

TECHNICAL SPECIFICATIONS

FOR

***Vermont Gas Systems, Inc.
85 Swift Street
South Burlington, VT 05403***

***Addison Natural Gas Project (ANGP)
Phase 1***

PREPARED BY:



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PROJECT NO.: 28757

SECTION 312333 - TRENCHING, PIPE LAYING AND BACKFILLING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the excavation of trenching, pipe laying, backfilling, compacting, dewatering, excavation support and disposal, as shown on the Contract Drawings, and as herein specified.
- B. The Construction Management Team will determine the suitability of materials that are to be used in the work and should any materials encountered be unsatisfactory for the purpose intended, they shall be removed from the site at the Contractor's expense.

1.2 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. The latest edition of the following standards, as referenced herein, shall be applicable.
 - a. "Standard Specifications for Highway Materials and Methods of Sampling and Testing, American Association of State Highway and Transportation Officials (AASHTO)."
 - b. American Society for Testing and Materials (ASTM).
 - c. Vermont Agency of Transportation (VTrans) Standard Specifications
- B. The Contractor shall comply with the requirements for soil erosion and sedimentation control and other requirements of governmental authorities having jurisdiction, including the State.
- C. The Owner shall provide and pay for all costs in connection with an approved independent testing facility to determine conformance of soils and aggregate with the specifications, in accordance with Section "Quality Requirements."

1.3 SUBMITTALS

- A. The Contractor shall submit certified gradation curves and moisture-density compaction results for each imported material. If multiple sources are utilized, information shall be submitted from each individual supplier.
- B. Pipe support systems: Contractor shall submit method of pipe support system(s) to be utilized, including details on how supports will be installed.
- C. Contractor shall submit details/designs for all shoring and trench boxes for excavations that exceed 20' in depth. Details and designs shall be sealed by a registered Vermont Professional Engineer.

1.4 PROJECT REQUIREMENTS

- A. Call Dig Safe at 811 before starting any excavation or verify that a Dig Safe ticket exists and is valid for the area. Contractor shall maintain Dig Safe marks and follow all Dig Safe laws. Contractor is responsible for contacting and complying with municipal and private utilities that are not members of Dig Safe. Excavate with care to avoid damage to structures and utilities - excavations shall be completed by hand if necessary. Promptly report any damages to utilities to Utility Owner and Construction Management Team, do not attempt repairs without the Utility Owners consent.
- B. Notify the Construction Management Team and Owner of any unexpected subsurface condition.
- C. Protect excavations by shoring, bracing, sheet piling, or by other methods, as required to ensure the stability of the excavation. Comply with VOSHA/OSHA requirements.
- D. Underpin or otherwise support structures and improved surfaces adjacent to the excavation which may be damaged by the excavation. This includes service lines and existing utilities.
- E. Contractor is responsible for protection of Existing Utilities:
 - 1. Specifically, Contractor shall use extreme protection around existing 10-inch transmission main in the vicinity of the Colchester Tie-in Site. This is the primary feed for the Burlington area. Owner will locate/flag the line prior to Contractor beginning work in this area. Contractor shall take all measures necessary to protect this existing transmission main during construction. The Owner must be present for any work or excavation around the existing 10-inch transmission main.
 - 2. Contractor will notify Owner before excavating around, or crossing, any existing natural gas distribution lines. Owner will determine if Owner should be present during any work.
 - 3. Locate existing underground and above ground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations. Comply with OSHA requirements.
 - 4. If necessary, coordinate interruption and/or termination of utilities with the utility companies and the Owner.
 - 5. Provide a minimum of seven days notice to the Owner and receive written notice to proceed before interrupting any utility.
- F. Demolish and completely remove from the site any existing underground utilities designated to be removed, as shown on the Drawings or as specified.
- G. Repair any damaged utilities as acceptable to the Owner, Construction Management Team, and utility companies at no additional cost to the Owner.
- H. Contractor shall comply with maintenance and protection requirements as approved by the authority having jurisdiction.
- I. Protection of Persons and Property:
 - 1. Barricade open excavations occurring as part of this work and post with warning lights, if required or comply with any applicable permits.
 - 2. Operate warning lights as recommended by authorities having jurisdiction.

3. Protect structures, utilities, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by construction operations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. **Select Backfill/Pipe Padding:**
 1. **On-site material:** The use of on-site native material for select backfill/pipe padding shall be approved and inspected by the Construction Management Team. Native material shall not contain any stones that are larger than 1.5” in the longest dimension. A shaker bucket or screen may be used if native material is too large.
 2. **Borrow Material:** If native material is not acceptable, as determined by the Construction Management Team, a sand material shall be imported to the site meeting the following criteria. Alternate select backfill/pipe padding materials may be submitted by the Contractor for review and approval from Construction Management Team.

