

# **Redington Wind Farm Project**

## **Blasting**

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**South Portland, Maine**

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Appendix A – Section 02229 Rock Removal Specifications

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**1.0 Blasting****1.1 Overview**

DeLuca-Hoffman Associates, Inc. has prepared the following Blasting report. Redington Mountain Windpower, LLC has retained DeLuca-Hoffman Associates, Inc. to prepare a number of reports for the Redington Wind Farm Project. The work of DeLuca-Hoffman Associates, Inc. is summarized in seven reports, which accompany the Maine Department of Environmental Protection (MeDEP) and LURC applications and are titled:

- ❑ Erosion and Sedimentation Control Plan for Roadway Construction;
- ❑ Basis of Design for the Roadways to Access Wind Turbines;
- ❑ Basis of Stormwater Management for Access Roadways;
- ❑ Access Road Maintenance;
- ❑ Blasting;
- ❑ Erosion and Sedimentation Control Plan for Transmission Line Corridor Construction; and
- ❑ Solid Waste

**Note: This blasting narrative and appended specification will require review by Endless Energy, the Geotechnical Consultant and the turbine footing designer prior to completion of detailed design and project implementation.**

Extensive blasting of open rock and trench rock removal is anticipated to be required for the project. Blasted rock or boulders may be broken into a well-graded mixture of the size recommended by the geotechnical engineer and used as follows:

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- Used for deeper fills (over 2' below finish grade) as specified in the geotechnical report (**requires verification by S.W. Cole prior to final design**).
- Crushed for topping gravel (**requires verification by S.W. Cole prior to final design**).
- Crushed for use as surface gravel for access road pavement. (**requires verification by S.W. Cole prior to final design**).
- Processed and used as rip rap.

This project is located in a remote area of the state and the Redington Mountain and Black Nubble Parcels, which turbines are proposed to be located upon, are abutted by only three entities: Department of the Navy, Dallas Corporation and Plum Creek.

Soils with the following depth to bedrock have been identified in the soils sections of this application in the area of the proposed turbines and access roads:

<u>Soil Type</u>	<u>Depth to Bedrock</u>
Saddleback-Mahoosuc-Sisk	10-20"
Ricker-Rock Outcrop	0-40"
Hermon Monadnock	>60"
Sisk Surplus	>65"

Blasting is expected to be required for the thirty (30) turbine foundations (30' deep x 15' diameter), the proposed access roads in areas requiring significant cut, the powerline trenches and for above ground transmission line poles. The shallow nature of the above listed soils suggest that extensive blasting will be required for this project.

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The anticipated blasting procedure for the removal of rock material at turbine foundation locations will consist of implementing line control to full depth and then the use of controlled blasting techniques in several benches to create minimum breakage outside the line control but create maximum rock fragmentation.

Maine Drilling and Blasting Inc. were consulted with to gain insight into the blasting techniques used for this type of project and to review and gain advice on this narrative and appended specification. The measures of paragraphs 1.2 and 1.3 of this section will become part of the contract documents for construction to address the proper method for blasting encountered during construction. LURC Chapter 10 provides only a small amount of blasting guidance. This application section has therefore been written in accordance with the requirements of MeDEP.

**1.2 Preblast Survey**

Qualification information will be required from the blasting subcontractor and a public meeting will be conducted prior to any blasting activity. The general contractor will be required to prepare a blasting plan and preblast survey prior to any rock removal. A written report of the preblast survey and blasting plan will be provided to Endless Energy Corporation by the contractor and will be available for review by LURC in accordance with MeDEP requirements. The scope of the blasting plan and preblast survey will be required to conform to the following specifications and the requirements of Section 1.3:

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- All structures within a minimum distance of 2,000 feet from any blasting activity shall be surveyed as part of the preblast survey. The extent beyond the 500-foot minimum shall be determined by the contractor, their blasting subcontractor, and their insurance companies.
  
- A blasting plan shall be prepared which addresses:
  - ◆ Airblast limits,
  - ◆ Ground vibrations, and
  - ◆ Maximum peak particle velocity.
  
- The blasting plan shall meet criteria established in Chapter 3 (Control of Adverse Effects) in the Blasting Guidance Manual of the United States Department of the Interior Office of Surface Mining Reclamation and Enforcement.
  
- The blasting plan should include provisions and measures to monitor and assure compliance with airblast, PPV and frequency limits.

**1.3 Blasting**

Blasting shall be performed only after approval has been given by the applicant for such operations and must comply with the following provisions set by MeDEP:

- A. *The contractor or any subcontractor shall use sufficient stemming, matting or natural protective cover to prevent fly rock from leaving property owned or under control of the permittee or operator or from entering protected natural resources or natural buffer strips. Crushed rock or other suitable material must be used for stemming when*

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*available; native gravel, drill cuttings or other material may be used for stemming only if no other suitable material is available.*

- B. The maximum allowable airblast at any inhabited building not owned or controlled by the developer may not exceed 129 decibels peak when measured by an instrument having a flat response (+ or – 3 decibels) over the range of 5 to 200 hertz.*
- C. The maximum allowable airblast at an uninhabited building not owned or controlled by the developer may not exceed 140 decibels peak when measured by an instrument having a flat response (+ or – 3 decibels) over the range of 5 to 200 hertz.*
- D. Monitoring of airblast levels is required in all cases for which a preblast survey is required by paragraph F. The contractor may file a MeDEP Permit Modification requesting the MeDEP waive the monitoring requirement if the contractor or subcontractor secures the permission of affected property owners to increase allowable airblast levels on their property and the Department determines that no protected natural resource will be adversely affected by the increased airblast levels. The cost to prepare the permit modification and the effect of project delay while MeDEP reviews the request shall be borne solely by the contractor or his subcontractor.*
- E. If a blast is to be initiated by detonating cord, the detonating cord must be covered by crushed rock or other suitable cover to reduce noise and concussion effects.*
- F. A preblast survey is required and must extend a minimum radius of 2,000 feet from the blast site. Notification that blasting will occur*

