



**Department of Veterans Affairs  
West Haven Combined Heat and Power (CHP)  
Plant Design**

West Haven, Connecticut

**Contract Number: VA701-P-0163  
Task Order: VA701-13-J-0093**

# **PROJECT MANUAL**

July 18, 2014

## **Construction Documents Submission**

**Volume 3**

**Divisions 31-48**

*THIS PAGE INTENTIONALLY LEFT BLANK*

Combined Heat and Power (CHP) Plant  
 West Haven Veteran's Affairs Medical Center  
 West Haven, Connecticut  
 VA Contract No. VA701-P-0163  
 Task Order VA701-13-J-0093  
 CannonDesign Project No. 004243.00

DEPARTMENT OF VETERANS AFFAIRS

TABLE OF CONTENTS  
 Section 00 01 10

	<b>VOLUME 1</b>	
	<b>DIVISION 00 - SPECIAL SECTIONS</b>	<b>DATE</b>
00 01 15	List of Drawing Sheets	09-11
	<b>DIVISION 01 - GENERAL REQUIREMENTS</b>	
01 00 00	General Requirements	10-13
01 32 16.13	Network Analysis Schedules	12-13
01 33 23	Shop Drawings, Product Data, and Samples	11-08
01 35 26	Governmental Safety Requirements	
01 42 19	Reference Standards	09-11
01 45 29	Testing Laboratory Services	07-13
01 57 19	Temporary Environmental Controls	01-11
01 58 16	Temporary Interior Signage	08-11
01 74 19	Construction Waste Management	09-13
01 75 00	Starting and Testing	
01 81 11	Sustainable Design Requirements	02-13
01 91 00	General Commissioning Requirements	06-13
	<b>DIVISION 02 - EXISTING CONDITIONS</b>	
02 21 00	Site Surveys	05-13
02 21 10	Geotechnical Investigation & Recommendations	
02 41 00	Demolition	04-13
02 82 01	Hazardous Materials Survey Report	
02 82 02	Alpha Analytical Laboratory Report	
02 82 03	Additional Hazardous Materials Sampling	
02 82 11	Traditional Asbestos Abatement	07-11
02 82 13.13	Glovebag Asbestos Abatement	07-11
02 82 13.21	Asbestos Roofing Abatement	07-11
02 82 13.41	Asbestos Abatementfor total Demolition Projects	
02 83 33.13	Lead-Based Paint Removal and Disposal	08-11
	<b>DIVISION 03 - CONCRETE</b>	
03 30 00	Cast-in-Place Concrete	10-12
03 45 00	Precast Architectural Concrete	09-11
	<b>DIVISION 04 - MASONRY</b>	
04 05 13	Masonry Mortaring	
04 05 16	Masonry Grouting	

Combined Heat and Power (CHP) Plant  
 West Haven Veteran's Affairs Medical Center  
 West Haven, Connecticut  
 VA Contract No. VA701-P-0163  
 Task Order VA701-13-J-0093  
 CannonDesign Project No. 004243.00

04 20 00	Unit Masonry	05-12
	<b>DIVISION 05 - METALS</b>	
05 12 00	Structural Steel Framing	11-12
05 31 00	Steel Decking	10-12
05 40 00	Cold-Formed Metal Framing	07-11
05 50 00	Metal Fabrications	09-11
05 51 00	Metal Stairs	09-11
	<b>DIVISION 06 - WOOD, PLASTICS AND COMPOSITES</b>	
06 10 00	Rough Carpentry	09-11
06 20 00	Finish Carpentry	06-13
	<b>DIVISION 07 - THERMAL AND MOISTURE PROTECTION</b>	
07 08 00	Facility Exterior Closure Commissioning	06-13
07 12 00	Built-Up Bituminous Waterproofing	09-11
07 13 00	Sheet Waterproofing	06-10
07 13 27	Waterproofing	
07 13 52	Modified Bituminous Sheet Waterproofing	04-13
07 21 13	Thermal Insulation	03-09
07 22 00	Roof and Deck Insulation	10-10
07 27 26	Fluid-Applied Membrane Air Barrier, Vapor Permeable	08-12
07 54 19	Polyvinyl-Chloride (PVC) Roofing	11-12
07 60 00	Flashing and Sheet Metal	12-13
07 71 00	Roof Specialties	10-11
07 72 00	Roof Accessories	10-11
07 81 23	Intumescent Fireproofing	
07 84 00	Firestopping	10-11
07 92 00	Joint Sealants	12-11
07 95 13	Expansion Joint Cover Assemblies	10-11
	<b>DIVISION 08 - OPENINGS</b>	
08 11 13	Hollow Metal Doors and Frames	01-13
08 31 13	Access Doors and Frames	10-11
08 33 00	Coiling Doors and Grilles	10-11
08 41 13	Aluminum-Framed Entrances and Storefronts	10-11
08 44 13	Glazed Aluminum Curtain Walls	10-11
08 51 13	Aluminum Windows	11-12
08 71 00	Door Hardware	12-13
08 80 00	Glazing	10-12
08 90 00	Louvers and Vents	10-11
	<b>DIVISION 09 - FINISHES</b>	
09 22 16	Non-Structural Metal Framing	07-13
09 30 13	Ceramic/Porcelain Tiling	05-12
09 91 00	Painting	07-13

Combined Heat and Power (CHP) Plant  
 West Haven Veteran's Affairs Medical Center  
 West Haven, Connecticut  
 VA Contract No. VA701-P-0163  
 Task Order VA701-13-J-0093  
 CannonDesign Project No. 004243.00

	<b>DIVISION 10 - SPECIALTIES</b>	
10 14 00	Signage	11-11
10 28 00	Toilet, Bath, and Laundry Accessories	11-11
10 44 13	Fire Extinguisher Cabinets	11-11
	<b>DIVISION 11 - EQUIPMENT - NOT USED</b>	
	<b>DIVISION 12 - FURNISHINGS - NOT USED</b>	
	<b>DIVISION 13 - SPECIAL CONSTRUCTION</b>	
13 05 41	Seismic Restraint Requirements for Non-Structural Components	12-13
13 31 33	Framed Fabric Structures	
	<b>DIVISION 14- CONVEYING EQUIPEMENT</b>	
14 24 00	Hydraulic Elevators	05-11
	<b>VOLUME 2</b>	
	<b>DIVISION 21- FIRE SUPPRESSION</b>	
21 05 11	Common Work Results for Fire Suppression	11-09
21 08 00	Commissioning of Fire Suppression System	06-13
21 13 13	Wet-Pipe Sprinkler Systems	05-08
21 22 00	Clean-Agent Fire Extinguishing Systems	
	<b>DIVISION 22 - PLUMBING</b>	
22 05 11	Common Work Results for Plumbing	04-11
22 05 12	General Motor Requirements for Plumbing Equipment	12-09
22 05 19	Meters and Gages for Plumbing Piping	02-10
22 05 23	General-Duty Valves for Plumbing Piping	12-09
22 05 33	Heat Tracing for Plumbing Piping	12-09
22 07 11	Plumbing Insulation	05-11
22 08 00	Commissioning of Plumbing Systems	06-13
22 11 00	Facility Water Distribution	07-13
22 11 23	Domestic Water Pumps	11-10
22 13 00	Facility Sanitary and Vent Piping	12-09
22 13 23	Sanitary Waste Interceptors	12-09
22 13 33	Packaged, Submersible Sewerage Pump Units	11-10
22 14 00	Facility Storm Drainage	12-09
22 14 29	Sump Pumps	01-11
22 15 00	General Service Compressed-Air Systems	12-09
22 33 00	Electric Domestic Water Heaters	02-10
22 40 00	Plumbing Fixtures	03-11
22 67 19.16	Pure Water Equipment	02-11

**Combined Heat and Power (CHP) Plant**  
**West Haven Veteran's Affairs Medical Center**  
**West Haven, Connecticut**  
**VA Contract No. VA701-P-0163**  
**Task Order VA701-13-J-0093**  
**CannonDesign Project No. 004243.00**

	<b>DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)</b>	
23 05 10	Common Work Results for Boiler Plant and Steam Generation	11-10
23 05 11	Common Work Results for HVAC	11-10
23 05 12	General Motor Requirements for HVAC and Steam Generation Equipment	11-10
23 05 51	Noise and Vibration Control for Boiler Plant	11-10
23 05 93	Testing, Adjusting, and Balancing for HVAC	05-11
23 07 11	HVAC and Boiler Plant Insulation	05-11
23 08 00	Commissioning of HVAC	06-13
23 08 11	Demonstrations and Tests for Boiler Plant	11-10
23 09 11	Instrumentation and Control for Boiler Plant	11-10
23 09 23	Direct-Digital Control System for HVAC	09-11
23 11 23	Facility Natural-Gas Piping	05-11
23 21 11	Boiler Plant Piping Systems	09-11
23 21 13	Hydronic Piping	09-12
23 21 23	Hydronic Pumps	02-10
23 22 13	Steam and Condensate Heating Piping	03-10
23 25 00	HVAC Water Treatment	02-10
23 31 00	HVAC Ducts and Casings	03-13
23 34 00	HVAC Fans	11-09
23 37 00	Air Outlets and Inlets	11-09
23 40 00	HVAC Air Cleaning Devices	
23 50 11	Boiler Plant Mechanical Equipment	05-11
23 51 00	Breechings, Chimneys, and Stacks	05-11
23 64 00	Packaged Water Chillers	04-11
23 65 00	Cooling Towers	02-10
23 81 23	Computer Room Air Conditioners	
23 82 39	Unit Heaters	
	<b>DIVISION 25 - INTEGRATED AUTOMATION - NOT USED</b>	
	<b>DIVISION 26 - ELECTRICAL</b>	
26 05 11	Requirements for Electrical Installations	12-12
26 05 13	Medium-Voltage Cables	12-12
26 05 19	Low-Voltage Electrical Power Conductors and Cables	07-13
26 05 26	Grounding and Bonding for Electrical Systems	12-12
26 05 33	Raceway and Boxes for Electrical Systems	09-10
26 05 36	Ladder Type Cable Trays	
26 05 41	Underground Electrical Construction	12-12
26 05 73	Overcurrent Protective Device Coordination Study	12-12
26 08 00	Commissioning of Electrical Systems	06-13
26 09 23	Lighting Controls	09-10
26 11 16	Secondary Unit Substations	12-12
26 12 19	Pad-Mounted, Primary Unit Substation, Liquid Filled, Medium-Voltage Transformers	
26 13 13	Medium-Voltage Circuit Breaker Switchgear	12-12
26 13 14	Medium Voltage Underground Distribution Switchgear	

**Combined Heat and Power (CHP) Plant**  
**West Haven Veteran's Affairs Medical Center**  
**West Haven, Connecticut**  
**VA Contract No. VA701-P-0163**  
**Task Order VA701-13-J-0093**  
**CannonDesign Project No. 004243.00**

26 13 16	Medium-Voltage Fusible Interrupter Switches	12-12
26 22 00	Low-Voltage Transformers	12-12
26 23 00	Low-Voltage Switchgear	12-12
26 24 13	Distribution Switchboards	12-12
26 24 16	Panelboards	12-12
26 27 26	Wiring Devices	12-12
26 29 11	Motor Controllers	12-12
26 29 21	Enclosed Switches and Circuit Breakers	12-12
26 36 23	Automatic Transfer Switches	12-12
26 41 00	Facility Lightning Protection	12-12
26 43 13	Surge Protector Device	12-12
26 51 00	Interior Lighting	12-12
26 56 00	Exterior Lighting	09-10
	<b>DIVISION 27 - COMMUNICATIONS</b>	
27 05 11	Requirements for Communications Installations	
27 05 26	Grounding and Bonding for Communications Systems	10-06
27 05 33	Raceways and Boxes for Communications Systems	12-05
27 08 00	Commissioning of Communications Systems	06-13
27 10 00	Structured Cabling	12-05
27 11 00	Communications Equipment Room Fittings	
27 15 00	Communications Horizontal Cabling	06-13
27 51 16	Public Address and Mass Notification System	
	<b>DIVISION 28 - ELECTRONIC SAFETY AND SECURITY</b>	
28 05 00	Common Work Results For Electronic Safety and Security	
28 05 13	Conductors and Cables for Electronic Safety and Security	09-11
28 05 26	Grounding and Bonding for Electronic Safety and Security	09-11
28 05 28.33	Conduits and Backboxes for Electronic Safety and Security	09-11
28 08 00	Commissioning of Electronic Safety and Security Systems	06-13
28 13 00	Physical Access Control Systems	10-11
28 23 00	Video Surveillance	
28 31 00	Fire Detection and Alarm	10-11
	<b>VOLUME 3</b>	
	<b>DIVISION 31 - EARTHWORK</b>	
31 00 00	Earthwork	
31 00 01	Rock Excavation	
31 09 01	Monitoring of Structures and Utilities	
31 23 19	Dewatering	10-12
31 50 00	Excavation Support and Protection	
	<b>DIVISION 32 - EXTERIOR IMPROVEMENTS</b>	

Combined Heat and Power (CHP) Plant  
 West Haven Veteran's Affairs Medical Center  
 West Haven, Connecticut  
 VA Contract No. VA701-P-0163  
 Task Order VA701-13-J-0093  
 CannonDesign Project No. 004243.00

32 05 23	Cement and Concrete for Exterior Improvements	05-13
32 12 16	Asphalt Paving	10-09
32 17 23	Pavement Markings	04-10
32 31 53	Perimeter Security Fences and Gates	
	<b>DIVISION 33 - UTILITIES</b>	
33 08 00	Commissioning of Site Utility Systems	06-13
33 10 00	Water Utilities	06-13
33 30 00	Sanitary Sewer Utilities	
33 40 00	Storm Sewer Utilities	10-11
	<b>DIVISION 34 - TRANSPORTATION - NOT USED</b>	
	<b>DIVISION 48 - Electrical Power Generation</b>	
48 20 10	Natural Gas-Fueled Combined Heat & Power Facility General Requirements	



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

SECTION 31 00 00

EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

A. General Requirements

1. Work governed by this section, as shown or specified shall be in accordance with the requirements of the Contract Documents and the 2003 International Building Code (including the 2005 Connecticut Supplement and the 2009 Connecticut Amendment).
2. Work of this Section, as shown or specified, shall be in accordance with the other relevant/applicable project Drawings and Specifications.

B. Work included: Provide all labor, materials, equipment and services and perform all operations required of this Section, included but not limited to the following:

1. All survey layout for excavation, demolition, soil tracking, and permanent structures.
2. Removal of existing pavements, curbs, pads, hardscapes, tanks, utilities, foundation structures, slabs, below-grade walls and other structures encountered which require removal for successful completion of the Work.
3. General excavation to levels established within the Contract Drawings and as described herein.
4. Local excavation of soil, weathered rock and rock for the shallow foundation elements, slabs, walls, utilities and other applicable structures indicated on the Contract Drawings and as directed by the Geotechnical Engineer of Record.
5. Excavation, fill placement, grading and compaction to required elevations for site improvements and general site work as shown on the Contract Drawings.
6. Excavation and trenching for temporary works as shown or as required; backfilling same with approved fill; compaction, and rough grading.
7. Installation of detectable warning tape in utility trenches.
8. Proofrolling, filling and grading to required lines, dimensions, contours and elevations for proposed improvements.

EARTHWORK

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

9. Removal of unsuitable subgrade soils and/or over-excavation (as required by project Drawings), disposal in accordance with the soil management plan, replacement with approved fills and compaction as dictated by site conditions or as directed by the Geotechnical Engineer of Record.
10. Scarifying, compaction, moisture content control and removal of unsuitable material to ensure proper preparation of areas for fills or proposed improvements.
11. Improvement of subgrade conditions via soil removal, compaction, installation of geotextiles, or placement of approved fill as directed by the Geotechnical Engineer of Record.
12. Providing additional approved suitable material for filling and rough grading.
13. Legal off-site disposal of surplus excavated materials, unsuitable for use as fill or backfill as described in the project Drawings and Specifications.
14. Subgrade preparation for footings, foundations, floor slabs, pavement and other applicable hardscapes.
15. Protection of adjacent structures, utilities and pavements.
16. Temporary groundwater control as required for execution of the Work of this Section and for all other related foundation Work.
17. The Contractor shall provide the Owner's third-party testing agency with reasonable office space (with heating, cooling, electricity) on-site to conveniently prepare and maintain all necessary project records pertinent to their duties and store necessary equipment. Adequate spaced to store inspection equipment shall be provided.
18. All other labor, equipment, and materials as may be reasonably inferred to be required to make the work under this Section complete.

C. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section.

## 1.2 STANDARDS AND REFERENCES

A. American Society for Testing and Materials (ASTM) standards, latest edition.

1. ASTM C 33 Standard Specifications for Concrete Aggregates.
2. ASTM D 422 Standard Test Method for Particle Size Analysis of Soils (sieve only)

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

3. ASTM D 1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
  4. ASTM D 2216 Test Method for Laboratory Determination of Water (Moisture) Content of Rock and Soil
  5. ASTM D 2487 Test Method for Classification of Soils for Engineering Purposes
  6. ASTM D 2922 Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
  7. ASTM D 3017 Test for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth)
  8. ASTM D 4318 Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- B. ACI-318 latest edition - Building Code Requirements for Structural Concrete, latest edition
- C. ACI-299R - Controlled Low Strength Materials, latest edition
- D. Site Information:
1. Geotechnical Investigation & Recommendations letter report prepared by Langan CT, Inc., dated 17 February 2014.
- E. Regulatory Requirements and Reference Standards
1. The Contractor shall comply with all the laws, ordinances, codes, rules and regulations of the Federal, State and Local authorities having jurisdiction over any of the work specified herein.
  2. Any transporter of contaminated/hazardous materials shall be licensed in the state in which handling and transportation shall take place in accordance with all applicable regulations.
  3. Comply with OSHA (Occupational Safety and Health Administration) Standards and Regulations contained in Title 29 CFR Part 1910.120 "Hazardous Waste Operations and Emergency Response."
  4. Where reference is made to one of the above standards the revision in effect at the time of the bid opening shall apply.
- F. All work shall comply with requirements of the 2003 International Building Code (including the 2005 Connecticut Supplement and the 2009 Connecticut Amendment), requirements of the Connecticut Department of Labor, requirements of Occupational Safety and Health Administration (OSHA), requirements of Connecticut Department of Public Health, requirements of the Connecticut Department of Energy & Environmental Protection (DEEP), requirements of the Connecticut Department of Transportation (CTDOT) and with applicable requirements of all other

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

authorities having jurisdiction.

1. In case of conflict between regulations and specifications, the Contractor shall comply with the most stringent applicable codes, regulations or specifications.

G. Applicable Department of Veteran Affairs standards and references.

### 1.3 SUBMITTALS

A. The Contractor shall furnish all required submittals, including but not limited to samples, calculations, test results, certification reports and shop drawings, at least 2 weeks prior to the start of work, unless specified otherwise.

B. Test Reports: Submit the following information for each source of each material submitted for review and approval of the Geotechnical Engineer of Record:

1. Test reports for all proposed fill materials (either from borrow sources or on-site) as follows:

- a. Particle size analysis in accordance with ASTM D 422 (sieve only)
- b. Atterberg Limits in accordance with ASTM D 4318
- c. Soil classification in accordance with ASTM D 2487
- d. Moisture content in accordance with ASTM D 2216
- e. Modified Compaction Curve in accordance with ASTM D 1557

2. Submit the results of each test for every 50,000 cubic yards of each proposed borrow source.

3. Include data for all samples indicating the exact location and methods of transportation and placement of all materials.

C. Samples:

1. Submit a 50-lb (minimum) sample of each material proposed for use as fill, including, but not limited to general fill, drainage fill, structural fill, pavement subbase course, etc.

D. Submit the name of approved material supplier and specific type and source of each material. Any change in source or soil type throughout the job requires approval of the Owner and the Geotechnical Engineer of Record.

E. Shop Drawings: Submit detailed shop drawings and calculations to be reviewed by the Geotechnical Engineer of Record. The drawings and calculations shall be prepared by a Professional Engineer registered in the State of Connecticut. The submittals shall include but not limited

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

to following:

1. Earth excavation procedures
  2. Temporary excavation support and underpinning where required by field conditions.
  3. Backfilling and compacting material, equipment and procedures.
- F. Catalog Cuts: Submit catalog cuts and manufacturer's literature for compaction equipment, and all geotextile and drainage materials.
- G. All required certifications and permits pertaining to the work of this Section.
- H. Certification for Examination of Site and Records: Before proceeding with the Work, submit certification in an acceptable form, signed by the Contractor, stating that careful examination has been made of the site, existing structures, existing adjacent structures, records of utility lines, test boring records, soil samples, subsurface exploration reports, the Contract Drawings and all other Contract Documents.

#### 1.4 DEFINITIONS

- A. Wherever the word "excavating", "excavate", "excavation", "carried down", "remove", etc., are used, they shall be taken to include the removal of all existing work, including rubble, former foundation remnants, rubbish, earth, as well as rock, boulders, concrete and all other materials and obstructions encountered; they shall also be taken to include all temporary excavation support, bracing, groundwater control, and all other operations and items needed for the proper execution of the Work. Excavation is considered unclassified.
- B. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Owner or Geotechnical Engineer of Record. Unauthorized excavation shall be without additional compensation.
- C. Where the words "finished grades", "finished grade lines", or "future finished grades", appear in these specifications, they shall be taken to mean the finished elevations as indicated on the Contract Drawings.
- D. Rough grading consists of cutting or filling to the elevation herein established with a permissible tolerance of plus or minus 1 inch.

#### 1.5 PROTECTION

- A. The work shall be executed so that no damage or injury will occur to the existing public and adjoining or adjacent structures, streets, paving, sewers, gas, water, electric or any other pipes. Should any damage or injury caused by the Contractor, or anyone in Contractor's employ, or by the work under this Contract occur, the Contractor shall

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

repair such damage at no cost to the Owner and shall assume all responsibility for such injury.

- B. The above shall include the protection of all existing utilities (including sewers, water lines, electrical lines, telecommunication lines, etc.) to remain in use within and adjacent to the area affected by the work of this project.
- C. Protect benchmarks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed/relocated it shall be referenced by a licensed land surveyor and replaced, as necessary, by the same at no additional cost to the owner.
- D. Excavation sides and adjacent structures and foundations shall be protected by means of adequate bracing, shoring and anchoring at all times. Excavation shall not proceed until adequate support for excavation sides is provided. Contractor is solely responsible for the stability, safety and protection of excavation sides. Excavations shall conform to the requirements of OSHA.
- E. Provide barricades and warning lights, barriers, to prevent accidents, to avoid all necessary hazards and protect the public, the work and property at all times, including Saturdays, Sundays and Holidays.
- F. Erosion and sediment control and dust control shall be in accordance with the project Drawings and Specifications.
- G. The Contractor shall maintain the cleanliness of paved streets immediately adjacent to the site through regular sweeping and moistening as required to remove any excess mud, dirt, or rocks tracked from the site. Dump trucks hauling material from the site will be covered with a tarpaulin.

#### 1.6 ERRORS IN DEPTH

- A. In the event that any part of the excavation be carried, through error, beyond the depth and the dimensions indicated on the drawings, called for in the specifications, or directed by the Geotechnical Engineer of Record, then the Contractor, at own expense, shall furnish and install approved backfill materials with which to fill to the required level without additional cost to the Owner.

#### 1.7 QUALITY ASSURANCE

- A. Contractor Qualifications: The Contractor performing the work of this Section shall be a qualified excavation contractor with at least 10 years of relevant field experience on projects of similar size, scope and complexity. All work shall comply with the project Drawings and Specifications.

- B. Codes and Permits:

1. Comply with the 2003 International Building Code (including the 2005

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

Connecticut Supplement and the 2009 Connecticut Amendment), and any other Federal, State or local codes having jurisdiction.

2. All labor, materials, equipment, and services necessary to make the work comply with such requirements shall be provided without additional cost to the Owner.
3. The Contractor shall procure and pay for all permits and licenses required for the completion of the work of this Section.

C. Third-Party Observation and Testing:

1. The Owner shall engage a third-party testing agency to observe and provide all necessary material testing related to the work of this Section.
2. The Owner's third-party testing agency shall prepare and submit daily reports summarizing the construction and/or material testing activities.
3. The Owner's third-party testing agency shall submit all logs and test reports necessary to facilitate any corrective design requirements by the Engineer of Record.
4. The Owner's third-party testing agency shall provide all necessary certifications of the work in compliance with Building Code requirements.
5. Third-party testing related to earthwork may include but not be limited to the following:
  - a. Observe and test the in-place backfill for compaction. In-place density tests shall be performed in accordance with ASTM D2922, or as approved by the Geotechnical Engineer of Record for specific fill materials.
6. Foundation, slab and other structural subgrades should be observed by the Geotechnical Engineer of Record.

- D. The Geotechnical Engineer of Record will review the Contractor's submittals related to temporary and permanent support of excavations, excavation procedures, dewatering and materials.
- E. The Contractor is responsible to perform all work in accordance with the project Drawings and Specifications and all applicable Federal, State, and City codes and standards. The Geotechnical Engineer of Record will not be responsible for giving notice of deviations from specifications whenever such deviations occur. The Contractor shall cooperate with the Geotechnical Engineer of Record and the Owner's third-party testing agency in performing all work.
- F. Preconstruction Conference: Before commencing work of this section,

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

meet with representatives of the governing authorities, Construction Manager, Owner, Architect, Structural Engineer, Environmental Engineer, Geotechnical Engineer and other concerned entities. Review the earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

1.8 PROJECT CONDITIONS

- A. Refer to the Geotechnical Investigation & Recommendations letter report prepared by Langan CT, Inc., dated 17 February 2014, and associated boring and test data for information pertaining to the general subsurface conditions within the project site.

1. Subsurface Conditions - The subsurface conditions at the project site are generally characterized by existing granular fill soils overlying weathered rock and bedrock. Till soils were observed overlying the weathered rock within portions of the site.

- B. Boring and other in situ test logs are made available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between borings. The Owner will not be responsible for interpretation conclusions drawn from this data by the Contractor.

1. The Contractor, by careful examination, shall inform himself as to the nature and location of the work; the conformation of the ground, the nature of the subsurface conditions; the locations of the groundwater table; the character, quality and quantity of the materials to be encountered; the character of the equipment and facilities needed preliminary to and during the execution of the work; and all other matters which can be in any way effect the work.

2. The Contractor shall be held to have visited the site and to have familiarized himself with the existing conditions of adjoining properties, utilities and buildings.

3. The Contractor shall investigate the conditions of public thoroughfares and roads as to availability, clearances, loads, limits, restrictions and other limitations affecting transportation to, ingress and egress of the site of the work. The Contractor shall conform to all Local, State and Federal regulations in regard to the transportation of materials to and from and at the job site and shall secure in advance such permits as may be required.

PART 2 PRODUCTS

2.1 SOIL MATERIALS:

- A. Before bringing any fill to the site, the Contractor shall submit the source for approval by the Geotechnical Engineer of Record. All imported fill must be preapproved by the Environmental Engineer prior



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

to importing to the site.

- B. Structural/General Fill: Well-graded mix of sand and gravel containing not more than 15 percent by weight of materials finer than No. 200 mesh sieve. Suitable soils should be free of organics and other deleterious materials, and have maximum particle size of 3 inches. In addition, any imported fill should be free of all hazardous substances.
- C. Drainage Fill: Clean, crushed and durable ¾-inch gravel (ASTM C-33 or approved equivalent).
- D. All fill materials shall be free from wood, debris, combustible materials, vegetable matter or any material subject to decay or disintegration.
- E. The use of recycled concrete aggregate as structural or general fill shall be permitted provided it meets the gradation requirements above.

2.2 DETECTABLE WARNING TAPE

1. Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 0.1 mm (4 mils) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

- a. Red: Electric.
- b. Yellow: Gas, oil, steam, and dangerous materials.
- c. Orange: Telephone and other communications.
- d. Blue: Water systems.
- e. Green: Sewer systems.

2.3 CONCRETE MATERIALS:

- A. Lean Concrete shall conform to ACI 301 and as specified in the project Specifications and Drawings.
- B. Controlled low strength material (CLSM) shall conform to ACI 299R.

2.4 EQUIPMENT

- A. Transport off-site materials to project using well-maintained and operating vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at no time endanger improvements by rutting, overloading, or pumping.
- B. Compactor: compactor shall be a vibratory roller having a minimum

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

static drum weight of at least 5 tons.

- C. Trench Compactor: A vibratory plate or a double drum walk-behind roller having a static weight not less than 1.5 tons for areas where access or maneuverability is limited.
- D. Pumps: Provide adequate pumps to maintain the work area dry at all times and the groundwater level below the excavation bases.
- E. Shoring: Provide adequate shoring elements to maintain the work area safe at all times.

PART 3 EXECUTION

3.1 GENERAL SITE PREPARATION

- A. Prior to performing any work on site, Contractor shall notify the Connecticut One Call Center, Call Before You Dig (CBYD - call 1-800-922-4455).
- B. The Contractor shall furnish all labor, equipment and materials required to prepare site and to excavate all materials of whatever type encountered to the lines and grades shown on the Contract Drawings and as specified.
- C. The Contractor shall give 48 hours advance notice to the Geotechnical Engineer of Record of the impending completion of excavations so as to allow the Geotechnical Engineer of Record to inspect the condition of the exposed surface for footings, slabs and pads and review the ground water conditions in accordance with the project requirements.
- D. The Contractor is to obtain and pay for all necessary permits to perform the work from the appropriate authorities and agencies prior to start of such work. Obey all applicable local and federal work safety rules and regulations.
- E. Install all necessary protection equipment, structures such as fences, signs, scaffolding etc. prior to start of work.
- F. Remove all existing structures, utilities, pavement in accordance with the Contract Documents.
- G. Protect all utility lines which are not to be abandoned. The Contractor shall be responsible for any damage to utilities resulting from the Contractor's actions.
- H. Stockpile on-site materials anticipated for re-use. Care shall be taken to avoid blending with the deleterious materials. Stockpiling shall comply with the project Drawings and Specifications.
- I. Provide all necessary erosion and sediment control requirements as outlined in the project Drawings and Specifications.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

### 3.2 GROUNDWATER AND SURFACE WATER CONTROL

- A. Groundwater control shall be in accordance with the project Drawings and Specifications.
- B. The Contractor shall be responsible for maintaining groundwater levels at least 2 feet below the levels of any excavation.
- C. Groundwater pumping shall be in accordance with the project Drawings and Specifications.
- D. Where required, the Contractor shall be responsible for obtaining all necessary discharge permits.
- E. All pumping and dewatering shall be performed in such a manner as to avoid the movement of fines or loss of ground from below the bearing level and shall not influence the stability of surrounding areas.
- F. The Contractor shall be responsible for controlling surface water on-site. Excavations shall be protected from deleterious effects of surface water accumulation. The Contractor shall grade accordingly to minimize run-off from entering and accumulating excavations.

### 3.3 EXCAVATION

- A. The excavation shall be unclassified and shall comprise and include the satisfactory removal and legal disposal of all materials encountered regardless of the nature of the materials and shall be understood to include, boulders, soil, weathered rock, rock, miscellaneous fill, foundations, structures, slabs, walls, utilities, pavements, curbs, pads, hardscapes and debris.
- B. All excavation shall extend to the depths of the form and size required for the installation of the work as indicated on the Contract Drawings. When excavations for foundations have reached the required depths, the Geotechnical Engineer of Record shall observe the condition of the subgrade and provide recommendations (as necessary) for remedial measures.
- C. Excavation shall be made to a depth that will allow installation of full depth of concrete slabs, sub-base, over-excavation (as required) and waterproofing as shown on drawings and 1 inch tolerance. Excavation lines shall provide sufficient clearance for the proper execution of all concrete work including allowances for form work, shoring and inspection.
- D. Materials that, in the opinion of the Owner's third-party testing agency and/or the Geotechnical Engineer of Record are not suitable for reuse as fill, any surplus earth and all rock shall be removed from the site and legally disposed of.
- E. The bottom of excavations shall be leveled off, free of standing water, frozen materials, loose materials and debris and graded to receive

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

foundations, slabs, trenches, etc.

- F. Where required, waterproofing shall be installed in accordance with the project Drawings and Specifications.
- G. Subgrades of foundations and slabs shall be level and free of loose soil, standing water and frost prior to acceptance for placing concrete. Excavate to achieve final subgrade elevation as directed by the Owner's third-party testing agency and/or the Geotechnical Engineer of Record.
- H. Excavated materials shall be handled in accordance with the project Drawings and Specifications.

3.4 SUBGRADE PREPARATION

- A. Proofrolling shall be performed for all subgrade within and outside the limits of the proposed building including all adjacent site work and pavements.
- B. Proofrolling of subgrades shall conform to the following requirements:
  - 1. All subgrades shall be proofrolled in the presence of the Geotechnical Engineer of Record and/or the Owner's third-party testing agency (as appropriate).
  - 2. Proofrolling shall be accomplished with a minimum of six overlapping cross-rolled coverages of a smooth drum roller having a static drum weight of at least 5 tons. A vibratory trench roller having a static drum weight of at least 1.5 tons shall be in confined areas as approved by the Geotechnical Engineer of Record and/or the Owner's third-party testing agency. Areas inaccessible to the heavy equipment shall be compacted using a vibratory plate or jumping jack compactor as directed by the Geotechnical Engineer of Record. The maximum travel speed of rollers should not exceed 1.5 mph.
  - 3. Vibratory or impact compaction shall not be performed on soils which are not within 2 percent of the optimum moisture content as determined by ASTM D1557. Disking, harrowing or other methods of drying the soils should be performed as necessary to facilitate drying and subsequent proofrolling.
  - 4. Fill shall not be placed until the subgrade is approved by the Owner's third-party testing agency.
  - 5. Soft Areas during Compaction: Areas deemed unsatisfactory due to "pumping, rutting or heaving" shall be undercut within the limits and extent ordered by the third-party testing agency and/or the Geotechnical Engineer of Record. These areas shall be replaced with an approved fill and compacted to the requirements of this Section or as directed by the Geotechnical Engineer of Record.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

3.5 FILL PLACEMENT, GRADING, AND COMPACTION

- A. Filling and backfilling shall not be performed until related work has been observed by the Geotechnical Engineer of Record and/or the Owner's third-party testing agency (as appropriate).
- B. All subgrades shall be free of standing water, frozen soils, wood, organics or other deleterious materials prior to placement of any fill.
- C. Fill shall be placed such that there are no void spaces below floors, bottoms of pits, trenches, pipe haunches, pavements, etc.
- D. Fill shall not be placed against concrete elements until the concrete has obtained its specified compressive strength, unless otherwise directed by the project team. Where fill is required on both sides of a wall, said fill shall be brought up simultaneously and evenly on both sides.
- E. Fill voids caused by the removal of boulders, and/or below grade improvements, with lean concrete, CLSM or structural fill.
- F. The Contractor to supply and install all fill materials necessary to bring the ground surfaces to the required levels as shown on the Contract Drawings and as necessary to make the work complete.
- G. Fill Placement:
  - 1. Begin placement of fill and backfill at the lowest section of the area. Spread material evenly by mechanical equipment or by manual means above the approved compacted subgrade in loose lifts not exceeding 12-inches for material compacted by heavy machinery and 8-inches for material compacted by smaller compaction equipment.
  - 2. Build layers as horizontally as practical to prevent thickness of lift from exceeding that specified but provide with sufficient longitudinal and transverse slope to provide for runoff of surface water from every point.
- H. Moisture Control: The moisture-density curve for the fill used shall be supplied by the Contractor as a guide in controlling moisture to achieve the required degree of compaction. If, in the opinion of the Owner's third-party testing agency, fill material becomes too wet for the required compaction, the fill shall be dried by a method approved by the Geotechnical Engineer of Record prior to commencing or continuing compaction operations. Likewise, if, in the opinion of the Owner's third-party testing agency, the fill material becomes too dry for the required compaction, the fill shall be moistened by a method approved by the Geotechnical Engineer of Record prior to commencing or continuing compaction operations.
- I. Compaction:

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

1. Footings, slabs-on-grade, pavement, and utilities:
    - a. Compact each lift to at least 95 percent of the soil's maximum dry laboratory density as determined by ASTM D1557.
  2. Landscaped areas away from retaining walls and engineered slopes:
    - a. Compact each lift to at least 90 percent of the soil's maximum dry laboratory density as determined by ASTM D1557.
  3. The degree of compaction shall be checked by the Owner's third-party testing agency and each successive lift shall not be placed or compacted until the previous lift is observed, tested and approved by the Owner's third-party testing agency. Compact all fill to elevations and limits shown on Contract Drawings.
- J. Install detectable warning tape in utility trenches at the locations and depth indicated on the Contract Drawings and Specifications.
- K. Frost: Do not place fill materials when either the fill materials or the previous lift (or subgrade) on which it is placed is frozen. In the event that any fill which has already been placed on the surface shall become frozen, it shall be scarified and recompact, or removed, to the approval of the Owner's third-party testing agency before the next lift is placed. Remove or recompact any soft spots resulting from frost to the satisfaction of the Engineer before new fill is placed.
- 3.6 MAINTENANCE
- A. Finished subgrades shall be verified to ensure proper elevation and conditions for construction above subgrade.
  - B. Protect subgrade from excessive wheel loading during construction, including concrete trucks and dump trucks.
  - C. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
  - D. Repair and re-establish grades in settled, eroded and rutted areas to specified tolerances.
  - E. During rainy weather, the Contractor shall take measures to protect fill from becoming saturated. Any water collecting in fill areas shall be removed before further fill placement.
  - F. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.
  - G. Where settling is measurable or observable at excavated areas during general project warrantee period, remove surface (pavement, or other finish), add backfill material, compact, and replace surface treatment.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

Restore appearance, quality and condition of surface or finish to match adjacent work and eliminate evidence of restoration to greatest extent possible.