<u>Sieve</u>	<u>Percent Passing</u>
1-1/2"	100
1/2"	70 - 100
No. 4	60-100
No. 100	0-20

- B. **General Backfill:** Native materials containing no stones or clods larger than 3” in the longest dimension are acceptable. If native material is not acceptable, as determined by the Construction Management Team, bank run gravel fill shall be imported to the site meeting the following criteria. General backfill area will be limited to the trench, or a maximum of 12-inches laterally from each side of the pipe. Alternative general backfill materials may be submitted by the Contractor for review and approval from Construction Management Team.

Sieve	Percent Passing
3”	100
No. 4	20 - 60
No. 100	0 -12
No. 200	0 - 6

PART 3 - EXECUTION

3.1 PRECONSTRUCTION MATERIAL QUALIFICATION TESTING

A. General:

1. Sufficient size samples shall be obtained from the potential borrow source to allow completion of tests listed in paragraph B below. Samples may be obtained from test borings, test pits, or from borrow pit faces provided that surficial dry or wet soil is removed to expose undisturbed earth. Tests listed below shall be performed on each sample obtained. A minimum of three (3) representative samples from each potential borrow source shall be furnished to the testing laboratory for prequalification testing.

B. Material Tests:

1. Particle Size Analysis:
 - a. Method: ASTM D422
 - b. Number of Tests: One (1) per sample; three (3) per potential source.
 - c. Acceptance Criteria: Gradation within specified limits.
2. Maximum Density Determination:
 - a. Method: ASTM D1557 - Modified Proctor
 - b. Number of Tests: One (1) per sample; three (3) per potential source.
3. Re-establish gradation and maximum density of fill material if source is changed during construction.

3.2 PREPARATION

- A. Establish required lines, levels, contours and datum.
- B. Maintain benchmarks and other elevation control points; re-establish if disturbed or destroyed, at no additional cost to the Owner.
- C. Establish location and extent of existing utilities prior to commencement of excavation.

3.3 EXCAVATION

- A. All excavation shall be made to such depth/width as required to provide suitable room for laying pipe and for sheeting, shoring, pumping and draining as necessary, and for removing peat, silt, or any other deleterious materials which the Construction Management Team may deem unsuitable. Hand trench excavation may be required to protect existing utilities and structures.
- B. Trench excavation for pipes shall be made by open cut to accommodate the pipe or structure at the depths indicated on the Contract Drawings. Excavation shall be made to such a depth and to the width indicated on the Contract Drawings so as to allow a minimum of six (6) inches of select backfill / padding to be placed beneath and on the sides of all pipes installed unless otherwise specified on the drawings. A minimum of twelve (12) inches of select backfill/padding shall be placed above all pipes installed.

- C. The bottom of the trench shall be accurately graded to provide a uniform layer of padding/bedding material, as required, for each section of pipe. Trim and shape trench bottoms and leave free of irregularities, lumps, and projections.
- D. Stockpile excavated subsoil for reuse where directed or approved.
- E. Over excavation/under cut: If, in the opinion of the Construction Management Team, existing material below the trench grade is unsuitable for properly placing select backfill/padding material and laying pipe, the Contractor shall excavate and remove the unsuitable material and replace the same with an approved select backfill/padding material properly compacted.
- F. Stability of Excavation: Slope sides of excavations shall comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavation in safe condition until completion of backfilling.
- G. Removal of materials beyond the indicated elevations, without authorization by the Construction Management Team, shall be classified as unauthorized excavation and shall be performed at no additional cost to the Owner.
- H. If a trench excavation crosses a road, sidewalk, bike path, driveway, or other transportation facility, the Contractor shall arrange temporary facilities for ingress/egress of all pedestrians and vehicles. One lane of traffic shall be maintained at all times – refer to VTrans/Local permits for additional construction conditions and traffic management details.