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*should be provided to all owners of structures to be surveyed at least 10 but not more than 30 days prior to commencement of blasting. Pre-blast surveys should include both the interior and exterior of each structure. The preblast survey must document any preexisting damage to structures and buildings and any other physical features within the survey radius that could reasonably be affected by blasting. Assessment of features such as pipes, cables, transmission lines and wells and other water supply systems must be limited to surface conditions and other readily available data, such as well yield and water quality. The preblast survey must be conducted prior to the initiation of blasting at the operation. The contractor or subcontractor shall retain a copy of all preblast surveys for at least one year from the date of the last blast on the development site.*

*(1) The contractor or the subcontractor is not required to conduct a preblast survey on properties for which the permittee or operator documents the rejection of an offer by registered letter, return receipt requested, to conduct a preblast survey. Any person owning a building within a preblast survey radius may voluntarily waive the right to a survey.*

*G. Blasting may not occur in the period between sundown and sunrise of the following day or in the period from 7:00 p.m. to 7:00 a.m., whichever is greater. Routine production blasting is not allowed in the daytime on Sunday. Detonation of misfires must be reported to the department within five (5) business days of the misfire detonation.*

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- H. *Sound from blasting may not exceed the following limits at any protected location:*

<i>Number of Blasts Per Day</i>	<i>Sound Level Limit</i>
<i>1</i>	<i>129 dbl</i>
<i>2</i>	<i>126 dbl</i>
<i>3</i>	<i>124 dbl</i>
<i>4 or more</i>	<i>123 dbl</i>

- I. *The maximum peak particle velocity at inhabitable structures not owned or controlled by the developer may not exceed the levels established in Table 1 in paragraph J and the graph published by the United States Department of the Interior in “Bureau of Mines Report of Investigations 8507,” Appendix B, Figure B-1. The contractor or subcontractor may apply for an MeDEP Project Modification to request a variance to allow ground vibration levels greater than 2 inches per second on undeveloped property not owned or controlled by the applicant if the Department determines that no protected natural resource, unusual natural area or historic site will be adversely affected by the increased ground vibration levels. If inhabitable structures are constructed on the property after approval of the MeDEP and prior to completion of blasting, the contractor immediately must notify the Department and modify blasting procedures to remain in compliance with the standards of this subsection. The cost to prepare the permit modification and the effect of project delay while MeDEP reviews the request shall be borne solely by the contractor or his subcontractor.*
- J. *Table 1 of this paragraph or the graph published by the United States Department of the Interior in “Bureau of Mines Report of Investigations*

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8507”, Appendix B. Figure B-1 must be used to evaluate ground vibration effects for all blasts.

- (1) *Either Table 1 of this paragraph or graph published by the United States Department of the Interior in “Bureau of Mines report of Investigations 8507”, Appendix B, Figure B-1 may be used to evaluate ground vibration when blasting is to be monitored by seismic instrumentation.*
- (2) *Blasting measured in accordance with Table 1 of this paragraph must be conducted so that the peak particle velocity of any one of the 3 mutually perpendicular components of motion does not exceed the ground vibration limits at the distances specified in Table 1 of this paragraph.*
- (3) *Seismic instruments that monitor blasting in accordance with Table 1 of this paragraph must have the instrument’s transducer firmly coupled to the ground.*
- (4) *An permittee or operator using Table 1 of this paragraph must use the scaled-distance equation,  $W=(D/D_s)^2$ , to determine the allowable charge weight of explosives to be detonated in any 8 millisecond or greater delay period without seismic monitoring, where  $W$  is equal to the maximum weight of explosives, in pounds, and  $D$  and  $D_s$  are defined as in Table 1 of this paragraph. The contractor may apply for a Permit Modification to MeDEP to authorize the use of a modified scaled-distance factor for production blasting if the contractor can demonstrate to a 95% confidence level, based upon records of seismographic monitoring at the specific site of the mining activity covered by*

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*the permit, that use of the modified scaled-distance factor will not cause the ground vibration to exceed the maximum allowable peak particle velocities of Table 1 of this paragraph. The cost to prepare the permit modification and the effect of project delay while MeDEP reviews the request shall be borne solely by the contractor or his subcontractor.*

- (5) *Blasting monitored in accordance with the graph published by the United States Department of the Interior in “Bureau of Mines Report of Investigations 8507”, Appendix B, Figure B-1 must be conducted so that the continuously variable particle velocity criteria are not exceeded.*

*The contractor may apply to MeDEP for a Permit Modification for a variance of the ground vibration monitoring requirement prior to conducting blasting at the development site if the contractor agrees to design all blasts so that the weight of explosives per 8 millisecond or greater delay does not exceed that determined by the equation  $W=(D/D_s)^2$ , where  $W$  is the maximum allowable weight of explosives per delay of 8 milliseconds or greater,  $D$  is the shortest distance between any area to be blasted and any inhabitable structure not owned or controlled by the developer, and  $D_s$  equals 70 ft./lb.<sup>1/2</sup>. As a condition of the variance, the Department may require submission of records certified as accurate by the blaster and may require the permittee or operator to document compliance with the conditions of this paragraph. The cost to prepare the permit modification and the effect of project delay while MeDEP reviews the request shall be borne solely by the contractor or his subcontractor.*

*The following is Table 1.*

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<i>Distance Versus Peak Particle Velocity Method</i>		
<i>Distance (D) from the blast area</i>	<i>Maximum allowable peak particle velocity (Vmax) for ground vibration (in./sec.)</i>	<i>Scaled-distance factor (Ds) to be applied without seismic monitoring</i>
<i>0 to 300</i>	<i>1.25</i>	<i>50</i>
<i>301-5000</i>	<i>1.00</i>	<i>55</i>
<i>Greater than 5000</i>	<i>0.75</i>	<i>65</i>