3.7 FIELD QUALITY CONTROL

- A. The Owner will employ, at his own expense, an Engineer to review all laboratory test results and submitted reports specified in this Section.
- B. The Geotechnical Engineer of Record will interpret the tests, state in each report whether or not the test specimens and results comply with all requirements of the Contract Documents and note any deviations.
- C. The Geotechnical Engineer of Record will identify when and where samples are to be obtained for the use of on-site materials. The Contractor shall collect samples, provide all necessary laboratory testing, and shall submit the following laboratory test reports to the Geotechnical Engineer of Record for review:
  - 1. Gradation Analysis - ASTM D 422
  - 2. Atterberg limits - ASTM D 4318
  - 3. Modified Moisture-density curve determination - ASTM D1557
- D. The Geotechnical Engineer of Record will determine the conformance of materials to be used for fills.
- E. Backfilling and Compaction: Backfilling and compaction below foundations, pavements, building slabs, behind foundation walls and any other backfilling and compaction work shall be inspected by the Owner's third-party testing agency. No fill shall be placed unless the previous lift is approved by the Owner's third-party testing agency.
- F. The Contractor shall cooperate with the Owner's third-party testing agency in the performance of the required tests and inspections.

3.8 CLEAN-UP

- A. All excess material including, earth, rock, fill, shall be removed from site and legally disposed of. Material handling and disposal shall be in accordance with the project Drawings and Specifications.
- B. All lumber, forms and metal work shall be removed immediately after completion of local areas. The Contractor shall be responsible for removal of all debris produced by work to this section from the site.
- C. Sidewalk and streets adjoining the property shall be broom cleaned and free of debris, rubbish, trash and obstructions of any kind caused by the work of this Section.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

3.9 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.
2. Corrective Work:
  - a. Remove, Repair and Reinstall, or Restore in Place damaged items.
  - b. Replace damaged materials or items with New if repair not acceptable to Architect.
3. Provide product data to complete Operation & Maintenance Manuals.
4. Submit executed Warranties.

3.10 WASTE MANAGEMENT

- A. Separate and dispose of waste in accordance with the project Drawings and Specifications.

END OF SECTION



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

SECTION 31 00 01

ROCK EXCAVATION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this section, as shown or specified, shall be in accordance with the requirements of the contract documents.

1.2 SCOPE OF WORK

- A. General Rock Excavation & Blasting - The encountering and removal of rock as defined in this section will be paid as part of the project excavation unless stated elsewhere in the contract documents.

1. Rock Required Removal Lines:

- a. Two feet outside of concrete work for which forms are required, except footings.
  - b. One foot outside perimeter of footings where forms are required. Additional depth may be required due to local codes or based on the geotechnical engineering study.
  - c. Neat outside dimensions of concrete work where no forms are required.
  - d. Under slabs on grade, 6 inches below subgrade.
- B. The contractor shall furnish all labor, equipment, materials and incidentals necessary to excavate and dispose of rock encountered as part of the excavation work as shown on the Drawings and as specified herein. Perform operations such that damage to adjacent utilities, structures, property and work is prevented and such that resulting ground vibrations are maintained below the maximum levels specified.
  - C. Protect existing structures, adjacent property, workers, all abutters and the general public from damage or injury from improper handling of explosives, fly rock, excessive ground vibrations and rock movements.
  - D. Furnish, install and put into operation an audible working system to indicate impending blasting. Familiarize workers, all abutters and the general public with the system implemented.
  - E. Perform vibration monitoring during all rock excavation operations using the vibration monitoring procedures and equipment specified herein.
  - F. Perform pre-construction documentation of adjacent structures.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

1.3 RELATED SECTIONS AND DOCUMENTS

- A. Geotechnical Investigation & Recommendations letter report prepared by Langan CT, Inc., dated 17 February 2014.
- B. Earthwork Section 310000.

1.4 REFERENCE STANDARDS

- A. National Fire Protection Association (NFPA) latest edition 495 Code for Explosive Materials.
- B. United States Department of Interior, Bureau of Mines, Seismic Effects of Blasting.
- C. State of Connecticut, Department of Public Safety Regulations Section 29-349 et. Seq. - Storage, Transportation and Use of Explosives and Blasting Agents.

1.5 SITE CONDITIONS

- A. Refer to the Geotechnical Investigation & Recommendations letter report prepared by Langan CT, Inc., dated 17 February 2014, and associated boring and test data for information pertaining to the general subsurface conditions within the project site.
  - 1. Subsurface Conditions - The subsurface conditions at the project site are generally characterized by existing granular fill soils overlying weathered rock and bedrock. Till soils were observed overlying the weathered rock within portions of the site.
- B. Boring and other in situ test logs are made available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between borings. The Owner will not be responsible for interpretation conclusions drawn from this data by the Contractor.
  - 1. The Contractor, by careful examination, shall inform himself as to the nature and location of the work, the conformation of the ground, the nature of the subsurface conditions, the locations of the groundwater table, the character, quality and quantity of the materials to be encountered, the character of the equipment and facilities needed preliminary to and during the execution of the work, and all other matters which can be in any way affect the work.
  - 2. The Contractor shall be held to have visited the site and to have familiarized himself with the existing conditions of adjoining properties, utilities and buildings.
  - 3. The Contractor shall investigate the conditions of public thoroughfares and roads as to availability, clearances, loads, limits, restrictions and other limitations affecting transportation to, ingress and egress of the site of the work. The Contractor shall

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

conform to all Local, State and Federal regulations in regard to the transportation of materials to and from and at the job site and shall secure in advance such permits as may be required.

4. The Contractor shall be familiar with applicable federal, state and local requirements for performing this work, including all specific requirements, as they relate to storage, transportation, use of explosives and blasting agents and permitted work hours.

C. Protection

1. Active utilities and structures exist on-site. Prior to commencement of any work, the Contractor shall consult the appropriate records for existing structures and utilities, and note all conditions and limitations which might affect the work required under this section. The locations of any utilities and structures shall be verified in the field by the Contractor prior to performing any earthwork. The Contractor shall be responsible for protecting all active utilities from disturbance and/or damage, including those located off site.
2. Existing structures are located immediately adjacent to the subject site. The Contractor shall be responsible for protecting all existing nearby structures from disturbance and/or damage.

1.6 DEFINITIONS

- A. "Rock" is defined as schist or similar bedrock. Further classification of rock is determined by the equipment method required to excavate and remove such rock. "Type 1 Rock" is rock which can be broken or removed by typical earth excavation equipment such as a large tracked excavator fitted with rock ripping teeth. "Type 1 Rock" can also be classified as "Weathered Rock." "Type 2 Rock" is rock which cannot be broken or removed using the aforementioned "Type 1" typical earth excavation equipment, but can be broken using chipping/splitting or dynamic chiseling equipment. "Type 3 Rock" is rock which cannot be broken/removed using the aforementioned "Type 1" and "Type 2" equipment, but requires blasting to break the rock for excavation and removal. Except as encountered in utility trenches, rock shall either be Type 1 or Type 3. Use of particular rock removal equipment/methods by the Contractor for reasons of economy shall not alter the rock type classifications.
- B. "Rock" is also defined as boulders over two (2) cubic yards in volume in open areas and one (1) cubic yard in volume in trenches.
- C. A "trench" shall mean an excavation having vertical sides with a depth exceeding its width.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

1.7 SUBMITTALS FOR REVIEW

- A. Submit pre-excavation conditions documentation report to the Owner and Engineer for review prior to the start of rock excavation.
- B. Submit to the Owner and Site Engineer in-progress top-of-rock surveys when requested by the Owner and Site Engineer to determine the rock excavation quantities for "Type 1 Rock", "Type 2 Rock" and "Type 3 Rock" as defined herein. The location of surveyed points along the top-of-rock surfaces used to generate the aforementioned surveys shall be as agreed upon by the Site Engineer and the Contractor at the site at the time of the surveys.
- C. Contractor shall provide a description of his means and methods for non-explosive rock excavation techniques including size and energy of any impact equipment and chemical properties of any chemical agents to be used for chemical splitting.
- D. When controlled blasting operations are to be performed, submit a blasting plan prepared by a professional engineer registered in the State of Connecticut with the following information:
  1. Drilling patterns.
  2. Number, location, inclination, diameter, and depth of drilled holes.
  3. Amount, type, and distribution of explosives per hole.
  4. Sketches to show blast locations at the site and relative to the existing structures.
  5. Powder factor; time delays, weight of explosives in each delay.
  6. Sequence of firing.
  7. Time of blast.
  8. Total pounds of explosive.
  9. Methods of transportation, storage and handling of explosives.
  10. Manufacturer's data sheets for all explosives, primers and initiators to be employed.
  11. Type of drilling equipment to be used and when last serviced.
  12. Scaling and stabilization procedures and methods to remove or stabilize all rock on the cut face which is loose, hanging, or which creates a potentially dangerous situation. Drilling of the next lift shall not be allowed until rock scaling and stabilization has been completed.

**Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00**

13. Any other pertinent data indicating Contractor's intent and purpose to produce smooth and sound surfaces of excavation.
  14. Plan for the fragmentation of large boulders and rubble.
  15. Calculations of anticipated ground vibration levels at existing structures and facilities.
  16. Methods for protection of the existing structures and utilities including special perimeter control blasting procedures. Include a depiction of areas where such measures will be used.
  17. Methods of matting or covering of the blast area in open excavations to prevent fly rock and excessive air blast overpressure.
  18. List of permits and clearances required, when applied for, and date of approval or anticipated approval.
  19. Name and address of Contractor's representative to which any claims for damage due to blasting should be addressed.
  20. Contingency plan for lightning hazard.
- E. A revised blasting plan shall be produced and forwarded to the Engineer if conditions change, the results of blasting do not produce the intended results or blasting causes excessive dispersal of material.
- F. Complete project team organization with duties, responsibilities and authorities clearly defined. The organizational outline shall also include a listing of all personnel authorizing to sign for, receive and use explosives on this contract.
- G. Written evidence of the licensing, experience and qualifications of the blasters who will be directly responsible for the blasting operations.
- H. Name and qualifications of the person(s) responsible for design and directing the blasting. This submittal shall document by project lists that the person has the required experience in controlling blast vibrations in blasting rounds of the type required on the project.
- I. Submit a copy of the blasting permit(s) obtained to conduct blasting on the site. Obtain and pay for all permits and licenses required to complete the work herein. Original permits shall be prominently displayed on the site prior to initiating blasting operations.
- J. Within 24 hours following each blast, the Contractor shall submit to the Owner and Engineer a Blast Monitoring Report. Each Blast Monitoring Report shall include a copy of strip chart (or other permanent record of velocity/time waveform) with calibration and monitoring record marked with the date, time and location of the blast as well as the monitoring location. Provide name, model number and catalog sheet describing the vibration monitoring equipment indicating location of the blast, location of seismograph(s), seismograph data

**Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00**

(max. ppv, etc.) and pounds of explosive per delay used.

- K. Submit the name and qualifications of the person(s) responsible for monitoring and reporting vibrations and air blast overpressures.
- L. In the event that the rock excavation operations result in ground vibrations which exceed the vibration limit criteria specified herein, the Contractor shall immediately submit a revised rock excavation plan and submit to the Engineer for review, identifying the procedures being taken to mitigate the vibrations.
- M. The Contractor shall submit to the Owner and Engineer in writing all blasting complaints received by the contractor within 24 hours of receipt. Each blast complaint report shall include the name and address of the complainant, time received, date and time of blast complained about and a description of the circumstances which lead to the complaint.
- N. Review by the Engineer of material submitted by the Contractor shall not relieve the Contractor of responsibility for the accuracy, adequacy and safety of the blasting, exercising proper supervision and field judgment and producing the results within the vibration and blasting limits required.
- O. Submit post-excavation conditions documentation report as specified herein.
- P. Should rock slope stability and safety measures be required, submit proposed means and methods to the Geotechnical Engineer for review.

**1.8 QUALITY ASSURANCE**

- A. Persons responsible for blasting shall be licensed blasters in the State of Connecticut and shall have at least 5 years of experience in responsible charge of similar excavations in rock and controlled blasting techniques.
- B. Vibration and blast monitoring shall be conducted, analyzed and reported by a qualified professional engineer registered in the State of Connecticut.
- C. The Contractor shall be responsible for achieving the final rock cut limits and slopes as shown on the Constructions Drawings. The Contractor shall use baseline information referenced and drawings for his use in establishing the correct location and grades.

**1.9 REGULATORY REQUIREMENTS - GENERAL**

- A. The Contractor shall comply with applicable laws, rules, ordinances and regulations of the Federal, State and local agencies governing the transportation, storage, handling, and use of explosives. All labor, materials, equipment and services necessary to make the blasting operations comply with such requirements shall be provided at no additional cost.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- B. The Contractor shall obtain and pay for permits and licenses required to complete the work of this section.
- C. In case of conflict between regulations or between regulations and this section, the Contractor shall comply with the most stringent applicable codes, regulations or Specification.
- D. If required by local or state regulations, blasting plans shall be reviewed by the appropriate agency or authority and revised as required to meet with their approval.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. The Contractor shall furnish all equipment and labor necessary for the excavation and removal of rock as specified herein.
- B. Explosives, detonator/delay device, and blast mat materials shall be of a type recommended by the explosive supplier and shall comply with requirements specified herein.
- C. Rock slope stability and safety measures, as necessary, include, but are not limited to, rock bolting, shotcreting, rock netting, fencing, etc.

## PART 3 EXECUTION

### 3.1 PRE-EXCAVATION DOCUMENTATION

- A. Prior to start of any earth/rock excavation or blasting work, engage the services of a professional engineer registered in the State of Connecticut to conduct a pre-construction conditions documentation report of the exteriors of existing structures and conditions within 500 feet of blasting areas and the interiors of existing structures within 200 feet of blasting areas.
  - 1. Coordinate activities, issue notices, obtain clearances and provide photographic and secretarial assistance necessary to accomplish the survey.
  - 2. Give notice in writing to the property owner and any representative of local authorities required to be present during performance of the pre-construction conditions documentation work. Provide the dates on which the pre-construction conditions documentation work is planned so that representatives are present.
  - 3. The pre-construction conditions documentation report shall consist of a video and still photo documentation of selected interior and exterior facades. Descriptions shall locate cracks, damage or other defects existing and shall include information to make it possible to determine the effect, if any, of the construction operations on the defect. Significant cracks may be monitored.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

4. Contractor's record of the pre-construction conditions documentation report shall consist of written documentation and photographs of the conditions identified.

### 3.2 ROCK EXCAVATION

- A. Perform all rock excavation work so as not to disturb or disrupt the neighboring off-site structures and their occupants. Rock excavation shall be performed in such a manner as to not impact or alter any ongoing construction. Additional limiting construction vibration requirements outlined herein apply to all rock excavation. Perform work in accordance with local and state requirements for permissible noise and work hours. The Contractor is cautioned that the on-site adjacent structures will remain in operation during the time rock excavation is to be performed. Facilities, access ways and utilities, including gas service, water service, oil tanks, etc. associated with the above mentioned structures will also remain operational and shall be coordinated and protected by the Contractor during all rock excavation and removal work while in operation.
- B. Cut rock to form level bearing at bottom of footing and trench excavations. Perform excavation so as to provide sound and unshattered base for footings or foundations.
- C. Perform rock excavation in a manner that will produce material of such size as to permit it to be removed or processed and reused onsite as engineered fill. Remove rock to limits as indicated on Construction Drawings and/or specified herein. Remove loose or shattered rock, overhanging ledges and boulders which might dislodge.
- D. Provide lean concrete or approved fill materials satisfying requirements for fill to replace rock overblast or over-excavation at no additional cost to the Owner to facilitate placement of utilities and future footings.

### 3.3 ROCK BLASTING

- A. General
  1. Blasting shall be employed as a means to assist rock excavation in areas where mechanical means have been deemed unsuccessful or incapable of providing the final layout shown on the Construction Drawings within the project schedule.
  2. Drilling and blasting methods and programs shall be those necessary to accomplish the rock excavation shown on the Contract Drawings in accordance with the procedure specified herein. All blasting shall be performed by a certified, licensed blasting Contractor. Proof of applicable license and certifications must be provided to the Owner at least one month prior to any blasting operations beginning. The blasting Contractor shall carry the following insurance: Workman's Compensation, Comprehensive General Liability, Broad Form Property Damage, Contractual Liability and Explosion, Collapse and Underground Hazard (naming the Owner as additionally insured).



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

3. Perform blasting only after receiving written approval from Owner and authorities having jurisdiction. Provide as necessary heavy mats to minimize concussion. Handle, store, and use explosives in accordance with the Manual of Accident Prevention in Construction by the Associated General Contractors of America, Inc., latest edition. Blasting work shall take place only after persons in the vicinity have had ample notice and have reached positions of safety. Adequate means shall be taken to prevent all persons from entering the blasting area. The Contractor shall use methods and programs that will prevent damage to adjacent buildings, retaining walls and other structures, and landscape features and that will minimize the scattering of rock, stumps or other debris.
4. The Contractor shall be responsible for any and all damage and/or injury from the use of explosives. Contractor shall save and hold harmless the Owner, Owner's representative, Architect and Engineer from all claims growing out of the use of explosives. Removal of materials of any nature by blasting shall be done in such a manner and at such times as to avoid damage affecting integrity of existing construction and damage to new or existing dwellings, and other structures, utilities, septic systems, and/or water wells in or adjacent to the area of the work. It shall be the Contractor's responsibility to determine the method of operation to ensure desired results and integrity of completed work. All damage caused by the Contractor's blasting operations shall be repaired to the full satisfaction of the affected property's Owner at no additional cost to the proposed development property Owner.
5. Approval of blasting and excavation methods and procedures for completion of the work, including, but not limited to, maximum blast particle criteria specified herein, shall not relieve the Contractor of his responsibilities in connection with the work, safety, the work adequacy and accuracy, exercising proper supervision and field judgment, producing the results within the blasting limits required by these Specifications and for direct or indirect damages to existing or new structures.
6. Prior to commencement of production blasting, the Contractor shall prepare a test blast program which shall be used to define the propagation characteristics of blast-induced vibrations. The test blast program as specified herein shall be submitted to the Owner and the Geotechnical Engineer for review.
7. Blasting shall be conducted in such a manner so as not to disrupt surrounding residences and businesses, and in accordance with local ordinances with regard to noise and work hours or as otherwise mandated by local agencies.
8. The Contractor shall take all precautions necessary to warn and/or protect any individuals exposed to his operations prior to any blasting. Blasting mats or other approved flyrock protection shall be employed as necessary to protect areas adjacent to blasting. The blasting Contractor shall obtain all Federal, State and Local permits that are applicable to the blasting operations. The blasting

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

Contractor shall conduct the blasting operations according to all regulatory authorities having jurisdiction, laws, regulations and ordinances. The blasting Contractor shall conduct the blasting operations in accordance with all industry standards and shall coordinate with the grading Contractor to insure that appropriate safety procedures are followed, including signage and signaling devices. Nothing contained in this document shall limit the blasting Contractor's obligations or duties under regulatory authorities having jurisdiction laws, regulations and ordinances.

9. The Contractor shall develop and maintain records covering pertinent data on the location, depth and area of the blast, the diameter, spacing, depth, overdepth, pattern, amount, distribution, charge weights per delay, and powder factor for the explosives used per hole and per blast; the sequence and pattern delays, and description and purpose of special methods. Contractor shall provide a copy of the records to the Owner upon the Owner's request. Receipt and acceptance by the Owner of blasting data will not relieve the Contractor of his responsibility to produce satisfactory results as set forth in these specifications. Drilling and blasting shall be done only to the depth, amount and at such locations using explosives of such quantity distribution and density that will not produce unsafe or damaged rock surfaces, or loosened/damaged rock beyond the prescribed excavation limits.
10. The Contractor shall be responsible for the cost of removal of overblast beneath the pay depths and also for the cost of placement and compaction of suitable replacement fill or placement of lean concrete where overblast removal beneath paylines occurs. As excavation operations progress, the drilling and blasting procedures shall be determined only by satisfactory results achieved by the Contractor.
11. The blasting Contractor shall prepare and maintain post-blast reports which include the amount of material displaced by each blast, the amount of explosive utilized in each blast, and the number of shots detonated. All reports shall be forwarded to the Owner.
12. Should the drilling and blasting program result in damage to the excavation or unacceptable peak particle velocity or frequency values, the Contractor shall be required to devise and employ methods at no additional cost to the Owner that will prevent such damage or unacceptable ground motions. Revisions may include special methods such as refined line drilling or channel drilling, pre-split and zone blasting, shallow lifts, reduction in size of individual blasts, small diameter blast holes, closely spaced blast holes, reduction of explosives, greater distribution of explosives by use of decking and primacord or variation in density of explosives and chemical or mechanical splitting of the rock.
13. Holes shall be stemmed with coarse sand or free-running gravelly sand having a maximum size of three-eighths (3/8") of an inch. Stemming may be required between each explosive charge in areas

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

where the rock contains open seams, joints or faults. Pre-split blast holes shall be detonated prior to drilling and blasting of adjacent rock except when conditions will not permit this method or when it can be demonstrated to the satisfaction of the Owner that in special cases a millisecond delay system will produce acceptable rock surfaces.

14. Any and all damage caused by the Contractor's excavation/blasting operations shall be repaired at the expense of the Contractor to the satisfaction of the governing agencies and the property Owner at no additional cost to the Owner.

B. Explosives

1. The Contractor shall take special precautions for proper use of explosives to prevent harm to human life or contaminate the environment, and damage to surface structures, utility lines, or other subsurface structures.
2. Explosives shall be stored, handled and employed in accordance with State and local regulations, or in the absence of such, in accordance with the provisions of the Manual of Accident Prevention in construction issued by the Associated General Contractors of America, Inc. and OSHA, as well as standards of the United States Department of Interior, Bureau of Mines.
3. The Contractor shall submit shop drawings showing the location, access to the type of construction of the proposed storage magazine for the explosives and detonation cap house. The contractor shall provide and maintain access to the explosive storage area at his own expense.

C. Test Blasting

1. The Contractor shall prepare a test blast program which shall be used to define the propagation characteristics of blast-induced vibrations.
2. Pre-blast holes shall be similar diameter and spacing as those to be used for production blasts. At least one of the tests shall contain holes having the same diameter and spacing as those to be used for pre-splitting. Depths of holes and type and quantities of explosives per hole shall match the expected depths and quantities respectively for use in production blasting.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

3. The Contractor shall utilize the information from the test blast program and develop a plan showing allowable explosive charge weights per delay which will result in the attenuation of ground motions less than the limiting velocities and air blast overpressures defined herein.

3.4 BLASTING VIBRATION AND LIMIT CRITERIA

- A. The Contractor shall limit vibrations from rock excavation to prevent damage to any existing structure, facility, utility or other feature near the site. In no case shall the following be exceeded.
- B. Peak Particle Velocity (PPV) limits at structures within 100 feet of blast shall not exceed 0.5 inches/second.
- C. Peak Particle Velocity (PPV) limits at ground surface at other existing adjacent buildings, facilities or structures:

Frequency (Hz)	Max Peak Particle Velocity (inch/second)
Over 40	2.0
Less than 40	0.75

D. Air blast Overpressure Limit:

1. The Contractor shall conduct all blasting activity in such a manner that the peak air blast overpressure measured at the location of the nearest above ground, occupied structure to air blast does not exceed 0.0014 psi.

- E. Rock excavation by impact methods or controlled blasting shall not be permitted within 300 feet of locations where concrete has been placed in the preceding 24 hours. Rock excavation by impact methods or controlled blasting shall not be permitted within 100-feet of concrete structures until the concrete has attained the specified design strength.

F. Vibration and Blast Monitoring

1. The Engineer will monitor vibrations and air overpressures at the site during rock excavation activities with seismograph during rock excavation operations at the site. Seismograph locations shall be such that they are between the nearest structures and the blast site. The Contractor will be notified of any exceedance of blast vibration and limit criteria and the Contractor shall modify their procedures as necessary such that the above vibration and limit criteria are not exceeded. Vibration monitoring performed by the Engineer shall not relieve the Contractor of any of his/her responsibility to perform such work.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

2. Vibration monitoring for blasting operations requires that time of firing to be precisely known so that the seismographs can be started before firing. The Contractor shall establish a notification and signal system which will allow the seismographs to be initialized prior to the start of each blasting operation to allow the blast induced vibrations and air overpressures to be recorded.

G. The Contractor shall cooperate with the Engineer in permitting observation of the rock excavation operation including the drilling and loading procedures, as well as providing detailed information on blasting operations.

H. The Contractor shall be completely responsible for all damages resulting from the blasting operations and shall, as a minimum, take whatever measures are necessary to maintain peak particle velocities within the specified limits. Modifications to blasting and other rock excavation methods required to meet these requirements shall be undertaken at no additional cost to the Owner.

### 3.5 PROCESSING EXCAVATED ROCK

A. Fragmented rock with dimensions not exceeding 3-inches in any direction may be mixed with common fill and used as fill in accordance with Section 310000 - Earthwork.

B. Rock and boulders may be crushed and screened for reuse in the work, provided that the resultant materials meet the requirements for fill or other products as specified in Section 310000 - Earthwork.

C. The Contractor shall process excavated rock for re-use on-site in accordance with the pre-approved Rock Processing Plan.

D. Processed materials shall be stockpiled at locations approved by the Owner.

### 3.6 POST EXCAVATION

A. A post-excavation conditions documentation report shall be performed upon completion of the excavation work, with the results transmitted to the Owner and the Geotechnical Engineer.

B. The Contractor will be solely responsible for any damage and associated delay costs caused by the excavation operation.

C. The entire rock slope should be scaled to remove any remaining loose rock material and the slope stabilized in accordance with submittal procedures.

### 3.7 MEASUREMENT AND PAYMENT

A. Rock excavation and disposal will be made at the unit price per cubic yard. The Contractor shall perform rock excavation in accordance with the requirements herein.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- B. When rock is encountered, the material shall be uncovered and the Engineer notified. Rock excavation shall be measured in accordance with the number of cubic yards and fraction thereof of calculated in-situ volume of rock excavated as defined herein. The volumetric calculations shall be based on the average end-area method with profiles generated every ten feet measured horizontally.

END OF SECTION

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

SECTION 31 09 01

MONITORING OF STRUCTURES AND UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including project Drawings and Specifications.

1.2 SUMMARY

- A. Work Included: The Work of this Section includes, but is not limited to the following:
  - 1. All labor, equipment, and materials to execute the work of this Section as specified herein.
  - 2. Collection, cataloging, and compilation of the observed conditions of existing structures to remain within 100 ft (horizontally) of above grade work limits (i.e. Pre-Construction Conditions Documentation).
  - 3. Furnish and install optical survey targets, surveying marks, benchmarks and settlement monitoring points as required and as outlined herein.
  - 4. Furnish all equipment and labor to provide continuous vibration monitoring within adjacent buildings and structures.
  - 5. Provide all surveying services required for performing optical survey monitoring as outlined herein.
  - 6. Provide all labor necessary for the periodic measurement of any installed crack gauges installed under this Section.
  - 7. Compilation, interpretation, and transmittal of monitoring data to the Construction Manager, Owner and others during construction.
  - 8. Provide all other labor, equipment, and materials as can reasonably be inferred to make the work of this Section complete.

1.3 QUALITY CONTROL

- A. The Contractor shall retain the services of a Land Surveyor, licensed in the Connecticut, to perform all survey monitoring during construction. The Contractor's surveyor shall have at least three years of professional experience or as approved by the Owner's Engineer.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- B. The Contractor shall retain a Professional Engineer, licensed in the Connecticut, to perform all other monitoring including measurement of vibration and movement of structures and the ground. The Contractor's Professional Engineer shall have at least five years of professional experience working under similar circumstances, or as approved by the Owner's Engineer.

#### 1.4 SUBMITTALS

- A. Unless otherwise indicated, transmit all submittals to the Construction Manager for review by the Owner's Engineers before proceeding with ordering, fabricating, or any other work of this Section.
- B. Submit product cut-sheets and calibration data and identify the allowable tolerances of all proposed equipment.
- C. The Contractor shall submit resumes for all personnel performing the work of this Section.
- D. Submit example weekly monitoring report and data sheets showing typical presentation of seismograph and crack gauge monitoring data.
- E. Submit sample survey monitoring report
- F. Submit Pre-Construction Documentation Reports to the Construction Manager for distribution to the Owner, and Owner's Architect and Engineers. Documentation shall include all applicable plans, sketches, notes, and photographs logging the conditions of structures and thoroughfares located within 100 ft of above grade work limits.
- G. Submit plan showing location of all instruments installed to document movement during construction activities.
- H. Monitoring Plans:
  - 1. The Contractor shall submit drawings showing the plan and vertical locations of all proposed monitoring points. The plan shall graphically identify the type of monitoring point (i.e. optical survey, surface points, seismographs, crack gages, borehole instruments, benchmarks, etc), with each monitoring point bearing a unique identification number. Where required, provide section drawings (i.e. excavation faces, building facades, etc) and identify the elevations (NAVD88 datum) at which monitoring points have been or will be installed.
  - 2. The drawings shall be updated and resubmitted in the event that monitoring points are abandoned, relocated or additional monitoring points are added.
- I. Submit all monitoring data directly to the Construction Manager for distribution to the Owner's Architect and Engineers. Measurement data shall be submitted within 24 hours of taking each reading. All data



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

shall be transmitted in electronic format suitable to the Owner's Architect and Engineers. Transmitted data shall show all cumulative measurements recorded as a function of time. Requisite notes shall be included to document construction activities performed during the monitoring increment. The Contractor shall clearly identify any exceedances or trends that could lead to an exceedance, as soon as one is identified.

- J. Submit weekly summary report to the Construction Manager for distribution to the Owner's Architect, Engineers, and others as required.

#### 1.5 SCHEDULING OF WORK

- A. Obtain all necessary permits and access agreements necessary prior to performance of the work.
- B. Pre-Construction Conditions Documentation of adjacent structures shall be completed at least 10 days, but no more than 60 days, prior to commencing earthwork and foundation construction.
- C. Crack gauges shall be installed during performance of the Pre-Construction Conditions Documentation as required to catalog and record the conditions of existing cracks.
- D. Seismographs shall be installed during or following performance of Pre-Construction Conditions Documentation. Seismographs shall be installed to allow for sufficient time (minimum one week) to evaluate background vibration levels resulting from ambient activities prior to construction.
- E. Additional crack gauges or seismographs shall be installed as required by earthwork and foundation construction activities.
- F. Survey targets, benchmarks, and settlement monitoring points shall be installed at least 10 days prior to commencing with earthwork and foundation construction.
- G. Additional monitoring points shall be established as required during construction.

#### 1.6 MONITORING

- A. Monitoring shall include construction vibrations, strain gauges and periodic measurement of existing cracks. Monitoring shall be performed prior to and during earthwork and foundation construction to evaluate the performance of the Contractor's activities.
- B. The field locations of seismographs and strain gauges shall be coordinated with the Owner and the Owner's Engineers.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- C. The Contractor shall be responsible for all maintenance of equipment as required to maintain monitoring on a continuous basis throughout the duration of construction activities on-site.
- D. Monitoring data shall be transmitted to the Construction Manager for distribution to Owner, and the Owner's Architect and Engineers.

#### 1.7 SURVEY MONITORING

- A. Survey monitoring shall include installation of survey monitoring points and periodic measurement of horizontal and vertical movements at existing structures within and adjacent to the project site.

#### 1.8 ADDITIONS

- A. The Contractor may elect to provide additional types of monitoring not specifically outlined herein, but shall at a minimum conform to the requirements of this Section. Where additional types of monitoring are proposed, the Contractor shall inform the Construction Manager in writing, and shall provide all information as requested by the Construction Manager and the Owner's Architect and Engineers.
- B. The Contractor shall be solely responsible for all means and methods not specifically addressed herein.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Contractor shall submit all details and other supporting data for materials proposed for use in performing the work of this Section.
  - 1. Optical Survey Targets: Survey targets shall consist of self-adhesive reflective sheet targets suitable for adherence to wood, steel, brick, concrete, etc.
  - 2. Surface Marker 1 (SM1): A ¼-inch by 2-inch PK nails set in paved streets or sidewalks with a 1-½" diameter hub identification tag (or approved equal).
  - 3. Surface Marker 2 (SM 2): Scribe surface of monitoring point as required to maintain permanent demarcation of the location. Scribed locations shall be identified on all drawings.

#### 2.2 EQUIPMENT

- A. Seismographs: Blastmate Series III portable seismograph as manufactured by Instatel Inc. or approved equal. Seismographs shall include a cellular modem (Verizon) or other means to allow for continuous real-time monitoring and alert via email and internet. Geophones and cases shall be affixed to the bench walls by means of concrete anchor bolts as manufactured by Hilti, Redhead, or equal.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- B. Crack Gages: Grid crack cages shall be as manufactured by Avongard Products (USA) Ltd., or approved equal. Anchors, bolts, screws and quick setting epoxy shall be as provided by Avongard Products or approved equal. A minimum of 50 gauges shall be procured prior to execution of Preconstruction Conditions Documentation.
- C. Optical Survey Equipment: Optical surveying equipment shall be suitable for achieving the following accuracies and repeatability:
  - 1. Vertical: at least plus or minus 0.005 ft
  - 2. Horizontal: at least plus or minus 0.005 ft

### PART 3 - EXECUTION

#### 3.1 GENERAL INSTALLATION

- A. Install monitoring systems prior to commencing construction activities. Where employed, monitoring websites for data transmittal and alarm notifications must be active a minimum of one week prior to construction.
- B. Install all equipment in accordance with manufacturer's recommendations.
- C. Submit drawings showing the as-built locations for all monitoring points installed, listing unique identifiers for each point and the type of monitoring.
- D. Install additional monitoring points as required as the work progresses. Replace all locations, lost, damaged or vandalized.

