City of Milwaukee

Department
of
Public Works

Infrastructure
Services Division
Facilities Development
& Management Section

COMPRESSED NATURAL GAS (CNG) FUELING SYSTEMS

at

LINCOLN GARAGE (3921 W LINCOLN AVE)

and

NORTHWEST GARAGE (3025 W RUBY AVE)

May, 2011

Project Number **LINCOLN GARAGE BU520104100**
NORTHWEST GARAGE BU520105100

Official Notice No. 126

CITY OF MILWAUKEE, WISCONSIN

DEPARTMENT OF PUBLIC WORKS

INFRASTRUCTURE SERVICES DIVISION

FACILITIES DEVELOPMENT &
MANAGEMENT SECTION

PROJECT MANUAL

GOVERNING THE

COMPRESSED NATURAL GAS (CNG) FUELING SYSTEMS

At

LINCOLN AVENUE GARAGE (3921 W LINCOLN AVE)

And

NORTHWEST GARAGE (3025 W RUBY AVE)

Project Nos:

LINCOLN GARAGE BU520104100

NORTHWEST GARAGE BU520105100

May, 2011

Official Notice No. 126

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CITY OF MILWAUKEE
GENERAL OFFICIAL NOTICE
TO CONTRACTORS

Separate sealed bids for each project will be received until 10:30 A.M. of the bid opening date at which time bids will be publicly opened and read for furnishing all material and doing all work for each project in accordance with the requirements of the respective Official Notice on the bid form furnished in accordance with plans, specifications, contract documents, and proposed form of contract on file in the office of the Department of Public Works, Municipal Building, 841 N. Broadway, Room 506, Milwaukee, Wisconsin, 53202.

PROSPECTIVE BIDDERS ARE TO CAREFULLY EXAMINE AND REVIEW ALL CONTRACT DOCUMENTS AND MATERIALS IN SAID OFFICE BEFORE SUBMITTING BID.

AFFIDAVITS OF NO INTEREST MUST ACCOMPANY THE BIDS, AND THE FAILURE OF PROSPECTIVE BIDDERS TO COMPLY WITH THESE REQUIREMENTS MAY DISQUALIFY THE BID.

THE CONTRACTOR/LESSEE AGREES TO COMPLY WITH ALL APPLICABLE REQUIREMENTS OF THE AMERICANS WITH DISABILITIES ACT OF 1990, 42 U.S.C. § 12101, ET. SEQ. THE TDD NUMBER FOR PUBLIC WORKS IS (414) 286-2025.

As part of the bid each bidder shall submit a list of anticipated subcontractors and the class of work to be performed by each, which list should not be added to nor altered without the written consent of the Commissioner of Public Works.

All contractor(s) and subcontractor(s) are required to furnish or have on file a certificate of insurance in accordance with the insurance provisions of the General Specifications.

All contractor(s) and subcontractor(s) are subject to the prevailing wage rates and hours of labor as prescribed by the Common Council of the City of Milwaukee consistent with provisions of Section 66.293 of the Wisconsin Statutes.

Copies of the actual work classifications and wage and fringe benefit rates enforced on this project are available in Room 506 of the Municipal Building.

Corporate surety will be required on performance and payment bonds for all projects listed in the following Official Notices. All applicable charter and Statutory provisions and ordinances, all the provisions of this official notice, invitation to bid, general and detailed specifications, special provisions, proposal, schedule of fixed prices, addendum and plans for this project and all other contract documents set forth in the invitation to bid will be incorporated and made part of the contract as if therein set forth in full.

Tie bids, when the lowest ones, will be decided by the Commissioner of Public Works.

The Commissioner of Public Works reserves the right to reject any or all bids.

Signed: JEFFREY J. MANTES,
Commissioner of Public Works

Countersigned: W. MARTIN MORICS,
City Comptroller

CITY OF MILWAUKEE
SPECIFIC OFFICIAL NOTICE NO. 126

Important Notice:

The Invitation to Bid, all bid documents and the Plans & Specifications for the projects listed will be available electronically to prospective bidders via http://www.mpw.net/bids/docs/126-2011. Any required addenda or responses related to the listed projects will be posted on said website.

Bidders are encouraged to utilize this electronic method of obtaining bid documents as the Department of Public Works intends to solely use this method for future projects. At this time however, a limited number of hard copies of the above documents will also be available at address listed below.

Sealed bids will be opened on Wednesday, June 22, 2011 at 10:30 A.M. for the **COMPRESSED NATURAL GAS (CNG) FUELING SYSTEMS, 3921 W LINCOLN AVENUE AND 3025 W RUBY AVENUE MILWAUKEE, WI.**

Bid Security Required: Bond, Certified Check, Cashier's Check, or Cash to accompany bid: 10% of Contractor's Base Bid

Time for Completion: Project shall be substantially complete by Friday, November 18, 2011. Final completion of project shall be by Friday December 16, 2011. Notice to Proceed is anticipated to be Monday, July 11, 2011.

Liquidated Damages, per diem: $1,000.00

The EBE requirement for this project is 25% of the contract base bid.
The residency requirement for this project is 40% of all hours worked on the project.

The apprenticeship requirements for this project are:

Apprentices from **2** of the following trade(s) are to be employed:

Electrician, Pipefitter, Mason, Laborer-General Buildings

The contractor shall specifically note the EBE, residency, and apprenticeship forms for this project. If the forms are not filled out properly, it will be cause for rejection of the bid.

Plans and project manual will be furnished to the prospective bidders upon payment of a $10.00 non-refundable fee in room 506, Frank P. Zeidler Municipal Building, 841 North Broadway, Milwaukee, Wisconsin 53202. For general questions call 414-286-3314.

A $10.00 per set additional non-refundable fee is required to obtain bid documents by mail. Plans are sent via U.S. mail unless other arrangements are made by the contractor.

Contractor must comply with all provisions of the CITY OF MILWAUKEE GENERAL OFFICIAL NOTICE TO CONTRACTORS published herein and at http://www.mpw.net/services/bids_home

Mandatory Pre-Bid Meeting: A Pre-Bid Meeting is scheduled for **Wednesday, June 08, 2011, at 2:00 p.m. in Room 606 of the Frank P. Zeidler Municipal Building, 841 North Broadway, Milwaukee, Wisconsin.** Bidder participation is required to become familiar with all aspects of the project and bidding requirements. Contractors not attending the Pre-Bid meeting and field visit shall be ineligible to bid.

SECTION 00100
INSTRUCTIONS TO BIDDERS

See also Instructions to Bidders in the "General Specifications" of the Department of Public Works, City of Milwaukee, Wisconsin, dated January 31, 1992, and all subsequent addenda.

BID FORM:

Submit lump sum for the work as indicated on the drawings and specified herein, complete in every respect.

Bids will not be accepted in any form except on the bid form included with this project manual.

The contractor must recognize and abide by the right of the Owner (City of Milwaukee) to accept or reject any or all bids in the best interests of the City.

ALTERNATE:

Each bidder shall examine the plans and project manual thoroughly to determine what extent the Alternate will affect the bid.

Northwest Garage:

Alternate 1: Install Concrete Pavement at Area 1

Alternate 1 includes the option for installation of concrete pavement in Area 1. The work requires removal of 21,200 square feet of asphalt pavement, the removal of 1,600 square feet of concrete, augmentation/preparation of base course, and installation of 22,800 square feet of new 9" thick concrete pavement.

Alternate 2: Install Concrete Pavement at Area 2

Alternate 2 includes the option for installation of concrete pavement in Area 2. The work requires removal of 8,800 square feet of asphalt pavement, the removal of 12,900 square feet of concrete, augmentation/preparation of base course, and installation of 21,700 square feet of new 9" thick concrete pavement.

Alternate 3: Install Concrete Pavement at Area 2

Alternate 3 includes the option for installation of concrete pavement in Area 3. The work requires removal of 11,000 square feet of concrete, augmentation/preparation of base course, and installation of 11,000 square feet of new 9" thick concrete pavement.

CONTRACT AWARD:

The Commissioner of Public Works will award the contract on the basis of the Base Bid only or the Base Bid and the Deduct Alternate as funds permit.

CONTRACT BREAKDOWN:

Shortly after the award of the contract, each contractor shall submit a list showing the cost breakdown of the items in his contract. This list will be used as a basis for estimates of work completed for partial payment.

SITE VISIT:

All contractors shall visit the site, consult the drawings and project manual, be familiar with the work of other contractors and determine for himself all conditions affecting the work.

Failure by a contractor to be familiar with the project shall not release him from any obligation under this contract to complete the work in strict conformity with the plans and project manual and all City, State and Federal Codes or regulations pertaining to the work.

CONSTRUCTION START AND COMPLETION DATES

The start and completion dates are stated in the Specific Official Notice. The contractor may begin procuring materials and off-site fabricating (as appropriate and approved by Engineer) on the date of Notice to Proceed. The Notice to Proceed will be sent to the contractor directly following the signing of the contract.

BASE BID EXCLUSIONS:

The following work will be performed by the City of Milwaukee:

1. Lincoln Garage
    a. Purchase and delivery CNG Equipment
    b. Purchaser and delivery of fuel management system

2. Northwest Garage
    a. Purchase and delivery for CNG Equipment
    b. Purchase and delivery for fuel management system

ADDITIONAL PLANS/PROJECT MANUALS

These will be available at: http://www.mpw.net/bids/docs/126-2011

SECTION 00700
GENERAL CONDITIONS

1. SCOPE:

   A. Index:

   1. Scope
   2. DPW General Specifications
   3. Definitions
   4. Control of Work and Materials
   5. Samples and Tests
   6. Project Coordination
   7. Supervision of Work
   8. Technical Specifications and Drawings
   9. Safety Regulations
   10. Code Rules

2. Department of Public Works General Specifications:

   Provisions of the Department of Public Works General Specifications dated January 31, 1992, and subsequent addenda except as may be modified or expanded upon in this project manual, shall apply to all contractors and subcontractors working on the project. Copies of the General Specifications may be obtained from http://www.mpw.net/services/bids_home.

3. Definitions:

   A. Owner: City of Milwaukee.

   B. Engineer: Individual or entity named as such in Agreement. Engineer for Plans and Specifications is AECOM.

   C. Facilities Manager: The Facilities Manager of Facilities Development and Management Section.

   D. Project Inspector: The authorized representative of the Commissioner assigned to make detailed inspection of any or all portions of the work and materials thereof. These inspections are not a substitute to those required by the Department of Neighborhood Services for permit and code compliance.

   E. Addenda: Written or graphic instruments issued prior to the execution of the contract which modify or interpret the bidding documents, including drawings and project manual by additions, deletions, clarifications or corrections. Addenda will become part of the contract documents when the contract is executed.

   F. Contract Drawings: Drawings of the work to be done as listed hereafter in Section 00850 Drawing Schedule and/or Section 00870 Plans and Details.

   G. Substantial Completion: The time at which the Work (or a specified part thereof) has progressed to the point where, in opinion of Owner and Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

H. Schedule of Values: A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

I. Furnish, Install, Perform, or Provide:

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.

J. Work: The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

4. Control of Work and Materials:

A. Detail and Shop Drawings: Shop drawings and other additional drawings which may be required for each contract of the work shall be prepared by each respective contractor unless otherwise directed by the Facilities Manager. Prints shall be the same size as contract documents when practical. Prints of each drawing shall be submitted to the Facilities Manager for approval before proceeding with the work. Changes ordered by the Facilities Manager shall be made and revised prints submitted as above. The Facilities Manager's approval of drawings shall not relieve the contractor of responsibility for errors.

REV 3/04

B. Primary Lines and Grades: The City of Milwaukee will mark two building corners along a line and will establish a benchmark, with a relative elevation, within close proximity to the site. Once established by the City, the contractor shall preserve all points and benchmark as long as needed during construction. The contractor will bear all costs associated with re-establishing points and benchmark.

C. Construction Lines and Grades: The contractor must bear sole responsibility for the correct transferal of all construction lines and grades from the primary lines and grades points. He shall take such measurements from existing work as may be necessary to insure the proper construction of his work.

D. Material Orders and Shipping Statements: The contractor shall furnish to the Facilities Manager at least two (2) copies of all material orders and shipping statements. Itemized weights of the materials and individual units of finished work shall be shown.

E. Weighing of Materials and Fabricated Units: The weighing of materials and fabricated units such as structural steel, casings, etc., when required, shall be done in the presence of the Commissioner's representative. The contractor shall be responsible for the satisfactory weighing of such materials and units.

F. Consignment and Delivery of Materials: The materials for the work shall be consigned to the contractor and he shall be responsible for the delivery of all materials required for the completion of the contract.

5. Samples and Tests:

A. Method of Sampling: Samples of the materials proposed or furnished for the work may be taken by the Commissioner at any time; at the point of manufacture, point of delivery or site of work. They will be selected, as far as practicable, in accordance with standard methods of sampling such materials as specified in the standard of the American Society for Testing Material. All sampling shall be done by authorized representatives of the Commissioner. Selections will be in an orderly and systematic manner, insuring samples representative of the lot.

B. A.S.T.M. Standards: Wherever the abbreviation A.S.T.M. is used in connection with the number of a standard specification, the specification referred to shall be the Standard of the American Society for Testing Materials, designated by that number, including all revisions in effect on the date of award of the contract. Should a revised or amended standard be issued
by the American Society for Testing Materials which, in the opinion of the Commissioner, conflicts with or causes undesirable changes in the standards referred to herein, the Commissioner reserves the right, by means of addenda to the project manual, to continue under the provisions of the pertinent standard referred to herein.

Rev. 1/04

C. Cost of Test Specimens and Samples: All test specimens of metals and all samples of non-metals required for tests shall be furnished by the contractor without cost to the City.

D. Costs of Tests: All tests on test specimens of metals will be made at the expense of the contractor and the original test on samples of non-metals will be made at the expense of the City. In all cases, the testing procedure will be in accordance with Standard A.S.T.M. tests for such materials. Subsequent tests of non-metals requested by the contractor, when such tests are permitted by A.S.T.M. Specifications and approved by the Commissioner or subsequent tests ordered by the Commissioner will be made at the expense of the contractor.

6. Project Coordination:

A. Contractors are required, so far as possible, to arrange work and to dispose of materials so as not to interfere with the work or storage of materials of other contractors or City forces engaged upon the work.

B. Contractors shall give full cooperation to other trades and furnish any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.

C. Where the work of a contractor will be installed in close proximity to the work of other trades, or where there is evidence that the work of a contractor will interfere with the work of other trades, he shall assist in working out space conditions to make satisfactory

adjustments.

D. If a contractor installs work before coordinating it with other trades or so as to cause interference with work of other trades, he shall make necessary changes in his work to correct the condition without extra charge.

E. Contractors are required to join their work to that of others in a proper manner, and in accordance with the spirit of the plans and project manual, and to perform the work in the proper sequence in relation to that of other contractors, and as may be directed by the Project Inspector.

7. Supervision of Work:

A. Contractors shall furnish the services of an experienced engineer or superintendent.

B. He shall be constantly in charge of the installation of the work together with all subcontractors, skilled workers, helpers, and labor required to unload, transfer, erect, connect up, adjust, start, operate and test each system.

C. He shall be thoroughly acquainted with and be responsible for the various subcontractors' work so that it is properly coordinated and supervised to the satisfaction of the Commissioner of Public Works or his representative.

D. Upon written notice to a contractor of the lack of such coordination and supervision, the Commissioner of Public Works may authorize such services as may be required and deduct the cost of this service at an hourly rate of $60.00 per hour per worker from the contract for the work.

8. Technical Specifications and Drawings:

A. Governing order of Contract Documents:

1. The following provision modifies DPW General Specifications Item 2.1.3.1:

Anything mentioned in the Technical Specifications and not shown on the drawings or shown on the drawings and not mentioned in the Technical Specifications, shall be as if shown on or mentioned in both. In case of difference between drawings and Technical Specifications, the Technical Specifications shall govern. In case of any discrepancy in drawings or Technical Specifications, the matter shall be immediately submitted to Buildings & Fleet Services for decision. Said discrepancy shall not be adjusted by the contractor.

B. All contractors shall have complete sets of plans and project manuals on the job site at all times.

9. Safety Regulations:

All work shall be done in accordance with the safety requirements referenced in the International Building Code, as adopted and amended by the State of Wisconsin and OSHA.

10. Code Rules:

The rulings, regulations and laws of the following shall be complied with in the completion of this project:

International Building Code, as amended and adopted by the State of Wisconsin
Plumbing and Drainage Codes of the City of Milwaukee
Ordinances of the City of Milwaukee
National Board of Fire Underwriters
OSHA
NFPA
FAA
NEC
IEEE
UL

SECTION 00821
INSPECTION CHARGES

The contractor will be charged a fee for inspection for each and every day such inspection is required after the time allowed for completion has expired.

Rev. 2/08 The amount of the fee for inspection shall be $325.00 per day.

The time allowed for completion is stated in the Specific Official Notice and shall start with the date on the Notice to Proceed which will be sent to the contractor directly following the signing of the contract. The time allowed includes the time required for fabricating and procuring material and doing the work at the building site.

KATHY THORNTON
BUILDINGS & FLEET

City of Milwaukee

Department of Public Works

Jeffrey J. Mantes
Commissioner of Public Works

Preston D. Cole
Director of Operations

May 23, 2011

To All Minimum Wage Scale Recipients:

Attached please find an updated Minimum Wage Scale (Bricklayers, Caulker/Tuckpointer, Cement Mason, Glazier, Operating Engineer, Painter, Plasterer, Sprinklerfitter, Truck Driver) which is effective May 23, 2011.

This document should replace the one you are currently using and should be placed in bid documents for any project being advertised as of May 23, 2011.

Please direct any questions to me at extension 3309.

Very truly yours,

Barbara Trible

Barbara Trible
Contract Compliance Officer

bt
Attachment

MAY 23 '11 PM 1:17

BUILDINGS & FLEET

Frank P. Zeidler Municipal Building, 841 N. Broadway, Milwaukee, Wisconsin 53202
Administration, Room 501 (414) 286-8333 ♦ Fax (414) 286-3953 ♦ TDD (414) 286-2025
Contract Administration, Room 506 (414) 286-3314 Fax (414) 286-8110 ♦ www.mpw.net

5/23/11

MINIMUM WAGE SCALE

RESOLVED, By the Common Council of the City of Milwaukee, that building and construction trades workers in the construction industry employed upon public work projects done by contract for the City of Milwaukee, either new construction or repair work, upon any roads, bridges, sewers, streets, alleys, buildings, or any other public work, shall be paid no less than the hourly wage rates and fringe benefits which prevail in the Milwaukee metropolitan area for the same type of work or for closely related work. (FILE NUMBER 68-1317)

Prevailing hours of labor for all classes of laborers and mechanics means no more than ten (10) hours per day nor more than forty (40) hours per week and may not include any hours worked on a Saturday, Sunday, or one of six holidays. ALL work performed in excess of these prevailing hours must be paid at a rate of at least 1-1/2 times the hourly basis rate of pay (plus fringe benefits). *Fringe Benefits must be paid on ALL hours worked for ALL job classifications.*

If a contractor or subcontractor anticipates employing a person or persons in classifications, trades, or occupations that are not set forth in the Minimum Wage Scale, then that contractor or subcontractor is required to apply to the Commissioner of Public Works PRIOR to the bid opening date set forth in the official notice for the project for a special wage determination containing the classification(s) and associated wage and benefit rate(s). Special wage determinations requested after the bid opening date MAY be issued at the discretion of the Commissioner of Public Works' Office if it is satisfied that a special classification is used as a prevailing practice in the City of Milwaukee.

The Prime Contractor must provide each subcontractor with a copy of the Minimum Wage Scale with the appropriate classifications and rates for the type of work to be performed. The Minimum Wage Scale, including this cover sheet, must be physically included in the subcontract agreement between the prime and subcontractor.

Bidders are required to utilize the Wisconsin Department of Workforce Development's "Dictionary of Occupational Classifications and Work Descriptions" to determine the appropriate job classifications/wage rates for their employees prior to bidding and ***to insure employees are paid for those job duties they actually perform.*** *This document can be found on their website at dwd.wisconsin.gov; type "dictionary" in the search box.* All disputes and/or controversies regarding the proper classification of any laborer, worker, or mechanic employed on a City project will be referred to the State of Wisconsin Department of Workforce Development for final resolution and disposition.

ss. 66.0903(8), Wis. Stats.

Any contractor, subcontractor, or agent thereof, who fails to pay the prevailing rate of wages determined by the department under this subsection or pays less than 1-1/2 times the hourly basic rate of pay for all hours worked on the project in excess of prevailing hours of labor determined under this subsection, shall be liable to the employees affected in the amount of their unpaid minimum wages or their unpaid overtime compensation and an additional amount as liquidated damages.

Each contractor, subcontractor, or agent thereof participating in a project covered by this subsection shall keep full and accurate records clearly indicating the name and trade or occupation of every laborer, workman, or mechanic employed by him in connection with the project and an accurate record of the number of hours worked by each employee and actual wages paid therefor.

5/23/11

JOB CLASSIFICATION	HOURLY RATE	WELFARE PER HOUR	VACATION PER HOUR	PENSION PER HOUR	OTHER SPECIFIC BENEFITS	TOTAL FRINGES	TOTAL WAGE
ACOUSTIC CEILING TILE INSTALLER	31.38					18.16	49.54
ASBESTOS ABATEMENT WORKER	24.50	7.55	1.72	6.05	.48 A,I,S,E,T	15.80	40.30
BITUMINOUS, DUMPER, IRONER, SMOOTHER & TAMPER(Paving)	21.86	7.65	1.85	7.05	.33 A.T.	16.88	38.74
BITUMINOUS LUTEMAN, RAKER (Paving)	22.21	7.65	1.85	7.05	.33 A,T.	16.88	39.09
BITUMINOUS SHOVELER, LOADER, UTILITY MAN (Paving)	21.86	7.65	1.85	7.05	.33 A.T.	16.88	38.74
BLASTER (Laborer-Sewer, Water, Tunnel)	29.63	7.65	1.85	7.05	.43	16.98	46.61
	Increase to $48.16 on 6/6/11; $49.89 on 6/4/12						
BLOCKLAYER - Buildings, Paving (see Cement/Concrete Blocklayer)							
BLOCKLAYER-Sewer,Water,Tunnel (see Cement/Concrete Blocklayer)							
BOILERMAKER	30.04	7.07	1.05	11.15	2.03 A,T; 3.50Annuity	24.80	54.84
BOILERMAKER FOREMAN	32.54	7.07	1.05	11.15	2.03 A,T; 3.50Annuity	24.80	57.34
BOILERMAKER GENERAL FOREMAN	34.54	7.07	1.05	11.15	2.03 A,T; 3.50Annuity	24.80	59.34
BOTTOM DIGGER,MISC.BOTTOM MAN	26.72	7.65	1.85	7.05	.43 A,I	16.98	43.70
	Increase to $45.28 on 6/6/11; $46.98 on 6/11/12						
BRACER (Laborer-Sewer,Water,Tunnel)	29.11	7.65	1.85	7.05	.43	16.98	46.09
BRACER (Laborer-Sewer,Water,Tunnel)-Compressed Air	30.23	7.65	1.85	7.05	.43	16.98	47.21
BRICKLAYER (Buildings)	33.15	7.50	none	7.24	4.00 A,I	18.74	51.89
Effective 6/6/11	33.19	7.50	none	7.69	4.01 A,I	19.20	52.39
BRICKLAYER (Paving,Sewer,Water)	34.58					14.92	49.50
BRICKLAYER FOREMAN	36.70	7.50	none	7.24	4.00 A,I	18.74	55.44
Effective 6/6/11	36.77	7.50	none	7.69	4.01 A,I	19.20	55.97
BRICKLAYER SUBFOREMAN	34.93	7.50	none	7.24	4.00 A,I	18.74	53.67
Effective 6/6/11	34.97	7.50	none	7.69	4.01 A,I	19.20	54.17
CABINET INSTALLER	28.31					14.91	43.22
CARPENTER (Buildings)	29.32	9.56	2.06	8.26	1.09 A,I,T	20.97	50.29
	6/6/11 Increase to $52.74						
CARPENTER (Paving)	31.38					16.29	47.67
CARPENTER (Sewer, Water, Tunnel)	31.38					16.11	47.49
CARPENTER FOREMAN	32.46	9.56	2.06	8.26	1.09 A,I,T	20.97	53.43
CARPENTER SUBFOREMAN	30.89	9.56	2.06	8.26	1.09 A,I,T	20.97	51.86
CARPET LAYER,SOFT FLOOR COVERER	29.32	9.56	2.06	8.26	1.09 A,I,T	20.97	50.29
	6/6/11 Increase to $52.74						
CAULKER, Cleaner, Tuckpointer (Buildings,Shaft,Tunnel)	32.73	7.50	none	7.24	3.05 A	17.79	50.52
Effective 6/6/11	32.96	7.50	none	7.69	3.06 A	18.25	51.21
CAULKER, Cleaner, Tuckpointer (Paving, Sewer, Water)	33.35					14.47	47.82
CAULKER, Cleaner, Tuckpointer FOREMAN	33.48	7.50	none	7.24	3.05A	17.79	51.27
Effective 6/6/11	33.53	7.50	none	7.69	3.06 A	18.25	51.78
	Add $.75 for Swing Stage-Foreman						
CEMENT OR CONC.BLOCK LAYER (Buildings)	35.53					15.92	51.45
	Add $1.95 on 6/6/11 = $53.40						
CEMENT OR CONC.BLOCK LAYER (Paving, Sewer, Water, Tunnel)	34.58					14.92	49.50
CEMENT OR CONC. BLOCK LAYER FOREMAN (Bldgs.;Shaft/Tunnel)	30.56	4.00		3.50	.61 A,I	8.11	38.67
CEMENT OR CONC. BLOCK LAYER FOREMAN (SWING STAGE)	31.31	4.00		3.50	.61 A,I	8.11	39.42
CEMENT MASON (FINISHER) (Buildings)	28.56	7.65	2.31	8.48	.37 A,I	18.81	47.37
Effective 5/30/11	30.26	7.80	2.31	8.93	.47 A,I	19.51	49.77
CEMENT MASON (Highway)	25.86	7.65	2.31	8.48	.20 A	18.64	44.50
Effective 6/1/11	27.02	7.80	2.31	8.93	.30 A	19.34	46.36
CEMENT MASON (Sewer,Water, Tunnel)	24.00					18.63	42.63
CEMENT MASON FOREMAN (Buildings)	31.65	7.65	2.31	8.48	.37 A,I	18.81	50.46
Effective 5/30/11	33.52	7.80	2.31	8.93	.47 A,I	19.51	53.03
CEMENT MASON FOREMAN (Highway)	27.11	7.65	2.31	8.48	.20 A	18.64	45.75
Effective 6/1/11	28.27	7.80	2.31	8.93	.30 A,I	19.34	47.61
CEMENT MASON FOREMAN (Sewer)	28.19	4.35		3.50	.30 A,I	8.15	36.34
CEMENT MASON FOREMAN (Tunnel)	28.96	4.45		3.90	.30 A,I	8.65	37.61
CONCRETE MANHOLE BUILDER (See Manhole Builder)							
DRYWALL TAPER OR FINISHER	28.17	8.40	none	6.45	.59 A,I	15.44	43.61
ELECTRICAL LINE CONSTRUCTION ONLY:							
Line Constructor (also under Line Constructor)-(Buildings,Paving,Sewer,Water,Tunnel)	31.66					13.94	45.60
Heavy Equipment Operator (Buildings,Paving,Sewer,Water,Tunnel)	26.88					13.71	40.59
Light Equipment Operator (Buildings,Sewer, Water, Tunnel)	27.66					0.00	27.66
Light Equipment Operator (Paving)	28.21					14.30	42.51
Heavy Truck Driver (Buildings, Sewer, Water, Tunnel)	17.00					8.50	25.50
Heavy Truck Driver (Paving)	24.68					16.16	40.84
Light Truck Driver (Buildings, Sewer, Tunnel, Water)	25.44					0.00	25.44
Light Truck Driver (Paving)	22.92					11.87	34.79
Groundman (Buildings, Sewer, Water, Tunnel)	17.41					9.80	27.21
Groundman (Paving)	29.06					15.39	44.45
ELECTRICIAN (Buildings)	31.10	8.70	3.11	5.53	.96 A,I; 2.40Annuity	20.70	51.80
ELECTRICIAN(Paving)	31.10					20.39	51.49
ELECTRICIAN (Sewer,Water,Tunnel)	32.53					18.34	50.87
ELECTRICIAN FOREMAN	34.21	8.70	3.42	5.63	1.05 A,I;2.40Annuity	21.20	55.41
ELECTRICIAN GENERAL FOREMAN	35.77	8.70	3.58	5.67	1.08 A,I;2.40Annuity	21.43	57.20
ELEVATOR CONSTRUCTOR/MECHANIC	41.71	10.525	3.34	6.46	2.15 E,H,W;4.25 Annuity	26.725	68.435

5/23/11

JOB CLASSIFICATION	HOURLY RATE	WELFARE PER HOUR	VACATION PER HOUR	PENSION PER HOUR	OTHER SPECIFIC BENEFITS	TOTAL FRINGES	TOTAL WAGE
FENCE ERECTOR (Buildings, Sewer, Water, Tunnel))	22.50					3.65	26.15
FENCE, GUARD RAIL, BRIDGE BUILDER (Paving)	21.86	7.65	1.85	7.05	.33 A,E,T	16.88	38.74
FIBER OPTIC LABORER - Buildings(Outside,other than Concrete Encased)	15.00					3.09	18.09
FIBER OPTIC LABORER - Paving (Outside, other than Concrete Encased)	22.79					15.30	38.09
FIBER OPTIC LABORER - Sewer,Water,Tunnel (Outside,other than Concrete Encased)	12.50					0.00	12.50
FIRE SPRINKLER FITTER - see SPRINKLER FITTER							
FLAGPERSON, TRAFFIC CONTROL (Paving)	18.35	7.65	1.85	7.05	.33 A,E,T	16.88	35.23
FLAGPERSON, TRAFFIC CONTROL (Sewer,Water,Tunnel)	19.83					15.65	35.48
FLOOR COVERER, Soft	29.32	9.56	2.06	8.26	1.09 A,I,T	20.97	50.29
FLOOR COVERER FOREMAN (Buildings, Tunnel)	32.46	9.56	2.06	8.26	1.09 A,I,T	20.97	53.43
FLOOR COVERER SUBFOREMAN	30.89	9.56	2.06	8.26	1.09 A,I,T	20.97	51.86
FORKLIFT-AIR, ELECTRIC EQUIPMENT & POWER BUGGY OPERATOR-LABORER	27.28					15.01	42.29
(also see under Laborer-Fork Lift Operator)	6/1/11 Add $2.25 = $44.54						
GAS OR UTILITY PIPELINE LABORER (other than Sewer & Water)	18.74					14.93	33.67
	6/1/11 Add $1.00 = $34.67						
GLAZIER	32.25	8.25	none	6.99	.70 A	15.94	48.19
Effective 6/1/11	32.80	9.15	none	7.54	.80 A	17.49	50.29
	Increase to $52.44 on 6/1/12						
GUNITE MACHINEMAN (Laborer-Buildings)	27.39					15.01	42.40
	6/1/11 Add $2.25 = $44.65						
INSULATOR (BATT & BLOWN)	17.11					17.69	34.80
INSULATOR (HEAT & FROST)(can also be used for ASBESTOS WORKER)	33.28	7.45	none	8.07	.74 A,E,I; 6.25 Annuity	22.51	55.79
INSULATOR FOREMAN (HEAT & FROST)(5 man crew incl. Foreman)	35.78	7.45	none	8.07	.74 A,E,I; 6.25Annuity	22.51	58.29
IRONWORKER-Buildings	31.31	8.87	none	8.07	.81 A,I; 4.25Annuity	22.00	53.31
	6/6/11 Increase to $55.10						
IRONWORKER-Paving,Sewer, Water, Tunnel	31.31					21.79	53.10
	Add $2.00 on 6/6/11= $55.10						
IRONWORKER FOREMAN	33.31	8.87	none	8.07	.81 A,I;4.25Annuity	22.00	55.31
IRONWORKER GENERAL FOREMAN	33.81	8.87	none	8.07	.81 A,I;4.25Annuity	22.00	55.81
JACKHAMMER OPERATOR (Laborer-Buildings)	25.54	7.65	1.85	7.05	.51	17.06	42.60
	6/1/11 Increase to $44.65						
JOINTMAN (Laborer-Sewer,Water)	29.11	7.65	1.85	7.05	.43	16.98	46.09
JOINTMAN (Laborer-Sewer,Water)-Compressed Air Effective 6/7/10:	30.23	7.65	1.85	7.05	.43	16.98	47.21
LABORER- Fork Lift Operator, Air & Electrical Equipment, Power Buggy Operators	27.28					15.01	42.29
(also listed under Fork Lift Operator-Laborer)	6/1/11 Add $2.25 = $44.54						
LABORER-GENERAL (Buildings)	25.32	7.65	1.85	7.05	.51	17.06	42.38
	6/1/11 Increase to $44.43						
LABORER-Paving	23.34					17.30	40.64
LABORER -Sewer,Water,Tunnel	24.80	7.65	1.85	7.05	.43	16.98	41.78
	Increase to $43.33 on 6/6/11; $45.06 on 6/4/12						
	Add $2.00 all tunnel work under 15 lbs. compressed air; $2.00 for 0-30 lbs. compressed air						
	Add $3.00 over 30 lbs. compressed air						
LABORER FOREMAN (Buildings)	26.68	7.55	1.85	7.05	.51	17.06	43.74
LANDSCAPER-Buildings	13.80					15.10	28.90
	6/1/12 Add $1.00 =$ 29.90; 6/1/13 add $1.00 = $30.90; 6/1/14 add $1.00 = $31.90						
LANDSCAPER - Paving	21.86	7.65	1.85	7.05	.33 A,E,T	16.88	38.74
LANDSCAPER-Sewer,Water	13.79	7.65	1.85	7.05	.43	16.98	30.77
LATHER	31.38					16.11	47.49
LINE CONSTRUCTOR(ELECTRICAL)(Building,Paving,Sewer,Water,Tunnel)	31.66					13.94	45.60
	ALSO SEE Electrical Line Construction						
MANHOLE BUILDER, Concrete	29.11	7.65	1.85	7.05	.43 A,I	16.98	46.09
MARBLE FINISHER	26.25	7.50	none	7.24	3.45	18.19	44.44
Effective 6/6/11	26.29	7.50	none	7.69	3.45	18.64	44.93
MARBLE MASON	33.15	7.50	none	7.24	3.66	18.40	51.55
Effective 6/6/11	33.19	7.50	none	7.69	3.67	18.86	52.05
MARBLE MASON FOREMAN	36.70	7.50	none	7.24	3.66	18.40	55.10
Effective 6/6/11	36.77	7.50	none	7.69	3.67	18.86	55.63
METAL BUILDING ERECTOR	13.00					6.86	19.86
MILLWRIGHT	26.70	9.56	1.60	7.18	6.48 A,I,M,T	24.82	51.52
MILLWRIGHT FOREMAN	29.20	9.56	1.60	7.18	6.48 A,I,M,T	24.82	54.02
MILLWRIGHT GENERAL FOREMAN	29.70	9.56	1.60	7.18	6.48A,I,M,T	24.82	54.52
MORTAR MIXER - Buildings	25.43	7.65	1.85	7.05	.51 I,S,E	17.06	42.49
	6/1/11 Increase to $44.54						

JOB CLASSIFICATION	HOURLY RATE	WELFARE PER HOUR	VACATION PER HOUR	PENSION PER HOUR	OTHER SPECIFIC BENEFITS	TOTAL FRINGES	TOTAL WAGE
OPERATORS-BUILDING CONSTRUCTION ***SITE PREPARATION, UTILITY & LANDSCAPING WORK ONLY***							
Crane, Backhoe 130,000 lbs. & over; Boring Machine	33.07	9.15	none	6.75	1.25	17.15	50.22
Effective 5/30/11	34.07	9.15	none	7.50	1.35	18.00	52.07
Tractor or Truck Mounted Hydraulic Backhoe; Gradall (Cruz-Aire type); Mechanic or Welder; Bulldozer or Endloader; Grader or Motor Patrol; Scraper(Self propelled or Tractor Drawn) 5 cu yards or more capacity; Power Subgrader; Asphalt Milling Machine; Boring Machine (Horizontal, Vertical or Directional); Air Track, Rotary or Percussion Drilling Machine; Trencher, Post Hole Digger or Driver; Compactor; Tug or Launch (Not Performing Work on the Great Lakes).	32.32	9.15	none	6.75	1.25	17.15	49.47
Effective 5/30/11:	33.32	9.15	none	7.50	1.35	18.00	51.32
ON SUNDAYS AND HOLIDAYS, PAY TWO TIMES THE HOURLY BASIC RATE							
Forklift, Backfiller, Broom or Sweeper; Environmental Burner,Stump Chipper	33.24					17.61	50.85
Effective 5/30/11	33.02	9.15	none	7.50	1.35	18.00	51.02
Crusher, Screening or Wash Plant; Air Compressor (400 CFM or Over); Pump (3 inch or over) or Well Points; Refrigeration Plant or Freeze Machine; Skid Steer Loader (with or without attachments); Skid Rig; Stump Chipper; Mulcher; Vibratory Hammer or Extractor,Greaser, Compactor (Self Propelled), Farm or Industrial Type Tractor	32.32					16.75	49.07
Add $1.85 on 5/31/11 = $50.92							
Work performed on the Great Lakes including Diver; Wet Tender or Hydraulic Dredge Engineer	35.05					18.08	53.13
Work performed on the Great Lakes including Crane or Backhoe Operator; Mechanic or Welder; Assistant Hydraulic Dredge Engineer; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder;70 Ton or Over Tug Operator	37.45					19.45	56.90
Add $ .50/hour for Friction Crane, Lattice Boom or Crane Certification (CCO)							
ON SUNDAYS & HOLIDAYS, PAY TWO TIME HOURLY BASIC RATE							
Work performed on the Great Lakes including Deck Equipment Operator or Machineryman (maintains Cranes over 50 tons or Backhoes over 115,000 lbs.); Tug, Launch or Loader, Dozer or like equipment when operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery	33.35					19.33	52.68
ON SUNDAYS & HOLIDAYS, PAY TWO TIME HOURLY BASIC RATE							
Work performed on the Great Lakes including Deck Equipment Operator; Machineryman or Fireman (operates 4 units or more or maintains Cranes 50 tons or under or Backhoes 115,000 lbs. Or under), Deck Hand, Deck Engineer or Assistant Tug Operator	32.20					18.69	50.89
OPERATORS-BUILDING CONSTRUCTION **EXCLUDING *SITE PREPARATION,UTILITY, PAVING & LANDSCAPING WORK***							
Crane, Tower Crane or Derrick, with or without attachments, with a lifting capacity of over 100 tons; Crane, Tower Crane or Derrick, with Boom, Leads and/orJib lengths measuring 176 feet or over	38.06	9.15	none	8.10	1.02 A,I,L,S	18.27	56.33
Effective 6/1/11	39.16	9.15	none	9.00	1.12 A,I,L,S	19.27	58.43
There will be a wage increase of the higher of $ .50 per 100 ton or per 100 feet of boom (or any portion thereof) for the length of the boom over 200 feet or lifting capacity of the crane over 200 tons to a maximum of 300 tons or 300 feet.							
ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE							
Crane Operators with CCO certification	38.56	9.15	none	8.10	1.02 A,I,L,S	18.27	56.83
Effective 6/1/11	39.66	9.15	none	9.00	1.12 A,I,L,S	19.27	58.93
ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE							
Cranes over 300 ton OR 300 ft.	Add $ .01/hour per foot OR ton, whichever is greater						
Crane, Tower Crane or Derrick, with or without attachments, with a lifting capacity of 100 tons or under; Crane, Tower Crane or Derrick, with Boom, Leads and/or Jib lengths measuring 175 or under; Backhoe (Track Type) having a Mfgr.'s rated capacity of 130,000 lbs. or over, Caisson Rig; Pile Driver	37.56	9.15	none	8.10	1.02 A,I,L,S	18.27	55.83
Effective 6/1/11	38.66	9.15	none	9.00	1.12 A,I,L,S	19.27	57.93
ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE							

