include the products' specific gravity and water resistance, for all explosives and blasting agents that may be used.

3.6.1.3 Blasting Safety Plan

Submit Blasting Safety Plan, that is in accordance with EM 385-1-1, Section 29, and all other Federal, state, and local regulations. Implement all other applicable safety requirements in addition to that required below. Include, as a minimum, the following items.

a. Permanently secure all onboard magazines to the deck as required by all applicable Code of Federal Regulations.

b. Do not store explosives on the boat or barge deck in the open except for the one case that is to be loaded immediately into the shot holes. Return explosives remaining on deck to the day magazine prior to the firing of any blast. Clearly identify the location of the day magazine in the 'Blasting Safety Plan'.

c. Mount the non-electric, shock tubing spool on the rig in a manner that it cannot be lost overboard. Use an approved blasting machine for detonation regardless of the number of caps used. Do not use an electric blasting system.

d. Limit the amount of explosives aboard the drill boat at any one time to be in accordance with the amount permitted by appropriate codes and regulations. Do not exceed the amount permitted.

e. Make arrangements to prevent damage to any vessel, moored or underway, building or structure and preserve the crew or occupants thereon from exposure to injury as a result of the Contractor's operations. The Contracting Officer may require additional arrangements.

f. Perform a certified marine survey of all floating plant proposed for underwater blasting work on this contract prior to starting any work.

g. Install automatic fire extinguishers of an appropriate type on air compressors and in all engine compartments aboard vessels including but not limited to (drill boats, barges) where explosives are stored, handled, and used.

h. Provide remote fuel shut-offs and fire signaling devices aboard the drill boats.

i. Coordination Plans with the local Coast Guard office to provide notice of blasting and for vessel traffic control.

j. Alert sequence signals and public notice of blasting and all clear. See paragraph PUBLIC NOTICE OF BLASTING OPERATIONS in this section.

3.6.1.4 Navigation Control Plan

Submit the Navigation Control Plan in accordance with EM 385-1-1, Section 29, and all other Federal, state, and local laws and regulations. Implement all other applicable safety requirements in addition to that are required below.

Develop a Navigation Control Plan, which is incorporated into the Master Blasting Plan, that will provide the procedures required to maintain safe passage of all vessels within [_____], during the project. The Contractor will maintain a 1/2 channel to a depth of [_____] m ft below the low water datum for [_____] for all marine traffic through [_____] during the project. The 1/2 channel will always be maintained, except during blasting events.

The Contractor will buoy the area with floating warning signs. The warning signs will be legible from a distance of 60 m 200 ft and must contain the message "DANGER - EXPLOSIVES IN USE" visible on either side of the sign.

Operate two or more patrol vessels during blasting operations equipped with a visible yellow flashing light, audible horn, and radio with a hailer, whose sole function will be to monitor and maintain security in the blast area. A patrol vessel will be stationed at the drill barge and remain in the blasting area during all blasting operations. Land oriented access control and visual observation locations should be determined and approved by the Contracting Officer. Inspect and insure there is no vessel traffic within the buoyed work area prior to providing the Shot's Warning Signals and until such time as the "All Clear Signal" has sounded. Establish and maintain a warning system as required by the Corps of Engineers Safety Manual. Equip and maintain floating plant with radio equipment capable of communications with the Coast Guard. After each blast, upon inspecting the area, immediately notify the U.S. Coast Guard and the Contracting Officer of the all clear or of a misfire.

Maintain the work areas that are not completed and accepted by the Corps to a depth of [_____] m ft below the low water datum for [_____]. In addition, for work located along the channel centerline, remove immediately obstructions that have impacted the main channel above a depth of [_____] m ft below the low water datum for [_____], prior to the "All Clear Signal," for marine traffic to resume.

The Corps of Engineers will provide clearance surveys, following rock blasting activities along the centerline of the main channel. The clearance surveys will be conducted immediately following a blast, to

ensure that no rock material has fallen into the 1/2 channel used for marine traffic.