#### 3.2 INSTALLATION OF CRACK GAUGES

- A. Installation shall be in accordance with the manufacturer's recommendations.
- B. Write ID # on gauge with permanent marker.
- C. After completion of installation, check that gauge parts are free to move over each other by passing a feeler gauge or thin plastic card between the two sections.
- D. After completion of installation, the as-built location and initial movement (if any) shall be recorded.
- E. Photograph crack gauge following installation and all subsequent readings.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

### 3.3 SEISMOGRAPHS

- A. Installation shall be in accordance with the manufacturer's recommendations.
- B. Seismographs shall be firmly mounted to the ground surface or structures. Where seismographs are placed on undisturbed soil, geophones shall be set with spikes as supplied by the manufacturer and shall be ballasted with sand bags having a minimum weight of 30 pounds.

### 3.4 MONITORING LOCATIONS

- A. The minimum number of locations and approximate orientation of all monitoring points shall be as outlined below:
  - 1. Buildings (Smoke Stack, Building 15, Building 16 and the Temporary Structure South of CHP Building Site):
    - a. Survey Targets or Survey Marks (SM 1, SM2): Monitoring locations shall be evenly spaced at 25 ft centers at the base of the structure and roofline, unless otherwise necessary to determine movement in critical areas such as cracked facades, etc.
    - b. Crack Gauges: Monitoring points shall be installed at cracks observed during execution of Preconstruction Conditions Documentation and as required as the work progresses, as determined by the Contractor and as directed the Construction Manager and Owner's Consultants.
    - c. Seismographs: One seismograph (each) shall be installed in the lowest level of the smoke stack structure, Building 16 and the Temporary Structure located south of the CHP site.
  - 2. Support of Excavation Systems:
    - a. Survey Targets and Survey Marks: Install monitoring points at 30 ft centers. Survey targets and survey marks shall be positioned as close as possible to the ground surface and where possible should be affixed to steel bracing members or concrete faces. Additional targets or marks shall be installed for each 10 ft of exposed vertical height.

### 3.5 BASELINE MEASUREMENTS

- A. Baseline measurements for all monitoring shall be established a minimum of 30 days prior to execution of construction activities on-site.
- B. Establishment of trigger values for vibration monitoring shall consider background vibration levels. Background levels shall be recorded prior to commencing construction activities to determine ambient levels of vibration resulting from rail operations. Trigger values for

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

seismographs shall be maintained at 0.2 inches per sec above that of the peak background levels recorded.

### 3.6 FREQUENCY OF MONITORING

- A. At a minimum, survey monitoring of structures shall be performed twice per week. The frequency of monitoring shall be increased or decreased as directed by the Construction Manager and the Owner's Consultants pending the results of recorded monitoring data trends.
- B. At a minimum, crack gauges shall be measured on a weekly basis. The frequency of monitoring shall be increased as directed by the Construction Manager, the Owner's Consultants or Owner.
- C. Vibration Monitoring and strain gauge monitoring shall be performed on a continuous basis (24/7). The Contractor shall be responsible for evaluating and reporting exceedances of this data in real-time.

### 3.7 MONITORING REPORT, DATA FORMAT AND TRANSMITTAL

- A. Weekly monitoring reports shall be prepared and submitted to the Construction Manager, Owner and Owner's Engineers that includes a summary of the measurements for that week, cumulative total movements, observed trends, changes in the monitoring program and any monitoring points that exceeded the trigger levels. The report shall correlate any observed trends in movement or trigger levels with weather and construction activities.
- B. Data shall be transmitted in an electronic format (MS Excel) and shall include all cumulative readings taken. Data shall include baseline values, offset measurements. Provide coordinates for readings, as requested. Include movement trend plots identifying any exceedances or trends that could lead to exceedances. Include the following information for all readings:
  - 1. Instrument Type
  - 2. Date and time of readings
  - 3. Name of observer
  - 4. Monitoring Point ID #
  - 5. Readings, both total and cumulative where appropriate
  - 6. Weather condition and temperature
  - 7. Remark of any visual observations of conditions, construction activities
- C. Transmit all data to the Construction Manager for distribution to the Owner's Architect and Engineers within 2 days of taking measurements.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- D. The Contractor shall alert Construction Manager and the Owner's Engineers immediately in the event that values exceed review levels specified herein. Such notification shall be made by email and in writing.
- E. Additional reports shall be prepared as directed by the Owner's Engineers in the event that exceedances occur.

### 3.8 REVIEW AND LIMIT VALUES

- A. The following criteria shall be used to evaluate the necessity for modifying or ceasing construction activities. Where a work stoppage is required, construction activities shall not continue until adequate measures are in place to ensure stability of adjacent structures, excavation support, or utilities. Where movements in excess of the Review level are detected the frequency of data collection shall be increased to once daily, or as directed by the Construction Manager or Owners Consultants. The criteria provided shall not relieve the Contractor of any responsibility with respect to damage incurred by any structures or utilities.

#### 1. Vibration Monitoring: Peak particle velocities

- a. Review Level - 1-inches per second or 0.5 ips + background level.
- b. Limit Level - 2 inches per second

#### 2. Crack Gauge Monitoring: Cumulative movement in any direction

- a. Review Level - 1/16<sup>th</sup> inch in any direction
- b. Limit Level - 1/8<sup>th</sup> inch in any direction

#### 3. Survey Monitoring:

##### a. Review Level:

- i) Vertical movement of buildings or other structures: 3/8-inch total movement or 3/16-inch between two consecutive readings.
- ii) Horizontal movement of building or other surface structures: 3/16-inch total movement or 1/8-inch between two consecutive readings

##### b. Limit Level: Vertical

- i) Vertical movement of buildings or other structures: 1/2-inch total movement or 1/4 -inch between two consecutive readings
- ii) Horizontal movement of building or other surface structures: 1/4-inch total movement, or 3/16-inch between two consecutive readings

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

### 3.9 ACTION ITEMS

- A. Any movement exceeding the criteria outlined above shall be reported immediately to the Construction Manager, the Owner and the Owner's Consultants. Work in the immediate area shall be suspended, unless directed otherwise by the Owner's Engineers. Corrective measures to ensure integrity and stability of adjacent structures shall be the responsibility of the Contractor.
- B. In the event that a Review Level is reached the following shall be required:
  - 1. Contractor shall meet with the Owner and Owner's Consultants to discuss the need for a response to mitigate the potential for readings exceeding the Review Level.
  - 2. Where required, submit a detailed plan of action to mitigate the potential for additional movement or vibration.
  - 3. Install additional instruments as required evaluate the need for any action necessary to prevent reaching the Limit Level.
- C. In the event of an Limit Level for is reached the following shall be required:
  - 1. Foundation construction shall be suspended and the structures shall be inspected by the Owner, Owner's Consultants and the Contractor's Engineer.
  - 2. The Contractor shall take all actions necessary to protect structures and utilities and maintain integrity and stability of said structures and utilities. The Contractor shall be solely responsible for providing all necessary services in conjunction with developing and applying remedial measures including any required engineering design.
  - 3. Should vibration levels exceed the Limit Level, construction activities shall be suspended. The adjacent structures shall be visually inspected, and construction methods modified as necessary to maintain vibrations within acceptable levels.

### 3.10 DECOMMISSIONING

- A. Upon notice from the Owner or Construction Manager, the Contractor shall remove all instruments installed and shall repair any resulting damage.

END OF SECTION 31 09 01

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

***THIS PAGE INTENTIONALLY LEFT BLANK***



# Modifications/Changes in this update

Department of Veterans Affairs



Office of Construction & Facilities  
Management

**DATE SUBMITTED:** 10/01/12

**DESCRIPTION OF DOCUMENT:** (previous section title, number and date)  
31 23 19 Dewatering (12-05M)

---

---

**CHANGES MADE:**

---

Modifications include updating references and adding requirements for dewatering plans.

---

**SECTION 31 23 19**  
**DEWATERING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies performance of dewatering required to lower and control ground water table levels and hydrostatic pressures to permit excavation, backfill, and construction to be performed in the dry. Control of surface water shall be considered as part of the work under this specification.

**1.2 SUMMARY:**

- A. The work to be completed by the Contractor includes, but is not necessarily limited to the following:
  - 1. Implementation of the erosion and sedimentation control features indicated on the Site Utility Plan.
  - 2. Dewater excavations, including seepage and precipitation.
- B. The Contractor shall be responsible for providing all materials, equipment, labor, and services necessary for care of water and erosion control. Excavation work shall not begin before the Erosion and Sedimentation Control Plan is in place.

**1.3 REQUIREMENT:**

- A. Dewatering system shall be of sufficient size and capacity necessary to lower and maintain ground water table to an elevation at least 300 mm (1 foot) in a reasonably dry condition. Materials to be removed shall be sufficiently dry to permit excavation to grades shown and to stabilize excavation slopes where sheeting is not required. Operate dewatering system continuously until backfill work has been completed.
- B. Reduce hydrostatic head below any excavation to the extent that water level in the construction area is a minimum of 300 mm (1 foot) below prevailing excavation surface.
- C. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.
- D. Maintain stability of sides and bottom of excavation.
- E. Construction operations are performed in the dry.
- F. Control of surface and subsurface water is part of dewatering requirements. Maintain adequate control so that:

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

1. The stability of excavated and constructed slopes are not adversely affected by saturated soil, including water entering prepared subbase and subgrades where underlying materials are not free draining or are subject to swelling or freeze-thaw action.
2. Erosion is controlled.
3. Flooding of excavations or damage to structures does not occur.
4. Surface water drains away from excavations.
5. Excavations are protected from becoming wet from surface water, or insure excavations are dry before additional work is undertaken.

G. Permitting Requirements: The contractor shall comply with and obtain the required State and County permits where the work is performed.

#### **1.4 RELATED WORK:**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety Requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Submittal requirements as specified in Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- D. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- E. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article 1.11, PHYSICAL DATA.
- F. Excavation, backfilling, site grade and utilities: Section 31 20 00, EARTH MOVING.

#### **1.5 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Drawings and Design Data:
  1. Submit drawings and data showing the method to be employed in dewatering excavated areas 30 days before commencement of excavation.
  2. Material shall include: location, depth and size of wellpoints, headers, sumps, ditches, size and location of discharge lines, capacities of pumps and standby units, and detailed description of dewatering methods to be employed to convey the water from site to adequate disposal.
  3. Include a written report outlining control procedures to be adopted if dewatering problem arises.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

4. Capacities of pumps, prime movers, and standby equipment.
5. Design calculations proving adequacy of system and selected equipment. The dewatering system shall be designed using accepted and professional methods of design and engineering consistent with the best modern practice. The dewatering system shall include the deep wells, wellpoints, and other equipment, appurtenances, and related earthwork necessary to perform the function.
6. Detailed description of dewatering procedure and maintenance method.
7. Materials submitted shall be in a format acceptable for inclusion in required permit applications to any and all regulatory agencies for which permits for discharge water from the dewatering system are required due to the discharge reaching regulated bodies of water.

C. Inspection Reports.

D. All required permits.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION:**

- A. Install a dewatering system to lower and control ground surface water in order to permit excavation, construction of structure, and placement of backfill materials to be performed under dry conditions. Make the dewatering system adequate to pre-drain the water-bearing strata above and below the bottom of structure foundations, utilities and other excavations.
- B. In addition, reduce hydrostatic pressure head in water-bearing strata below structure foundations, utility lines, and other excavations, to extent that water levels in construction area are a minimum of 300 mm (1 foot) below prevailing excavation surface at all times.

### **3.2 OPERATION:**

- A. Prior to any excavation below the ground water table, place system into operation to lower water table as required and operate it continuously 24 hours a day, 7 days a week until utilities and structures have been satisfactorily constructed, which includes the placement of backfill materials and dewatering is no longer required.
- B. Place an adequate weight of backfill material to prevent buoyancy prior to discontinuing operation of the system.

### **3.3 WATER DISPOSAL:**

- A. Dispose of water removed from the excavations in such a manner as:

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

1. Will not endanger portions of work under construction or completed.
2. Will cause no inconvenience to Government or to others working near site.
3. Will comply with the stipulations of required permits for disposal of water.
4. Will Control Runoff: The Contractor shall be responsible for control of runoff in all work areas including but not limited to: excavations, access roads, parking areas, laydown, and staging areas. The Contractor shall provide, operate, and maintain all ditches, basins, sumps, culverts, site grading, and pumping facilities to divert, collect, and remove all water from the work areas. All water shall be removed from the immediate work areas and shall be disposed of in accordance with applicable permits.

**B. Excavation Dewatering:**

1. The Contractor shall be responsible for providing all facilities required to divert, collect, control, and remove water from all construction work areas and excavations.
2. Drainage features shall have sufficient capacity to avoid flooding of work areas.
3. Drainage features shall be so arranged and altered as required to avoid degradation of the final excavated surface(s).
4. The Contractor shall utilize all necessary erosion and sediment control measures as described herein to avoid construction related degradation of the natural water quality.

**C. Dewatering equipment shall be provided to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work during construction. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.**

**3.4 STANDBY EQUIPMENT:**

Provide complete standby equipment, installed and available for immediate operation, as may be required to adequately maintain dewatering on a continuous basis and in the event that all or any part of the system may become inadequate or fail.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

**3.5 CORRECTIVE ACTION:**

If dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system (loosening of the foundation strata, or instability of slopes, or damage to foundations or structures), perform work necessary for reinstatement of foundation soil and damaged structure or damages to work in place resulting from such inadequacy or failure by Contractor, at no additional cost to Government.

**3.6 DAMAGES:**

Immediately repair damages to adjacent facilities caused by dewatering operations.

**3.7 REMOVAL:**

Insure compliance with all conditions of regulating permits and provide such information to the Resident Engineer. Obtain written approval from Resident Engineer before discontinuing operation of dewatering system.

----- E N D -----

# Modifications/Changes in this update

Department of Veterans Affairs



Office of Construction & Facilities  
Management

**DATE SUBMITTED:** 10/01/12

**DESCRIPTION OF DOCUMENT:** (previous section title, number and date)  
31 23 19 Dewatering (12-05M)

---

---

**CHANGES MADE:**

---

Modifications include updating references and adding requirements for dewatering plans.

---

SECTION 31 23 19  
DEWATERING

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies performance of dewatering required to lower and control ground water table levels and hydrostatic pressures to permit excavation, backfill, and construction to be performed in the dry. Control of surface water shall be considered as part of the work under this specification.

**1.2 SUMMARY:**

- A. The work to be completed by the Contractor includes, but is not necessarily limited to the following:
  - 1. Implementation of the erosion and sedimentation control features indicated on the Site Utility Plan.
  - 2. Dewater excavations, including seepage and precipitation.
- B. The Contractor shall be responsible for providing all materials, equipment, labor, and services necessary for care of water and erosion control. Excavation work shall not begin before the Erosion and Sedimentation Control Plan is in place.

**1.3 REQUIREMENT:**

- A. Dewatering system shall be of sufficient size and capacity necessary to lower and maintain ground water table to an elevation at least 300 mm (1 foot) in a reasonably dry condition. Materials to be removed shall be sufficiently dry to permit excavation to grades shown and to stabilize excavation slopes where sheeting is not required. Operate dewatering system continuously until backfill work has been completed.
- B. Reduce hydrostatic head below any excavation to the extent that water level in the construction area is a minimum of 300 mm (1 foot) below prevailing excavation surface.
- C. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.
- D. Maintain stability of sides and bottom of excavation.
- E. Construction operations are performed in the dry.
- F. Control of surface and subsurface water is part of dewatering requirements. Maintain adequate control so that:
  - 1. The stability of excavated and constructed slopes are not adversely affected by saturated soil, including water entering prepared subbase



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

and subgrades where underlying materials are not free draining or are subject to swelling or freeze-thaw action.

2. Erosion is controlled.
3. Flooding of excavations or damage to structures does not occur.
4. Surface water drains away from excavations.
5. Excavations are protected from becoming wet from surface water, or insure excavations are dry before additional work is undertaken.

G. Permitting Requirements: The contractor shall comply with and obtain the required State and County permits where the work is performed.

#### **1.4 RELATED WORK:**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety Requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Submittal requirements as specified in Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- D. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- E. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article 1.11, PHYSICAL DATA.
- F. Excavation, backfilling, site grade and utilities: Section 31 20 00, EARTH MOVING.

#### **1.5 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Drawings and Design Data:
  1. Submit drawings and data showing the method to be employed in dewatering excavated areas 30 days before commencement of excavation.
  2. Material shall include: location, depth and size of wellpoints, headers, sumps, ditches, size and location of discharge lines, capacities of pumps and standby units, and detailed description of dewatering methods to be employed to convey the water from site to adequate disposal.
  3. Include a written report outlining control procedures to be adopted if dewatering problem arises.
  4. Capacities of pumps, prime movers, and standby equipment.
  5. Design calculations proving adequacy of system and selected equipment. The dewatering system shall be designed using accepted and

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

professional methods of design and engineering consistent with the best modern practice. The dewatering system shall include the deep wells, wellpoints, and other equipment, appurtenances, and related earthwork necessary to perform the function.

6. Detailed description of dewatering procedure and maintenance method.
7. Materials submitted shall be in a format acceptable for inclusion in required permit applications to any and all regulatory agencies for which permits for discharge water from the dewatering system are required due to the discharge reaching regulated bodies of water.

C. Inspection Reports.

D. All required permits.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION:**

- A. Install a dewatering system to lower and control ground surface water in order to permit excavation, construction of structure, and placement of backfill materials to be performed under dry conditions. Make the dewatering system adequate to pre-drain the water-bearing strata above and below the bottom of structure foundations, utilities and other excavations.
- B. In addition, reduce hydrostatic pressure head in water-bearing strata below structure foundations, utility lines, and other excavations, to extent that water levels in construction area are a minimum of 300 mm (1 foot) below prevailing excavation surface at all times.

### **3.2 OPERATION:**

- A. Prior to any excavation below the ground water table, place system into operation to lower water table as required and operate it continuously 24 hours a day, 7 days a week until utilities and structures have been satisfactorily constructed, which includes the placement of backfill materials and dewatering is no longer required.
- B. Place an adequate weight of backfill material to prevent buoyancy prior to discontinuing operation of the system.

### **3.3 WATER DISPOSAL:**

- A. Dispose of water removed from the excavations in such a manner as:
  1. Will not endanger portions of work under construction or completed.
  2. Will cause no inconvenience to Government or to others working near site.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

3. Will comply with the stipulations of required permits for disposal of water.
4. Will Control Runoff: The Contractor shall be responsible for control of runoff in all work areas including but not limited to: excavations, access roads, parking areas, laydown, and staging areas. The Contractor shall provide, operate, and maintain all ditches, basins, sumps, culverts, site grading, and pumping facilities to divert, collect, and remove all water from the work areas. All water shall be removed from the immediate work areas and shall be disposed of in accordance with applicable permits.

B. Excavation Dewatering:

1. The Contractor shall be responsible for providing all facilities required to divert, collect, control, and remove water from all construction work areas and excavations.
2. Drainage features shall have sufficient capacity to avoid flooding of work areas.
3. Drainage features shall be so arranged and altered as required to avoid degradation of the final excavated surface(s).
4. The Contractor shall utilize all necessary erosion and sediment control measures as described herein to avoid construction related degradation of the natural water quality.

- C. Dewatering equipment shall be provided to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work during construction. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

**3.4 STANDBY EQUIPMENT:**

Provide complete standby equipment, installed and available for immediate operation, as may be required to adequately maintain dewatering on a continuous basis and in the event that all or any part of the system may become inadequate or fail.

**3.5 CORRECTIVE ACTION:**

If dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system (loosening of the foundation strata, or instability of slopes, or damage to foundations or structures), perform work necessary for reinstatement of foundation soil and damaged

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

structure or damages to work in place resulting from such inadequacy or failure by Contractor, at no additional cost to Government.

**3.6 DAMAGES:**

Immediately repair damages to adjacent facilities caused by dewatering operations.

**3.7 REMOVAL:**

Insure compliance with all conditions of regulating permits and provide such information to the Resident Engineer. Obtain written approval from Resident Engineer before discontinuing operation of dewatering system.

----- E N D -----

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

SECTION 31 50 00

EXCAVATION SUPPORT AND PROTECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Work of this Section consists of excavation support and protection, and includes but is not limited to the following:
  - 1. All engineering, surveying, layout, monitoring and submittals required to make the work of this Section complete.
  - 2. Installation of lateral bracing, and soil support as shown on drawings, as specified herein, and as required by conditions at the site, necessary to maintain a safe excavation, and to protect existing buildings, streets, walkways, utilities, and other improvements and excavation against loss of support.
  - 3. Maintenance of excavation support and bracing.
  - 4. Removal of excavation support and bracing as required.
  - 5. The Contractor shall provide the Owner's third-party testing agency with reasonable office space (with heating, cooling, electricity) on-site to conveniently prepare and maintain all necessary project records pertinent to their duties and store necessary equipment. Adequate spaced to store inspection equipment shall be provided.
- B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section.

1.2 REFERENCES AND REGULATORY REQUIREMENTS

- A. All work and materials under this section shall conform to the latest revision of the following standard specifications, where not otherwise required by the Contract Documents:
  - 1. American Society for Testing and Materials (ASTM) Standards
  - 2. The 2003 International Building Code (including the 2005 Connecticut Supplement and the 2009 Connecticut Amendment), and the requirements and regulations of any other Federal, State or Local ordinances having jurisdiction.
  - 3. Geotechnical Investigation & Recommendations letter report prepared by Langan CT, Inc., dated 17 February 2014.
  - 4. Post-Tensioning Institute "Recommendations for Prestressed rock and soil anchors", latest edition.

EXCAVATION SUPPORT AND PROTECTION

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- B. Applicable Department of Veteran's Affairs standards and references.

### 1.3 SUBMITTALS

- A. Unless otherwise indicated, transmit all submittals to the Construction Manager for review by the Owner's Geotechnical and Structural Engineers before proceeding with ordering, fabricating, or any other work of this Section. Submittal review will be of the concept only and shall not in any way diminish or limit the Contractor's responsibility for the design, performance and quality of the work of this section and for the protecting of existing structures. The Contractor shall be solely responsible for protection of adjacent structures and maintaining a safe excavation. Review of submittals shall in no way be construed as approval of design on means and methods of shoring, bracing and underpinning work. The Contractor is solely responsible for all aspects of work in this section.
- B. Professional Engineering: Submit name of Contractor's Professional Engineer engaged and assigned to supervise sheeting, bracing and soil support design and installation. Consultant and field supervisor shall be Professional Engineers licensed in the State of Connecticut.
- C. The Contractor's Professional Engineer shall prepare an outline of the Contractor's construction methods and step-by-step procedures together with plans and details of proposed excavation support and bracing. This shall be coordinated with the relevant submittals identified in Section 310000 Earthwork, and shall be submitted and reviewed prior to submittal of the more detailed shop drawings.
- D. Shop Drawings: Prepare and submit shop drawings of all items in this Section, in accordance with the Contract Documents at least 15 days before beginning work for review. The shop drawings shall be submitted signed and sealed by Professional Engineer licensed in the State of Connecticut engaged by the Contractor. Shop drawings shall show in detail the various portions of the work, kind of materials and method of securing same together, the sequence of all proposed work and the work of other trades.
  - 1. Excavation Support: Provide shop drawings that show the limits and layout of the excavation support system. Provide representative sections for each side of the excavation that include structural details of the chosen method of earth support, embedment depth and bracing elements. Provide elevations that give the location and identification of all lateral bracing elements. Provide a schedule that gives design load in each brace, proof test load and lock-off load. Details for temporary needles, shores, tie backs, etc., shall be included in the shop drawings.
- E. Calculations: Provide complete design calculations signed and sealed by a Professional Engineer licensed in the State of Connecticut for the excavation support system shown on the shop drawings. The calculations shall include the design assumptions, lateral earth pressures,

**Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00**

surcharge loads and vertical building loads. They shall include design stresses and total loads in the structural steel and concrete elements. Lastly, the calculations shall provide an overall stability analysis to justify embedment depths and extent of lateral bracing. Provide separate calculations for concentrated loadings such as that imposed by the hoist or crane (as applicable).

- F. Submit qualification data for design firm and excavation contractor and persons specified herein, to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, telephone numbers and names of Architects and Owners.
- G. Pre-Construction Conditions Documentation: The Owner's Representative will document the pre-construction condition of adjacent structures and site improvements, the results of which will be made available to the Contractor when completed. The Contractor shall perform, if he wishes, his own conditions documentation work and shall submit any findings that differ from the Owner's survey as specified herein at least 15 days before beginning the work.
- H. Submit approvals and permits to the Construction Manager a minimum of 15 days prior to commencement of construction.

**1.4 QUALITY ASSURANCE**

- A. Contractor Qualifications: The Contractor performing the work of this Section shall demonstrate that they have at least 10 years of recent field experience on projects of similar size, scope and complexity.
- B. Design Supervision: The Contractor shall retain the services of a Professional Licensed Engineer licensed in the State of Connecticut who shall design and supervise installation of all work of this Section.
- C. Monitoring:
  - 1. Monitoring of all structures, utilities and tunnels shall be performed in accordance with the project Drawings and Specifications.
  - 2. The monitoring data shall serve as means to evaluate the performance of the installed excavation support system. The Contractor may elect to provide additional monitoring at his own accord. Where additional monitoring is performed by the Contractor, such data shall be provided to the Geotechnical Engineer of Record for review.
- D. Surveying: The Contractor shall engage a Licensed Land Surveyor to provide all necessary surveying including layout and any monitoring to make the work of this section complete.
- E. Codes and Permits:

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

1. Comply with the 2003 International Building Code (including the 2005 Connecticut Supplement and the 2009 Connecticut Amendment), and any other Federal, State, or Local codes and ordinances having jurisdiction.
  2. All labor, materials, equipment and services necessary to make the work comply with such requirements shall be provided without additional cost to the Owner.
  3. The Contractor shall procure and pay for all permits and licenses required to complete the work of this Section.
- F. The Contractor shall retain at his own cost a consultant experienced with tieback operations, if tiebacks are needed. The Contractor's consultant shall be a registered professional engineer in the State of Connecticut. He shall provide final design of tiebacks, as required for specific means and methods. The Contractor's consultant shall sign and seal all submittals related to tiebacks and shall be present at all meetings associated with this work.
- G. Third-Party Observation and Testing:
1. The Owner shall engage, under the requirements of Section 1704.1 of the Building Code, one or more third-party testing agencies to observe installation and provide all necessary material testing related to the work of this Section.
  2. Observation of excavation, sheeting, shoring and bracing installation, and all necessary materials testing shall be by the Owner's third-party testing agency.
  3. The Owner's third-party testing agency for installation shall log the installation and prepare records of daily activities. This shall not relieve the Contractor's responsibility to provide an excavation support system capable of meeting the requirements outlined on the Contract Drawings and specified herein.
  4. The Owner's third-party testing agency shall prepare and submit daily reports summarizing the installation and/or material testing activities. The Owner's third-party testing agency shall prepare records, including items completed each day, job and weather conditions, a detailed construction log of each element installed, including sheeting depths, other general quantities and any other pertinent construction details. The Contractor shall cooperate and assist the Owner's third-party testing agency(s) in the making of these records.
  5. The Contractor shall have the sole responsibility for coordinating his work with the Owner's third-party testing agency(s) to assure that all tests and inspection procedures required by the Contract Documents are properly provided. The Contractor shall cooperate fully with the Owner's third-party testing agency(s) in the



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

performance of their work.

6. The Owner's third-party testing agency(s) shall submit all field logs and test reports necessary to facilitate any corrective design requirements.
7. The Owner's third-party testing agency(s) shall provide all necessary certifications of the work in compliance with Building Code requirements.
8. The Owner's third-party testing agency(s) shall notify the Construction Manager promptly of any part of the work of this section not in compliance with the Contract Documents.

#### 1.5 PRECONSTRUCTION MEETING

- A. Prior to work on site, the Construction Manager will arrange a series of meetings to discuss coordination and scheduling. Parties to be present: Structural Engineer, Geotechnical Engineer, Testing Laboratory, Construction Manager, and SOE Contractor and his Engineer, the Owner's third-party testing agency and the Owner. Agenda to include:

1. Size and capacity of equipment used
2. Review of boring and groundwater data
3. Excavation procedures and installation of SOE
4. SOE testing requirements
5. Third-party testing reporting requirements
6. Safety measures to be followed
7. Groundwater control
8. Monitoring requirements and reporting
9. Emergency procedures for unanticipated instability of SOE or ground

#### 1.6 DAILY PLANNING MEETING

- A. Construction Manager shall arrange for daily site meeting with Owner's third-party testing agency, Contractor, Environmental Engineer and Construction Manager to review all proposed work before the start of each shift.

#### 1.7 PROJECT CONDITIONS

- A. Refer to the Geotechnical Engineering Report prepared and associated boring and test data for information pertaining to the general

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

subsurface conditions within the project site.

- B. Boring and other in situ test logs are made available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between borings. The Owner will not be responsible for interpretation and conclusions drawn from this data by the Contractor.
1. The Contractor, by careful examination, shall inform himself as to the nature and location of the work, the conformation of the ground, the nature of the subsurface conditions, the locations of the groundwater table, the character, quality and quantity of the materials to be encountered, the character of the equipment and facilities needed preliminary to and during the execution of the work and all other matters which can in any way effect the work.
  2. The Contractor shall be held to have visited the site and to have familiarized himself with the existing conditions of adjoining properties, utilities and buildings.
  3. The Contractor shall investigate the conditions of public thoroughfares and roads as to availability, clearances, loads, limits, restrictions, and other limitations affecting transportation to, ingress and egress of the site of the work. The Contractor shall conform to all State and Federal regulations in regard to the transportation of materials to and from and at the job site and shall secure in advance such permits as may be required.

## PART 2 PRODUCTS

### 2.1 MATERIAL

- A. Provide suitable sheet piles, soldier piles, trench boxes, tie-backs, lateral bracing and soil support materials which will withstand loads imposed without movement. Materials shall be kept in serviceable condition at all times.
- B. Lagging or other lumber shall meet requirements for structural lumber.

## PART 3 EXECUTION

### 3.1 GENERAL

- A. The Contractor shall provide, erect and maintain excavation support and bracing, around the four sides of the excavation, as necessary. Locate the system to clear permanent construction and to permit forming and finishing of concrete surfaces.
- B. Excavation support and bracing shall be erected and maintained to the entire satisfaction of any City, State or local authorities having jurisdiction. Maintain system until structural elements are replaced

## EXCAVATION SUPPORT AND PROTECTION

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

by other bracing or until permanent construction is able to resist lateral earth, surcharge and hydrostatic pressures.

- C. The design, construction and performance of the sheeting, bracing and soil support work for the purpose of which it is erected shall be the entire responsibility of the Contractor.
- D. Should any subsidence or any other damage occur due to the inefficiency of the work, the damage shall be made good by the Contractor at his own expense.
- E. The Contractor shall make use of such methods of work as are best adapted to preserve the safety and stability of foundations, rails, walls, utilities and other parts of affected buildings or structures.

3.2 EXCAVATION SUPPORT AND BRACING

- A. Excavation support and bracing shall be designed and constructed in accordance with the 2003 International Building Code (including the 2005 Connecticut Supplement and the 2009 Connecticut Amendment) and other jurisdictional agency requirements.
- B. Install excavation support and bracing to permit excavation to foundation subgrade level.
- C. Excavation support shall be adequate to resist earth and hydrostatic pressures and lateral pressures due to surcharge loads, to prevent displacement of adjacent ground and to prevent loss of support or damage to buildings, utilities, sidewalks and streets. Lateral loads created from adjacent buildings, cranes and/or street loads shall be included in the design.
- D. Members shall have adequate size to meet design standards for allowable stresses and factors of safety for temporary construction.
- E. During the excavation work specified in Section 310000 - Earthwork, if additional locations require excavation support and bracing based on the Contractor's construction methods and procedures, then the Contractor shall provide such additional supports at no additional cost to the Owner. Such additional supports shall be designed and constructed in accordance with the requirements of this Section.
- F. All the above work shall be carried on in such a manner as not to interfere with the progress of the work under this Contract.
- G. Excavation support and bracing may be removed, left in place, or cut as approved by the Owner's Structural and Geotechnical Engineers and as directed by the Construction Manager. Any material that affects finished construction shall be removed. Carefully remove materials such that no loss of support occurs beneath areas adjacent to the sheeting. Any material left in place must be removed not less than 4-feet below finished grade. Excavation support and bracing material

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

removed from the excavation shall be immediately removed from the site and properly disposed of in accordance with all applicable State, City, and Federal Codes.

- H. Where excavation support and bracing is required to withstand earth pressures resulting from backfill placement, the backfill shall not be placed until after sheeting and bracing has been completely installed. Materials shall not be removed until the supporting structure has attained adequate strength.
- I. Lateral bracing shall be external tiebacks or internal braces.
- J. Excavations should not exceed a depth of 2 feet below the point of lateral support to be installed. Lateral support shall be installed and preloaded prior to continuing excavation.
- K. Monitoring of all structures, utilities and tunnels shall be performed in accordance with the project Drawings and Specifications.

### 3.3 WASTE MANAGEMENT

- A. Separate and dispose of waste in accordance with the project requirements.

### 3.4 CLOSEOUT

- A. Substantial Completion Requirements:
  - 1. Provide Final Cleaning immediately prior to Substantial Completion inspection.
  - 2. Corrective Work:
    - a. Remove, Repair and Reinstall or Restore in Place damaged items.
    - b. Replace damaged materials or items with New if repair not acceptable to Owner.
  - 3. Provide product data to complete Operation & Maintenance Manuals.
  - 4. Submit executed Warranties.

END OF SECTION

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

**SECTION 32 05 23**  
**CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section shall cover site work concrete constructed upon the prepared subgrade and in conformance with the lines, grades, thickness, and cross sections shown on the Drawings. Construction shall include the following:
- B. Curb, and wheel stops.

**1.2 RELATED WORK**

- A. Section 00 72 00, GENERAL CONDITIONS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- F. Section 31 20 00, EARTHWORK.

**1.3 DESIGN REQUIREMENTS**

Design all elements with the latest published version of applicable codes.

**1.4 SUBMITTALS**

Contractor shall submit the following.

- A. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.
  - 1. Precast Concrete Curbing
  - 2. Parking lot Wheel Stops
  - 3. Expansion joint filler

**1.6 APPLICABLE PUBLICATIONS**

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Refer to the latest edition of all referenced Standards and codes.

- A. American Association of State Highway and Transportation Officials (AASHTO):
  - M147-65-UL.....Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses (R 2004)
- B. American Society for Testing and Materials (ASTM):
  - C150/C150M-12.....Standard Specification for Portland Cement
  - D1751-04(2008).....Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Precast Concrete Type: Concrete shall be as per Table 1 - Concrete Type, air entrained.

TABLE I - CONCRETE TYPE

	Concrete Strength		Non-Air-Entrained	Air-Entrained	
	Min. 28 Day Comp. Str. Psi (MPa)	Min. Cement lbs/c. yd (kg/m <sup>3</sup> )	Max. Water Cement Ratio	Min. Cement lbs/c. yd (kg/m <sup>3</sup> )	Max. Water Cement Ratio
Precast Concrete Curbing-Type A	5000 (35) <sup>1,3</sup>	630 (375)	0.45	650 (385)	0.40
Parking Lot Wheel Stops- Type B	4000 (30) <sup>1,3</sup>	550 (325)	0.55	570 (340)	0.50

### 2.2 SELECT SUBBASE (WHERE REQUIRED)

- A. Subbase material shall consist of select granular material composed of sand, sand-gravel, crushed stone, crushed or granulated slag, with or without soil binder, or combinations of these materials conforming to AASHTO M147, as follows.