K. *A record of each blast, including seismographic data, must be kept for at least one year from the date of the last blast, must be available for inspection at the development or at the offices of the permittee or operator if the development has been closed, completed or abandoned before the one-year limit has passed, and must contain at a minimum the following data:*

- (1) Name of blasting company or blasting contractor;*
- (2) Location, date and time of blast;*
- (3) Name, signature and social security number of blaster;*
- (4) Type of material blasted;*
- (5) Number and spacing of holes and depth of burden or stemming;*
- (6) Diameter and depth of holes;*
- (7) Type of explosives used;*
- (8) Total amount of explosives used;*

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- (9) *Maximum amount of explosives used per delay period of 8 milliseconds or greater;*
  - (10) *Maximum number of holes per delay period of 8 milliseconds or greater;*
  - (11) *Method of firing and type of circuit;*
  - (12) *Direction and distance in feet to the nearest structure neither owned nor controlled by the developer;*
  - (13) *Weather conditions, including such factors as wind direction and cloud cover;*
  - (14) *Height or length of stemming;*
  - (15) *Amount of mats or other protection used;*
  - (16) *Type of detonators used and delay periods used;*
  - (17) *The exact location of each geophone and the distance of each geophone from the blast;*
  - (18) *Seismographic readings, including peak particle velocity and frequency measured in the horizontal, vertical and longitudinal directions, and airblast data*
  - (19) *Name and signature of the person operating each seismograph;  
and*
  - (20) *Names of the person and the firm analyzing the seismographic data.*
  - (21) *The stratum or structure on which the geophone is located during each blast.*
- L. *All field seismographs must record the full analog wave form of each of the 3 mutually perpendicular components of motion in terms of particle*

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*velocity and frequency. All seismographs must be capable of sensor check and must be calibrated according to the manufacturer's recommendations.*

**1.4 Related Sections**

Development Description

Soils

Basis of Design for the Roadway to Access Wind Turbines

**APPENDIX A**

**SECTION 02229**

**ROCK REMOVAL SPECIFICATIONS**

SECTION 02229

ROCK REMOVAL SPECIFICATIONS

PART 1 - GENERAL

- A. Rock removal shall only be conducted by qualified contractors who have at least 15 years experience in rock removal by blasting and have five recent projects and references for rock removal within 100 feet of existing buildings. The qualifications of the contractor who will conduct the rock removal shall be provided for review at the preconstruction conference.
- B. The Division 2 contractor and the contractor who will conduct the rock removal shall attend a public informational meeting to address questions and explain the techniques and methods which will be used for rock removal. This meeting shall occur at least 14 days prior to any rock removal.

1.01 SECTION INCLUDES

- A. The work to be done includes furnishing all labor, equipment, materials and services and performing operations required to fragment intact bedrock utilizing controlled blasting techniques to enable the excavation of blasted material using conventional excavation equipment. The work shall be completed such that damage is prevented to adjacent pipes, structures, property, utilities and operations. Controlled perimeter blasting and pre-splitting the bedrock shall be utilized to create foundation holes for each wind turbine and to create desired grades for the proposed access roads.
- B. Pre-blast Surveys, Public Meetings, and Quality Control.
- C. Removal of identified and discovered rock during excavation.
- D. Use of Explosives to assist rock removal.
- E. Incorporating removed rock into fills and embankments.
- F. Conducting blast monitoring of every blast round during construction and utilizing the blast monitoring procedures and equipment specified herein.
- G. Overblasting in the foundation area for future footings, foundations, and underslab utilities.
- H. Coordinate work with other trades affecting or affected by the work and cooperate with such trades to assure the steady progress of work.
- I. Obtaining all required permits and licenses to perform the blasting for this project.

1.02 RELATED SECTIONS

- A. Section 02200 – Earthwork
- B. Section 02221 – Excavation, Backfilling and Compacting for Structures
- C. Section 02222 - Excavation, Backfilling and Compacting for Utilities
- D. Section 02223 – Excavation, Backfilling and Compaction for Roadways
- E. Geotechnical Report for boring locations and findings of subsurface materials and conditions (**Not Available**).
- F. Construction Drawings.

1.03 REFERENCE STANDARDS

NFPA 495 - Code for Explosive Materials

1.04 ENVIRONMENTAL REQUIREMENTS

Determine all environmental effects associated with proposed work and safeguard those concerns as regulated by law and all others by reasonable and practiced methods.

Coordinate blasting, monitoring, seismographs, and permittee radon testing.

1.05 JOB CONDITIONS

- A. **The contractor shall be fully responsible for conducting any investigations necessary to determine the extent and quality of rock on the site prior to submitting his bid. Rock locations may vary from that inferred by the geotechnical report based upon the inherent limitations of this work.**
- B. The permittee may elect to modify the design to reduce rock removal cost. The reduction and or adjustment of rock removal quantity shall not be a basis of claims for loss of materials obtained from rock removal for use on other portions of the work.

1.06 QUALIFICATIONS

Contractor to remove rock by blasting shall submit records of documented experience to the permittee.

1.07 QUALITY ASSURANCE

- A. Qualifications
  - 1. Persons responsible for blasting shall be licensed blasters in the State of Maine and shall have had experience in similar excavations in rock and controlled blasting techniques.
  - 2. The contractor shall engage the services of a qualified, independent professional consultant, acceptable to the Engineer, to conduct a pre-blast condition survey of

adjacent buildings, utilities and other concerned structures within 2,000 ft. of the blast or as required by Code.

3. Blast monitoring shall be conducted by a qualified professional engineer or seismologist trained in the use of seismographs. The name and experience of the seismologist shall be submitted to the permittee for review and approval. The seismologist shall also attend the public informational meeting. The blast records shall be maintained, analyzed and reported by persons familiar with the frequency content of a seismograph record.