3.6.1.5 Production Blasting Design

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NOTE: Have an experienced person, who is provided with the work restrictions, determine the maximum charge weight per delay, when potential natural-resource impacts are being considered or have been accepted/negotiated. In absence of potential natural-resource impacts, the maximum charge weight per delay will not specifically be resolved. The allowable PPV at specific monitoring locations will govern the charge weight per delay designed for each shot pattern. The monitoring data for smaller charge weights per delay will be assembled from the Test-Blasting program.

Include within the Master Blasting Plan the detailed design of all required safety, protective, and natural-resource actions required of the Contractor or the engagement of a specialty subcontractor by the Contractor. Some of these safety, protective, and natural-resource actions for a project may include: special monitoring of a critical or essential facility or of a government or commercial structure; a fish repelling charge sequence prior to firing every shot pattern; an aviarian or mammalian watch program for assurance that a shot is not initiated at a time when the cited species is present; underwater pressure wave monitoring; and/or, an air-curtain mitigation program.

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No blasting, including the Test Blasting, may differ from the approved Master Blasting Plan. Shot-hole drilling must not begin until the Master Blasting Plan is approved in writing. Reflect changes to the blasting or monitoring procedures, equipment, plant, products or personnel in a revised Master Blasting Plan or portion thereof. Obtain approval from the Contracting Officer, in writing, prior to implementation of any Master Blasting Plan changes or revisions.

Confine the loaded charge with angular, granular stemming materials, placed within competent rock, to perform the most work and to avoid a rifling plume from occurring within any shot hole. See paragraph STEMMING. The shortest delay period both between two adjacent shot holes and between two adjacent shot rows in the shot pattern is 25 milliseconds (ms). The maximum charge weight per delay may not exceed [_____] kg [_____] pounds of all combined explosives and blasting agents in each 25-ms delay period.

Include in the Production Blasting Design Section, as a minimum, the following items.

a. Proposed method of transportation, storage, and handling of explosives.

b. Procedure for monitoring the blast operations and handling misfires.

c. Plan showing the intended layout of the shot-hole patterns, timing and sequence, anticipated burden dimensions and depth of sub-drilling for a specified maximum charge weight per delay. Identify each drill hole by a unique, sequential identifier.

d. Typical size, depth, and spacing of blast holes; methodology to assure loading of explosives is only within sound rock; the maximum load density (in pounds per foot of drill hole length) and the maximum powder factor (in pounds of explosive per cubic yard of rock shot); type of explosive and method of loading and detonating; procedure to confine the charge with stemming; and maximum number of holes to be detonated for a production shot pattern. Initiation system to be deployed and the means to assure each shot hole fires on its own delay.

e. Sequencing of delays for each shot hole that will be employed during blasting and the maximum explosive loading in pounds of explosive per delay.

f. Indication as to whether decking or boosters will be used.

g. Type and number of drill frames, including drill hole diameter, and expected production rates/day.

h. Type of blast seismographs to be used, manufacturer, and when last calibrated or certified, and types of video cameras.

i. The formats of all logs and reports to be used throughout the life of the project designed to record pertinent data before, during, and after the blasting operation. Pertinent information includes, but not be limited to, those items specified in paragraphs detailing the submittals.

j. Names, office mailing addresses and phone numbers of Contractor's representatives (Blasting Consultant, Blasting Specialist, Blaster in Charge, and Seismic Specialist) to which any informational inquiries may be addressed.

k. Location plan, manufacturer's literature, and parameters to be used in site selection for the blast seismographs and video cameras. The location of any other monitoring equipment, when used.

l. The methods that will be used to prevent all cited adverse impacts during the blasting activities, including protection of natural resources.

m. Complete list of floating plant involved in production blasting operations.

n. Within the blasting plan consider the multiple types of commercial vessels that will be on the water over the period of the excavation and removal program. Notify the sail/yacht clubs, etc., of plans to blast in advance and what traffic control and proximity restrictions will be implemented.

o. Submit the means and methods to be used to recover and dispose of all shock cord/tubing and initiation transmission-line debris immediately following each shot.