3.4 DEWATERING

- A. The Contractor shall remove all water from the excavation promptly and continuously throughout the progress of the work and shall keep the excavation dry at all times until the work is completed and excavation is backfilled or have sufficient weight to resist uplift pressures. Groundwater levels shall be depressed to a minimum of 2 feet below excavation subgrade. No pipe or structure is to be laid in water and water shall not be allowed to rise on or flow over any pipe or structure until such time as approved by the Construction Management Team.
- B. Provide a suitable point of discharge from dewatering operations shall be conveyed in a non erosive manner satisfactory to the EPSC Specialist and Construction Management Team and all applicable environmental permit regulations.
- C. Precautions shall be taken to protect uncompleted work from flooding during storms or from other causes. All pipe lines not stable against uplift during construction or prior to completion shall be thoroughly braced or otherwise protected to the satisfaction of the Construction Management Team.

3.5 BEDDING AND BACKFILLING

- A. Contractor shall take all necessary precautions to ensure that backfill materials are kept free of all skids, stumps, welding rods, cans, bottles, trash and other deleterious debris.
- B. Pipe supports shall be installed in all locations prior to backfilling, unless otherwise directed by the Construction Management Team – refer project design drawings for further requirements. Stacked sandbags, pipe pillows, or owner approved equal are acceptable methods. Spacing shall be per manufacturers recommendations, if a commercial product, or 15’ maximum intervals if sandbags.
- C. Trench breakers shall be installed per construction plan details prior to backfilling operations begin.

- D. All pipe trenches backfill (select backfill/padding, general backfill, subbase) shall be thoroughly compacted by mechanical means as follows:
1. Typical Cross-country areas: Thoroughly compacted by mechanical means to avoid any future trench settlement.
 2. VELCO corridor: All backfill in pipe trenches in the VELCO corridor shall be compacted to a minimum of 90 percent of modified Proctor maximum dry density by installing 12-inch (maximum) loose lifts.
 3. Existing and Proposed Road Areas (unpaved and paved): All backfill in pipe trenches in, or directly adjacent to (with 10' of edge of road surfaces – existing or proposed) road surfaces, shall be compacted to a minimum of 95 percent of modified Proctor maximum dry density. Backfill materials shall be placed with water content within plus or minus 3 percent of optimum moisture content per the modified Proctor method (ASTM D1557). Any water used for compaction shall be provided by the Contractor at their own expense. The Contractor is responsible for the repair of any trench settlement at no expense to the Owner for the period of one year after substantial completion of the project.
- E. Provide uniform bearing and support for pipe in all locations, except where necessary to excavate for connections, tie-ins, and other required appurtenances. Dig no deeper, longer, or wider than needed to make the joint connection properly.
- F. The bedding/padding material shall be placed to the full width of trench. The bedding material shall be placed evenly along the bottom of the trench to provide proper support of the pipe to the elevation shown on the Contract Drawings or directed by the Construction Management Team. . The backfill shall be placed on both sides of the pipe at the same time and to approximately the same elevation. Any pipe that is damaged or moved out of alignment, regardless of cause, shall be replaced or realigned at the Contractor's expense. Bedding/padding shall be thoroughly compacted by hand-tamping or mechanical means being careful not to damage the pipe. When the bedding/padding reaches one (1) foot over the top of the pipe, the entire surface shall be compacted by mechanical means.

3.6 PIPE STRINGING & LAYING

- A. Pipe shall be installed per the depth, alignment, and coating type shown on the project design plans. Depth of cover shall be measured from top of pipe to finished/final grade (after site restoration).
- B. Stringing
1. No pipe shall be strung before the trench is excavated to full depth and accepted by the Owner to meet the requirements of this specification. Pipe shall not be placed directly on the ground, but on wooden skids with proper protective padding. The skids and protective padding material shall be subject to Construction Management Team approval. Dragging, skidding or dropping the pipe is not permitted. Wooden wedges shall be used to prevent movement of each strung pipe.
 2. Where possible the skid elevations shall be planned such that minor differences between grade profile and bottom of trench profile (e.g. at locations where an increased trench depth is required) can be accommodated without an additional tie-in. The distance between the trench edge and the pipe string shall be planned such that safe working space is provided. Contractor shall follow applicable OSHA/VOSHA regulations.