B. Codes, Permits and Regulations

1. The contractor shall comply with all applicable laws, rules, ordinances and regulations of the Federal Government, the State of Maine, and the Redington Township, governing the transportation, storage, handling and use of explosives. All labor, material, equipment and services necessary to make a blasting operation comply with such requirements shall be provided without additional cost to the permittee.
2. The contractor shall obtain and pay for all permits and licenses required to complete the work of this Section.
3. In the case of a conflict between regulations or between regulations and Specifications, the contractor shall comply with the strictest applicable codes, regulation or specification.

C. Blast Vibration Limits for Curing Concrete

1. Mass concrete on-grade which would not be subject to bending such as footings:

<u>Age of Concrete</u>	<u>Allowable (PPV)</u>
Less than 72 hours	1.0 inch/second
At least 72 hours	4.0 inch/second

2. Concrete which could potentially undergo bending such as walls, structural slabs, columns, and elevated slabs:

<u>Age of Concrete</u>	<u>Allowable (PPV)</u>
Less than 72 hours	0.5 inch/second
At least 72 hours	2.0 inch/second

3. Blasting shall not be permitted within 50 ft. of new concrete unless a blast plan for the specified blast is forwarded by the contractor and approved by the Engineer.
4. The contractor shall comply with the Blasting Limit Criteria during all blasting. Adjustments to the drilling and blasting program and procedures to comply with the Blasting Limit Criteria shall be made by the contractor during the execution of the work at no additional expense to the permittee.

D. Blast Monitoring

1. The contractor shall monitor PPV and air-blast over-pressures resulting from each blast. Additional locations for blast monitoring may be necessary due to concerned structures within and around the blast.

E. Blast Monitoring Reports

1. Following each blast, a Blast Monitoring Report shall be submitted to the permittee and Engineer within 24 hours.
2. Any vibrations or air over-blast pressures close to or outside the specified limits shall be immediately reported to the permittee and Engineer.

F. Blast Monitoring Instrumentation

1. All instrumentation proposed for use on the project shall have been calibrated within the previous six (6) months to a Standard which is traceable to the National Bureau of Standards. Characteristics of the required instrumentation are listed below.
2. Measure the three (3) mutually perpendicular components of particle velocity and frequency in directions vertical, horizontal and longitudinal from the vibration source.
3. Measure and display the maximum PPV component, the associated frequency, and the peak air-blast over-pressure. The readings must be displayed and be able to read in the field immediately after each blast.
4. Furnish a permanent time history paper record  (or from computer disk), of PPV and frequency components and air-blast over-pressure.
5. The contractor shall cooperate with the Engineer in permitting observation of the contractor's drilling and loading procedures, as well as providing detailed information on blasting operations.

- G. The contractor shall be completely responsible for all damages resulting from the blasting operations and shall, at a minimum, take whatever measures necessary to maintain PPV, frequency and peak air-blast over-pressure within specified or required limits. Modifications to the blasting and excavation methods required to meet these requirements shall be undertaken at no additional cost to the permittee.

- H. Airborne Dust and Noise Limits: The contractor shall take precautions, such as the use of water, vacuums, and mufflers to minimize noise and dust from the air track operations, and shall keep noise and airborne dust levels below regulatory limits.

1.08 SUBMITTALS

- A. The contractor shall submit the following information to the permittee and Engineer within seven (7) days prior to commencing drilling and blasting operations. Technical

Submittals and blast designs shall be completed by experienced, competent Engineers familiar with controlled blasting.

1. Sequence and schedule of blasting rounds, including the general method developing the excavation, lift heights, etc.
2. Specifics of a typical blast round to be implemented in each of the following areas:
  - (a) Test blast areas,
  - (b) The closest blasting area to adjacent structures,
  - (c) Where perimeter control blasting is required and
  - (d) At the deepest rock cut areas.
3. In each area specified, include the following blast round details:
  - (a) Diameter, spacing, burden, depth and orientation of each blast hole for each round design.
  - (b) Nomenclature and amount (in terms of weight and number of cartridges) of explosive and distribution of charge to be used within each hole, on each delay and the total for the blast.
  - (c) Nomenclature and type of detonators, delay pattern wiring diagram for the round, type and capacity of firing source, size, type and location of safety switches and lightening gap.
  - (d) Type and location of stemming to be used in the holes.
  - (e) Calculations of anticipated vibration levels at nearest adjacent structure.
  - (f) Methods of matting or covering of the blast area in open excavations to prevent fly rock and excessive air-blast over-pressure.
  - (g) Written evidence of the licensing, experience and qualifications of the blasters who will be directly responsible for the loading and firing of each shot.
  - (h) Name and qualifications of the person(s) responsible for the design and directing the blasting.
  - (i) Name and qualifications of the independent professional responsible for conducting the pre-blast condition surveys.
  - (j) Name and qualifications of the independent professional or seismologist responsible for monitoring and reporting blast vibrations.
  - (k) Recent calibration certificates (within previous 6 months) for the proposed blast monitoring instrumentation.
  - (l) Listing of instrumentation that the contractor proposed to use to monitor vibrations and air-blast over-pressure levels complete with performance specifications and users manual supplied by the manufacturer.

