PART 1 - GENERAL

1.1 Summary:

A. Section Includes:

1. Utility tunnels for steam and condensate piping, chilled water piping, compressed air piping, telephone and data raceway systems, and other systems as applicable.

B. Related Sections:

1. Section 02200 - Earthwork
2. Section 02221 - Trenching, Backfilling, Compacting.
4. Section 02695 - Steam Distribution Systems.
5. Section 02785 - Electric Power Transmission.
6. Section 02790 - Communication Transmission.
7. Section 02795 - Compressed Air Systems.
8. Section 09900 - Paint.
9. Section 07100 - Waterproofing.
10. Section 07160 - Bituminous Dampproofing.

1.2 System Description:

The Main Campus’ utility tunnel system is nearly three miles in length and its principle utility is steam piping. The tunnels are situated to leave the Power House through a radial pattern. The age of the utility tunnel dates back nearly to the turn of the century, with the majority of the tunnel segments being constructed in the 1920-1960 timeframe. These tunnels are used to convey other campus utilities, including environmentally-sensitive telecommunications cabling, potable water, and compressed air.

PART 2 - DESIGN

2.1 Materials:

A. Utility Tunnels shall be cast-in-place or pre-cast reinforced concrete in accordance with Section 03000. Comply with applicable requirements of other Division 2 through 16 sections.

B. New tunnel concrete shall have a minimum 28-day compressive strength of 4000 psi.

C. Structural Steel:
Structural Tubing: ASTM A500, Grade B
Plates:            ASTM A36
D.   Reinforcing Steel: ASTM A615, Grade 60.

E.   Materials used in the tunnels shall be of industrial grade, e.g. only rigid piping is acceptable for electrical installation.

2.2 Waterproofing
A.   The tunnel roof and side walls shall have a sheet membrane waterproofing installed in accordance with Section 07110 of these UCB Standards.
B.   The top of the tunnel roof shall be arched and sloped at a minimum of 2.0% to avoid ponding of water on the roof surface.

2.3 Drainage:
A.   The tunnel floor shall be sloped at a minimum of 2% to floor drains which are connected to storm sewer system. Slope floors to the piping side of the tunnel to minimize water on the walking surface. Piping shall be located at sufficient height above floor, such that water will not wick up into the insulation and cause corrosion.
B.   Floor drains shall located no more than on 50 foot spacing.
C.   A perforated under-drain shall be constructed under the tunnel to remove groundwater from around the tunnel.

2.4 Tunnel Penetrations
A.   Pipe crossing through the tunnel walls are generally prohibited as egress is inhibited.
B.   All tunnel penetrations, regardless of size, shall evaluate the structural impact that the penetration has on the tunnel’s integrity. Additional reinforcement is required to mitigate structural deficiencies. This reinforcement shall have a design life commensurate with the design life of that section of the tunnel. In addition, the reinforcement shall not impact egress beyond current egress conditions specific to the segment of tunnel. Piping shall be sleeved as it crosses the tunnel wall(s).
C.   All piping penetrations greater than or equal to 3” diameter through tunnel walls shall be core-drilled and sealed with a mechanical seal that is both expandable and watertight. In addition, the penetration must be sealed on the exterior with a watertight, non-shrink grout.
D.   Any piping penetrations less than 3” diameter through tunnel walls or lids must be sealed with an elastomeric sealant that is suitable for submerged conditions. In addition, the penetration must be sealed on the exterior with a watertight, non-shrink grout. The maximum clear space between the pipe and the tunnel wall shall be less than 0.5 inch.
E. Prior to coring, the contractor shall call for a utility locate to verify utilities located in and near the utility tunnel. The contractor shall especially be aware of electrical high voltage lines which may exist in or adjacent to the tunnel wall.

F. Location(s) of the tunnel penetration shall be coordinated with the University Tunnel Manager and Utility Engineer, prior to coring.

2.5 General Design Criteria:

A. Obtain written approval from the University of Colorado at Boulder Utilities Engineer prior to using utility tunnels for utility placement. Reference specific utility for preferred type of installation. Adequate spacing between the utilities shall be provided to accommodate required insulation.

B. Tunnel design shall conform to the most recent version of the International Building Code, published by the International Code Council, Inc.

C. Structural concrete shall conform to the most recent version of ACI 318, published by the American Concrete Institute.

D. Steel design shall conform to the most recent version of Structural Steel Buildings, Allowable Stress Design, published by American Institute of Steel Construction.

E. Provide 6” minimum gravel base below tunnel floor.

F. Provide sufficient energy-efficient lighting to achieve a minimum of 2-foot candles in all locations. Light switches to be located at each tunnel point of entry. Consult with the University’s Tunnel Manager for specification of lighting.