JOB CLASSIFICATION		HOURLY RATE	WELFARE PER HOUR	VACATION PER HOUR	PENSION PER HOUR	OTHER SPECIFIC BENEFITS	TOTAL FRINGES	TOTAL WAGE
OPERATORS - BUILDING CONSTRUCTION								
EXCLUDING SITE PREPARATION, UTILITY, PAVING & LANDSCAPING WORKS								
CONTINUED								
Crane Operators with CCO certification		38.06	9.15	none	8.10	1.02 A,I,L,S	18.27	56.33
	Effective 6/1/11	39.16	9.15	none	9.00	1.12 A,I,L,S	19.27	58.43
		ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE						
Backhoes (excavators) under 130,000 lbs.; self-erecting tower cranes with a lifting capacity of 4,000 lbs and under; skid rigs; dredge operator; mechanic; contrete paver (over 27E); concrete spreader and distributor; forklift; hydro-blaster (10,000 psi and over);Traveling Crane (Bridge Type); Dredge(not performing work on the Great Lakes)		37.06	9.15	none	8.10	1.02 A,I,L,S	18.27	55.33
	Effective 6/1/11	37.47	9.15	none	9.00	1.12 A,I,L,S	19.27	56.74
		ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE						
Crane Operators with CCO certification		37.56	9.15	none	8.10	1.02 A,I,L,S	18.27	55.83
	Effective 6/1/11	38.66	9.15	none	9.00	1.12 A,I,L,S	19.27	57.93
Material hoists; stack hoists; tractor or truck mounted hydraulic backhoe; tractor or truck mounted hydraulic crane (5 tons or under); hoist (tuggers, 5 ton and over); hydro-excavators;daylighters; concrete pumps; Rotec type conveyors; tractor (over 40 H.p.); bulldozer; endloader, scraper operator; sideboom; straddle carrier; welder; bituminous plant and paver operator; roller (over 5 tons); rail leveling, machine (railroad); tie placer; tie extractor; tie tamper; stone leveler; rotary drill operator and blaster; percussion drill operator; air track drill and/or hammers; trencher (wheel type or chain type having over 8-inch bucket); milling machine,post hole digger,Concrete breaker, tamper,Gradall, Concrete Paver;Boring Machine		36.47					18.10	54.57
	Effective 6/1/11	37.47	9.15	none	9.00	1.12 A,I,L,S	19.27	56.74
		ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE						
Backfiller; concrete auto breaker (large), concrete finishing machines(road type); roller(rubber-tired);concrete batch hopper; Concrete conveyor systems; grout pumps; concrete mixers (14S or over); screw type pumps and gypsum pumps; tractor; trencher (chain type having bucket 8-inch and under); industrial locomotives; rollers (under 5 tons); timber shear; processor; timber equipment; firemen (pile drivers and derricks); robotic tool carrier with or without attachments		29.82					17.96	47.78
	Effective 6/1/11	35.59	9.15	none	9.00	2.12 A,I,L,S	19.27	54.86
		ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE						
Farm or Industrial Type Tractor; Greaser, Compactor (Self-Propelled); Concrete Saw (Vermeer Type); Concrete Bump Cutter or Grooving Machine; Tining or Curing Machine; Roller (5 tons or under); Broom or Sweeper; Hoist (Tugger); Environmental Burner; Crusher, Screening or Wash Plant; Air, Electric or Huydraulic Jacking System; Air Compressor (400 CFM or over);Generator (150KW or over); Pump (3 inch or over) or Well Points; refrigeration Plant or Freeze Machine; Skid Steer Loader (with or without attachments); Stump Chipper; Mulcher; Vibratory Hammer or Extractor; Robotic Tool Carrier (with or without attachments),Oiler, Forklift		29.44	9.15	none	8.10	1.02 A,I,L,S	18.27	47.71
	Effective 6/1/11	30.44	9.15	none	9.00	1.12 A,I,L,S	19.27	49.71
		ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE						
Gas or Utility Pipeline, except Sewer & Water (Primary Equipment)		34.89					19.68	54.57
Gas or Utility Pipeline, except Sewer & Water (Secondary Equipment)		30.21					16.85	47.06
		Add $1.60 on 6/1/11 - $48.66						
Fiber Optic Cable Equipment		24.39					15.45	39.84
		Add $1.75 on 2/1/11 = $41.59						

JOB CLASSIFICATION	HOURLY RATE	WELFARE PER HOUR	VACATION PER HOUR	PENSION PER HOUR	OTHER SPECIFIC BENEFITS	TOTAL FRINGES	TOTAL WAGE
OPERATORS -SEWER,WATER,SHAFT & TUNNEL							
Crane, Tower Crane or Derrick, with or without attachments, with a lifting capacity of over 100 tons; Crane, Tower Crane or Derrick, with Boom, Leads and/or Jib lengths measuring 176 feet or over;Backhoe (Track Type) 130,000 or over	33.59	9.15	none	7.75	1.09 A,I,L,S	17.99	51.58
Effective 6/6/11	34.69	9.15	none	8.45	1.19 A,I,L,S	18.79	53.48
Increase to $55.29 on 6/4/12							
Add $ .25/hour for operating Tower Crane							
ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE							
Crane, Tower Crane or Derrick, with or without attachments, with a lifting capacity of 100 tons or under; Crane, Tower Crane or Derrick, with Boom, Leads and/or Jib lengths measuring 175 feet or under; Backhoe (Track type) having a Mfgr.'s rated capacity of under 130,000 lbs. or over; Traveling Crane (Bridge type); Caisson Rig; Pile Driver; Dredge operator (not performing work on the Great Lakes),Skid Rigs,Concrete Paver Concrete Spreader, Concrete Pumps,Concrete Conveyor (Rotec), Boring Machines	32.81	9.15	none	7.75	1.09 A,I,L,S	17.99	50.80
Effective 6/6/11	33.91	9.15	none	8.45	1.19 A,I,L,S	18.79	52.70
Increase to $54.51 on 6/4/12							
Add $ .25/hour for operating Tower Crane							
ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE							
Truck Mounted Hydraulic Crane (10 tons or under); Tractor or Truck Mounted Hydraulic Backhoe; Gradall (Cruz-Aire Type); Mechanic or Welder; Bulldozer or Endloader; Grader or Motor Patrol; Grout Pump, or Concrete Conveyor (Bidwell type); Concrete Breaker (Manual or Remote); Concrete Batch Plant; Power Subgrader; Concrete Paver; Concrete Grinder or Planing Machine; Concrete Conveyor System; Concrete Slipform Placer, Curb and Gutter Machine; Roller (over 5 ton); Shouldering Machine; Air Track, Rotary or Percussion Drilling Machine; Straddle Carrier or Travel Lift; Manhoist or Elevator; Material or Stack Hoist; Trencher; Sideboom; Post Hole Digger or Driver; Tug or Launch (not performing work on the Great Lakes)	31.86	9.15	none	7.75	1.09 A,I,L,S	17.99	49.85
Effective 6/6/11	32.96	9.15	none	8.45	1.19 A,I,L,S	18.79	51.75
Increase to $53.56 on 6/4/12							
Add $ .25/hour for operating Tower Crane							
ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE							
Farm or Industrial Type Tractor; Compactor (self-propelled); Concrete Saw (Vermeer type); Concrete Bump Cutter or Grooving Machine; Tining or Curing Machine; Roller (5 ton or under); Broom or Sweeper; Hoist (Tugger); Environmental Burner	30.81					17.75	48.56
Effective 6/6/11	31.91	9.15	none	8.45	1.19 A,I,L,S	18.79	50.70
Increase to $52.52 on 6/4/12							
Add $ .25/hour for operating Tower Crane							
ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE							
Crusher, Screening or Wash Plant; Air, Electric or Hydraulic Jacking System; Air Compressor (400 CFM or over); Generator (150kw or over); Pump (3 inch or over) or Well Points; Refrigeration Plant or Freeze Machine; Skid Steer Loader (with or without attachments); Robotic Tool Carrier (with or without attachments); Stump Chipper; Mulcher; Vibratory Hammer or Extractor;Oiler; Forklift, High Pressure Utility Locating Machine(daylighting machine),Greaser	29.41					17.75	47.16
Effective 6/6/11	30.81	9.15	none	8.45	1.19 A,I,L,S	18.79	49.30
Increase to $51.11 on 6/4/12							
Add $ .25/hour for operating Tower Crane							
ON SUNDAYS & HOLDAYS, PAY TWO TIMES HOURLY BASIC RATE							
Work performed on the Great Lakes including Diver; Wet Tender or Hydraulic Dredge Engineer	37.70	9.00	none	7.65	1.05	17.70	55.40
Work performed on the Great Lakes including Crane or Backhoe Operator; Mechanic or Welder; Assistant Hydraulic Dredge Engineer; Hydraulic Dredge Leverman or Diver's Tender	36.20	9.00	none	7.65	1.05	17.70	53.90
Work performed on the Great Lakes including Deck Equipment Operator or Machineryman (maintains Cranes over 50 tons or Backhoes over 115,000 lbs); Tug, Launch or Loader, Dozer or like equipment when operated on a Barge, Breakwater Wall, Slip, Dock or Scow	32.20					18.69	50.89

JOB CLASSIFICATION	HOURLY RATE	WELFARE PER HOUR	VACATION PER HOUR	PENSION PER HOUR	OTHER SPECIFIC BENEFITS	TOTAL FRINGES	TOTAL WAGE
Work performed on the Great Lakes including Deck Equipment Operator; Machineryman or Fireman (operates 4 units or more or maintains Cranes 50 tons or under or Backhoes 115,000 lbs. or under), Deck Hand, Deck Engineer, or Assistant Tug Operator	32.20					18.69	50.89
OPERATORS - LOCAL STREET OR MISCELLANEOUS PAVING *CONCRETE PAVEMENT OR BRIDGE WORK ONLY*							
Crane, Tower Crane or Derrick, with or without attachments, with a lifting capacity of over 100 tons; Crane, Tower Crane or Derrick, with Boom, Leads and/or Jib Lengths measuring 176 feet or over	33.07	9.15	none	8.10	.93 A,L	18.18	51.25
Effective 6/1/11	34.22	9.15	none	8.80	1.03 A,L	18.98	53.20
Crane, Tower Crane or Derrick, with or without attachments, with a lifting capacity of 100 tons or under; Crane, Tower Crane or Derrick, with Boom, Leads and/or Jib lengths measuring 175 feet or under;Backhoe (Track type) having a Mfgr.rated capacity of 130,000 lbs. or over;Caisson Rig; Pile Driver;Dredge (not performing work on the Great Lakes)	32.57	9.15	none	8.10	.93 A,L	18.18	50.75
Effective 6/1/11	33.72	9.25	none	8.80	1.03 A,L	18.98	52.70
Increase to $54.62 on 6/1/12; $56.62 on 6/1/13;$58.37 on 6/1/14 Premium Pay: For State Highway Construction type project,add $1.50/hour for work on projects involving temporary traffic control setup, for lane & shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period). ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE							
Backhoe (Track Type) having a Mfgr.'s rated capacity of under 130,000 lbs.; Tractor or Truck Mounted Hydraulic Backhoe; Gradall (Cruz-Aire Type); Mechanic or Welder; Bulldozer or Endloader; Grader or Motor Patrol; Scraper (Self propelled or Tractor Drawn) 5 cu yards or more capacity; Concrete Pump, Grout Pump or Concrete Conveyor (Rotec or Bidwell Type); Concrete Breaker (Manual or Remote); Concrete Batch Plant; Power Subgrader; Concrete Paver; Concrete Grinder or Planing Machine; Concrete Conveyor System; Concrete Slipform Placer Curb and Gutter Machine; Air Track, Rotary or Percussion Drilling Machine; Straddle Carrier or Travel Lift; Trencher; Post Hole Digger or Driver; Tug or Launch (not performing work on the Great Lakes), Concrete Bump Cutter or Grooving Machine	32.07	9.15	none	8.10	.93 A,L	18.18	50.25
Effective 6/1/11	33.22	9.15	none	8.80	1.03 A,L	18.98	52.20
Farm or Industrial Type Tractor; Greaser; Compactor (Self-Propelled); Concrete Saw (Vermeer Type); Tining or Curing Machine; Environmental Burner, Mulcher, Concrete Spreader	31.81	9.15	none	8.10	.93 A,L	18.18	49.99
Effective 6/1/11	32.96	9.15	none	8.80	1.03 A,L	18.98	51.94
ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE							
Crusher, Screening or Wash Plant; Air Compressor; Generator; Pump (3 inch or over) or Well Points; Forklift; Skid Steer Loader (with or without attachments); Skid Rig; Stump Chipper; Vibratory Hammer or Extractor; Oiler	31.52	9.15	none	8.10	.93 A,L	18.18	49.70
Effective 6/1/11	32.67	9.15	none	8.80	1.03 A,L	18.98	51.65
ON SUNDAYS AND HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE.							
Fiber Optic Cable Equipment	22.79					15.30	38.09
Work performed on the Great Lakes including Diver, Wet Tender, or Hydraulic Dredge Engineer	35.05					18.08	53.13
Work performed on the Great Lakes including Crane or Backhoe Operator, Mechanic or Welder, Assistant Hydraulic Dredge Engineer, Hydraulic Dredge Leverman or Diver's Tender	35.05					18.08	53.13
Work performed on the Great Lakes including Deck Equipment Operator or Machineryman (maintains Cranes over 50 tons or Backhoes over 115,000 lbs.); Tug, Launch or Loader, Dozer or like equipment when operated on a Barge, Breakwater Wall, Slip, Dock or Scow	32.20					18.69	50.89
Work performed on the Great Lakes including Deck Equipment Operator; Machineryman or Fireman (operates 4 units or more and maintains Cranes 50 tons or under or Backhoes 115,000 lbs. Or under) or Assistant Tug Operator	32.20					18.69	50.89

JOB CLASSIFICATION	HOURLY RATE	WELFARE PER HOUR	VACATION PER HOUR	PENSION PER HOUR	OTHER SPECIFIC BENEFITS	TOTAL FRINGES	TOTAL WAGE
OPERATORS - *ASPHALT PAVEMENT OR OTHER WORK*							
Crane, Tower Crane or Derrick, with or without attachments, with a lifting capacity of over 100 tons; Crane, Tower Crane or Derrick, with Boom, Leads and/or Jib lengths measuring 176 feet or over	33.07	9.15	none	8.10	.93 A,L	18.18	51.25
Effective 6/1/11	34.22	9.15	none	8.80	1.03 A,L	18.98	53.20
Crane, Tower Crane or Derrick, with or without attachments, with a lifting capacity of 100 tons or under; Crane, Tower Crane or Derrick, with Boom, Leads and/or Jib lengths measuring 175 or under; Backhoe (Track Type) having a Mfgr.'s rated capacity of 130,000 lbs. or over; Caisson Rig; Pile Driver; Dredge (not performing work on the Great Lakes)	32.57	9.15	none	8.10	.93 A,L	18.18	50.75
Effective 6/1/11	33.72	9.15	none	8.80	1.03 A,L	18.98	52.70
Backhoe (Track Type) having a Mfgr.'s rated capacity of under 130,000 lbs.; Tractor or Truck Mounted Hydraulic Backhoe; Gradall (Cruz-aire Type); Mechanic or Welder; Bulldozer or Endloader; Grader or Motor Patrol; Scraper (Self Propelled or Tractor Drawn) 5 cu yards or more capacity; Concrete Breaker (Manual or Remote); Power Subgrader; Concrete Grinder or Planing Machine; Concrete Slipform Placer; Curb and Gutter Machine; Asphalt Plant; Asphalt Paver; Asphalt Screed; Asphalt Milling Machine; Roller (over 5 ton); Shouldering Machine; Trencher; Post Hole Digger or Driver	32.07	9.15	none	8.10	.93 A,L	18.18	50.25
Effective 6/1/11	33.22	9.15	none	8.80	1.03 A,L	18.98	52.20
	Increase to $53.22 on 6/1/12; $55.22 on 6/1/13;$56.97 on 6/1/14						
	ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE						
Farm or Industrial Type Tractor; Greaser; Compactor (self-propelled); Roller (5 ton or under); Broom or Sweeper; Environmental Burner	31.61	9.15	none	8.10	.93 A,L	18.18	49.99
Effective 6/1/11	32.96	9.15	none	8.80	1.03 A,L	18.98	51.94
	Increase to $53.22 on 6/1/12; $55.22 on 6/1/13;$56.97 on 6/1/14						
	ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE						
Crusher, Screening or Wash Plant; Air Compressor; Generator; Pump (3 inch or over) or Well Points; Forklift; Skid Steer Loader (with or without attachments); Skid Rig; Stump Chipper; Mulcher; Vibratory Hammer or Extractor; Oiler	31.52	9.15	none	8.10	.93 A,L	18.18	49.70
Effective 6/1/11	32.67	9.15	none	8.80	1.03 A,L	18.98	51.65
	Increase to $53.22 on 6/1/12; $55.22 on 6/1/13						
	ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE						
Fiber Optic Cable Equipment	22.79					15.30	38.09
OVERHEAD DOOR INSTALLER	25.04					13.01	38.05
PAINTERS:							
Bridges, Iron	28.82	8.65	none	7.45	.69 I,A	16.79	45.61
	Increase to $47.66 on 6/1/11; $49.86 on 6/1/12						
Buildings	28.47	8.65	none	7.45	.69 I,A	16.79	45.26
	Increase to $47.31 on 6/1/11; $49.51 on 6/1/12						
Drywall	28.82	8.65	none	7.45	.69 I,A	16.79	45.61
	Increase to $47.66 on 6/1/11; $49.86 on 6/1/12						
Paperhanging	28.67	8.65	none	7.45	.69 I,A	16.79	45.46
	Increase to $47.51 on 6/1/11; $49.71 on 6/1/12						
Paving Construction	27.82					15.39	43.21
Sandblasting & Spraying	29.22	8.65	none	7.45	.69 I,A	16.79	46.01
	Increase to $48.06 on 6/1/11; $50.26 on 6/1/12						
	ALL Painter Classifications: Add $ .60 for EIFS work and $1.00 for Lead Based Paint Remova						
PAINTER FOREMAN (Buildings)	29.22	8.65	none	7.45	.69 I,A	16.79	46.01
Effective 6/1/11	29.72	9.10	none	7.90	.79 I,A	17.79	47.51
PAVEMENT MARKING OPERATOR - Buildings,Sewer,Water	25.65					13.10	38.75
PAVEMENT MARKING OPERATOR - Paving	23.46					9.45	32.91
PILEDRIVER - BUILDINGS	26.05	9.56	2.06	8.84	5.56 A,M,T	26.02	52.07
	6/6/11 Increase to $54.52						
PILEDRIVER-LOFTSMAN	26.70	9.56	2.06	8.84	5.56 A,M,T	26.02	52.72
	6/6/11 Increase to $55.17						
PILEDRIVER-SHEET PILING LOFTSMAN	26.80	9.56	2.06	8.84	5.56 A,M,T	26.02	52.82
	6/6/11 Increase to $55.27						
PILEDRIVER - PAVING	28.11					21.16	49.27
PILEDRIVER - SEWER, WATER, TUNNEL	28.11					23.76	51.87
PILEDRIVER FOREMAN	28.86	9.56	2.06	8.84	5.56 A,M,T	26.02	54.88
PIPELAYER (Sewer,Water,Tunnel)	29.11	7.65	1.85	7.05	.43 A,I	16.98	46.09
PIPELAYER (Tunnel)(in compressed air 0-15)	30.23	7.65	1.85	7.05	.43 A,I	16.98	47.21
	Over 15-30 lbs. - add $2.00; Over 30 lbs. - Add $3.00 hour						
PIPELINE FUSER OR WELDER (Gas or Utility)	29.85					17.34	47.19

5/23/11

JOB CLASSIFICATION		HOURLY RATE	WELFARE PER HOUR	VACATION PER HOUR	PENSION PER HOUR	OTHER SPECIFIC BENEFITS	TOTAL FRINGES	TOTAL WAGE
PLASTERER		30.36	7.65	none	8.93	.49 A	17.07	47.43
	Effective 5/30/11	32.06	7.80	none	9.38	.59 A	17.77	49.83
PLASTERER FOREMAN		33.40	7.65	none	8.93	.49 A	17.07	50.47
	Effective 5/30/11	35.27	7.80	none	9.38	.59 A	17.77	53.04
PLASTERER LABORER-Buildings		25.13	7.65	1.85	7.05	.40 I,T	16.95	42.08
PLASTERER LABORER FOREMAN		26.91	7.65	1.85	7.05	.40 I,T	16.95	43.86
PLUMBER (Buildings)		37.42	8.05	none	8.05	2.22 E,I	18.32	55.74
PLUMBER (Sewer,Water,Tunnel)		34.45					15.50	49.95
PLUMBER FOREMAN/GENERAL FOREMAN		41.91	8.05	none	8.05	2.22 E,I	18.32	60.23
POWER BUGGY OPERATOR - LABORER		24.32					12.01	36.33
PUMP INSTALLER (BUILDINGS)		24.22					14.80	39.02
PUMP INSTALLER (SEWER,WATER,TUNNEL)		23.52					13.90	37.42
RAILROAD TRACK LABORER-BUILDINGS,PAVING,SEWER,WATER		12.50					3.96	16.46
REFRIGERATION MECHANIC		37.21	9.45	none	8.68	1.20 I,T	19.33	56.54
REFRIGERATION FOREMAN		40.93	9.45	none	8.68	1.20 I,T	19.33	60.26
REFRIGERATION GENERAL FOREMAN		42.79	9.45	none	8.68	1.20 I,T	19.33	62.12
ROOFER (BUILDINGS) *		28.85	6.90	none	7.42	.28 T	14.60	*43.45
		*All Roofers MUST be paid the Total Wage Rate Amount FOR ALL hours worked						
ROOFER (PAVING) *		28.85					13.60	*42.45
ROOFER FOREMAN *		29.85	6.90	none	7.42	.28 T	14.60	*44.45
SEWER, WATER, TUNNEL FOREMAN		31.84	7.65	1.85	7.05	.43 A, I	16.98	48.82
SEWER & WATER TUNNEL FOREMAN-Compressed Air		32.97	7.65	1.85	7.05	.43 A,I	16.98	49.95
SHEET METAL WORKER		37.20	6.60	none	9.08	1.02 I,T	16.70	53.90
SHEET METAL FOREMAN		40.40	6.60	none	9.08	1.02 I,T	16.70	57.10
SHEET METAL GENERAL FOREMAN		41.90	6.60	none	9.08	1.02 I,T	16.70	58.60
SIDING INSTALLER		36.60					15.48	52.08
SPRINKLER FITTER		33.70	7.40	3.12	10.78	.85 E,I,T	22.15	55.85
SPRINKLER FITTER FOREMAN		36.65	7.40	3.12	10.78	.85 E,I,T	22.15	58.80
STEAMFITTER (Buildings)		37.21	9.45	none	8.68	1.20 A,I,T	19.33	56.54
STEAMFITTER (Sewer,Water,Tunnel)		31.65					15.04	46.69
STEAMFITTER FOREMAN		40.93	9.45	none	8.68	1.20 A,I,T	19.33	60.26
STEAMFITTER GENERAL FOREMAN		42.79	9.45	none	8.68	1.20 A,I,T	19.33	62.12
STONE MASON-BUILDINGS		35.53					15.92	51.45
		Add $1.95 on 6/6/11 = $53.40						
STONE MASON-PAVING,SEWER,WATER		34.58					14.92	49.50
STONE MASON FOREMAN		30.56	4.00		3.50	.61 A,I	8.11	38.67
STONE MASON FOREMAN ON SWING STAGE		31.31	4.00		3.50	.61 A,I	8.11	39.42
TAPER - See DRYWALL TAPER								
TELEDATA INSTALLER (Buildings)		24.65					15.17	39.82
TELEDATA INSTALLER (Paving,Sewer,Water,Tunnel)		24.09					14.48	38.57
TELEDATA TECHNICIAN		24.65	7.70	2.47	3.15	1.40 A,E,I; .70Annuity	15.42	40.07
TEMPERATURE CONTROL INSTALLER		35.81					16.98	52.79
TERRAZZO FINISHER		29.40					14.31	43.71
TERAZZO MECHANIC		29.40					14.31	43.71
TERAZZO FOREMAN (more than 3 journeymen)		32.95	7.10	none	8.16	.66	15.92	48.87
TILE FINISHER		15.05					9.43	24.48
TILE SETTER/LAYER		28.48	7.10	none	8.16	2.25 A,E	17.51	45.99
TILE SETTER/LAYER FOREMAN		30.48	7.10	none	8.16	2.25A,E	17.51	47.99
TOPMAN (Sewer & Water)		24.80	7.65	1.85	7.05	.43 A,I	16.98	41.78
TRUCK DRIVERS - **Building Construction**								
Single		26.87	8.80	3.16	7.30		19.26	46.13
	Effective 6/1/11	27.87	10.12	3.16	7.70		20.98	48.89
Two Axle		21.42					5.62	27.04
Three or More Axle		26.62					17.81	44.43
Articulated, Euclid, Dumptor or Off Road Material Hauler		32.32					16.75	49.07
		Add $1.85 on 5/31/11 = $50.92						
		ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE						
TRUCK DRIVERS - **Sewer,Water,Tunnel**								
Single, Two Axle		21.42					5.62	27.04
Tandem/Tri Axle		25.22	10.00	3.33	6.45	.12	19.90	45.12
	Effective 6/1/11	26.60	10.00	3.33	6.45	.12	19.90	46.50
Quad/Semi Trailer Truck		25.11	10.00	3.33	6.45	.12	19.90	45.01
	Effective 6/1/11	26.49	10.00	3.33	6.45	.12	19.90	46.39
Articulated, Euclid, Dumptor or Off Road Material Hauler		31.89					17.96	49.85
		ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE						
TRUCK DRIVERS - **Paving**								
Single, Two, Three or More Axle		26.87	8.80	3.16	7.30		19.26	46.13
	Effective 6/1/11	27.87	10.12	3.16	7.70		20.98	48.89
Articulated, Euclid, Dumptor or Off Road Material Hauler		31.89					17.96	49.85
		ON SUNDAYS & HOLIDAYS, PAY TWO TIMES HOURLY BASIC RATE						
Pavement Marking Vehicle (Buildings, Paving, Sewer, Water, Tunnel)		20.85					11.02	31.87
Shadow or Pilot Vehicle		21.42					5.62	27.04
Truck Mechanic (Buildings)		26.62					17.81	44.43
Truck Mechanic (Paving)		13.00					13.60	26.60
Truck Mechanic (Sewer,Water,Tunnel)		17.03					12.89	29.92

5/23/11

JOB CLASSIFICATION	HOURLY RATE	WELFARE PER HOUR	VACATION PER HOUR	PENSION PER HOUR	OTHER SPECIFIC BENEFITS	TOTAL FRINGES	TOTAL WAGE
TUCKPOINTER,CAULKER,CLEANER (Buildings,Shaft,Tunnel)	32.73	7.50	none	7.24	3.05 A	17.79	50.52
Effective 6/6/11	32.96	7.50	none	7.69	3.06 A	18.25	51.21
TUCKPOINTER, CAULKER,CLEANER (Paving,Sewer,Water)	33.35					14.47	47.82
TUCKPOINTER, CAULKER, CLEANER FOREMAN	33.48	7.50	none	7.24	3.05 A	17.79	51.27
Effective 6/6/11	33.53	7.50	none	7.69	3.06 A	18.25	51.78
	Add $.75 for Swing Stage - Buildings, Shaft, Tunnel & Foreman						
UNDERWATER DIVER (EXCEPT ON GREAT LAKES) (Buildings, Paving, Sewer, Water, Tunnel)	32.31					14.91	47.22
UTILITY OR GAS PIPELINE LABORER (other than Sewer & Water)	18.74					14.93	33.67
	6/1/11 Add $1.00 = $34.67						
WATERPROOFER-BUILDINGS *	28.85					14.60	43.45
WATERPROOFER-PAVING *	28.85					13.60	42.45
	*All Waterproofers/Roofers MUST be paid the Total Wage Rate Amount FOR ALL hours worked						
WELDER, Certified (Laborer-Buildings)	27.39					15.01	42.40
	6/1/11 Add $2.25 = $44.65						
WELLDRILLER, PUMP INSTALLER (Buildings,Sewer,Water,Tunnel)	24.22					14.80	39.02
	6/1/11 Add $1.60 = $40.62						
	ON SUNDAYS AND HOLIDAYS, PAY TWO TIMES THE HOURLY BASIC RATE						

FUND CODES:

A - APPRENTICESHIP FUND
B - EMPLOYEE SAVINGS FUND
C - CONTRACTOR FUND OR COOPERATION FUND
D - DEVELOPMENT FUND
E - EDUCATION TRUST FUND
H - HOLIDAYS
I - INDUSTRY ADVANCEMENT PROGRAM FUND
L - LABOR MANAGEMENT FUND
M - MUIAR FUND
S - SKILL IMPROVEMENT FUND
T - TRAINING FUND
W - WORK PRESERVATION

SECTION 00850:
DRAWING SCHEDULE

The following listed drawings accompany and form a part of the project contract documents along with this project manual and generally illustrate the nature of the work.

Sheet No.	Drawing No.	SHEET TITLE
		00-GENERAL – LINCOLN AVENUE & NORTHWEST GARAGE SITE
1	00-G-01	COVER SHEET AND SITE LOCATIONS
2	00-G-02	DRAWING INDEX
3	00-G-03	ARCHITECTURAL AND STRUCTURAL LEGEND
4	00-G-04	PROCESS AND INSTRUMENTATION DIAGRAM LEGEND
5	00-G-05	PROCESS AND INSTRUMENTATION DIAGRAM SYMBOLS
6	00-G-06	ELECTRICAL ONE-LINE SCHEMATIC SYMBOLS
7	00-G-07	ELECTRICAL ABBREVIATIONS AND SYMBOLS
		01 - LINCOLN AVENUE SITE
8	00-C-01	NEW FACILITIES AND PIPING PLAN
9	00-C-02	NEW PAVING PLAN BY DPW
		PROCESS AND INSTRUMENTATION
10	01-N-01	GAS COMPRESSION AND STORAGE
11	01-N-02	CNG STORAGE AND DISPENSING
12	01-N-03	NETWORK DIAGRAM
		STRUCTURAL
13	01-S-01	OVERALL SITE PLAN
14	01-S-02	FOUNDATIONS
15	01-S-03	CNG TIME FILL AREA
		MECHANICAL
16	01-M-01	OVERALL SITE PLAN
17	01-M-02	AREAS
18	01-M-03	CNG TIME FILL AREA
19	01-M-04	DETAILS
		ELECTRICAL
20	01-E-01	OVERALL SITE PLAN
21	01-E-02	CNG STATION AND DPW FAST-FILL AREA
22	01-E-03	CNG STATION AND DPW FAST-FILL AREA GROUNDING
23	01-E-04	CNG STATION AND DPW FAST-FILL AREA HAZARDOUS LOCATIONS
24	01-E-05	CNG TIME FILL AREA
25	01-E-06	CNG TIME FILL AREA HAZARDOUS LOCATIONS
26	01-E-07	PUBLIC CNG STORAGE AND DISPENSING AREA
27	01-E-08	PUBLIC CNG STORAGE AND DISPENSING AREA GROUNDING
28	01-E-09	PUBLIC CNG STORAGE AND DISPENSING AREA HAZARDOUS LOCTIONS
29	01-E-10	ONE-LINE DIAGRAM

Sheet No.	Drawing No.	SHEET TITLE
		02 – NORTHWEST GARAGE SITE
		CIVIL
30	02-C-01	NEW FACILITIES AND PIPING PLAN
31	02-C-02	NEW PAVING PLAN
		PROCESS AND INSTRUMENTATION
32	02-N-01	GAS COMPRESSION AND STORAGE
33	02-N-02	CNG STORAGE AND DISPENSING
34	02-N-03	NORTHWEST GARAGE NETWORK DIAGRAM
		STRUCTURAL
35	02-S-01	CNG STATION AREA AND DPW FAST-FILL
		MECHANICAL
36	02-M-01	CNG STATION AND DPW FAST-FILL AREA
		ELECTRICAL
37	02-E-01	OVERALL SITE PLAN
38	02-E-02	CNG STATION AND DPW FAST-FILL AREA
39	02-E-03	CNG STATION AND DPW FAST-FILL AREA GROUNDING
40	02-E-04	CNG STATION AND DPW FAST-FILL AREA HAZARDOUS LOCATIONS
41	02-E-05	ONE-LINE DIAGRAM
		10 – LINCOLN GARAGE MODIFICATIONS
		TO BE ISSUED WITH BID ADDENDUM NO.1 – JUNE 8, 2011
		ARCHITECTURAL AND STRUCTURAL
42	10-AS-01	OVERALL BUILDING PLAN
43	10-AS-02	REMOVAL PLAN
44	10-AS-03	FLOOR PLAN
45	10-AS-04	ROOF PLAN
46	10-AS-05	BUILDING SECTIONS
47	10-AS-06	SCHEDULES AND DETAILS
48	10-AS-07	ELEVATIONS AND DETAILS
		PLUMBING
49	10-P-01	
50	10-P-02	
51	10-P-03	
		HVAC
52	10-H-01	
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54	10-H-03	
55	10-H-04	
56	10-H-05	
		ELECTRICAL
57	10-E-01	POWER & SYSTEMS
58	10-E-02	LIGHTING AND RECEPTACLES
59	02-E-03	ONE-LINE DIAGRAM & SCHEDULES

99 – STANDARD DETAILS – LINCOLN AVE & NORTHWEST GARAGE SITE

		STRUCTURAL
60	99-S-01	DETAILS
61	99-S-02	DETAILS
		STRUCTURAL AND MECHANICAL
62	99-SM-01	STANDARD DETAILS
63	99-SM-02	STANDARD DETAILS
		PROCESS
64	99-M-01	STANDARD DETAILS
65	99-M-02	SAFETY SIGN DETAILS
		ELECTRICAL
66	99-E-01	DETAILS
67	99-E-02	DETAILS

DIVISION 1

GENERAL

SECTION 01010
SUMMARY OF WORK

1. SCOPE:

   A. Index:

      1. Scope
      2. Project Description
      3. Work by Others
      4. Scheduling of Work

2. PROJECT DESCRIPTION:

   A. Work of Project includes infrastructure improvements to provide Compressed Natural Gas (CNG) Fueling Systems at both Lincoln Garage and Northwest Garage sites in City of Milwaukee, Wisconsin. Contractor shall install Owner furnished equipment and complete Work of Project by December 16, 2011, in accordance with calendar schedule of grant funding agreement between City of Milwaukee and State of Wisconsin Office of Energy Independence. WE Energies will provide necessary electrical and gas service for Work of Project at both sites per Contract Agreement with City of Milwaukee.

   B. Project Work is at two (2) City of Milwaukee Department of Public Works (DPW) facility sites:

      1. Site 01 = Lincoln Garage Site
         3921 W. Lincoln Ave
         Milwaukee, WI 53215

      2. Site 02 = Northwest Garage Site
         3025 W. Ruby Ave.
         Milwaukee, WI 53209

   C, Plan Drawings beginning with the number "01" are for Work at the Lincoln Garage Site. Plan Drawings beginning with the number "02" are for Work at the Northwest Garage Site. Plan Drawings beginning with the number "00" are general index and legend sheets applicable to Work. Plan Drawings beginning with the number "99" are standard details applicable to either site. Specifications in the project manual are applicable to both sites.

   D. For Site 01-Lincoln Garage Site, Work entitled CNG Fueling Systems is generally described as follows:

      1. Install new natural gas dryer system, new CNG compression and control package, and new CNG storage and new priority valve panel for CNG distribution at fenced CNG compressor "station" located north of existing Waste Transfer Station near existing DPW diesel fueling island.

      2. Install new "fast-fill" CNG fuel dispensers and CNG fuel management system for DPW vehicles at existing DPW fueling island.

      3. Install new "time-fill" CNG fuel dispensing and CNG fuel management system for DPW vehicles along south fence of site.

      4. Provide new driveway entrance off of Lincoln Avenue and new CNG fueling island

with canopy to serve as a "public access CNG refueling station".

5. Install new CNG fuel storage and dispensing system and CNG fuel management system at new "public access CNG refueling station".

6. Provide modifications to Lincoln Garage for CNG vehicle maintenance as described in Contract Documents to be issues as Bid Addendum No. 1 to Compressed Natural Gas Fueling Systems. Bid Addendum No. 1 to be issued at mandatory Pre-Bid Meeting on June 8, 2011.

E. For Site 02-Northwest Garage Site, Work entitled CNG Fueling Systems is generally described as follows:

1. Install new natural gas dryer system, new CNG compression and control package, new CNG storage and new priority valve panel for CNG distribution at rear (west end) of Northwest Garage site.

2. Provide new "fast-fill" CNG fueling island with canopy at rear (west end) of Northwest Garage site

3. Install new "fast-fill" CNG fuel dispensing and CNG fuel management system at new CNG fueling island (with public access to Northwest Garage CNG refueling station to be defined by DPW).

4. Replace existing asphalt and concrete pavement at Northwest Garage site as defined in Contract Documents.

F. Lincoln Garage and Northwest Garage serve as fleet locations for the City of Milwaukee. As such, normal City operations will continue during the construction projects. The City will cooperate with contractor to minimize construction disruption.

G. <u>Examine Documents and Visit Site</u>:

1. Before submitting a bid proposal, bidders should carefully examine the drawings and specifications; visit the site of work; fully inform themselves as to all existing conditions and limitations, including those of labor; and shall include in the bid proposal a sum sufficient to cover the cost of all items contemplated by the construction documents.

2. Each sub-bidder further represents that he has inspected the site of the proposed work to ascertain any obstacles that might be encountered and other matters and conditions relevant to this work. This includes location of concealed service, utilities, structures, etc., which may be encountered or be affected by the contractor's work, and shall be responsible for any damage caused by neglect to provide proper precautions or protection.

3. The nature of the work demands thorough review of all drawings and the project manual, and diligent and careful site inspection by all prospective sub-bidders as a means of determining the extent of work and conditions under which the work is to be performed.

4. Additional charges will not be as considered for work which, prior to bidding, could reasonably be inferred as appropriate by examination of the drawings and specifications, visiting the site, and closely reviewing the work as indicated above.

No representations as to subsurface conditions are made.