3.6.1.6 Test-Blast Plan

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NOTE: Have an experienced person, who is provided with the work restrictions, determine the first test shot's number of shot holes, the initial maximum charge weight per delay for the test blasting, and the second test blast's number of shot holes. For some underwater blasting projects, the restrictions may be so limiting that the initial charge weight per delay will be quite low, perhaps kg, 5 lb per 25 ms delay. Other large projects with few natural-resource concerns and great lateral distances to non-federal structures may have a large initial charge weight per 25 ms delay. The former projects may have a production blasting allowable maximum charge weight per delay.

****

Test Blasting is the initial blasting for the project starting with lower explosive loading in shot holes and fewer shot-holes in each initial shot pattern. The purpose of the Test Blasting is to safely build to the level of Production Blasting and to accumulate data to avoid shot-hole rifling and the cited adverse effects from blasting. An Individual Shot Plan must be provided for each Test Blast.

A minimum of three shots are required for the Test Blasting. Increase the number of shot holes loaded and the maximum charge weight per delay of subsequent test and production shot patterns only if the prior test shot was apparently successful. An apparently successful shot pattern is defined as a properly fired pattern without riffling plumes that has seemed to have been effective prior to excavation and has remained below the maximum, peak particle velocity values, as prescribed in paragraph ALLOWABLE VIBRATION. For the next immediate test shot pattern, use a smaller number of loaded drill holes and a smaller maximum charge weight per delay, if (1) the prior shot pattern had a rifling plume [and][or] (2) underestimated the recorded, PPV by 25 percent at any monitoring location [and][or] (3) had any type of misfire, damage or injury or accident or claim thereof.

a. Limit the first test shot to [3] [_____] total drilled shot holes in a single row and have a maximum charge weight per delay of [_____] kg [_____] lb of explosive materials per 25-ms delay.

b. Limit the second test shot to [7] [_____] total shot holes in a single row of the shot pattern of the Contractor's choosing and to a maximum charge weight per delay of double the first shot's maximum charge weight per delay, if the first test shot was completely satisfactory.

c. The third and any further test shot patterns may use double the number of the shot holes of the preceding satisfactory shot, included within two or more shot rows, and double maximum charge weight per delay of the preceding satisfactory shot[to the production-shot maximum allowable charge weight per delay of [_____] kg [_____] lb of explosive materials per 25-ms delay].

A Test-Blast Evaluation Report must be provided within two business days to the Contracting Officer's representative in writing and by e-mail to the cited e-mail address listing once the last Test Blast has reached the

explosive load per shot hole and the number of shot holes and rows to conduct Production Blasting.

3.6.2 Individual Shot Plans

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NOTE: The Master Blasting Plan must provide the format of the Individual Shot Plan for approval with the Master Blasting Plan. Include within list item 3.6.2 b.(6) all special duties and/or actions required for the project that have been established for protection of individuals, natural resources, and/or structures.

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The Contractor must submit an Individual Shot Plan 24 hours prior to any subsequent drilling and blasting for that shot pattern. The format may utilize a spreadsheet for ease data entry but requires an actual signature and handwritten date for its submission.

Prior to each blast, including Test Blasts, the Contractor must submit for the Contracting Officer's documentation a plan detailing all the data required in the Individual Shot Plan's format of the approved Master Blasting Plan. The plan will provide all the pertinent aspects of the blast design including, but not limited to, the loading, firing, delay sequence, and special considerations. The Individual Shot Plan will provide the location and depth of holes, inclination of all holes that will not be vertical, the proposed depth and the spacing of the blast holes, amount, and strength of explosives per hole and per pattern, the proposed sequence of firing and time delays, and estimated time and day for the pattern's initiation. Each proposed shot pattern will be designed by the Contractor's Blasting Specialist with changes being determined by observation of the way the rock breaks as the operations progress. The Contractor must take such precautions as are necessary to prevent displacement, cracking or damaging the rock outside the prescribed limits of dredging or excavation. The rock outside the limits of the dredging must be left in as sound and undamaged a condition as possible.