- (m) Submit a Certificate of Insurance documenting that liability insurance coverage in an amount no less than \$2,000,000, or as otherwise required by the permittee, will be in force during the duration of the project.
  - (n) Pre-blast condition surveys for neighboring residential and commercial property. A written report of the pre-condition survey shall be provided to the property owners. Notification shall be given to the neighbors no more than 30 days and no less than 10 days prior to the commencement of any blasting.
  - (o) The contractor shall perform a pre-blast survey of nearby structures as specified in this specification. The survey will include, as a minimum, photographs made with a 35 mm or digital camera or video with audio description of areas of exterior and interior building surfaces. One copy will be maintained by the contractor and one copy shall be supplied to the permittee.
- B. In the event that the ground vibrations and/or air blast over-pressures exceed the blasting limit criteria in this Section, the contractor shall immediately notify the engineer, then revise the design appropriately and submit the revised design to the Engineer for review.
- C. Review by the Engineer or permittee of the blast design and techniques shall not relieve the contractor of responsibility for the accuracy, adequacy and safety of the blasting as well as the protection of existing structures and overall safety. Loose, over-hanging or unstable rock along permanent rock cuts shall be removed as necessary or as directed by the Engineer. Controlled blasting procedures shall be utilized in areas of permanent rock cuts to minimize over-breakage and fracturing.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

Explosives, delay device and blast mat materials shall be the type recommended by the explosive firm that will comply with the requirements of this section.

## PART 3 - EXECUTION

### 3.01 SAFETY PRECAUTIONS

- A. Clearing the Danger Area Before Blasting: No blasting shall be permitted until all personnel in the danger area have been removed to a place of safety. A loud, audible warning system shall be sounded before each blast. The contractor shall familiarize all personnel on the project, Engineer, permittee and the general public with the implemented system. The danger area shall be patrolled before each blast to make certain that it has been completely cleared prior to a blast.
- B. Explosives shall be stored, handled and employed in accordance with federal, state and local regulations.

- C. No explosives, caps, detonators or fuses shall be stored on the site during non-working hours.
- D. The contractor shall be responsible for determining any other safety requirements unique to blasting operations so as not to endanger life, property, utility services, any existing or new construction, or any property adjacent to the site.
- E. Blasting mats or other cover will be used for each blast if needed to secure fly rock.

### 3.02 GENERAL BLASTING PROCEDURES

- A. Blasting shall be limited to between the hours of 7:00 am and 7:00 pm, Monday through Friday, or as otherwise restricted by the Redington Fire Department. No blasting shall be completed on weekends, holidays or other weekday times until written permission is received by the Redington Fire Department and the permittee.
- B. The contractor shall notify the permittee and Engineer at least 48 hours before blasting operations are to commence.
- C. The contractor shall conduct all blasting operations such that damage or disruption is prevented to adjacent structures, utilities, property and operations, and such that PPV, frequency and air-blast over-pressure levels do not lie outside the specified limits.
- D. The contractor shall control dust so as to prevent dust from leaving the site boundaries.
- E. Designed blast rounds shall be utilized with adjacent relief to allow the rock to move out towards a free face.
- F. All overburden soils and loose rock shall be removed from areas where blasting is planned. The exposed bedrock surface shall be surveyed by a licensed land surveyor to determine the limits for payment.
- G. *In areas where blasting is required in the foundation footprint, a base gravel fill is required one foot below and laterally beyond the footing limits [Patrick & Henderson input]. Loose, heaved and/or highly fractured bedrock below this depth shall be completely removed to expose intact bedrock or a tight fragmented over-blast suitable to the Engineer. In order to ensure good bearing material for the footings, the contractor shall conduct blasting such that over-break and fracturing of the rock is minimized below the required subgrade level. Sub-drilling (depth of blast hole below required subgrade) shall be kept to the minimum necessary to adequately fragment and remove the rock to the limits of excavation. The sub-drilling shall not exceed 2 ft. unless the contractor has submitted in advance a written request indicating why additional sub-drilling is necessary for the project.*
- H. Highly fractured, heaved and/or disturbed over-blast ledge beyond the payment limits shall be removed by the contractor and replaced with compacted Structural Fill or ¾ inch crushed stone at no additional cost to the permittee except in the foundation overblast area. Tight over blast ledge may remain in-place provided it is reviewed and acceptable to the Engineer.

- I. The contractor shall use controlled blasting procedures. The permanent rock face shall be stable with no over-hanging or highly fractured rock. Particular attention, design, precautions and blasting operations shall be focused on these areas of the site.

### 3.03 MEASUREMENT, PAYMENT AND BLASTING LIMITS

- A. Bedrock blasting will be based on a lump sum price for the entire project. The contractor will submit progress claims to the permittee upon completion of each milestone. The following blasting limits shall apply.
  - 1. For wind turbine foundations. The blasting limits will be 2 ft beyond the bottom of the foundation.
  - 2. For utility poles, the blasting limit will be at the minimum amount required to install utility poles to proper depth.
  - 3. For utility trenches within and outside the building, the blasting limit will be one foot below the pipe invert and two feet beyond the outside diameter of the typical pipe section.
  - 4. For access roads segments, the blasting limit shall be 2 ft. below the finish road grade.
  - 5. For rock cut slopes, the blasting limit shall be as shown on the Drawings for location and batter.
- B. Bedrock blasting and removal beyond the blasting limits shall be replaced with compacted structural fill at no additional cost to the permittee. Highly fractured, heaved, and/or distribution over-blast shall be removed from the project area as required by the Engineer at no additional cost to the permittee.
- C. No separate payment will be made for pre-condition surveys, surveying, vibration monitoring, blast designs, blast re-designs, acquisition of permits, safety measures, or other associated items which are considered incidental to the safe performance of controlled drilling and blasting.

### 3.04 PREPARATION

- A. Verify site conditions and note subsurface conditions affecting work of this section. Coordinate permittee radon monitoring.
- B. Identify required lines, levels, and elevations that will determine the extent of the proposed removals.