5. Information pertaining to existing conditions that appear on the drawings is based on original construction. While such data has been collected with reasonable care, there is no expressed or implied guarantee that conditions so indicated are entirely representative of those actually existing or that unseen developments may not occur. They are merely provided to assist the Contractor in the investigation of conditions.

6. Damage to the structure not documented prior to the renovation work will be the Contractor's responsibility to repair.

3. WORK BY OTHERS:

A. ANGI Energy Systems, Inc. (ANGI)
15 Plumb Street
Milton, WI 53563
(800) 955-4626
Dan Hicks
DHicks@angienergy.com
www.angiinternational.com

1. Furnish CNG equipment at both sites for installation by Contractor:

a. Natural Gas Dryer
b. CNG compression packages
c. CNG storage vessels
d. CNG fuel dispensers
e. Power distribution panel
f. CNG station control and SCAD

B. AssetWorks
998 Old Eagle School Road
Wayne, PA, 19087
Joseph A Basile
VP Fueling Technologies
Joseph.Basile@assetworks.com
610-228-0120

Jill Coffin
Jill.Coffin@assetworks.com
(610) 228-0126

1. Furnish CNG fuel management system equipment at both sites for installation by Contractor

C. Utility Services Contract with Owner:

1. WE Energies will extend gas service and provide gas regulation and meter at both site locations shown on Drawings.
2. WE Energies will furnish and install electrical power transformer and metering to point of termination at both site locations as shown on Drawings.

4. SCHEDULING OF WORK:

A. The contractor shall provide a construction schedule which includes all phases of construction, indicating the anticipated start and completion times for each of those phases. The contractor shall provide that complete schedule at the Pre-Construction Meeting arranged by the City.

B. Work shall be conducted during normal business hours of 6am – 6pm.

C. Offhours work pertains to times from 8pm – 4am during weekdays and 4am – 9pm on weekends. Offhours work must conducted with at least three (3) days prior written consent from the Engineer.

D. The contractor shall sign in and identify all personnel working at the site on a daily basis with the supervisor in charge at the site. All personnel leaving the site will sign out at departure.

E. Shut downs of existing equipment and connections to existing equipment must be arranged in advance with the Project Inspector from Facilities Development and Management Section. Power outages, if any, must be scheduled on Saturdays.

F. Dispose of all materials in a legal manner.

G. The City of Milwaukee reserves the right of not allowing the contractor to work when special events are scheduled for the building or noise being created by the contractor is disturbing to personnel in the building. These changes in work schedule shall be conducted at no additional cost to the City of Milwaukee.

5. MILESTONES (WORK SEQUENCE)

A. Construct Work in stages to accommodate operation of existing facilities during construction period; coordinate Construction Progress Schedule and operations with Owner.

1. Provide equipment pads at both sites for WE Energies natural gas Meter Set Assembly no later than 8/15/2011.
2. WE Energies natural gas service shall be available at both sites no later than 9/10/2011.
3. WE Energies electrical service shall be available at both sites no later than 9/28/2011.
4. Substantial Completion at both sites by Friday November 18, 2011.
5. Final Completion at both sites by Friday December 16, 2011.

6. OWNER FURNISHED MATERIALS OR EQUIPMENT

A. Owner will place orders with certain supplier(s) for equipment or material for purpose of expediting delivery, and other purposes in Owner's interest to be purchased by Owner.

1. Section 40 01 00- Compressed Natural Gas Fueling System Equipment–Lincoln Garage.
2. Section 40 02 00- Compressed Natural Gas Fueling System Equipment–Northwest Garage.

B. Owner's Responsibilities:

1. Arrange for and deliver Shop Drawings, product data, and samples to Contractor.
2. Arrange and pay for delivery to site in accordance with construction progress schedule.
3. Deliver supplier's bill of materials to Contractor.
4. Inspect deliveries jointly with Contractor.
5. Submit claims for transportation damage.
6. Arrange for replacement of damaged, defective or missing items.
7. Arrange for manufacturer's warranties, bonds, service, and inspections as required.

C. Contractor's Responsibilities:

1. Designate delivery date for equipment or material in construction progress schedule.
2. Review shop drawings, product data, and samples.

   a. Submit to Owner with identifications of discrepancies or problems anticipated in use of equipment or material.

3. Handle materials or equipment at site, including receiving and unloading, uncrating and storage in accordance with manufacturer's recommendations.
4. Inspect materials or equipment jointly with Owner, record shortages and damaged or defective items.
5. Store and protect materials or equipment from exposure to elements, and from damage.
6. Assemble, install, connect, adjust, finish, and as required in Specifications.
7. Repair or replace items damaged by Contractor.

7. STORAGE OF MATERIALS:

A. The Contractor shall be assigned a portion of site for staging and materials storage. The exact dimensions and location of staging are to be determined by Owner.

B. The Contractor shall assume full responsibility for the protection and safekeeping of products stored on the premises. Construction equipment, tools, etc., shall not be stored in areas of the Owner's continued use.

C. Materials shall be stored so as to assure the preservation of their quality and fitness for the work. When considered necessary, they shall be placed on wooden platforms or other hard, clean surfaces, and not on the ground, and they shall be placed under cover. Materials stored at the site shall not damage the structure in any way. Oil, grease or gasoline spills shall be cleaned up immediately.

D. Stored materials shall be located in a neat and orderly manner so as to facilitate prompt inspection.

8. PROTECTION AND REPAIRS:

A. The Contractor shall continuously maintain adequate protection of all his work and materials, whether worked or unworked, on or off the site of the project, and shall protect the work and materials of all other Contractors and the City of Milwaukee's property from damage arising in connection with their contracts.

B. Whenever damage or destruction of property of any character resulting from neglect, misconduct or omission due to the manner or method of execution or non-execution of the work or caused by defective work or the use of improper materials, the Contractor shall be held responsible and not released until the work shall have been corrected, completed and the requirements and intent of these documents complied with.

C. All damages of each and every kind resulting from neglect or refusal of the Contractor to protect such work materials, and property during erection, construction and completion of the project shall be made good by the Contractor.

D. No damaged or imperfect materials, equipment accessories, etc., will be accepted. All materials, equipment, accessories, etc., furnished or installed by this Contractor must function perfectly and as designed. If any argument should arise in regard to this requirement, the City will replace the parts and deduct the costs from the contract price.

E. The Contractor shall repair all damages that the Contractor, employees or subcontractors may do to any other work or the parking structure. Repairs must be done in a neat and workmanlike manner to match existing construction and must meet with the approval of the Commissioner of Public Works or his representative.

F. If any faults are found with the Contractor's work, the Contractor shall repair or replace any of the parts furnished or installed as directed without any additional costs to the City of Milwaukee.

9. CONTRACTOR'S USE OF PREMISES

A. Owner will occupy site and existing buildings during entire period of construction for conduct of normal operations. Cooperate with Owner and work by others during construction operations to minimize conflict and facilitate Owner's operations.

B. Contractor shall, at all times, conduct operations to ensure least inconvenience to Owner other contractors, general public, and operation of steel manufacturing facilities.

C. Coordinate use of premises under direction of Contractor and as specified in Section 01500.

D. Assume full responsibility for protection and safekeeping of materials and equipment under this Contract.

E. Obtain and pay for use of additional storage or Work areas needed for operations at no additional cost to Contractor.

SECTION 01210
PROJECT MEETINGS

1. SCOPE:

   A. Index:

      1. Scope
      2. Pre-Construction Meeting
      3. Progress Meetings

2. PRE-CONSTRUCTION MEETING:

   A. Soon after the award of the contract and prior to the start of construction, the contractor shall attend a pre-construction conference with representatives of the City.

   B. The contractor shall have at the meeting responsible representatives from subcontractors who are to perform major work on the project.

   C. The purpose of the meeting is to discuss in detail the plans and specifications. The discussion shall include:

      1. Schedule
      2. Equipment
      3. Material Storage
      4. Traffic Control
      5. Inspection Requirements
      6. Protection Procedures for the structure, adjacent facilities, environment, and personnel.
      7. Hours of Work

   D. The contractor shall submit the construction progress schedule to the Engineer at this meeting and a listing of subcontractors and their work. The contractor shall describe, in detail, when each portion of the work is expected to be accomplished. The subcontractors shall participate in the discussion. The architect/engineer will serve to interpret the contract documents should such questions arise.

   E. Any other questions that the contractor or his subcontractors have about the work or its scheduling shall be raised at this meeting.

   F. Requirements for contract administration and construction operations will be defined for participants.

   G. Time, date, and place of the meetings will be determined by the Engineer.

3. WEEKLY FOREMAN'S MEETINGS:

   A. Weekly foreman's meetings will be held for the purpose of coordinating and expediting the work.

   B. Attendance at weekly foreman's meetings, run by the contractor, is mandatory. These meetings shall also be attended by representatives of each subcontractor who is either working at the site or is affected by work being done at the site.

C. Contractors shall give a verbal report of progress on the project, discuss the work schedule for the coming period, and present all conflicts, discrepancies, or other difficulties for resolution.

4. MONTHLY PROGRESS MEETINGS:

A. Monthly progress meetings will be held for the purpose of coordinating and expediting the work, updating progress schedule and reviewing monthly contractor pay applications

B. Attendance at weekly foreman's meetings, run by the contractor, is mandatory. These meetings shall also be attended by representatives of each subcontractor who is either working at the site or is affected by work being done at the site.

C. Contractors shall submit Construction Progress Schedule update per Section 01326, discuss the work schedule for the coming period, and present all conflicts, discrepancies, or other difficulties for resolution.

SECTION 01290
SCHEDULE OF VALUES

PART 1 GENERAL

1.01 SUMMARY

A. Submit Schedule of Values of Work.

B. Upon request of ENGINEER, support values with data substantiating their correctness.

1.02 FORM AND CONTENT OF SCHEDULE OF VALUES

A. Type schedule on 8-1/2 in. x 11 in. white paper; CONTRACTOR'S standard forms and automated printout will be considered for approval by ENGINEER upon CONTRACTOR'S request. Identify schedule with the following:

1. Project title and location.
2. ENGINEER and ENGINEER'S Project number.
3. Name and address of CONTRACTOR.
4. Contract designation.
5. Date of submission.

B. Identify installed value of component parts of Work in sufficient detail to serve as basis for computing values for progress payments during construction.

C. Use general table of contents of this Project Manual to establish format for listing component items in schedule.

1. Identify each line item with number and title of respective Specification division and section.
2. If Project consists of multiple structures, break down schedule by structure.

D. Provide separate listing for General Requirements (Division 1) items, such as bonds, insurance premiums, mobilization, field supervision and layout, construction facilities and temporary controls, contingency allowance, construction schedule, O&M data, record drawings, and submittals.

E. For each Specification division, list subvalues of major materials, equipment or operations under division.

F. For various portions of work:

1. Each item shall include directly proportional amount of CONTRACTOR'S overhead and profit.
2. For items on which progress payments will be requested for stored materials, break down value into the following:

a. Cost of materials, delivered and unloaded, with taxes paid.
b. Total installed value including CONTRACTOR'S overhead and profit.

G. Sum of values listed in schedule shall equal total Contract sum.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

* * * END OF SECTION * * *

SECTION 01312
ENGINEER'S STATUS DURING CONSTRUCTION

PART 1 GENERAL

1.01 OWNER'S REPRESENTATIVE

A. Project has been designed by AECOM, Inc. who is hereinafter called ENGINEER, and who is to act as OWNER'S representative, assume duties and responsibilities, and have rights and authority assigned to ENGINEER in Contract Documents in connection with completion of Work in accordance with Contract Documents.

1.02 DEFINITIONS

A. ENGINEER.

1. As used in Specification Divisions 1 through 44 and on Drawings refers to AECOM Inc.
2. As used in other documents is defined in City of Milwaukee General Specifications.

1.03 VISITS TO SITE

A. ENGINEER will make visits to Site at intervals appropriate to various stages of construction as ENGINEER deems necessary in order to observe as experienced and qualified design professional progress that has been made and quality of various aspects of CONTRACTOR'S executed Work. Based on information obtained during such visits and observations, ENGINEER, for benefit of OWNER, will determine, in general, if Work is proceeding in accordance with Contract Documents. ENGINEER will not be required to make exhaustive or continuous inspections on Site to check quality or quantity of Work. ENGINEER'S efforts will be directed toward providing for OWNER greater degree of confidence that completed Work will conform generally to Contract Documents. On basis of such visits and observations, ENGINEER will keep OWNER informed on progress of Work and will endeavor to guard OWNER against defective Work.

B. ENGINEER will furnish Resident Project Representatives (RPR) and other field staff to assist OWNER in observing Work.

Through additional observations of CONTRACTOR'S Work in progress and field checks of materials and equipment by RPR and assistants, ENGINEER shall endeavor to provide further protection for OWNER against defects and deficiencies in Work. However, ENGINEER shall not, during such visits or result of such observations of CONTRACTOR'S Work in progress, supervise, direct, or have control over CONTRACTOR'S Work nor shall ENGINEER have authority over or responsibility for means, methods, techniques, sequences or procedures selected by CONTRACTOR, for safety precautions or programs incident to CONTRACTOR'S performing Work, or responsibility of construction for CONTRACTOR'S failure to perform Work in accordance with Contract Documents.

C. RPR'S duties and responsibilities limited to those of ENGINEER in agreement with OWNER and in Contract Documents, and further limited and described as follows:

1. Duties and Responsibilities of RPR Representative:

a. Conduct preconstruction conference with OWNER, CONTRACTOR(S), utilities, and other appropriate parties affected by Project.
b. Attend meetings with CONTRACTOR, such as progress meetings, job conferences and other Project-related meetings.

c. Report to OWNER when clarifications and interpretations of Contract Documents are needed and transmit to CONTRACTOR clarifications and interpretations as issue by ENGINEER.
d. Review Applications for Payment with CONTRACTOR for compliance with established procedure for their submission and forward with recommendation to ENGINEER.
e. Provide direction for assistants and coordinate observation activities.
f. Assist OWNER with modifications amending, modifying or supplementing Contract Documents as Project proceeds.
g. Report to OWNER whenever RPR believes that any part of CONTRACTOR'S Work in progress will not produce completed Project that conforms generally to Contract Documents or will prejudice integrity of design concept of completed Project as functioning whole as indicated in Contract Documents, or has been damaged, or does not meet requirements of any inspection, test or approval required to be made; and advise OWNER of that part of Work in progress that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.
h. Review testing of equipment and systems provided by CONTRACTOR and assess its compliance with Contract Documents.
i. Determine final quantities for Work installed which will serve as basis for final payment to CONTRACTOR.
j. Coordinate efforts required to prepare record drawings showing those changes during construction process, based on marked-up prints, drawings, and other data furnished by CONTRACTOR to ENGINEER and which ENGINEER considers significant.
k. Participate in inspections for substantial and final completion of Project and prepare list of items to be corrected or completed.

1.04 SHOP DRAWINGS AND SAMPLES

A. ENGINEER'S Review:

1. ENGINEER will provide timely review of Shop Drawings and Samples in accordance with schedule of submittals acceptable to ENGINEER. ENGINEER'S review and approval will be only to determine if items covered by submittals will, after installation or incorporation in Work, conform to information given in Contract Documents and be compatible with design concept of completed Project as functioning whole as indicated by Contract Documents.
2. ENGINEER'S review and approval will not extend to means, methods, techniques, sequences or procedures of construction (except where specific means, method, technique, sequence or procedure of construction is specifically and expressly called for by Contract Documents) or to safety precautions or programs incident thereto. Review and approval of separate item as such will not indicate approval of assembly in which item functions.
3. ENGINEER'S review and approval shall not relieve CONTRACTOR from responsibility for any variation from requirements of Contract Documents unless CONTRACTOR has in writing called ENGINEER'S attention to each such variation at time of submittal and ENGINEER has given written approval of each such variation by specific written notation thereof incorporated in or accompanying Shop Drawing or Sample. ENGINEER'S approval will not relieve CONTRACTOR from responsibility for complying with CONTRACTOR'S submittal procedures established in Contract Documents.

B. Resubmittal Procedures:

1. CONTRACTOR shall make corrections required by ENGINEER, and return required number of corrected copies of Shop Drawings and submit as required new Samples for review and approval. CONTRACTOR shall direct specific attention in writing to revisions other than corrections called for by ENGINEER on previous submittals.

C. Where Shop Drawing or Sample is required by Contract Documents, related Work performed prior to ENGINEER'S review and approval of pertinent submittal will be at CONTRACTOR'S sole expense and responsibility.

1.05 LIMITATIONS ON ENGINEER'S AUTHORITY AND RESPONSIBILITIES

A. Neither ENGINEER'S authority or responsibility under this Specification Section or under any other provision of Contract Documents nor any decision made by ENGINEER in good faith to either exercise or not exercise such authority or responsibility or undertaking, exercise, or performance of any authority or responsibility by ENGINEER shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by ENGINEER to CONTRACTOR, any Subcontractor, any Supplier, or any other individual or entity, or to any surety for or employee or agent of any of them.

B. Whenever in Contract Documents terms "as allowed", "as approved" or terms of like effect or import are used, or adjectives "reasonable", "suitable", "acceptable", "proper" or "satisfactory" or adjectives of like effect or import are used to describe action or determination of ENGINEER as to Work, it is intended that such action or determination will be solely to evaluate, in general, completed Work for compliance with requirements of and information in Contract Documents and conformance with design concept of completed Project as functioning whole as shown or indicated in Contract Documents (unless there is specific statement indicating otherwise). Use of any such term or adjective shall not be effective to assign ENGINEER any duty or authority to supervise or direct performance of Work or any duty or authority to undertake responsibility contrary to provisions of Contract Documents.

C. ENGINEER will not supervise, direct, control or have authority over or be responsible for CONTRACTOR'S means, methods, techniques, sequences or procedures of construction, or safety precautions and programs incidental thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to performance of Work. ENGINEER will not responsible for CONTRACTOR'S failure to perform Work in accordance with Contract Documents.

D. ENGINEER will not be responsible for acts or omissions of CONTRACTOR or of any Subcontractor, any Supplier, or of any other individual or entity performing any Work.

E. Limitations upon authority and responsibility set forth shall also apply to ENGINEER'S Consultants, Resident Project Representative, and assistants.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

* * * END OF SECTION * * *

SECTION 01300
SUBMITTALS/PERMITS

1. SCOPE:

   A. Index:

      1. Scope
      2. Submittals
      3. Permits
      4. Inspection

2. SUBMITTALS:

   A. Comply with the requirements of the General Conditions and as follows:

      1. Forward Submittals not more than 20 calendar days after the Notice to Proceed date. No work, as indicated on any shop drawing, samples, hardware list, etc., shall be started until those submittals have been reviewed and work authorized.

      2. All submittals must be thoroughly reviewed by the prime contractor for conformance to contract documents, prior to submission to the City, or its agents, for review. Shop drawings and catalog information shall be stamped "Reviewed By" and signed by the contractor's reviewer. The prime contractor shall review all subcontractor submittals prior to submittal to the City for compliance with contract documents and to coordinate all work.

      3. Include with each submittal a transmittal letter signed and dated by the prime contractor containing the following:

         a. Name of Contractor
         b. Name of Project
         c. List of Submittals
         d. Name of Manufacturer or Supplier
         e. Additional information as required for the items being provided.

      4. Send submittal/transmittals to:

         Tom Tarkowski, P.E.
         Thomas.Tarkowski@milwaukee.gov
         City of Milwaukee
         DPW - Facilities Development and Management Section
         Zeidler Municipal Building
         841 N. Broadway, Room 602
         Milwaukee, WI 53202
         p - 414-286-3295
         c - 414-581-0443

         Bryan Lewis, P.E.
         Bryan.Lewis@aecom.com
         AECOM
         4135 Technology Parkway
         Sheboygan, WI 53083
         P – 920-451-2764

B. Form of Shop Drawings, Catalog Information, Calculations, and Samples:

1. Shop Drawings: Submit three (3) sets of prints and PDF file to Bryan Lewis of AECOM with PDF file copy to Tom Tarkowski, City of Milwaukee. The City will notify the contractor in writing and return one copy marked "REVIEWED - NO EXCEPTIONS TAKEN" with minor or no notations. The City will also notify the contractor in writing and return one copy, along with comments, when the drawings are marked either "REJECTED" or "REVISE AND RESUBMIT". For those shop drawings, the contractor will be responsible for resubmitting a new print.

2. Catalog Information and Calculations: Submit four copies of prints and PDF file to Bryan Lewis of AECOM with PDF file copy to Tom Tarkowski, City of Milwaukee for City's record and additional numbers of copies required for the contractor's purpose. The City will notify the contractor in writing and return the contractor's copies, with or without notation, marked either "REVIEWED - NO EXCEPTIONS TAKEN", "REVISE AND RESUBMIT", OR "REJECTED". Catalog information or calculations marked "REVISE AND RESUBMIT" or "REJECTED" must be resubmitted in the same quantities as originally required.

3. Samples: Submit two samples of requested materials for the City's records and additional samples, if desired, to be returned to the contractor. The City will notify the contractor in writing, whether the samples are approved or rejected. If they are rejected, new samples must be resubmitted as originally required.

4. Corrections or comments made on the submittals during the review do not relieve the contractor from compliance with requirements of the contract documents. The check is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. Contractors are responsible for conforming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating their work with that of all other trades; and performing their work in a safe manner.

C. "Or Equal": Whenever the words "or equal" or similar term is used, it shall mean as determined by the Commissioner of Public Works or agent. All drawings, data and bulletins necessary to make an "or equal" determination shall be submitted to the Facilities Manager of Buildings & Fleet Services. Such review shall apply to design only and shall in no way relieve the contractor from the responsibilities as outlined in Item 2B above. Evaluation of "or equal" products will be made at the time of shop drawing submission. Any change required in design and coordination between all contractors, subcontractors, or trades due to the use of "or equal" materials shall become the contractor's responsibility. Any costs for detailed engineering reviews and/or any costs to incorporate "or equal" products will be borne by the contractor.

3. PERMITS:

A. The City of Milwaukee will provide the general building and occupancy permits.

B. Contractors shall obtain, from the City of Milwaukee Department of City Development and/or other government or private agencies, all special permits as may be necessary in their work.

C. Contractors shall obtain all permits to occupy or work in the public way as may be necessary for their work.

D. Contractors shall notify the City and/or appropriate utilities when making utility connections as part of the project.

4. INSPECTION:

A. Facilities Development and Management Section will provide daily inspection to verify compliance with contract documents, identify contractors and crews on the job, verify compliance with contract conditions (EBE, residency, wage requirements), and record job progress and conditions.

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B. Contractors shall arrange with the Department of Neighborhood Services/Construction Trades Division and permit issuing agencies for all code compliance inspections as required by all permits including, but not limited to, the general building and all special permits issued by that agency.

C. Contractors shall arrange with the appropriate City agency for compliance inspections, as required, for all permits including, but not limited to, curb and pavement cuts and patches, and public way occupancy and utility connections.

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SECTION 01323
CONSTRUCTION PHOTOGRAPHS

PART 1 GENERAL

1.01 SUMMARY

A. Take construction photographs during course of Work.

1.02 SUBMITTALS

A. Deliver digital image CD to ENGINEER with each Application for Payment. Prints are not required.

B. Digital Images:

1. Submit complete set of digital image electronic files on CD. Digital image shall include picture number, date and time picture was taken.
2. Place CD(s) in single or multiple disk jewel case.
3. Identify CD with Project name, ENGINEER'S Project number, time frame covered by file.
4. Include on CD, in Word format, an index by picture number and description of vantage point, indicating location, direction (by compass point), and description of object photographed.

PART 2 PRODUCTS

A. Digital Images: JPEG format, with minimum sensor size of 2.0 mega pixels.

PART 3 EXECUTION

3.01 PHOTOGRAPHIC REQUIREMENTS

A. Take photographs at each major stage of construction.

1. Before commencement of construction.
2. At completion of site clearing.
3. At completion of excavations
4. At 50 ft intervals for driveway, pavement, and trenches.
5. At completion of foundations.
6. At completion of equipment setting.
7. At completion of building modifications.
8. At 1-month intervals during construction of facilities. Photographs of any month need show only new Work for that month.

3.02 VIEWS REQUIRED

A. Photograph from locations to adequately illustrate condition of construction and state of Project.

1. At each specified time, photograph project from 3 different views, as approved by OWNER.
2. At successive periods of photography, take at least 1 photograph from same overall view as previously.
3. Consult with OWNER at each period of photography for instructions concerning views required.

* * * END OF SECTION * * *

SECTION 01326
CONSTRUCTION PROGRESS SCHEDULES

PART 1 GENERAL

1.01 SUMMARY

A. Prepare and submit to OWNER for review, preliminary Progress Schedule in accordance with General Conditions.

1.02 FORM OF SCHEDULE

A. Prepare schedule in form of horizontal-bar-chart type.

1. Provide separate horizontal time bar for each trade, activity or operation.
2. Provide continuous vertical line to identify first working day of each week.
3. Scale and space to allow for notations and future revisions.
4. Schedule each activity in construction sequence.

B. Format of Listings: Chronological order of start of each activity or operation.

1.03 CONTENT OF SCHEDULE

A. Construction Progress Schedule:

1. Show complete sequence of construction by activity or operation.
2. Coordinate Construction Progress Schedule with Submittals.
3. Show dates for beginning and completion of each activity or operation during construction and installation dates for major items of equipment. Activities and operations shall include, but not be limited to following.

a. Material and equipment order, manufacturer, delivery, installation, and checkout, including allowance items.
b. Performance tests and supervisory services activity.
c. Piping, duct work, and wiring installation.
d. Construction of various facilities.
e. Concrete pour sequence.
f. Structural steel erection.
g. Backfilling, grading, seeding, sodding, landscaping, fence construction, and paving.
h. Electrical work activity.
i. Heating, ventilating, and air conditioning work activity.
j. Plumbing work activity
k. Sewer installation.
l. Equipment installation.
m. Subcontractor's items of Work.
n. Alterations work.
o. Concrete driveway and pavement
p. System demonstration
q. Final cleanup.
r. O&M data submittal.

4. Show projected percentage of completion for each item as of first day of each month.

1.04 SCHEDULE REVISIONS

A. Every 30 days, revise Construction Progress Schedule to reflect changes in progress of Work.

1.06 SUBMITTAL REQUIREMENTS

A. For initial submittal of Construction Progress Schedule and subsequent revisions thereof, submit PDF file copies of schedule to OWNER. Failure to submit schedule on timely basis as previously noted shall be considered cause for withholding progress payments otherwise due under this Contract.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

* * * END OF SECTION * * *

SECTION 01350
ALTERATION PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Alterations to existing buildings or structures.
2. Cutting and patching.

B. Cut, move or remove items as necessary to provide access to allow alterations and new Work to proceed in existing structures, buildings, or facilities.

C. Work Includes:

1. Alterations:

a. Cutting, moving or removal of items as shown on Drawings.
b. Cutting, moving or removal of items not shown to be cut, moved or removed, but which must be cut, moved or removed to allow new Work to proceed. Patch or reinstall Work or items which are to remain in finished Work after cutting, moving or removal, and make joints and finishes match adjacent or similar Work.
c. Removal of existing surface finishes as needed to install new Work and finishes.
d. Removal of abandoned items and removal of items serving no useful purpose, such as piping and electrical conduit.
e. Repair or removal of dangerous or unsanitary conditions.
f. Removal of unsuitable or extraneous materials not marked for salvage, such as abandoned furnishings, debris, grease buildup, rotted wood, rusted trench covers, and deteriorated concrete and masonry.

2. Cutting and Patching:

a. Uncovering Work for installation of ill-timed Work.
b. Removal and replacement of defective Work and Work not conforming to Contract Documents.
c. Uncovering Work to provide observation by ENGINEER or inspection or tests by others of covered Work.
d. Removal of samples of installed materials for testing.
e. To make several parts fit properly.

3. Temporary enclosures and services.

1.02 ALTERATIONS, CUTTING, AND PROTECTION

A. CONTRACTOR shall survey and record condition of existing facilities to remain in-place that may be affected by alteration operations. After alteration work is complete, survey conditions again and restore existing facilities to pre-alteration condition.

B. Perform Work of moving, removal, cutting, and patching with trades qualified to perform Work in manner causing least damage to each type of Work.

1. Cut finish surfaces such as masonry, tile, plaster or metals, by methods to terminate surfaces in straight line at natural point of division.

C. Protect existing finishes, equipment, and adjacent Work which is to remain, from damage.

1. Protect existing and new Work from weather and extremes of temperature.

a. Maintain existing interior work area above 60°F.
b. Provide weather protection, waterproofing, heat, and humidity control as needed to prevent damage to remaining existing and new Work.

D. Provide shoring, needling, and bracing to keep building(s) or structures structurally secure and free of damaging deflection for installation of new structural members.

E. Do not pile material to endanger building or structure.

1.03 SECURITY

A. When keys to locked areas are needed to provide access to areas to perform Work, obtain from OWNER. Return keys at end of each day's Work.

B. Refer to Section 01500

1.04 PROTECTION AND CONTINUITY OF UTILITIES AND OPERATIONS

A. Protect existing utilities so they will continue to function during and after construction.

B. Where interference with such facilities occurs, cooperate with OWNER of facility and, if necessary, alter facility to eliminate interference.

C. Service Continuity:

1. Provide and maintain continuous electrical, plumbing, and HVAC services to functioning portions of process, building, facilities, or areas during hours normally in use.
2. Temporary outages are permitted during cutover Work at such times and places as can be pre-arranged with Owner. Keep such outages to minimum number and length of time. Make no outages without prior approval.
3. Include costs for temporary equipment, materials, and Work required in Contract Price.
4. Remove temporary equipment and materials when no longer required or at completion of Work.

D. Plant Operation:

1. Maintain continuity of plant operation to functioning portions of existing plant.
2. Temporary shutoff is permitted during cutover Work at such times and places as can be pre-arranged with Owner.Keep such shutoffs to minimum number and length of time and, once Work has started on temporary shutoff, continue until Work is complete. Make no shutoffs without prior approval.
3. Include costs for temporary piping and Work required in Contract Price.
4. Remove temporary piping when no longer required or at completion of Work.

1.05 TEMPORARY ELECTRICAL AND MECHANICAL SERVICES

A. Comply with Section 01500.

B. Electrical:

1. Maintain existing electric service to existing equipment until removed from service.

2. Provide temporary electrical connections to new equipment if permanent wiring is not complete and equipment is required to be placed into service to continue operation of facility.
3. Provide temporary electrical connections to temporary equipment or existing equipment that has been relocated, but is required to continue operation of facility.

PART 2 PRODUCTS

2.01 SALVAGED MATERIALS

A. Items marked or listed by ENGINEER for salvage shall remain property of OWNER and be carefully removed and stored.

B. Salvaged items remaining after completion of Work shall be delivered to place of storage designated by OWNER or disposed of by CONTRACTOR.

2.02 PRODUCTS FOR PATCHING, EXTENDING, AND MATCHING

A. Provide same products, salvaged materials, types of construction or finish as that in existing structure, as needed to patch, extend or match existing Work.

1. Generally, Contract Documents will not define products or standards of workmanship present in existing construction, determine products by inspection and necessary testing and workmanship by use of existing as sample of comparison.

PART 3 EXECUTION

3.01 PREPARATION

A. Where new work conceals existing surfaces or spaces CONTRACTOR shall remove foreign substances such as accumulated dirt, dust, grease, sludge, and odoriferous material before concealing existing surfaces.

B. Where surfaces are to remain exposed CONTRACTOR shall remove foreign substances described above.

3.02 TEMPORARY ENCLOSURES

A. Exterior: Provide temporary weathertight enclosure for successive areas of building as Work progresses, to provide:

1. Acceptable working conditions.
2. Weather protection for materials.
3. Effective temporary heating.
4. Prevention of entry by unauthorized persons.

B. Interior: Provide temporary enclosures to separate Work areas from areas of existing building occupied by OWNER to prevent penetration of dust or moisture into occupied areas, to prevent damage to existing equipment, and to protect OWNER'S employees and operations from Work.

1. Temporary Partition and Ceiling Enclosures: Use framing and sheet materials complying with structural and fire rating requirements of applicable codes and standards.

a. Close joints between sheet materials, and seal edges and intersections with existing surfaces to prevent penetration of dust or moisture.

b. Provide mats at doors to reduce tracking of dust.
c. In locations where fire protection is required, paint both sides of partitions and ceilings with fire retardant paint to provide maximum flame spread of 25 when tested under ASTM E84 or as required by local fire regulations.

C. Relocate as required by progress of construction, by storage or Work requirements, and to accommodate requirements of OWNER and other contractors employed at site.

D. Remove temporary materials, equipment, and services:

1. When construction needs can be met by use of permanent construction.
2. At completion of Project.

3.03 REMOVAL, RELOCATION AND SECURING MATERIALS AND EQUIPMENT

A. Where existing materials and equipment are removed or relocated, remove materials no longer used such as studs, straps, conduits, ducts, wires, anchors, piping and supports. Remove or cut off concealed or embedded materials such as conduit, boxes, anchors, piping or other materials to not less than 3/4 in. below finished surface.

B. Materials that cannot be removed shall be secured to adjacent structure to prevent coming loose.

C. Repair affected surfaces to conform to type, quality, and finish of adjacent surfaces.

3.04 CUTTING AND PATCHING

A. Inspect existing conditions of Work, including components subject to damage or movement during cutting, patching, excavating or backfilling.

B. After uncovering Work, inspect conditions affecting installation of new materials.

C. Do not cut or notch structural members without specific written approval of **[ENGINEER]**.

3.05 RESTORATION

A. Where existing partitions are removed, patch floors, walls, and ceilings with finish materials matching existing to provide smooth planes without breaks, steps or bulkheads.

1. Where change of plane is 2 in. or more, request instructions from ENGINEER as to method of making transition.
2. Trim and refinish existing doors as necessary to clear new floors or flooring material.

B. Patch and replace portions of existing finished surface damaged by CONTRACTOR'S operations.

1. Provide adequate support of substrate prior to patching finish.
2. Refinish patched portions of painted or coated surfaces to produce uniform color and texture over entire surface.
3. When existing surface finish cannot be matched, refinish entire surface to nearest intersections.

C. When new Work abuts or finishes flush with existing Work, transition shall match existing adjacent Work in texture and appearance so patch or transition is not visible at distance of 6 ft.

1. When finished surfaces are cut so smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division, and provide trim appropriate to finished surface.

D. Clean and repair damage caused by installation or by use of temporary facilities.

1. Remove foundations and underground installations used for construction aids.
2. Grade areas of site affected by temporary installations to required elevations and slopes.

E. Restore existing facilities used for temporary purposes to specified, or to original, condition.

3.06 CLEANING

A. Perform periodic and final cleaning as specified in Section 01700, and:

1. Clean OWNER-occupied areas daily.
2. Clean spillage, overspray, and heavy collection of dust in OWNER-occupied areas immediately.

B. At completion of alterations work in each area, provide final cleaning and return space to condition suitable for use by OWNER.

C. Remove debris from site each day. Removed material, except that listed or marked by ENGINEER for retention, becomes property of CONTRACTOR.

* * * END OF SECTION * * *

SECTION 01430
TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 PERFORMANCE REQUIREMENTS

A. Employ and pay for services of testing laboratory approved by OWNER to perform specified services and testing as described in Specifications.

1. Employment of laboratory shall, in no way, relieve CONTRACTOR'S obligations to perform Work of Contract.

B. Related Requirements in Other Parts of Contract Documents:

1. Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals of public authorities, Conditions of Contract.

1.02 QUALIFICATION OF LABORATORY

A. Meet basic requirements of ASTM E329.

B. Authorized to operate in state in which Project is located.

C. Testing Equipment:

1. Calibrated at reasonable intervals by devices of accuracy traceable to either:

a. National Bureau of Standards.
b. Accepted values of natural physical constants.

1.03 LABORATORY DUTIES

A. Cooperate with ENGINEER and CONTRACTOR; provide qualified personnel to perform Work after due Notice to Proceed.

B. Perform specified inspections, secure samples, and test materials.

1. Comply with specified standards.
2. Ascertain compliance of materials with Contract Documents.

C. Promptly notify ENGINEER of observed irregularities or deficiencies of Work, equipment or material.

D. Promptly submit written report of each test and inspection; one copy each to ENGINEER, OWNER, material supplier, and CONTRACTOR, and one copy to record document file. Each report shall include following.

1. Date issued.
2. Project title and number.
3. Testing laboratory name, address, and telephone number.
4. Name and signature of laboratory inspector.
5. Date and time of sampling or inspection.
6. Record of temperature and weather conditions if test performed in field.
7. Date of test.

8. Identification of product and Specification section.
9. Location of sample or test in Project.
10. Type of inspection or test.
11. Results of tests and compliance with Contract Documents.
12. Interpretation of test results, when requested by ENGINEER.

E. Perform additional tests as required by ENGINEER.

1.04 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

A. Laboratory is not authorized to:

1. Release, revoke, alter or enlarge on requirements of Contract Documents.
2. Approve or accept any portion of Work.
3. Perform duties of CONTRACTOR.

1.05 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with laboratory personnel and provide access to Work.

B. Provide to laboratory preliminary design mix proposed to be used for concrete and other material mixes which require control by testing laboratory.

C. Furnish copies of product test reports.

D. Furnish incidental labor and facilities.

1. Provide access to Work to be tested.
2. Obtain and handle samples at Project site or at source of product to be tested.
3. Facilitate inspections and tests.
4. Store and cure test samples.

E. Notify laboratory and ENGINEER sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests.

1. When tests or inspections cannot be performed after such notice, reimburse OWNER for laboratory personnel and travel expenses incurred due to CONTRACTOR'S negligence.

F. Pay for services of testing laboratory to perform additional inspections, sampling, and testing required when initial tests indicate Work does not comply with Contract Documents.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

* * * END OF SECTION * * *

SECTION 01500
JOB SITE UTILITIES, FACILITIES, AND SECURITY

1. SCOPE:

A. Index:

1. Scope
2. Building Security
3 Temporary or Trial Usage
4. Occupancy During Construction
5. Scaffolding
6. Electrical Power
7. Water
8. Toilet Facilities
9. Security and Weather Protection
10. Parking

2. BUILDING SECURITY:

A. General:

The Downtown Complex is open to the public from 8:00 AM until 4:45 PM, Monday through Friday, excluding holidays. Since most contracted work takes place outside normal business hours, it is essential that contractors and their City agents understand and abide by security policy.

Outlying buildings are not generally open to the public. Contracted work in these buildings can take place at any time. It is essential that contractors and their City agents understand and abide by security policy.

B. Scope:

At the beginning of any project, a copy of this policy and procedure statement will be added to the project manual for bid consideration and shall be distributed at the Pre-Construction Meeting. All City agents/officials responsible for engaging contractors, all contractors, and all subcontractors shall be held responsible for following the procedures.