a. Submit an Individual Shot Plan to the Contracting Officer, with the anticipated plan for the next shot pattern prior to drilling the shot holes. Furnish each submitted Individual Shot Plan as a signed paper copy and in digital form to the e-mail listing required by the Contracting Officer. The Individual Shot Plan may be developed in a format that easily provides data that remains the same for the actual shot information in the Daily Blasting and Removal Log and the Individual Shot Report with its included reports.

b. The Individual Shot Plan includes, as a minimum, the following items:

(1) The shot pattern's name/number, coordinate locations of the outermost holes of the shot pattern, any specific purpose for the shot, the anticipated time, date, weather conditions, and the water conditions and its elevation at the anticipated time of the shot;

(2) The total number of holes to be shot, the shot-hole diameter, the total weight of explosives, number of delays, load density and powder factor for the shot, the maximum charge weight per delay, the closest approach, scaled distance and estimated PPV and

airblast overpressures at each monitoring location;

(3) A large-scale plan map depicting the proposed layout of shot hole pattern, timing and delay sequence;

(4) An elevation sketch showing a typical hole's loading from the water surface to the bottom of the drill hole with an elevation scale, including the elevation of the removal grade, the top of sound rock, the top and bottom elevation of stemming, the top and bottom position of explosive materials, and the position of all detonators, boosters and primers in the hole;

(5) A tabular listing, which may be a printed spreadsheet page, by hole in the ascending total delay time order by the describing: row and number within the row of the shot hole, total delay time, the total charge weight of explosive materials for the entire hole, the largest charge weight of any deck within a hole on a separate 25-ms delay if any, top of sound rock elevation, bottom hole elevation or the top of stemming elevation at the bottom of a shot hole that was over-drilled in depth and backfilled, stemming elevations, and detonator, primer and booster elevations in the hole;

(6) The estimated PPV and airblast overpressure at each seismograph location and the lateral close approach distance from the shot pattern to each seismograph;

(7) the means to remove and dispose of all shock cord/tubing and/or initiation transmission-line debris immediately following the shot;

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NOTE: Complete the required Natural Resource activities that the Contractor must either conduct or initiate the shot with coordination of other offices for them to conduct the required Natural Resource activities of paragraph NATURAL RESOURCE ASSESSMENT.

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[(8) The Contractor must employ a Natural Resource Subcontractor, submitted to the Contracting Officer to [list activities] and the Contractor must conduct the shot in coordination with other offices as they perform [list activities]; and

] (9) The name, title, and signature of the Blasting Specialist providing the form with the date of the signature.

3.6.3 Test-Blast Evaluation Report

Provide a report summarizing the Test Blasting and submit the report with the Individual Shot Report of the first apparently successful production shot.

3.6.4 Individual Shot Reports

The Contractor must submit an Individual Shot Reports, both in writing to the Contracting Officer and by e-mail distribution to the required e-mail addresses, on the next business day and prior to any subsequent drilling

and blasting for the next shot pattern. The supporting reports related to each shot pattern, which was not included with the Individual Shot Report, must be provided with their required data by the submission date of each supporting submission. The Individual Shot Report may utilize the spreadsheets, maps, and sketches of that shot's Individual Shot Plan, which have been corrected or revised for the actual shot-hole use, loading, timing firing, and observed or recorded impacts.

The Contractor must submit for the Area Office's documentation a specific set of reports of all the actual information from an initiated shot pattern, including Test Blasts, required in the Individual Shot Report's format of the approved Master Blasting Plan. The record will provide all the pertinent aspects of the blast design including, but not limited to: the time, date and weather conditions at the blast's initiation; proposed shot holes that were abandoned; the actual shot holes' positions and elevations of stemming, loading, decking, its delay and firing sequence, and special considerations; the total weight of explosives and the maximum charge weight per delay for the pattern; all pertinent factors about signaling and providing the all-clear signal; the peak particle velocity of all seismographs; and, any delays to shot initiation and all blast impediments, including by not limited to, shot-hole rifling plumes, observed impacts from blasting, misfiring, and reports of damage from blasting. The Individual Shot Report will include or be followed with all the supporting reports from the shot pattern. Each Individual Shot Report will be signed by the Contractor's Blasting Specialist or Blaster in Charge, whoever initiated the shot pattern's firing. The Contractor must take such precautions as are necessary to prevent displacement, cracking or damaging the rock outside the prescribed limits of dredging or excavation. The rock outside the limits of the dredging must be left in as sound and undamaged a condition as possible.