GRADE REQUIREMENTS FOR SOILS USED AS SUBBASE MATERIALS,  
BASE COURSES AND SURFACES COURSES

AASHTO M147		Percentage Passing by Mass					
Sieve	Size	Grades					
(mm)	(in)	A	B	C	D	E	F
50	2	100	100				
25	1		75-95	100	100	100	100
9.5	3/8	30-65	40-75	50-85	60-100		
4.47	No. 4	25-55	30-60	35-65	50-85	55-100	70-100
2.00	No. 10	15-40	20-45	25-50	40-70	40-100	55-100
0.425	No. 40	8-20	15-30	15-30	25-45	20-50	30-70
0.075	No. 200	2-8	5-20	5-15	5-20	6-20	8-25

- B. Materials meeting other gradations than that noted will be acceptable whenever the gradations are within a tolerance of three to five percent, plus or minus, of the single gradation established by the job-mix

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

formula, or as recommended by the geotechnical engineer and approved by the Resident Engineer.

- C. Subbase material shall produce a compacted, dense-graded course, meeting the density requirement specified herein.

### **2.3 EXPANSION JOINT FILLERS**

Material shall conform to ASTM D1751-04.

## **PART 3 - EXECUTION**

### **3.1 SUBGRADE PENETRATION**

- A. Prepare, construct, and finish the subgrade as specified in Section 31 20 00, EARTHWORK.
- B. Maintain the subgrade in a smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.
- C. Compaction:
1. Perform compaction with approved hand or mechanical equipment well suited to the material being compacted.
  2. Moisten or aerate the material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.
  3. Compact each layer to at least 95 percent or 100 percent of maximum density as specified in Section 31 20 00, EARTHWORK.
- D. Smoothness Test and Thickness Control: Test the completed subbase for grade and cross section with a straight edge.
1. The surface of each layer shall not show any deviations in excess of 3/8 inch (10 mm).
  2. The completed thickness shall be within 1/2 inch (13 mm) of the thickness as shown on the Drawings.
- E. Protection:
1. Maintain the finished subbase in a smooth and compacted condition until the concrete has been placed.
  2. When Contractor's subsequent operations or adverse weather disturbs the approved compacted subbase, excavate, and reconstruct it with new material meeting the requirements herein specified, at no additional cost to the Government.

### **3.3 SETTING CURB**

- A. Base Support:

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

1. Compact the base material under the forms true to grade so that, when set, they will be uniformly supported for their entire length at the grade as shown.
2. Correct imperfections or variations in the base material grade by cutting or filling and compacting.

B. Setting Curb:

1. Set precast concrete curb (straight and curved sections), to the lengths and radii indicated on the Site Utility Plans.

**3.4 EQUIPMENT**

- A. The Resident Engineer shall approve equipment and tools necessary for handling materials and performing all parts of the work prior to commencement of work.
- B. Maintain equipment and tools in satisfactory working condition at all times.

**3.16 EXPANSION JOINTS**

- A. Use a preformed expansion joint filler material of the thickness as shown to form expansion joints.
- B. Material shall extend the full depth of concrete, cut and shaped to the cross section as shown, except that top edges of joint filler shall be below the finished concrete surface where shown to allow for sealing.
- C. Anchor with approved devices to prevent displacing during placing and finishing operations.
- D. Round the edges of joints with an edging tool.
- E. Form expansion joints as follows:
  1. Without dowels, about structures and features that project through, into, or against any site work concrete construction.
  2. Using joint filler of the type, thickness, and width as shown.
  3. Installed in such a manner as to form a complete, uniform separation between the structure and the site work concrete item.

**3.22 PROTECTION**

The contractor shall protect the concrete against all damage prior to final acceptance by the Government. Remove concrete containing excessive cracking, fractures, spalling, or other defects and reconstruct the entire section between regularly scheduled joints, when directed by the Resident Engineer, and at no additional cost to the Government.

**3.23 FINAL CLEAN-UP**

Remove all debris, rubbish and excess material from the Station.

- - - E N D - - -



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

**SECTION 32 05 23**  
**CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section shall cover site work concrete constructed upon the prepared subgrade and in conformance with the lines, grades, thickness, and cross sections shown on the Drawings. Construction shall include the following:
- B. Curb, and wheel stops.

**1.2 RELATED WORK**

- A. Section 00 72 00, GENERAL CONDITIONS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- F. Section 31 20 00, EARTHWORK.

**1.3 DESIGN REQUIREMENTS**

Design all elements with the latest published version of applicable codes.

**1.4 SUBMITTALS**

Contractor shall submit the following.

- A. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.
  - 1. Precast Concrete Curbing
  - 2. Parking lot Wheel Stops
  - 3. Expansion joint filler

**1.6 APPLICABLE PUBLICATIONS**

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Refer to the latest edition of all referenced Standards and codes.

- A. American Association of State Highway and Transportation Officials (AASHTO):
  - M147-65-UL.....Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses (R 2004)
- B. American Society for Testing and Materials (ASTM):
  - C150/C150M-12.....Standard Specification for Portland Cement
  - D1751-04(2008).....Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural

Combined Heat and Power (CHP) Plant  
 West Haven Veteran's Affairs Medical Center  
 West Haven, Connecticut  
 VA Contract No. VA701-P-0163  
 Task Order VA701-13-J-0093  
 CannonDesign Project No. 004243.00

Construction (Non-extruding and Resilient  
 Bituminous Types)

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Precast Concrete Type: Concrete shall be as per Table 1 - Concrete Type, air entrained.

TABLE I - CONCRETE TYPE

	Concrete Strength		Non-Air-Entrained	Air-Entrained	
	Min. 28 Day Comp. Str. Psi (MPa)	Min. Cement lbs/c. yd (kg/m <sup>3</sup> )	Max. Water Cement Ratio	Min. Cement lbs/c. yd (kg/m <sup>3</sup> )	Max. Water Cement Ratio
Precast Concrete Curbing-Type A	5000 (35) <sup>1,3</sup>	630 (375)	0.45	650 (385)	0.40
Parking Lot Wheel Stops- Type B	4000 (30) <sup>1,3</sup>	550 (325)	0.55	570 (340)	0.50

### 2.2 SELECT SUBBASE (WHERE REQUIRED)

- A. Subbase material shall consist of select granular material composed of sand, sand-gravel, crushed stone, crushed or granulated slag, with or without soil binder, or combinations of these materials conforming to AASHTO M147, as follows.

GRADE REQUIREMENTS FOR SOILS USED AS SUBBASE MATERIALS,  
 BASE COURSES AND SURFACES COURSES

AASHTO M147		Percentage Passing by Mass					
Sieve	Size	Grades					
(mm)	(in)	A	B	C	D	E	F
50	2	100	100				
25	1		75-95	100	100	100	100
9.5	3/8	30-65	40-75	50-85	60-100		
4.47	No. 4	25-55	30-60	35-65	50-85	55-100	70-100
2.00	No. 10	15-40	20-45	25-50	40-70	40-100	55-100
0.425	No. 40	8-20	15-30	15-30	25-45	20-50	30-70
0.075	No. 200	2-8	5-20	5-15	5-20	6-20	8-25

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- B. Materials meeting other gradations than that noted will be acceptable whenever the gradations are within a tolerance of three to five percent, plus or minus, of the single gradation established by the job-mix formula, or as recommended by the geotechnical engineer and approved by the Resident Engineer.
- C. Subbase material shall produce a compacted, dense-graded course, meeting the density requirement specified herein.

### **2.3 EXPANSION JOINT FILLERS**

Material shall conform to ASTM D1751-04.

## **PART 3 - EXECUTION**

### **3.1 SUBGRADE PENETRATION**

- A. Prepare, construct, and finish the subgrade as specified in Section 31 20 00, EARTHWORK.
- B. Maintain the subgrade in a smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.
- C. Compaction:
  - 1. Perform compaction with approved hand or mechanical equipment well suited to the material being compacted.
  - 2. Moisten or aerate the material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.
  - 3. Compact each layer to at least 95 percent or 100 percent of maximum density as specified in Section 31 20 00, EARTHWORK.
- D. Smoothness Test and Thickness Control: Test the completed subbase for grade and cross section with a straight edge.
  - 1. The surface of each layer shall not show any deviations in excess of 3/8 inch (10 mm).
  - 2. The completed thickness shall be within 1/2 inch (13 mm) of the thickness as shown on the Drawings.
- E. Protection:
  - 1. Maintain the finished subbase in a smooth and compacted condition until the concrete has been placed.
  - 2. When Contractor's subsequent operations or adverse weather disturbs the approved compacted subbase, excavate, and reconstruct it with new material meeting the requirements herein specified, at no additional cost to the Government.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

### **3.3 SETTING CURB**

#### **A. Base Support:**

1. Compact the base material under the forms true to grade so that, when set, they will be uniformly supported for their entire length at the grade as shown.
2. Correct imperfections or variations in the base material grade by cutting or filling and compacting.

#### **B. Setting Curb:**

1. Set precast concrete curb (straight and curved sections), to the lengths and radii indicated on the Site Utility Plans.

### **3.4 EQUIPMENT**

- A. The Resident Engineer shall approve equipment and tools necessary for handling materials and performing all parts of the work prior to commencement of work.
- B. Maintain equipment and tools in satisfactory working condition at all times.

### **3.16 EXPANSION JOINTS**

- A. Use a preformed expansion joint filler material of the thickness as shown to form expansion joints.
- B. Material shall extend the full depth of concrete, cut and shaped to the cross section as shown, except that top edges of joint filler shall be below the finished concrete surface where shown to allow for sealing.
- C. Anchor with approved devices to prevent displacing during placing and finishing operations.
- D. Round the edges of joints with an edging tool.
- E. Form expansion joints as follows:
  1. Without dowels, about structures and features that project through, into, or against any site work concrete construction.
  2. Using joint filler of the type, thickness, and width as shown.
  3. Installed in such a manner as to form a complete, uniform separation between the structure and the site work concrete item.

### **3.22 PROTECTION**

The contractor shall protect the concrete against all damage prior to final acceptance by the Government. Remove concrete containing excessive cracking, fractures, spalling, or other defects and reconstruct the entire section between regularly scheduled joints, when directed by the Resident Engineer, and at no additional cost to the Government.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

### **3.23 FINAL CLEAN-UP**

Remove all debris, rubbish and excess material from the Station.

- - - E N D - - -

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

***THIS PAGE INTENTIONALLY LEFT BLANK***

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

**SECTION 32 12 16**  
**ASPHALT PAVING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This work shall cover the composition, mixing, construction upon the prepared subgrade, and the protection of hot asphalt concrete pavement. The hot asphalt concrete pavement shall consist of an aggregate or asphalt base course and asphalt surface course constructed in conformity with the lines, grades, thickness, and cross sections as shown. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

**1.2 RELATED WORK**

- A. Laboratory and field testing requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation: Paragraph 3.3 and Section 31 20 00, EARTH MOVING.
- C. Pavement Markings: Section 32 17 23, PAVEMENT MARKINGS.

**1.3 INSPECTION OF PLANT AND EQUIPMENT**

The Resident Engineer shall have access at all times to all parts of the material producing plants for checking the mixing operations and materials and the adequacy of the equipment in use.

**1.4 ALIGNMENT AND GRADE CONTROL**

The Contractor's Registered Professional Land Surveyor shall establish and control the pavement (aggregate or asphalt base course and asphalt surface course) alignments, grades, elevations, and cross sections as shown on the Drawings.

**1.5 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Data and Test Reports:
  - 1. Aggregate Base Course: Sources, gradation, liquid limit, plasticity index, percentage of wear, and other tests required by State Highway Department.
  - 2. Asphalt Base/Surface Course: Aggregate source, gradation, soundness loss, percentage of wear, and other tests required by the Connecticut Department of Transportation (ConnDOT).
  - 3. Job-mix formula.



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

C. Certifications:

1. Asphalt prime and tack coat material certificate of conformance to State Highway Department requirements.
2. Asphalt cement certificate of conformance to ConnDOT requirements.
3. Job-mix certification - Submit plant mix certification that mix equals or exceeds the ConnDOT Specification.

D. One copy of the ConnDOT Specifications.

E. Provide MSDS (Material Safety Data Sheets) for all chemicals used on ground.

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. Aggregate base and asphalt concrete materials shall conform to the requirements of the following and other appropriate sections of the latest version of the ConnDOT Material Specifications, including amendments, addenda and errata. Where the term "Engineer" or "Commission" is referenced in the State Highway Specifications, it shall mean the VA Resident Engineer or VA Contracting Officer.

**2.2 AGGREGATES**

- A. Provide aggregates consisting of crushed stone, gravel, sand, or other sound, durable mineral materials processed and blended, and naturally combined.
- B. Subbase aggregate (where required) maximum size: 38mm(1-1/2").
- C. Base aggregate maximum size:
1. Base course over 152mm(6") thick: 38mm(1-1/2");
  2. Other base courses: 19mm(3/4").
- D. Asphaltic base course:
1. Maximum particle size not to exceed 25.4mm(1").
  2. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.
- E. Aggregates for asphaltic concrete paving: Provide a mixture of sand, mineral aggregate, and liquid asphalt mixed in such proportions that the percentage by weight will be within:

<u>Sieve Sizes</u>	<u>Percentage Passing</u>
19mm(3/4")	100
9.5mm(3/8")	67 to 85
6.4mm(1/4")	50 to 65

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

2.4mm(No. 8 mesh)	37 to 50
600µm(No. 30 mesh)	15 to 25
75µm(No. 200 mesh)	3 to 8

plus 50/60 penetration liquid asphalt at 5 percent to 6-1/2 percent of the combined dry aggregates.

### **2.3 ASPHALTS**

A. Comply with provisions of Asphalt Institute Specification SS2:

1. Asphalt cement: Penetration grade 50/60
2. Prime coat: Cut-back type, grade MC-250
3. Tack coat: Uniformly emulsified, grade SS-1H

### **2.4 SEALER**

- A. Provide a sealer consisting of suitable fibrated chemical type asphalt base binders and fillers having a container consistency suitable for troweling after thorough stirring, and containing no clay or other deleterious substance.
- B. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

The Asphalt Concrete Paving equipment, weather limitations, job-mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate sections of the State Highway Specifications for the type of material specified.

### **3.2 MIXING ASPHALTIC CONCRETE MATERIALS**

- A. Provide hot plant-mixed asphaltic concrete paving materials.
1. Temperature leaving the plant: 143 degrees C(290 degrees F) minimum, 160 degrees C(320 degrees F) maximum.
  2. Temperature at time of placing: 138 degrees C(280 degrees F) minimum.

### **3.3 SUBGRADE**

- A. Shape to line and grade and compact with self-propelled rollers.
- B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.
- C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.
- E. Proof-roll the subgrade with maximum 45 tonne (50 ton) gross weight dump truck as directed by VA Resident Engineer or VA Contracting Officer. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

### **3.4 BASE COURSES**

- A. Subbase (when required)
  - 1. Spread and compact to the thickness shown on the drawings.
  - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
  - 3. After completion of the subbase rolling there shall be no hauling over the subbase other than the delivery of material for the top course.
- B. Base
  - 1. Spread and compact to the thickness shown on the drawings.
  - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
  - 3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.
- C. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0mm (0.0") to plus 12.7mm (0.5").
- D. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 5mm in 3m (3/16 inch in ten feet).
- E. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

### **3.5 PLACEMENT OF ASPHALTIC CONCRETE PAVING**

- A. Remove all loose materials from the compacted base.
- B. Apply the specified prime coat, and tack coat where required, and allow to dry in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.
- C. Receipt of asphaltic concrete materials:
  - 1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 130 degrees C (280 degrees F).
  - 2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 10 degrees C (50 degrees F), not during fog, rain, or other unsuitable conditions.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

D. Spreading:

1. Spread material in a manner that requires the least handling.
2. Where thickness of finished paving will be 76mm (3") or less, spread in one layer.

E. Rolling:

1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown on the drawings.
2. Roll in at least two directions until no roller marks are visible.
3. Finished paving smoothness tolerance:
  - a. No depressions which will retain standing water.
  - b. No deviation greater than 3mm in 1.8m (1/8" in six feet).

**3.6 APPLICATION OF SEAL COAT**

- A. Prepare the surfaces, mix the seal coat material, and apply in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.
- B. Apply one coat of the specified sealer.
- C. Achieve a finished surface seal which, when dry and thoroughly set, is smooth, tough, resilient, of uniform black color, and free from coarse textured areas, lap marks, ridges, and other surface irregularities.

**3.7 PROTECTION**

Protect the asphaltic concrete paved areas from traffic until the sealer is set and cured and does not pick up under foot or wheeled traffic.

**3.8 FINAL CLEAN-UP**

Remove all debris, rubbish, and excess material from the work area.

- - - E N D - - -

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

**SECTION 32 17 23**  
**PAVEMENT MARKINGS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This work shall consist of furnishing and applying paint on pavement surfaces, in the form of traffic lanes, parking bays, areas restricted to handicapped persons, crosswalks, and other detail pavement markings, in accordance with the details as shown or as prescribed by the Resident Engineer. Conform to the Manual on Uniform Traffic Control Devices for Streets and Highways, published by the U.S. Department of Transportation, Federal Highway Administration, for details not shown.

**1.2 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish Manufacturer's Certificates and Data certifying that the following materials conform to the requirements specified.
- B. Paint.

**1.3 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.):
  - TT-B-1325C.....Beads (Glass Spheres); Retro-Reflective
  - TT-P-1952D.....Paint, Traffic Black, and Airfield Marking,  
Waterborne
- C. Master Painters Institute (MPI):
  - Approved Product List - 2010

**PART 2 - PRODUCTS**

**2.1 PAINT**

Paint for marking pavement (parking lot and zone marking) shall conform to MPI No. 97, color as shown. Paint for obliterating existing markings shall conform to Fed. Spec. TT-P-1952D. Paint shall be in containers of at least 18 L (5 gallons). A certificate shall accompany each batch of paint stating compliance with the applicable publication.

**2.2 PAINT APPLICATOR**

Apply all marking by approved mechanical equipment. The equipment shall provide constant agitation of paint and travel at controlled speeds.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

Synchronize one or more paint "guns" to automatically begin and cut off paint flow in the case of skip lines. The equipment shall have manual control to apply continuous lines of varying length and marking widths as shown. Provide pneumatic spray guns for hand application of paint in areas where a mobile paint applicator cannot be used. // If the equipment does not have a glass bead dispenser, use a separate piece of equipment. Adjust and synchronize the equipment with the paint applicator so that the reflective beads are distributed uniformly on the paint lines within ten seconds without any waste. // An experienced technician that is thoroughly familiar with equipment, materials, and marking layouts shall control all painting equipment and operations.

## **2.3 SANDBLASTING EQUIPMENT**

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall furnish not less than 0.08 m<sup>3</sup>/s (150 cfm) of air at a pressure of not less than 625 kPa (90 psi) at each nozzle used.

## **PART 3 - EXECUTION**

### **3.1 SURFACE PREPARATION**

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.
- B. Thoroughly clean all surfaces to be marked before application of paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods. Completely remove rubber deposits, existing paint markings, and other coatings adhering to the pavement with scrapers, wire brushings, sandblasting, mechanical abrasion, or approved chemicals as directed by the Resident Engineer. The application of paint conforming to Fed. Spec. TT-P-1952D is an option to removal of existing paint markings on asphalt pavement. Apply the black paint in as many coats as necessary to completely obliterate the existing markings. Where oil or grease are present on old pavements to be marked, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application. After cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint. Pavement marking shall follow as closely as practicable after the surface has been cleaned and dried, but do not begin any marking until the Resident Engineer has inspected the

surface and gives permission to proceed. The Contractor shall establish control points for marking and provide templates to control paint application by type and color at necessary intervals. The Contractor is responsible to preserve and apply marking in conformance with the established control points.

### **3.2 APPLICATION**

Apply uniformly painted and reflective pavement marking of required color(s), length, and width with true, sharp edges and ends on properly cured, prepared, and dried surfaces in conformance with the details as shown and established control points. The length and width of lines shall conform within a tolerance of plus or minus 75 mm (3 inches) and plus or minus 3 mm (1/8 inch), respectively, in the case of skip markings. The length of intervals shall not exceed the line length tolerance. Temperature of the surface to be painted and the atmosphere shall be above 10°C (50°F) and less than 35°C (95°F). Apply the paint at a wet film thickness of 0.4 mm (0.015 inch). Apply paint in one coat. At the direction of the Resident Engineer, markings showing light spots may receive additional coats. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of asphalt, and pick-up, displacement, or discoloration by tires of traffic. If there is a deficiency in drying of the marking, discontinue paint operations until cause of the slow drying is determined and corrected. Remove and replace marking that is applied at less than minimum material rates; deviates from true alignment; exceeds stipulated length and width tolerances; or shows light spots, smears, or other deficiencies or irregularities. Use carefully controlled sand blasting, approved grinding equipment, or other approved method to remove marking so that the surface to which the marking was applied will not be damaged.

### **3.3 PROTECTION**

Conduct operations in such a manner that necessary traffic can move without hindrance. Protect the newly painted markings so that, insofar as possible, the tires of passing vehicles will not pick up paint. Place warning signs at the beginning of the wet line, and at points well in advance of the marking equipment for alerting approaching traffic from both directions. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

crossing by traffic. Efface and replace damaged portions of markings at no additional cost to the Government.

### **3.4 DETAIL PAVEMENT MARKING**

Use Detail Pavement Markings, exclusive of actual traffic lane marking, at exit and entrance islands and turnouts, on curbs, at crosswalks, at parking bays, and at such other locations as shown. Place detail pavement markings of the color(s), width(s) and length(s), and design pattern at the locations shown.

### **3.5 TEMPORARY PAVEMENT MARKING**

When shown or directed by the Resident Engineer, apply Temporary Pavement Markings of the color(s), width(s) and length(s) shown or directed. After the temporary marking has served its purpose and when so ordered by the Resident Engineer, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method so that the surface to which the marking was applied will not be damaged. As an option, an approved preformed pressure sensitive, adhesive tape type of temporary pavement marking of the required color(s), width(s) and length(s) may be furnished and used in lieu of temporary painted markings. The Contractor shall be fully responsible for the continued durability and effectiveness of such marking during the period for which its use is required. Remove any unsatisfactory tape type marking and replace with painted markings at no additional cost to the Government.

### **3.6 FINAL CLEAN-UP**

Remove all debris, rubbish and excess material from the Station.

- - - E N D - - -



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

**SECTION 32 17 23**  
**PAVEMENT MARKINGS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This work shall consist of furnishing and applying paint on pavement surfaces, in the form of traffic lanes, parking bays, areas restricted to handicapped persons, crosswalks, and other detail pavement markings, in accordance with the details as shown or as prescribed by the Resident Engineer. Conform to the Manual on Uniform Traffic Control Devices for Streets and Highways, published by the U.S. Department of Transportation, Federal Highway Administration, for details not shown.

**1.2 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish Manufacturer's Certificates and Data certifying that the following materials conform to the requirements specified.
- B. Paint.

**1.3 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.):
  - TT-B-1325C.....Beads (Glass Spheres); Retro-Reflective
  - TT-P-1952D.....Paint, Traffic Black, and Airfield Marking,  
Waterborne
- C. Master Painters Institute (MPI):
  - Approved Product List -2010

**PART 2 - PRODUCTS**

**2.1 PAINT**

Paint for marking pavement (parking lot and zone marking) shall conform to MPI No. 97, color as shown. Paint for obliterating existing markings shall conform to Fed. Spec. TT-P-1952D. Paint shall be in containers of at least 18 L (5 gallons). A certificate shall accompany each batch of paint stating compliance with the applicable publication.

## **2.2 PAINT APPLICATOR**

Apply all marking by approved mechanical equipment. The equipment shall provide constant agitation of paint and travel at controlled speeds. Synchronize one or more paint "guns" to automatically begin and cut off paint flow in the case of skip lines. The equipment shall have manual control to apply continuous lines of varying length and marking widths as shown. Provide pneumatic spray guns for hand application of paint in areas where a mobile paint applicator cannot be used. // If the equipment does not have a glass bead dispenser, use a separate piece of equipment. Adjust and synchronize the equipment with the paint applicator so that the reflective beads are distributed uniformly on the paint lines within ten seconds without any waste. // An experienced technician that is thoroughly familiar with equipment, materials, and marking layouts shall control all painting equipment and operations.

## **2.3 SANDBLASTING EQUIPMENT**

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall furnish not less than  $0.08 \text{ m}^3/\text{s}$  (150 cfm) of air at a pressure of not less than 625 kPa (90 psi) at each nozzle used.

# **PART 3 - EXECUTION**

## **3.1 SURFACE PREPARATION**

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.
- B. Thoroughly clean all surfaces to be marked before application of paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods. Completely remove rubber deposits, existing paint markings, and other coatings adhering to the pavement with scrapers, wire brushings, sandblasting, mechanical abrasion, or approved chemicals as directed by the Resident Engineer. The application of paint conforming to Fed. Spec. TT-P-1952D is an option to removal of existing paint markings on asphalt pavement. Apply the black paint in as many coats as necessary to completely obliterate the existing markings. Where oil or grease are present on old pavements to be marked, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each

application. After cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint. Pavement marking shall follow as closely as practicable after the surface has been cleaned and dried, but do not begin any marking until the Resident Engineer has inspected the surface and gives permission to proceed. The Contractor shall establish control points for marking and provide templates to control paint application by type and color at necessary intervals. The Contractor is responsible to preserve and apply marking in conformance with the established control points.

### **3.2 APPLICATION**

Apply uniformly painted and reflective pavement marking of required color(s), length, and width with true, sharp edges and ends on properly cured, prepared, and dried surfaces in conformance with the details as shown and established control points. The length and width of lines shall conform within a tolerance of plus or minus 75 mm (3 inches) and plus or minus 3 mm (1/8 inch), respectively, in the case of skip markings. The length of intervals shall not exceed the line length tolerance. Temperature of the surface to be painted and the atmosphere shall be above 10°C (50°F) and less than 35°C (95°F). Apply the paint at a wet film thickness of 0.4 mm (0.015 inch). Apply paint in one coat. At the direction of the Resident Engineer, markings showing light spots may receive additional coats. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of asphalt, and pick-up, displacement, or discoloration by tires of traffic. If there is a deficiency in drying of the marking, discontinue paint operations until cause of the slow drying is determined and corrected. Remove and replace marking that is applied at less than minimum material rates; deviates from true alignment; exceeds stipulated length and width tolerances; or shows light spots, smears, or other deficiencies or irregularities. Use carefully controlled sand blasting, approved grinding equipment, or other approved method to remove marking so that the surface to which the marking was applied will not be damaged.

### **3.3 PROTECTION**

Conduct operations in such a manner that necessary traffic can move without hindrance. Protect the newly painted markings so that, insofar as possible, the tires of passing vehicles will not pick up paint. Place

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

warning signs at the beginning of the wet line, and at points well in advance of the marking equipment for alerting approaching traffic from both directions. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic. Efface and replace damaged portions of markings at no additional cost to the Government.

#### **3.4 DETAIL PAVEMENT MARKING**

Use Detail Pavement Markings, exclusive of actual traffic lane marking, at exit and entrance islands and turnouts, on curbs, at crosswalks, at parking bays, and at such other locations as shown. Place detail pavement markings of the color(s), width(s) and length(s), and design pattern at the locations shown.

#### **3.5 TEMPORARY PAVEMENT MARKING**

When shown or directed by the Resident Engineer, apply Temporary Pavement Markings of the color(s), width(s) and length(s) shown or directed. After the temporary marking has served its purpose and when so ordered by the Resident Engineer, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method so that the surface to which the marking was applied will not be damaged. As an option, an approved preformed pressure sensitive, adhesive tape type of temporary pavement marking of the required color(s), width(s) and length(s) may be furnished and used in lieu of temporary painted markings. The Contractor shall be fully responsible for the continued durability and effectiveness of such marking during the period for which its use is required. Remove any unsatisfactory tape type marking and replace with painted markings at no additional cost to the Government.

#### **3.6 FINAL CLEAN-UP**

Remove all debris, rubbish and excess material from the Station.

- - - E N D - - -

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

**SECTION 32 31 53**  
**PERIMETER SECURITY FENCES AND GATES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This work consists of all labor, materials, and equipment necessary for furnishing and installing perimeter security fences, gates and accessories in conformance with the lines, grades, and details as shown.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- C. Section 32 31 13, CHAIN LINK FENCES AND GATES.

**1.3 MANUFACTURER'S QUALIFICATIONS**

Fence, gates, and accessories shall be products of manufacturers regularly engaged in manufacturing items of type specified.

**1.4 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES, furnish the following:
  - 1. Manufacturer's Literature and Data: Fencing, gates and all accessories.
  - 2. Manufacturer's Certificates:
    - a. Zinc-coating complies with specifications.
    - b. Structural characteristics comply with indicated and criteria.
    - c. Connections comply with requirements indicated.
- B. Shop Drawings for entire fencing and gate track system.
- C. Certification that fence alignment meets requirements of contract documents.

**1.5 APPLICABLE PUBLICATIONS**

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

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

B. American Society for Testing and Materials: Use the latest edition of all sections listed.

ASTM A853-04(R2010).....Steel Wire, Carbon, for General Use

ASTM C94/C94M-11.....Ready-Mixed Concrete

ASTM F626-08.....Fence Fittings

ASTM F1083-10.....Pipe, Steel, Hot-Dipped Zinc-Coated  
(Galvanized) Welded, for Fence Structures

ASTM F 1184 .....Standard Specification for Industrial and  
Commercial Horizontal Slide Gates

Connecticut Department of Transportation (ConnDOT) Standard  
Specifications for Roads, Bridges and Incidental Construction

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

A. Materials shall conform to standards referenced above for ferrous metals, zinc-coated; and detailed specifications forming the various parts thereto; and other requirements specified herein. Zinc-coat metal members (including gates, posts, rails, hardware and other ferrous metal items) after fabrication shall be reasonably free of excessive roughness, blisters and sal-ammoniac spots.

### **2.2 PERIMETER SECURITY FENCE**

A. The perimeter security fence system shall include all components such as rails, posts, cantilever sliding gate system on rollers, couplings, adjustable truss rods, fasteners, straight security wire and miscellaneous hardware required.

1. black vinyl, clad wire mesh fabric, #6 gauge.

B. Material:

The perimeter security fence shall be black vinyl, clad wire mesh fabric, #6 gauge.

1. Strength requirements for posts shall meet the ConnDOT Standard Specifications for Roads, Bridges and Incidental Construction, Section 9.06, Wire Fence.

2. Strength requirements for the wire shall conform to ASTM A 853 Grade AISI 1006.

C. Heights:

**Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00**

1. Horizontal members that might be used as foot- or hand-holds shall be spaced at a minimum 8 feet (2400 mm) apart.
2. Extend fence posts 3.5' below grade.

**D. Framework:**

1. Fence shall withstand a 120 MPH wind load requirement applied to AASHTO 2001 provisions for wind loads.
2. Fence panels shall be capable of supporting a 400 LB. (882 KG) load applied at mid-span without permanent deformation.

**E. Gate:**

1. Gate shall be designed to meet the same forced entry and anti-climb characteristics as the other portions of the fence.
2. Provide manually operated sliding gates for vehicle access.
3. Gate track system shall be keyed to interlock into gate frame member (providing 200% additional strength when compared to weld only keyless systems). When interlocked with and welded to the "keyed" frame top member, gate track forms a composite structure.
4. Entire gate frame (including counterbalance section) shall include 2 adjustable stainless steel cables (minimum 3/16") per bay to allow complete gate frame adjustment (maintaining strongest structural square and level orientation).
5. Gate truck assemblies shall be tested for continuous duty and shall have precision ground and hardened components. Bearings shall be pre-lubricated and contain shock resistant outer races and captured seals.
6. Gate truck assemblies shall be supported by a minimum 5/8" plated steel bolt with self-aligning capability, rated to support a 2,000 # reaction load.
7. Gate top track and supporting hangar bracket assemblies shall be certified by a licensed professional engineer in the State of Connecticut to withstand a 2,000 lb. vertical reaction load without exceeding allowable stresses.

**F. Finishes:**

1. Zinc Coatings: 2 oz./sq. ft. (570 g/m<sup>2</sup>).

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

## **2.3 ACCESSORIES**

Accessories as necessary include caps, rail and brace ends, wire ties or clips, braces and tension bands, tension bars, truss rods, and miscellaneous accessories conforming to ASTM as referenced above.

## **2.4 CONCRETE**

Concrete to have a maximum size aggregate of 3/4 inch (19 mm), and have a minimum compressive strength of 3500 psig at 28 days. Non-shrinking grout shall consist of one part Portland cement to three parts clean, well-graded sand, non-shrinking grout additive and the minimum amount of water to produce a workable mix.

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION**

- A. Install fence by properly trained crew, on previously prepared surfaces, to line and grade as shown. Install fence in accordance with the manufacturers printed installation instructions, except as modified herein or as shown. Maintain all equipment, tools, and machinery while on the project in sufficient quantities and capacities for proper installation of posts, rails, gate, and accessories.

## **3.2 EXCAVATION**

Excavation for concrete-embedded items shall be of the dimensions shown, except in bedrock. If bedrock is encountered before reaching the required depth, continue the excavation to the depth shown or 18 inches (450 mm) into the bedrock, whichever is less, and provide a minimum of 2 inches (50 mm) larger diameter than the outside diameter of the post. Clear loose material from post holes. Grade area around finished concrete footings as shown and dispose of excess earth as directed by the Resident Engineer.

## **3.3 POST SETTING**

Install posts plumb and in alignment. Set post in concrete footings of dimensions as shown, except in bedrock. Thoroughly compact concrete so as it to be free of voids and finished in a slope or dome to divert water running down the post away from the footing. Install posts in bedrock with a minimum of one inch (25 mm) of non-shrinking grout around each post. Thoroughly work non-shrinking grout into the hole so as to be free of voids and finished in a slope or dome. Cure concrete



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

and grout a minimum of 72 hours before any further work is done on the posts.

### **3.4 POST CAPS**

Fit all exposed ends of post with caps. Provide caps that fit snugly and are weather tight. Where top rail is used, provide caps to accommodate the top rail. Install post caps as recommended by the manufacturer and as shown.

### **3.5 SUPPORTING ARMS**

Design supporting arms, when required, to be weather tight. Where top rail is used, provide arms to accommodate the top rail. Install supporting arms as recommended by the manufacturer and as shown.

### **3.6 TOP RAILS AND BOTTOM RAILS**

Provide suitable means for securing rail ends to terminal and intermediate post. Top rails shall pass through intermediate post supporting arms or caps as shown. The rails shall have expansion couplings (rail sleeves) spaced as recommended by the manufacturer. Where fence is located on top of a wall, install expansion couplings over expansion joints in wall.

### **3.7 ACCESSORIES**

Supply accessories (post braces, truss rods, and miscellaneous accessories), as required and recommended by the manufacturer, to ensure complete installation.

### **3.8 GATES**

Install gates plumb, level, and secure for full opening without interference. Set keepers, stops and other accessories into concrete as required by the manufacturer and as shown. Test gates, hardware, locking mechanisms and releases for proper operation. Adjust and lubricate as necessary.

### **3.9 REPAIR OF GALVANIZED SURFACES**

Use galvanized repair compound, stick form, or other method, where galvanized surfaces need field or shop repair. Repair surfaces in accordance with the manufacturer's printed directions.

### **3.10 FINAL CLEAN-UP**

Remove all debris, rubbish and excess material from the station.