3. Contractor shall be responsible for proper stringing and locating of the pipe by coating type.
 4. Contractor shall string the pipe in such a manner so as to cause no interference with public roads, sidewalks, or bike paths. Suitable gaps shall be left at intervals as necessary to permit the passage of livestock and/or equipment across the right-of-way and as directed by the Construction Management Team.
 5. Contractor shall layout and measure the pipes such that the number of pieces required to be cut-off with less than 5 feet in length is kept to a minimum.
 6. Pipe shall be strung with the use of a spreader bar and two guide lines.
- C. Bending - Contractor shall make all necessary field pipe bends required in construction of the pipeline. The Contractor shall be responsible for determining the degree of the field bend necessary where a change in direction is necessary.
1. All bending shall be completed using the cold smooth method using a bending machine, approved by the Construction Management Team. Wrinkle bends will not be acceptable. Welded longitudinal pipe seams shall be right angles (neutral axis) to the direction of the bend. The Contractor shall use an internal bending mandrel to achieve smooth and undistorted bends. Padded bending shoes are required for coated pipe. Heating the pipe for bending purposes is not allowable. Prior to beginning work, Contractor shall submit and demonstrate their bending procedure, which shall conform to the recommendations of the manufacture of the bending machine. This procedure shall be approved by the Construction Management Team prior to beginning work.
 2. For field cold bends, the longitudinal axis shall not be deflected more than 1-1/2 degrees in any length along the pipe access equal to the diameter of the pipe. The maximum diametrical reduction in a pipe bend shall not exceed 2-1/2% of the nominal pipe diameter. There shall be no deviation from the above requirements without prior written approval from the Construction Management Team. Individual approvals shall be obtained for each application.
 3. The distance between centerline of bending points shall be such that there will be no distortion of the pipe or of the bend previously made and in no event shall be closer than seven (7) feet to the end of the joint of the pipe. When pipe is double jointed before bending, the bend shall not be closer than three (3) feet to the butt (girth) weld.
 4. Bends shall not be straightened under any circumstances.
 5. Pipe that is buckled, wrinkled, flattened, egged or gouged, as determined by the Construction Management Team, by bending operations shall be cut out and replaced at the sole expense of the Contractor. Hammering, the use of jacks, or other mechanical machinery to repair bucked or deformed pipe is prohibited. A buckle shall be defined as any anomaly in the contour of a bend which, when measured with a six (6) inch metal straight edge oriented on the longitudinal axis, yields a depression or void beneath the straight edge equal to, or greater than, 0.06".
 6. For pipe line-up, the pipe shall be placed on skids with sufficient clearance between the bottom of the pipe and ground to accommodate the finishing weld. Pipe shall be handled in a manner to prevent damage to the pipe walls and shall be placed over or parallel to the ditch in such manner that when the pipe is lowered, the bends will rest in the ditch at the proper location. In the laying of the pipe other than seamless pipe, the longitudinal seams shall be offset by 20 degrees on adjoining pipes in the top 120 degrees of the pipe and welded sections shall be assembled and lowered into the trench so that the longitudinal seams will remain on the top 120 degrees of the pipe as laid. Exceptions shall be weld seams on side bends, which shall be located on top of the pipe, and weld seams on sag bends and over bends, which shall be located on either side of the pipe as laid.

7. Contractor shall make all necessary bends required for proper construction of the pipeline, following a trigonometric survey to establish the number and degree of bends required, to ensure that the installed pipe conforms to the contours of the excavated trench.
- D. Welding – Refer to Specification 137000
 - E. Coating Weld Joints and Fittings – Refer to Specification 138000
 - F. Lowering – Prior to lowering the pipe into the trench, the Contractor shall ensure that all water, debris, skids, rocks, welding rods and other foreign or deleterious material is removed from the trench. During lowering operations coated pipe shall be handled by use of adequately spaced lowering belts or cradles, as determined to be acceptable by the Construction Management Team, but shall be a maximum of 250'. At a minimum, belts shall be equal to the outside diameter of the pipe and shall be made of material that is free of protrusions that may cause damage to the protective coating. Roller cradles shall have nylon/neoprene roller wheels. The pipe shall be lowered into the trench in a manner that will allow proportional distribution of the total weight of the pipeline to all of the lifting points to prevent undue stress or strain on the pipe and to prevent damage to the pipe coating. The pipe shall not be dropped or subjected to jarring or impact. At water crossings or any other locations which may require pulling or dragging of the pipe into place, the coated pipe shall be properly protected from damage using wood lagging or rollers. Welded pipe strings shall be lowered-in within 96 hours of completion of joint coating.
 - G. Holiday Inspection – Holiday inspection (“jeeping”) shall be performed on all pipe and fittings with an electronic holiday detector, supplied by the Contractor and operated in such a manner to audibly and visually detect the presence of all holidays in the coatings. Jeeping shall be completed twice (minimum) – once when on skids adjacent to trench, and again as it is lowered into the ditch. Additional jeeping may be required as determined by the Construction Management Team. Refer to Coatings, Specification 138000 for additional jeeping requirements.
 - H. Rock Shield – Contractor shall furnish and install Tuff Nuff 11 mm rockshield, or Construction Management Team approved equal, on the pipeline in areas of rock trench or as otherwise directed by Construction Management Team or utility inspector.
 - I. Trench Breakers – Trench breakers shall be installed as defined on the project design drawings.
 - J. Electrolysis Test Leads – Locations for test leads are determined on the project design drawings and shall be connected prior to backfilling operations – follow Cathodic Protection Details for installation. If an electrical continuity test fails after backfilling operations, Contractor shall excavate and replace test lead at no cost to the Owner. All test lead cables shall be continuous without splices.
 - K. Drainage Tile Repair – Tiles within the limit of disturbance that are damaged shall be repaired by the Contractor.
 1. The replacement tile shall be installed to the gradient and alignment of the previous tile. Tile shall be supported at trench crossings as necessary in order for the tile to maintain the gradient/alignment during backfilling operations.
 2. Replacement tile materials shall be new. Reusing excavated existing drain tile is not acceptable.
 3. Drain tile couplings shall be utilized to splice in new drain tile. Couplings shall be installed per the manufacturer’s recommendations.
 4. During backfilling operations, soil adjacent to and under tiles shall be compacted to eliminate future settlement.