a. The Individual Shot Report may be developed in a format that easily provides data that remains the same from the proposed design of the Individual Shot Plan and the actual shot information for the shot's supporting reports and in the Daily Blasting.

b. The Individual Shot Record includes, as a minimum, the following items:

    (1) The shot pattern's name/number, coordinate locations of the outermost holes of the shot pattern, any specific purpose for the shot, the anticipated time, date, weather conditions, water conditions and its elevation at the time of the shot;

    (2) The total number of holes to be shot, the shot-hole diameter, the total weight of explosives, number of delays, load density and powder factor for the shot, the maximum charge weight per delay, the closest approach, scaled distance and recorded PPV and airblast overpressures at each monitoring location;

    (3) A large-scale plan map depicting the layout of shot hole pattern, timing, and delay sequence;

    (4) A tabular listing, which may be a printed spreadsheet page, by the loaded shot hole in the ascending total delay time order by the describing: row and number within the row of the shot hole, total delay time, the total charge weight of explosive materials for the entire hole, the largest charge weight of any deck within a hole on a separate 25-ms delay if any, top of sound rock elevation, bottom hole elevation or the top of stemming elevation

at the bottom of a shot hole that was over-drilled in depth and backfilled, stemming elevations, and detonator, primer and booster elevations in the hole;

(5) The recorded PPV and airblast overpressure at each seismograph location and the lateral close approach distance from the shot pattern to each seismograph;

(6) The removal and disposal of all shock cord/tubing and initiation transmission-line debris immediately following the shot[; each required safety, protective, and natural-resource action conducted for the initiated shot with their supporting data];

(7) A short narrative of any peculiarities or impediments or adverse impacts or accident/misfire with the shot, if any;

(8) The name, title, and signature of the Blasting Specialist providing the form with the date of the signature.

3.6.4.1 Drilling Logs

The Blaster in Charge or a Blaster with the assistance of the driller will log each shot hole, as the hole is being advanced. No drilling will be initiated without the Blaster in Charge or a Blaster to log the hole by a measurement means of drill bit's depth, the downward rig pressure, advancement rate of drilling, and air-water return of cutting with the driller's full assistance. The log must record the material encountered at the drill bit's depth to a precision of 0.03 m 0.1 ft. The drilling for each shot hole must be assessed to determine, and the log must record, the vertical depth/elevation of encountering sediment, weathered rock, the Top of Firm Rock, and voids to the total drilled depth. The shot-hole logs for all the shot holes in a shot pattern must be provided at the same time as the Individual Shot Report. An acceptable sample drilling log is provided in EM 1110-2-3800.

3.6.4.2 Individual Shot Vibration Monitoring Report

After each shot, submit an Individual Shot Vibration Monitoring Report, which will require the use of blast seismographs, to measure the vibration created from the blasting activities. Submit the Individual Shot Vibration Report to the Contracting Officer by or before Noon of the second business day following the shot, which is being reported. Submit each Individual Shot Vibration Report as a signed paper copy and in digital form to the e-mail listing required by the Contracting Officer. This will be provided at the pre-construction meeting.

Direct the specialty firm providing the seismic specialist, with approval of the Contracting Officer, to place blast seismographs, consisting of three component seismographs, (1) at important structures, and (2) other locations designated by the Contracting Officer. At least [three] [_____] seismograph locations will be required for every blast during this project.[Place additional seismographs at each specified monitoring locations.]