- - - E N D - - -

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

## **SECTION 33 08 00**

### **COMMISSIONING OF SITE UTILITY SYSTEMS**

#### **PART 1 - GENERAL**

##### **1.1 DESCRIPTION**

- A. The requirements of this Section apply to all sections of Division 31.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

##### **1.2 RELATED WORK**

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

##### **1.3 SUMMARY**

- A. This Section includes requirements for commissioning the Facility site utilities systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.
- B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

##### **1.4 DEFINITIONS**

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

##### **1.5 COMMISSIONED SYSTEMS**

- A. Commissioning of a system or systems specified in Division 31 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 31, is required in cooperation with the VA and the Commissioning Agent.
- B. The Facility site utilities systems commissioning will include the systems listed in Section 01 19 00 General Commissioning Requirements:

##### **1.6 SUBMITTALS**

- A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

### **COMMISSIONING OF SITE UTILITY SYSTEMS**

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION**

**3.1 CONSTRUCTION INSPECTIONS**

- A. Commissioning of Site Utility systems will require inspection of individual elements of the site utility systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 19 00 and the Commissioning plan to schedule site utility systems inspections as required to support the Commissioning Process.

**3.2 PRE-FUNCTIONAL CHECKLISTS**

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

**3.3 CONTRACTORS TESTS**

- A. Contractor tests as required by other sections of Division 31 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

**3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING**

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

### **3.5 TRAINING OF VA PERSONNEL**

- A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 19 00. The instruction shall be scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 31 Sections for additional Contractor training requirements.

----- END -----

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

***THIS PAGE INTENTIONALLY LEFT BLANK***

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

## SECTION 33 10 00

### WATER UTILITIES

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

A. This section specifies materials and procedures for construction of underground water distribution for domestic and/or fire supply systems outside the building that are complete and ready for operation. This includes piping, structures, appurtenances and all other incidentals.

##### 1.2 RELATED WORK

- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.
- B. Concrete: Section 03 30 00, CAST IN-PLACE CONCRETE.
- C. Fire Protection System connection: Section 21 12 00, FIRE-SUPPRESSION STANDPIPES.
- D. General plumbing: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- E. Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- F. Metering: Section 25 10 10, ADVANCED UTILITY METERING SYSTEM.
- G. Erosion and Sediment Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

##### 1.3 DEFINITIONS

- A. Water distribution system: Pipelines and appurtenances which are part of the distribution system outside the building for potable water and fire supply.
- B. Water service line: Pipeline from main line to 5 feet outside of building.

##### 1.4 ABBREVIATIONS

- A. PVC: Polyvinyl chloride plastic.
- B. DI: Ductile iron pipe.
- C. WOG: Water, Oil and Gas.

##### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Ensure that valves are dry and internally protected against rust and corrosion. Protect valves against damage to threaded ends and flange faces.

WATER UTILITIES

33 10 00 - 1

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- B. Use a sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- C. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- D. Protect stored piping from moisture and dirt by elevating above grade. Protect flanges, fittings, and specialties from moisture and dirt.
- E. Store plastic piping protected from direct sunlight and support to prevent sagging and bending.
- F. Cleanliness of Piping and Equipment Systems:
  - 1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
  - 2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.

#### 1.6 COORDINATION

- A. Coordinate connection to water main with the South Central Connecticut Regional Water Authority.
- B. Coordinate water service lines with building contractor.

#### 1.7 QUALITY ASSURANCE:

- A. Products Criteria:
  - 1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
  - 2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- B. Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least three years.
- C. Regulatory requirements:

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

1. Comply with the rules, regulations and requirements of the public utility company having jurisdiction over the connection to public water lines and the extension and/or modifications to public utility systems (New Haven Regional Water Authority).
  2. Comply with the rules and regulations of the Local Health Department having jurisdiction for potable water-service (West Haven Health Department).
- D. Provide certification of factory hydrostatic testing of not less than 500 psi (3.5 MPa) in accordance with AWWA C151. Piping materials shall bear the label, stamp or other markings of the specified testing agency.
- E. Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
  2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
  3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
  4. All welds shall be stamped according to the provisions of the American Welding Society.
- F. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Resident Engineer prior to installation.
- G. Applicable codes:
1. Plumbing Systems: IPC, International Plumbing Code.
  2. Electrical components, devices and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.
  3. Fire-service main products shall be listed in the FM Global "Approval Guide" or Underwriters Laboratories (UL) "Fire Protection Equipment Directory".



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

#### 1.8 APPLICABLE PUBLICATIONS

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

B. American National Standards Institute (ANSI):

MSS SP-60-2004 .....Connecting Flange Joint Between Tapping Sleeves  
and Tapping Valves

MSS SP-108-2002.....Resilient-Seated Cast Iron, Eccentric Plug  
Valves

MSS SP-123-1998(R2006)..Non-Ferrous Threaded and Solder-Joint Unions  
for Use With Copper Water Tube

C. American Society of Mechanical Engineers (ASME):

A112.1.2-2004.....Air Gaps in Plumbing Systems (for Plumbing  
Fixtures and Water-Connected Receptors))

A112.6.3-2001.....Floor Drains

B16.1-2010.....Gray Iron Pipe Flanges and Flanged Fittings,  
Class 25, 125, 250

B16.18-2001.....Cast Copper Alloy Solder Joint Pressure  
Fittings

B16.22-2001.....Wrought Copper and Copper Alloy Solder Joint  
Pressure Fittings

B16.24-2006.....Cast Copper Alloy Pipe Flanges and Flanged  
Fittings; Classes 150, 300, 600, 900, 1500 and  
2500

B31.....Code for Pressure Piping Standards

D. American Society for Testing and Materials (ASTM):

A36/A36M-08.....Carbon Structural Steel

A48/A48M-08(2008).....Gray Iron Castings

A536-84(2009).....Ductile Iron Castings

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

A674-10.....Polyethylene Encasement for Ductile Iron Pipe  
for Water or Other Liquids

B61-08.....Steam or Valve Bronze Castings

B62-09.....Composition Bronze or Ounce Metal Castings

B88/B88M-09.....Seamless Copper Water Tube

C651-05.....Disinfecting Water Mains

C858-10e1.....Underground Precast Utility Structures

D1785-06.....Poly(Vinyl Chloride) (PVC) Plastic Pipe,  
Schedules 40, 80, and 120

D2239-03.....Polyethylene (PE) Plastic Pipe (SIDR-PR) Based  
on Controlled Inside Diameter

D2464-06.....Threaded Poly(Vinyl Chloride) PVC Pipe  
Fittings, Schedule 80

D2466-06.....Poly(Vinyl Chloride) (PVC) Pipe Fittings,  
Schedule 40

D2467-06.....Poly(Vinyl Chloride) (PVC) Plastic Pipe  
Fittings, Schedule 80

D2609-02(2008).....Plastic Insert Fittings for Polyethylene (PE)  
Plastic Pipe

D3350-10a.....Polyethylene Plastics Pipe and Fittings  
Materials

F714-10.....Polyethylene (PE) Plastic Pipe (SDR-PR) Based  
on Outside Diameter

F1267-07.....Metal, Expanded, Steel

E. American Water Works Association (AWWA):

B300-10.....Hypochlorites

B301-10.....Liquid Chlorine

C104-08.....Cement-Mortar Lining for Ductile Iron Pipe and  
Fittings  
WATER UTILITIES  
33 10 00 - 5

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

C105/A21.5-10.....Polyethylene Encasement for Ductile Iron Pipe  
Systems

C110-08.....Ductile Iron and Gray-Iron Fittings

C111/A21.11-07.....Rubber-Gasket Joints for Ductile Iron Pressure  
Pipe and Fittings

C115/A21.11-11.....Flanged Ductile Iron Pipe with Ductile Iron or  
Gray-Iron Threaded Flanges

C151/A21.51-09.....Ductile Iron Pipe, Centrifugally Cast

C153/A21.53-11.....Ductile Iron Compact Fittings for Water Service

C502-05.....Dry-Barrel Fire Hydrants

C503-05.....Wet-Barrel Fire Hydrants

C504-10.....Rubber-Seated Butterfly Valves

C508-09.....Swing-Check Valves for Waterworks Service, 2-  
In. Through 24-In. (50-mm Through 600-mm) NPS

C509-09.....Resilient-Seated Gate Valves for Water Supply  
Service

C510-07.....Double Check Valve Backflow Prevention Assembly

C511-07.....Reduced-Pressure Principle Backflow Prevention  
Assembly

C512-07.....Air Release, Air/Vacuum and Combination Air  
Valves

C550-05.....Protective Interior Coatings for Valves and  
Hydrants

C600-10.....Installation of Ductile Iron Mains and Their  
Appurtenances

C605-11.....Underground Installation of Polyvinyl Chloride  
(PVC) Pressure Pipe and Fittings for Water

C606-11.....Grooved and Shouldered Joints

C651-05.....Disinfecting Water Mains

WATER UTILITIES

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- C700-09.....Cold-Water Meters, "Displacement Type," Bronze  
Main Case
- C800-05.....Underground Service Line Valves and Fittings
- C900-09.....Polyvinyl Chloride (PVC) Pressure Pipe and  
Fabricated Fittings, 4 In. Through 12 In. (100  
mm Through 300 mm), for Water Transmission and  
Distribution
- C906-07.....Polyethylene (PE) Pressure Pipe and Fittings, 4  
In. (100 mm) Through 64 In. (1,600 mm), for  
Water Distribution and Transmission
- C907-04.....Injection-Molded PVC Pressure Fittings, 4 Inch  
through 12 Inch (100 mm through 300 mm), for  
Water Distribution
- M23-2nd Ed.....PVC Pipe, Design and Installation
- M44-2nd Ed.....Distribution Valves: Selection, Installation,  
Field Testing and Maintenance
- F. National Fire Protection Association (NFPA):
- NFPA 24-2010 Ed.....Installation of Private Fire Service Mains and  
Their Appurtenances
- NFPA 1963-2009 Ed.....Fire Hose Connections
- G. NSF International (NSF):
- NSF/ANSI 61-2010.....Drinking Water System Components - Health  
Effects
- H. American Welding Society (AWS):
- A5.8/A5.8M-2004 .....Filler Metals for Brazing and Braze Welding
- I. American Society of Safety Engineers (ASSE):
- 1003-2009 .....Water Pressure Reducing Valves

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

1015-2009.....Double Check Backflow Prevention Assemblies and  
Double Check Fire Protection Backflow  
Prevention Assemblies

1020-2004.....Pressure Vacuum Breaker Assembly

1047-2009.....Performance Requirements for Reduced Pressure  
Detector Fire Protection Backflow Prevention  
Assemblies

1048-2009.....Performance Requirements for Double Check  
Detector Fire Protection Backflow Prevention  
Assemblies

1060-2006.....Performance Requirements for Outdoor Enclosures  
for Fluid Conveying Components

J. Underwriters' Laboratories (UL):

246.....Hydrants for Fire-Protection Service

262.....Gate Valves for Fire-Protection Service

312.....Check Valves for Fire-Protection Service

405.....Fire Department Connection Devices

753.....Alarm Accessories for Automatic Water-Supply  
Control Valves for Fire Protection Service

789.....Indicator Posts for Fire-Protection Service

1091.....Butterfly Valves for Fire-Protection Service

1285.....Pipe and Couplings, Polyvinyl Chloride (PVC),  
and Oriented Polyvinyl Chloride (PVC0) for  
Underground Fire Service

**1.9 WARRANTY**

A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance. Further, the Contractor will furnish all manufacturers' and supplier's written

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

guarantees and warranties covering materials and equipment furnished under this Contract.

## **PART 2 - PRODUCTS**

### **2.1 FACTORY-ASSEMBLED PRODUCTS**

A. Standardization of components shall be maximized to reduce spare part requirements. The contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

### **2.2 SAFETY GUARDS**

A. All equipment shall have moving parts protected to prevent personal injury. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gauge sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 1/4 inch (6 mm) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.

### **2.3 LIFTING ATTACHMENTS**

A. Equipment shall be provided with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

### **2.4 DUCTILE IRON PIPE AND FITTINGS**

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated, 350 psi (2400 kPa).

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Cement Mortar Internal Lining: Cement mortar lining and bituminous seal coat as per AWWA C104.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

## 2.5 VALVES

A. Gate Valves: AWWA C509, Non-rising Stem, Resilient Seat, 200 psi (1380 kPa).

1. Valves 3 inches (75 mm) and larger: Resilient seat valve with gray- or ductile iron body and bonnet; cast iron or bronze double-disc gate; bronze gate rings; non-rising bronze stem and stem nut.
2. Interior and exterior coating: AWWA C550, thermo-setting or fusion epoxy.
3. Underground valve nut: Furnish valves with 2 inch (50 mm) nut for socket wrench operation.
4. Aboveground and pit operation: Furnish valves with hand wheels.
5. End connections shall match main line pipe.

B. Gate Valve Accessories and Specialties

1. Tapping-Sleeve Assembly: ANSI MSS SP-60; sleeve and valve to be compatible with the drilling matching.
  - a. Tapping Sleeve: Ductile Iron, two-piece bolted sleeve. Sleeve to match the size and type of pipe material being tapped.
  - b. Valve shall include one raised face flange mating tapping-sleeve flange.
2. Valve Boxes: AWWA M44 with top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel.
3. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut. (Provide two wrenches for Project.)
4. Indicator Posts: UL 789, FMG approved, vertical-type, cast iron body with operating wrench, extension rod, and adjustable cast iron barrel of length required for depth of burial of valve.

C. Curb Valves

1. Curb Valves: AWWA C800, bronze body, ground-key plug or ball, wide tee head, with inlet and outlet matching service piping material, minimum pressure of 200 psi (1375 kPa).

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

2. Service Boxes for Curb Valves: AWWA M44, cast iron telescoping top section; plug shall include lettering "WATER"; bottom section with base that fits over curb valve.
- D. Shutoff Rods: Steel, tee-handle with one pointed end. Stem length shall extend 2 feet (600 mm) above top of valve box for operation of deepest buried valve, with slotted end matching curb valve.
- E. Corporation Valves and Curb Valves
  1. Service-Saddle Assemblies: AWWA C800.
    - a. Service Saddle: Copper alloy with seal and threaded outlet for corporation valve.
    - b. Corporation Valve: Bronze body and ground-key plug, with threaded inlet and outlet matching service piping material.
    - c. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.
  2. Curb Valves: AWWA C800, bronze body, ground-key plug or ball, wide tee head, with inlet and outlet matching service piping material, minimum pressure of 200 psi (1375 kPa).
  3. Service Boxes for Curb Valves: AWWA M44, cast iron telescoping top section; plug shall include lettering "WATER"; bottom section with base that fits over curb valve.
  4. Shutoff Rods: Steel, tee-handle with one pointed end. Stem length shall extend 2 feet (600 mm) above top of valve box for operation of deepest buried valve, with slotted end matching curb valve.
- F. Post-Indicator: NFPA 24 and be fully compatible with the valve and supervisory switches.

## 2.6 FIRE HYDRANTS

- A. All new hydrant installations shall be Metropolitan 250 (right turning), as required by the South Central Connecticut Regional Water Authority. Upper barrel shall be of sufficient length to permit setting hydrant with barrel flange not more than 4 inches (100 mm) above finished grade. All fire hydrants shall have 6 inch (150 mm) bottom connection, 6" lateral and 6" gate. Provide one (1) hydrant wrench not less than 14 inches (350 mm) long.



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

## **2.7 DISINFECTION CHLORINE**

- A. Liquid chlorine: AWWA B301.
- B. Sodium Hypochlorite: AWWA B300 with 5 percent to 15 percent available chlorine.
- C. Calcium hypochlorite: AWWA B300 supplied in granular form of 5 g. tablets, and shall contain 65 percent chlorine by weight.

## **2.8 WARNING TAPE**

- A. Warning tape shall be standard, 4 mil. Polyethylene, 3 inch (76 mm) wide tape, non-detectable type, blue with black letters and imprinted with "CAUTION BURIED WATER LINE BELOW".

# **PART 3 - EXECUTION**

## **3.1 PIPING APPLICATIONS**

- A. Use pipe, fittings, and joining methods for piping systems according to the following applications.
  - 1. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
  - 2. Do not use flanges or unions for underground piping.
  - 3. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- B. Underground 6" hydrant service piping
  - 1. Ductile iron, mechanical-joint pipe; ductile iron, mechanical-joint fittings; and mechanical joints.

## **3.2 VALVE APPLICATIONS**

- A. Use mechanical-joint-end valves for NPS 3 (DN 80) and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 (DN 50) and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

1. Underground Valves, NPS 3 (DN 80) and Larger: AWWA, cast iron, nonrising-stem, high-pressure, resilient - seated gate valves with valve box.

### **3.3 DUCTILE IRON PIPE**

- A. Install Ductile Iron, water-service piping according to AWWA C600 and AWWA M41-3rd Edition.
- B. Pipe shall be sound and clean before laying. When laying is not in progress, the open ends of the pipe shall be closed by watertight plug or other approved means.
- C. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Bevel cut ends of pipe to be used with push-on bell to conform to the manufactured spigot end. Cement lining shall be undamaged.

### **3.4 VALVE INSTALLATION**

- A. AWWA Valves: Install each underground valve with stem pointing up and with valve box.
- B. UL/FMG, Valves: Install each underground valve and valves in vaults with stem pointing up and with vertical cast iron indicator post.
- C. MSS Valves: Install as component of connected piping system.
- D. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
- E. Raise or lower existing valve and curb stop boxes and fire hydrants to finish grade in areas being graded.
- F. Post indicator valve open/shut readout shall be set 30" above finished grade.

### **3.5 FIRE HYDRANT INSTALLATION**

- A. Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

### **3.6 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

### 3.7 FIELD QUALITY CONTROL

- A. Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.
- C. Perform hydrostatic tests at not less than one-and-one-half times working pressure for two hours.
  - 1. Increase pressure in 50-psi (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psi (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- D. Prepare reports of testing activities.

### 3.8 IDENTIFICATION

- A. Install continuous underground warning tape 12 inches (300 mm) directly over piping.

### 3.9 CLEANING

- A. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
- B. Use purging and disinfecting procedure prescribed by local utility provider or other authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
  - 1. Fill the water system with a water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
  - 2. Drain the system of the previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow system to stand for 3 hours.
  - 3. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

4. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

C. Prepare reports of purging and disinfecting activities.

--- E N D ---

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

## SECTION 33 30 00

### SANITARY SEWER UTILITIES

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This section specifies materials and procedures for construction of outside, underground sanitary sewer systems that are complete and ready for operation. This includes piping, structures and all other incidentals.

##### 1.2 RELATED WORK

- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.
- B. General plumbing, protection of Materials and Equipment, and quality assurance: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- C. Fabrication of Steel Ladders: Section 05 50 00, METAL FABRICATION.
- D. Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- E. Erosion and Sediment Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

##### 1.3 ABBREVIATIONS

- A. PVC: Polyvinyl chloride plastic

##### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Store plastic piping protected from direct sunlight and support to prevent sagging and bending. Protect stored piping from moisture and dirt by elevating above grade. Protect flanges, fittings, and specialties from moisture and dirt.
- B. Handle manholes according to manufacturer's written rigging instructions.

##### 1.5 COORDINATION

- A. Coordinate connection to sanitary sewer main with the West Haven Dept. of Public Works.
- B. Contractor to obtain approval from the West Haven Dept. of Public Works that the existing sanitary sewer systems have the capacity to handle the discharge from the facility.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

C. Coordinate exterior utility lines and connections to building lines up to 5 feet of building wall.

D. Coordinate connection to public sewer system with the West Haven Dept. of Public Works.

#### **1.6 QUALITY ASSURANCE:**

##### **A. Products Criteria:**

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.

2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Sanitary Sewer lines and the extension, and/or modifications to Public Utility Systems.

#### **1.7 SUBMITTALS:**

A. Manufacturers' Literature and Data shall be submitted for the following as one package:

1. Pipe, Fittings, and, Appurtenances.
2. Jointing Material.
3. Manhole and Structure Material.
4. Frames and Covers.
5. Steps and Ladders.

#### **1.8 APPLICABLE PUBLICATIONS**

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

B. American Society for Testing and Materials (ASTM):

A185/A185M-07.....Steel Welded Wire Reinforcement, Plain, for  
Concrete

A615/A615M-09b.....Deformed and Plain Carbon-Steel Bars for  
Concrete Reinforcement

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

C478-09.....Precast Reinforced Concrete Manhole Sections

C857-11.....Minimum Structural Design Loading for  
Underground Precast Concrete Utility Structures

C890-11.....Minimum Structural Design Loading for  
Monolithic or Sectional Precast Concrete Water  
and Wastewater Structures

C913-08.....Precast Concrete Water and Wastewater  
Structures

C923-08.....Resilient Connectors Between Reinforced  
Concrete Manhole Structures, Pipes, and  
Laterals

C990-09.....Joints for Concrete Pipe, Manholes, and precast  
Box Sections using Preformed Flexible Joint  
Sealants

C1173-10.....Flexible Transition Couplings for Underground  
Piping Systems

C1440-08.....Thermoplastic Elastomeric (TPE) Gasket  
Materials for Drain, Waste and Vent (DWV),  
Sewer, Sanitary and Storm Plumbing Systems

C1460-08.....Shielded Transition Couplings for Use With  
Dissimilar DWV Pipe and Fittings Above Ground

C1461-08.....Mechanical Couplings Using Thermoplastic  
Elastomeric (TPE) Gaskets for Joining Drain,  
Waste and Vent (DWV), Sewer, Sanitary and Storm  
Plumbing systems for Above and below Ground Use

D2321-11.....Underground Installation of Thermoplastic Pipe  
for Sewers and Other Gravity-Flow Applications

D3034-08.....Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe  
and Fittings

F477-10.....Elastomeric Seals (Gaskets) for Joining Plastic  
Pipe

SANITARY SEWER UTILITIES

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

F949-10.....Poly(Vinyl Chloride) (PVC) Corrugated Sewer  
Pipe With a Smooth Interior and Fittings

F1417-11.....Standard Test Method for Installation  
Acceptance of Plastic Gravity Sewer Lines Using  
Low-Pressure Air

F1668-08.....Construction Procedures for Buried Plastic Pipe

C. American Water Works Association (AWWA):

C900-07.....Polyvinyl Chloride (PVC) Pressure Pipe and  
Fabricated Fittings, 4 In. Through 12 In. (100  
mm Through 300 mm), for Water Transmission and  
Distribution

## **1.9 WARRANTY**

A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of two years from final acceptance. Further, the Contractor will provide all manufacturers' and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

## **PART 2 - PRODUCTS**

### **2.1 FACTORY-ASSEMBLED PRODUCTS**

A. Standardization of components shall be maximized to reduce spare part requirements.

B. The Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

### **2.2 PVC, GRAVITY SEWER PIPE AND FITTINGS**

A. PVC Gravity Sewer Piping:

1. Pipe and Fittings shall conform to ASTM D3034, SDR 35.
2. Gaskets: ASTM F477.
3. Fittings: ASTM D3034, SDR 35.

B. PVC Corrugated Sewer Piping:

1. Pipe: ASTM F949, corrugated pipe with bell and spigot ends.

SANITARY SEWER UTILITIES



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

2. Fittings: ASTM F949.

3. Gaskets: ASTM F477.

4. Gaskets: ASTM F477.

## **2.3 NONPRESSURE-TYPE TRANSITION COUPLINGS**

A. Comply with ASTM C1173, elastomeric, sleeve type, reducing or transition coupling, for joining underground nonpressure piping. Include ends to match same sizes of main line piping and install corrosion-resistant metal tension bands and tightening mechanism on each end.

B. Sleeve Materials:

1. For Plastic Pipes: ASTM F477, elastomeric seal.

2. For Dissimilar Pipes: PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Couplings shall be elastomeric sleeve with corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:

1. Couplings shall meet ASTM C1460 with elastomeric with full-length, corrosion-resistant outer shield with corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:

1. Couplings shall be elastomeric compression seal with dimensions to fit inside bell of larger mainline pipe and for spigot of smaller main line pipe to fit inside ring.

F. Nonpressure-Type, Rigid Couplings:

1. Coupling shall be ASTM C1461, sleeve-type, reducing-coupling, molded from ASTM C1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.

## **2.4 MANHOLES**

A. Standard precast concrete manholes and vaults shall be constructed of precast concrete segmental blocks, precast reinforced concrete rings, precast reinforced sections or cast-in-place concrete.

1. Precast Concrete Manholes: Material shall be as per ASTM C478, precast, reinforced concrete, of depth indicated, with sealed joints.

**Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00**

2. Concrete Base: Concrete for base of manhole shall have a minimum compressive strength of 5000 psi (35 MPa) at 28 days. Thickness to be 8 inches (200 mm), minimum.
3. Riser Section: 4 inch (100 mm) minimum thickness, of lengths to provide the total depth of manhole.
4. Top Section: Eccentric-cone type unless otherwise indicated. Top section to match adjustment ring configurations.
5. Joint Sealant: ASTM C990.
6. Resilient Pipe Connectors: ASTM C923.
7. Steps: If over 60 inches (1500 mm) in depth, ASTM A615 deformed, 1/2 inch (13 mm) steel reinforcing rods encased in precast concrete sections with 16 inch (400 mm) minimum width, 12 to 16 inches (300 to 400 mm) center-to-center from top to bottom.
8. Adjusting Rings: Reinforced-concrete rings; 6 to 9 inch (150 to 225 mm) total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

**B. Designed Concrete Manholes:**

1. Description: ASTM C913; designed according to ASTM C890 for AASHTO HS20-44, heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
2. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required to prevent flotation.
3. Joint Sealant: ASTM C990, bitumen or butyl rubber.
4. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls, for each pipe connection.
5. Steps: If over 60 inches (1500 mm) in depth, ASTM A615, deformed, 1/2 inch (13 mm) steel reinforcing rods encased in precast concrete sections; width 16 inches (400 mm) minimum, 12 to 16 inches (300 to 400 mm) center-to-center from top to bottom.
6. Adjusting Rings: Reinforced-concrete rings; 6 to 9 inch (150 to 225 mm) total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

C. Manhole Base Channels: Manhole channels shall be main line pipe material. Lay main pipe through manhole and cut top of pipe out to be three-fourths of pipe diameter. Slope through manhole to match run slopes of the main pipe.

## **2.5 CONCRETE**

A. Cast-in-place concrete shall be 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.

B. Reinforcement

1. Reinforcing fabric shall be ASTM A185, steel, welded wire fabric, plain.

2. Reinforcing bars shall be ASTM A615, Grade 60 (420 MPa) deformed steel.

C. Benches shall be concrete, sloped to drain into the channel. Provide 6 inches (150 mm) from the cut section of top of pipe to edge of manhole.

D. Ballast and Pipe Supports shall be Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water/cementitious materials ratio.

## **2.6 WARNING TAPE**

A. Warning tape shall be standard, 4 mil (0.1 mm) polyethylene 3 inch (76 mm) wide tape detectable type, green with black letters and imprinted with "CAUTION BURIED SEWER LINE BELOW".

## **PART 3 - EXECUTION**

### **3.1 PIPING INSTALLATION**

A. Drawing plans and details indicate the general location and arrangement of underground sanitary sewer piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at the low point, true to grades and alignment indicated on the drawings, with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- C. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
- D. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- E. Inspect pipes and fittings for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
- F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
- G. Do not walk on pipe in trenches until covered by layers of bedding or backfill material to a depth of 12 inches (300 mm) over the crown of the pipe.
- H. Warning tape shall be continuously placed 12 inches (300 mm) above sewer pipe
- I. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- J. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- K. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process or microtunneling.
- L. Install gravity-flow, non-pressure, drainage piping according to the following:
  - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
  - 2. Install piping with 36 inch (915 mm) minimum cover as shown on Drawings.
  - 3. Install PVC cellular-core, PVC corrugated sewer, PSM sewer and PVC gravity sewer according to ASTM D2321 and ASTM F1668.
- M. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

### **3.2 PIPE JOINT CONSTRUCTION**

- A. Join gravity-flow, non-pressure, drainage piping according to the following:
  - 1. Join ductile iron, gravity sewer piping according to AWWA C600 for push-on joints.
  - 2. Join PVC piping according to ASTM D2321.
  - 3. Join dissimilar pipe materials with nonpressure-type, flexible couplings.
- B. Join force-main, pressure piping according to the following:
  - 1. Join ductile iron pressure piping according to AWWA C600 for push-on joints.
  - 2. Join PVC pressure piping according to manufacturer's recommendations.
  - 3. Join dissimilar pipe materials with pressure-type couplings.
- C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
  - 1. Use non-pressure flexible couplings where required to join gravity-flow, non-pressure sewer piping unless otherwise indicated.
    - a. Flexible couplings for pipes of same or slightly different OD.
    - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
    - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

### **3.3 SEWER AND MANHOLE SUPPORTS, CONCRETE CRADLES WITHIN VAULTS**

- A. Install reinforced concrete as detailed on the drawings. The concrete shall not restrict access for future maintenance of the joints within the piping system.

### **3.4 BUILDING SERVICE LINES**

- A. Install sanitary sewer service lines to point of connection within approximately 5 feet (1500 mm) outside of building(s) where service is required and make connections. Coordinate the invert and location of the service line with the Contractor installing the building lines.

### **3.5 MANHOLE INSTALLATION**

- A. Install manholes complete with appurtenances and accessories indicated.

SANITARY SEWER UTILITIES

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

1. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 1/2 inch (15 mm) or cement mortar applied with a trowel and finished to an even glazed surface.
2. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top, shall be sealed as per manufacturer's recommendations. Adjust the length of the rings so that the top section will be at the required elevation. Cutting the top section is not acceptable.
3. Concrete manhole risers and tops: Install as specified.

B. Designed Concrete Structures:

1. Concrete structures shall be installed in accordance with Section 03 30 00, CAST-IN-PLACE CONCRETE.

C. Do not build structures when air temperature is 32 deg F (0 deg C), or below.

D. The wall that supports access rungs or ladder shall be 90 deg vertical from the floor of structure to manhole cover.

E. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.

F. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. In unpaved areas, the rim elevation shall be 2 inches (50 mm) above the adjacent finish grade.

G. Install manhole frames and covers on a mortar bed, such that frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. Install an 8 inches (200 mm) thick, by 12 inches (300 mm) wide concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

### 3.6 CONNECTIONS

- A. Make connections to existing piping and underground manholes by coring and installing the pipe at the design invert. Install an elastomeric gasket around the pipe, and grout the interstitial space between the pipe and the core.

- B. Connection to an existing manhole: The bench of the manhole shall be cleaned and reshaped to provide a smooth flowline for all new pipes connected to the manhole.
- C. Use commercially manufactured wye fittings for piping branch connections. Encase entire wye fitting plus 6-inch (150-mm) overlap with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
  - 1. Make branch connections from the side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500), by removing a section of the existing pipe.
  - 2. Make branch connections from the side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes by cutting an opening into existing unit large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in concrete to provide additional support of collar from connection to undisturbed ground.
  - 3. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

### 3.7 REGRADING

- A. Raise or lower existing manholes and structures frames and covers, cleanout frames and covers and valve boxes in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Adjust the elevation of the cleanout pipe riser, and reinstall the cap or plug. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
- B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

### 3.8 CLOSING ABANDONED SANITARY SEWER SYSTEMS

- A. Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed.
  - 1. Piping under and within 5 feet (1500 mm) of building areas shall be completely removed.
  - 2. Piping outside of building areas shall // be completely removed // plugged with concrete, and abandoned in-place //.
- B. Excavate around manholes as required and use either procedure below:
  - 1. Manholes and structures outside of building areas: Remove frame and cover, cut and remove the top of an elevation of 2 feet (600 mm) below finished grade. Fill the remaining portion with compacted gravel or crushed rock or concrete.
  - 2. Manholes and structures with building areas: Remove frame and cover and remove the entire structure and the base.
- C. Backfill to grade according to Division 31 Section 31 20 00, EARTH MOVING.
- D. When the limit of the abandonment terminates in an existing manhole to remain, the flow line in the bench of the manhole to the abandoned line shall be filled with concrete and shaped to maintain the flowline of the lines to remain.

### 3.9 PIPE SEPARATION

- A. Horizontal Separation - Water Mains and Sewers:
  - 1. Existing and proposed water mains shall be at least 10 feet (3 m) horizontally from any proposed gravity flow and pressure (force main) sanitary sewer or sewer service connection.
  - 2. Gravity flow mains and pressure (force) mains may be located closer than 10 feet (3 m) but not closer than 6 feet (1.8 m) to a water main when:
    - a. Local conditions prevent a lateral separation of 10 feet (3 m); and
    - b. The water main invert is at least 18 inches (450 mm) above the crown of the gravity sewer or 24 inches (600 mm) above the crown



of the pressure (force) main; and the water main is in a separate trench separated by undisturbed earth.

3. When it is impossible to meet (1) or (2) above, both the water main and sanitary sewer main shall be constructed of push-on or mechanical joint ductile iron pipe, and encased in concrete.

**B. Vertical Separation - Water Mains and Sewers at Crossings:**

1. Water mains shall be separated from sewer mains so that the invert of the water main is a minimum of 24 inches (600 mm) above the crown of gravity flow sewer or 48 inches (1200 mm) above the crown of pressure (force) mains. The vertical separation shall be maintained within 10 feet (3 m) horizontally of the sewer and water crossing. When these vertical separations are met, no additional protection is required.
2. In no case shall pressure (force) sanitary main cross above, or within 24 inches (600 mm) of water lines.
3. When it is impossible to meet (1) above, the gravity flow sewer may be installed 18 inches (450 mm) above or 12 inches (300 mm) below the water main, provided that both the water main and sewer shall be constructed of push-on or mechanical ductile pipe, and encased in concrete. Pressure (Force) sewers may be installed 24 inches (600 mm) below the water line provided both the water line and sewer line are constructed of ductile iron pipe.
4. The required vertical separation between the sewer and the water main shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer line is at least 10 feet (3 m).

**3.10 IDENTIFICATION**

- A. Install green warning tape directly over piping and at outside edges of underground manholes.

**3.11 FIELD QUALITY CONTROL**

- A. All systems shall be inspected and obtain the Resident Engineer's approval. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.
- B. To inspect, thoroughly flush out the lines and manholes before inspection. Lamp test between structures and show full bore indicating

sewer is true to line and grade. Lips at joints on the inside of gravity sewer lines are not acceptable.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:
  - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
  - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
  - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
  - d. Infiltration: Water leakage into piping.
  - e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Re-inspect and repeat procedure until results are satisfactory.

C. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

1. Test plastic gravity sewer piping according to ASTM F1417.
2. Test concrete gravity sewer piping according to ASTM C924.
3. Clean and isolate the section of sewer line to be tested. Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be included in the test to prevent air leakage. The line shall be pressurized to 4 psi (28 kPa) and allowed to stabilize. After pressure stabilization, the pressure shall be dropped to 3.5 psi (24 kPa) greater than the average back-pressure of any groundwater above the sewer.
4. For force mains, perform testing after supports and anchors are installed. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psi (1035 kPa).
5. Testing of Fiberglass Sewage Holding Tanks shall show no leakage during a 5 psi (35 kPa) air pressure test with 5:1 safety factor.
6. Testing of Concrete Wet Well shall show no leakage with the wet well completely filled with water for a duration of 4 hours.

### 3.12 CLEANING

- A. Clean dirt and superfluous material from interior of piping.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

--- E N D ---

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

## SECTION 33 40 00

### STORM SEWER UTILITIES

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

This section specifies materials and procedures for construction of outside, underground storm sewer systems that are complete and ready for operation. This includes piping, structures, stormwater quality control structures, stormwater disposal chamber systems (stormwater infiltrators) and all other incidentals.

##### 1.2 RELATED WORK

- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.
- B. Concrete Work, Reinforcing, Placement and Finishing: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- C. General plumbing, protection of Materials and Equipment, and quality assurance: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Fabrication of Steel Ladders: Section 05 50 00, METAL FABRICATIONS.
- E. Materials and Testing Report Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- F. Erosion and Sediment Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

##### 1.3 ABBREVIATIONS

- A. HDPE: High-density polyethylene
- B. PE: Polyethylene

##### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Handle manholes, catch basins, stormwater quality structures, stormwater infiltrators and stormdrains according to manufacturer's written rigging instructions.