C. City Agents/Officials:

1. Any City agents/officials who commission outside contractors to work in any of the facilities managed by Facilities Development and Management Section shall provide the following information no less than twenty-four (24) hours in advance of the work:

   a. The names of any contract or subcontract employees who will be present in the facilities (for the purpose of designing badges appropriate to their work area):

      Green – Zeidler Municipal Building, 841 North Broadway
      Red – City Hall, 200 East Wells Street
      Yellow – 809 North Broadway
      Gold – Any outlying buildings

These names must be listed on a sign-in sheet available in the Zeidler Municipal Building, Room 602 (Buildings & Fleet Services support staff – Extension 8222). City agents/officials shall be responsible to ensure the sheet and badges are transported to the appropriate location where the work is to be completed (in the Downtown Complex it would go to the City Hall Information Center, for outlying buildings to the person responsible for controlling access in the facility) the day before work is to begin.

b. A list of keys and/or access cards required for access only to the areas necessary for work involved in the project. The keys and card will be received from the Security Manager or his designee and signed out to the City agents/officials responsible for the contracted work. The City employee will take the keys and/or access cards to the City Hall Information Center or the person responsible for controlling access in the outlying building where they shall be logged under the name of the contractor's company. When a project is complete, the City agents/officials must retrieve the keys/cards and return them to Buildings & Fleet Services support staff in Room 602 of the Zeidler Municipal Building.

c. The City agents/officials are responsible for communicating the security policy and procedures to contractors. The City agents/officials shall act as liaison for all communication between Buildings & Fleet Services and the contractor.

D. Contractors:

1. Contractors shall abide by City security policy and procedures at all times during the scope of their participation in a project. Failure to comply will result in the contracted employee being escorted from the premises and the resulting lost time and expense shall be deducted from the contractor's invoice or penalties of $50.00 per occurrence as determined by the contracting City agent/official.

a. All access should be provided in advance through the City agent/official. Contractors shall enter and exit only through those doors designated by City agents/officials (the Market Street entrance to City Hall and the doors established by the person responsible for access at outlying buildings). All other exterior doors are locked and alarmed and are not to be used as delivery points unless the City agent/official has been provided 24 hour notification to provide additional security coverage at that point while the delivery is in progress.

b. All of the contractor's employees and all of the employees of any of his subcontractors shall wear at all times while on the site, in a clearly visible location, an identification card. The identification card is to have a minimum 1" x 1" color photo of the head and shoulders. The photo is to have been taken no more than one year previously. The card is to be laminated with clear plastic and is to contain the company name, employee's name, and the employee's signature, and is to be furnished by the contractor or respective subcontractor.

c. **Effective October 1, 2004 - City of Milwaukee Policy Change**

The following policy has been established to maintain control of City Property and to ensure the physical protection of the City Hall Complex.

Anyone signing out access cards and/or keys from the Information Center will be following the steps below.

1) Sign in on the sheet assigned to the project you are working on and pull that sheet and provide it to the Operator noting that you will need to sign out City property to access the building.

2) Provide the Operator your driver's license as collateral for the return of City property.

3) Sign out the property in the sign out book as per current policy.

4) The Operator will file your driver's license until such time as you sign in and return the City property at which time your license will be returned.

5) Sign out at the end of your workday on the sign out sheet.

Under NO circumstances will keys or cards be disbursed without the user signing for the property and providing the City Hall Operator their driver's license as collateral.

In the event that keys or cards are not returned daily the contractor in question will have a deduct (security violation) as per the contract. Individuals who loose or fail to return keys will be responsible for the cost of re-keying to the City.

Contractors will sign in on pre-approved forms and also wear the City identification badges (also to be worn at all times on the premises). Keys or access cards will be signed out as provided by the City agent/official and required for the work. These keys, cards, and badges must be returned at the end of each shift before signing out. Failure to do so will result in a $50.00 penalty for each occurrence.

d. Contractors shall not ask custodians or mechanics to unlock doors. All access should be provided in advance through the City agent/official. In the rare case where access is not provided, the City Hall Operator may be contacted to assist in providing access. The contractor shall cooperate with security personnel at all times. The contractor should be prepared to allow searches of equipment when leaving, and should remain only in the areas designated on the sign-in sheets. Security will question a contractor who has an identification badge that indicates a work area other than the area he or she is in.

e. If the contractor requires use of the loading dock in Upper Parking, 24 hour advance notice shall be given to the City agent/official to make arrangements to provide additional security coverage while the delivery is in progress. The contractor or subcontractor shall meet the delivery driver and take delivery at that point. At no time shall a driver be allowed in the facilities without following the access procedure stated above.

f. If after normal business hours work is required in the outlying buildings, all subcontractors and trades will arrange appropriate security measures and

lock-up procedures with the contractor in writing. Any work completed at night shall be left "open" for City inspection of the work. The contractor shall notify the City agent/official 24 hours in advance of after-hours work in writing, indicating the type of work to be done and the security measures to be taken by the contractor.

g. The contractor shall provide plywood door and window closures during construction to secure the structure from weather and damage from vandalism. The contractor is responsible to maintain the security of the space where they are working during construction.

h. If proper notification is not provided to the contractor, the subcontractor or trades shall be liable for any subsequent damage/vandalism/inspection cost, etc., due to lack of security/inspection coordination.

i. Use of City materials is strictly prohibited unless pre-arranged through the City employee contact.

j. At no time shall any interior doors that control access or exterior doors be propped open.

3 TEMPORARY OR TRIAL USAGE:

The owner shall have the right to make temporary or trial usage of any mechanical device, machinery, apparatus, equipment, work, material or construction supplied under contract before final completion or acceptance of the work, and the same shall not be construed as evidence of acceptance of the work by the owner.

4. OCCUPANCY DURING CONSTRUCTION:

The owner will occupy the premises while work is in progress. Contractor is to coordinate his work as to not interfere with the owner's operation or compromise building security.

5. ELECTRICAL POWER:

Contractor may use existing outlets for power. Available outlets are 120 and 240 Volt single phase and 480 Volt three phase. Contractor is to supply his own lines. OSHA regulations require that employers use either ground fault circuit interrupters or an assured equipment grounding conductor program in addition to any other regulations for equipment grounding conductors. The cost of the current used will be paid for by the City.

6. WATER:

Contractor may use existing hose bibs for water. Contractor is to supply his own hoses. Contractor's hoses shall be leak free and contractor is to regulate the flow to limit it to project related use. The cost of the water will be paid for by the City.

7. TOILET FACILITIES:

Contractor may use existing toilet facilities in the building.

8. SECURITY AND WEATHER PROTECTION:

Contractor is to furnish, install, and maintain 8' high, nine gauge steel fence fabric at the exterior of

the building, across any door or other openings into the building during construction to maintain security after work hours when not working on these openings. The fabric is to be securely fastened at the sides of the opening. Contractor is also to furnish, install, and maintain a waterproof tarp that completely covers the door opening between the fence and the building fastened to prevent rain from entering the building and secured against wind release. Contractor is to remove the fence fabric and tarp at the completion of each phase of the project when the permanent doors provide security and weather protection.

9. PARKING:

Contractor is responsible for parking of vehicles. No parking areas will be provided by the City.

SECTION 01505
CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 SCOPE:

A. This section specifies requirements for salvaging, recycling and disposing of construction waste for purposes of protecting the environment and reducing project cost.

Requirements include the following:

1. Developing a Construction Waste Management Plan including waste management goals and provisions for waste reduction and recycling.
2. Implementing, monitoring and documenting the waste management plan.
3. Incorporating special programs.
4. Evaluating construction waste management.

1.2 RELATED DOCUMENTS AND SECTIONS:

A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.

B. Related documents include the following

1. Section 01010 "Summary of Work"
2. Section 01300 "Submittal & Permits"
3. Section 001500 "Utilities, Facilities, and Security" for environmental-protection measures during construction.

1.3 PRECONSTRUCTION MEETING:

A. After award of Contract and prior to the commencement of the Work, schedule and conduct a meeting with the Owner and Architect to discuss the proposed Construction Waste Management Plan and to develop a mutual understanding regarding details of environmental protection.

1.4 CONSTRUCTION WASTE MANAGEMENT PLAN:

A. Construction Waste Management Plan

1. The purpose of the Construction Waste Management Plan is to identify construction waste reduction goals, identify targeted materials, and explain specific waste reduction actions to be taken, by whom, and when.
2. The Contractor shall develop a Construction Waste Management Plan for this Project within 15 working days after Contract award or prior to any waste removal. The Owner and the Architect will furnish the Contractor with information that will assist in the development of the Construction Waste Management Plan. Submit the Construction Waste Management Plan (include document/report form) to the Architect for approval prior to implementing the Plan.

B. The Plan, which should be entered into and generated by WasteCapTRACE, shall include the following:

1. A list of waste materials expected to be generated from the Project debris.

2. A list of each material proposed to be salvaged, reused, recycled, and discarded. Identify applicable markets for reuse and recycling. At a minimum, all materials required by state law to be recycled shall be recycled (e.g., cardboard, cans, bottles, office paper, fluorescent tubes, refrigerants mercury, etc.) and scrap metal shall be recycled.
3. Separation and materials handling procedures: Description of how waste materials identified above will be separated, cleaned (if necessary) and protected from contamination.
4. Educational and Motivational Procedures: Meetings to be held and other proposed methods for educating construction personnel regarding waste reduction and recycling. Construction waste management requirements should be discussed at least monthly at project site meetings.
5. Waste Auditing Procedures: Methods of monitoring and enforcing the Plan.
6. Documentation procedures: Methods of documenting materials leaving the Project site as waste, for the reuse or recycling to allow Summary or Waste progress Reports to be submitted with Applications for Payment.
7. The Lead contractor shall distribute copies of the Construction Waste Management Plan to DPW's Project manager.

C. Progress Documentation: Document solid waste disposal and diversion. Include the date of removal, type of waste removed, quantity by weight and volume, final destination and use (recycled, reused or landfilled), and net cost or income.
   1. Document on the Form acceptable to the Owner and Architect.
   2. With each Application for Payment, submit updated documentation identifying solid waste disposal and diversion.
   3. With each Application for Payment, submit manifests, weight tickets, receipts and invoices identifying the Project and construction waste material.

D. Record Submittals: Submit the following:
   1. Summary of solid waste disposal and diversion. Submit on form acceptable to the Owner and Architect.
   2. End-of-Project recycling rates and landfill rates demonstrating the percentage of construction waste that was recycled or reused.

1.5 WASTE MANAGEMENT GOALS:

A. Develop Construction Waste Management Plan that results in end-of-Project rates for the reuse/recycling of **50%** percent by weight or volume of total waste generated by the Project. Record the total construction waste reduction goal on the Construction Waste Management Plan Form.

B. Reduce: The Project shall generate the least amount of waste and methods shall be used that minimize waste due to error, poor planning, breakage, mishandling, contamination, or similar factors. Promote the resourceful use of materials to the greatest extent possible.

C. Reuse: The Contractor and Subcontractors shall reuse materials to the greatest extent possible. Reuse includes the following:
   1. Salvage reusable materials for resale, for reuse on this Project, or for storage for use on future projects.
   2. Return reusable items (e.g., pallets or unused products) to the material suppliers.

D. Recycle: As many of the waste materials not able to be eliminated in the first place or salvaged for reuse shall be recycled. Waste disposal in landfills shall be minimized to greatest extent possible.

1.6 MATERIALS HANDLING AND SORTING:

A. Handling:

1. Materials that are contaminated prior to placing in collection containers shall be properly cleaned. Deliver materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to recycling processes.
2. Cover materials with tarps and keep truckloads level so as to prevent spillage.
3. Arrange for collection by or delivery to the appropriate recycling or reuse facility.
4. Hazardous Waste and Hazardous Materials: Handle in accordance with applicable regulations. If encountered, such waste and materials shall be abated under separate contract.

B. The following sorting methods are acceptable:

1. Sorting recyclable materials at the Project site and transporting them to recycling markets directly from the Project site.
2. Employing haulers who make use of a materials-recovery facility or a transfer station where recyclable materials are sorted from the waste and recycled before disposing of the remainder. If using a hauler or recycling facility to sort out recyclables, verify that the hauler sorts out all construction waste loads and is not limited to those that are not acceptable at the landfill. Also, verify that the hauler or recycling facility recycles at least three types of materials.

1.11 WASTE MANAGEMENT PLAN IMPLEMENTATION:

A. The Contractor shall designate a party (or parties) who shall be responsible for instructing construction personnel and overseeing and documenting results of the Construction Waste Management Plan.

B. Distribution: The Contractor shall distribute copies of the Construction Waste Management Plan to the Project Foreman, each Subcontractor, the Owner, and the Architect.

C. Instruction: The Contractor shall provide on-site instruction regarding appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all construction personnel at the appropriate phases of the Project.

D. Separation Facilities: The Contractor shall lay out and identify a specific area on the Project site to facilitate separation of materials for recycling, salvage, reuse, and return. Recycling and waste bin areas shall be kept neat and clean, and clearly marked to avoid contamination of materials. Materials for recycling include concrete, non-fibrous wallboard, paper, clean corrugated cardboard (no pizza boxes), non-treated wood, metals (steel, aluminum and copper), and glass bottles (no windows). Provide separate containers, preferably near the job trailer, with smaller containers located at convenient places throughout the job site. Empty smaller containers into larger containers every night or when full. Cover outdoor containers to keep out rain, snow, and wind-driven debris. Lock containers whenever site is not in use to prevent illegal dumping.

E. Hazardous Waste: Hazardous waste shall be separated, stored, and disposed of according to applicable regulations.

F. Application for Payments: With each Application for Payment, the Contractor shall submit a Summary of Waste generated by the Project. This reporting shall take place using

WasteCapTRACE, an online documentation system. There is a fee, to be included in the bid, of two cents per square foot of gross construction for use of WasteCapTRACE. Failure to submit this information shall render the Application for Payment void, thereby delaying the Progress Payment. The Summary of Waste shall contain the following information:

1. The amount (in tons and/or cubic yards) of material landfilled from the Project, the identity of the landfill, and the related disposal cost. Include corresponding manifests, weight tickets, receipts, and invoices.
2. For each material recycled from the Project, the amount (in tons and/or cubic yards), the date removed from the Project site, the receiving party, the transportation cost, the amount of any money paid or received for the recycled or salvaged material, and the net total cost or savings of recycling. Include corresponding manifests, weight tickets, receipts, and invoices.
3. Final Payment: Prior to application for Final Payment, the Lead Contractor shall submit a Final Summary of Waste: reuse the recycling results for all prime and subcontractors, including the quantity of each material recycled, reused, or salvaged, the receiving party and the applicable diversion rates. The final report will be generated by WasteCapTRACE based on information entered throughout the project by the Lead Contractor.

G. Implementing the Plan: The Contractor shall designate a party (or parties) responsible for implementing the Construction Waste Management Plan. This party (or parties) shall explain to Contractor's and Subcontractor's construction personnel, the Plan's goals and methods for achieving those goals.

1.12 SPECIAL PROGRAMS:

A. The Contractor shall be responsible for final implementation of programs involving tax credits, rebates, or similar incentives related to recycling, if applicable to the Project. Revenues or other savings obtained for recycling or returns shall accrue to the Contractor.

B. The Contractor shall be responsible for obtaining information packets related to the special programs prior to commencing Work.

C. The Contractor shall document work methods, recycled materials, etc., as required for the tax credits, rebates, or other savings described above.

SECTION 01600
MATERIALS AND EQUIPMENT

1. SCOPE:

   A. Index:

      1. Scope
      2. Materials
      3. Equipment
      4. Hazardous Material Requirements
      5. Material Storage
      6. Protection
      7. Revisions

2. MATERIALS:

   A. Furnish materials of the type, qualities, and characteristics specified. The specification of a trade name and catalog number is intended to establish quality, type, character, and operating characteristics of the material required. Materials by other manufacturers of equal specifications will be accepted, excepting as may be specifically stated otherwise.

   B. Materials shall be delivered adequately protected, in merchantable condition, and in original unbroken packages if normally packaged. They shall be stored and handled so as to protect and maintain their merchantable condition.

   C. The Commissioner of Public Works or his representative shall have the right to reject material not in compliance with the project manual, as well as damaged material, and the contractor shall remove such material from the construction site when and as directed.

3. EQUIPMENT:

   A. Internal combustion engine and compressor shall be equipped with mufflers to reduce noise to a minimum and shall not be operated in enclosed areas without adequate ventilation.

   B. All materials and work procedures used shall be in accordance with all air pollution control regulations in effect at the work site.

4. HAZARDOUS MATERIAL REQUIREMENTS:

   A. The requirements set forth in the OSHA Hazard Communication Standard, 29CFR19101.1200, U.S. Environmental Protection Agency (EPA), and Wisconsin Department of Natural Resources in the Wisconsin Administrative Code NR600, shall be met by each on-site contractor.

      1. Material Safety Data Sheets (M.S.D.S.):

         a. All contractors, which may/may not include the City of Milwaukee, shall provide the M.S.D.S. for all hazardous chemicals to which any person may be exposed at the work site.

         b. A master list will be kept in the office of the Project Supervisor/Construction Manager and updated as materials are delivered.

2. Container Labeling:

a. Each container of hazardous material at the work site shall be clearly labeled with:

(1) Identity of the hazardous chemical(s).

(2) Appropriate hazard warning(s).

(3) Name and address of the manufacturer.

B. The City of Milwaukee reserves the right to stop the work of a contractor if compliance with OSHA regulations is inadequate. Work will not proceed until all applicable safety and health procedures are implemented by the contractor.

5. MATERIAL STORAGE:

A. The storage areas shall be kept in good order and free of all rubbish and debris.

B. Coordinate the delivery and storage of all materials and equipment with the Facilities Development and Management Section Project Inspector.

C. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.

D. Store and protect products in accordance with manufacturers' instructions.

E. Store with seals and labels intact and legible.

F. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

G. For exterior storage of fabricated products, place on sloped supports above ground.

H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

I. Prevent contact with material that may cause corrosion, discoloration, or staining.

J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

6. PROTECTION:

A. The premises and the work shall be adequately protected from damage from the commencement of work to the date of final acceptance.

B. All construction work and traffic shall remain within the construction area.

C. All damage shall be corrected or repaired by the contractor or contractors causing same at his or their own expense.

D. All open pipes, pipe threads, fittings, and insulation must be protected during construction.

7. REVISIONS:

The right is reserved to make modifications to a reasonable extent as building conditions may require, or as may be required to conform to code rulings, or manufacturer's standards without extra cost to the City.

SECTION 01700
CLEANING AND PROJECT CLOSE-OUT

1. SCOPE:

   A. Index:

   1. Scope
   2. General
   3. Safety Cleaning
   4. Progress Cleaning
   5. Disposal
   6. Final Cleaning
   7. Charges
   8. Record Drawings
   9. Operating Instructions and Maintenance Manuals
   10. Guarantees

2. GENERAL:

Article 2.5.4 of the General Requirements of City of Milwaukee Department of Public Works shall be supplemented as specified hereinafter.

3. SAFETY CLEANING:

Safety cleaning: Each contractor is responsible for safety cleaning, which includes but is not limited to the following:

A. Keep work areas, passageways, ramps, stairs, free of debris and scrap.

B. Form and scrap lumber shall have nails withdrawn or bent over and lumber shall be stacked or removed.

C. Remove spills of oil, grease, or other liquids immediately or sprinkle with sand.

D. Hazardous material shall be handled in accordance with Section 01600. Each container of hazardous material at the work site shall be clearly labeled with:

   a. Identity of the hazardous chemical(s).

   b. Appropriate hazard warning(s).

4. PROGRESS CLEANING:

A. Prime Contractor and subcontractor shall remove his rubbish and debris from building site promptly upon its accumulation, and prior to the contractor's regular Friday general clean up. Contractor shall perform broom cleaning of all appropriate surfaces each Friday afternoon.

B. Combustible waste shall be stored in fire resistive containers and disposed of regularly.

C. Oily, flammable or hazardous wastes such as caustics, acids, harmful dusts, etc., shall be stored in appropriate covered containers.

5. DISPOSAL:

A. No burning of rubbish or debris will be allowed at site. No rubbish shall be thrown through opening or from heights without proper protection. Where dust will be generated or flying debris is likely to occur, provide dust tight chutes or other means to control dust.

B. Containers: Contractor shall provide mobile industrial type waste containers in the number and size required, placed at adequate locations to handle debris or provide other methods of disposing of debris.

C. Oil, flammable or hazardous wastes such as, but not limited to, caustics, acids, harmful dusts, etc., shall be placed in properly marked containers as necessary and disposed of at a site designed for such wastes.

6. FINAL CLEANING:

A. Immediately prior to substantial completion.

B. Contractors shall expedite or perform thorough cleaning, sweeping, washing and polishing of work to remove from work and equipment provided under his contract, all foreign matter, spots and soil, so as to put all such work and equipment, including finishes, in a complete and finished condition ready for acceptance and use intended.

C. The contractor is responsible for final sweeping and dusting not covered by other subcontractors. This general cleaning shall include all areas and floors of the building, including the site outside the building.

7. CHARGES:

A. If prime contractors do not remove rubbish or clean building as specified above, owner reserves right to have work done by others at contractor's expense.

B. Employees of the owner who are required to clean up any rubbish or to sweep any floors will record all hours involved to complete such work. The cost incurred by the owner for this special cleaning and sweep-up work shall be charged against the contract price of the contractor as determined by owner.

8. RECORD DRAWINGS:

A. At the completion of work and prior to final payment, the mechanical and electrical contractors shall provide Tom Tarkowski, Buildings & Fleet Services with three (3) marked up sets of prints showing all changes or variations from contract drawings, and not specified on change order drawings theretofore issued. Contractors providing buried or concealed piping, conduit, or similar items shall locate such items by dimensions and elevations.

B. Other contractors shall provide one (1) marked up set of prints showing all changes or variations from contract drawings to Tom Tarkowski, City of Milwaukee per Section 01300.

C. Drawings shall show complete layout of revised piping, equipment, etc., as actually installed.

9. OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS:

A. The contractor shall, upon completion of all work, furnish the necessary skilled labor to instruct City personnel in the operation, adjustment, and maintenance of all equipment furnished.

B. At termination of work, the contractor shall submit maintenance and operating manuals presenting full details of care and maintenance and operation of mechanical and electrical equipment of every nature. See specific requirements in relevant sections as applicable.

C. The manual shall include manufacturer's instructions for maintenance and operation and shall be completely indexed, including the spare parts list. See specific requirements in relevant sections.

D. Submit three (3) final copies in hard bound cover to Buildings & Fleet Services.

E. The contractor shall allow for a four (4) hour training session for City maintenance personnel on all equipment and controls installed under this contract.

10. GUARANTEES:

A. Each contractor shall guarantee to replace or repair promptly at his own expense, as directed by the Commissioner of Public Works or his agent, all workmanship or materials in which defects may develop within one (1) year from the date of final acceptance of his work. This guarantee includes all damage done to the City due to faulty equipment, poor installation or poor construction.

B. Guarantee periods other than the one year time period are indicated in specific specification sections.

DIVISION 3

CONCRETE

SECTION 03 20 00
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SUBMITTALS

A. Shop Drawings:

1. Conform to ACI SP-66 showing bending diagrams; assembly diagrams; location diagrams; splicing and laps of bars, shapes, and dimensions; and details for bar reinforcing, stirrup spacing, accessories, and openings.
2. Coordinate bar splicing and placement with CONTRACTOR'S concrete placing schedule and joint locations.
3. Submit with construction joint submittals required in Section 03 30 10.
4. Unless otherwise approved by ENGINEER, each submittal shall include reinforcement for individual structures they pertain to.

B. Product Data:

1. Dowel bar splicer system and reinforcing bar splicer and manufacturer's product data.

C. Miscellaneous Submittals:

1. Welder's certification in accordance with AWS D1.4/D1.4M prior to welding when welding indicated; specified or approved by ENGINEER.

D. Submit in accordance with Section 01300.

1.02 DELIVERY, STORAGE, AND HANDLING

A. Store reinforcing steel on supports above ground; cover and keep clean.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel Reinforcing Bars:

1. Deformed bars conforming to ASTM A615/A615M, Grade 60.

B. Reinforcing Supports:

1. Exterior exposed surfaces, surfaces in contact with earth or liquid, and interior exposed surfaces in humid areas shall have all plastic or stainless steel supports.
2. Interior exposed surfaces in dry areas shall have all plastic, stainless steel, or plastic tipped steel supports.

C. Reinforcing Tension Bar Splicers:

1. Manufacturers:

a. Cadweld or Lenton rebar splicers by Erico Products, Inc.
b. Dayton Barsplice, Inc.

c. Or equal.

2. Develop minimum 125% of yield capacity of bars spliced in tension when tested as assembly in accordance with ASTM A370 and ASTM A615/A615M.

2.02 FABRICATION

A. Fabricate to schedules and details on Drawings and in accordance with ACI 318/318R.

PART 3 EXECUTION

3.01 PLACEMENT

A. Placement of reinforcing steel shall be approved by ENGINEER before covered with concrete.

B. Correct displacement of reinforcement prior to and during concrete pouring operations. Maintain clear cover as noted on Drawings. Tolerances shall be in accordance with ACI 117 and ACI 318/318R, unless noted otherwise.

C. Support reinforcing steel in accordance with CRSI "Placing Reinforcing Bars" with maximum spacing of 4 ft 0 in.

D. Tie reinforcing steel at intersections in accordance with CRSI "Placing Reinforcing Bars."

1. Maximum Tie Spacing for Footings, Walls, and Columns: Every third intersection or 3 ft 0 in.
2. Maximum Spacing for Slabs and Other Work: Every fourth intersection or 3 ft 0 in.

E. Locate reinforcing to avoid interference with items drilled in later, such as concrete anchors.

F. Reinforcement shall be continuous through construction joints.

G. Reinforcement may be spliced at construction joints provided that entire lap is placed within only 1 concrete pour.

H. Use concrete brick for supporting bottom mat reinforcing on grade. Use bolsters or chairs supported on concrete brick or tied to bottom mat for supporting upper reinforcing mat on grade. Use bolsters or chairs for supporting reinforcing on mud slabs and forming.

I. Reinforcing bar splicers may be substituted for lapped splices at CONTRACTOR'S option when approved by ENGINEER. Stagger splices.

J. Do not field bend bars, including bars partially embedded in concrete unless indicated or approved by ENGINEER.

K. Do not place bars having kinks and bends other than shown on approved Shop Drawings.

L. Welding of reinforcing bars is not permitted.

M. Tack welding reinforcement is prohibited.

N. Reinforcement shall be clean and free from loose mill scale, dirt, grease, oil, form release agent, dried concrete or any material reducing bond with concrete.

* * * END OF SECTION * * *

SECTION 03 30 10
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUBMITTALS

A. Shop Drawings:

1. Construction Joints: Sequence of placing concrete and location and details of joints, openings, and embedded items not shown on Drawings. Coordinate sequence of placement and joint location with reinforcement Shop Drawings. Submit with reinforcement submittals required in Section 03 20 00.
2. Control Joints in Slabs on Grade: Location and details of joints.
3. Verification of Mix Design:

   a. Proposed mix design for each class of concrete to be used as specified using designations indicated. Provide dry weight of cement, saturated surface dry weight of coarse and fine aggregates, brand name and quantity of admixtures when applicable, fly ash or Ground Granulated Blast Furnace slag (GGBF slag) when applicable or in combination and gallons of water required for 1 cu yd of concrete.
   b. Test data supporting proportions of design mixes (excluding Class AA) based on laboratory trial batches in accordance with ACI 318/318R, Chapter 5.
   c. As alternative to test data based on laboratory trial batches, test data supporting proportions of design mixes based on past field experience in accordance with ACI 318/318R, Chapter 5 may be submitted. If this data, in ENGINEER'S opinion, is not in accordance with ACI 318/318R, ENGINEER will require submittal of test data based on trial batches.
   d. Submit with admixture product data and miscellaneous submittals required herein.
   e. Mix design shall be approved by ENGINEER before concrete is delivered to site.

B. Product Data:

1. Curing Compound: Proposed rate of coverage and manufacturer's literature indicating conformance with these Specifications.
2. Concrete Admixtures:

   a. Manufacturer's literature.
   b. Submit with mix design.

3. High Range Water Reducers:

   a. Name of product and manufacturer's literature.
   b. Intended use area.
   c. Submit with mix design.

4. Miscellaneous Materials:

   a. Finishing Grout manufacturer's literature.
   b. Bonding Compound manufacturer's literature.
   c. Control Joint manufacturer's literature.
   d. Epoxy Joint Filler manufacturer's literature.
   e. Form Liners manufacturer's literature.

C. Test Results:

1. Concrete test results.
2. With each load of concrete delivered, provide duplicate delivery tickets, one for CONTRACTOR and one for ENGINEER, with following information.

    a. Date and serial number of ticket.
    b. Name of ready mixed concrete plant, operator, and job location.
    c. Type of cement, admixtures, if any, and brand name.
    d. Cementitious content, in bags/cu yd of concrete, and mix design.
    e. Truck number, time loaded, and name of dispatcher.
    f. Amount of concrete in load, cu yds, delivered.
    g. Maximum size aggregate.
    h. Gallons of water added at job, if any, and slump of concrete after water was added.
    i. Temperature of concrete at delivery.
    j. Time unloaded.

D. Miscellaneous Submittals:

1. NRMCA certification or certificate stating plant and equipment complies with NRMCA requirements specified herein.
2. Statement by ready mix supplier giving source and material certificates of cement and fine and coarse aggregates, including sieve analysis, that will be used in manufacture of each class of concrete. Make no changes in sources of materials.
3. Fly Ash: Source and test reports showing fly ash in compliance with these Specifications. Reports shall be for actual fly ash to be used in Work.
4. GGBF Slag: Source and test reports showing slag in compliance with these Specifications. Reports shall be for actual GGBF slag to be used in Work.
5. Method of pumping concrete.
6. Submit with mix design.

E. Submit in accordance with Section 01300.

1.02 QUALITY ASSURANCE

A. Plant Certification: Plant or concrete supplier shall comply with requirements of National Ready Mixed Concrete Association (NRMCA) certification plan as regards material storage and handling, batching equipment, central mixer, truck mixers with counters, agitators, non-agitating units, and ticketing system.

B. Concrete Testing: Testing shall be provided by CONTRACTOR in accordance with Section 01430 and this section.

1. Conduct tests on sample material in accordance with applicable ASTM methods listed below.

    a. Slump: ASTM C143/C143M.
    b. Air-Entrainment: ASTM C231.
    c. Compressive Strength Test: ASTM C31/C31M (making and cylinders curing) and ASTM C39/C39M (testing).

1.03 PROJECT/SITE CONDITIONS

A. Hot Weather:

1. Comply with ACI 301.
2. Concrete temperature shall not exceed 90°F at placement.
3. At air temperatures of 80°F or above, keep concrete as cool as possible during placement and curing. -Fog-spray forms, steel reinforcement and sub-grade just before placing concrete.

4. When concrete temperatures exceed 80°F, water reducing, set retarding admixtures shall be used in accordance with manufacturer's recommendations.
5. Rate of evaporation from concrete surface shall not exceed 0.2 lb/ft^2/h based on ACI 305R Table 2.1.5 and Figure 2.1.5. Use fog-spray or evaporation retardant to maintain evaporation at 0.2 lb/ft^2/h or less.

B. Cold Weather:

1. Comply with ACI 306.1.
2. Temperature of reinforcement, forms, fillers, and other materials in contact with concrete at time of placement shall not be less than 35°F. Preheat if temperature below 35°F.
3. Maintain air and forms in contact with concrete sections having minimum dimension less than 12 in. at temperature above 50°F for at least first 3 days and at temperature above 32°F for remainder of specified curing period.
4. Maintain air and forms in contact with concrete in more massive sections at temperature above 40°F for at least first 3 days and at temperature above 32°F for remainder of specified curing period.

PART 2 PRODUCTS

2.01 MATERIALS

A. Portland Cement:

1. ASTM C150.
2. Non-hydraulic Structures: Type I or II except tricalcium aluminate (C_3A) content of Type I shall not exceed 12%.

B. Fly Ash:

1. ASTM C618, Class C or F including requirements of Table 1A.
2. Supplemental Requirements:

   a. Loss on Ignition (maximum): 3%.
   b. Fineness (maximum retained on No. 325 sieve): 25%.

C. Ground Granulated Blast-Furnace Slag:

1. ASTM C989 modified as follows.

   a. Slag activity classification: Grade 100 or 120.

D. Aggregates:

1. ASTM C33 modified as follows.

   a. Fine Aggregate: Natural sand.
   b. Coarse Aggregate: Crushed gravel, crushed stone or gravel uniformly graded (8% to 18% on any sieve).

E. Admixtures for Concrete:

1. Air-Entraining: ASTM C260.
2. Chemical Admixtures: ASTM C494/C494M, non-corrosive and chloride free.

F. Water: Potable.

G. Premolded Joint Filler:

1. ASTM D1751.
2. ASTM D1752, Type I, II or III.
3. Closed cell polyethylene.

H. Membrane Forming Curing Compound:

1. Manufacturers:

   a. Day-Chem Cure & Seal J-20 by Dayton Superior.
   b. Kure-N-Seal by Sonneborn.
   c. Masterseal by Master Builders.
   d. Super Floor Coat by Euclid Chemical Company.
   e. Cure and Seal by Symons.
   f. Dress and Seal WB by L&M Construction Chemicals, Inc.
   g. Achro Kure AK-2 or Achro Seal AS-1 by TK Products.

2. ASTM C309, and compatible with scheduled finishes and coatings.

I. Finishing Grout:

1. Manufacturers:

   a. Thoroseal with Acryl 60 by Thoro.
   b. Concrete Finisher with AKKRO-7T by Tamms Industries Company.
   c. Tri-Mix with TK-225 Liquid Bonding Agent by TK Products.

J. Cement Grout: Mixture of cement and fine sand in proportions used in concrete being finished.

K. Epoxy Bonding Compound:

1. Manufacturers:

   a. Sikadur Hi-Mod by Sika Corporation.
   b. Euco Epoxy 452 MV or 620 by Euclid Chemical Company.
   c. Resi-Bond J-58 by Dayton Superior.
   d. Epobond by L&M Construction Chemicals, Inc.
   f. TK-310 Concrete Bonding Agent by TK Products.

2. Use when joining new to existing concrete.
3. Conforming to ASTM C881/C881M.

L. Non-Epoxy Bonding Compound:

1. Manufacturers:

   a. Weld-Crete, by Larsen Products Corporation.
   b. Acryl 60 by Thoro.
   c. Acryl-Set by Master Builders.
   d. Everbond by L&M Construction Chemicals, Inc.
   e. TK-225 Liquid Bonding Agent by TK Products.

2. Use when joining new to existing concrete where bonding compound cannot be placed immediately prior to pouring of new concrete.
3. Conforming to ASTM C1059 Type II.

M. Preformed Control Joint Strips:

1. Manufacturers:

   a. Zipcap by Greenstreak.
   b. Quick Strip by Schlegel Corporation.

2. Plastic joint former with locking tabs.
3. Depth: 1/4 of slab thickness.

N. Epoxy Joint Filler:

1. Manufacturers:

   a. Euco Epoxy 800 by Euclid Chemical Company.
   b. Sikadur 51 by Sika Corporation.
   c. MM-80 by Metzger/McGuire.
   d. ResCon Flexresin R810 or ResCon Flexresin Paste R811 by Symons.
   e. Epoflex SL by L&M Construction Materials, Inc.
   f. Poxy-Fil J-52 by Dayton Superior.
   g. Sikadur CJR by Sika Corporation.

2. Minimum Shore Hardness of 70.

O. Evaporation Retardant:

1. Manufacturers:

   a. E-CON by L&M Construction Chemicals, Inc.
   b. Confilm by Master Builders.
   c. Eucobar by Euclid Chemical Company.
   d. TK-2120 Tri-Film by TK Products.
   e. SikaFilm by Sika Corporation.

P. Fiber Reinforcement:

1. Manufacturers:

   a. Fibermesh Company.
   b. W.R. Grace & Company.
   c. Euclid Chemical Company.
   d. Forta Corp.

2. 1/2 in. to 3/4 in. collated fibrillated virgin polypropylene fibers.
3. ASTM C1116/C1116M Type III.

2.02 CONCRETE MIX DESIGN

A. Concrete Mix: Measure and combine cements, aggregates, water, and admixtures in accordance with ASTM C94/C94M and ACI 211.1.

1. Cement: When used in exposed concrete shall be one brand from one source. Do not mix different cements in same element or portion of Work.
2. Air-Entrainment: Air-entrain all concrete.
3. Chemical Admixtures: Use is optional to aid concrete properties and allow for efficient placement. Manner of use and amount shall be in accordance with manufacturer's written

recommendations and as approved by ENGINEER. Do not use admixtures which increase shrinkage or negatively affect finishing.

4. Fly Ash: Use is optional unless otherwise noted. Combine fly ash with cement at rate of 1.0 lb fly ash/lb reduction in cement. Amount of fly ash shall not be less than 15% nor more than 25% of weight of cement plus fly ash. When fly ash is used, minimum amount of cement given in table for Class of Concrete may be proportionately reduced. Water to cementitious ratio shall not exceed water to cement ratio given in table for Class of Concrete.
5. Ground Granulated Blast-Furnace Slag (GGBF Slag): Use is optional unless otherwise noted. Combine GGBF slag with cement at of 1.0 lb GGBF slag /lb reduction in cement. Amount of GGBF slag shall not be less than 25% nor more than 50% of weight of cementitious material. When GGBF slag is used, minimum amount of cement given in table for Class of Concrete may be proportionately reduced. Water to cementitious ratio shall not exceed water to cement ratio given in table for Class of Concrete.
6. Fly Ash and GGBF Slag Mix Ternary Systems: Use is optional unless otherwise noted. Combinations of Portland cement, GGBF slag and fly ash will be allowed. Minimum amount of Portland cement shall be 337 lb/cubic yard of concrete. Total replacement of cement with fly ash and GGBF slag shall not exceed 50%. Total replacement of cement with fly ash shall not exceed 25%. Water to cementitious ratio shall not exceed water to cement ratio given in table for Class of Concrete.
7. Use no admixture other than specified, unless approved by ENGINEER.
8. Slabs on grade shall be fiber reinforced.

    a. Dosage Rate: 1-1/2 lbs/cu yd minimum.
    b. Comply with manufacturer's recommendations and as specified in ASTM C94/C94M.

B. Class of Concrete:

1. Furnish in accordance with table. Cement contents listed are minimum values and shall be increased as required to attain other specified characteristics.
2. Air contents listed are for concrete requiring air-entrainment as specified herein. Contents listed shall be maintained after addition of admixtures.
3. Slumps listed are maximum, except when high range water reducer is used. Maximum slump when high range water reducer is used, 10 in.
4. Chloride ion content shall not exceed values listed in ACI 318/318R, Table 4.3.1.

Class	Compressive Strength (psi)	Coarse Aggregate (maximum size)	Minimum Cement Factor (lbs/cu yd)	Air Content (%)	Slump (in.)	Water/Cement Ratio (maximum)
A	4,500	1-1/2 in.	517	5.5 ±1.5	3 ±1	0.42
B	3,000	1-1/2 in.	423	5.5 ±1.5	3 ±1	N/A
C	4,000	3/4 in.	564	6 ±1.5	3 ±1	0.45
F	2,000	3/4 in.	212	---	---	---
Note: Interior concrete floor with trowel-finished surface, limit air content to 3% max.						

C. Concrete Usage:

1. Class A: Locations, except where Class B and C specified.
2. Class B: Equipment bases, fence post piers, and where specifically stated.
3. Class C: Exterior un-reinforced concrete pavement and curbs.
4. Class F: Mud slabs and backfill below and around structures where noted.
5. Nominal maximum size of coarse aggregate shall be as noted in Table above, nor shall it exceed 3/4 of minimum clear spacing between reinforcing bars, 1/5 of narrowest dimension between sides of forms or 1/3 of thickness of slab.