Samples of possible Individual Shot Vibration Report formats are in EM 1110-2-3800, pp B-9 and B-10. The minimum required information to be submitted in the Individual Shot Vibration Report includes:

a. Date and time of recording from each seismograph;

b. Type (brand and model) of three-component seismographs used, serial #, and position name;

c. Who performed, and the date of, the most recent calibration of each seismograph, and its sensitivity;

d. The firm and employee who placed the blast seismograph;

e. Seismograph installation procedures to prevent disturbance during monitoring, vandalism, and damage, and whether the seismic data is being telemetered or downloaded individually;

f. Set trigger levels;

g. Maximum for each of the three, component PPV in units of centimeters per second (cps) inches per second (ips), the maximum total vector-sum peak particle velocity in units of centimeters per second (cps) inches per second (ips), and a log-log graph of all maximum total vector-sum peak particle velocity versus square-root scaled distance in units of sqr meter/kilogram (sqr m/kg) sqr feet/pound (sqr ft/lb) for all seismic records of all prior shots for this project;

h. A graph of the PPV versus frequency for each seismograph location that triggered;

i. The maximum airblast overpressures in units of kilopascals (kPa) pounds per square inch (psi) at any triggered monitoring location and the results from noise tests before blasting in the first report;

j. A narrative description of any peculiarities or impediments or adverse impacts or accident/misfire for the shot; and,

k. The name, title, and signature of the Seismic Specialist processing and interpreting the data and providing the report with the date of the signature.

3.6.4.3 Individual Shot Videos

The Contractor will make a video recording of each shot pattern in a clear and consistent manner. Video recording must include date, time, and location. The digital video file must be furnished with the Individual Shot Report in a format noted within the Master Blasting Plan and approved by the Contracting Officer. The submission must be made to the Project Office and to all on the e-mail address listing. A library of blast videos will be maintained for all blasts and will be readily cross referenced with individual blast plans and post blast evaluations.

3.6.4.4 Reports of Required Safety, Protective, and Natural Resource Programs

Specify the data submission for required safety, protective, and natural-resource actions. A summary report must be submitted by noon [2] [_____] business days after the shot of the [special monitoring of a critical or essential facility or of a government or commercial structure, [and][or] an avian or mammalian watch program for assurance that a shot is not initiated at a time when the cited species is present, [and][or] underwater pressure wave monitoring, [and][or] other agreed/negotiated program].

3.6.5 Daily Blasting and Removal Log

The Contractor must submit a Daily Blasting and Removal Log, both in writing to the Contracting Officer and by e-mail distribution to the required e-mail addresses, on the next business day. The Daily Blasting and Removal Log summaries all the drilling and blasting activities, surveying, dredging [and][or] removal of spoils, and disposal operations for any day that one or more of those operations were conducted. The Daily Blasting and Removal Log will be signed by the designated representative of the Contractor, approved in the Master Blasting Plan.

3.7 DRILLING AND BLASTING

3.7.1 Underwater Shot Holes

No drilling will be initiated without the Blaster in Charge or a Blaster to log the hole and confirm the proper positioning of the shot hole. For underwater blasting, the Contractor must be prepared to: drill; log the hole; resolve the units encountered in drilling; reassess the Shot Plan's intent for that particular shot hole; load explosives, boosters, initiators and delays, place stemming in sound rock; and raise the firing line. If a shot hole cannot be drilled or cleaned out, the Contractor will be required to re-drill that shot hole or properly correct the shot design to delete that hole.

3.7.2 Shot Hole Logging

The Blaster in Charge or a Blaster will log each drilled hole, as the hole is being drilled. The Blaster in Charge or a Blaster will log the shot hole by a measurement means of drill bit's elevation, the downward rig pressure, advancement rate of drilling, and air-water return of cutting with the driller's full assistance. The shot holes must be logged during drilling and measured upon completion with a weighted tape for its full depth before any explosives are loaded into any of the holes.

If any holes are too deep, then these holes will be filled to the proper depth with stemming. Repeated, significant voids, 0.2 m 0.5 ft or larger, must be reported to the Contracting Officer. The Blasting Consultant may need to assess the issue of voids. Should voids become confinement issue blasting will be delayed until the Contracting Office is satisfied that potential problems related to blasting around the void have been properly addressed.

3.7.3 Stemming

All shot holes must have appropriately sized stemming material of the proper vertical placement length to optimize the blast design. Loss of explosive confinement can be due to improper stemming material type and poorly placed stemming. Tamped stemming must be placed from the top of firm rock (or hard material), as determined from the drilling log, to the top of the explosive charge. Stemming must also be used to fill voids, if any, as noted on the drilling log of that shot hole.