5. In areas where the tile alignment is parallel and directly adjacent to the pipeline alignment, the tile will be moved/offset to the side of the pipeline alignment.
 6. Tile and pipeline separation shall be a minimum of 12-inches.
 7. Conditions in construction line list regarding existing and future tile locations shall be adhered to by the Contractor.
 8. If directed by Construction Management Team, both existing and replacement tiles shall be inspected to ensure that tiles are not plugged, crushed, mis-aligned, or otherwise damaged. If damage is found, tile shall be repaired at no cost to the Owner.
- L. Warning Tape – Contractor shall install Owner provided pipeline warning tape as indicated on project design drawings.
- M. Pipeline Markers – After completion of backfilling operations, Contractor shall install Owner supplied pipeline markers as directed by Construction Management Team.

3.7 BACKFILLING AROUND STRUCTURES

- A. The Contractor shall not place backfill against any structure without obtaining the approval of the Construction Management Team. No dumping shall be allowed where materials would flow against or around such structures. Backfill material shall be deposited in horizontal layers not exceeding 6 inches in loose thickness or as shown on the Contract Drawings and thoroughly compacted by hand or by mechanical means to the satisfaction of the Construction Management Team.

3.8 SUSPENSION OF WORK

- A. Whenever the work is suspended, excavations shall be protected and the roadways, if any, left unobstructed. Within or adjacent to private property, material shall be stored at such locations as will not unduly interfere with traffic of any nature and in no case shall materials be stored in locations which will cause damage to existing improvements.

3.9 DISPOSAL OF MATERIAL

- A. Excess and unsuitable materials shall be legally disposed of by the Contractor off site at the Contractor's expense unless otherwise approved by the Owner.

3.10 FIELD QUALITY CONTROL

- A. Notify the Construction Management Team at least three (3) working days in advance of all phases of excavation and backfilling operations. The contractor shall not conduct backfilling operations unless the Construction Management Team is present for inspections. Backfilling operations shall commence as soon as possible after the pipe has been lowered into trench. The amount of lowered pipe that is not backfilled shall be kept at a minimum at all times. Contractor shall not backfill trench until the Owner's as-built survey crew has completed their necessary tasks.

- B. In-place density testing at road crossings and VELCO corridor shall be performed to ascertain the compacted density of the fill and backfill materials in accordance with the following methods:
 - 1. In-place relative density:
 - a. Method: AASHTO T238, Nuclear Method
- C. Perform initial density testing to verify that contractors proposed compaction effort will obtain the minimum required densities.
- D. In-place density tests on trench backfills shall be provided as follows:
 - 1. Open-cut road crossings: One test per lift and at least once daily.
 - 2. Cross-country areas: Visual only – subject to Construction Management Team approval.
 - 3. VELCO corridor: Minimum of one every 500 cubic yards of fill, and not exceeding every 2 feet vertically, or once daily.
- E. The Construction Management Team may direct additional tests to establish gradation, maximum density, and in-place density as required by working conditions.
- F. Acceptance Criteria: The criteria for acceptability of in-place fill shall be both visual and in-situ dry density and moisture content. If a test fails to qualify, the fill shall be further compacted and re-tested/inspected. Subsequent test failures shall be followed by removal and replacement of the material, at no cost to the Owner. Minimum compaction of backfill materials noted in Section 3.5.D of this specification.

END OF SECTION