##### 1.5 COORDINATION

- A. Coordinate connection to storm sewer main with the Public Agency providing storm sewer off-site drainage.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

B. Coordinate exterior utility lines and connections to building services up to the actual extent of building wall.

#### 1.6 QUALITY ASSURANCE:

A. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

#### 1.7 SUBMITTALS

A. Manufacturers' Literature and Data shall be submitted, as one package, for pipes, fittings and appurtenances, including jointing materials, hydrants, valves and other miscellaneous items.

#### 1.8 APPLICABLE PUBLICATIONS

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

B. American Society for Testing and Materials (ASTM):

A185/A185M-07.....Steel Welded Wire Reinforcement, Plain, for  
Concrete

A242/A242M-04(2009).....High-Strength Low-Alloy Structural Steel

A536-84(2009).....Ductile Iron Castings

A615/A615M-09b.....Deformed and Plain Carbon-Steel Bars for  
Concrete Reinforcement

A760/A760M-10.....Corrugated Steel Pipe, Metallic-Coated for  
Sewers and Drains

A798/A798M-07.....Installing Factory-Made Corrugated Steel Pipe  
for Sewers and Other Applications

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

A849-10.....Post-Applied Coatings, Paving, and Linings for  
Corrugated Steel Sewer and Drainage Pipe

A929/A929M-01(2007).....Steel Sheet, Metallic-Coated by the Hot-Dip  
Process for Corrugated Steel Pipe

B745/B745M-97(2005).....Corrugated Aluminum Pipe for Sewers and Drains

B788/B788M-09.....Installing Factory-Made Corrugated Aluminum  
Culverts and Storm Sewer Pipe

C14-07.....Non-reinforced Concrete Sewer, Storm Drain, and  
Culvert Pipe

C33/C33M-08.....Concrete Aggregates

C76-11.....Reinforced Concrete Culvert, Storm Drain, and  
Sewer Pipe

C139-10.....Concrete Masonry Units for Construction of  
Catch Basins and Manholes

C150/C150M-11.....Portland Cement

C443-10.....Joints for Concrete Pipe and Manholes, Using  
Rubber Gaskets

C478-09.....Precast Reinforced Concrete Manhole Sections

C506-10b.....Reinforced Concrete Arch Culvert, Storm Drain,  
and Sewer Pipe

C507-10b.....Reinforced Concrete Elliptical Culvert, Storm  
Drain, and Sewer Pipe

C655-09.....Reinforced Concrete D-Load Culvert, Storm  
Drain, and Sewer Pipe

C857-07.....Minimum Structural Design Loading for  
Underground Precast Concrete Utility Structures

C891-09.....Installation of Underground Precast Concrete  
Utility Structures

STORM SEWER UTILITIES

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

C913-08.....	Precast Concrete Water and Wastewater Structures
C923-08.....	Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
C924-02(2009).....	Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
C990-09.....	Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
C1103-03(2009).....	Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
C1173-08.....	Flexible Transition Couplings for Underground Piping Systems
C1433-10.....	Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
C1479-10.....	Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations
D448-08.....	Sizes of Aggregate for Road and Bridge Construction
D698-07e1.....	Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft <sup>3</sup> (600 kN-m/m <sup>3</sup> ))
D1056-07.....	Flexible Cellular Materials—Sponge or Expanded Rubber
D1785-06.....	Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
D2321-11.....	Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

D2751-05.....Acrylonitrile-Butadiene-Styrene (ABS) Sewer  
Pipe and Fittings

D2774-08.....Underground Installation of Thermoplastic  
Pressure Piping

D3034-08.....Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe  
and Fittings

D3350-10.....Polyethylene Plastics Pipe and Fittings  
Materials

D3753-05e1.....Glass-Fiber-Reinforced Polyester Manholes and  
Wetwells

D4101-11.....Polypropylene Injection and Extrusion Materials

D5926-09.....Poly (Vinyl Chloride) (PVC) Gaskets for Drain,  
Waste, and Vent (DWV), Sewer, Sanitary, and  
Storm Plumbing Systems

F477-10.....Elastomeric Seals (Gaskets) for Joining Plastic  
Pipe

F679-08.....Poly(Vinyl Chloride) (PVC) Large-Diameter  
Plastic Gravity Sewer Pipe and Fittings

F714-10.....Polyethylene (PE) Plastic Pipe (SDR-PR) Based  
on Outside Diameter

F794-03(2009).....Poly(Vinyl Chloride) (PVC) Profile Gravity  
Sewer Pipe and Fittings Based on Controlled  
Inside Diameter

F891-10.....Coextruded Poly(Vinyl Chloride) (PVC) Plastic  
Pipe With a Cellular Core

F894-07.....Polyethylene (PE) Large Diameter Profile Wall  
Sewer and Drain Pipe

F949-10.....Poly(Vinyl Chloride) (PVC) Corrugated Sewer  
Pipe With a Smooth Interior and Fittings

STORM SEWER UTILITIES



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

F1417-11.....Installation Acceptance of Plastic Gravity  
Sewer Lines Using Low-Pressure Air

F1668-08.....Construction Procedures for Buried Plastic Pipe

C. American Association of State Highway and Transportation Officials  
(AASHTO):

M190-04.....Bituminous-Coated Corrugated Metal Culvert Pipe  
and Pipe Arches

M198-10.....Joints for Concrete Pipe, Manholes, and Precast  
Box Sections Using Preformed Flexible Joint  
Sealants

M252-09.....Corrugated Polyethylene Drainage Pipe

M294-10.....Corrugated Polyethylene Pipe, 12 to 60 In. (300  
to 1500 mm) Diameter

D. American Water Works Association(AWWA):

C105/A21.5-10.....Polyethylene Encasement for Ductile iron Pipe  
Systems

C110-08.....Ductile-Iron and Gray-Iron Fittings

C219-11.....Bolted, Sleeve-Type Couplings for Plain-End  
Pipe

C600-10.....Installation of Ductile iron Mains and Their  
Appurtenances

C900-07.....Polyvinyl Chloride (PVC) Pressure Pipe and  
Fabricated Fittings, 4 In. Through 12 In. (100  
mm Through 300 mm), for Water Transmission and  
Distribution

M23-2nd ed.....PVC Pipe "Design And Installation"

E. American Society of Mechanical Engineers (ASME):

A112.6.3-2001.....Floor and Trench Drains

A112.14.1-2003.....Backwater Valves

STORM SEWER UTILITIES

33 40 00 - 6

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

A112.36.2M-1991.....Cleanouts

F. American Concrete Institute (ACI):

318-05.....Structural Commentary and Commentary

350/350M-06.....Environmental Engineering Concrete Structures  
and Commentary

G. National Stone, Sand and Gravel Association (NSSGA): Quarried Stone for  
Erosion and Sediment Control

## **1.9 WARRANTY**

The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance. Further, the Contractor will furnish all manufacturers' and suppliers' written guarantees and warranties covering materials and equipment furnished under this Contract.

## **PART 2 - PRODUCTS**

### **2.1 FACTORY-ASSEMBLED PRODUCTS**

A. Standardization of components shall be maximized to reduce spare part requirements. The Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

### **2.2 PE PIPE AND FITTINGS**

A. Corrugated PE drainage pipe and fittings, NPS 3 to NPS 10 (DN 80 to DN 250); ASTM F714, SDR 21 with smooth waterway for coupling joints.

1. Soil-tight Couplings: AASHTO M252, corrugated, matching tube and fittings.

B. Corrugated PE pipe and fittings, NPS 12 to NPS 60 (DN 300 to DN 1500); ASTM F714, SDR 21 for pipes 3 to 24 inches (300 to 600 mm).

1. Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477. Soil tight joints shall conform to requirements in AASHTO HB-17, Division II, for soil tightness and shall be as recommended by the manufacturer.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

C. PVC Type PSM Sewer Piping

1. Pipe: ASTM D3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends.
2. Fittings: ASTM D3034, PVC with bell ends.
3. Gaskets: ASTM F477, elastomeric seals.

**2.3 NONPRESSURE TRANSITION COUPLINGS**

A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials

1. For concrete pipes: ASTM C443, rubber.
2. For plastic pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
3. For dissimilar pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings: Couplings shall be an elastomeric sleeve with // stainless-steel shear ring and // corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, flexible couplings shall be elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, flexible couplings shall be elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

**2.4 MANHOLES AND CATCH BASINS**

A. Standard Precast Concrete Manholes:

1. Description: ASTM C478 (ASTM C478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 6 inch (150 mm) minimum thickness for floor slab and 4-inch (102 mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.

**Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00**

5. Riser Sections: 4 inch (102 mm) minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C990 (ASTM C990M), bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C923 (ASTM C923M), cast or fitted into manhole walls, for each pipe connection.
9. Steps: If total depth from floor of manhole to finished grade is greater than 60 inches (1500 mm), Individual FRP steps; FRP ladder; or ASTM A615, deformed, 1/2 inch (13 mm) steel reinforcing rods encased in ASTM D4101, PP, width of 16 inches (400 mm) minimum, spaced at 12 to 16 inch (300 to 400 mm) intervals.
10. Adjusting Rings: Reinforced-concrete rings, 6 to 9 inch (150 to 225 mm) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

**B. Designed Precast Concrete Manholes:**

1. Description: ASTM C913; designed for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
2. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required to prevent flotation.
3. Joint Sealant: ASTM C990 (ASTM C990M), bitumen or butyl rubber.
4. Resilient Pipe Connectors: ASTM C923 (ASTM C923M), cast or fitted into manhole walls, for each pipe connection.
5. Steps: If total depth from floor of manhole to finished grade is greater than 60 inches (1500 mm), individual FRP steps; FRP ladder; or ASTM A615, deformed, 1/2 inch (13 mm) steel reinforcing rods encased in ASTM D4101, PP, width of 16 inches (400 mm) minimum, spaced at 12 to 16 inch (300 to 400 mm) intervals.
6. Adjusting Rings: Reinforced-concrete rings, 6 to 9 inch (150 to 225 mm) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

C. Fiberglass Manholes:

1. Description: ASTM D3753.
2. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
3. Ballast: Increase thickness of concrete base as required to prevent flotation.
4. Base Section: Concrete, 8 inch (203 mm) minimum thickness.
5. Resilient Pipe Connectors: ASTM C923 (ASTM C923M), cast or fitted into manhole walls, for each pipe connection.
6. Steps: If total depth from floor of manhole to finished grade is greater than 60 inches (1500 mm), individual FRP steps; FRP ladder; or ASTM A615, deformed, 1/2 inch (13 mm) steel reinforcing rods encased in ASTM D4101, PP, width of 16 inches (400 mm) minimum, spaced at 12 to 16 inch (300 to 400 mm) intervals.
7. Adjusting Rings: Reinforced-concrete rings, 6 to 9 inch (150 to 225 mm) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

D. Manhole Frames and Covers:

1. Description: Ferrous; 24 inch (610 mm) ID by 7 to 9 inch (175 to 225 mm) riser with 4 inch (102 mm) minimum width flange and 26-inch (600 mm) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A48/A48M, Class 35 gray.

**2.5 CONCRETE FOR MANHOLES AND CATCH BASINS**

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C150, Type II.
2. Fine Aggregate: ASTM C33, sand.
3. Coarse Aggregate: ASTM C33, crushed gravel.
4. Water: Potable.

B. Concrete Design Mix: 4000 psi (27.6 MPa) minimum, compressive strength in 28 days.

1. Reinforcing Fabric: ASTM A185, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615, Grade 60 (420 MPa) deformed steel.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

C. Manhole Channels and Benches: Channels shall be the main line pipe material. Include benches in all manholes and catch basins.

1. Channels: Main line pipe material or concrete invert. Height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope. Invert Slope: Same slope as the main line pipe. Bench to be concrete, sloped to drain into channel. Minimum of 6 inch slope from main line pipe to wall sides.

## **2.6 STORMWATER DISPOSAL SYSTEMS**

A. Chamber Systems:

1. Storage and leaching chambers: Molded PE with perforated sides and open bottom. Include number of chambers, distribution piping, end plates, and other standard components as required for system total capacity.
2. Filtering material: ASTM D448, Size No. 24, 3/4 to 2-1/2 inch (19 to 63 mm) washed, crushed stone or gravel. Include Geotextile woven or spun filter fabric, in one or more layers, for minimum total unit weight of 4 oz./sq. yd (135 g/sq. m).

## **2.7 RESILIENT CONNECTORS AND DOWNSPOUT BOOTS FOR BUILDING ROOF DRAINS**

A. Resilient connectors and downspout boots: Flexible, watertight connectors used for connecting pipe to manholes and inlets, and shall conform to ASTM C923.

## **2.8 WARNING TAPE**

A. Standard, 4-Mil polyethylene 3 inch (76 mm) wide tape detectable type, purple with black letters, and imprinted with "CAUTION BURIED STORM SEWER BELOW".

# **PART 3 - EXECUTION**

## **3.1 PIPE BEDDING**

A. The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe requirements are such that when no bedding class is specified, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform with the lowest one-fourth of the outside portion of circular

pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Plastic pipe bedding requirements shall meet the requirements of ASTM D2321. Bedding, haunching and initial backfill shall be either Class IB or Class II material. Corrugated metal pipe bedding requirements shall conform to ASTM A798.

### **3.2 PIPING INSTALLATION**

- A. Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 1. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
  - 2. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
  - 3. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
  - 4. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
  - 5. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
  - 6. Do not walk on pipe in trenches until covered by layers of shading to a depth of 12 inches (300 mm) over the crown of the pipe.

7. Warning tape shall be continuously placed 12 inches (300 mm) above storm sewer piping.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- F. Install gravity-flow, nonpressure drainage piping according to the following:
  1. Install piping pitched down in direction of flow.
  2. Install piping NPS 6 (DN 150) and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fittings; or cast in-place concrete supports or anchors.
  3. Install hub-and-spigot, cast iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
  4. Install ductile iron piping and special fittings according to AWWA C600.
  5. Install corrugated steel piping according to ASTM A798.
  6. Install corrugated aluminum piping according to ASTM B788.
  7. Install ABS sewer piping according to ASTM D2321 and ASTM F1668.
  8. Install PE corrugated sewer piping according to ASTM D2321 with gasketed joints.
  9. Install PVC cellular-core piping, PVC sewer piping, and PVC profile gravity sewer piping, according to ASTM D2321 and ASTM F1668.

### 3.3 REGRADING

- A. Raise or lower existing manholes and structures frames and covers in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.

### **3.4 CONNECTIONS TO EXISTING VA-OWNED MANHOLES**

- A. Make pipe connections and alterations to existing manholes so that finished work will conform as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting, and shaping.

### **3.5 DRAIN INSTALLATION**

- A. Install type of drains in locations indicated.
  - 1. Use Heavy-Duty, top-loading classification cleanouts/inspection ports as part of the stormwater disposal chamber systems.
- B. Embed drain frames and covers in 4 inch (102 mm) minimum concrete around bottom and sides.
- C. Set drain frames and covers with tops flush with pavement surface.

### **3.6 MANHOLE INSTALLATION**

- A. Install manholes, complete with appurtenances and accessories indicated. Install precast concrete manhole sections with sealants according to ASTM C891.
- B. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches (76 mm) above finished surface elsewhere unless otherwise indicated.
- C. Circular Structures:
  - 1. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 1/2 inch (15 mm) or cement mortar applied with a trowel and finished to an even glazed surface.
  - 2. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the

required elevation. Cutting the conical top section is not acceptable.

3. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

D. Rectangular Structures:

1. Precast concrete structures shall be placed on a 8 inch (200 mm) reinforced concrete pad, or be provided with a precast concrete base section. Structures provided with a base section shall be set on an 8 inch (200 mm) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D698. Set precast section true and plumb. Seal all joints with preform flexible gasket material.
2. Do not build structures when air temperature is 32 deg F (0 deg C), or below.
3. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:
  - a. Forming directly in concrete base of structure.
  - b. Building up with brick and mortar.
4. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1 to 12 or more than 1 to 6. Bottom slab and benches shall be concrete.
5. The wall that supports access rungs or ladder shall be 90 deg vertical from the floor of structure to manhole cover.
6. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.
7. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall be 2 inches (50 mm) above the adjacent finish grade. Install an 8 inch (203 mm) thick, by 12

inch (300 mm) concrete collar around the perimeter of the frame.

Slope the top of the collar away from the frame.

### **3.7 CATCH BASIN INSTALLATION**

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

### **3.8 STORMWATER DISPOSAL SYSTEM INSTALLATION**

- A. Chamber Systems: Excavate trenches of width and depth, and install system and backfill according to chamber manufacturer's written instructions. Include storage and leaching chambers, filtering material, and filter mat.

### **3.9 CONNECTIONS**

- A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section FACILITY STORM DRAINAGE PIPING.
- B. Encase entire connection fitting, plus 6 inch (150 mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
- C. Make connections to existing piping and underground manholes.
  - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping.
  - 2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping.
  - 3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, use epoxy-bonding compound as interface between new and existing concrete and piping materials.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

D. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

a. Unshielded flexible couplings for same or minor difference OD pipes.

b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.

c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure-type pipe couplings for force-main joints.

### 3.10 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8 inch (203 mm) thick, brick masonry bulkheads.

2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

1. Remove manhole or structure and close open ends of remaining piping.

2. Remove top of manhole or structure down to at least 36 inches (915 mm) below final grade. Fill to within 12 inches (300 mm) of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Division 31 Section EARTH MOVING.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

### **3.11 IDENTIFICATION**

- A. Install green warning tape directly over piping and at outside edge of underground structures.

### **3.12 FIELD QUALITY CONTROL**

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.
  - 1. Submit separate reports for each system inspection.
  - 2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    - d. Infiltration: Water leakage into piping.
    - e. Exfiltration: Water leakage from or around piping.
  - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  - 4. Reinspect and repeat procedure until results are satisfactory.

### **3.13 TESTING OF STORM SEWERS:**

- A. Submit separate report for each test.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
  - 1. Do not enclose, cover, or put into service before inspection and approval.
  - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
  - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours advance notice.
  - 4. Submit separate report for each test.
  - 5. Air test gravity sewers. Concrete Pipes conform to ASTM C924, Plastic Pipes conform to ASTM F1417, all other pipe material conform to ASTM

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

C828 or C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.

6. Test force-main storm drainage piping. Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psi (1035 kPa.

a. Ductile iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.

b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

C. Leaks and loss in test pressure constitute defects that must be repaired. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

### **3.14 CLEANING**

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

--- E N D ---

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

## **SECTION 48 20 10**

### **NATURAL GAS-FUELED COMBINED HEAT & POWER FACILITY GENERAL REQUIREMENTS**

#### **PART 1 - GENERAL**

##### **1.1. DESCRIPTION**

- A. The purpose of this document is to outline the overall scope of supply, basic requirements and minimum level of performance and quality for a natural gas-fueled Combined Heat & Power (CHP) facility. The intent is to provide a defined framework within which the Construction Manager will further develop the detailed design, specifications, and construction documents for the associated facilities. CHP shall not be used to meet any of mission critical power or heat demand.
- B. Bidders may submit bids based on one of three system arrangements which have been identified herein as Systems #1 through #3. The specific equipment requirements, layout, connection points, piping and ductwork indicated on the drawings are based upon system #1. Physical space requirements and equipment sizes are based on the largest system, System #3. It is expected that the equipment package used as the basis of bid contains all necessary ancillary equipment properly sized based on the manufacturer's requirements.

##### **1.2. RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS: General construction practices.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES: Submittals.
- C. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS: General requirements for commissioning.
- D. Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANT AND STEAM GENERATION: General requirements for Steam Generation systems.
- E. Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT: General requirements for plant controls.
- F. Section 23 50 11, BOILER PLANT MECHANICAL EQUIPMENT: General requirements for breeching and other related materials.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- G. Section 23 51 00, BREECHINGS, CHIMNEYS AND STACKS: General requirements for breeching and other related materials.
- H. Section 23 65 00, COOLING TOWERS: General requirements for cooling towers and related equipment.
- I. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical installation requirements.
- J. Section 26 05 13, MEDIUM-VOLTAGE CABLES: Requirements for medium-voltage cables, splices, and terminations.
- K. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Requirements for current conductors.
- L. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for grounding.
- M. Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS: Requirements for boxes, conduits, and raceways.
- N. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Requirements for forming a complete underground raceway system.
- O. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.
- P. Section 26 08 00, COMMISSIONING OF ELECTRICAL SYSTEMS: Requirements for commissioning the electrical system, subsystem, and equipment.
- Q. Section 26 09 23, LIGHTING CONTROLS: Requirements for plant lighting controls.
- R. Section 26 11 16, SECONDARY UNIT SUBSTATIONS: Requirements for secondary unit substations.
- S. Section 26 12 19, PAD-MOUNTED, LIQUID FILLED, MEDIUM-VOLTAGE TRANSFORMERS: Requirements for pad-mounted transformers.
- T. Section 26 13 13, MEDIUM-VOLTAGE CIRCUIT BREAKER SWITCHGEAR: Requirements for medium-voltage switchgear.
- U. Section 26 22 00 LOW-VOLTAGE TRANSFORMERS: Requirements for low voltage dry type transformers.
- V. Section 26 23 00 LOW-VOLTAGE SWITCHGEAR: Requirements for low voltage switchgear.
- W. Section 26 29 11, LOW VOLTAGE MOTOR STARTERS.
- X. Section 26 29 21, DISCONNECT SWITCHES: Requirements for disconnects.



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- Y. Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- Z. Section 26 43 13 TRANSIENT VOLTAGE SURGE SUPPRESSION.
- AA. Division 27 Communications for cabling and fiber to support control devices.
- BB. VHA Boiler Plant Safety Device Testing Manual, Third Edition

### **1.3. DEFINITIONS**

- A. Commissioning Authority: An entity identified by the Contracting Officer's Representative (COR) who plans, schedules and coordinates the Commissioning Team to implement the Commissioning Process.
- B. Commissioning Plan: A document prepared and updated by the Commissioning Authority, the Commissioning Plan outlines the organization, schedule, allocation of resources, and documentation requirements of the Commissioning Process.
- C. Commissioning Process: A quality focused process for enhancing the delivery of a project. The Process focuses on verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the design intent. Commissioning is typically abbreviated by "Cx". Commissioning and Cx have the exact same meaning and will be used interchangeably throughout the Contract documents.
- D. Commissioning Team: The team is comprised of the selected leader from each individual company constructing the equipment and/or systems to be commissioned. These individuals through coordinated actions are responsible for implementing the Commissioning Process.
- E. Contractor: General Contractor/Construction Manager selected to provide the described CHP facility
- F. Corrective Issue Report (CIR): A report generated by the (Cx) Authority during Performance Testing documenting issues found during the performance of functional and integrated system testing procedures that require follow-up corrective action.
- G. COR: VA Contracting Officer's Representative
- H. Functional Performance Testing (FPT): The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the sequence of operation and contract documents.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- I. Integrated Systems Testing (IST): The process by which various systems and their cooperative interaction and operation are confirmed to comply with the sequence of operation and contract documents (e.g. a gas turbine, heat recovery steam generator, and peripheral equipment reacting to a shutdown).
- J. Pre-Functional Checklist (PFC): Documents prepared by the Cx Authority and issued to the Contractor at the commencement of the Construction Phase. The purpose of the Checklist is to verify that appropriate components are on site, correctly installed, functional and ready for Functional Performance Testing.
- K. Provide: Furnish and install, complete and ready for intended use.
- L. Supplier: Entity supplying equipment and/or materials to Contractor
- M. Unless otherwise specified or indicated, electrical and electronics terms used in this document shall be as defined in IEEE 100.

#### **1.4. QUALITY ASSURANCE**

- A. The Contractor shall demonstrate that they have successfully installed at least four projects that, in aggregate, equal or exceed the size of the proposed project. References shall be provided for each of these referenced projects.
- B. CHP system contract documents shall be prepared under the signature(s) of a licensed Professional Engineer(s) (PE), registered in state in which CHP system is installed.
- C. The Gas Compressor Vendor shall have at least 10 years experience in the design, application, and supply of packaged systems and shall submit a list of not fewer than 10 similar installations.
- D. The Contractor shall have in place a complete and functioning comprehensive Quality Assurance program covering the design, procurement, fabrication, packaging and delivery of the specified systems, equipment and materials. This program shall ensure that the equipment and materials furnished by the Contractor meet the requirements of contract documents as well as the Contractor's own procedures and processes. Process shall be included in submittals for review and approval by the VA.
- E. The Contracting Officer's Representative (COR) shall be given the opportunity to witness all testing.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- F. The COR reserves the right to reject equipment or components which require major modification or alteration to meet contract documents.
- G. Non-conformances to this document and major equipment or component repairs that occur shall be documented and approved by the COR in writing prior to testing and shipment.
- H. Software Quality Assurance (SQA):
  - 1. Establish an SQA plan that addresses software tests normally performed by programmers and tests performed to verify system operation.
  - 2. Perform software tests to benchmark functional evaluations, including the following:
    - a. Conformance to contract requirements.
    - b. Language deviation.
    - c. Error handling.
    - d. Operational speed.
    - e. Maintain a software error log to record occurrence, solution, and corrected resolution.

Furnish software programming as required to perform functions as specified. Provide annotations in the programming describing functions and changes such that the Owner and others in the future can understand the logic so that changes can be readily made.
  - f. Provide software licensed to the Government in perpetuity.

#### **1.5. SUBMITTALS**

- A. Submit six copies of all design documents, shop drawings, product data, and samples in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES to the COR.
- B. Submit calculations, sizing and drawings for pipe expansion compensation systems, including anchors, guides, expansion joints and loops, and hangers. Calculations and design shall bear the seal of a registered professional engineer.
- C. Submit calculations, sizing and drawings for vibration isolation and seismic restraint of all equipment and systems in accordance with specification sections 13 05 41 and 23 05 51. Calculations and design shall bear the seal of a registered professional engineer.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- D. Submit computerized pipe stress analysis for high pressure steam and boiler feed system. Calculations shall bear the seal of a registered professional engineer.
- E. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements.
- F. If equipment submitted differs in arrangement from that shown on the contract drawings, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract and acceptable to the COR.
- G. Prior to submitting shop drawings for approval, Contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications from the applicable other manufacturers, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
- H. Submittals and shop drawings for independent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient installation. Final review and approvals will be made only with their completed groups.
- I. Shop Drawing Submittals: Shop Drawings shall be submitted for all products described in subsequent sections of this document. Shop drawings shall include a complete list of equipment and materials proposed for the project. The following Shop Drawing submittal requirements shall apply:
  - 1. Failure to comply with the submittal requirements defined herein and in Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, resulting in a resubmittal and additional review, shall not be justification for schedule delays or change orders.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

2. All documents, drawings, and data submitted shall be in the English language, English units followed by metric units in brackets (example: 6 in [155 mm ]).
  3. The review of submittals by the COR does not relieve or modify Contractor's responsibility for compliance with project requirements or dimensions or errors contained in the submittal or quantity count. It is clearly understood that noting some discrepancies but not others does not grant Contractor permission to proceed in error. Regardless of any information contained in the submittals, contract documents govern the work, and are neither waived nor suspended in any way by the review of the submittals.
- J. Product Data: Include detailed information for all components and materials of the CHP system.
- K. Certificates: Submit technical representative's certification that the installation has been implemented as depicted by the contract documents and where applicable, recommended by the manufacturer.
- L. Manufacturer's Instructions and Operation and Maintenance Documentation:
1. Safety precautions
  2. Operator restart
  3. Startup, shutdown, and post-shutdown procedures
  4. Normal operations
  5. Emergency operations
  6. Environmental conditions
  7. Preventive maintenance plan and schedule
  8. Troubleshooting guides and diagnostic techniques
  9. Wiring and control diagrams
  10. Maintenance and repair procedures
  11. Removal and replacement instructions
  12. Spare parts and supply list
  13. Operations and Maintenance submittal data
  14. Parts identification
  15. Testing equipment and special tool information
  16. Warranty information

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

17. Testing and performance data

18. Contractor information

M. Closeout Submittals:

1. Contractor shall provide six (6) hard copy bound and two (2) compact disc copy sets of Operations and Maintenance Manuals for all equipment and auxiliaries provided.
2. Provide a complete schedule of normally required inspection, preventative maintenance, predictive maintenance, and overhaul tasks and the outage hours required for all of the equipment and auxiliary systems supplied under the work of this contract, plus replacement parts associated with each task. Provide inspection and maintenance plans required to support the performance and minimum on-line availability specified herein. List requirements by year with a list of recommended spare parts for each through one entire overhaul cycle.
3. Provide a minimum of three (3) licenses/copies of all proprietary software required for installation, testing, tuning, or operation of the equipment, instrumentation, and/or protective devices furnished under this scope.
4. At Contract completion the Contractor shall turn over two (2) neatly marked sets of reproducible record documents representing the "as-built" work to the VA COR for verification and subsequent transmittal to the Owner.

N. Emissions Testing

**1.6. APPLICABLE PUBLICATIONS**

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this document to the extent referenced. Publications are referenced in the text by the basic designation only.

B. American Society of Mechanical Engineers / American National Standards Institute (ASME/ANSI):

B16.5-2009	Pipe Flanges and Flanged Fittings
B16.10-2009	Face to Face and End to End Dimensions of Valves
B16.34-2009	Valves-Flanged, Threaded, and Welding End
B31.1-2012	Power Piping

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- C. ASME Boiler and Pressure Vessel Code (BPVC):
  - Section I-2013 Rules for Construction of Power Boilers
  - Section VIII-2013 Rules for Construction of Pressure Vessels (Div. 1)
  - Section IX-2013 Welding and Brazing Qualifications
- D. ASME Performance Test Codes (PTC):
  - 46-1996 Overall Plant Performance
- E. American Petroleum Institute (API):
  - 614-2008 Lubrication, Shaft-sealing and Oil-Control Systems and Auxiliaries
  - 686-2009 Machinery Installation and Installation Design
- F. American Welding Society (AWS):
  - QC1-2007 Standard for AWS Certification of Welding Inspectors (2007)
- G. Hydraulic Institute (HI):
  - 1.1-1.2-2008 Centrifugal Nomenclature
- H. Institute of Electrical and Electronics Engineers (IEEE):
  - 485-2010 IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications
  - 100-2009 IEEE Standards Dictionary: Glossary of Terms and Definitions
  - C2-2012 National Electric Safety Code (NESC)
  - 1547-2003 Standard for Interconnecting Distributed Resources with Electric Power Systems
- I. International Code Council (ICC):
  - IBC-2012 International Building Code
- J. International Society of Automation (ISA):
  - 5.1-2009 Instrumentation Symbols and Identification
- K. Manufacturers Standardization Society (MSS):
  - SP-58-2009 Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation
- L. National Electric Manufacturers Association (NEMA):
  - Guide to Preparing a Design Proposal for Paralleling Customer Generation with an Electric Utility
  - MG 1-2011 Motors and Generators
- M. National Fire Protection Association (NFPA):

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

37-2010 Standard for the Installation and Use of Stationary  
Combustion Engines and Gas Turbines

54-2012 National Fuel Gas Code

70-2011 National Electric Code (NEC)

85-2011 Boiler and Combustion Systems Hazard Code

N. Underwriters Laboratories (UL):

142-2006 Steel Aboveground Tanks for Flammable and Combustible  
Liquids

O. VHA Boiler Plant Safety Device Testing Manual

## **PART 2 - PRODUCTS**

### **2.1. GENERAL**

A. Provide equipment and materials to construct a fully functioning Combined Heat and Power (CHP) facility to provide electricity and steam to West Haven VA Medical Center utilizing natural gas as the primary fuel source.

The new plant will burn natural gas fuel in a Combined Heat and Power (CHP) arrangement. The fuel shall be combusted directly in a prime mover which will generate electric power, and the resultant waste heat from said prime mover will be utilized to generate steam for space heating, domestic hot water production and absorption chilled water production.

B. The natural gas fuel to be utilized for the described CHP plant is sourced from Southern Connecticut Gas Company, derived from Algonquin Gas Transmission, LLC. The utility's Gas Quality Tariff Provisions document is attached to this specification section.

C. Provide utility interconnections as described below:

1. Steam generated by the new CHP facility will be supplied to the existing steam distribution network at 120 psig into the main HPS header in the Central Boiler Plant.
2. Natural gas fuel for use at the new CHP will be available at the plant site via a 4" inch Class 150 steel pipe at the north wall of the Central Boiler Plant. Available capacity is [95,260] cu ft/hr at 25-60 psig delivery pressure.



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

3. Boiler feed water is available from the existing boiler feed deaerator/feed pump skid located in the exiting Central Boiler Plant.
4. Instrument quality compressed air will be provided under the scope of this project for control device actuation, under specification division 22.
5. Generator output will be fed at 13.8 kV to new utility switchgear located on level 3 of the new Combined Heat and Power (CHP) plant.
6. Plant auxiliaries will be fed at 480V by a new double ended switchgear lineup on Level 2 of the new CHP plant].

#### D. Site Ambient Conditions

1. Site elevation: 130 ft abv MSL
2. Guarantee point temperatures:
  - a. Dry Bulb: 59 deg. F)
3. Maximum dry bulb temperature: 86 deg. F
4. Minimum dry bulb temperature: 0 deg. F

#### E. Seismic and Wind Loading Criteria

1. Site Class: C
2. 0.2 Second Spectral Response Acceleration: 0.245 g
3. 1 Second Spectral Response Acceleration: 0.062 g
4. Seismic Importance Factor: 1.5
5. Wind Load Criteria: 145 MPH (3-second gust)

#### F. Site Survey and Geotechnical Soils Data

Refer to Geotechnical Report

### 2.2. COMBINED HEAT AND POWER SYSTEM

- A. Natural gas fuel supply system, including gas booster compressors, valves, fuel gas conditioning equipment, and interconnecting piping.
- B. Two natural gas-fueled combustion turbine-generators (i.e. the "prime movers") to generate electric power.

Combined Heat and Power (CHP) Plant  
 West Haven Veteran's Affairs Medical Center  
 West Haven, Connecticut  
 VA Contract No. VA701-P-0163  
 Task Order VA701-13-J-0093  
 CannonDesign Project No. 004243.00

- C. Two Heat Recovery Steam Generator to utilize the waste heat from the prime mover.
- D. Two Fuel Gas Compressor Packages, each sized to serve both prime movers upon loss of one compressor package.
- E. Emissions and pollution control systems as specified herein.
- F. Any specific equipment requirements for to provide for emissions control such as water injection or combustion air preheating shall be fully packaged and controlled by the turbine controller. Field connections shall be clearly indicated on installation piping and wiring drawings.
- G. Interconnecting piping, valves, pipe supports, insulation, piping specialties, miscellaneous pumps, cable/conduit, interconnecting wiring, instrumentation, and controls as specified herein and otherwise required to provide complete and functioning plant systems.
- H. Shop testing and field testing as specified herein and otherwise required by codes referenced herein.
- I. Startup and commissioning of all plant systems provided in this work scope.
- J. Operations and maintenance training for all plant systems provided in this work scope.