2.03 MODIFICATION OF MIX DESIGN

A. After sufficient test data available from Project, provisions of ACI 318/318R may be used to reduce amount by which average strength must exceed specified 28-day compressive strength provided.

1. Probable frequency of strength tests more than 500 psi below specified 28-day compressive strength will not exceed 1 in 100.
2. Probable frequency of average of 3 consecutive strength tests below specified 28-day compressive strength will not exceed 1 in 100.

B. Submit verification of mix design.

2.04 MIXING AND DELIVERY

A. Use ready mixed concrete.

B. Deliver and complete discharge within 1-1/2 hrs of commencing of mixing or before 300 revolutions of drum or blades, whichever comes first. Includes revolutions required by transit mix trucks. Limitations may be waived by ENGINEER if concrete slump, after 1-1/2 hrs or 300-revolution limit reached, that concrete can be placed without addition of water. In hot weather, time or number of revolutions criteria may be reduced by ENGINEER.

C. Do not add water on-site unless slump and water-cement ratio, after addition of water are below maximum allowed. If water added, mix concrete at site additional 30 revolutions of drum.

D. Deliver concrete to site having temperature not less than 50°F nor greater than 90°F.

E. If high range water-reducing admixture added on-site, mix concrete at site additional 85 revolutions of drum after addition of high range water-reducing admixture.

PART 3 EXECUTION

3.01 FORMS

A. Formwork design, detailing, and installation shall be CONTRACTOR'S responsibility and shall conform to requirements of ACI 347R.

B. Materials and Construction: Type of forms used is CONTRACTOR'S option, except as otherwise indicated below or on Drawings. Plywood and other wood surfaces shall have smooth, level surfaces treated with form oil or sealer to produce clean release of concrete from forms.

1. Use bolts, rods or other approved devices for form ties. Plastic cone snap ties are approved as form ties. Ties for liquid holding structures or dry structures below grade shall have integral waterstop. Do not use wire ties on exposed concrete.
2. Ties shall be removed minimum of 1 in. from formed surface. Removal of ties shall leave holes clean cut and without appreciable spalling at face of concrete. Provide plastic cone or other approved device.
3. Provide 3/4 in. chamfer on external corners of exposed equipment bases and exposed edges of construction joints.

C. Treat or Wet Contact Forms: Coat plywood and wood moldings with non-staining form release agent. Apply release agent before reinforcement is placed.

D. Repairing and Cleaning: Clean, patch, and repair form material before reusing.

E. Workmanship:

1. Formwork shall prevent leakage of mortar, shall not deflect under weight of concrete and workman, and shall withstand fluid pressures of concrete.
2. Removal of wall ties shall leave holes clean cut and without appreciable spalling at face of concrete.

3.02 SUB-GRADE PREPARATION

A. Sub-grade and bedding shall be compacted and free of frost. If placement allowed at temperatures below freezing, provide temporary heat and protection to remove frost. Do not place concrete on frozen material.

B. Provide mud slabs where noted, where necessary, and when required by ENGINEER to obtain dry and stable working platform for placement of slabs on grade. Mud slabs shall be 2 in. thick minimum.

C. Soak sub-grade evening before placement and sprinkle ahead of placement of concrete.

D. Remove standing water, ice, mud, and foreign matter before concrete deposited.

3.03 PLACING CONCRETE

A. Notify OWNER 24 hrs in advance of placing operation.

B. Place concrete, except as modified herein, in accordance with ACI 304R, Chapter V.

C. Concrete will not be allowed to drop freely where reinforcing will cause segregation of mix.

1. Superplasticized Concrete: 10 ft maximum drop.
2. Other Concrete: 5 ft maximum drop.

D. If pumping is used, do not use aluminum piping for delivery system.

E. When placing of concrete is temporarily halted or delayed, provide construction joints as shown on Drawings and as specified.

F. Place in lifts not exceeding 24 in. and compact with internal mechanical vibrator equipment.

1. Insert vibrator so area visibly affected by vibrator overlaps adjacent just-vibrated area by few inches.
2. Slabs: Insert vibrators for full depth of slab.
3. Do not spread concrete with vibrators.

G. Provide bonding compound between new and hardened or existing concrete where shown on Drawings.

H. When heat or wind conditions will result in evaporation of 0.2 lb/sf/hr or more, use evaporation retardant in accordance with manufacturer's recommendations to minimize plastic shrinkage cracking.

3.04 JOINTS

A. Unless otherwise noted, construction joints shown are optional. Joints not shown on Drawings shall be approved by ENGINEER. Locate to miss splices in reinforcement.

B. Limit size of concrete pours. Maximum length of slab pours shall not exceed 60 ft.

C. Before concrete placed, construction joints shall be cleaned and laitance removed and surface wetted. Remove standing water.

D. Construction joints shall have keys or roughened surfaces. Where roughened surface used, surface shall have amplitude of 1/4 in. minimum.

E. Make control joints in slabs on grade of preformed control joint strips set flush with finished surface, by construction joint, by tooled joint, or cut 1/4 in. wide joints with diamond saw within 12 hrs after pouring.

1. Cut alternate reinforcing bars or wires crossing joint.
2. Provide preformed control joint strip in full length unspliced pieces unless special splice designed to prevent misalignment of splice joint.
3. Control joints shall be 1/4 depth of slab, unless shown otherwise on Drawings.
4. Fill construction joint, tooled joint, and sawed control joints with epoxy joint filler.
5. Unless otherwise indicated on Drawings, spacing of control joints shall not exceed 24 ft in each direction.

F. Install premolded joint filler where noted in accordance with manufacturer's recommendations. Joint filler shall be compatible with sealant and suitable for intended purpose.

G. Clean and prime joints in accordance with manufacturer's written instructions before applying sealant.

3.05 EMBEDDED ITEMS

A. Cast pipe and other embedded items into concrete as placement progresses. Do not provide blockouts.

B. Following restrictions shall be adhered to, unless otherwise noted.

1. Reinforcing steel shall be in-place before embedded items placed and reinforcing cut or removed shall be replaced with additional reinforcing as indicated on Drawings or approved by ENGINEER.

C. Set items such as bolts, anchors, piping, and frames in concrete as shown on Drawings.

D. Set miscellaneous items according to templates and setting diagrams.

F. Place items constructed of dissimilar metals to avoid physical contact with reinforcing. Secure item and reinforcing to ensure they will not shift and come into contact during pouring. Contact between reinforcing and other metal, other than bare, coated or plated carbon steel not permitted, unless approved by ENGINEER.

G. Support wall pipes from formwork to prevent contact with reinforcing.

H. Other Contractors furnishing embedded items to be cast into concrete shall be responsible for setting and maintaining alignment during concrete placing operations.

3.06 REPAIR OF SURFACE DEFECTS

A. General:

1. Prior to starting repair work, except as specified otherwise, obtain ENGINEER'S approval of proposed repair techniques and mixes.

2. Develop patching techniques and mixes on portion of as-cast surface selected by ENGINEER for this purpose. Dress surface of patches remaining exposed to view to match color and texture of adjacent surfaces.

B. Tie Holes:

1. Fill tie holes, except where sealant is indicated, with patching mortar as specified in Section 03 61 10.

C. Defective Areas:

1. Remove honeycombing, stone pockets, spalls, and other defective concrete down to sound concrete. If chipping required, make edges perpendicular to surface. Do not feather edges.
2. Fill defective area with patching mortar as specified in Section 03 61 10.

D. Blockouts at Pipes or Other Penetrations:

1. Fill with non-shrink grout.
2. Match appearance to adjacent concrete on exposed surfaces.
3. Conform to details shown.

E. Cracks:

1. All cracks in concrete with exterior exposure, 13 mils or greater in width shall be repaired,
2. Repair method shall be CONTRACTOR'S, subject to requirements of these Specifications and review by ENGINEER.

3.07 FINISHING SLABS AND FLATWORK

A. Slab Finishes:

Description	Concrete Finish
Exterior Exposed Slabs	Float and Broom Finish
Exterior Stairs, Ramps, Walks	Float and Broom Finish

B. After placement, screed concrete with straightedges, power strike-offs or vibrating screeds.

C. After screeding, bull float or darby surface to eliminate ridges and to fill in voids left by screeding.

D. Float:

1. Use magnesium or aluminum hand floats or power floats with slip on float shoes after concrete has stiffened to point where 1/4 in. maximum indentation can be imparted by normal foot pressure. Do not use combination blades for floating.
2. Float finish shall result in uniform smooth granular texture.
3. After floating, check slab tolerances with 10-ft straightedge. Fill low spots with fresh concrete.
4. Do not sprinkle with dry cement or add water.

E. Broom Finish: Use fine, soft-bristled broom and broom at right angles to direction of traffic to give nonskid finish. Texture shall be approved by ENGINEER.

3.08 FINISHING FORMED CONCRETE

A. Ordinary Finish: Finish resulting directly from formwork for surfaces which will be hidden from view by earth, submergence in water or wastewater or subsequent construction.

1. Patch honeycombing, stone pockets, form ties, spalls, and other irregularities as specified in this section and cure.
2. Where joint marks or fins on submerged surfaces exceed 1/4 in., grind smooth.

B. Rubbed Finish: Exterior cast-in-place concrete surfaces permanently exposed to view, unless otherwise indicated on Drawings.

1. After removal of forms, patch or point up defects as specified and cure.
2. Remove joint marks, fins, and stains as described for smooth finish.
3. Apply heavy coat of Finishing Grout. After first coat has set, apply second coat. When second coat has set, float to uniform texture.
4. Follow manufacturer's written instructions for finishing concrete.
5. Finish color shall be gray.

3.09 PROTECTION AND CURING

A. Protect concrete from frost and keep moist for minimum curing period of 7 days after placing in accordance with ACI 308.

B. Formed Surfaces:

1. Wet cure by spraying surfaces during curing period as frequently as drying conditions may require to keep concrete surfaces moist.
2. Ceilings, walls, columns, and beam sides may be cured by leaving forms in-place. For vertical surfaces, apply water to run down on inside of forms, if necessary, to keep concrete wet.
3. After forms are removed, wet cure for remainder of curing period or apply curing compound.
4. Do not use curing compound where epoxy, urethane, mortar bed, grout, additional concrete or other coatings or adhesives will be applied.

C. Concrete Flatwork:

1. Start curing activities as soon as free water has disappeared from surface of concrete after placing and finishing.
2. Cure flatwork using liquid curing compound or wet cure.
3. Do not use curing compound where epoxy, urethane, mortar bed, grout, additional concrete or other coatings or adhesives will be applied.

D. Curing Compound:

1. Apply curing compound at uniform rate sufficient to comply with requirements for water retention as specified and as measured in accordance with ASTM C156.
2. Cover areas subjected to direct sunlight during curing period with ambient temperature expected to exceed 80°F with white pigmented compound; others may be covered with fugitive dye compound.

E. Protect from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration.

F. Protect finished concrete surfaces from damage caused by construction equipment, materials or methods, and rain or running water.

G. Do not load self-supporting structures to overstress concrete.

3.10 REMOVAL OF FORMING AND SHORING

A. Do not remove forming or shoring until member supported has acquired sufficient strength to safely support own weight and any imposed loads. Forming shall remain in place for at least minimal time recommended by ACI 347R. In addition, forming for horizontal members such as elevated slabs and beams shall remain in place minimum of 7 days. In no case shall forming for horizontal members be removed before concrete has reached at least 70% of its specified design strength.

B. Reshore areas as required to carry additional imposed loads.

C. Repair damage to structure caused by early removal of forming and shoring at no additional cost to OWNER.

3.11 FIELD QUALITY CONTROL

A. Obtain samples of concrete in accordance with ASTM C172. Transport cylinders to place on-site where they can be stored under conditions affecting concrete they represent without being disturbed for first 24 hrs.

B. Make slump tests daily and when requested by ENGINEER, in accordance with ASTM C143/C 143M. Make slump tests from same batch from which strength tests are made.

C. When air-entrained concrete is used, make air content tests daily and when requested by ENGINEER in accordance with ASTM C231. Test pumped concrete at pipe discharge.

D. If measured slump or air content falls outside limits specified, make check test immediately on another portion of same sample. In event of second failure, concrete shall be considered to have failed to meet requirements of Specifications and will be rejected.

E. Strength test for each class of concrete consists of 4 cured standard cylinders made from composite samples secured from single load of concrete in accordance with ASTM C172. Make compressive strength tests on 1 cylinder at 7 days and 2 cylinders at 28 days. Test results at 28 days shall be average strength of 2 specimens as determined in accordance with ASTM C39/C39M, except if 1 specimen in test shows manifest evidence of improper sampling, molding or testing, it will be disregarded. Test remaining cylinder if needed.

F. Make strength test for each following condition for each class of concrete.

1. Each day's pour.
2. Each change of source.
3. Each 100 cu yds of concrete poured.
4. When temperatures are below or expected to fall below 45°F within 48 hrs after concrete placed, make 2 additional cylinders and cure in field under conditions approximating conditions affecting concrete they represent. Test one at 7 days, other at 28 days.

G. Strength level of individual class of concrete considered satisfactory if following requirements met.

1. Average of all sets of 3 consecutive strength tests equal or exceed specified 28 day compressive strength.
2. No individual strength test falls below specified 28 day compressive strength by more than 500 psi.

H. If analysis of strength tests indicates above requirements are not being met, make immediate adjustments to mix. Also, if likelihood of low strength concrete is confirmed, make additional tests as required by ENGINEER to determine strength of concrete in-place in portion of structure identified with deficient cylinders. If tests and analysis verify Work in-place is not in conformance with Specifications, ENGINEER will determine whether or not Work in-place is adequate for

intended use in location. If Work is determined inadequate, CONTRACTOR shall follow such remedial or replacement measures which ENGINEER may require. CONTRACTOR shall bear costs in connection with testing, engineering analyses, remedial work, and replacement required under terms of this paragraph.

* * * END OF SECTION * * *

SECTION 03 61 10
PATCHING MORTAR

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Polymer modified, cementitious, fast setting, mortar for repair of concrete surfaces.

1.02 SUBMITTALS

A. Product Data:

1. Manufacturer's literature.

B. Submit in accordance with Section 01300.

PART 2 PRODUCTS

2.01 MATERIALS

A. Manufacturers:

1. Sikatop, by Sika Corporation.
2. Duratop, by L&M Construction Chemicals.

B. Polymer modified cementitious system consisting of 2 components.

1. Component A: Liquid polymer emulsion of acrylic copolymer base and additives.
2. Component B: Blend of selected Portland cements, specially graded aggregates, organic accelerator, and admixtures for controlling setting time, water reducers for workability, and corrosion inhibitor.
3. System shall not contain chlorides, nitrates, added gypsum, added lime or high alumina cements. System shall be noncombustible, before or after cure.
4. Color: Concrete gray.
5. Minimum Compressive Strength: 5,000 psi.
6. Bond Strength: 100% concrete substrate failure (pull off method), minimum 400 psi.
7. System shall not produce vapor barrier, shall be thermally compatible with concrete, and freeze-thaw resistant.

PART 3 EXECUTION

3.01 PREPARATION

A. Prepare surface in accordance with manufacturer's written recommendations and Sections 03 30 10.

3.02 APPLICATION

A. Apply and cure patching mortar in accordance with manufacturer's written recommendations.

* * * END OF SECTION * * *

SECTION 03 62 00
NONSHRINK GROUT

PART 1 GENERAL

1.01 SUBMITTALS

A. Product Data

B. Submit in accordance with Section 01300.

PART 2 PRODUCTS

2.01 MATERIALS

A. Manufacturers:

1. Five Star Grout, Five Star Products, Inc.
2. Masterflow 928, Master Builders.
3. Unisorb V-1, Unisorb Machinery.

B. Grout:

1. Cement base, nonmetallic, nongas forming, nonshrink, preblended and ready-to-use requiring only addition of water at Project site.
2. Comply with ASTM C1107/C1107M Grade C.
3. Of moderate fluidity with minimum compressive strength of 5,000 psi at 28 days and shall not bleed.

C. Clean Water

PART 3 EXECUTION

3.01 PREPARATION

A. Clean grout contact surfaces of oil, grease, scale, and other foreign matter. Chip away unsound concrete leaving surface level but rough.

B. Underside of base plates of machinery, rails, and bolts shall be free of grease, oil, dirt or coatings.

3.02 MIXING AND PLACING

A. Mix and place in accordance with manufacturer's written instructions.

B. Provide sealing materials where necessary to retain grout until hardened.

C. Work grout from one side to other. Avoid trapping air under base plates.

D. Remove plastic anchor bolt sleeve tops where used, and fill with grout at same time base plates are grouted.

3.03 CURING

A. Cure with curing compound or as recommended by grout manufacturer.

* * * END OF SECTION * * *

SECTION 03 63 00
EPOXY GROUT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Material for grouting reinforcing bars into existing concrete and other uses where noted.

B. Alternatives:

1. CONTRACTOR may use premixed adhesive anchor material as specified in Section 05 50 00 when approved by ENGINEER, rather than using field mixed grout as specified herein.

1.02 SUBMITTALS

A. Product Data:

1. Manufacturer's literature.

B. Submit in accordance with Section 01300.

PART 2 PRODUCTS

2.01 MATERIALS

A. Epoxy:

1. Manufacturers:

a. Sikadur Hi-Mod or Sikadur Hi-Mod gel, by Sika Corporation.
b. Five Star Epoxy Grout, by Five Star Products, Inc.
c. Ceilcote 648, by Master Builders.

B. Sand: Hard, durable, oven dry.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean contact surfaces of oil, grease, and other foreign matter. Chip away unsound concrete.

3.02 MIXING

A. Mix components of epoxy compound as directed by manufacturer's instructions immediately before combining liquid with sand.

B. After binder thoroughly mixed, add sand as recommended by manufacturer.

3.03 PLACING

A. Place in accordance with manufacturer's written instructions following requirements regarding temperature and pot life.

B. Provide suitable materials where necessary to retain grout until hardened.

3.04 CURING

A. Cure as recommended by manufacturer.

* * * END OF SECTION * * *

DIVISION 5

METALS

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Miscellaneous metal fabrications.
2. Concrete anchors.
3. Steel lintels.

1.02 SUBMITTALS

A. Shop Drawings:

1. Indicate materials, sizes, connections, anchors, and painting.

B. Product Data:

1. Manufacturer's catalog sheets on premanufactured items.

C. Miscellaneous Submittals:

1. Provide International Conference of Building Officials (ICBO) or other similar building code organization recommendations regarding safe allowable design loads for concrete anchors.

D. Submit in accordance with Section 01300.

1.04 QUALITY ASSURANCE

A. Welding:

1. Steel:

a. Conform to codes for arc and gas welding in building construction of AWS and to AISC Specifications. Surfaces to be welded shall be free from loose scale, rust, grease, paint, and other foreign material, except mill scale which will withstand vigorous wire brushing may remain. No welding shall be done when base metal lower than 0°F.
b. Qualify welding operators in accordance with AWS D1.1. Qualification tests shall be run by recognized testing laboratory approved by ENGINEER at CONTRACTOR'S expense.
c. Welding operators shall be subject to examination for requalification using equipment, materials, and electrodes employed in execution of Work. Such requalification, if ordered by ENGINEER, shall be done at CONTRACTOR'S expense.

1.05 DELIVERY, STORAGE AND HANDLING

A. Tag miscellaneous iron, steel and aluminum including anchor bolts, concrete anchors, sleeves, and bases or otherwise mark for ease of identification at Project site.

PART 2 PRODUCTS

2.01 MATERIALS

A. Conform to following.

1. Structural Steel Shapes:

a.	W Shapes:	ASTM A992, 50 ksi.
b.	S, C and MC Shapes:	ASTM A36.
c.	L Shapes:	ASTM A36.
d.	HSS Square and Rectangular Shapes:	ASTM A500, Grade B, 46 ksi.
e.	HSS Round Shapes:	ASTM A500, Grade B, 42 ksi
f.	Pipe Shapes:	ASTM A53, Grade B, 35 ksi.
g.	Plates and Bars:	ASTM A36.

2. Stainless Steel:

a.	Exterior and Submerged Uses:	AISI, Type 316.
b.	Industrial Uses:	AISI, Type 316.
c.	Interior and Architectural Uses:	AISI, Type 304.
d.	Cast-in-Place Anchor Bolts:	AISI, Type 302, 303 or 304.

3. Connection Bolts for Steel Members: ASTM A325.
4. Anchor Bolts: ASTM A307, 1/2 in. minimum diameter; stainless steel.

2.02 FABRICATION

A. Connections and Workmanship:

1. Fabricate details and connection assemblies in accordance with Drawings and Specifications, with projecting corners clipped and filler pieces welded flush.
2. Weld shop connections and bolt or weld field connections, unless otherwise noted or specified.
3. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.
4. Use connections of type and design required by forces to be resisted and to provide secure fastening.

   a. AISC standard 2-angle web connections or single plate framing connections capable of supporting minimum of 50% total uniform load capacity of members joined as tabulated in uniform load constants of AISC M016.
   b. Connections shall consist of minimum of two 3/4 in. diameter bolts or welds developing minimum of 10,000 lbs.
   c. Make bearing type bolted connections with minimum 3/4 in. diameter bolts with threads included in shear plane, unless detailed otherwise.

5. Welding:

   a. Grind exposed edges of welds to 1/8 in. minimum radius. Grind burrs, jagged edges, and surface defects smooth.
   b. Prepare welds and adjacent areas so there is:

      1) No undercutting or reverse ridges on weld bead.
      2) No weld spatter on or adjacent to weld or other area to be painted or coated.

3) No sharp peaks or ridges along weld bead.

c. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

6. Bolting:

a. Draw up bolts or nuts tight in accordance with AISC specifications. Use bolts of lengths required so bolts do not project more than 1/4 in. beyond face of nut. Do not use washers unless specified. Provide hexagonal head bolts with hexagonal nuts.
b. Provide holes required for connection of adjacent or adjoining Work wherever noted on Drawings. Locate holes for bolting equipment to supports to tolerance of ±1/16 in. of dimensions indicated.

B. Fit Work together in fabrication shop and deliver complete or in parts, ready to be set in-place or assembled in field.

C. Galvanizing:

1. Galvanize after fabrication.
2. Galvanize by hot-dip process conforming with ASTM A123 and AHDGA specifications.
3. Galvanize in plant having facilities to produce quality coatings and capacity for volume of Work.
4. Ship and handle in manner to avoid damage to zinc coating.

D. Painting or Coating and Finishes:

1. Do not paint or coat ferrous metal surfaces embedded in concrete.
2. Review and comply with Section 09 91 10. Where other finish is not specified, clean ferrous metal after fabrication to remove oil, mill scale, rust, and foreign matter in accordance with SSPC SP 6. Apply 1 coat of shop primer.
3. Steel lintels and surfaces not accessible after assembly or erection shall be given 2 shop coats using different colors of paint to coating, 3.0 mil total dry thickness.

E. Castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion, smooth, and well cleaned by shot blastings.

2.03 CONCRETE ANCHORS

A. Expansion Anchors:

1. Manufacturers:

a. Liebig Anchor by Liebig.
b. HSL Expansion Anchor by Hilti.
c. Power Bolt by Powers Fasteners.

2. Usage: In concrete.

a. Zinc or chromate-plated carbon steel may be used where totally embedded, in interior locations with controlled humidity, and other protected locations.
b. Stainless steel shall be used in other locations such as outside, in tanks, or when attaching aluminum or galvanized steel.
c. Do not use expansion anchors when subjected to dynamic loads.

B. Sleeve Anchors:

1. Manufacturers:

   a. Sleeve Anchor by Hilti Corporation
   b. Dynabolt Sleeve by ITW Ramset/Red Head.
   c. Lok/Bolt by Powers Rawl Fasteners.
   d. Sleeve-All by Simpson Strong-Tie.

2. Usage: In masonry.

   a. Zinc or chromate-plated carbon steel in interior locations and other protected locations.
   b. Stainless steel in other locations.

C. Undercut Anchors:

1. Manufacturers:

   a. Liebig Ultraplus by Liebig.
   b. Maxi-Bolt by Drillco Devices Ltd.

2. Usage: In concrete, overhead applications, and for dynamic loads.

   a. Zinc or chromate-plated carbon steel may be used where totally embedded, in interior locations with controlled humidity, and other protected locations.
   b. Stainless steel shall be used in other locations such as outside, in tanks, or when attaching aluminum or galvanized steel.

2.04 STEEL LINTELS

A. Provide steel lintels over doors, louvers, grille openings, wall recesses, duct openings, and other openings in masonry walls as noted and wherever reinforced concrete or masonry lintels not provided.

B. Fabricate lintels from structural shapes as detailed, selected for straightness of section.

C. Unless otherwise shown, lintels shall have minimum bearing of 8 in. at each side of opening.

D. Fabricate lintels of multiple sections by welding, grind exposed welds smooth.

E. Openings less than 4 ft wide without lintel scheduled shall have reinforced masonry lintels or double steel angle lintels. Total width of horizontal legs shall be 1 in. less than wall thickness. Weld angles together.

F. Masonry Lintels: Comply with Section 04 22 00.

PART 3 EXECUTION

3.01 INSTALLATION

A. Layout and install connectors such as concrete anchors and anchor bolts to secure metal fabrications to structure.

B. Concrete Anchors:

1. Drill holes in concrete and masonry work with rotary driven twist drills only. Fill voids in masonry with grout.
2. Do not install until concrete has reached specified minimum strength (f'c).
3. Do not install closer than 6-bolt diameter to edge of concrete or masonry or closer than 12-bolt diameter to another anchor unless detailed on Drawings.
4. Minimum embedment shall be 8-bolt diameter.
5. Locate to clear reinforcing bars in concrete.
6. Install in accordance with manufacturer's recommendations.

C. Erect to lines and levels, plumb and true, and in correct relation to adjoining Work. Secure parts using concealed connections when practicable.

D. Plumb and true vertical members to tolerance of ±1/8 in. in 10 ft. Level horizontal members to tolerance of ±1/8 in. in 10 ft.

E. Provide items such as bolts, shims, blocks, nuts, washers, and wedging pieces to complete installation.

F. Drill field holes for bolts. Do not burn holes.

G. New holes or enlargement of unfair holes by use of cutting torch is cause for rejection of entire member.

H. Perform cutting, drilling, and fitting required for installation of metal fabrications.

I. Field welds shall be approved by ENGINEER before prime coating. Clean slag from welds prior to inspection.

3.02 ADJUSTING AND CLEANING

A. Field repair of damaged galvanized coatings.

1. Repair galvanized surfaces damaged during shipping or erection/construction operations.
2. Repair surfaces using zinc-rich paint.
3. Prepare surfaces and apply in accordance with ASTM A780, Annex A2.

* * * END OF SECTION * * *

DIVISION 13

SPECIAL CONSTRUCTION

SECTION 13 12 90
PREFABRICATED SHELTER

PART 1 GENERAL

1.01 Section Includes:

A. Prefabricated Shelter.

1.02 DESIGN REQUIREMENTS

A. Provide factory built, prefabricated structures and shelters capable of withstanding effects of gravity loads and following loads and stresses within limits and under conditions indicated.

B. Wind Loads: Determine loads based on following minimum design wind pressures:

1. Uniform pressure of 50 lbf/sq ft, acting inward or outward (standard).
2. Wind Load:

a. Shelters: 90 mph. (standard).

3. Snow Loads: 50 lbf/sq ft. (standard).

C. Seismic Performance: Provide factory built, prefabricated structures and shelters capable of withstanding effects of earthquake motions determined according to:

1. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads".

D. Thermal Movements: Provide factory built, prefabricated structures and shelters that allow for thermal movements resulting from following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Installation methods.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Certificates: Product certificates signed by manufacturer certifying material compliance with specified performance characteristics and criteria, and physical requirements.

F. Warranty documents specified herein.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing prefabricated structures and shelters with minimum documented experience of twenty years and with quality assurance program utilizing quality inspection for each system.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Protect all components and accessories from corrosion, deformation, damage and deterioration when stored at job site. Keep materials free from dirt and foreign matter.

1.06 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.07 WARRANTY

A. Provide manufacturer's 5 year limited warranty on anodized aluminum surfaces against oxidation and manufacturers 20 year limited warranty against peeling, flaking and chipping of deck and fascia when properly maintained.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Austin Mohawk and Company, Inc.

B. Or equal.

2.02 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish specified, and as follows:

1. Sheet: ASTM B 209.
2. Extruded Shapes: ASTM B 221.
3. Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T4 or 6061-T6.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A, Commercial Steel (CS), Type B.

C. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A, commercial quality, G90 (Z275) coating designation; mill phosphatized.

D. Aluminum Treadplate: 1/8-in. aluminum plate conforming to ASTM B 209.

E. Steel Mechanical Tubing: ASTM A 513, welded steel mechanical tubing.

F. Expanded Polystyrene (EPS) Core: Minimum of .95 pcf complying with ASTM C-578 Type 1.

G. Oriented Strand Board (OSB): Standard Grade; minimum physical properties conforming to APA PRP-108.

H. Clear Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality q3.

I. Ballistics-Resistant Glazing: Comply with requirements of UL 752 and/or NIJ.

J. Anchorages: Anchor bolts, as specified in Section 05 50 00.

2.03 PREFABRICATED STEEL SHELTERS

A. Size:

1. 4 ft by 4 ft.

B. Height: Nominal outside height 96 in. (2438 mm). Interior floor to ceiling height 88 in. (2235 mm).

C. Prefabricated with 14 gauge (1.78 mm) mechanical tube, welded framing system. Exterior smooth and flat with no exposed fasteners on building exterior.

1. Shelter Style:

a. Classic.

2. Roof Type:

a. Flat Deck Roof with 3 inch high overlapping deck pans.

3. Roof Overhang:

a. 4 in. overhang (standard).

D. Frame Construction: Framing shall be 14 gauge (1.78 mm) or heavier mechanical tube. All joints shall be MIG welded.

1. Finish: Provide manufacturer's epoxy primer with a urethane finish as follows:

a. Color as selected from manufacturer's standard colors.

E. Glazed Window Panels: Glazed within wall panel system extrusions and not fastened to the exterior wall. Glass sealed with concealed gasket system.

1. 3/16 in. (4.76 mm) thick, clear tempered safety glass.

F. Ceiling: Interior ceiling, foam core panel system providing smooth flat interior. Fabricate of 24 gauge prefinished steel painted white with expanded polystyrene core.

G. Roof: Galvanized steel, 20 to 24 gauge, G-60 zinc coating, interlocking pan sections, 3 in. (76.2 mm) high varying widths and capable of supporting a minimum 40 psf (1915 Pa) live load. Roof drains into full perimeter gutter system.

H. Anchoring: Shelter requires 6 in. (152 mm) thick (minimum) concrete pad 12 in. (305 mm) (minimum) larger than shelter in length and width. Shelter anchored to pad using height adjustable steel base plates with minimum 2 in. by 1/4 in. (51 mm to 6.3 mm) expansion anchors. Concrete pad by others.

2.04 SHELTER ACCESSORIES

A. Lighting Fixtures: Supplied only for wiring and installation by others.

1. Hi Abuse Fixture, Linear Fluorescent 40 Watts, Lamp Quantity 2, 120 V. Length 49.38 in. (1254 mm), width 9.25 in. (235 mm), depth 3.38 in. (85.8 mm), white, cold weather.
2. Provide photoelectric controller.

2.05 FABRICATION

A. Fabricate factory built, prefabricated structures and shelters completely in factory.

B. Preglaze windows and doors at factory.

C. Prewire factory built, prefabricated structures and shelters at factory, ready for connection to service at Project site.

D. Separate dissimilar materials using nonconductive tape, paint, or other material not visible in finished work.

E. Fabricate factory built, prefabricated structures and shelters for forklift unloading under base of booth with forklift pockets in base of booth or welded in place concealed lifting lugs at roof that are suitable for placement of structure on prepared foundations.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine supporting foundations for compliance with manufacturer's requirements, including installation tolerances and other conditions affecting performance of supporting members.

B. Check installed anchor bolts for accuracy. Verify that bearing surfaces are ready to receive the work.

C. Verify the rough-in of required mechanical and electrical services prior to placement of the structure.

D. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Separate dissimilar materials using nonconductive tape, paint, or other material not visible in finished work.

C. Place on prepared concrete foundations and slabs provided as specified under Section 03 30 10.

D. Anchor securely in place, allowing for required movement, including expansion and contraction.

E. Connect electrical services as specified in Division 26.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

* * * END OF SECTION* * *

SECTION 13 34 22
PRE-ENGINEERED METAL CANOPIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Freestanding, pre-engineered metal canopies including concrete foundation, steel framing, metal roof, roof drains and leaders, fascia components, and metal ceiling and accessories.

1.02 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide pre-engineered canopies capable of withstanding effects of gravity loads and following loads and stresses within limits and under conditions indicated for specific location where Canopy will be installed:

1. Uniform pressure as indicated on drawings – minimum design wind load per ASCE 7, CH. 6.
2. Snow load as indicated on drawings – minimum design snow load per ASCE 7, CH. 7.
3. Seismic performance – minimum design seismic criteria per ASCE 7, CH. 11 – 13.

B. Thermal Movements: Provide pre-engineered canopies that allow for thermal movements resulting from following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

1.03 SUBMITTALS

A. General: Submit under provisions of Section 01300 - Submittal Procedures.

B. Product Data: Submit manufacturer's data sheets on each product to be used, including:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Installation methods.

C. Shop Drawings: Submit shop drawings. Include plans, elevations, sections, details, and attachments to other work. Canopy supplier shall furnish complete canopy drawings signed and sealed by Professional Engineer licensed in State of Wisconsin.

D. Samples:

1. Submit samples for initial color selection. Submit samples of each specified finish. Submit samples in form of manufacturer's color charts showing full range of colors and finishes available. Where finishes involve normal color variations, include samples showing full, range of variations expected.
2. Submit samples for verification purposes. Samples shall be submitted prior to installation.

E. Certificates: Submit product certificates signed by manufacturer certifying material compliance with specified performance characteristics and criteria, and physical requirements.

F. Warranty Data: Submit warranty documents specified herein.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in engineering and manufacturing pre-engineered canopies with minimum documented experience of 20 yrs and with quality assurance program utilizing quality inspection for each system.

B. Welding: Qualify procedures and personnel according to following:

1. Welding shall be in accordance with AWS D1.1 (with E70XX electrodes).
2. Structural shop welding shall be done by certified welders.
3. Steel shop connections shall be welded and field connections shall be bolted unless otherwise noted on Drawings. Shop welds may be changed to field welds with approval of project engineer.
4. Slag shall be cleaned from welds and inspected. Steel shall be painted with red oxide rust-inhibitive primer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NEC, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Source Limitations: Obtain pre-engineered metal canopy through one source from single manufacturer who shall manufacture and install canopy.

E. Product Options:

1. Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance. Do not modify intended aesthetic effects, as judged solely by ARCHITECT, except with ARCHITECT'S approval. If modifications are proposed, submit comprehensive explanatory data to ARCHITECT for review.
2. Drawings indicate size, profiles, and dimensional requirements of pre-engineered metal canopies and are based on specific system indicated. Refer to Refer to Section 01600 - Product Requirements. Do not modify intended aesthetic effects, as judged solely by ARCHITECT, except with ARCHITECT'S approval. If modifications are proposed, submit comprehensive explanatory data to ARCHITECT for review.

F. Coordination:

1. CONTRACTOR shall conduct site meetings to verify project requirements, substrate conditions, utility connections, manufacturer's drawings and installation instructions. Comply with Division 1 section on project meetings.
2. CONTRACTOR shall prepare for and pour concrete footers for pre-engineered metal canopies. Manufacturer shall furnish recommended footing drawings and prints and rebar details for concrete footings, as well as provide anchor bolts to be embedded in concrete footer. Such items shall be delivered to project site in time for installation.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Protect components and accessories from corrosion, deformation, damage, and deterioration when stored at job site. Keep materials free from dirt and foreign matter.

1.06 PROJECT CONDITIONS

A. Field Measurements: CONTRACTOR shall verify location and elevation of footings relative to finished grade, columns, and other construction contiguous with pre-engineered metal canopies by field measurements before fabrication and indicate measurements on shop drawings.

1. Established Dimensions: CONTRACTOR shall, where field measurements cannot be made without delaying work, establish dimensions and proceed with fabricating metal canopies without field measurements. CONTRACTOR is responsible to coordinate footer locations and elevations with any interferences with or attachments to abutting structures.

1.07 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive OWNER of other rights OWNER may have under other provisions of Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under requirements of Contract Documents.

B. Special Warranty on Roof Panel Finishes: Written warranty, signed by manufacturer agreeing to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling and loss of film integrity.

1. Warranty Period for Roof Panels: 20 yrs from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Austin Mohawk and Company, Inc.

B. Jimco Sales & Manufacturing.

C. Or Equal.

2.02 MATERIALS

A. Structural Steel:

1. Material and work shall conform to latest AISC 360.
2. Wide flange I-beam shall conform to ASTM A 572/A 572M GR.50, Fy = 50 ksi. Other rolled sections shall conform to ASTM A 36/A 36M, Fy = 36 ksi.
3. Square and rectangular tubing shall conform to ASTM A 500/A 500M, Grade B, Fy = 46 ksi.
4. Plate steel shall conform to ASTM A 36/A 36M, Fy = 36 ksi.
5. Structural steel shall be painted with rust inhibitive (red oxide) primer (std).
6. Structural steel shall be hot-dip-galvanized.

B. Sheet Metal:

1. Decking: 3 in. (76 mm) by 16 in. (406 mm) by 20 gage smooth white, ASTM A.
2. Center and Tapered Gutter: 24 gage hot-dip galvanized steel baked enamel finish.
3. Perimeter Gutter: 20 gage hot-dip galvanized steel baked enamel finish.
4. Internal Downspout: 3 in. (76 mm) diameter PVC.
5. External Downspouts: 3 in. (76 mm) by 4 in. (102 mm) by 24 gage hot-dip galvanized steel with baked enamel finish.
6. Manufacturer shall be capable of providing seamless gutter profiles up to 40 ft (12 m) in length.

C. Concrete Foundation:

1. Minimum 28 day compressive strength of 3000 psi. Cast-in-place concrete shall conform to Section 033010.
2. Minimum 28 day compressive strength of 3000psi.

2.03 PRE-ENGINEERED METAL CANOPY

A. General: Provide complete, integrated set of manufacturer's standard fixed base design canopy components wherein steel framing system uses stacked I Beam construction transferring moment to concrete footing without requiring rigid connection between steel frame members. Beam arrangements allow for canteliever design which can bring columns from perimeter of structure to inner protected zones between drive lanes. These mutually dependent components form pre-engineered canopy, ready for construction on project site. Pre-engineered metal canopy will be designed to meet all site structural wind, snow and seismic requirements.

B. Canopy Fascia:

1. Aluminum Composite Panel (ACM): Available with fluorocarbon paint finish, masked on one side. Shall be warranted for 10 or 20 years depending on color and finish.
2. 2 in. Laminated Foam Core Fascia: Panel face shall be 24 gage hot-dip galvanized steel with baked enamel finish. Finishes shall be warranted against cracking, checking, peeling, or adhesion failure. Warranties for 5, 10, 20 yrs shall be available depending on color selection. Foam core shall be 2 in. (51 mm) expanded virgin polystyrene. Backing shall be 24 gage galvanized steel.
3. Fascia: Various custom fascia to meet design requirements such as architectural shingle, EIFS, standing seam panels.