- C. Conduct a pre-blast survey in accordance with the following requirements:
1. The contractor shall conduct a Pre-Blast Survey of all structures within the Blast Area and provide the permittee and LURC in accordance with MeDEP requirements, a written report of the Pre-Blast Survey and Blasting Plan. The Pre-Blast Survey shall be filed with the MeDEP for future reference and kept on file for a period of at least 6 months. This survey should include:
    - All structures within a minimum distance of 2,000 feet from any blasting activity. The area extending beyond the 2,000 feet minimum shall be determined by the contractor. This distance shall be confirmed after consultation of the General Contractor, Site Contractor, Blasting Contractor and Insurance Companies.
    - A blasting plan which addresses:
      - Airblast limits
      - Maximum peak particle velocity
      - Frequency
    - The blasting plan shall meet criteria established in Chapter 3 (Control of Adverse Effects) in the Blasting Guidance Manual of the United States Dept. of the Interior.
    - Provisions and measures to monitor and assure compliance with the blasting plan.
  2. The contractor shall provide the Engineer with a Blasting Log for the work. The Blasting Log shall contain the following information:
    - Location
    - Time and Date
    - Number of Holes
    - Amount and type of explosive used per hole
    - The names of persons, companies, corporations, or public utilities contacted, owning, leasing, or occupying property or structures in proximity to the site of the work of the contractor's intention to use explosives.
  3. Drilling equipment will be equipped with suitable dust control apparatus which must be kept in repair and used during all drilling operations.

A copy of the MeDEP approval of the pre-blast survey and blasting plan obtained by the contractor shall be submitted to the permittee prior to blasting.
  4. Blasting shall not commence until the permittee has secured baseline radon tests.

### 3.05 ROCK EXCAVATION

- A. Rock Excavation - definition - Igneous, metamorphic or sedimentary rock that cannot be removed by rippers or other mechanical methods and, therefore, requires drilling and blasting. Cut rock to form level bearing at bottom of trench. In the utility trenches, excavate to 6" below invert elevation of pipe. This excludes pavement, concrete, and boulders less than 3 cubic yards.

Reuse excavated materials on-site in accordance with Section 02200, if applicable.

- B. Comply with all laws, rules, and regulations of Federal, State and local authorities and insurer which govern storage, use, manufacture, sale, handling, transportation, licensing, or other disposition of explosives. Take special precautions for proper use of explosives to prevent harm to human life and damage to surface structures, all utility lines, or other subsurface structures.

Do not conduct blasting operations until persons in vicinity have had ample notice and have reached positions of safety.

All blasting shall be performed in accordance with all pertinent provisions of the "Manual of Accident Prevention in Construction" issued by the Associated General Contractors of America, Inc., of the "Construction Safety Rules and Regulations," as adopted by the State Board of Construction Safety, Redington, Maine, and Maine Department of Transportation "Standard Specifications" Section 107.12, Use of Explosives. Blasting through the over burden will not be allowed.

- C. Contractor shall save harmless permittee, architect, engineer, and permittee's representative from any claim growing out of use of such explosives. Removal of materials of any nature by blasting shall be done in such manner and such time as to avoid damage affecting integrity of design and to avoid damage to any new or existing structure included in or adjacent to work. It shall be the contractor's responsibility to determine method of operation to ensure desired results and integrity of completed work.
- D. Perform rock excavation in a manner that will produce material of such size as to permit it being placed in embankments in accordance with Section 02200. Remove rock to limits as indicated. Remove loose or shattered rock, overhanging ledges and boulders which might dislodge.
- E. When during the process of excavation rock is encountered, such material shall be uncovered and exposed. Remove as much weathered rock as possible with conventional excavating equipment.

Blasting operations shall be accomplished in compliance with the "Blasting" clause of the Supplemental General Conditions. Rock shall be trimmed so that none protrudes within 6 inches of all utilities when said utilities are installed to correct line and grade.

F. Extra Rock Removal

Rock removal for this project is to be completed and paid for on a lump sum basis; however, if work elements beyond the scope of the Base Bid are requested, rock removal for this added work may be done on a unit price basis.

G. Provisions for Blasting

Blasting shall be performed only after approval has been given by the permittee for such operations and must comply with the following provisions:

1. *The contractor or any subcontractor shall use sufficient stemming, matting or natural protective cover to prevent flyrock from leaving property owned or under control of the permittee or operator or from entering protected natural resources or natural buffer strips. Crushed rock or other suitable material must be used for stemming when available; native gravel, drill cuttings or other material may be used for stemming only if no other suitable material is available.*
2. *The maximum allowable airblast at any inhabited building not owned or controlled by the developer may not exceed 129 decibels peak when measured by an instrument having a flat response (+ or – 3 decibels) over the range of 5 to 200 hertz.*
3. *The maximum allowable airblast at an uninhabited building not owned or controlled by the developer may not exceed 140 decibels peak when measured by an instrument having a flat response (+ or – 3 decibels) over the range of 5 to 200 hertz.*
4. *Monitoring of airblast levels is required in all cases for which a preblast survey is required by paragraph F. The contractor may file an MeDEP Permit Modification requesting the MeDEP waive the monitoring requirement if the contractor or subcontractor secures the permission of affected property owners to increase allowable airblast levels on their property and the department determines that no protected natural resource will be adversely affected by the increased airblast levels. The cost to prepare the permit modification and the effect of project delay while MeDEP reviews the request shall be borne solely by the contractor or his subcontractor.*
5. *If a blast is to be initiated by detonating cord, the detonating cord must be covered by crushed rock or other suitable cover to reduce noise and concussion effects.*
6. *A preblast survey is required and must extend a minimum radius of 2,000 feet from the blast site. The preblast survey must document any preexisting damage to structures and buildings and any other physical features within the survey radius that could reasonably be affected by blasting. Assessment of features such as pipes, cables, transmission lines and wells and other water supply systems must be limited to surface conditions and other readily available data, such as well yield and water quality. The preblast survey must be conducted prior to the initiation of blasting at the operation. The contractor or subcontractor shall retain a copy of all preblast surveys for at least one year from the date of the last blast on the development site.*
  - (a) *The contractor or the subcontractor is not required to conduct a preblast survey on properties for which the permittee or operator documents the rejection of an offer by registered letter, return receipt requested, to conduct a preblast survey.*