G. Provide access hatches by Bilco Co. or approved equal with panic hardware at 300 ft. O.C. and at all changes in alignment, unless specifically approved by the University’s Tunnel Manager. The hatches shall be capable of removal of tunnel equipment and 20 foot sections of pipe. Provide units rated for HS20 loading and of size acceptable to the University’s Tunnel Manager.

H. Tunnel access hatch shall be equipped with an extension bar on the ladder for stability while descending from street level.

I. At a minimum, all new tunnel sections and modified tunnel sections shall be capable of withstanding HS20 loading and full hydrostatic loading.

J. Layout piping and other utilities as acceptable to the University of Colorado at Boulder Utility Engineer(s). Refer to tunnel cross-section and stanchion standard details.

K. Provide continuous ventilation at 50 fpm across tunnel face.

L. Granular backfill shall be placed along the side walls of the tunnel.

M. Water-stop joints shall be located at concrete joints.

N. Provide non-slip texture finish on floor.

O. Pre-cast reinforced concrete box sections may be used as approved by the University of Colorado at Boulder Utility Engineer. Box sections shall meet the
requirements of Section 02722.

P. The University prefers a 6’6” I.D. vertical dimension for utility tunnels. Coordinate with the University of Colorado at Boulder Utilities Engineer when shallow trench are required.

Q. A minimum of 24 inches horizontal clearance shall be maintained for egress through the tunnel, unless specifically approved by the University’s Tunnel Manager.

PART 3 - CONSTRUCTION

3.1 General

A. The Contractor shall stake the alignment of the proposed utility tunnel and verify location and dimensions of existing utility tunnel at the start of construction. Any conflicts and/or discrepancies shall be reported to the University of Colorado at Boulder Utility engineer.

B. The Contractor shall verify location and type of all utilities as necessary to avoid damage or conflicts.

C. Construction joints not shown on the plans shall be approved by the Engineer.

D. All transverse reinforcing shall be normal to the centerline of the tunnel.

E. No work shall be performed in the tunnel without first notifying the University’s Tunnel Manager. Keys for entrance to the tunnel systems must checked out daily for work performed in the tunnel and the key(s) returned at the end of the day. Keys not returned at the end of the day are subject to a fine by the tunnel manager.

F. Abandoned utility lines shall be removed to their source.

G. High voltage electrical which is to be placed in the tunnel wall itself or in a utility chase paralleling the utility tunnel shall have red dyed concrete for the tunnel wall.

H. Utility lines in the tunnel shall have markings every 50 feet indicating the type of utility conveyed.

I. The contractor shall follow the University’s confined space policy and all applicable EPA, OSHA, and University requirements.

3.2 Installation:

A. Installation of Utility Tunnels shall comply with applicable requirements of other Division 2 through 16 sections.

B. Cast-in-place utility tunnels shall not be backfilled for a minimum of five days after the placement of concrete and not until the concrete has reached a design strength of 3000 psi.

C. When connecting to an existing utility tunnel, the exterior tunnel surface at construction joints between the new utility tunnel and the existing utility tunnel shall receive joint waterproofing in accordance with Section 07100.

D. During construction, tunnel access points at street level which remain open while
the contractor is working in the tunnel shall have a barricade installed around the opening.

E. The contractor shall protect utilities while working in and around the tunnels.

3.3 Construction Equipment on Tunnel

A. Due to the condition of many of the utility tunnels, heavy construction equipment operating above or crossing the tunnel should be minimized or avoided. Prior to operating such equipment, the contractor shall verify with the University Engineer which equipment is allowed to be operated. It is the responsibility of the project operating the heavy equipment to install temporary shoring in order for the tunnel to support the loading. For purposes of this standard, heavy construction equipment is defined as any piece of construction equipment or construction material weighing greater than a HS20 wheel load.

3.4 Quality Assurance

A. Quality assurance testing is required in accordance with Section 01400 of these UCB Standards.

3.5 Inspection:

A. Notify Facilities Management at least 48 hours in advance of requested inspection time. The contractor is responsible for coordinating inspections with the University’s Inspector.

B. Inspections are required for the following events:

1. Intermediate Inspections:
   a. An inspection is required for rebar prior concrete placement.
   b. An inspection is required prior to backfilling the tunnel segment.
   c. An inspection is required on all tunnel penetrations prior to backfill.

2. Final Inspection
   a. Should be called for after the tunnel segment has been constructed and the site has been restored.

3. Final Walkthrough
   a. Prior to substantial completion.

END OF SECTION 02300