3.7.3.1 Stemming Material

Stemming must consist of well-graded, crushed, angular stone without fines. The gradation of the crushed, angular stone is between 3.0 mm 1/8

inch and 10.0 mm 3/8 inch in diameter. No soil or drill cuttings or rounded particles of the noted grading may be used as stemming material.

3.7.3.2 Length of Stemming

The minimum vertical length of tamped stemming within rock, or hard materials, of a shot hole must be the greater of 0.60 m 2.0 ft or eight times the shot hole's diameter. This minimum length of stemming must be placed in firm rock, or hard materials, to contain the gaseous products of detonation both below the top of firm rock and on either side of (above or below) voids, if any, with an explosive charge.

3.7.4 Loading Shot Holes

Stemming, decking, shot hole explosives' loading, and shot plan revisions for each shot hole must be made upon completion of drilling to the total depth from the logging of that underwater shot hole. Resolve whether to abandon the shot hole or load the hole from the Shot Plan's intent and the information resolved by the shot hole's log.

3.8 IMPACT MONITORING

Monitoring of the blasting may be required for public safety or natural-resource protection. The Contractor will be responsible for the payment and services of one or more, independent, third-party firms to conduct the required monitoring. The Contractor will make available the schedule and blasting documents to coordinate with other specialists monitoring issues for: the public's safety; environmental concerns for air, water, and property; natural resource protection; and the safety of structures and features.

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NOTE: Delete inapplicable sections. The coordination with other federal, state, and local jurisdictions and agencies, the public, and private entities must be completely resolved before finalizing the specifications.

****

3.8.1 Public-Use Area Effects

The Contractor will provide personnel, patrolling vessels or vehicles, and the signage necessary to assure safe distances from all shot patterns are maintained and physically monitored at public-use areas on land or on water, and at occupied structures or highways or other features requiring control.

3.8.2 Airblast and Seismic Monitoring

****

NOTE: Determine the number of seismographs required for the project by the nearer structures or features to protect and their general azimuthal direction. Every blasting program should have at least three blast seismographs deployed. More seismographs may be needed at the project temporarily for green concrete or other temporary considerations or by the request of the Contracting Officer. While airblast is rarely a concern for underwater blasting,

airblast should be recorded at a minimum of three seismograph locations in different azimuthal directions.

****

Airblast and vibration monitoring must conform to current industry standards and use equipment developed for blast monitoring. The Contractor will hire a subcontracted specialty firm, independent of the Contractor's firm and other sub-contractors to locate, maintain, and record the airblast and vibrations from every shot. The subcontracted seismic firm through their employee, the Seismic Specialist, will monitor the [three] seismic positions shown on the plans or accepted by the Contracting Officer. Additional seismographs may be required temporarily for (green) concrete placement or other temporary considerations or as required by the Contracting Officer for specific airblast or vibration issues due to blasting suspected at locations without seismographs. The seismic records and the Individual Shot Vibration Monitoring Reports will inform the Contractor of the actual airblast and vibration parameters from every shot and assure the government that the blasting has remained within the allowable airblast and vibration levels.

Provide 3 blast Seismographs capable of sampling rates of 15,000 samples per second or higher that meets ISEE PSBS. The 15,000 samples per second accuracy is required to acquire reproducible vibration readings. Each seismograph provided to the project must have been calibrated by the manufacturer within six months of its installation. No seismograph may be used at the project may have manufacturer's calibration longer than eleven months prior to its date of use. The units must be self-contained except for external geophones and microphones. The seismographs without erasing the stored data must be capable of telemetering the digital data or downloading the digital data to a portable device. The units must be programmed with specific data for each site of seismograph placement, which includes seismograph location, geophone burial or mounting method, calibration signal, date, and time of the record. The seismographs must be housed in protective enclosures, if vandalism or high-traffic concerns or weather or other conditions could limit the continuous, proper recording by the seismographs.