### 2.3. PERFORMANCE GUARANTEES

- A. The CHP facility specified herein shall be guaranteed to generate the range of production capacities at maximum fuel consumption as tabulated below:

SYSTEM #	FULL LOAD CONDITIONS					
	KW	FUEL IN MMBTU/H	EXHAUST FLOW LBS/HR	EXHAUST TEMP	STEAM PRODUCTION	
					UNFIRED LBS/HR	FIRE LBS/HR
1	1142	17.45	51543	953	8778	17476
2	1439	20.85	62640	993	11322	21238
3	1727	24.62	68850	1070	13827	23344

SYSTEM	PART LOAD CONDITIONS
--------	----------------------

Combined Heat and Power (CHP) Plant  
 West Haven Veteran's Affairs Medical Center  
 West Haven, Connecticut  
 VA Contract No. VA701-P-0163  
 Task Order VA701-13-J-0093  
 CannonDesign Project No. 004243.00

#					STEAM PRODUCTION		
					UNFIRED LBS/HR	FIRE LBS/HR	
	KW	FUEL IN MMBTU/H	EXHAUST FLOW LBS/HR	EXHAUST TEMP			DUCT FIRING MMBTU/H
1	1100	16.65	55975	693	5737	17519	13.20
2	1100	18.43	73440	740	8426	22985	16.42
3	1100	17.11	79775	654	7365	24967	19.62

**NOTES:**

1. Entering air pressure drop 4" wc
  2. Exhaust pressure drop 10"wc
  3. Full load conditions: 59f/60%rh entering air, 150 ft above sea level.
  4. Part load conditions: 0 deg f, electric load fixed at load indicated.
  5. kW refers to electrical output at generator terminals @ 13.8 kv
  6. Steam production (gross) at 120 psig saturated steam, 228f feedwater, and 300 deg f hrsg gas exit temp.
  7. Hrsg exit temperature of 300f under all cases.
  8. Fired steam capacity based on duct firing to 1600 deg f.
  9. Gas entering compressor at 15 psig.
- B. The natural gas fuel consumption for the CHP facility specified herein shall be guaranteed not to exceed the fuel consumption tabulated above, utilizing the attached fuel quality tariff as a basis (refer to tariff appended to this specification section)
- C. Emissions of the noted pollutants for the CHP facility specified herein shall be guaranteed in writing not to exceed the following for the full range of load conditions described above:

Pollutant	Emission Limit while firing Natural Gas	Averaging time, except as specified for a performance test by the Ct DEEP
NOx	2.5 ppmvd @ 15% O2	1-hour block

Combined Heat and Power (CHP) Plant  
 West Haven Veteran's Affairs Medical Center  
 West Haven, Connecticut  
 VA Contract No. VA701-P-0163  
 Task Order VA701-13-J-0093  
 CannonDesign Project No. 004243.00

<b>Pollutant</b>	<b>Emission Limit while firing Natural Gas</b>	<b>Averaging time, except as specified for a performance test by the Ct DEEP</b>
CO	10 ppmvd @ 15% O <sub>2</sub>	3-hour block
PM <sub>10/2.5</sub>	2 lbs/hr	1-hour block
Ammonia	5.0 ppmvd @ 15% O <sub>2</sub>	1-hour block

For the purposes of designing pollution control systems, the figures tabulated below show each CGT manufacturer's expected emissions levels:

<b>System#</b>	<b>Full Load Conditions</b>				<b>Part Load Conditions</b>			
	<b>PPM Nox</b>	<b>PPM CO</b>	<b>PPM UHC</b>	<b>PM<sub>10</sub> mg/nm<sup>3</sup></b>	<b>PPM Nox</b>	<b>PPM CO</b>	<b>PPM UHC</b>	<b>PM<sub>10</sub> mg/nm<sup>3</sup></b>
1	42	50	25	Note 1	42	200	25	Note 1
2	30	80	5	Note 1	30	80	5	Note 1
3	15	1	3	Note 1	40	200	3	Note 1

Notes:

1. Particulate matter (PM<sub>10</sub>) to be obtained from CGT manufacturer.
2. Expected levels of emissions, to be confirmed by bidder

D. Overall noise levels generated by the CHP facility specified herein shall be guaranteed to meet the following noise criteria under the full range of normal operating conditions

1. The aggregate of all operating CHP plant equipment shall not generate sound levels within the plant building such that the broadband sound level at the property boundary (90 feet away from

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

CHP plant) increases by more than 40 dB(A) above the current existing ambient noise levels.

2. The aggregate of new louver duct connections, including combustion inlet air, enclosure ventilation air, and boiler stack shall not radiate sound levels such that the broadband sound level at the property boundary (90 ft away from CHP plant) increases by more than 40 dB.
3. The CHP plant shall not produce any "pure tone" condition. A "pure tone" exists if the sound pressure level, at any given octave band center frequency, exceeds the levels of the two adjacent octave bands by three (3) or more decibels. Submit report of sound pressure levels with CHP system running at half and full rated electrical output.

#### **2.4. COMBUSTION TURBINE GENERATOR**

- A. The combustion turbine generator (CTG) package shall include all features needed for safe, highly reliable, efficient, long-term operation. Design shall be in accordance with good engineering practice, applicable standards, and shall meet the strict demands typical of industrial power plants for safety and reliability, as well as those imposed by VA and all regulatory agencies having jurisdiction in the State of Connecticut. Turbine and generator equipment shall be selected from manufacturers who have been routinely engaged in the production of such equipment for a minimum of 10 years.
- B. The CTG package shall be designed for automated, continuous duty electric power generation. Load control shall be accomplished by packaged turbine control systems provided with the equipment, based based on 1) minimum electrical import (electrical tracking), and 2) high pressure steam header pressure (thermal tracking). The CTG shall be capable of operating over the full range of ambient and load conditions specified herein and on the drawings.
- C. The CTG package shall be furnished with all necessary gas, lube oil cooling, compressed air, and cooling water connections, instrumentation, and controls for completely automated control,

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- monitoring and testing. All connections shall be furnished with valves and fittings.
- D. The CTG package shall be designed for indoor installation with enclosure ventilation and turbine combustion air ducted directly from/to outdoors. The CTG shall be capable of sustained operation with utility pipeline natural gas fuel. The natural gas will be compressed prior to reaching the CTG skid. Supplier shall specify required gas pressure to the CTG package.
- E. The unit shall be capable of operating in an isochronous mode to satisfy facility electric loads or synchronized to the existing utility grid. The unit governor response time shall be compatible with this operation. Controls and operation shall be suitable for operation in parallel with the utility electrical grid.
- F. The CTG package shall be mounted on a structurally isolated reinforced concrete foundation. Foundation shall be designed utilizing dynamic analytical techniques (including evaluation of harmonic characteristics) to ensure that the anchorage is capable of withstanding both live and dead load characteristics as specified by the manufacturer without exceeding manufacturer's limits for displacement and vibration. Copies of the dynamic analysis and modeling calculations shall be furnished to the VA COR prior to construction.
- G. The CTG package shall include, but not necessarily be limited to, the following:
1. CTG package mounted in indoor, sound attenuated, ventilated enclosure.
  2. Electric Generator:
    - a. 13,800V
    - b. 3 Phase
    - c. 0.85 power factor
    - d. 60 Hz
    - e. 1800 or 3600 RPM
    - f. Totally-Enclosed Fan Cooled (TEFC)

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

3. Electric/hydraulic or electric-only turbine starting system including variable frequency drive (where applicable) for starter motor.
4. Lube oil systems, pumps and coolers for turbine and generator, including filtering/purification system.
5. Lube oil cooling shall be 1) completely self-contained air cooled, or water cooled based on a supply of 120F 40% glycol solution. Oil cooler shall be mounted such that all oil-containing components are protected by the package fire suppression system. The turbine enclosure shall provide protection against loss of lubricating oil beyond the equipment enclosure upon failure of any oil containing component.
6. Fuel system capable of burning natural gas, including fuel control valves, shutoff valve(s), vent valves, filters, and controls.
7. Compressor water wash system for offline and online washing, with pumps, tanks, valves, piping, and appurtenances.
8. Self-cleaning inlet air filter housing and media with ladders, platforms and safety rails (as needed) for maintenance.
9. One set of clean new filters for startup and commissioning of the CTG, and a complete second set of clean new filters upon turnover of the unit to Owner.
10. Ventilation fans for generator compartment.
11. Sound attenuators if required and necessary filters for supply and exhaust ducts for ventilation of generator and turbine compartments.
12. Sound attenuators for combustion air and exhaust systems, as required to meet overall noise limits specified herein.
13. Air intake anti-icing system, to prevent ice formation at compressor inlet down to the minimum ambient temperature conditions specified herein. Supplier shall specify method used for ice prevention and associated utility requirements.
14. Insulation and cladding for heat retention, noise reduction and personnel protection (140 degrees F maximum surface temperature, or as required by applicable codes and standards).

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

15. Instruments and equipment required for interface with distribution switchgear such as resistance temperature detectors, potential and current transformers, neutral ground resistor and associated current transformer.
16. Borescope inspection ports.
17. Vibration monitoring, condition monitoring, and data management systems.
18. Real-time event recorder with first-out identification and reporting to the operator.
19. Turbine performance monitoring system.
20. Complete automatic clean agent fire suppression system including fire, heat and combustible gas detectors, manual disable switches on outside of enclosure, clean agent bottles or storage unit, automatic dampers, etc., per NFPA requirements. Package fire alarm control system shall be interfaceable with the plant fire alarm control panel.
21. DC emergency power distribution system including battery rack and charger for controls, emergency lights and pre/post lube oil pumps for a coast down and cool down period sufficient to prevent equipment damage after a full load trip.
22. AC power/lighting system for interior of enclosure.
23. Sound attenuation to achieve average noise levels of 85 dBA (max.) at 3 feet distance and 5 feet above grade under free field conditions over a reflecting plane.
24. Steel base frame with full size, continuous drip pan.
25. Base plates, shims, alignment/leveling equipment, and any other special foundation imbeds required to set and align equipment.
26. Safety rails as required in accordance with OSHA standards. All safety ladders, hand rails, gratings, steps, external structural or support members shall be hot dipped galvanized.
27. Control valves, block valves and instrument isolation/root valves as required. Include required instruments and transmitters such as pressure and temperature indicators, resistance temperature detectors and thermometers, potential and current transformers.



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

28. Painting, suitable for indoor exposure and corrosion protection, appropriate for the corrosive effects of a typical power plant environment.
29. Safety guards on exposed rotating parts, in accordance with OSHA standards. Safety guards on exposed rotating parts shall be painted "Safety Yellow."
30. Required lifting/moving equipment and tools to remove and replace turbine rotor, generator, and gear equipment (if required) within 24 hours, including lugs, spreader bars, etc.
31. Adequately sized and positioned lifting lugs for all furnished equipment.
32. Expansion joint between turbine exhaust connection and Heat Recovery Steam Generator in accordance with 23 51 00 BREECHINGS, CHIMNEYS AND STACKS.
33. Computer-based turbine-generator control system including unit governor controls compatible with local electric utility, meters, gages, alarms and miscellaneous controls, locally mounted in modular enclosure. All control equipment requiring a conditioned space shall be centrally located in a conditioned environment. Control system shall be capable of interface with the Plant Control System (PCS) via data link.

## **2.5. HEAT RECOVERY STEAM GENERATOR**

- A. Provide Heat Recovery Steam Generator in general accordance with the applicable portions of the VA Steam Generation Systems Design Manual (Including Energy Center), with Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANT AND STEAM GENERATION, and with the requirements specified herein.
- B. The Heat Recovery Steam Generator (HRSG) package shall include all features needed for safe, highly reliable, efficient, long-term operation. Design shall be in accordance with good engineering practice, applicable standards, and shall meet the strict demands typical of industrial power plants for safety and reliability, as well as those imposed by VA and all regulatory agencies having jurisdiction in the State of Connecticut. HRSG equipment shall be

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- selected from manufacturers who have been routinely engaged in the production of such equipment for a minimum of 10 years.
- C. The HRSGs shall be water tube style designed to utilize waste heat extracted from the prime mover exhaust stream to generate saturated steam for heating and absorption chilling use.
- D. All HRSG pressure parts shall be designed for operating and design pressure ranges corresponding to the equipment being served. The HRSG shall be constructed and stamped in accordance with the most recent edition of the ASME Boiler and Pressure Vessel Code, Section I (Rules of Construction of Power Boilers) and Section VIII (Rules for Construction of Pressure Vessels) as applicable. The HRSG shall be registered with the National Board of Boiler and Pressure Vessel Inspectors.
- E. The HRSG shall be furnished with all necessary flue gas, feedwater and steam connections, instrumentation, and controls for completely automated control, monitoring and testing. All connections shall be furnished with valves and fittings which comply with all specifications related to controls, valves, and monitoring. Sample ports shall be provided with pipe caps or blind flanges.
- F. The boiler duct burner combustion systems shall be designed in accordance with the latest edition of NFPA 85, Boiler and Combustion Systems Hazards Code. Duct burner systems and components shall be reviewed and approved by the VA. The VA reserves the right to modify and to include items that go beyond the requirements of NFPA 85.
- G. The HRSG package shall be designed for indoor installation. Anticipated indoor temperatures will range between 65F and 105F. The HRSG package shall include, but not necessarily be limited to, the following:
1. Steam drum with steam separator
  2. Mud drum(s)
  3. Evaporator section
  4. Feedwater economizer
  5. SCR and CO catalysts (refer to section on Emissions Control Equipment herein)

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

6. Double-wall insulated stack and flexible connection for field installation as shown on drawings to accommodate offset.
7. Stack sampling ports in accordance with local permitting requirements.
8. Fully modulating supplemental firing duct burner assembly utilizing natural gas fuel to allow for additional steam generating capacity as specified herein.
9. VA approved burner management system and associated controls, with interface capability to the PCS.
10. All code-required safeties including low- and high water cutoff.
11. Steam drum safety relief valve(s) with drip pan elbows.
12. Ultraviolet flame scanners
13. Painting, suitable for indoor exposure and corrosion protection, appropriate for the corrosive effects of a typical power plant environment.
14. Programmable logic controller (PLC) based three element drum level controls and combustion controls, with interface capability to the PCS. Provide prepiped makeup valve train and flow elements per 23 09 11, Instrumentation and Control for Boiler Plants.
15. Fully packaged system mounted on a common structural steel frame
16. HRSG surface blowdown piping and valves to be controlled by remote sampling/control system provided under separate contract.
17. Manual blow down valves from mud drum and instrument columns.

## **2.6. FUEL GAS COMPRESSOR PACKAGE**

- A. The Vendor shall design, fabricate, assemble, factory test, deliver and provide startup and commissioning services and training for (2) fuel gas compressor systems (FGC). FGC systems shall be a complete, skid-mounted fuel gas compressor package and shall be provided for each of the two prime movers to boost the incoming gas pressure from the utility to that required by the prime mover.

It is the intention of this specification that the Vendor shall be solely and entirely responsible for the design, procurement of materials and components, fabrication and assembly, inspection and

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

testing, preparation of equipment for shipment, delivery and guarantee of the performance of the equipment. The individual components of the FGC system shall be integrated by the Vendor to form a completely functional system such that the purchaser need only connect utilities, interconnection piping, wiring and appurtenances to come a complete functional and reliable system.

The FGC system shall be designed for an automated, unattended mode for continuous operation 24 hours a day, 365 days per year. FGC operation will be monitored and alarms will be annunciated at a central plant control panel.

The compressor shall automatically adjust to gas turbine fuel flow requirements through the full range of turbine operating conditions. Additionally, the compressor system shall be capable of operating if either of the turbines shut down.

The package shall include, but not necessarily be limited to, the following:

1. (2) 100%-capacity, rotary screw type gas compressor and electric motor driver
2. Fuel gas conditioning system
3. Motor starter
4. Variable Frequency Drive
5. Suction/discharge manifolded to the edge of the skid
6. Intercoolers and aftercoolers
7. External air cooled glycol/water cooling system.
8. Glycol pump set.
9. Glycol/water shell and tube aftercooler
10. Bulk oil separator with immersion heater
11. Final polishing gas filter
12. Filters, separators and scrubbers
13. Lube oil system
14. Gas/Oil Coolers
15. Automatic on/off systems

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

16. Flow and pressure control systems
  17. All valves, relief valves, drains, vents, instrumentation and compressor accessories required by applicable codes.
  18. Inlet and outlet fire safe shutoff valves skid-mounted. Inlet valve shall be pneumatically operated, while outlet valve shall be manually controlled. Inlet valve shall close quickly due to low pressure on the suction of the compressor.
  19. Sound attenuation enclosure and silencers as required with gas/fire detection system and fire suppression system.
  20. Ventilation as required to limit gas levels per NFPA. Include notification/alarm of excessive gas levels within the enclosed area.
  21. Surface preparation and painting for indoor exposure per manufacturer's standard.
  22. Computer-based compressor package control system including pressure controls, meters, gages, alarms and miscellaneous controls, locally mounted in modular enclosure. All control equipment requiring a conditioned space shall be centrally located in a conditioned environment. Control system shall be capable of interface with PCS via data link.
  23. All equipment shall be suitable for a hazardous area classification Class 1, Division 2, Group D area.
- B. Fuel gas conditioning system
1. Contractor shall provide a complete skid-mounted fuel gas conditioning package to treat the incoming pipeline-quality fuel gas such that it meets the prime mover Supplier's requirements for cleanliness and moisture content. Package shall include, but not necessarily be limited to, the following:
    - a. Two 100%-capacity fuel gas filter separators. Each fuel gas separator shall be designed with a demister pad or vane pack to remove 90% of moisture droplets 10 micron or larger. The filter separator shall also remove 100% of solid particles 60 micron and larger. If additional pre-treatment equipment (e.g. knockout drum, etc.) is required or recommended by

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- Supplier to achieve the specified fuel gas quality on a continuous basis, this equipment shall be included as well.
- b. One 100%-capacity electrically-powered fuel gas preheater, if required to meet fuel gas superheat requirements. Include skid-mounted local SCR power controller.
  - c. Block valves for complete isolation of each individual vessel.
  - d. Common structural steel skid for mounting of piping, valves, instrumentation, and vessels.
  - e. All internals, nozzle connections, and accessories.
  - f. Full-flow-capacity relief valves for protection of each pressure vessel, designed per ASME Section VIII requirements.
  - g. Automated liquid drain valves and/or traps from each vessel chamber, piped to a common drain header.
  - h. Double-wall, vented waste drain tank for collection of all liquids, including pump-out connection with quick-disconnect fitting as well as manual drain. Tank shall be designed in accordance with Underwriters Laboratories' UL-142 specifications and so labeled. Vent size shall be sufficient to prevent over pressurization of waste drain tank in the event of fully-open discharge of gas from all connected drain lines.
  - i. Continuously welded support legs for vessels.
  - j. Vent piping and valves to provide required venting for start-up and normal operation.
  - k. Instrumentation and controls as required to allow for complete control and monitoring of the preconditioning package by the PCS, wired to terminal boxes on the common structural steel skid-mounted package.
  - l. Surface preparation and painting for indoor exposure per manufacturer's standard.
  - m. Adequately sized and positioned lifting lugs for all furnished equipment.
  - n. Vessel testing per ASME Section VIII requirements.
  - o. One (1) full set of spare filter elements.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

2. All pressure vessels shall be designed, manufactured and tested in accordance with ASME Section VIII. Furnish ASME stamp and label in accordance with ASME code for required maximum working pressure.
- C. Components and systems within Vendor's Scope shall be skid mounted, and complete including all control valves, piping, equipment, instrumentation, controls, alarms, wiring, insulation, cladding and any other items required for a complete, functional, highly reliable and highly-automated installation in accordance with good engineering practices and the rigorous demands of industrial power plant service.
- D. The fuel gas compressor package shall be mounted on a structurally isolated reinforced concrete foundation. Foundation shall be designed utilizing dynamic analytical techniques (including evaluation of harmonic characteristics) to ensure that the anchorage is capable of withstanding both live and dead load characteristics as specified by the manufacturer without exceeding manufacturer's limits for displacement and vibration. Copies of the dynamic analysis and modeling calculations shall be furnished to the VA COR prior to construction.
- E. Equipment layout - there are space limitations for this equipment that the Vendor must comply with while meeting the design requirements stated herein. The Vendor shall prepare an equipment arrangement clearly identifying all equipment along with the recommended maintenance space requirements.
- F. Enclosure - each system shall be housed in a self-contained, weatherproof, painted industrial grade aluminum or painted galvanized steel acoustical enclosure to form a complete package. Refer to project acoustical requirements.
- G. Fire Detections/Suppression System
1. Primary fire detection system shall utilize dual ultraviolet (UV) detectors. The system shall include a self-checking automatic optical integrity feature.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

2. Secondary detection system shall be provided consisting of a dual rate-of-rise thermal detectors. The two detection systems shall act independently in detecting a fire.
  3. A fire system supervisory release panel shall be provided to supervise the fire system circuitry.
  4. The compressor shall trip on the detection of a fire.
  5. The enclosure shall be equipped with a fire suppression system consisting of a primary (main) total flooding distribution system and a secondary (reserve) metered distribution system including a 'main to reserve' transfer switch. The system shall be designed in accordance with NFPA 12. The system shall use either FM-200 or Inergen as a fire suppression agent.
  6. Exterior audio and visual alarms to activate upon release of the fire suppressant.
  7. Two manual pull stations.
- H. A dual channel combustible gas monitoring system shall be provided to continuously monitor for combustible gasses within enclosure. The gas sensors are to be monitored by the fire and gas detection system.
- I. The compressor start signal shall be interlocked with the combustible gas monitoring system to ensure the atmosphere is clear prior to initiating the compressor to start.
- J. Gas monitoring system shall include provisions to monitor and alarm gas vent system provided with compressor package as well as automated suction/discharge header vent lines with two (2) off skid suction and discharge piping sensors.
- K. The enclosure ventilation and exhaust air openings shall be equipped with roof mounted straight-through type silencers.
- L. Controls: The control system shall provide complete control and monitoring of the FGC system to be done in a local control panel.



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

THE FGC PAC will communicate with the Balance of Plant PAC system and the CTG PAC via Ethernet IP. The communications will include stop/start commands and retrieval of FGC data sufficient for full control and monitoring capabilities from the Control Room. The Vendor shall develop and supply a soft point I/O list for use by the BOP system integrator for system programming.

## **2.7. POST-COMBUSTION EMISSIONS CONTROL SYSTEM(S)**

Post-combustion emissions control systems shall be provided with the HRSG to ensure that the criteria pollutants at the stack are within the specified permit limitations at all operating conditions. Contractor shall be responsible for selection and design of the necessary technologies to meet these limits, which may include one or more of the following:

### **A. NO<sub>x</sub> Control via Selective Catalytic Reduction System (SCR)**

1. A fully automated Selective Catalytic Reduction (SCR) system shall be provided to reduce NO<sub>x</sub> emissions to permissible levels. The SCR shall control nitrogen oxide (NO<sub>x</sub>) emissions from the HRSG by the injection of a reagent (ammonia) into the boiler flue gas in the presence of a catalyst installed in the HRSG.
2. The system shall utilize aqueous urea as the NO<sub>x</sub> reduction reagent ammonia source. The following components shall be included as a minimum to comprise a complete and functional SCR system:
  - a. Aqueous urea truck unloading station, including visual indication of storage tank level and high-level alarm.
  - b. Aqueous urea storage tank, fiberglass reinforced plastic construction, including all required instrumentation, fill/return/outlet connections, and vent. Tank shall be sized for 6,000 gallons for low pressure operation (below threshold of ASME Boiler and Pressure Vessel Code, Section VIII).
  - c. Two (2) 100% capacity aqueous urea circulating pumps sized to recirculate the entire urea tank volume once per 24 hours.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- d. (2) urea to ammonia thermal decomposition units with urea metering pumps, dilution air blowers, electric heaters and controls. The system shall be designed to respond to an emergency stop immediately with no release of ammonia to atmosphere or the need for the collection of and disposal of ammonia at any time. Continued ammonia product generation will stop at that time.
- e. SCR Catalyst Modules. Design life shall not be less than 26,100 operating hours (from first fuel-in) or 39 months from delivery, whichever occurs first. Supplier shall provide catalyst life guarantee and replacement schedule based upon year-round base-loaded operation, assume 8,500 hours/year.
- f. Ammonia distribution manifolds internal to the HRSG and upstream of the catalyst modules for optimal distribution of ammonia across the catalyst at the appropriate temperature zone(s). System shall be designed to limit ammonia slip to less than or equal to the permit limits.. Under all operating conditions, the ammonia product vapor shall remain in a safe and nonflammable concentration and shall meet applicable NFPA and Factory Mutual codes and standards for safety in handling ammonia.
- g. Access hatch, hoist and rigging, and clearances for maintenance and replacement of the catalyst modules. Access and removal of modules should take into account the minimization of chemical burn potential of individuals when removing the units.
- h. Supplier will include test elements preinstalled in the catalyst modules (minimum 4). Each test element will have a replacement supplied with the initial shipment of catalyst.
- i. Control and monitoring instrumentation to interface with the ammonia storage, vaporization, and forwarding system described herein. This includes test ports immediately upstream and downstream of the catalyst.
- j. Combustion analyzers mounted upstream and downstream of the SCR catalyst to provide basis of control for the SCR system.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- k. Catalyst temperature and pressure indicators/transmitters shall be located upstream and downstream of the catalyst
- l. All required instrumentation, controls, valves, and interconnecting piping (stainless steel construction) to complete the system.
- m. Ammonia detectors installed adjacent to all potential ammonia leakage locations, with high- and high-high alarm indication to the PCS.
- n. Computational Fluid Dynamics (CFD) modeling of the SCR to ensure minimum flow requirements are met.

Flow Criteria to be met:

Velocity deviation RMSE <15%

NH3/NOx deviation RMSE <5%

#### B. CO Reduction via CO Catalyst

- 1. A post-combustion catalytic CO reduction system shall be provided. It shall be fully integrated with the HRSG, shop assembled to the maximum extent possible and shall include components & accessories for a complete installation within the hot gas path of the HRSG. The catalyst shall be capable of reducing the combined CO emissions from the prime mover and duct burner to meet the permit limitations specified herein. The unit shall be complete with:
  - a. CO Catalyst Modules. Design life shall not be less than 26,100 operating hours (from first gas-in) or 39 months from delivery, whichever occurs first. Supplier shall provide catalyst life guarantee and replacement schedule based upon year-round base-loaded operation, assume 8,500 hours/year.
  - b. Structural frame work for maintenance and replacement of the catalyst modules, including hoists and rigging. Access and removal of modules should take into account the minimization of chemical burn potential of individuals when removing the units.
  - c. Test ports upstream and downstream of the CO catalyst shall be provided (downstream can be the same as the upstream NOx catalyst ports).

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

## **2.8. STAINLESS STEEL HIGH PURITY TUBING, FITTINGS AND VALVES**

- A. Carrier Tubing (Single Melt):
- B. Tubing, All Sizes: Conform to ASTM A269 or A632 type 316L, vacuum annealed or hydrogen bright annealed and electropolished. The manufacturer is expected to perform all of the following steps to ensure the chemistry, smoothness, cleanliness, and physical characteristics of the tubing products. Document the mill source; submit subsequent changes of the mill source to the Owner. Sizes below 1 ½-inch nominal diameter shall be seamless.
  - 1. Finish 10µin Ra maximum; reference SEMASPEC 90120400A-STD or ANSI B46.1 for test methodology.
  - 2. Sulfur Content: Between 0.005 percent and 0.015 percent.
  - 3. Tubing Hardness: Between Rockwell "B" hardness Rb 60-Rb 80.
  - 4. Tubing of Same Size: Manufacturer to provide tubing from same heat or test for cross-heat weldability.
  - 5. Include a mill test report with each lot of tubing from the same heat indicating heat chemistry; the permanent marking on each length of tube shall correspond to this report.
  - 6. Provide at least 90% of tubing in 20 foot lengths ± 3", remaining shall be not be under 18'-6" in length.
  - 7. Flush the tube clear of cleaning chemicals. Under no circumstances shall cleaning solutions be allowed to dry on the tube ID surface.
  - 8. A nitric acid flush is required to remove any residual contamination. This is followed by flushing, using filtered ambient temperature DI water until the final rinse shows effluent water greater than 17.5 megohms. Times rinses are acceptable once resistivity levels are established.
  - 9. The tube is to be dried using 0.01 micron filtered heated nitrogen until the moisture content is less than 5 ppm.
  - 10. While still under nitrogen purge, cap and seal the tubing end using polyimide film placed over the ends and a push on cap, followed by a plastic bag over the cap.
  - 11. The quality of the tube shall allow for the butt welding of the products successfully with an automatic orbital tube welder.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

The chemistry of the material shall be such that successful welds can be obtained using the fittings and valves as specified herein.

12. Permanently mark tubing and tube fittings continuously on the OD with the following information:

- a) Manufacturer's name.
- b) Manufacturer's product code.
- c) Nominal size.
- d) Wall thickness.
- e) Alloy.
- f) Heat number.
- g) Wall thickness:

<u>Size</u>	<u>Thickness</u>
1/8-inch through 3/8-inch OD tube	0.035-inch (±10%)
1/2-inch through 5/8-inch OD tube	0.049-inch (±10%)
3/4-inch through 3-inch OD tube	0.065-inch (±10%)
4-inch OD and above tube	0.083-inch (±10%)

- h) Ovality, Concentricity, and Wall Thickness Tolerance:

C. Welded Tube Fittings:

- 1. Conform to the same qualities and cleaning procedures as the tube described herein.
- 2. Butt weld fittings.
- 3. Fitting Angularity: ±1 degree.
- 4. Fitting Dimensional Tolerances: ±1/32-inch.
- 5. Welded Fittings; Helium leak tested to less than  $1 \times 10^{-9}$  scc/sec.

D. JOINING MATERIALS/METHOD

- 1. Automatic Orbital Welding.
- 2. Mechanical Joints:
  - a) 1-inch and Smaller Only: Face Seal (VCR) fitting couplings of the same surface qualities and cleaning procedures as the tube described herein; gasket material to be annealed nickel or stainless steel plated parts are not acceptable.

E. 316L SS BODY PACKLESS VALVES

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

1. Materials

- a) 1-inch OD and Under: Packless diaphragm type valves with a 316L SS body or 316L SS VAR. Conform to same surface quality and cleaning procedures as tubing described above.
- b) Valve Diaphragm: 316L SS or equal.
- c) Salve Seat: Kel-F or equal.
- d) End connections: Tubing extensions to match tubing specified above for automatic orbital TIG welder, VCR (male or female) or combination of both.
- e) Diaphragm Valve, 1/4" (for tool hookup).

F. 316L SS CHECK VALVES

1. Materials

- a) 1/2-inch OD and Under: 316L SS body. Conform to same surface quality and cleaning procedures as tubing described above.
- b) Seal material: Fluorocarbon FKM or equal.
- c) End Connections: Tubing extensions to match tubing specified above for automatic orbital TIG welder, VCR (male or female) or combination of both.

G. GASES FOR PURGING

- 1. Use argon for all welding operations. Gases used for weld shield/purge and pressure test shall conform to the following:
  - a) Moisture Content: Less than 1 ppm.
  - b) Oxygen Content: Less than 2 ppm.
  - c) Particles: Less than 10 greater than 0.1 micron.
- 2. Nitrogen for Drying:
  - a) Ultra-high purity grade.
  - b) Moisture Content: Less than 1 ppm.
  - c) Oxygen Content: Less than 2 ppm.
  - d) Particles: Less than 5 greater than 0.1 micrometer or filtered through 0.003 micron filter.

**2.9. MECHANICAL GENERAL REQUIREMENTS**

- A. Provide CHP mechanical and piping systems in general accordance with the applicable portions of the VA Steam Generation Systems Design

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- Manual (Including Energy Center), with Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANT AND STEAM GENERATION, and with the requirements specified herein.
- B. The design, fabrication, installation and testing of all piping shall conform to the latest edition with all current addenda of ASME B31.1 (Power Piping), and Section I of the ASME Boiler and Pressure Vessel Code (Rules for Construction of Power Boilers) along with all applicable federal, state and local laws.
  - C. All welding shall be in accordance with the latest edition with all current addenda of Section IX of the ASME Boiler and Pressure Vessel Code.
  - D. All connections to equipment nozzles shall be made in such a manner to not exceed the allowable loads on the nozzles.
  - E. Pipe joints shall be normally welded or flanged. Threaded joints are permitted only when required to make connections to equipment and shall be in accordance with the requirements and limitations specified in ASME B31.1.
  - F. Natural gas and compressed air piping shall be blown clean using compressed air. Steam piping shall be blown with steam. All pipe cleaning procedures shall be designed to meet the cleanliness criteria of the relevant connected equipment manufacturers.
  - G. All piping 2 inch NPS in diameter and smaller shall be schedule 80 at a minimum.
  - H. All cast steel body valves shall have the pressure containing parts constructed of ASTM designation A216 Gr. WCB carbon steel. Gate and globe (rising stem) valves shall be bolted bonnet with pressure temperature rating conforming to ANSI B16.34. Stems shall meet ASTM designation A186 F6 chromium stainless steel. Wedges (gate valves) shall meet ASTM A182 F6 chromium stainless steel on valves from 2" to 6". Sizes 8" and larger may be A216 WCB with forged rings or overlay equal to 182 F6. Seat rings shall be hard faced carbon steel or 13% chromium A182 F6 stainless.
  - I. All forged steel body valves shall have the pressure containing parts constructed of ASTM A105, Grade 2 forged carbon steel. Seat and wedges shall meet ASTM A182 F6 chromium stainless steel. Seat

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- rings shall be hard faced. Valves shall conform to ANSI B16.34 pressure temperature rating.
- J. Gate valves 2-1/2" and larger in steam service shall have flexible wedges. Gate, globe, angle, check, and ball valves in steam, steam drains, steam condensate, feedwater and blowdown services shall have "Stellite" or other approved hard facing on both seats and wedges/discs/plugs.
- K. All gate and globe valves 4" and larger shall be drilled and tapped in accordance with MSS SP 45 and equipped with a standard size drain valve and equalizing by-pass valve assembly.
- L. Isolation valves for natural gas service shall be of the ball or plug type. Valves shall be specifically suited for natural gas service and shall conform to the design requirements of API 6D. Valves shall be fire tested in accordance with API 607. Valves supplying high pressure gas to gas turbines shall be of the non-lubricated type to prevent contamination of fuel lines.
- M. Butterfly valves, where used, shall be of the high-performance type. Butterfly valves are to be used for water service only.
- N. All steam and high pressure boiler feedwater (downstream of boiler feedwater pump discharge) shall have support requirements which are specifically identified on the design drawings based on stress analysis considerations. Contractor shall submit copies of all stress analysis reports.
- O. Pipe hangers shall comply with MSS-SP-58. Support spacing for horizontal pipe hangers shall be in accordance with MSS-SP-58 and table 121.5 of ASME B31.1. Horizontal and vertical pipe attachments shall be selected in accordance with MSS-SP-58.
- P. Process piping shall be supported using either shoes or hangers. Supporting these lines directly on steel is not acceptable.
- Q. All pipe support hardware (including spring hangers) shall be hot dipped galvanized, unless field welding is required. Repair any damaged galvanized plating with a field applied cold galvanized coating.
- R. Contractor shall provide insulation for piping and equipment for the following purposes as applicable:



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

1. Reduction of unwanted energy loss or gain to processes.
  2. Maintaining safe surface temperatures for the purpose of personnel protection.
  3. Preventing condensation on systems that operate below ambient dew point.
- S. Insulation thickness shall be selected to meet current ASHRAE 90.1 requirements for thermal resistance. Application of all insulation types shall be done in accordance with manufacturer's recommendations. Insulating materials shall be selected from the following approved types as appropriate for the service:
1. Calcium Silicate
  2. Cellular Glass
  3. Mineral Fiber Blanket
  4. Phenolic
- T. General duty pumps shall be provided where required in the CHP facility to meet system pressure, temperature, and flow rate requirements, as well as requirements dictated by the installed environment. Pump Suppliers shall be responsible for selecting materials of construction that are compatible with the fluid properties and operating conditions.
- U. Pump motors shall include the following characteristics:
1. Motors shall be NEMA MG-1 Premium Efficiency™ motors.
  2. Motors shall be "inverter ready".
  3. Motors shall include oversized conduit box.
  4. Motors shall include stator heaters.