C. Canopy Finishes: Comply with NAAMM MFM for recommendations for applying and designating finishes.

1. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of range of approved samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved samples and are assembled or installed to minimize contrast.

D. Fabrication: Fabricate pre-engineered canopies completely in factory.

2.04 FOUNDATION DESIGN

A. Assume 1500 psf bearing capacity. To be field verified prior to design of canopy foundation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Examine areas and conditions under which work is to be installed, and notify CONTRACTOR in writing, with copy to OWNER and ARCHITECT, of any conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

1. Examine supporting foundations for compliance with manufacturer's requirements, including installation tolerances and other conditions affecting performance of supporting members.
2. Check installed anchor bolts for accuracy. Verify that bearing surfaces are ready to receive work.
3. Verify rough-in of required mechanical and electrical services prior to placement of structure.
4. If preparation is responsibility of another installer, notify ARCHITECT of unsatisfactory preparation before proceeding.
5. Beginning of work shall indicate acceptance of areas and conditions as satisfactory by Installer.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under project conditions.

3.03 INSTALLATION

A. Work area shall be required extending 10 ft (3 m) beyond buildings and canopies in all directions to extent practical. Work area shall be flat, comprised of hard-packed soil or gravel, asphalt, or concrete, and free of open excavation, debris, construction equipment and construction workers. Additional flat work space minimum of 25 ft (7.6 m) by 25 ft (7.6 m) or as practical shall be provided adjacent to canopy and/or building for unloading and storing materials. Site to meet OSHA guidelines to allow lift equipment and scaffolding to maneuver work area.

B. Set pre-engineered metal canopy plumb and aligned. Level base plates true to plane with full bearing on concrete bases.

C. Fasten pre-engineered metal canopy columns to anchor bolts and/or foundation bolts.

D. Provide anchor bolts as follows:

1. Anchor bolts or foundation bolts will be set by OWNER in accordance with approved site specific drawings. They must not vary from size and dimensions shown on erection drawings. Use of plywood template is recommended. Remove template prior to column erection.
2. Anchor bolts shall conform to ASTM A 307, and shall have minimum of 7 in. (178 mm) of exposed thread and 23 in. (584 mm) minimum embedment with 1-1/4 in. (32 mm) nut and washer as embedment end.
3. Shrinkage-resistant grout shall be ASTM C 1107, factory-packaged, aggregate grout, non-corrosive, non-staining, mixed with water to consistency suitable for application and 30 min. working time installed by CONTRACTOR.

E. Provide bolted connections as follows:

1. Structural erection bolts shall conform to ASTM A 325/A 325M.
2. Minimum diameter of 3/4 in. (19 mm) erection bolts shall be used for cross beam-to-column connections and minimum of 5/8 in. (16 mm) diameter bolts for all other connections.
3. Drilled holes in structural steel shall be deburred.
4. Flat structural washers (minimum of one) shall be used on bolted connections.
5. Bolts shall be tightened to snug tight per latest RCSC specifications (unless otherwise specified).

F. Provide screws as follows:

1. Fastening shall be performed per installation prints provided by manufacturer.
2. Installation screws shall be furnished with electrode deposited cadmium coating unless otherwise noted.
3. Self-drilling and self-tapping screws shall have sufficient cut point and 1/2 in. (13 mm) outside dia dished metal-backed neoprene washer to be used in water sealing applications .

G. Provide pedestrian protection and warnings during construction which comply with local, Federal, and OSHA codes.

H. Prior to steel erection of any kind, CONTRACTOR shall grade, backfill and otherwise prepare job site to allow for rolling scaffold and ensure safe working conditions including removal or relocation of overhead power lines.

I. Any grade or elevation situations which deviate from approved manufacturer's plans shall be conveyed to manufacturer prior to fabrication.

J. All anchor bolts and/or leveling plates shall be set within 1/4 in. (6 mm) tolerance on layout and grade level.

K. Temporary electrical power shall be provided.

L. Connect electrical power service to power distribution system according to requirements specified in Division 16 - Electrical.

M. Dumpster for trash and debris shall be provided by CONTRACTOR.

3.04 ADJUSTING AND CLEANING

A. After completing installation, inspect exposed finishes and repair damaged finishes.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

* * * END OF SECTION * * *

DIVISION 26

ELECTRICAL

SECTION 26 05 19
LOW VOLTAGE CONDUCTORS AND CABLES
(600V and Less)

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Building wires and cables and associated splices, connectors, and terminations for wiring systems rated 600v and less.

1.02 DEFINITIONS

A. Under-floor Conduits.

1. Conduits run underground within perimeter of building walls under building floor. This may consist of 1 conduit, or several conduits grouped together.

B. Duct Bank Conduits

1. Conduits run underground outside perimeter of building walls. This may consist of 1 conduit, or several conduits grouped together.

C. Underground Conduits

1. Underground conduits are both underfloor conduits and duct bank conduits.

1.03 QUALITY ASSURANCE

A. Items provided under this Section shall be listed or labeled by Underwriters' Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

B. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver wire and cable according to NEMA WC-26.

PART 2 PRODUCTS

2.01 BUILDING WIRES AND CABLES

A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as required meeting application and NEC requirements.

B. Wire and cable for 600 volts and below: Soft drawn, copper wire with 600 volt insulation.

1. Conductors:

a. Annealed, copper in accordance with ASTM B33.
b. Stranding: Class B in accordance with ASTM B8, except No. 12 AWG branch circuits may be solid.

2. Insulations and Coverings:

a. Rubber: Conform to NEMA WC 70, NEMA WC 71, NEMA WC 74.
b. Thermoplastic: Conform to NEMA WC 70, NEMA WC 71, NEMA WC 74.
c. Cross-Linked Polyethylene: Conform to NEMA WC 70, NEMA WC 71, NEMA WC 74.
d. Ethylene Propylene Rubber: Conform to NEMA WC 70, NEMA WC 71, NEMA WC 74.

C. Feeders and service conductors: Single conductor Type XHHW-2.

D. Branch Circuits:

1. Single Conductor Type THHN/THWN: Above ground and underfloor conduits.
2. Single Conductor Type XHHW-2: Duct bank conduit.
3. No. 12 AWG minimum size (unless otherwise noted) for branch circuit wiring, including motor circuits.
4. Size 120 v branch circuits for length of run on following basis.

a. 0 to 50 ft Run From Panelboard to first outlet: No. 12 AWG minimum.
b. 51 to 100 ft Run: Increase one wire size, i.e., No. 12 AWG becomes No. 10 AWG.
c. 101 to 150 ft Run: Increase two wire sizes, i.e, No. 12 AWG becomes No. 8 AWG.
d. 151 ft and Above: Wiring sized for 3% maximum voltage drop.

5. For other branch circuits, voltage drop for branch circuits and feeder circuit combined shall not exceed requirements of NEC 215.

E. Control Circuits:

1. Single conductor Type THHN/THWN: Above ground, underfloor conduits and duct bank conduits.

F. Non-shielded Instrumentation, Graphic Indication, and Other Control Wiring Operating at Less Than 120v: No. 14 AWG except as otherwise indicated with same insulation as control circuits.

1. Single conductor Type THHW/THWN, above ground, underfloor conduits and duct bank conduits.

G. Shielded Instrumentation Wiring, above ground, underfloor conduits and duct bank conduits:

1. PVC insulation, tinned copper (19 by 27) stranded, No. 16 AWG, twisted pair or triplet cabled with aluminum mylar shielding, stranded, tinned, No. 18 AWG copper drain wire, and overall black FR-PVC, 90°C, 600 volt jacket.

2.02 CONNECTORS AND SPLICES

A. Underwriters Laboratories (UL)-listed factory-fabricated wiring connectors of size, ampacity rating, material, and type and class for application and for service indicated.

B. Select to comply with Project's installation requirements and as required to meet application.

C. Conductors No. 10 AWG and Smaller: 3M Electric Products, Skotchlok, or equal preinsulated spring connector. Comply with manufacturer's packaging requirements for number, size, and combination of conductors.

D. Conductors No. 8 AWG and Larger: Bronze 2-bolt type connectors with spacer.

2.03 TERMINATIONS

A. Power Conductors: Compression crimp type lugs.

B. Control and Instrumentation Conductors: Compression crimp type fork tongue, insulated support type lugs on terminal strips. Do not splice.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA "Standard of Installation".

B. Run wire and cable in conduit unless otherwise indicated on Drawings. Pull conductors into raceway simultaneously where more than 1 is being installed in same raceway.

1. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.
2. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
3. Do not draw conductor into conduits until building is enclosed, watertight, and work causing cable damage has been completed.

C. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie cables in individual circuits.

D. Seal cable and wire entering building from underground between wire and conduit, where cable exits conduit, with nonhardening approved compound.

E. Install wire and cables in separate raceway systems as follows:

1. ac Control.
2. dc control.
3. Shielded instrumentation.
4. As required by NEC.

F. Where power cables and instrument/signal cables enter and pass through same distribution box, steel barrier or separate raceways shall continue through box to avoid magnetic interaction between power cables and instrumentation conductors.

G. Do not run instrumentation cables into control cabinets or MCC unless cables are terminated in cabinet or MCC.

H. Wiring at Outlets: Install with at least 12 in. (300 mm) of slack conductor at each outlet.

I. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL 486A-486B.

J. Drawings do not designate number of conductors in conduit nor does location of branch circuits and switch legs indicated on Drawings designate location or routing. Route branch circuits and switch legs as dictated by construction and these Specifications.

3.02 TERMINATIONS AND SPLICES

A. Terminate control, instrumentation, and communication cables on terminal strips in separate terminal cabinets or as shown on Drawings.

B. Power Cable Splices: Keep to minimum.

1. Install splices and taps that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
2. Use splice and tap connectors that are compatible with conductor material.
3. Where preinsulated spring connectors are used for equipment connections, tape connector to wire to prevent loosening under vibration.
4. Each tap, joint or splice in conductors No. 8 AWG and larger shall be taped with 2 half-lap layers of vinyl plastic electrical tape and finish wrap of color coding tape where required by code.
5. Cable splices shall be made only in wireways, distribution boxes, and junction boxes.

C. Power Cable Terminations:

1. Termination of wires with full compression type lugs installed with appropriate hand or hydraulic tool. Use proper dies to achieve the desired compression.
2. For screw type terminal blocks, terminations for stranded conductors shall be made with T & B lock-on fork connector with insulated sleeves.
3. Motor lead conductor terminations shall be made with a T & B or approved equal, full compression lug, full ring type, bolted, and taped as required. For connecting motor lead to service wiring fasten full ring lugs together with cadmium plated steel cap screws, and cover with a minimum of 2 layers 1/2 lap, 3M Scotch No. 33 tape; option: T & B "Motor Stub Splice Insulator".

3.03 CONTROL CIRCUITS

A. Control circuit home runs from same area for the same system returning to same panel, (e.g., LCP, DPC, etc.,) may be combined provided signal and voltage type are not mixed.

B. Following types of home runs shall not be combined with other types:

1. 4-20 ma dc analog; Type 2 shielded cable.
2. 24 vdc discrete (e.g., field or LCP powered dry contacts).

3.04 BRANCH CIRCUITS

A. Motor branch circuits and branch circuits for 3 phase circuits shall not be combined.

B. Branch circuits for single phase equipment devices from same LP or PP may be combined provided that such combining does not result in having to derate ampacity of conductors.

3.05 FEEDERS:

A. Extend feeders at full capacity from origin to termination.

B. Each conduit raceway shall contain only those conductors constituting single feeder circuit.

C. Where multiple raceways are used for single feeder, each raceway shall contain conductor of each phase and neutral if used.

D. Where feeder conductors run in parallel, conductors shall be of same length, material, circular-mil area, insulation type, and terminated in same manner.

E. Where parallel feeder conductors run in separate raceways, raceways shall have same physical characteristics.

F. Confine feeders to insulated portions of building unless otherwise shown.

G. On network systems, neutral shall be run with phase wires. Unbalanced neutral current shall not exceed normal or derated conductor capacity.

3.06 MOTORS AND EQUIPMENT WIRING

A. Provide motor circuits in accordance with diagrams and schedules on Drawings and code requirements, from source of supply to associated motor starter and starter to motor terminal box, including necessary and required intermediate connections.

B. Do not include associated control conductors in same conduit with power conductors.

C. Provide branch circuits to conform with NEC requirements and nameplate ratings. CONTRACTOR responsible for verification of ratings of motors and installing proper branch circuits.

3.07 COLOR CODING

A. Conductors for Lighting and Power Wiring:

Phase	208/120v	480/277v
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Travelers	Pink	Purple
Neutral	White	Gray with non-green stripe
Ground	Green	Green

B. Colored pressure-sensitive plastic tape.

1. Apply in half overlapping turns for minimum of 3 in. at terminal points, and in junction boxes, pull boxes and troughs.
2. 3/4 in. wide with colors as specified.
3. Apply last two laps of tape with no tension to prevent possible unwinding.
4. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.

C. Color code for insulated power system wiring shall be in accordance with NEC.

D. Color code for intrinsically safe systems shall be light blue.

3.08 CONTROL, COMMUNICATION AND SIGNAL SYSTEM IDENTIFICATION

A. Install permanent wire marker at termination.

B. Identifying numbers and letters on wire markers shall correspond to those on terminal blocks or wiring diagrams used for installing systems.

C. Plastic sleeve or self adhesive vinyl cloth.

D. Comply with Section 26 05 53.

3.09 FEEDER IDENTIFICATION

A. Pullboxes and junction boxes, install metal tags on circuit cables and wires to clearly designate circuit identification and voltage.

B. Comply with Section 26 05 53.

3.10 FIELD QUALITY CONTROL

A. Visual and Mechanical Inspection:

1. Inspect cables for physical damage and proper connection in accordance with single-line diagram.
2. Test cable mechanical connections to manufacturer's recommended values using calibrated torque wrench.
3. Check cable color coding with specifications and NEC standards.

B. Electrical Tests:

1. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 1000 volts dc for 1 min.
2. Perform continuity test to insure proper cable connection.

C. Test Values:

1. Evaluation results by comparison with cables of same length and type. Investigate any value less than 50 megohms.

* * * END OF SECTION * * *

SECTION 26 05 26
GROUNDING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Grounding of electrical systems and equipment and basic requirements for grounding for protection of life, equipment, circuits, and systems.
2. Grounding requirements specified in this Section may be supplemented in other Sections of these Specifications.

1.02 SUBMITTALS

A. Report of Field Tests and Observations: Certified by CONTRACTOR.

B. Test Results:

1. Certified field tests and observation reports indicating and interpreting test reports for compliance with performance requirements.

C. Submit in accordance with Section 01300.

1.03 QUALITY ASSURANCE

A. Comply with UL 467.

B. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

C. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association NFPA 70.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING PRODUCTS

A. Governing Requirements: Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, more stringent requirements and greater size, rating, and quantity indications govern.

2.02 WIRE AND CABLE GROUNDING CONDUCTORS

A. Conform to NEC, Table 8, except as otherwise indicated, for conductor properties, including stranding.

1. Material: Copper.

B. Equipment Grounding Conductors: Insulated with green color insulation.

C. Grounding-Electrode Conductors: Stranded cable.

D. Underground Conductors: Bare, tinned, stranded, except as otherwise indicated.

E. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Assembly of Stranded Conductors: ASTM B8.
3. Tinned Conductors: ASTM B33.

2.03 MISCELLANEOUS CONDUCTORS

A. Grounding Bus: Bare, annealed-copper bars of rectangular cross section.

B. Braided Bonding Jumpers: Copper tape, braided No. 30 AWG bare copper wire, terminated with copper ferrules.

C. Bonding Straps: Soft copper, 0.05 in. (1 mm) thick and 2 in. (50 mm) wide, except as indicated.

2.04 CONNECTOR PRODUCTS

A. Pressure Connectors: High-conductivity-plated units.

B. Bolted Clamps: Heavy-duty type.

C. Exothermic-Welded Connections: Provided in kit form and selected per manufacturer's written instructions for specific types, sizes, and combinations of conductors and connected items.

2.05 GROUNDING ELECTRODES AND TEST WELLS

A. Grounding Rods: Copper-clad steel.

1. Size: 3/4 in. by 120 in. (19 by 3000 mm).

B. Test Wells: Fabricate as detailed on Drawings.

PART 3 EXECUTION

3.01 APPLICATION

A. Equipment Grounding Conductors: Comply with NEC, Article 250 for types, sizes, and quantities of equipment grounding conductors, except where specific types, larger sizes, or more conductors than required by NEC are indicated.

1. Install equipment grounding conductor with circuit conductors for items below in addition to those required by Code:

a. Feeders and branch circuits.
b. Lighting circuits.
c. Receptacle circuits.
d. Single-phase motor or appliance branch circuits.
e. Three-phase motor or appliance branch circuits.
f. Flexible raceway runs.

2. Nonmetallic Raceways: Install equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

B. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding-electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on 1/4 by 2 by 12 in. (6 by 50 by 300 mm) grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

C. Separately Derived Systems: Where NEC requires grounding, ground according to NEC, Paragraph 250-26.

D. Piping Systems and Other Equipment: Comply with NEC Article 250 for bonding requirements.

3.02 INSTALLATION

A. Ground electrical systems and equipment according to NEC requirements, except where Drawings or Specifications exceed NEC requirements.

B. Grounding Rods: Locate minimum of 1 rod length from each other and at least same distance from any other grounding electrode.

1. Drive until tops are 2 in. (50 mm) below finished floor or final grade, except as otherwise indicated.
2. Interconnect with grounding-electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make these connections without damaging copper coating or exposing steel.

C. Grounding Conductors: Route along shortest and straightest paths possible, except as otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

D. Underground Grounding Conductors: Use bare copper wire. Bury at least 24 in. (600 mm) below grade.

E. Metal Water Service Pipe: Provide insulated copper grounding conductors, sized as indicated, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding-clamp connectors. Where dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Do not install grounding jumper across dielectric fittings. Bond grounding-conductor conduit to conductor at each end.

F. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding-clamp connectors.

G. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

H. Test Wells: One for each driven grounding electrode system, except as otherwise indicated. Set top of well flush with finished grade or floor. Fill with 1 in. (25 mm) maximum-size crushed stone or gravel.

3.03 CONNECTIONS

A. Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to assure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding-Wire Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: Where metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors, except as otherwise indicated.

E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and grounding rods.

F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. Where these requirements are not available, use those specified in UL 486A-486B.

G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make visible indication that connector has been adequately compressed on grounding conductor.

H. Moisture Protection: Where insulated grounding conductors are connected to grounding rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.04 FIELD QUALITY CONTROL

A. Testing:

1. Subject completed grounding system to megger test at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.
2. Measure ground resistance not less than 2 full days after last trace of precipitation, and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
3. Perform tests by 2 point method according to Section 9.03 of IEEE 81.

B. Maximum grounding to resistance values are as follows:

1. Equipment Rated 500 kVA and Less: 10 ohms.
2. Equipment Rated 500 to 1000 kVA: 5 ohms.
3. Equipment Rated More than 1000 kVA: 3 ohms.
4. Unfenced Substations and Pad-Mounted Equipment: 5 ohms.

C. Excessive Ground Resistance: Where resistance to ground exceeds specified values, notify ENGINEER promptly and include recommendations to reduce ground resistance and to accomplish recommended work.

D. Report: Prepare certified test reports, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

3.07 RESTORATION

A. Restore surface features, including vegetation, at areas disturbed by work of this Section.

1. Re-establish original grades, except as otherwise indicated.
2. Where sod has been removed, replace it as soon as possible after backfilling is completed.
3. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition.
4. Include topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.
5. Maintain restored surfaces.
6. Restore disturbed paving.

* * * END OF SECTION * * *

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Supports from building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.02 QUALITY ASSURANCE

A. Items provided under this section shall be listed and labeled by UL or other Nationally Recognized Testing laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel or malleable iron.

B. Aluminum where indicated.

C. Stainless steel where indicated.

2.02 COATINGS

A. Protect steel and malleable iron supports, support hardware, and fasteners with zinc coating.

B. Products for use outdoors.

C. Use PVC coating where indicated on Drawings.

2.03 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

B. Fasteners: Types, materials, and construction features as follows:

1. Expansion Anchors: Carbon steel wedge or sleeve type.
2. Toggle Bolts: All steel springhead type.
3. Powder-Driven Threaded Studs: Heat-treated steel, designed specifically for intended service.
4. Nuts, Washers, and Bolts: Stainless steel in outdoor applications.

C. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

D. U-Channel Systems: Galvanized channels, with 9/16-in. dia holes, at minimum of 8 in. on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of same manufacture.

2.04 FABRICATED SUPPORTING DEVICES

A. Shop- or field-fabricate supports or manufacture supports assembled from U-channel components.

B. Brackets: Fabricated of galvanized angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

C. Pipe Sleeves: Provide pipe sleeves of 1 of following:

1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from following gage metal for sleeve diameter noted:

   a. 3 in. and smaller: 20 ga.
   b. 4 in. to 6 in.: 16 ga.
   c. Over 6 in.: 14 ga.

2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.
3. Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe.

2.05 FIRE RESISTANT JOINT SEALERS

A. Manufacturers:

1. "Dow Corning Fire Stop Foam," Dow Corning Corp.
2. "Pensil 851," General Electric Co.
3. Or equal.

B. Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors.

C. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Coordinate with structural system and with other electrical installation.

C. Raceway Supports: Comply with NEC and following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.
2. Strength of each support shall be adequate to carry present and future load multiplied by safety factor of at least 4. Where this determination results in safety allowance of less than 200 lbs, provide additional strength until there is minimum of 200 lbs safety allowance in strength of each support.
3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
4. Support parallel runs of horizontal raceways together on trapeze-type hangers.
5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1 in. and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4 in. dia or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.

D. Miscellaneous Supports: Support miscellaneous electrical components as required to produce same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

E. Sleeves: Install in concrete slabs and walls and other fire-rated floors and walls for raceways and cable installations. For sleeves through fire rated-wall or floor construction, apply UL listed firestopping sealant in gaps between sleeves and enclosed conduits and cables.

F. Conduit Seals: Install seals for conduit penetrations of slabs below grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

G. Conduit extending through roof shall pass through ceiling box at roof line.

1. Provide 14 ga minimum copper box complete with watertight soldered seams and flanged to serve as pitch pocket for each conduit.
2. Install conduit and pitch pocket in advance of roofing work.

H. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with following:

1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
2. Holes cut in concrete shall not cut main reinforcing bars. Fill holes that are not used.
3. Load applied to any fastener shall not exceed 25% of proof test load. Use vibration- and shock- resistant fasteners for attachments to concrete slabs.

* * * END OF SECTION * * *

SECTION 26 05 33
RACEWAYS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. Raceways:

a. Galvanized rigid steel conduit (GRS).
b. PVC externally coated galvanized rigid steel conduit (CGRS).
c. Liquidtight flexible metal conduit (LFMC).
d. Rigid nonmetallic polyvinyl chloride conduit (PVC).
e. Wireway (WW).

1.02 DEFINITIONS

A. Underfloor Conduits.

1. Conduits which run underground within perimeter of building walls under building floor. This may consist of 1 conduit, or several conduits grouped together.

B. Duct Bank Conduits

1. Conduits which run under ground outside perimeter of building walls. This may consist of 1 conduit, or several conduits grouped together.

C. Underground Conduits

1. Underground conduits are both underfloor conduits and duct bank conduits.

1.03 SUBMITTALS

A. Submittals are not required if CONTRACTOR supplies materials or equipment of specified or named manufacturers. If CONTRACTOR proposes substitutions to material or equipment of specified or named manufacturers, submittals identified below are required.

1. Product data.
2. Submit in accordance with Section 01300.

1.04 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. National Electrical Code: Components and installation shall comply with NFPA 70.

C. Comply with NECA "Standard of Installation."

PART 2 PRODUCTS

2.01 METAL CONDUIT AND TUBING

A. Galvanized Rigid Steel Conduit: NEMA C80.1.

B. Plastic Coated Steel Conduit and Fittings: NEMA RN1.

C. Liquidtight Flexible Metal Conduit: Flexible steel conduit with PVC jacket.

2.02 NONMETALLIC CONDUIT

A. Rigid Nonmetallic Polyvinyl Chloride (PVC) Conduit: NEMA TC 2, Schedule 80 PVC.

B. PVC Conduit Fittings: NEMA TC 3; match to conduit type and material.

2.03 FITTINGS

A. Fittings for steel conduits:

1. Cast aluminum or malleable iron with galvanized finish.
2. Synthetic inserts for sealing or insulation as required.
3. Comply with ANSI C80.4.
4. Comply with NEMA FB 1, compatible with conduit materials.

B. Conduit bodies:

1. Malleable iron with galvanized finish.

C. Fittings for liquidtight flexible metal conduit.

1. Insulated throat type.
2. One piece sealing "O" rings with connectors when entering boxes or enclosures.

2.04 WIREWAYS

A. Material: Sheet metal sized and shaped as indicated.

B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireway as required for complete system.

C. Select features where not otherwise indicated, as required to complete wiring system and to comply with NEC.

D. Wireway Covers:

1. Hinged type for dry locations.
2. Bolted cover with gasket for wet locations.

E. Finish: Manufacturer's standard enamel finish unless other wise noted.

2.05 RACEWAY/DUCT SEALING COMPOUND

A. Nonhardening, putty-like consistency workable at temperatures as low as 35°F.

B. Compound shall not slump at temperature of 300°F and shall readily adhere to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive raceways, wireways, and fittings for compliance with installation tolerances and other conditions affecting performance of raceway system.

B. Coordinate layout and installation of raceway and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

3.02 WIRING METHODS

A. Outdoors, Damp or Wet Locations: Use following wiring methods unless otherwise noted on Drawings:

1. Exposed: Galvanized rigid steel.
2. Concealed: Galvanized rigid steel.
3. Underground Power and 120V Discrete Signal, Single Run: Rigid nonmetallic (PVC) conduit, Schedule 80 with PVC-coated rigid steel stub-ups.

   a. Direct buried.

4. Underground Power and 120 Discrete Signal, Grouped: Rigid nonmetallic (PVC) conduit, Schedule 80 with PVC-coated rigid steel stub-ups.

   a. Direct buried.

5. Underground Communications Cables, Single Run or Grouped: Galvanized Rigid Steel, with PVC-coated rigid steel stub-ups.

   a. Direct buried.

6. Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Liquidtight flexible metal conduit.

B. Indoor Dry Locations: Use following wiring methods unless otherwise noted.

1. Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Liquidtight flexible metal conduit.
2. Steel conduit.
3. Exposed: Galvanized rigid steel conduit.
4. Concealed: Galvanized rigid steel conduit.

C. Unless specifically indicated otherwise on Drawings, use galvanized rigid steel or intermediate metal conduit for general wiring.

1. Use 3/4 in. minimum size unless otherwise noted except conduit runs to room light switches may be 1/2 in.

D. Schedule 80 PVC conduit and galvanized rigid steel conduit may be used without encasing in concrete for underground conduit.

1. Underground conduit shall be minimum of 1 in., buried at depth of not less than 24 in. below grade.
2. Provide conduits or ducts terminating below grade with means to prevent entry of dirt and moisture.
3. Transition to PVC-coated rigid steel conduit for stub-ups.

E. Raceways Embedded in Slabs: Comply with Section 03 30 10 and the following:

1. Use galvanized rigid steel conduit.
2. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
3. Space raceways laterally to prevent voids in concrete.
4. Install in middle third of slab thickness where practical, and leave at least 1 in. (25 mm) concrete cover.
5. Run conduit larger than 1 in. trade size parallel to or at right angles to main reinforcement and spaced on center of at least 3 times conduit trade diameter with minimum 2 in. concrete covering. Conduits over 1 in. may not be installed in slab without approval of ENGINEER.
6. When at right angles to reinforcement, place conduit close to slab support.
7. Conduits embedded in concrete frame shall comply with applicable provisions of ACI 318.

3.03 INSTALLATION

A. Provide watertight conduit system where installed in wet places, underground or where buried in masonry or concrete.

1. Use threaded hubs when entering top of enclosures.
2. Use sealing type locknuts when entering sides or bottom of enclosures.

B. Install raceways level and square and at proper elevations. Provide adequate headroom.

C. Complete raceway installation before starting conductor installation.

D. Support raceway as specified in Section 26 05 29.

E. Use temporary closures to prevent foreign matter from entering raceway.

F. Run concealed raceways with minimum of bends in shortest practical distance considering type of building construction and obstructions, except as otherwise indicated.

G. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow surface contours as much as practical.

1. Mount exposed horizontal runs as high above floor as possible, and in no case lower than 7 ft above floors, walkways, or platforms in passage areas.
2. Run parallel or banked raceways together, on common supports where practical.
3. Make bends in parallel or banked runs from same center line to make bends parallel. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways.

H. Join raceways with fittings designed and approved for purpose and make joints tight.

1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.

2. Use insulating bushings to protect conductors.

I. Tighten set screws of threadless fittings with suitable tool.

J. Terminations: Where raceways are terminated with locknuts and bushings, align raceway to enter squarely, and install locknuts with dished part against box. Use two locknuts, 1 inside and 1 outside box. Use insulating bushings. Provide insulated grounding bushings to terminate ground wire.

K. Where terminating in threaded hubs, screw raceway or fitting tight into the hub so end bears against wire protection shoulder. Where chase nipples are used, align raceway so coupling is square to box, and tighten chase nipple so no threads are exposed.

L. Install pull wires in empty raceways. Use monofilament plastic line having not less than 200 lb (90 kg) tensile strength. Leave not less than 12 in. (300 mm) of slack at each end of pull wire.

M. Telephone and Signal System Raceways 2 in. Trade Size and Smaller: In addition to above requirements, install in maximum lengths of 150 ft (45 m) and with maximum of two 90° bends or equivalent. Install pull or junction boxes where necessary to comply with these requirements.

N. PVC Externally Coated Galvanized Rigid Steel Conduit: Only use fittings approved for use with that material. Patch nicks and scraps in PVC coating after installing conduit.

3.05 CONDUIT STUB-UPS

A. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above finished slab.

B. Transition under floor conduit to galvanized rigid steel conduit, before rising above floor.

C. Stub-Up Connections: Extend conduits for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used starting at 6 in. (150 mm) above floor. Where equipment connections are not made under this Contract, install screwdriver-operated threaded flush plugs, flush with floor.

3.06 CONDUIT BENDS

A. Make bends and offsets so inside diameter is not reduced. Unless otherwise indicated, keep legs of bend in same plane and straight legs of offsets parallel.

B. Provide NEMA standard conduit bends, except for conduits containing 5 kV and 15 kV cables.

C. For conduits containing fiber optic cables, provide conduit bends with minimum radius of 20 times cable diameter.

3.07 FLEXIBLE CONNECTIONS

A. Terminate conduits at motor terminal boxes, motor operated valve stations or pipe-mounted instruments and other equipment subject to vibration with maximum of 3 ft (915 mm) liquid-tight flexible metal conduit unless other wise indicated.

B. Use liquidtight flexible conduit in wet or damp locations.

C. Use approved flexible connections in hazardous locations.

D. Install separate ground conductor inside flexible conduit connections.

3.08 FITTINGS

A. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. Install raceway sealing fittings at following points and elsewhere as indicated:

1. Where conduits enter or leave hazardous locations.
2. Where conduits pass from warm locations to cold locations, such as boundaries of refrigerated spaces and air-conditioned spaces.
3. Where otherwise required by NEC.

B. Use raceway fittings compatible with raceway and suitable for use and location. For GRS, use threaded galvanized rigid steel conduit fittings, except as otherwise indicated.

C. Install automatic breather drain fittings according to manufacturers written instructions. Locate fittings to drain conduit system and prevent condensate from entering device enclosures. Install automatic breather drain fittings at following points and elsewhere as indicated.

1. Where vertical seals are installed.
2. Low points in conduit system.
3. Below field instruments at junction of flexible and rigid conduit.
4. Where otherwise required by NEC.

D. Install wall entrance seal as dictated by application where conduits pass through foundation walls below grade.

E. Install conduit expansion fittings complete with bonding jumper in following locations.

1. Conduit runs crossing structural expansion joint.
2. Conduit runs attached to 2 separate structures.
3. Conduit runs where movement perpendicular to axis of conduit may be encountered.

F. Where conduit passes from inside of building to outdoors, it shall be firmly packed at fitting nearest wall line with Johns-Manville Duxseal to depth of at least 1 in. after wires and cables are pulled in; or, if conduit enters directly into equipment, it shall be fitted with seal and drain fitting to prevent water entering equipment.

3.09 GROUNDING

A. Ground in accordance with Section 26 05 26.

B. Provide grounding connections for raceway, boxes, and components as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL 486A-486B.

3.10 PROTECTION

A. Provide final protection and maintain conditions, in manner acceptable to manufacturer and Installer, to ensure that coatings, finishes, and cabinets are without damage or deterioration at Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touch-up coating recommended by manufacturer.

3.11 CLEANING

A. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

* * * END OF SECTION * * *

SECTION 26 05 34
CABINETS, BOXES, AND FITTINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Outlet and device boxes.
2. Pull and junction boxes.
3. Hinged door enclosures.
4 Boxes and fittings for hazardous locations.

B. Conduit-body-type electrical enclosures and wiring fittings are specified in Section 26 05 33.

1.02 DEFINITIONS

A. Cabinets: Enclosure designed either for surface or for flush mounting and having frame, or trim in which door or doors may be mounted.

B. Device Box: Outlet box designed to house receptacle device or wiring box designed to house switch.

C. Enclosure: Box, case, cabinet, or housing for electrical wiring or components.

D. Hinged Door Enclosure: Enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with walls of box.

E. Outlet Box: Wiring enclosure where current is taken from wiring system to supply utilization equipment.

F. Wiring Box: Enclosure designed to provide access to wiring systems or for mounting of indicating devices or of switches for controlling electrical circuits.

1.03 SUBMITTALS

A. Product Data: Submit for cabinets and enclosures with classification higher than NEMA 1.

B. Submit in accordance with Section 01300.

1.04 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA 70).

PART 2 PRODUCTS

2.01 CABINETS, BOXES, AND FITTINGS, GENERAL

A. Electrical Cabinets, Boxes, and Fittings: Of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for use and location. Provide items complete with covers and accessories required for intended use. Provide gaskets for units in damp or wet locations.

2.02 MISCELLANEOUS MATERIALS AND FINISHES

A. Fasteners for General Use: Corrosion resistant screws and hardware including cadmium and zinc plated items.

B. Fasteners for Damp or Wet Locations: Stainless steel screws and hardware.

C. Fittings for Boxes, Cabinets, and Enclosures: Conform to UL 514B. Malleable iron or zinc plated steel for conduit hubs, bushings and box connectors.

D. Finishes:

1. Exterior Finish: Galvanized or Gray baked enamel for items exposed in finished locations except as otherwise indicated.
2. Interior Finish: Where indicated, white baked enamel.

2.03 METAL OUTLET, DEVICE, AND SMALL WIRING BOXES

A. General:

1. Conform to UL 514A and UL 514B.
2. Boxes shall be of type, shape, size, and depth to suit each location and application.

B. Steel Boxes: Conform to NEMA OS 1. Boxes shall be sheet steel with stamped knockouts, threaded screw holes and accessories suitable for each location including mounting brackets and straps, cable clamps, exterior rings and fixture studs.

C. Galvanized Cast-Iron Boxes: Iron alloy, waterproof, with threaded raceway entries and features and accessories suitable for each location, including mounting ears, threaded screw holes for devices and closure plugs.

2.04 PULL AND JUNCTION BOXES

A. Comply with UL 50 for boxes over 100 cu in. volume. Boxes shall have screwed or bolted on covers of material same as box and shall be of size and shape to suit application.

B. Galvanized Steel Boxes: Flat rolled, code gauge, sheet steel with welded seams. Where necessary to provide rigid assembly, construct with internal structural steel bracing. Hot-dip galvanized after fabrication. Cover shall be gasketed.

C. Stainless-Steel Boxes: Fabricate of stainless steel conforming to Type 304 of ASTM A167. Where necessary to provide rigid assembly, construct with internal structural stainless steel bracing. Cover shall be gasketed.

D. Boxes Approved for Classified Locations: Cast metal or cast nonmetallic boxes conforming to UL 886 listed and labeled for use in specific location classification, and with specific hazardous material encountered. Conduit entrances shall be integral threaded type.

2.05 STEEL ENCLOSURES WITH HINGED DOORS

A. Comply with UL 50 and NEMA ICS 6.

B. Construction:

1. Sheet steel, 16 ga, minimum, with continuous welded seams. NEMA class as indicated; arranged for surface mounting.
2. Stainless steel.

C. Doors: Hinged directly to cabinet and removable, with approximately 3/4 in. flange around each edge, shaped to cover edge of box. Provide handle operated, key locking latch. Individual door width shall be no greater than 24 in. Provide multiple doors where required.

D. Mounting Panel: Provide painted removable internal mounting panel for component installation.

E. Enclosure: NEMA 12 except as indicated. Where door gasketing is required, provide neoprene gasket attached with oil-resistant adhesive, and held in place with steel retaining strips. For enclosures of class higher than NEMA 1, use hubbed raceway entrances.

2.06 TERMINAL STRIPS

A. Manufacturers:

1. Square D.
2. Buchanan.
3. Or equal.

B. Channel mount snap-on type.

C. Individual gangable with nylon bases.

D. Solderless box lug type rated at 600 v to accommodate No. 22 to 8 AWG wire or as otherwise indicated.

E. Provide 50% spare terminals.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Locations: Install items where indicated and where required to suit code requirements and installation conditions.

B. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.

C. Support and fasten items in accordance with Section 26 05 29.

D. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated.

E. Remove sharp edges where they may come in contact with wiring or personnel.

3.02 APPLICATIONS

A. Hinged Door Enclosures: Sheet steel, baked enamel finish, NEMA type 12 enclosure except as indicated.

B. Hinged Door Enclosures in Outdoor or Corrosive Locations: NEMA type 4X stainless steel metal enclosure, or as indicated on Drawings.

C. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types for each location in conformance with following requirements unless otherwise noted:

1. Interior Dry Locations: Feraloy Type FS or FD cast boxes with threaded conduit hubs for surface mounting.
2. Locations Exposed to Weather or Dampness: Galvanized, cast metal, NEMA Type 3R.
3. Wet Locations: Stainless Steel, NEMA type 4X enclosures.
4. Corrosive Locations: Stainless Steel, NEMA type 4X enclosures.
5. Hazardous (Classified) Locations: NEMA type listed and labeled for location and class of hazard indicated.

D. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types suitable for each location.

3.03 INSTALLATION OF OUTLET BOXES

A. Outlets at Windows and Doors: Locate close to window or door trim.

B. Column and Pilaster Locations: Locate outlet boxes for switches and receptacles on columns or pilasters so centers of columns are clear for future installation of partitions.

C. Gasketed Boxes: At following locations use cast metal, threaded hub type boxes with gasketed weatherproof covers:

1. Exterior locations.
2. Where surface mounted on unfinished walls, columns or pilasters. (Cover gaskets may be omitted in dry locations).
3. Where exposed to moisture laden atmosphere.
4. Where indicated.