The blast seismographs must not be placed inside of a structure, unless required for the designated purpose and authorized by the Contracting Officer. The seismographs should not be placed near a structure unless the intent is to measure that particular structure's specific response to the blast. The microphone must be positioned to avoid wave reflections of the airblast from the vertical, front or side of a structure, wall or rock face. The microphone should be placed at a height of 0.91 m 3.0 ft. The geophone for each seismograph must appropriate for buried in soil or for being physically secured to rock or sidewalk or pavement or a concrete foundation.

The seismographs must be operated continuously beginning [seven] days before the first anticipated Test Blast. All The airblast and vibration amplitudes' maximal, frequencies of those amplitudes, repeated occurrences, and other parameters for the first period of operation before the first Test Blast will be reported as the project's background conditions in the first Individual Shot Vibration Monitoring Report.

The seismographs must be operated continuously until the excavation has been approved by the Contracting Officer. The seismograph may be removed from the project and replaced after their initial deployment, if there

will be no blasting for a period of seven days or longer and if there will be no explosives stored onsite during that period.

3.8.3 Individual Shot Videos

Record every shot pattern's blast with Full High Definition, 1080p, digital video recordings with a minimum of 30 frames per second from two designated locations, approximately perpendicular to one another, that provide side and front or rear views of the blast and area above it. The video images must not contain any other text than the shot number. Include metadata consisting of the blast ID, date, and time of the blast. Index the two video recordings to properly identify each blast. Submit the proposed locations of the two video recorders on a map with the Individual Shot Plan. Furnish electronic file copies of video recordings on the sFTP within 24 hours of a blast. If the Contracting Officer requests that a copy of the video be submitted earlier, then deliver a copy within one hour of the request. Maintain a digital video library of all blasts.

3.8.4 Air, Water or Land Protections

The Contractor will assure that all escaping or released gases, fluids, and solids are within applicable limits of all federal, state, and local laws, regulations, ordinances, and guidelines. Any releases of fluids or solids that are not such limits will be immediately reported, mitigated, retained, and removed from the project.

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NOTE: This section should emphasize the importance of recovering all shock tube. Additional details could include typical methods of recovery and best practices for the containment of shock tube.
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The Contractor will remove all shock cord/tubing and initiation transmission-line debris immediately following each shot. Submit means and methods for removal in Master Blasting Plan.

****
NOTE: Delete inapplicable NATURAL RESOURCE ASSESSMENTS, MITIGATION AND MONITORING paragraphs that are not required by coordination with other federal, state, and local jurisdictions and agencies, the public, and private entities, which must be completely resolved before finalizing the specifications. Each of the paragraphs for Natural Resources will require a design by a qualified professional(s), who has experience with such activity(ies). The activity's paragraph text for the Contractor's action must be written for the specific project and unique Natural Resource requirements. None of these activities or other possible required actions or coordination by the Contractor have generic or standard approaches, much less narratives. The Contractor may be required to hire a specialty contractor to perform the designed assessment, mitigation, or monitoring, or to coordinate the blasting with an external organization responsible for the activity.

****

3.8.5 Natural Resource Assessments, Mitigation and Monitoring

[_____]

3.8.5.1 Fish-Repelling Noise

[_____]

3.8.5.2 Watch Program

[_____]

3.8.5.3 Post-Blast Fish Surveys

[_____]

3.8.5.4 Air-Curtain Mitigation

[_____]

3.8.5.5 Underwater Overpressure Monitoring

[_____]

3.9 EXCAVATION VERIFICATION

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NOTE: This Blasting Section presumes that the excavation(s) will fully achieve the required vertical and lateral limits. This paragraph references the location of the verification procedures by its section in the specifications.

****

Conduct the verification of the completed excavation, as specified in Section [EXCAVATION], Paragraph [SURVEYS].

3.10 SUBMERGED MATERIAL DISPOSAL

****

NOTE: The Guide Spec presumes that material disposal will properly place any onsite material disposal. This paragraph references the location of the material disposal procedures by its section in the specifications.

****

Transport and place all dredged, displaced, or excavated materials within the limits of the disposal zones below the specified elevations, as specified in Section [DISPOSAL].

-- End of Section --