*Any person owning a building within a preblast survey radius may voluntarily waive the right to a survey.*

7. *Blasting may not occur in the period between sundown and sunrise the following day or in the period 7:00 p.m. and 7:00 a.m., whichever is greater. Routine production blasting is not allowed in the daytime on Sunday. Detonation of misfires may occur outside of these times but must be reported to the department within 5 business days of the misfire detonation. Blasting may not occur more frequently than 4 times per day. Underground production blasting may be exempted from these requirements provided that a waiver is granted by the department.*
8. *Sound from blasting may not exceed the following limits at any protected location:*

<u>Number of Blasts Per Day</u>	<u>Sound Level Limit</u>
1	129 dbl
2	126 dbl
3	124 dbl
4 or more	123 dbl

9. *The maximum peak particle velocity at inhabitable structures not owned or controlled by the developer may not exceed the levels established in Table 1 in paragraph E and the graph published by the United States Department of the Interior in “Bureau of Mines Report of Investigations 8507,” Appendix B, Figure B-1. The contractor or subcontractor may apply for a MeDEP Project Modification to request a variance to allow ground vibration levels greater than 2 inches per second on undeveloped property not owned or controlled by the permittee if the department determines that no protected natural resource, unusual natural area or historic site will be adversely affected by the increased ground vibration levels. If inhabitable structures are constructed on the property after approval of the MeDEP and prior to completion of blasting, the contractor immediately must notify the department and modify blasting procedures to remain in compliance with the standards of this subsection. The cost to prepare the permit modification and the effect of project delay while MeDEP reviews the request shall be borne solely by the contractor or his subcontractor.*
10. *Table 1 of this paragraph or the graph published by the United States Department of the Interior in “Bureau of Mines Report of Investigations 8507”, Appendix B. Figure B-1 must be used to evaluate ground vibration effects for those blasts for which a preblast survey is required.*
  - (a) *Either Table 1 of this paragraph or graph published by the United States Department of the Interior in “Bureau of Mines report of Investigations 8507”, Appendix B, Figure B-1 may be used to evaluate ground vibration when blasting is to be monitored by seismic instrumentation.*
  - (b) *Blasting measured in accordance with Table 1 of this paragraph must be conducted so that the peak particle velocity of any one of the 3 mutually perpendicular components of motion does not exceed the ground vibration limits at the distances specified in Table 1 of this paragraph.*
  - (c) *Seismic instruments that monitor blasting in accordance with Table 1 of this paragraph must have the instrument’s transducer firmly coupled to the ground.*

- (d) A permittee or operator using Table 1 of this paragraph must use the scaled-distance equation,  $W=(D/D_s)^2$ , to determine the allowable charge weight of explosives to be detonated in any 8 millisecond or greater delay period without seismic monitoring, where  $W$  is equal to the maximum weight of explosives, in pounds, and  $D$  and  $D_s$  are defined as in Table 1 of this paragraph. The contractor may apply for a Permit Modification to MeDEP to authorize the use of a modified scaled-distance factor for production blasting if the contractor can demonstrate to a 95% confidence level, based upon records of seismographic monitoring at the specific site of the mining activity covered by the permit, that use of the modified scaled-distance factor will not cause the ground vibration to exceed the maximum allowable peak particle velocities of Table 1 of this paragraph. The cost to prepare the permit modification and the effect of project delay while MeDEP reviews the request shall be borne solely by the contractor or his subcontractor.
- (e) Blasting monitored in accordance with the graph published by the United States Department of the Interior in "Bureau of Mines Report of Investigations 8507", Appendix B, Figure B-1 must be conducted so that the continuously variable particle velocity criteria are not exceeded.

The contractor may apply for a Permit Modification to MeDEP for a variance of the ground vibration monitoring requirement prior to conducting blasting at the development site if the contractor agrees to design all blasts so that the weight of explosives per 8 millisecond or greater delay does not exceed that determined by the equation  $W=(D/D_s)^2$ , where  $W$  is the maximum allowable weight of explosives per delay of 8 milliseconds or greater,  $D$  is the shortest distance between any area to be blasted and any inhabitable structure not owned or controlled by the developer, and  $D_s$  equals  $70 \text{ ft./lb.}^{1/2}$ . As a condition of the variance, the department may require submission of records certified as accurate by the blaster and may require the permittee or operator to document compliance with the conditions of this paragraph. The cost to prepare the permit modification and the effect of project delay while MeDEP reviews the request shall be borne solely by the contractor or his subcontractor.

The following is Table 1.

<b>Distance Versus Peak Particle Velocity Method</b>		
<b>Distance (D) from the blast area</b>	<b>Maximum allowable peak particle velocity (Vmax) for ground vibration (in./sec.)</b>	<b>Scaled-distance factor (Ds) to be applied without seismic monitoring</b>
0 to 300	1.25	50
301-5000	1.00	55
Greater than 5000	0.75	65

11. A record of each blast, including seismographic data, must be kept for at least one year from the date of the last blast, must be available for inspection at the development or at the offices of the permittee or operator if the development has been closed, completed

*or abandoned before the one-year limit has passed and must contain at a minimum the following data:*