## **2.10. ELECTRICAL GENERAL REQUIREMENTS**

- A. Provide CHP electrical systems in general accordance with the applicable portions of Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and with the requirements specified herein.
- B. Provide electrical distribution equipment as required for a complete plant operation to include:
1. Generator paralleling control.
  2. Generator isolation transformer where required.
  3. Distribution switchgear to tie new cogeneration facility into the existing power distribution infrastructure.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

4. Plant auxiliary power system including transformers, distribution switchboards, motor control centers, and low voltage systems as necessary for a complete and functional CHP system.
5. Provide critical power systems as required for the plant including DC systems, UPS systems, and life safety equipment.
- C. Provide all necessary documentation and studies as required by the supplying electric utility for paralleling the new generation resource to the electric utility.
  1. Reference the NEMA "Guide to Preparing a Design Proposal for Paralleling Customer Generation with an Electric Utility" as a basis for initiating negotiations with the electric utility.
  2. Comply with all local, regional and national requirements for paralleling the new generation to the utility.
- D. Provide electrical studies as required for safe system operation. Study results shall include recommended system settings which optimize selective coordination and allow for safe operation and maintenance of equipment. The target result of the studies is to achieve a maximum NFPA 70E hazard risk category of 2. Hazard risk category of 3 must be approved by the client. Hazard risk category of 4 or higher is unacceptable and will require mitigating efforts to reduce the hazard risk category to acceptable levels.
  1. Short circuit study
  2. Selective coordination study
  3. Arc flash study
- E. Limit harmonics to less than 5%. The Point of Common Coupling for this evaluation shall be the CHP plant main voltage bus.
- F. Electrical conservation
  1. Provide metering of primary and secondary distribution systems as well as any loads in excess of 10 kW for energy monitoring and management.
- G. Control interface
  1. All process equipment shall be configured for operation via the plant control system.
  2. Protective functions and interlocks shall be hardwired.
  3. Control functions for motor controllers shall be hardwired.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

H. Acceptance testing

1. All electrical systems shall be set, evaluated and tested in accordance with NETA ATS recommendations. All materials and combined systems shall be UL listed.

I. Commissioning

1. Provide support for system commissioning activities.

**2.11. INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS**

- A. Provide CHP instrumentation and control systems in general accordance with the applicable portions of the VA Steam Generation Systems Design Manual (Including Energy Center), and with Section 25 10 10, ADVANCED UTILITY METERING SYSTEM, and with the requirements specified herein.
- B. Provide a centralized Plant Control System (PCS) which will allow for fail-safe startup, dispatch, modulation, and shutdown of the CHP plant systems. The PCS shall be designed to integrate control and monitoring of individual equipment PLC's and unit controllers as well as all Balance of Plant (BOP) field devices, instrumentation, and subsystems. Integration of CHP and BOP systems shall be the responsibility of the CHP/boiler plant integrator, Able Co. (refer to specification section 23 09 11).
- C. The primary user interface to the PCS shall be via the Engineering Control Center computer system utilizing a graphical user interface which diagrammatically presents operational status information on all equipment and associated subsystems. This system will be provided under section 23 09 23. Design of GUI interfaces for the CHP controls will be by the CHP plant integrator.
- D. The PCS shall be compatible with the existing control system at the plant site, which consists of a distributed boiler control system/system. Operating parameters will be integrated into the GUI provided by the BAS contractor under specification section 23 09 23.
- E. Plant control features shall include, but not necessarily be limited to, the following:
  1. Manual start-up, sequencing, load control, monitoring, and shut-down of all electrical generating equipment. Load control to the

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

turbine-generators shall be configured as 4-20 mA isolated inputs.

2. Manual start-up, dispatch, sequencing, monitoring, and shut-down of all CHP plant auxiliary systems.
  3. Automatic control of electrical switching and distribution system
  4. Display of all system alarms and equipment status, with hard-copy logging of events
  5. Hourly, daily, and monthly logging and trending of key system parameters, including:
    - a. Fuel consumption
    - b. Steam production
    - c. Steam pressure
    - d. Utility and self-generated kilowatt demand levels
    - e. Electrical energy consumption and self-generation per minute (to allow electric billing calculations)
- F. Coordinate integration and interoperability between individual equipment package PLC's and the overall PCS. To the extent possible, utilize manufacturer-furnished equipment package PLC platforms which are consistent with that of the PCS to support full integration. In the event that a manufacturer-furnished equipment package PLC control platform differs from that of the PCS, the following objectives and guidelines shall be met:
1. Support native peer-to-peer (controller-to-controller), deterministic communications between the equipment package PLC control system and the PCS, to allow the greatest flexibility for implementation of optimization and supervisory control strategies.
  2. Control access to both the equipment package PLC Human-Machine Interface (HMI) and controller data. Control system security is considered a primary concern, therefore those systems that can support controlled (secured) access via the PCS are preferred. Interface and access controls shall be provided to prevent unintended, unauthorized or malicious actions, and to facilitate troubleshooting by defining a limited set of access points to

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

control and monitor. The following actions shall be possible via the PCS:

- a. Viewing of all equipment package PLC HMI data without having to develop or support duplicate HMI screens.
  - b. Secure, remote operation of the equipment package PLC HMI via the PCS.
  - c. Direct historization of equipment package PLC controller data using a PCS-based historian, without the necessity of interfacing or duplicating data in the PCS controller.
  - d. System administration functions utilizing software and hardware (computers) common to the PCS engineering workstation(s).
- G. All portions of the control systems shall be comprised of equipment that is routinely available from established manufacturers. Software shall be modular in design for flexibility in expansion or revision of the system. All materials and combined systems shall be UL listed.
- H. Graphics software shall be provided that permits the easy construction and addition of variable graphics shapes and sizes, and allows all graphics to be easily moved, copied, edited, added or deleted. The software shall support the import and export of computer aided design (CAD) graphics files generated with other software packages using DXF or PCX file formats.
- I. The PCS shall support a multi-level user security system per the following user group permission guidelines:
1. Guest: View only access. Navigation to all process status windows.
  2. Operator: Permissions to operate equipment, enter process setpoints, acknowledge/reset alarms.
  3. Maintenance: Permissions to tune control loops, calibrate instruments, modify process alarms, modify process constraint parameters.
  4. Engineer: Access to all process and machine parameters.
  5. Admin: Edit control system and security configuration.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- J. Furnish, install and test process instruments, transmitters and local gages, for monitoring and indicating flow, level, pressure, and temperature for all systems in the CHP facility. Provide instruments, valves and associated equipment rated as industrial grade to provide a 30 year installed equipment life.
- K. Unless specifically indicated otherwise, all electrical/electronic devices shall be explosion-proof, designed for NEC Class I, Div. 2, Group D hazardous area classification (minimum).
- L. Provide transmitters with required environmental ratings for service duty, for process and location (indoor or outdoor) temperature and pressure ratings. Provide process instruments with wetted parts that are compatible with the intended service.
- M. Provide actuated control valves where required to automatically regulate the flow, pressure, and/or temperature of process systems in the CHP facility. Control valve and actuator assemblies shall be selected from manufacturers who have been routinely engaged in the production of such equipment for a minimum of 10 years. Control valves shall be fitted with pneumatic or electric motor actuators to facilitate remote operation via the Plant Control System (PCS).
- N. Area Classification: Contractor shall develop a plan view (or views, as necessary) of the CHP facility identifying all areas classified as hazardous per NFPA 70 (National Electric Code) as part of the detailed design documentation. All electrical and/or electronic equipment and materials installed in areas classified as hazardous shall be designed and selected for such service and bear appropriate labeling indicating the type and level of protection applied. The suitability of equipment for the specific hazardous area must be tested by a Nationally Recognized Testing Laboratory.
- O. Instrument Tagging: Assign unique alphanumeric tag numbers using a VA COR-approved format and numbering system to each of the following device categories:
  - 1. Instruments
  - 2. Control Valves
  - 3. Plant Control System I/O Interface Points

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

Tag numbering shall be based on standard nomenclature as specified in ANSI/ISA-5.1, Instrumentation Symbols and Identification. The tag name shall consist of an alpha prefix, alpha suffix combinations (where needed) and a numeric tag number.

The plant Piping & Instrumentation Diagrams (P&ID's) shall be annotated with the described tag numbers to identify field devices as well as control system "virtual" I/O points. These tag numbers shall also be referenced in the plant system Control Sequences that are developed by Contractor. All work shall be done with the cooperation of the Engineering Services Operations Unit Supervisor, Foreman of the Mechanical Shop, or the Chief of Engineering Department at the Medical Center.

### **PART 3 - EXECUTION**

#### **3.1. INSTALLATION**

- A. Install the CHP plant components and materials in accordance with this section, applicable codes and standards referenced herein, and the printed instructions of the respective equipment manufacturers. Prior to system start-up, ensure no copper wire remains exposed with the exception of grounding wire in certain circumstances per manufacturer instructions.
- B. Prior to any excavation, trenching, or drilling, all buried utilities, drainage, and irrigation systems shall be located and flagged by the appropriate utility and contractor representative.
- C. Piping installation shall be compliant with ASME Section I and ANSI/ASME B31.1 as applicable.
- D. Wiring Installation: Utilize on site measurements in conjunction with engineering designs to accurately cut wires and layout before making permanent connections. Locate wires out of the way of windows, doors, openings, and other hazards. Ensure wires are free of snags and sharp edges that have the potential to compromise the wire insulation. Installation shall be UL listed.
- E. Instrumentation: Install instruments as recommended by the control manufacturers.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- F. Contractor shall coordinate with COR and with equipment manufacturers to schedule on-site manufacturer representation during equipment erection, installation, alignment, and testing.
- G. Equipment-Specific Requirements:
  - 1. Installation and stamping of all boiler external piping shall be in accordance with Part PG-105 of Section I of the ASME Boiler and Pressure Vessel Code.

### **3.2. FIELD QUALITY CONTROL**

- A. Field Inspection: Prior to initial operation, inspect the CHP systems for conformance to drawings, specifications and applicable codes and standards. Inspect the following information on each piece of equipment:
  - 1. Manufacturer's name or trademark
  - 2. Model name or number
  - 3. Certifying agency label and rating. Provide UL and FM approvals for all safety devices.
- B. Tests: Provide equipment and apparatus required for performing inspections and tests as specified in applicable codes, standards, and manufacturer's recommendations. Correct defects disclosed by the tests and repeat tests. Conduct testing in the presence of the COR.
  - 1. Operation Tests: Perform tests on electrical systems, in accordance with the manufacturer's written recommendations. On site UL inspection and listing is required.
  - 2. Non-Destructive Examination (NDE): Perform NDE on piping welds and structural welds utilizing inspection techniques as specified in applicable codes and in accordance with equipment manufacturer's written procedures.
  - 3. HRSG Pressure Tests: The completed HRSG assemblies shall be hydrostatically tested in accordance with the requirements of Part PG-99, Section I of the ASME Boiler and Pressure Vessel Code. Conduct tests after the equipment is installed and connected for operation and prior to initial firing. An authorized inspector shall witness the hydrostatic test. Correct any deficiencies discovered during the testing, and retest



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

equipment until satisfactory results are achieved and are accepted by the Inspector. Identify and remove any connecting equipment that is not rated for the test pressure. Cap the openings left by the disconnected equipment. Reinstall the equipment after the tests are complete. Internal and external inspections shall be made by a national board inspector at time of delivery, prior to start-up, and after acceptance at contractor's expense.

4. Piping Pressure Tests: Hydrostatically test all new or modified piping in accordance with the requirements of ASME B31.1 at a test pressure of 1.5 times the design (maximum allowable working) pressure. Where leaks occur, repair pipe and the repeat tests. Remove and replace defective piping and joints.
5. Electrical Testing: All electrical testing shall be completed in accordance with the latest approved version of IEEE 1547, Section 5.0.

### **3.3. INSTALLATION - HIGH PURITY STAINLESS STEEL TUBING**

- A. Certify personnel in accordance with corresponding procedures section.
- B. Certify facilities in accordance with these specifications and corresponding procedures section. A level 3 protocol is required for all welding operations.
- C. Specific task execution shall be in strict accordance with corresponding procedures.
- D. Maintain all tools in a clean condition. Segregate tools for stainless steel and keep separate from carbon steel and copper system installation tools. Handle tubing and fittings with clean gloves at all times.
- E. Make welds using automatic orbital tube welders. Welds will be done on a single pass only. Use GTAW process with 100 percent argon shielding and backup purge. Use dedicated welding power source. Allow only certified welders to make welds.
- F. Each welder will prepare welding coupons per the following schedule: One in the beginning of each shift, and one at the end of each shift. One for each change in tube size, personnel, power source,

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- welding machine, weld head, purge source, electrode, immediately after weld failure, and when requested by the CM. Each welder collects, tags, and bags each day's coupon for CM inspection.
- G. Continuously purge all gas lines with 100 percent argon gas. Vent argon through a restrictor to atmosphere. Locate welded joints more than 12 inches away from end of the restrictor.
  - H. Use sufficient purge gas to carry off vapors, prevent discoloration, and keep the heat affected zone to a minimum.
  - I. Just prior to installation, inspect each sealed tube length. Never leave lines without positive pressure or without a continuous purge.
  - J. Run lines as direct as possible from nearest terminal valve. Provide accessibility to valves. Stagger valve spacing to allow for valve operation and for lockout/tagout devices.
  - K. Support lines and fittings, keeping axis straight and in alignment.
  - L. Apply positive pressure purge gas to tubing when it is cleaned, inspected, and ready for erection.
  - M. After a section is welded and no further work is being done on the system, maintain purge with restrictor open to continually purge tubing system. Always keep a slight positive pressure on the line so that if a leak develops, the system will not lose the inert gas pressure. When cutting an existing line, purge tubing from both ends. Horizontal cuts into a vertical line are not permitted.
  - N. Replace welded joints that show evidence of overheating, cracking, poor penetration, or other defects.
  - O. If the system is contaminated due to fabrication technique, reclean or replace the system at no expense to the Owner.
  - P. Install lines without springing, forcing, or placing undue stress on the tube, fittings, connected equipment, or terminals. Do not contact tube with the structure, except where shown.
  - Q. Minimize use of fittings for 1/4-inch through 1/2-inch stainless tubing by using tube bends. Bend tubing at a minimum radius of 10 times the nominal tube diameter. Where physical constraints prevent 10 diameter radius or the tube is larger than 1/2-inch, use pre-made fittings and welded joints. Make all bends free of flat spots and

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

corrugations. No continuous bends more than 90 degrees shall be permitted. No bends are permitted on coaxial tubing.

R. Bag VCR end connections while under purge after cooling.

### **3.4. INSTALLATION - HIGH PURITY STAINLESS STEEL VALVES**

- A. Install in accordance with manufacturer's instructions.
- B. Provide clearance for installation of insulation where required and access to valves.
- C. Provide access where valves are not exposed.
- D. Install valves with stems positioned for easy access.
- E. Use only clean, dry nonlubricated valves that have not been cleaned in any fluorocarbon product.
- F. Use only precleaned valves received in sealed inert gas filled bags.
- G. No oil, grease, or foreign material is allowed in valves.

### **3.5. TESTING GENERAL**

- A. Submit testing procedure reports per Section 22 0500 - Common Work Results.
- B. Conduct tests prior to applying insulation.
- C. Examine for leakage at joints and connections. Correct visible leakage.
- D. Replace damaged gaskets and bolting.
- E. Install new gaskets each time a mechanical joint is made.
- F. Testing equipment and materials. Provide the following test equipment calibrated to NBS standards within the last 12 months:
  - 1. Leak Detector: System must be capable of  $1 \times 10^{-9}$  scc/sec He leak sensitivity, as determined by AVS Standard 2.1.
  - 2. Gases: 100% Argon for Pressure Testing, 90% Argon / 10% Helium Mixture for Outboard Leak Testing, and 100% Helium for Inboard Leak Testing. Gases shall be in accordance with these specifications.
- G. Record test results. Include the following data on test reports.
  - 1. Date of test.
  - 2. Description and identification of tubing tested.
  - 3. Test fluid.
  - 4. Test pressure.
  - 5. Test duration.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

6. Remarks to include:
  - a. Leaks (type, location).
  - b. Repairs made.
7. Date and signature of witness.
8. Certification by CM or Consultant.
- H. Replace defective materials and correct any problems with workmanship at no cost to Owner. Conduct testing until system is satisfactory.
- I. Repair defective welded joints by removing and replacing with a sound weld of the proper section. Additional welding over defects is not allowed. Cost of repairs due to poor workmanship shall be born by the installing contractor.

### **3.6. TESTING - PRESSURIZATION TESTING**

- A. Use liquid source Argon, filtered through dual 0.05 micron or better filters, at purity levels as defined in these specifications.
- B. Pressurize to test pressure of 150 psig for a 2-hour minimum time period. Record gauge pressure and ambient temperature at start and end of test period. The final pressure must be corrected for any temperature changes that occurred between the initial pressurization and the end of the test period.
- C. All pressure gauges on the system shall be removed and ports capped with VCR caps prior to testing to prevent damage to gauges. System shall be pressure tested up to the tool connection point, capped but not connected to the tool.
- D. System pressure shall be monitored using a 4-1/2 inch dial face gauge with knife-edged pointer, with 1 psig divisions, accuracy of  $\pm 0.25\%$  of span, and full scale of 300-600 psig. Gauge shall meet ASME B40.100 grade 3A.
- E. Acceptance criteria is that no pressure decay ( $\pm 0\%$ ) compensated for temperature, may be detected. Any confirmed decrease shall require repair and re-testing of the system.

### **3.7. FOLLOW-UP VERIFICATION**

- A. Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that all CHP systems are in good operating condition and properly performing the

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

intended functions. System shall be run continuously for minimum (45) calendar days without faults or failures. If a fault or failure occurs, the time period starts over after corrective action has been made.

- B. Perform overall CHP plant performance testing in accordance with ASME PTC 46.

### **3.8. COMMISSIONING**

- A. The purpose of the commissioning process is to provide the Owner/Operator of the facility with independent verification that the systems to be commissioned have been installed according to the contract documents and operate within the performance guideline set in the design intent and the specifications. Commissioning is a prerequisite for beneficial use as a milestone of this project. The Commissioning Authority will provide the Owner with independent, unbiased, objective view of the system's installation, operation and performance. The commissioning process does not alleviate or reduce the responsibility of the design consultants or installing contractors to provide a complete and finished product, installed and fully functional in accordance with the contract documents.
- B. Commissioning is intended to enhance the quality of system start-up and aid in the orderly transfer of systems for use to the Owner. Quality commissioning requires participation by all parties involved with the design and construction process, including the owner, architect and engineer, general and sub-contractors, and owner's facilities department. The Commissioning Authority will lead the commissioning team planning and coordinating all commissioning activities in conjunction with the design professionals, project manager, general contractors, manufacturers and equipment vendors.
- C. Scope and Responsibilities of Commissioning Agent - Design Phase
  - 1. Refer to General Commissioning Section 01 91 00 1.11.
- D. Scope and Responsibilities of Commissioning Agent - Construction Phase
  - 1. Refer to General Commissioning Section 01 91 00 1.11.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

E. Scope and Responsibilities of Commissioning Agent - Testing Phase

1. Refer to General Commissioning Section 01 91 00 1.11.

F. Scope and Responsibilities of Commissioning Agent - Operational Phase

1. Refer to General Commissioning Section 01 91 00 1.11.

G. Documentation Requirements

1. Cx Specification
2. Cx Plan
3. Site Observation Reports
4. Pre-Functional Checklist
5. Functional Performance Test
6. Integrated Systems Test
7. Cx Final Report

**3.9. EMISSIONS PERFORMANCE TESTING**

- A. The Contractor shall conduct an initial performance test to determine compliance with the applicable emissions limits of Section 22a-174-3d. *Permit-by-Rule for Combined Heat-and-Power Systems*. A performance test conducted in accordance with the applicable provisions of 40 CFR 60, 61 or 63 for each pollutants listed in Table 3d-1 as follows:

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

**Table 3d-1. CHP system combustion turbine emissions limits.**

<b>Pollutant</b>	<b>Emission limit while firing natural gas</b>	<b>Emission limit while firing distillate fuel</b>	<b>Averaging time, except as specified for a performance test approved by the Department</b>
NOx	2.5 ppmvd @ 15% oxygen	9.6 ppmvd @ 15% oxygen	1-hour block
CO	10 ppmvd @ 15% oxygen	10 ppmvd @ 15% oxygen	3-hour block
PM10/2.5	2 lbs/hr	3 lbs/hr	1-hour block
Ammonia	5.0 ppmvd @ 15% oxygen	5.0 ppmvd @ 15% oxygen	1-hour block

- B. The results of the performance test shall be used by the Contractor to demonstrate compliance for each pollutant with the emission limits listed in Table 3d-1.
- C. The Contractor shall perform the initial performance test once CHP system start-up, troubleshooting has been completed, and prior to the Contractor transfers operation of the CHPs to the VAMC. At the latest, initial performance testing shall be conducted no later than the earlier of the dates determined by 60 days after achieving the maximum production rate; or 180 days after initial startup.
- D. Unless otherwise specified in this subsection, all performance testing shall be conducted in accordance with the CT DEEP's Source Emissions Monitoring Test Guidelines, section 22a-174-5 of the Regulations of Connecticut State Agencies and the following:
1. Ammonia testing shall be conducted in accordance with EPA Conditional Test Method (CTM) 027 or an equivalent method approved by the Connecticut Department of Energy and Environmental Protection (CT DEEP) Commissioner and Administrator;

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

2. PM10/2.5 testing shall be conducted in accordance with 40 CFR 60, Appendix A, Reference Method 201A or an equivalent method approved by the CT DEEP Commissioner and Administrator; and
  3. Any test conducted under this section shall be completed within 24 hours of initiation unless completion in such time would endanger public health or safety.
- E. As part of the initial performance testing, the Contractor shall determine the acceptable range for operation parameters to be continually monitored as proposed in Section 3.10.

### **3.10. EMISSIONS MONITORING PLAN**

- A. Based on the results of performance testing the Contractor shall develop a written monitoring plan that specifies proposed methods of continuous parameter monitoring or continuous emissions monitoring that shall be used to demonstrate compliance of the CHPs and pollution controls with emission limits and monitoring requirements of Section 22a-174-3d.
- B. The Contractor shall prepare a written monitoring plan to address monitoring of emissions, CHP system operating parameters and air pollution control equipment operating parameters. The plan shall be prepared no later than 60 days following the completion of the initial performance test. The monitoring plan shall include, at a minimum, the following information as may be applicable to the CHP system and chosen methods of determining compliance with the requirements of this section:
1. A description of how all pollutants and parameters will be monitored to demonstrate compliance with the emissions limits set forth in Tables 3d-1 and 3d-2, as applicable, of this section;
  2. Definitions of startup, shutdown and malfunction;
  3. A description of the method and a sample calculation by which emissions during startup, shutdown and malfunction will be determined;



Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

4. An identification of all the parameters to be monitored, including the following:
  - a. For CHP systems that use selective catalytic or non-catalytic reduction to meet the NO<sub>x</sub> limits of this section, monitored parameters shall include but not be limited to the hourly ammonia injection rate, oxygen content of the exhaust, exhaust temperature, fuel firing rate and pressure drop across the catalyst,
  - b. For turbine CHP systems that use low-NO<sub>x</sub> burner technology, monitored parameters shall include, but not be limited to, the operating characteristics specified by the burner manufacturer to indicate the unit is operating in low NO<sub>x</sub> mode, and
  - c. For CHP systems that use an oxidation catalyst to meet the CO limits of this section, monitored parameters shall include, but not be limited to, the exhaust gas temperature and the pressure drop across the catalyst;
  - d. Monitor the actual system efficiency on an hourly basis.
5. A specification of the ranges or designated conditions of the parameters, and a description of the process by which such ranges or designated conditions have been established during the initial performance test;
6. An explanation of the process used to ensure that the data obtained is representative of the emissions or parameters being monitored using such considerations as detector location or the installation specification;
7. A description of the quality assurance and control practices to ensure the continuing validity of the data; and
8. A description of the frequency of monitoring and the data collection procedures that the owner or operator will use.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

- C. A monitoring plan established to satisfy requirements of 40 CFR 60, 61 or 63 applicable to the CHP system may be used to satisfy the monitoring plan requirements of this section, provided the plan is supplemented to address all the requirements of this section.

### **3.11. INSTRUCTION**

- A. Provide training, at the VA's facility, for the personnel listed herein so that VA personnel can operate, maintain, change system configurations, and repair the complete CHP system. Training for Operators shall be conducted to accommodate a multiple shift schedule.
- B. Separate training sessions shall be held for each of the following groups:
  - 1. Engineers.
  - 2. Plant Operators.
  - 3. Mechanical Maintenance Technicians.
  - 4. Electrical/ Instrumentation Maintenance Technicians.
- C. Prior to project closeout and field acceptance testing, provide training plan and schedule including the following information:
  - 1. List of all classes/courses.
  - 2. Description of each course.
  - 3. Duration of each course.
  - 4. Sequence of courses.
- D. Provide competent, factory authorized personnel to provide instruction to O and M personnel. Include sufficient hours of training to provide complete training for operation and maintenance of the equipment and systems.
- E. Provide the name and resume of proposed instructor; instructor must have at least 5 years' experience teaching the designated course. Instructor's primary language must be English.
- F. Provide training manual that includes, as a minimum, the following:
  - 1. Course objective.
  - 2. Course outline.
  - 3. Theory of operation.

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

4. Case studies that demonstrate application, operation (including casualty control), troubleshooting, repair and maintenance of equipment.
  5. Notes that supplement and enhance information provided in the manufacturer's operation and maintenance manuals.
  6. Thorough review of applicable drawings, photos, tables, diagrams and schematics.
  7. List of references for further independent study.
- G. VA reserves the right to require Contractor to repeat training classes if not satisfied objectives are met, at cost of Contractor.
- H. VA reserves the right to video record the training sessions.
- I. Provide certification in writing that this training has been accomplished.

---END---

#### 4. QUALITY OF GAS

- 4.1 Composition of Gas. The gas received by Algonquin for Customer's account, or delivered by Algonquin to Customer, shall be a combustible gas consisting wholly of, or a mixture of:
- (a) Natural gas of the quality and composition produced in its natural state except that Algonquin may extract or permit the extraction of any of the constituents thereof except methane.
  - (b) Gas generated by vaporization of liquefied natural gas (LNG).
  - (c) Manufactured, reformed, synthesized, or mixed gas consisting essentially of hydrocarbons of the quality and character produced by nature in the petroleum, oil, and gas fields with physical properties such that when such gas is commingled with natural gas, the two become indistinguishable.
- 4.2 Heating Value and Wobbe Number. Gas received by Algonquin for Customer's account at each Point of Receipt, or delivered by Algonquin to Customer at the Point(s) of Delivery shall have a Total Heating Value of at least 967 Btu and not greater than 1,110 Btu per Cubic Foot of gas volume. The gas shall have a Wobbe Number of not less than 1314 nor greater than 1400 (calculated using Total Heating Value (THV)), dry, under standard conditions at 14.73 psia at 60 degrees Fahrenheit based on the following mathematical definition and in accordance with Section 5 of these GT&C:

$$\text{THV} / \text{Sqrt SG}_{\text{gas}}$$

Where:

THV = Total Heating Value (Btu/standard Cubic Foot)  
SG<sub>gas</sub> = Specific Gravity  
Sqrt = Square Root of

- 4.3 Objectionable Properties. The gas received and delivered hereunder:
- (a) Shall be commercially free from dust, gum, gum-forming constituents, and free liquids under continuous gas flow conditions at the pressure and temperature conditions in Algonquin's pipeline at a point approximately fifty feet in advance of the interconnection into Algonquin's system that is serving as the Point of Receipt and the meter inlet header located at or near any Point of Delivery;
  - (b) Shall not contain an amount of water vapor exceeding seven pounds per 1,000,000 Cubic Feet of gas volume as measured by methods in

accordance with accepted industry practice, or by other methods mutually agreed upon by Customer and Algonquin;

- (c) Shall contain less than one-half (0.5) grain of hydrogen sulphide per 100 Cubic Feet of gas volume as measured by methods in accordance with accepted industry practice, such as, but not limited to, lead acetate testing, analysis by titrator, analysis by chromatograph, or by other methods mutually agreed upon by Customer and Algonquin;
- (d) Shall not contain more than five (5) grains of total sulphur per 100 Cubic Feet of gas volume as measured by methods in accordance with accepted industry practice, such as, but not limited to, analysis by titrator, analysis by chromatograph, or by other methods mutually agreed upon by Customer and Algonquin;
- (e) Shall be of a flowing temperature which is adequate to prevent interference with the proper operation of lines, regulators, meters and other equipment of Algonquin. Algonquin may impose restrictions on the temperature of the flowing gas that it receives when, in Algonquin's reasonable judgment, these restrictions are necessary to insure the proper operation of Algonquin's facilities;
- (f) Shall not contain more than four percent (4.0%) by volume of a combined total of any non-hydrocarbon gas including, without limitation carbon dioxide, nitrogen, krypton, helium, argon, xenon, and neon. Within this volume of non-hydrocarbons, the total carbon dioxide content shall not exceed two percent (2.0%) by volume, and the total combined nitrogen and oxygen content shall not exceed two and three quarters percent (2.75%) by volume;
- (g) Shall not have uncombined oxygen content in excess of two-tenths of one percent (0.2%) by volume; and
- (h) Shall not contain, either in the gas or in any liquids with the gas, any microbiological organism, active bacteria or bacterial agent capable of contributing to or causing corrosion and/or operational and/or other problems. Microbiological organisms, bacteria or bacterial agents include, but are not limited to, sulfate reducing bacteria (SRB) and acid producing bacteria (APB). Tests for bacteria or bacterial agents shall be conducted on samples taken from the meter run or the appurtenant piping using American Petroleum Institute (API) test method API-RP38 or any other test method acceptable to Algonquin and Customer which is currently available or may become available at any time.

- (i) The non-methane hydrocarbon content shall contain no more than twelve percent (12.0%) of ethanes and heavier hydrocarbons (C2+), of which the content of butanes and heavier hydrocarbons (C4+) shall not exceed one and one half percent (1.5%).
- (j) Algonquin shall accept delivery of gas with a Liquefiable Hydrocarbons content equal to or less than 0.032 GPM C6+, provided that such gas satisfies all other applicable provisions of Algonquin's FERC Gas Tariff. This Standard shall be referred to as Algonquin's Liquefiable Hydrocarbons Safe Harbor, and the Liquefiable Hydrocarbons Safe Harbor correlates to a cricondentherm hydrocarbon dewpoint of approximately 15 degrees Fahrenheit. Absent a Liquefiable Hydrocarbon Problem, as defined in Section 1 of these General Terms and Conditions, Algonquin shall accept delivery of gas with a C6+ content greater than 0.032 GPM, provided that such gas satisfies all other applicable provisions of Algonquin's FERC Gas Tariff.

4.4 Liquefiable Hydrocarbon Postings: If Algonquin reasonably believes, based on available data, that there is a Liquefiable Hydrocarbon Problem and Algonquin reasonably believes, based on available data, that a limit on Liquefiable Hydrocarbons is operationally necessary, Algonquin shall post on its Web Site a limit on Liquefiable Hydrocarbons (no lower than the Liquefiable Hydrocarbons Safe Harbor) for receipts on specified Monitoring Segments to cure or prevent hydrocarbon liquid fallout ("Liquefiable Hydrocarbon Limit").

- (a) Location: Algonquin shall establish such Liquefiable Hydrocarbon Limits at the point where liquid fallout occurs or is anticipated to occur if known and then to the receipt points upstream of that location within the Monitoring Segment where the fallout is occurring or is anticipated to occur, or to the entire Monitoring Segment if the point of liquid fallout or anticipated fallout is not known. If that will not correct the Liquefiable Hydrocarbon Problem, Algonquin shall apply Liquefiable Hydrocarbon Limits for each Monitoring Segment immediately upstream of the Monitoring Segment where the liquid fallout occurs or is anticipated to occur up to the nearest Monitoring Point that satisfies the Liquefiable Hydrocarbon Limit.
- (b) Application: Any such Liquefiable Hydrocarbon Limit shall be applied uniformly to all receipt points in such Monitoring Segments upstream of the point where liquid fallout occurs or is anticipated to occur if known or uniformly to all receipt points in the entire such Monitoring Segment if the point of liquid fallout or anticipated fallout is not known. Algonquin's analysis and posting of Liquefiable Hydrocarbon Limits shall not skip over any Monitoring Segment between the Liquefiable Hydrocarbon Problem and the furthestmost upstream Monitoring Segment at which a



Liquefiable Hydrocarbon Limit is posted. Algonquin shall post Liquefiable Hydrocarbon Limits in a given Monitoring Segment only to the extent necessary, in Pipeline's reasonable determination, to prevent or cure a Liquefiable Hydrocarbon Problem. Such posted Liquefiable Hydrocarbon Limits shall remain in effect no longer than necessary.

- (c) Notice: Algonquin will provide as much notice of such a Liquefiable Hydrocarbon Limit as reasonably practicable, via Algonquin's Web Site.

- 4.5 Verification of Gas Quality. At Algonquin's request, Customer shall use all reasonable efforts to obtain and provide to Algonquin all records regarding gas quality kept by upstream pipelines transporting the gas received by Algonquin for Customer's account. Customer shall use all reasonable efforts to ensure and verify for Algonquin that such upstream pipelines are using appropriate equipment to monitor compliance with the gas quality specifications applicable on Algonquin's system as stated in this Section 4.
- 4.6 Failure To Conform to Specifications. If the gas tendered by Customer for receipt by Algonquin, or offered for delivery by Algonquin to Customer, shall fail at any time to conform to any of the specifications set forth in this Section 4, then the party asserting such deficiency shall notify the other of such deficiency and may, at its option, refuse to accept nonconforming gas pending correction by Algonquin or Customer as appropriate. Algonquin may refuse to accept gas or may impose additional gas quality specifications and restrictions if Algonquin, in its reasonable judgment, determines that harm to Algonquin's facilities or operations could reasonably be expected to occur if it receives gas that fails to meet such additional specifications and restrictions.
- 4.7 Odorization. Algonquin shall have no obligation to odorize the gas tendered by Customer other than to conform to the regulations of appropriate governmental authorities having jurisdiction. However, if Algonquin odorizes the gas, such odorization shall be by use of a malodorant agent of such character as to indicate by a distinctive odor the presence of gas. Whenever odorized gas is delivered, the quality and specifications, as set forth in this Section 4, of such gas shall be determined prior to the addition of malodorant or with proper allowance for changes or additions due to such malodorant. Such odorization of the gas by Algonquin shall be for the purpose of detection of the gas only during the time when the gas is in the possession of Algonquin, prior to delivery to the Customer.
- 4.8 Waiver of Requirements. Algonquin may waive the requirements set forth in this Section 4 in order to allow Customer to tender or cause to be tendered gas which does not, when injected into Algonquin's pipeline, meet the quality specifications set forth in Section 4; provided that acceptance of such gas shall not adversely affect Algonquin's system facilities or operations, and further provided that once such gas has been blended, to the extent blending occurs, the commingled gas

Combined Heat and Power (CHP) Plant  
West Haven Veteran's Affairs Medical Center  
West Haven, Connecticut  
VA Contract No. VA701-P-0163  
Task Order VA701-13-J-0093  
CannonDesign Project No. 004243.00

Algonquin Gas Transmission, LLC  
FERC Gas Tariff  
Sixth Revised Volume No. 1

Part 6 - General Terms and Conditions  
4. Quality of Gas  
Version 1.0.0  
Page 5 of 5

stream at any delivery point on Algonquin's system shall be compliant with the quality specifications set forth in Section 4. Algonquin shall post on LINK® any waiver of Algonquin's gas quality requirements. Algonquin shall implement this Section 4.8 on a non-discriminatory basis and may cancel any waiver at any time if necessary to assure that the commingled gas stream is compliant with the quality specifications set forth in Section 4 at any delivery point on Algonquin's system.

Issued on: March 31, 2011  
Effective on: May 1, 2011