D. Mounting: Mount outlet boxes for switches with long axis vertical or as indicated. Mount boxes for receptacles vertically. Gang boxes shall be mounted with long axis horizontal. Locate box covers or device plates so they will not span different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on side opposite hinges and close to door trim, even though electrical floor plans may show them on hinge side.

E. Cover Plates for Surface Boxes: Use plates sized to box front without overlap.

F. Protect outlet boxes to prevent entrance of plaster, and debris. Thoroughly clean foreign material from boxes before conductors are installed.

G. Secure boxes rigidly to substrate upon which being mounted or solidly embed boxes in concrete or masonry. Do not support from conduit, mechanical ductwork or piping.

H. Set outlet boxes parallel to construction, securely mounted and adjusted to set true and flush with finished surface.

I. Do not burn holes, use knockout punches or saw.

J. Provide outlet box divider barriers between 277/480 v and 120/240 v devices as required and per NEC.

3.04 OUTLET BOX LOCATIONS

A. Locate flush mounted wall boxes in corner of nearest brick or block to keep cutting to minimum.

B. Location of outlets and equipment as shown on Drawings is approximate and exact location to be verified and shall be determined by:

1. Construction or code requirements.
2. Conflict with equipment or other trades.
3. Equipment manufacturer's drawings.

C. Minor modification in location of outlets and equipment considered incidental up to distance of 10 ft with no additional compensation, provided necessary instructions given prior to roughing in of outlet.

D. Mounting heights for devices and equipment to be measured from finished floor to centerline of device and unless otherwise noted on Drawings as follows.

1. Switches: 48 in. above floor.
2. ac Receptacles: 15 in. above floor or 6 in. above counters, counter backsplashes, and baseboard radiators in finished areas; 48 in. above floor in unfinished areas.
3. Pushbuttons: 48 in. above floor.
4. Motor Starters and Disconnect Switches: 60 in. above floor.

3.05 INSTALLATION OF PULL AND JUNCTION BOXES

A. Box Selection: For boxes in main feeder conduit runs, use sizes not smaller than 8 in. sq by 4 in. deep. Do not exceed 6 entering and 6 leaving raceways in single box. Quantities of conductors (including equipment grounding conductors) in pull or junction box shall not exceed following:

Size of Largest Conductors in Box	**Maximum No. of Conductors in Box**
No. 4/0 AWG	30
250 MCM	20
500 MCM	15
Over 500 MCM	10

1. Cable Supports: Install clamps, grids, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30 in. inside boxes.
2. Mount pull boxes in inaccessible ceilings with covers flush with finished ceiling.
3. Size: Provide pull and junction boxes for telephone, signal, instrumentation, control, and other systems at least 50% larger than would be required by Article 370 NEC, or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems.

3.06 INSTALLATION OF CABINETS AND HINGED DOOR ENCLOSURES

A. Mount with fronts straight and plumb.

B. Install with tops 78 in. above floor.

C. Terminate wires and cables on terminal strips.

3.07 GROUNDING

A. Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes grounding conductor, provide grounding terminal in interior of cabinet, box or enclosure.

3.08 CLEANING AND FINISH REPAIR

A. Upon completion of installation, inspect components. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, abrasions and weld marks.

B. Galvanized Finish: Repair damage using zinc-rich paint recommended by manufacturer.

C. Painted Finish: Repair damage using matching corrosion inhibiting touch-up coating.

* * * END OF SECTION * * *

SECTION 26 05 43
UNDERGROUND DUCTS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Ducts.
2. Duct banks.

1.02 DEFINITIONS

A. Duct: General term for electrical conduit and other raceway, either metallic or nonmetallic, specified for use underground, embedded in earth or concrete.

B. Duct Bank: Group of 2 or more ducts in continuous run between 2 points.

C. Underfloor Conduits.

1. Conduits which run underground within perimeter of building walls under building floor. This may consist of 1 conduit, or several conduits grouped together.

D. Duct Bank Conduits

1. Conduits which run under ground outside perimeter of building walls. This may consist of 1 conduit, or several conduits grouped together.

E. Underground Conduits

1. Underground conduits are both underfloor conduits and duct bank conduits.

F. Handhole: Below-the-surface enclosure in connection with ducts into which people reach, but do not enter, for purpose of installing, operating, or maintaining equipment or wiring.

G. Manhole: Below-the-surface enclosure or chamber, large enough for person to enter, connecting with ducts, and affording facilities for installing, operating, and maintaining equipment or wiring.

1.03 SUBMITTALS

A. Submittals are not required if CONTRACTOR supplies materials or equipment of specified or named manufacturers. If CONTRACTOR proposes substitutions to material or equipment of specified or named manufacturers, submittals identified below are required.

1. Product data.
2. Submit in accordance with Section 01300.

1.04 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term 'NRTL' shall be as defined in OSHA Regulation 1910.7.

2. Terms 'listed' and 'labeled' shall be as defined in National Electrical Code, Article 100.

C. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

1.05 SEQUENCING AND SCHEDULING

A. Coordination of Work:

1. Coordinate elevations of duct and raceway with other utilities, underground obstructions, and buildings.
2. Establish locations and elevations to suit field conditions.

PART 2 PRODUCTS

2.01 DUCTS AND FITTINGS

A. Comply with Section 26 05 33.

2.02 DUCT BANK ACCESSORIES

A. Duct Supports: Rigid PVC spacers selected to provide minimum duct spacings and concrete cover depths indicated, while rigidly supporting ducts during installation and backfilling.

2.03 RACEWAY/DUCT SEALING COMPOUND

A. Compound:

1. Non-hardening, putty-like consistency workable at temperatures as low as 35°F.
2. Compound shall not slump at temperature of 300°F and shall readily adhere to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

PART 3 EXECUTION

3.01 WIRING METHOD

A. General: Install ducts for wiring runs indicated. Provide sizes as indicated.

B. Single Duct Runs: Rigid nonmetallic conduit, Schedule 80, direct buried in earth, for power and 120V discrete signals. Galvanized rigid steel conduit, direct buried in earth, for communications cables.

C. Duct Banks: Rigid nonmetallic conduit, Schedule 80, direct buried in earth, for power and 120V discrete signals. Galvanized rigid steel conduit, direct buried in earth, for communications cables.

D. Stub-ups: Transition from PVC and galvanized rigid steel conduit to PVC-coated rigid steel conduit for stub-ups.

3.02 EXCAVATION AND BACKFILL

A. Conform to Section 31 23 33 except as modified below:

1. Do not use heavy-duty, hydraulic-operated compaction equipment.
2. Excavation: Cut trenches neatly and uniformly, and slope uniformly to required pitch.
3. For direct-buried, non-encased ducts prepare trench bottoms free from stones, soft spots, and sharp objects. Add 6 in. layer of stone-free sand or earth to trench bottom and compact to density of adjacent undisturbed soil to provide suitable bearing for ducts. Backfill over and around ducts on bottom of trench with stone-free sand or earth to 6 in. minimum above tops of ducts and compact by hand or pneumatic tamper to density of adjacent undisturbed earth.
4. For each additional layer of direct-buried ducts above bottom ducts, backfill over and around each layer of ducts with stone-free sand or earth to 12 in. minimum above tops of ducts and compact by hand or pneumatically to density of adjacent undisturbed earth.
5. Separation Between Direct-Buried, Non-encased Ducts: 3 in.

3.03 INSTALLATION OF DUCTS

A. Curves and Bends: Use manufactured elbows for stub-ups at equipment and at building entrances. For other curves and bends, except as otherwise indicated, use manufactured long sweep bends with minimum radius of 24 in in both horizontal and vertical directions.

B. For ducts containing fiber optic cables, provide bends with minimum radius of 20 times cable diameter.

C. Make joints in ducts and fittings watertight in accordance with manufacturer's instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

D. Duct Entrances to Buildings: Transformations from underground PVC duct to PVC-coated steel conduit shall be made 10 ft. minimum, outside building wall and shall use fittings manufactured for purpose. Install in accordance with following:

1. Direct-Buried, Non-encased Duct Entering Non-waterproofed Walls: Install Schedule 40 galvanized steel pipe sleeve for each duct. Caulk space between conduit and sleeve with duct sealing compound on both sides for moisture-tight seal.
2. Waterproof Entrances: Where ducts enter buildings through waterproofed floor or wall, watertight entrance-sealing device shall be installed with sealing gland assembly on inside. Anchor device securely into masonry construction with 1 or more integral flanges and membrane waterproofing secured to device in permanently watertight manner.

E. Stub-ups: Duct stub-ups to equipment shall be PVC-coated galvanized rigid steel. For equipment mounted on outdoor concrete pads, PVC-coated steel conduit shall extend minimum of 5 ft away from edge of pad. Install insulated grounding bushings on terminations. Couple steel conduits to ducts with adapters designed for purpose.

F. Sealing: For ducts to be wired in this Project, provide temporary closure at terminations. For spare ducts, seal bore of ducts at terminations. Use sealing compound and plugs as required to withstand 15 psi minimum hydrostatic pressure.

G. Pulling Cord: Provide 100 lb test nylon cord in ducts including spares.

H. Marker Tape: Provide plastic marker tape over ducts at 12 in. below finished grade.

3.04 TESTING

A. Field Quality Control:

1. Duct Integrity: Rod ducts with mandrell 1/4 in. smaller in diameter than internal diameter of ducts. Where rodding indicates obstructions in ducts, remove obstructions and retest.

3.05 CLEANING AND RESTORATION

A. Clean Ducts: Clean full length of ducts with round bristle brush with dia 1/2 in. greater than internal diameter of duct.

3.06 RESTORATION

A. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated.

B. Where sod has been removed, replace it as soon as possible after backfilling is completed.

C. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other work to their original condition.

D. Include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.

E. Restore disturbed paving as indicated.

* * * END OF SECTION * * *

SECTION 26 05 53
ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes identification of electrical materials, equipment, and installations.

1.02 QUALITY ASSURANCE

A. National Electrical Code: Components and installation shall comply with NFPA 70.

PART 2 PRODUCTS

2.01 RACEWAY AND CABLE LABELS

A. Manufacturer's Standard Products: Where more than one type is listed for specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ASME A13.1, NFPA 70, or as specified elsewhere.

B. Conform to ASME A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.

1. Color: Black legend on orange field.
2. Legend: Indicates voltage.

C. Adhesive Labels: Preprinted, flexible, self adhesive vinyl. Legend is over-laminated with clear, wear and chemical resistant coating.

D. Pre-tensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color coded, acrylic bands sized to suit diameter of line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position.

E. Colored Adhesive Tape: Self adhesive vinyl tape not less than 3 mils thick by 1 to 2 in. wide (0.08 mm thick by 25 to 51 mm wide).

F. Underground Line Warning Tape: Permanent, bright colored, continuous printed, vinyl tape with following features:

1. Size: Not less than 6 in. wide by 4 mils thick (152 mm wide by 0.102 mm thick).
2. Compounded for permanent direct burial service.
3. Embedded continuous metallic strip or core.
4. Printed Legend: Indicates type of underground line.

G. Tape Markers: Vinyl or vinyl cloth, self adhesive, wraparound type with preprinted numbers and letters.

H. Aluminum, Wraparound Marker Bands: Bands cut from 0.014 in. (0.4 mm) thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

I. Plasticized Card Stock Tags: Vinyl cloth with preprinted and field printed legends. Orange background, except as otherwise indicated, with eyelet for fastener.

J. Aluminum Faced Card Stock Tags: Wear resistant, 18 point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 in. (0.05 mm) thick, laminated with moisture resistant acrylic adhesive, and punched for fastener. Preprinted legends suit each application.

K. Brass or Aluminum Tags: Metal tags with stamped legend, punched for fastener. Dimensions: 2 by 2 in. (51 by 51 mm) by 0.05 in. (1.3 mm).

2.02 ENGRAVED NAMEPLATES AND SIGNS

A. Manufacturer's Standard Products: Where more than one type is listed for specified application, selection is Installer's option, but provides single type for each application category. Use colors prescribed by ASME A13.1, NFPA 70, or as specified elsewhere.

B. Engraving stock, melamine plastic laminate, 1/16 in. (1.6 mm) minimum thick for signs up to 20 sq in. (129 sq cm), 1/8 in. (3.2 mm) thick for larger sizes.

1. Engraved Legend: Black letters on white face.
2. Punched for mechanical fasteners.

C. Baked Enamel Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size as indicated or as otherwise required for application. 1/4 in. (6.4 mm) grommets in corners for mounting.

D. Exterior, Metal Backed, Butyrate Signs: Wear resistant, non-fading, preprinted, cellulose acetate butyrate signs with 0.0396 in. (1 mm), galvanized steel backing, with colors, legend, and size appropriate to application. 1/4 in. (6.4 mm) grommets in corners for mounting.

E. Fasteners for Plastic Laminated and Metal Signs: Self tapping stainless steel screws or No. 10/32 stainless steel machine screws with nuts, flat washers and lock washers.

2.03 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self extinguishing, 1 piece, self locking, Type 6/6 nylon cable ties with following features:

1. Minimum Width: 3/16 in. (5 mm).
2. Tensile Strength: 50 lb (22.3 kg) minimum.
3. Temperature Range: Minus 40 to 185°F (-4 to 85°C).
4. Color: As indicated where used for color coding.

B. Paint: Alkyd-urethane enamel. Primer as recommended by enamel manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install identification devices according to manufacturer's written instructions.

B. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

C. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and or designations used for electrical identification with corresponding designations used in Contract Documents or required by codes and standards. Use consistent designations throughout Project.

D. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

E. Self Adhesive Identification Products: Clean surfaces of dust, loose material, and oily films before applying.

F. Install painted identification as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.
2. Prime Surfaces: For galvanized metal, use single component, acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy duty, acrylic resin block filler. For concrete surfaces, use clear, alkali resistant, alkyd binder type sealer.
3. Apply 1 intermediate and 1 finish coat of silicone alkyd enamel.
4. Apply primer and finish materials according to manufacturer's instructions.

G. Identify Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communications lines, install continuous underground plastic line marker located directly above line at 6 to 8 in. (150 to 200 mm) below finished grade. Where multiple lines installed in common trench or concrete envelope do not exceed an overall width of 16 in. (400 mm), use single line marker.

1. Install line marker for underground wiring, both direct buried and in raceway.

H. Color Code Conductors: Secondary service, feeder, and branch circuit conductors throughout secondary electrical system.

1. Field applied, color coding methods may be used in lieu of factory coded wire for sizes larger than No. 10 AWG.

   a. Colored, pressure sensitive plastic tape in half lapped turns for distance of 6 in. (150 mm) from terminal points and in boxes where splices or taps are made. Apply last 2 turns of tape with no tension to prevent possible unwinding. Use 1 in. (25 mm) wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings.
   b. Colored cable ties applied in groups of 3 ties of specified color to each wire at each terminal or splice point starting 3 in. (76 mm) from terminal and spaced 3 in. (76 mm) apart. Apply with special tool or pliers, tighten to snug fit, and cut off excess length.

2. 208/120-V System: As follows:

   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
   d. Neutral: White.
   e. Ground: Green.

3. 480/277 - System: As follows:

   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.
   d. Neutral: Grey with non-green stripe.
   e. Ground: Green.

I. Power Circuit Identification: Use metal tags or aluminum wraparound marker bands for cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms.

1. Legend: 1/4 in. (6.4 mm) steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
2. Fasten tags with nylon cable ties; fasten bands using integral ears.

J. Apply identification to conductors as follows:

1. Conductors to Be Extended in Future: Indicate source and circuit numbers.
2. Multiple Power or Lighting Circuits in Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color coding for voltage and phase indication of secondary circuit.
3. Multiple Control and Communications Circuits in Same Enclosure: Identify each conductor by its system and circuit designation. Use consistent system of tags, color coding, or cable marking tape.

K. Apply warning, caution, and instruction signs and stencils as follows:

1. Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved, plastic laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
2. Emergency Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8 in. (9 mm) high lettering for emergency instructions on power transfer, load shedding, and or emergency operations.

L. Install identification as follows:

1. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Except as otherwise indicated, provide single line of text with 1/2 in. (13 mm) high lettering on 1-1/2 in. (38 mm) high label; where 2 lines of text are required, use lettering 2 in. (51 mm) high. Use black lettering on white field. Apply labels for each unit of following categories of equipment.

    a. Panelboards, electrical cabinets, and enclosures.
    b. Access doors and panels for concealed electrical items.
    c. Electrical switchgear and switchboards.
    d. Motor control centers.
    e. Motor starters.
    f. Push button stations.
    g. Contactors.
    h. Control devices.
    i. Transformers.

2. Apply designation labels of engraved plastic laminate for disconnect switches, breakers, push buttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

* * * END OF SECTION * * *

SECTION 26 08 10
ELECTRICAL SYSTEM DEMONSTRATIONS

PART 1 GENERAL

1.01 SUMMARY

A. Demonstrate proper operation of electrical systems and equipment in presence of ENGINEER.

1.02 SUBMITTALS

A. Demonstration log.

B. Submit in accordance with Section 01300.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 PERFORMANCE

A. Demonstrations:

1. Each piece of equipment.
2. Each integrated system.

B. Demonstration Log:

1. Keep log of individual demonstrations.
2. Data:

a. Date and time of demonstration.
b. OWNER'S representative.
c. Equipment or system demonstrated.
d. Result of demonstration.

1) Success or fail.
2) If failure, description of failure.
3) Corrective action taken.
4) Redemonstration result.

* * * END OF SECTION * * *

SECTION 26 22 13
DRY-TYPE TRANSFORMERS (1000 V AND LESS)

PART 1 GENERAL

1.01 SUBMITTALS

A. Product Data: Include data on features, components, ratings, and performance for each type of transformer specified. Include dimensioned plans, sections, and elevation views. Show minimum clearances and installed devices and features.

B. Shop Drawings:

1. Wiring Diagrams: Detail wiring and identify terminals for tap changing and connecting field-installed wiring.

C. Test Results:

1. Reports on transformer tests.

D. Submit in accordance with Section 01300.

1.02 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

C. Comply with IEEE C2.

D. Comply with NFPA 70.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within enclosure of each ventilated-type unit throughout periods during which equipment is not energized and is not in space that is continuously under normal control of temperature and humidity.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton Electrical/Cutler-Hammer.

B. Schneider Electric/Square D.

C. Or Equal.

2.02 TRANSFORMERS, GENERAL

A. Factory-assembled and -tested, air-cooled units of types specified, designed for 60 Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous copper windings without splices, except for taps.

D. Internal Coil Connections: Brazed or pressure type.

E. Enclosure: Class complies with NEMA 250 for environment in which installed.

2.03 GENERAL-PURPOSE DISTRIBUTION AND POWER TRANSFORMERS

A. Comply with NEMA ST 20 and list and label as complying with UL 1561.

B. Cores: 1 leg per phase.

C. Windings: One coil per phase in primary and secondary.

D. Enclosure:

1. Indoor, ventilated for indoor use.
2. Totally enclosed, nonventilated, suitable for outdoor use, NEMA 250, Type 4X stainless steel.

E. Insulation Class: 220°C class 115□C maximum rise above 40□C for transformers 15 kVA or smaller; 220□C class 80□C maximum rise above 40□C for transformers larger than 15 kVA.

F. Taps: For transformers 3 kVA and larger, full-capacity taps in high-voltage windings are as follows:

1. Taps, 3 through 15 kVA: Two 5% taps below rated high voltage.
2. Taps, 15 through 500 kVA: Six 2.5% taps, 2 above and 4 below rated high voltage.

G. Wall-Mounting Brackets: Manufacturer's standard brackets for transformers up to 75 kVA.

2.04 CONTROL AND SIGNAL TRANSFORMERS

A. Units comply with NEMA ST 1 and are listed and labeled as complying with UL 506.

B. Ratings: Continuous duty. If rating is not indicated, provide capacity exceeding peak load by 50% minimum.

C. Self-cooled, 2 windings.

2.05 FINISHES

A. Indoor Units: Manufacturer's standard paint over corrosion-resistant pretreatment and primer.

B. Outdoor Units: Comply with IEEE C57.12.28.

2.06 SOURCE QUALITY CONTROL

A. Factory Tests: Design and routine tests comply with referenced standards.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with safety requirements of IEEE C2.

B. Arrange equipment to provide adequate spacing for access and for circulation of cooling air.

C. Identify transformers and install warning signs according to Section 26 05 53.

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

3.02 GROUNDING

A. Comply with NFPA 70 requirements separately derived systems for connecting to grounding electrodes and for bonding to metallic piping near transformer.

B. Comply with Section 26 05 26 for materials and installation requirements.

3.03 FIELD QUALITY CONTROL

A. Testing: Perform field quality-control testing.

1. Test Objectives: To ensure transformer is operational within industry and manufacturer's tolerances, is installed according to Contract Documents, and is suitable for energizing.
2. Report: Submit written report of observations and tests. Report defective materials and installation.
3. Tests: Include following minimum inspections and tests according to manufacturer's written instructions. Comply with IEEE C57.12.91 for test methods and data correction factors.

   a. Inspect accessible components for cleanliness, mechanical and electrical integrity, and damage or deterioration. Verify that temporary shipping bracing has been removed. Include internal inspection through access panels and covers.
   b. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A-486B.
   c. Insulation Resistance: Perform megohmmeter tests of primary and secondary winding to winding and winding to ground.

      1) Minimum Test Voltage: 1000 V, dc.
      2) Minimum Insulation Resistance: 500 megohms.
      3) Duration of Each Test: 10 min.
      4) Temperature Correction: Correct results for test temperature deviation from 20□C standard.

4. Test Failures: Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest. Verify that transformers meet specified requirements.

3.04 CLEANING

A. On completion of installation, inspect components. Remove paint splatters and other spots, dirt, and debris. Repair scratches and mars on finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.05 ADJUSTING

A. After installing and cleaning, touch up scratches and mars on finish to match original finish.

B. Adjust transformer taps and connections to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility. Record primary and secondary voltages and tap settings or connections and submit with test results.

* * * END OF SECTION * * *

SECTION 26 24 16
PANELBOARDS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Lighting and power panelboards and associated auxiliary equipment rated 600 V and less.

1.02 SUBMITTALS

A. Product Data: For each type of panelboard, accessory item, and component specified.

B. Shop Drawings: For panelboards. Include dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include following:

1. Enclosure type with details for types other than NEMA 250, Type 1.
2. Bus configuration and current ratings.
3. Short-circuit current rating of panelboard.
4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

C. Test Results:

1. Indicate and interpret field test results for compliance with performance requirements.

D. Submit in accordance with Section 01300.

1.03 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

C. Comply with NEMA PB 1.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton Electrical/Cutler-Hammer.

B. Schneider Electric/Square D.

2.02 PANELBOARD FABRICATION

A. Enclosures: Flush- or surface-mounted cabinets as indicated. NEMA PB 1, Type 1, unless otherwise indicated to meet environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 4X, stainless steel.
2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4X, stainless steel.
3. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

B. Front: Secured to box with concealed trim clamps, unless otherwise indicated. Front for surface-mounted panelboards shall be same dimensions as box. Fronts for flush panelboards shall overlap box, unless otherwise indicated.

C. Directory Frame: Metal, mounted inside each panelboard door.

D. Bus: Hard drawn copper of 98% conductivity.

E. Main and Neutral Lugs: Compression type.

F. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.

G. Service Equipment Approval: Listed for use as service equipment for panelboards with main service disconnect.

H. Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for over-current protective device ampere ratings indicated for future installation of devices.

I. Special Features: Include following features for panelboards as indicated:

1. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.

J. Extra Gutter Space: Dimensions and arrangement as indicated.

1. Subfeed: Overcurrent protective device or lug provision as indicated.

K. Feed-through Lugs: Sized to accommodate feeders indicated.

2.03 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Over-current Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Doors: In panelboard front, with concealed hinges. Secure with flush catch and tumbler lock, keyed alike.

2.04 DISTRIBUTION PANELBOARDS

A. Branch-Circuit Breakers: Where overcurrent protective devices are indicated to be circuit breakers, use bolt-on circuit breakers, except circuit breakers 225-A frame size and greater may be plug-in type where individual positive-locking device requires mechanical release for removal.

2.05 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 1, handle lockable.

1. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting capacity rating to meet available fault current.
2. Application Listing: Appropriate for application, including Type SWD for switching fluorescent lighting loads, Type HACR for heating, air-conditioning, and refrigerating equipment and Class B GFCI for pipeline and vessel fixed electrical heating equipment unless otherwise indicated.
3. Circuit Breakers, 200 A and Larger: Trip units interchangeable within frame size.
4. Circuit Breakers, 400 A and Larger: Field-adjustable short-time and continuous current settings.
5. Current-Limiting Trips: Where indicated, let-through ratings less than NEMA FU 1, Class RK-5.
6. Current Limiters: Where indicated, integral fuse listed for circuit breaker.
7. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.
8. Shunt Trip: Where indicated.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install panelboards and accessory items according to NEMA PB 1.1.

B. Mounting Heights: Top of trim 74 in. (1880 mm) above finished floor, unless otherwise indicated.

C. Mounting: Plumb and rigid without distortion of box. Mount flush panelboards uniformly flush with wall finish.

D. Circuit Directory: Type directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing.

E. Install filler plates in unused spaces.

F. Wiring in Panelboard Gutters: Arrange conductors into groups, and bundle and wrap with wire ties after completing load balancing.

3.02 IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs as specified in Section 26 05 53

B. Panelboard Nameplates: Label each panelboard with engraved laminated-plastic or metal nameplates mounted with corrosion-resistant screws.

3.03 GROUNDING

A. Make equipment grounding connections for panelboards.

B. Provide ground continuity to main electrical ground bus.

3.04 CONNECTIONS

A. Tighten electrical connectors and terminals, including grounding connections, according to

manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

3.05 FIELD QUALITY CONTROL

A. Make insulation-resistance tests of each panelboard bus, component, and connecting supply, feeder, and control circuits.

B. Make continuity tests of each circuit.

C. Visual and Mechanical Inspection.

1. Check circuit breaker for proper mounting and compare nameplate data to drawings and specifications.
2. Operate circuit breaker to ensure smooth operations.
3. Inspect case for cracks or other defects.

D. Balancing Loads: After Substantial Completion, conduct load-balancing measurements and make circuit changes as follows:

1. Perform measurements during period of normal working load as advised by OWNER.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of facility. Make special arrangements with OWNER to avoid disrupting critical 24 hr services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. Recheck loads after circuit changes during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20% between phase loads, within panelboard, is not acceptable. Rebalance and recheck as required to meet this minimum requirement.

3.06 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

* * * END OF SECTION * * *

SECTION 26 28 00
DISCONNECTS, FUSES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Service disconnects.
2. Feeder and equipment disconnects.
3. Enclosed circuit breakers.

1.02 SUBMITTALS

A. Product Data:

1. Submit for switches, circuit breakers, and accessories.

B. Test Results:

1. Report of Field Tests and Observations certified by CONTRACTOR.

C. Operating and Maintenance Data:

1. Maintenance data for tripping devices.

D. Submit in accordance with Section 01300.

1.03 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

C. Single-Source Responsibility: Enclosed switches, fuses and circuit breakers shall be product of single manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Molded-Case Circuit Breakers:

1. Eaton Electrical/Cutler-Hammer.
2. Schneider Electric/Square D.

B. Combination Circuit Breaker and Ground Fault Trip:

1. Eaton Electrical/Cutler-Hammer.
2. Schneider Electric/Square D.

2.02 ENCLOSED SWITCHES

A. Enclosed Nonfusible Switch: NEMA KS 1, Type HD handle lockable with 2 padlocks.

B. Enclosure: NEMA KS 1, Type 12, unless specified or required otherwise to meet environmental conditions of installed location.

1. Outdoor or Other Wet or Damp Indoor Locations: NEMA Type 4X stainless steel.
2. Hazardous Areas Indicated on Drawings: NEMA Type 7C.

2.03 ENCLOSED CIRCUIT BREAKERS

A. Enclosed Molded-Case Circuit Breaker: NEMA AB 1, handle lockable with 2 padlocks.

B. Characteristics:

1. Frame size, trip rating, number of poles, and auxiliary devices as indicated
2. Interrupting capacity rating to meet available fault current, 10,000 symmetrical rms amps minimum
3. Appropriate application listing when used for switching fluorescent lighting loads or heating, air conditioning, and refrigeration equipment.

C. Interchangeable Trips: Circuit breakers, 200 amps and larger, with trip units interchangeable within frame size.

D. Field-Adjustable Trips: Circuit breakers, 400 amps and larger, with adjustable short time and continuous current settings.

E. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.

F. Shunt Trip: Where indicated, 120 volts, 60 Hz.

G. Accessories: As indicated.

H. Enclosure: NEMA AB 1, Type 12, unless specified or required otherwise to meet environmental conditions of installed location.

1. Outdoor or Other Wet or Damp Indoor Locations: NEMA Type 4X stainless steel.
2. Hazardous Areas Indicated on Drawings: NEMA Type 7C.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions to verify proper sizes and characteristics.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install enclosed switches and circuit breakers in locations as indicated, according to manufacturer's written instructions.

B. Install enclosed switches and circuit breakers level and plumb.

C. Connect enclosed switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A-486B.

3.03 FIELD QUALITY CONTROL

A. Testing:

1. Reports: Prepare certified written reports on tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include complete records of repairs and adjustments made.
2. Labeling: Upon satisfactory completion of tests and related effort, apply label to tested components indicating test results, date, and responsible person.
3. Schedule visual and mechanical inspections and electrical tests with at least 1 week's advance notification.
4. Upon completing installation of system, perform following preparations for tests:

   a. Make insulation resistance tests of circuit breaker buses, components, and connecting supply, feeder, and control circuits.
   b. Make continuity tests of circuits.
   c. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.
   d. Comply with manufacturer's instructions for installation and testing of circuit breaker.

5. Visual and mechanical inspection: Include following inspections and related work.

   a. Overcurrent-Protective-Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system arrangement and parameters. Where discrepancies are found, ENGINEER shall recommend final protective device ratings and settings. Use accepted revised ratings or settings to make final system adjustments.
   b. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.
   c. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
   d. Check tightness of electrical connections of circuit breaker with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
   e. Clean circuit breaker using manufacturer's approved methods and materials.
   f. Verify installation of proper fuse types and ratings in fusible circuit breaker.

6. Electrical Tests: Include following items performed in accordance with manufacturer's instructions:

   a. Check key and other interlock and safety devices for operation and sequence. Make closing attempts on locked-open and opening attempts on locked-closed devices including moveable barriers and shutters.

7. Retest: Correct deficiencies identified by tests and observations and retest. Verify by system tests that specified requirements are met.

3.04 CLEANING

A. Upon completion of installation, inspect OCPDs. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

* * * END OF SECTION * * *

SECTION 31 23 33
TRENCHING, BACKFILLING, AND COMPACTING

PART 1 GENERAL

1.01 SUMMARY

A. Alternatives:

1. Bedding Alternate:

a. Allowed for pressure piping or for gravity piping greater than 30 in. diameter and upon approval of ENGINEER.
b. In lieu of over-excavation and granular support under pipe, trench bottom may be rounded and graded to provide continuous uniform bearing of at least 1/4 pipe circumference on undisturbed soil. At bells or other joint locations, excavate only to extent necessary to permit making joints. Following placement of pipe, continuation of bedding shall, if required, be as specified herein.
c. If trench bottom is over-excavated, or where trench bottom is found to be of unsuitable material, this alternate method of bedding is not permitted.

1.02 DEFINITIONS

A. Influence Zone Around Piping or Electrical Ducts: Area below limits bounded by line 6 in. below pipe or duct and by 1 horizontal to 2 vertical slope extending outward from that line 1 ft beyond outer edge of pipe or duct.

B. Influence Zone Under Foundations, Pavements or Sidewalks: Area below foundation or pavement and sidewalk subbase bounded by 1 horizontal to 2 vertical slope extending outward from 1 ft beyond outer edges of foundation, pavement or sidewalk.

C. Unsuitable Material: Topsoil, peat, organic soils, and materials containing slag, cinders, foundry sand, debris, and rubble or soil with less than required bearing capacity as determined by ENGINEER.

D. Hard Material:

1. Weathered rock, dense consolidated deposits, including conglomerate materials (excluding manmade materials such as concrete) which are not included in definition of "rock" but which usually require use of heavy excavation equipment, ripper teeth or jack hammers for removal.

1.03 QUALITY ASSURANCE

A. Testing shall be performed by CONTRACTOR in accordance with Section 01430 and this section.

1.04 SUBMITTALS

A. Test results.

B. Shoring, Bracing, and Sheet Piling Construction Procedures and Details: ENGINEER will review submitted material to ascertain shoring effect on new construction. ENGINEER will not review shoring, bracing, and sheet piling construction procedures and details for structural integrity or effect on existing facilities.

C. Submit in accordance with Section 01300.

1.05 PROJECT/SITE CONDITIONS

A. Do not block or obstruct sidewalks or pavements with excavated materials, except as authorized by OWNER. Trim banks to minimize inconvenience to public travel.

B. Sheeting, Bracing, and Shoring:

1. When close sheeting required, drive to prevent soil from entering trench below or through such sheeting.
2. Fill voids remaining after sheeting pulled with sand or other approved material.

PART 2 PRODUCTS

2.01 FINE AGGREGATE

A. Granular material, consisting of durable particles ranging in size from fine to coarse in substantially uniform combination. Unwashed bank-run sand and crushed bank-run gravel will be considered.

1. Gradation No. 1:

Sieve Size	% Passing by Weight
1 in.	100
No. 16	45 - 80
No. 200	2 - 10

2. Gradation No. 2:

Sieve Size	% Passing by Weight
1 in.	100
3/4 in.	85 - 100
3/8 in.	50 - 80
No. 4	35 - 65
No. 40	15 - 30
No. 200	5 - 15

2.02 COARSE AGGREGATE

A. Crushed stone chips from crushing sound limestone or dolomite ledge rock or other rock materials of regional availability shall be hard, tough, and durable.

1. Gradation No. 1:

Sieve Size	% Passing by Weight
1/2 in.	100
3/8 in.	90 - 100
No. 8	0 - 15
No. 30	0 - 3

2. Gradation No. 2 (ASTM C33 - Size No. 67):

Sieve Size	% Passing by Weight
1 in.	100
3/4 in.	90 - 100
3/8 in.	20 - 55
No. 4	0 - 10
No. 8	0 - 5

3. Gradation No. 3 (ASTM C33 - Size No. 2):

Sieve Size	% Passing by Weight
3 in.	100
2-1/2 in.	90 - 100
2 in.	35 - 70
1-1/2 in.	0 - 15
3/4 in.	0 - 5

4. Gradation No. 4 (ASTM C33 - Size No. 3):

Sieve Size	% Passing by Weight
2-1/2 in.	100
2 in.	90 - 100
1-1/2 in.	35 - 70
1 in.	0 - 15
1/2 in.	0 - 5

2.03 STRUCTURAL FILL

A. Well-graded sand, well-graded sand and gravel, crushed stone or other approved granular material, of 2 in. maximum size, free from organic and deleterious materials.

B. Plasticity Index: With ASTM D4318, 6 or less.

C. Maximum Fines: ASTM D1140, 15% clay or 20% silt-clay.

D. Uniformity Coefficient: 10 or greater.

2.04 CONTROLLED FILL

A. Natural soils classified as CL, SM, SC or ML in Unified Soil Classification System.

B. Maximum Liquid Limit: ASTM D4318, 30.

C. Plasticity Index: ASTM D4318, 10.

2.05 EARTH FILL

A. Subsoil, excess topsoil or sand, free of wood, peat, cinders, vegetable matter or other rubbish.

B. Rubble such as rock, boulders, concrete, and other approved inorganic materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive fill to determine existence of areas loosened by frost action, softened by flooding or weather or of unsuitable materials.

3.02 PREPARATION

A. Notify corporations, companies, individuals or authorities owning above or below ground conduits, wires, pipes or other utilities running to property or encountered during excavating operations.

B. Cap or remove and relocate services in accordance with instructions by owners of services.

C. Protect, support, and maintain conduits, wires, pipes, and other remaining utilities in accordance with requirements of owners of said services.

D. Remove and replace or compact natural soils or compacted fills softened by frost, flooding or weather.

E. Remove unsuitable material from within trenches.

F. Stabilize trench bottom and replace unsuitable material with coarse aggregate gradation No. 3 or 4.

G. Dewatering:

1. Keep construction site free-draining.
2. Keep excavations free from water.
3. Maintain groundwater minimum of 12 in. below excavations.
4. Remove soil which disturbed by pressure or flow of groundwater and replace with free draining material.
5. Maintain dewatering systems to prevent uplifting of structures.
6. Protect adjacent properties from damage resulting from dewatering operations.
7. Dewatering wells shall be drilled, maintained, and abandoned in accordance with federal, state, and local ordinances.

3.03 EXCAVATION

A. Excavate to elevations and dimensions necessary to complete construction.

B. Trenching Tolerances:

1. Excavate so pipes, ducts, and conduits can be laid straight at uniform grade, without sags or humps, between elevations shown on Drawings.
2. Maximum width of excavation at top of pipe shall be outside diameter of pipe plus 24 in. When stringers and sheathing are required, width of trench may be increased to allow for their use, provided provisions for this excess width of trench are met.
3. Where trench width for that portion of trench depth between trench bottom and outside top of pipe barrel, for any reason within CONTRACTOR'S control, exceeds specified limits,

CONTRACTOR, at his expense, shall furnish pipe with strength adequate for actual trench width.

4. Maximum width at surface of ground shall not exceed width of trench at top of pipe by more than 2 ft without permission of ENGINEER, unless specifically shown on Drawings.
5. Minimum trench width shall be outside pipe diameter plus 18 in.
6. Excavate electrical duct or conduit trenches as required so top of concrete encasement or top of conduit shall be minimum of 24 in. below final grade or as shown on Drawings.

C. Do not advance excavation of trenches more than 300 ft ahead of completed pipe installation.

D. Do not excavate for manholes and other structures until scheduled for construction.

E. Do not excavate within influence zone of existing footings or foundations without prior approval of ENGINEER.

F. Upon completion of excavation, notify ENGINEER before proceeding with further Work.

G. Excavation of Rigid Surfacing:

1. Remove width 1 ft beyond anticipated edge of excavation.
2. Saw to ensure straight joint.
3. Surface replacement shall match existing surfacing.

H. Excavation Across Roadways: Excavation, backfill, and surface replacement shall conform to requirements of local highway authority. In no case shall surface replacement edges bear on less than 12 in. of undisturbed soil.

3.04 FILL USAGE

A. Bedding Material:

1. Plastic, Copper, and Electrical Conduit or Ducts: Fine aggregate gradation No. 1.
2. Other Piping:

   a. Pipe 18 in. diameter or less: Coarse aggregate gradation No. 1.
   b. Pipe larger than 18 in. diameter: Coarse aggregate gradation No. 2.

B. Cover Material:

1. Plastic, Copper, and Electrical Conduit: Fine aggregate gradation No. 1.
2. Other Piping: Fine aggregate gradation No. 2.
3. Electrical Ducts: Earth fill.
4. Bedding material may be substituted for cover material.

C. Structural Fill: Within trenches under pavements.

D. Controlled or Structural Fill: Within piping or electrical duct influence zone and within influence zone under pavements or sidewalks.