- (a) Name of blasting company or blasting contractor;*
  - (b) Location, date and time of blast;*
  - (c) Name, signature and social security number of blaster;*
  - (d) Type of material blasted;*
  - (e) Number and spacing of holes and depth of burden or stemming;*
  - (f) Diameter and depth of holes;*
  - (g) Type of explosives used;*
  - (h) Total amount of explosives used;*
  - (i) Maximum amount of explosives used per delay period of 8 milliseconds or greater;*
  - (j) Maximum number of holes per delay period of 8 milliseconds or greater;*
  - (k) Method of firing and type of circuit;*
  - (l) Direction and distance in feet to the nearest structure neither owned nor controller by the developer;*
  - (m) Weather conditions, including such factors as wind direction and cloud cover;*
  - (n) Height or length of stemming;*
  - (o) Amount of mats or other protection used;*
  - (p) Type of detonators used and delay periods used;*
  - (q) The exact location of each geophone and the distance of each geophone from the blast;*
  - (r) Seismographic readings;*
  - (s) Name and signature of the person operating each seismograph; and*
  - (t) Names of the person and the firm analyzing the seismographic data.*
12. *All field seismographs must record the full analog wave form of each of the 3 mutually perpendicular components of motion in terms of particle velocity and frequency. All seismographs must be capable of sensor check and must be calibrated according to the manufacturer's recommendations.*

### 3.06 SPECIAL PERIMETER CONTROL BLASTING PROCEDURES

- A. When blasting at the perimeter of the excavation area, care shall be taken at the excavation limits to minimize over-breakage and fracturing of remaining rock. Pre-splitting or cushion blasting or line drilling shall be utilized at such locations and/or as indicated on the Drawings as described below.
- B. If, in the judgment of the Engineer, the contractor's perimeter control blasting procedures are causing rock fracturing at a distance beyond the limits of work, the geometry (diameter, spacing), stemming and loading of perimeter holes and adjacent production holes shall be adjusted until results acceptable to the Engineer are obtained or the perimeter control blasting technique shall be changed. The following descriptions of pre-splitting, cushion blasting and line drilling should be considered general guidelines. The contractor shall use appropriate methods to conduct the work based on his experience, the project requirement and site conditions.
- C. The perimeter controlled blasting procedures shall be employed in areas where a permanent rock slope is to be constructed for site grading and other critical areas. Perimeter rock slopes steeper than 1H:4V and taller than 5 ft. in overall vertical height as shown on the Drawings shall require special controlled blasting procedures.
- D. The contractor shall adjust the blasting operations according to the characteristic and structure of the rock formation to obtain the required slope without fracturing the rock beyond the pre-split face.
- E. Pre-Splitting
  - 1. Pre-splitting rock shall, at a minimum, conform to the *Maine Highway Department-Standard Specifications for Highways and Bridges. Section 203.04 – Pre-splitting Rock* shall be used for this project on 1:6 slopes.
  - 2. Pre-split blast holes shall be loaded and fired separately before the main round to create a fracture plane along the perimeter of the excavation.
  - 3. Pre-split holes shall be string-loaded or space-loaded with light, distributed charges and shall be thoroughly stemmed for the full length of hole with sand. The top of the hole, for a minimum 18 inches, shall be unloaded and stemmed with tamped sand and gravel.
  - 4. Spacing, burden, hole diameter and loading shall be maintained within the Guidelines listed in Table I unless deviation from the Guidelines is approved by the Engineer based on field performance.

**TABLE I  
PRE-SPLITTING GUIDELINES**

HOLE DIAMETER (in)	HOLE SPACING (ft)	COLUMN LOAD CHARGE CONCENTRATION (lb/ft)
1.5 to 2.5	1.0 to 1.5	0.06 to 0.15
3.0 to 4.0	1.5 to 2.0	0.10 to 0.20

5. The bottom charge concentration within the bottom 1 to 3 ft. of hole shall be approximately three (3) times the column charge concentration.
  6. Pre-split holes shall be fired simultaneously if particle velocity and air blast considerations will permit. Otherwise, groups of pre-split holes in segments along the pre-split line shall be systematically fired with millisecond (ms) delays.
  7. Pre-split holes shall not deviate more than 6 inches out of alignment over the full maximum vertical lift height.
  8. Loading of the first-row-in of production holes shall be approximately 50 to 75% of normal production hole loading.
- F. Cushion Blasting
1. If used, cushion blast holes shall be loaded and fired separately after the main round to ensure a free face and equal burden.
  2. Cushion blast holes shall be string-loaded or space-loaded with light charges, and shall be thoroughly stemmed with a maximum of 18 inches of tamped sand, peastone or other material capable of maintaining explosive gas pressures. Spacing, burden, blast hole diameter and loading shall be maintained within the Guidelines outlined in Table II.

**TABLE II  
CUSHION BLASTING GUIDELINES**

HOLE DIAMETER (in)	SPACING (ft)	BURDEN (ft)	COLUMN LOAD CHARGE CONCENTRATION (ob/ft)
1.5 to 2.0	1.0 to 1.5	2.5 to 3.0	0.06 to 0.15
2.5 to 4.0	1.5 to 2.0	3.0 to 3.5	0.15 to 0.25

NOTE: Small diameter, unloaded guide holes shall be used if required for satisfactory results, located midway between each cushion blast hole.

3. The first row of drill holes in from the perimeter row shall be loaded with not more than four (4) times the charge weight indicated in the Table. Spacing and burden of the first-row-in holes shall be decreased sufficiently from those of other production holes to ensure that the perimeter holes have a free face and equal burden for the full depth of the round.

G. Line Drilling

1. Line drilling shall consist of a minimum of 3-inch diameter holes evenly spaced at 2 per lineal foot. Drill holes shall not be deviated by more than 3-inches from their required plane over the entire length of the hole. The line drilled holes are to be left unloaded. As the perimeter is approached with the primary blasting, the distance should be about 50% of the normal hole spacing. The spacing of holes in the row adjacent to the perimeter holes shall also be about 50-75% of the normal hole spacing. The loading of the holes in the adjacent row should be about 50% of the loading used in the primary holes.

H. Condition of the Permanent Rock Face

1. The permanent rock face shall not deviate by more than 5% batter and 2 ft. in plan location as shown on the Drawings. Loose, fractured or over-hanging rock as determined by the Engineer to be unstable shall be removed as directed. Care shall be taken during the excavation to minimize over-breakage and fracturing.

END OF SECTION 02229