E. Earth Fill: Other areas not previously specified. Rubble may be used for earth fill under following conditions.

1. Do not bury within vertical projection of influence zone of future construction.
2. Landscaped Areas: Provide minimum of 3 ft of earth fill.
3. Place in single thickness, parallel layers with 6 in. of earth fill between.

3.05 PLACING FILL

A. Notify ENGINEER before placing fill material.

B. Do not use frozen material or place fill on frozen subgrade.

C. Bedding Material Limits (see Drawings for requirements):

1. Electric Ducts:

   a. Hand grade and rake bottom of trench to establish uniform trench gradient not less than 4 in./100 ft.
   b. Use bedding to bring grade to desired level.

2. Plastic, Copper, Fiberglass or Reinforced Plastic Pipe and Electrical Conduit: Minimum of 6 in. below, to spring line and minimum of 9 in. each side.
3. Other Piping: Minimum of 6 in. below, minimum of 5 in. below bell of pipe, to spring line, and entire trench width.

D. Cover Material Limits (see Drawings for requirements):

1. Plastic, Copper, Fiberglass or Reinforced Plastic Pipe and Electrical Conduit: Minimum 6 in. above and 9 in. each side.
2. Other Piping: Minimum 12 in. above and 12 in. each side.

E. Trench backfill beyond limits of cover material specified above shall be as specified elsewhere in this section.

F. Where pipes or electrical ducts cross, protect piping or ducts at higher elevation by backfilling trench within higher pipe or duct influence zone down to bedding of lower pipe or duct with structural fill or controlled fill.

G. Where pipes or electrical ducts leave structures, protect by backfilling pipe or duct influence zone down to undisturbed soil with structural or controlled fill.

H. Do not backfill until new concrete has properly cured and required tests accepted.

I. Place fill simultaneously on both sides of free-standing structures.

J. Provide mechanical compaction for cohesive material and vibratory compaction for granular materials. When approved by ENGINEER, jetting, flooding, puddling or vibroflotation methods may be used for compacting if CONTRACTOR furnishes test results to confirm required degree of compaction being obtained uniformly throughout entire mass.

K. Lift Thickness and Compaction: Place and compact fill materials in maximum lift thickness and to minimum densities listed below.

Location	Lift Thickness (in.)	Modified Proctor (%)	Relative Density (%)
**Sidewalk, Paving, Piping or Electrical Duct Influence Zone	Granular Material		
	12	90	60
	Cohesive Material		
	8	85	--
Bedding Material or Cover Material	6	90	70
**Lawns and Landscaped Areas	12	80	50
Crop Lands	--	80	50

3.06 FIELD QUALITY CONTROL

A. Testing:

1. One sieve analysis and plasticity index for each source of structural fill, bedding material, and cover material.
2. One liquid limit and plasticity index for each source of controlled fill.
3. One field density test for each 25 cu yd of structural (minimum one each lift) or controlled fill, bedding or cover material.
4. One field density test for each 50 cu yd of controlled fill (minimum one each lift).
5. One field density test for each 500 cu yd of earth fill.

B. Degree of Compaction: ASTM D1557, (Modified Proctor) or ASTM D4253 (Relative Density). Relative density applies to granular soils only.

C. Moisture Content of Controlled Fill: Within 3% of optimum when placed and compacted.

3.07 ADJUSTMENT AND CLEANING

A. Excess Material:

1. OWNER has first right to excess excavated material suitable for backfilling or site grading not required at job site.
2. Deliver to site not greater than 10 miles away – see Section 01505.
3. Remove material not required by OWNER from site.

B. Stockpile excavated material suitable for backfill on designated site. Place no fill where trenches for sewers, water lines or other utilities will be located.

C. Place excavated material not suitable for backfilling or site grading and other unsuitable materials in designated spoil areas and grade to drain. If spoil areas not provided on-site, remove excess material from site.

* * * END OF SECTION * * *

DIVISION 33

UTILITIES

SECTION 33 71 73
ELECTRIC SERVICE

PART 1 GENERAL

1.01 SUMMARY

A. Electric Utility Charges:

1. Electric Utility charges for extension of distribution system to point of service termination and meters will be paid by OWNER.

1.02 DEFINITIONS

A. Electric Utility: WE Energies.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements:

1. National Fire Protection Association (NFPA):

a. NFPA No. 70 - National Electrical Code (NEC).

PART 2 PRODUCTS

2.01 ELECTRIC SERVICE

A. Electric Service Characteristics:

1. As indicated on Drawings and provided by Electric Utility.

PART 3 EXECUTION

3.01 PREPARATION

A. Confirmation of Electric Service:

1. Consult with Electric Utility to verify service information specified and shown on Drawings.
2. Include deviations required by Electric Utility from contract documents to comply with Electric Utility standards and requirements.

B. Metering:

1. Consult with Electric Utility regarding service entrance requirements and metering equipment.
2. Install metering equipment and empty conduit for metering conductors to meet standards and requirements of Electric Utility.

C. Application for Electric Service.

1. Obtain required forms from Electric Utility.
2. Assist OWNER in completion of forms and deliver completed forms to Electric Utility.
3. Coordinate schedule for installation of electric service with Electric Utility.

* * * END OF SECTION * * *

DIVISION 40

PROCESS INTEGRATION

SECTION 40 01 00
CNG FUELING SYSTEM EQUIPMENT – LINCOLN GARAGE

PART 1 GENERAL

1.01 SUMMARY

A. This specification covers installation of compressed natural gas (CNG) fueling system equipment (furnished by others) for the City of Milwaukee Department of Public Works (DPW) Lincoln Garage at 3921 W. Lincoln Ave., Milwaukee, WI 53215.

B. The City of Milwaukee is awarding purchase order for supply of equipment in this section to:

1. ANGI Energy Systems, Inc. (ANGI)
   15 Plumb Street
   Milton, WI 53563
   (800) 955-4626
   Dan Hicks
   DHicks@angienergy.com
   www.angiinternational.com

2. AssetWorks
   998 Old Eagle School Road
   Wayne, PA, 19087
   Joseph A Basile
   VP Fueling Technologies
   Joseph.Basile@assetworks.com
   610-228-0120

   Jill Coffin
   Jill.Coffin@assetworks.com
   (610) 228-0126

C. CNG fueling system equipment furnished by ANGI shall consist of following components and services:

1. Tag Nos. **01-CMP-01, -02:** Twin Gas Compressors in enclosure.
2. Tag No. **01-GD-01**: Gas Dryer.
3. Tag Nos. **01-TK-01 thru -06:** CNG Storage Vessels.
4. Tag Nos. **01-FD-01, -02, -03:** CNG Fast-Fill Dispensers.
5. Tag Nos. **1 thru 8** Dual Time-Fill Hose Post Assemblies.
6. Tag No. **01-PDP-01:** Power Distribution- Motor Starter Panel
7. Tag No. **01-PVP-01,-02,-03:** Valve Panels for CNG fill systems.
8. Tag No. **01-FMS-01,-02,-03**: Fuel Management Systems.
9. Factory acceptance testing by ANGI in Milton, WI.
10. Delivery of equipment to site.
11. Field testing support services.
12. Operation and maintenance manuals and record drawings.
13. Operation and maintenance training in field.

D. Equipment information to be issued as Attachment 1 to Section 40 01 00 at Pre-Bid Meeting will include:

1. General arrangement drawings with equipment weights.
2. Product data.
3. Shop drawings (as available).
4. Installation and maintenance instructions.
5. Equipment delivery schedules.

1.02 PROJECT CONDITIONS

A. Natural Gas – pipeline quality from WE Energies:

1.	Specific gravity:	0.59 (assumed).
2.	Temperature:	70 deg F (assumed).
3.	Heating value:	varies – assume 1015 Btu/SCF.
4.	Moisture content:	<7 lb/MM SCF.
5.	Gas pressure at station inlet:	65 psig (nominal).

Minimum "float" of compressor suction shall be from 40 psig to 80 psig.

B. Electrical Service (See Drawings and Division 26 Specifications):

1. Electrical power supplied to compressor's motor starter panel shall be 480VAC to 10%, 3-phase, 60 hertz.
2. Electrical power supplied to dispensers shall be 120VAC, single-phase, 60 hertz.
3. Electrical power supplied at other voltages shall be furnished as shown on drawings

C. Design Conditions:

1. Compressor System:

a.	Compressor suction gas pressure:	40 psig (min) 60 psig (design flow rate) 80 psig (max)
b.	Discharge pressure from compressor:	4,500 psig.
c.	Design flow rate:	500 scfm per compressor.
d.	Max gas discharge temperature:	20 deg F above ambient.

2. Site:

a.	Ambient temperature:	-20 deg F to 95 deg F.
b.	Elevation above MSL:	649 ft.

1.03 REFERENCES

A. All equipment and entire packaged fueling system shall comply with latest revisions of applicable codes and standards and Wisconsin Department of Commerce Chapter Comm. 40. All materials shall be new and unused. As a minimum, equipment shall comply with following codes and standards:

1. American Gas Association (AGA):

a. 2-93 – Requirements for Manually Operated Valves for High Pressure Natural Gas.

2. American Petroleum Institute (API):

   a. 520 – Sizing, Selection, and Installation of Pressure-relieving Devices.

3. American Society of Mechanical Engineers (ASME):

   a. Boiler and Pressure Vessel (B&PV) Code:

      (1) Section VIII, Division I – Pressure Vessels.
      (2) Section IX – Welding and Brazing Qualifications.

4. American Welding Society (AWS):

   a. D1.1 – Structural Welding Code.

5. National Fire Protection Association (NFPA):

   a. 52 – Vehicular Gaseous Systems Code – 2002 (per WI Comm. 40).
   b. 52 – Vehicular Gaseous Systems Code – 2010 (for future).
   c. 54 – National Fuel Gas Code – 2009.
   d. 70 – National Electrical Code (NEC) – 2008.

6. Underwriters Laboratories Inc. (UL):

   a. 508 – Industrial Control Equipment.
   b. 508A – Industrial Control Panels.

7. American National Standards Institute (ANSI):

   a. B31.3 – Process Piping (ASME Code for Pressure Piping).

8. Occupational Safety and Health Act (OSHA):

   a. 29 CFR1910.95 – Occupational Noise Exposure.

1.04 QUALITY ASSURANCE

A. Paint, coatings, and priming products shall be lead, chromium, and cadmium free. In addition, products and all other materials used shall comply with local, regional, state, and federal air quality rules and regulations.

B. Materials and surfaces exposed to exterior, unless pre-finished or otherwise treated with a corrosion-resistant finish, shall receive a minimum of a two-coat, shop-applied, epoxy coating system with surface preparation in accordance with SSPC standards and coating manufacturer recommendations.

PART 2 – PRODUCTS

(Furnished by Owner per Contract with ANGI; Received, Unloaded, Set, and Installed by Contractor)

2.01 CNG COMPRESSOR SYSTEM PACKAGE (01-CMP-01, 01-CMP-02 and 01-PDP-01)

A. Natural Gas Compressor System (furnished by ANGI):

1. CNG Compressor Manufacturer:

   a. Ariel Model JGQ.

2. Each compressor system has been sized to handle quoted capacity with gas analysis and conditions specified in Article 1.02, paragraphs A and C.

3. System will be a self-contained electric-driven package, consisting of an electric motor driven compressors, control panel with PLC controls, auxiliary systems, and safety devices. Each compressor will be designed specifically to compress natural gas.

4. Compressor will be of multi-stage, reciprocating design. Compressor will be air-cooled trunk piston or cross head design.

5. Compressor cylinders will be splash or pressure lubricated with pressure lubricated crankcase running gear. Compressor lubrication shall be ISO150 grade synthetic oil or as approved by compressor manufacturer.

6. CNG compressor system enclosure by ANGI:

   a. Totally enclosed weatherproof and sound attenuating enclosure (75 dBA at 10 ft outside of enclosure) shall be provided for compressor skid.
   b. Enclosure will be of welded steel construction.
   c. One (1) 150W minimum light fixture suitable for Class 1, Division 2, Group D location will be provided complete with explosion-proof wall mounted manual switch.
   d. Exterior surface will be weatherproof, rain-tight, and factory coated with manufacturer's recommended coating system.
   e. All doors will be either swing out; shall be lockable; and shall have hold-open devices with means to open at least one door from inside.
   f. ESD Push-button will be located inside system enclosure near primary access door and outside skid enclosure.

7. Each compressor system will be furnished by ANGI with following items skid mounted inside enclosure (EXCEPT for item a. which shall be installed by Contractor):

   a. Inlet line assembly including a particulate filter, check valve, fail-closed actuated valve, isolation valve, flexible hose, and relief valve for field installation by Contractor as shown on Drawings.
   b. Direct compressor drive.
   c. Interstage gas coolers, gauges, separators, and relief valves.
   d. Piston rings shall have a guaranteed minimum life of 4,000 hours. Supplier shall provide manufacturer's written guarantee of compliance.
   e. Compressor valves shall have a minimum life of 3,000 hours.
   f. Compressor shall have a guaranteed maximum oil carryover after final discharge filtration system of no more than 0.5 lb/MMscf of natural gas.

g. Fan belts if required shall be V-belt, cogged type.
h. Guards for drive belts and hot surfaces that provide protection in conformance with OSHA and other safety regulations.
i. Automatic condensate drain system.
j. Discharge line assembly including pre-coalescing and coalescing filters, relief valve, check valve, and isolation valve.
k. Parker-type zero tolerance o-ring face seal fittings for tubing sized 1/2 in. to 1-1/2 in.
l. Service vent valves to depressurize line for servicing.

8. Equipment vibrations shall not exceed following displacement measured with a three-component measuring system (see paragraph 2.02D):

Frequency (cycles per second)	Displacement (inches)
0 - 10	0.0020
10 - 20	0.0010
20 - 30	0.0006
30 - 40	0.0004
40 - 50	0.0003
50+	0.0001

9. Electric Motors:

a. Manufacturers:

1) A.O. Smith.
2) Baldor.
3) GE.
4) Regal Beloit (Leeson, Lincoln, or Marathon).
5) WEG Electric Motors.

b. Constant speed, NEMA Premium®, TEFC motor.
c. 250 HP / 480 VAC / 3-phase /60 Hz / 1800 rpm.
d. Rated for continuous duty with minimum 1.15 service factor.
e. Rated for Class 1 Division 2 Group D location.

B. Motor Starter Panel **(01-PDP-01) (furnished by ANGI):**

1. Shipped separately for installation by Contractor off compressor skid in a non-hazardous area as shown on Drawings.
2. Stainless steel enclosure.
3. Acceptable Manufacturers for AC motor controller products:

a. Square D.
b. Cutler Hammer / Westinghouse.
c. Allen Bradley Co.

4. Lockable main breaker sized to adequately handle compressor horsepower.
5. SCR solid-state type reduced voltage starter.
6. Over-current protection on all circuits.
7. Minimum "Interrupting Rating" rating of 65,000 amp SCCR.
8. Exterior indicating lights shall include "Power On" and "Compressor Running."
9. Provision for 480VAC supply.
10. Transformer(s) for control circuit power, inputs, and outputs.

C. CNG Cooling System (provided by ANGI on compressor skid)

1. Gas coolers suitable for service in ambient temperatures of between -20°F and 120°F and designed to deliver gas at a maximum temperature of ambient plus 20°F.
2. Forced draft air circulation will be used to cool CNG from effects of compression. Fan drive may be either derived from prime mover or separate electric motor.
3. Tube material will be seamless Type 316SS; manufactured and labeled according to ASTM A213.
4. Cooler intake and exhaust sections will be oriented so as to minimize introduction of exhaust air into enclosure. Coolers will include sound attenuating louvers at intake and exhaust sections.

D. Gas Recovery System (provided by ANGI on compressor skid):

1. Gas recovery system will recover any gas that is vented during compressor shutdown.
2. Upon compressor shutdown, gas within compressor system will be routed to recovery system to allow unloaded compressor starting.
3. All oil separators will drain to a single manual drain piped to edge of enclosure (contractor shall provide elbow discharge off skid for open vessel collection by owner- NOT hard piped to drain).
4. Gas recovery vessel will be ASME-rated and have necessary capacity and pressure rating to accumulate blowdown gas without relieving gas to atmosphere or to station inlet line.
5. Gas recovery vessel will have a relief valve and manual service vent valve.

E. Vibration Monitoring System (provided by ANGI)

1. Manufacturer:

   a. Wilcoxon Research.

2. Vibration monitoring system (sensor/transmitter, monitor, software) with output to station control PLC and SCADA system for following applications on each compressor:

   a. Cross-head vibration (cross-head looseness) for each compressor.
   b. Compressor frame vibration (shaft imbalance) for each compressor.

3. Factory pre-wired to PLC installed in CNG station PLC control system.

4. Tested during factory acceptance test and log data.

F. Filters (provided by ANGI):

1. Acceptable Manufacturers:

   a. Parker / Finite.
   b. Nowata.

2. Inlet Gas Suction Filter:

   a. Sized to filter particulate of 50 micron diameter or greater at maximum compressor flow rate.

b. Manual drain valve with differential pressure gauge.

3. Interstage Coalescing Filters:

a. Coalescer downstream of each cylinder between interstage cooler and next-stage compressor inlet.
b. Sized to eliminate 95% entrained liquids and liquid accumulation from up to 8 hours of continuous operation.

4. Discharge Coalescing Filters:

a. Two filters (pre-coalescer and coalescer) for each compressor.
b. Coalescing filters (in-series) as far as possible downstream of final stage aftercooler but before priority/direct fill valve panel.
c. Filters sized for discharge not to exceed 50 ppm liquid hydrocarbon or oil.
d. Pressure drop shall not exceed 2% at compressor's maximum flow rate over gas pressures ranging from 2,000 to 4,500 psig.

5. Automatic Condensate Drain System:

a. Actuated drain valve for each coalescing filter piped to system blowdown tank and controlled by programmable controller adjustable at controller user interface.
b. ASME-rated condensate blowdown tank(s) with sufficient volume for maximum system condensate flow, tank relief valve, and tank drain piped to edge of skid with manual isolation ball valve.

2.02 NATURAL GAS DRYER (01-GD-01) (Furnished by ANGI)

A. Xebec Adsorption, Inc. Model STR30NGX Duplex Dryer – Manual Regeneration.

1. Shop drawing submittals from ANGI to be furnished when available.
2. Refer to XEBEC installation manual.

B. Maximum Allowable Discharge-Moisture Content:

1. Discharge gas will comply with SAE standard J-1616, base on inlet natural gas with up to 9 lb moisture per MMSCF, and a design low ambient temperature of minus 20°F.

C. Adsorbent:

1. Adsorbent will be 3A molecular sieve and shall not affect character and odor of incoming gas.
2. Dryer design shall be such that adsorbent shall have a minimum useful life of five years.

D. Design:

1. Dryer will utilize a manual-simplex design consisting of one desiccant vessel.
2. Dryer will be pre-assembled on a skid and shall include common connection at system inlet and outlet.
3. Piping, vessels and valves will be sized, configured and ported so that pressure drop between inlet and outlet flanges of dryer does not exceed 5 psig at design supply pressure from WE Energies.

4. MAWP of vessels, piping and complete assembly will be based on final dryer-supply pressure plus allowance as required to accommodate for pressure rise during regeneration-heating and plus an additional 10% safety factor.

E. Capacity:

1. Dryer vessel will be sized so that regeneration shall be required after no less than 40 hours of full gas throughput during normal operation of compressor system, based on an inlet gas-moisture content of 9 lb/MMSCF.
2. Dried gas shall pass through an after filter.

F. Instrumentation and Control:

1. Regeneration heating and cooling cycles will be controlled by programmable logic controller (PLC).
2. Dryer system will be equipped with controls, instrumentation, status indication and alarms as follows:

   a. ASME-certified vessel pressure relief valves
   b. 2.5-inch dial locally mounted chamber pressure gauge at inlet piping to each desiccant chamber.
   c. 2.5-inch dial regeneration loop pressure gauge.
   d. Regeneration heater outlet gas temperature thermocouple.
   e. Regeneration cooler inlet gas temperature thermocouple.
   f. Regeneration cooler outlet gas temperature thermocouple.
   g. Heater sheath temperature alarm and shutdown.
   h. Heater outlet temperature alarm and shutdown.
   i. Blower motor overload tripped alarm and shutdown.
   j. Cooler motor overload tripped alarm and shutdown.
   k. Cooler outlet temperature alarm and shutdown.
   l. Regeneration heater “fail to heat” alarm and shutdown.
   m. Power ON/OFF switch.
   n. Keyed REGENERATION START switch.
   o. REGENERATION STOP push-button.
   p. Hygrometer (ceramic-type moisture sensor) coupled with dewpoint monitor.
   q. Text display for dryer/dew point status.
   r. Independent form “C” relays for dryer and dew point alarms.
   s. Compressor contact.
   t. Alarm light.

3. Precision dewpoint monitor (with digital dewpoint indication in degrees F.) will be installed at dryer control panel.

   a. Hygrometer will annunciate dew point data on a text display located on a NEMA 4 enclosure.
   b. Moisture sensor will be installed at dryer outlet to verify gas dew point on a continuous basis.
   c. Two hygrometer setpoints will be factory set with dry contacts (SAE J1616) for remote alarm:

      1) AL-1: first to signal deteriorating dew point performance.
      2) AL-2: second when regeneration is required. A set of form "C" dry contacts shall be provided for remote signal.

4. Differential pressure gauges will be provided on inlet and outlet filters.

G. Manual Regeneration:

1. Regeneration of desiccant bed will be by temperature swing with closed loop gas circulation, and shall be initiated manually and terminate automatically.
2. Maximum regeneration and cooling time will be eight (8) hours.

H. Bypass Capability:

1. Dryer bypass and isolation manual valves will be provided so that compressors may operate while entire dryer is off line.

I. Gas Blower Assembly:

1. Gas blower will be a vane- or lobe-type with an electric motor rated in accordance with NFPA 70.
2. Blower/motor will be installed in an ASME "U" or "UM" stamped carbon steel pressure vessel with same pressure rating as dryer vessel.
3. Horizontal blower bell housing will be fitted with stainless steel glides mating stainless steel runners fitted to support skid to permit removal from blind flange with minimal effort by one person.
4. Suitable anchoring of blower housing will be provided to support blower housing once installed.

J. Gas Heater Assembly:

1. Gas heater will use incoloy sheathed, low-Watt-density electric heating elements mounted inside an insulated heating chamber.
2. Heater bundle will be furnished with a thermocouple and temperature switch for heater sheath over-temperature alarm and shutdown.
3. A heater high outlet temperature switch will be furnished at heater outlet.
4. Heater vessel will be an ASME "U" or "UM" stamped carbon steel pressure vessel with same pressure and temperature rating as desiccant chamber.

K. Aftercooler Assembly:

1. An air-to-gas fin tube aftercooler complete with electric motor and non-sparking fan blades with motor in compliance to Class 1, Div. 2, Group D electrical class will be provided.
2. A high-efficiency coalescing-separator with two-piece aluminum bowl and head construction will be provided.

    a. Carbon steel condensate reservoir and a manual drain valve piped to skid edge. Reservoir will have a liquid capacity for at least two regeneration cycles.

2.03 CNG-STORAGE VESSELS (01-TK-01,-02,-03,-04,-05, and -06) (Furnished by ANGI)

A. Manufacturer: CP Industries or FIBA

1. Two (2) 3-Pack storage assemblies with ASME-rated CNG storage vessels will be provided (nominal 36,000 scf at 5,000 psig). Each vessel shall be 20 in. dia. x 23 ft. long with capacity of 11,500 scf at 4,500 psig, and MAWP of 5,500 psig, and shall include framing and bracing.
2. Each 3- Pack Vessel Assembly weighs approximately 21,000 lbs.

B. Arrangement:

1. Tube-type vessel shall be bolted to their foundation by Contractor by structural steel rack per Drawings.
2. Vent Risers shall be provided by Contractor per Drawings.

C. Valves and Drains:

1. Each vessel will include a full-port 3/4 in. pressure relief valve (PRV) set at vessel MAWP with a full-port 3/4 in. ball valve locked open between PRV and vessel.
2. Each vessel will include a 3/4 in. service ball valve, a drain port at its low point with a needle type drain valve.

2.04 FAST-FILL DISPENSERS (01-FD-01,-02,-03) (Furnished by ANGI)

A. Manufacturer: ANGI Energy Systems

1. Two (2) dual-hose medium-duty 3,600 psig CNG dispensers with internal fill-control logic for DPW fast-fill system.
2. One (1) dual-hose medium-duty 3,600/3,000 psig CNG dispenser with internal fill-control logic for public fast-fill system and display on both sides of dispenser (one hose at 3,600 psig / one hose at 3,000 psig).

B. Specifications:

1. Dispensers will be capable of delivering fills of specified CNG temperature compensated to 70°F, based on control logic housed in dispenser.
2. Dispensers will include two MicroMotion CNG-050 meters, mechanical vehicle pressure gauge for each hose inside cabinet, and shall have a backlit data display.
3. All CNG tubing and fittings will be 1/2 in. x .065 in., grade 304/316 SS.
4. Vent tubing will be 3/8 in. x .049 in., grade 304/316 SS.
5. A means of preventing escape of CNG from fast-fill system in case dispenser is knocked off of its base shall be provided.
6. Dispenser-control valves will use actuated ball valves.

C. Filters:

1. Dispensers will include one inline oil-coalescing filter for each of three sequence-bank feed lines and a block and bleed valve arrangement to facilitate servicing of filters. Three total filters will be housed in Parker-Hannifin J2 housings and will include a grade-4 coalescer element. Filters will be located upstream of meter and control valves in dispenser cabinet.

D. Hose and Nozzle:

1. Hoses will be 3/8 in. x 12 ft. long with 5,000 psig MAWP.
2. Inline breakaways mechanisms with check valves, which will be electrically conductive.
3. Nozzle will be NGV-1 type-2.
4. Hose will not contact ground when nozzle is in its keeper.

E. Operation:

1. Dispenser will be controlled by internal logic controller.
2. Dispenser will include internal 3-bank sequencing with 3/8 in. tubing connections to storage array.

F. Interface with Fuel-Management Terminal:

1. Dispensers shall be configured for connection to CNG industry standard fuel-management terminal, so that terminal must authorize dispensing of fuel, and so that CNG fuel consumption mass is recorded by terminal, along with user ID, time of day and vehicle ID.

2. Pulse-Count Output:

   a. Dispenser will generate 100 pulse-count per mass of CNG dispensed (i.e. 100 pulses per gasoline-gallon equivalent of CNG).
   b. Actual mass-calibration rate shall be diesel gallon equivalent for DPW Fast Fill and Gasoline Gallon Equivalent for Public Access Dispenser.

3. Contractor shall install connections between each dispenser and fuel management terminal for following signals:

   a. Handle switch.
   b. Low-voltage meter pulser.
   c. "Authorize" signal.
   d. Conductors of different voltages shall be routed in separate conduits.

2.05 TIME-FILL DUAL HOSE POST ASSEMBLIES (furnished by ANGI)

A. Manufacturer: ANGI Energy Systems

1. Eight (8) Dual Fill Hose Posts setup for Type K barrier rail installation.
2. Sixteen (16) 1/2 in. x 1/4 in. x 15 ft. long electrically conductive hoses, with MAWP of 5,000 psig.
3. Includes inline breakaways with 1/4 in. male pipe thread at supply end of hose.
4. Dispenser nozzles will be NGV-1 Type-2 with P-36 profiles for 3,600 psig NGV.
5. Bourdon tube pressure gauge for manifold pressure at each dual hose post.

2.06 CNG STATION PLC CONTROL PANEL IN ENCLOSURE (furnished by ANGI)

A. PLC:

1. Programmable logic controller(s) (PLC) will be provided to control compressor operation, priority / time-fill valve panels, and an emergency shutdown system.

2. PLC Manufacturer: Horner

3. Local Display:

   a. Touch-type LCD display.
   b. Fault annunciation.
   c. Operating conditions.
   d. Interface for modifying setpoints by authorized operator.

4. Programmability:

   a. Owner will have unimpeded access to modify setpoints and operating parameters upon completion of work.
   b. Supplier will provide PC-host software (or similar) as required to modify controller program, including any specialized PC interface connector.

B. Control Panel:

1. NEMA 3R type (outdoor use) enclosure.
2. Located on compressor skid.
3. Compressor keyed on/off switch.
4. Exterior indicating lights will include "Compressor Running" and "Compressor Fault."
5. Emergency shutdown push-button and keyed alarm reset accessible from exterior of panel.
6. All 120VAC wiring shall be terminated at a single, clearly labeled terminal strip ready for field termination by Contractor.
7. Additional termination points for remote emergency shutdown push-button stations (remote push-button stations shall be provided by Contractor except for push-button at compressor which shall be provided by Supplier).
8. Incorporate with SCADA system.

C. Performance Specification

1. Compressor Starting:

   a. Logic in base controller shall prohibit a second compressor from starting within 10 seconds of primary starting compressor but shall allow both compressors to operate concurrently based on demand from time-fill/fast fill dispensers and storage pressure, which shall be adjustable.
   b. Controller shall facilitate incremental compressor startup based on threshold storage pressure.
   c. Incremental compressor start sequence shall be associated with storage-bank pressure; i.e. first compressor starts when bank falls to 3,600 psig. and second compressor starts when mid-bank falls to 3,300 psig. Both setpoints shall be adjustable.
   d. Second compressor shall be prohibited from starting based on field programmable time of day.

2. Storage Bypass:

a. Controller shall control and prioritize compressor discharge to time-fill header, priority storage banks, fast-fill direct supply to DPW fast-fill dispensers, or supply to public area storage banks.

D. Shutdowns, Alarms, and Annunciations:

1. Compressors (minimum requirement):

a.	High/low suction gas pressure:	shutdown
b.	High interstage pressure (all stages):	shutdown
c.	High gas discharge pressure:	shutdown
d.	Low lube oil pressure:	shutdown
e.	High interstage temperature (each stage):	shutdown
f.	High discharge temperature:	shutdown
g.	High compressor/cooler vibration:	shutdown
h.	High oil temperature:	shutdown
i.	Lubricator failure:	shutdown
j.	Excessive motor starts:	shutdown

2. System:

a.	High storage pressure, each bank:	shutdown
b.	High blowdown pressure (95% MAWP):	shutdown

E. Emergency Shutdown System:

1. An emergency shutdown (ESD) system shall be provided. When ESD system is activated:

   a. Power to PLC outputs, gas supply to compressors, and dispenser(s) are shut off.
   b. Signal shall be available to activate optional visual warning devices.

2. ESD system shall be activated by:

   a. CNG station shutdown push-buttons (various locations).
   b. Loss of station electrical power.

3. System shall not allow station to resume operation without a manual reset and station returning to normal.

2.07 SCADA (Supervisory Control and Data Acquisition) SYSTEM (furnished by ANGI)

A. Summary:

1. SCADA system will provide centralized monitoring and recording of programmable controllers for compressors, dryers, priority panels, storage, and dispensers.
2. SCADA system will include computer and program software.
3. SCADA will monitor devices and display natural gas process.
4. Motors, pumps, valves, pressures, temperatures, switches, vibration monitors, etc., shall have a graphical representation.
5. SCADA will manage and monitor CNG processes and facilities management.
6. Graphics, controls, configuration data and programming associated with SCADA installation will be configured and implemented based on representation of

infrastructure equipment deployed at CNG site, allowing entire system to be monitored and controlled in real-time.

B. Screens:

1. Screens shall properly display CNG equipment as process piping schematic.
2. Main menu screen shall include a general arrangement representing CNG site.
3. Sub menu screens shall display specific CNG equipment.

C. Ethernet:

1. CNG equipment PLC will include a built in Ethernet Port with standard TCP/IP.
2. Each controller will have a unique IP Address and be configured to site specifications.
3. Ethernet Port will support 10/100BaseT.
4. Ethernet protocol to be finalized by Owner with ANGI.

D. Alarms:

1. Alarm functions shall display alarms (and related alarm help pages), and acknowledge, disable, and enable alarms.
2. SCADA will provide information about alarms and allow operators to add comments to alarm records.
3. Alarms will be logged with a time and date stamp.

E. Mapping:

1. SCADA program will have a tag configurable database that polls CNG stations and tells software which parameters within station are to be accessed.
2. Database will schedule frequency at which parameters of station are accessed.
3. Parameters will include measured values, data points, and alarm setpoints.

F. Logging and Trending Data:

1. Trend graphs.
2. Trending will provide dynamic visual analysis (trend and graphs), production records, and status of equipment, efficiency and preventive maintenance.

G. Messages:

1. SCADA PC software shall provide messaging for SMS or E-mails that report status and alarm condition reported to external personal.

H. Web Browser: to be finalized by ANGI in submittals.

2.08 MAIN PRIORITY VALVE PANEL (01-PVP-01) (furnished by ANGI)

A. Manufacturer: ANGI Energy Systems.

1. Priority valve panel will direct flow of CNG from DPW CNG fueling station.

2. Storage will be accessed first in event of a demand for vehicle fast filling. If storage pressure drops to set point, station control system will start compressor and shall run until fast filling demands have been met. If there are no further fast fill demands, compressor shall replenish storage.

3. Main priority valve panel control system will direct compressor discharge gas to dispensers or to storage. Control logic for priority for compressor flow is summarized as follows:

   a. First priority: Direct flow to DPW fast-fill dispenser.
   b. Second priority: Direct flow to "Public" priority system fast-fill dispenser.
   c. Third priority: Direct flow to DPW time-fill system.
   d. Fourth priority: Replenish DPW fast-fill storage high to mid to low bank.

4. In addition to I/O signals required for CNG Station Control, PLC shall interface with following I/O signals:

   a. ESD push-buttons (provided by Contactor as shown on Drawings).
   b. Storage pressure.
   c. Actuated valves in valve panel.

5. ESD valves shall fail closed.

2.09 PRIORITY VALVE PANEL (01-PVP-02) (Public Fast Fill Area) (furnished by ANGI)

A. Manufacturer: ANGI Energy Systems.

1. Priority valve panel will direct flow of CNG from DPW CNG fueling station to public fueling dispenser (01-FD-03).

2. Storage will be accessed first in event of a demand for vehicle fast filling. If storage pressure drops to set point, station control system will start compressor and shall run until fast filling demands have been met. If there are no further fast fill demands, compressor shall replenish storage.

3. Priority valve panel control system will direct compressor discharge gas to dispensers or to storage. Control logic is from system PLC priority for compressor flow summarized as follows:

   a. First priority: Direct flow to DPW fast-fill dispenser.
   b. Second priority: Direct flow to "Public" priority system fast-fill dispenser.
   c. Third priority: Direct flow to DPW time-fill system.
   d. Fourth priority: Replenish DPW fast-fill storage high to mid to low bank.

4. In addition to I/O signals required for CNG Station Control, PLC shall interface with following I/O signals from this Priority Valve Panel:

   a. ESD push-buttons (provided by Contactor as shown on Drawings).
   b. Storage pressure.
   c. Actuated valves in valve panel.

5. ESD valves shall fail closed.

2.10 SEQUENTIAL TIME-FILL PANEL (01-PVP-03) (For DPW Metered Sequential Fill)

A. Manufacturer: ANGI Energy Systems

B. Time-Fill Flow Metering:

1. Includes (1) one MicroMotion CNG-050 coriolis gas flow meter for measurement of flow dispensed through time-fill dual hose post assemblies based on individual, sequenced, fill at each time-fill post assembly via PLC control.

C. Solenoid valves for sequential time fill will be factory installed and pre-wired in Time Fill Panel

D. Sequential Time-Fill System and Fuel Management Control Logic (or equal):

1. Time-fill supply flow transmitter shall measure and transmit flow data from time-independent time-fill system branch supply header.

2. Each time-fill hose post solenoid valve shall be electromechanically controlled to open and close for filling vehicle.

3. Only one solenoid valve shall be open at a time, to enable measuring of flow to time-fill hose dispenser connection via common supply header flow meter; therefore, time-fill shall be sequential fill at time-fill dispensers.

4. Vehicle driver (with unique ID number) will connect truck (unique ID number per truck) to a time-fill hose (with unique ID number per hose dispenser) and input corresponding ID numbers in time-fill fuel management system controller.

5. Driver and equipment ID shall be authenticated for accuracy before time-fill fueling at hose dispenser is authorized.

6. Each additional vehicle will follow similar connection to time-fill hose system and will be added to "queue" for sequential filling via CNG compressor system.

7. At programmable "start-time" for time-fill fueling session (i.e. evening shift), control system shall authorize compressor start to sequentially fill vehicles by opening and closing solenoid valves based on authorization order in system queue.

8. Control system shall monitor temperature-compensated pressure in header to indicate when vehicle CNG fuel tank is "full" and sequence opening next valve filling next vehicle in time-fill queue.

9. Upon satisfying fill pressure for last vehicle in queue, control system shall:

   a. Signal end of time-fill session.
   b. De-authorize time-fill session.
   c. Log quantity of fuel from flow meter data by hose ID, vehicle ID, and driver ID.

10. City of Milwaukee Fleet Services administrator shall be able to extract site data through host control processor database management application for export to Excel, CSV or other specific format.

11. Any interruption or errors in time-fill sequence shall be alarmed and documented by control system.

2.11 INSTRUMENTATION AND CONTROLS (provided by ANGI on pre-wired skids)

A. All pressure gauges shall conform to following requirements:

1. All gauges will read at least 1.2 times system design pressure (NFPA 52).
2. Accuracy, including hysteresis, will be +0.5% of full scale or better.
3. Rear blowout protection will be provided.
4. All gauges will be waterproof and liquid-filled.
5. Dial will have a minimum diameter of 2-1/2 inches.

B. Instrument components interfacing with natural gas will be made of material compatible with odorized natural gas. No copper metal or alloys containing more than 70% copper shall be used in natural gas service.

C. Gauges and manually operated valves shall be located no higher than five (5) feet above grade.

D. Pressure gauges will be installed at following locations as a minimum:

1. Suction pressure downstream of suction filter.
2. Inter-stage pressures at filters and cooler.
3. Oil pressure on compressor frame oil filter.
4. Final discharge pressure at discharge filters.
5. Blowdown vessel pressure.
6. Control gas pressure (if installed) downstream of regulator.

2.12 FUEL MANAGEMENT SYSTEM (01-FMS-01, -02, -03) (furnished by Owner)

A. Manufacturer: AssetWorks

B. Equipment details to be provided with Attachment 1 to this section at Pre-Bid Meeting

2.13 PIPING / TUBING ON SKIDS FURNISHED BY ANGI

A. Piping and tubing systems will be rated for maximum pressure and temperature to which they will be subjected under normal operating conditions and be properly supported and protected to prevent damage from vibration during shipment, operation, and maintenance. Piping and tubing systems shall be installed in a neat and orderly arrangement, adapting to contours of skid package. Piping and tubing systems shall not obstruct access openings. Supports shall not be welded directly to piping or tubing.

B. Piping design, inspection and testing shall be in accordance with ANSI/ASME B31.3. Piping shall be seamless, minimum Schedule 40 (standard weight), and conforming to ASTM A53 or A106, Gr. B. Cast iron or semi-steel piping will not be used. Testing shall be pneumatic.

C. Gas tubing on compressor skid will be seamless stainless steel ASTM A269, Type 316. Hardness of stainless steel tubing shall be no more than Rockwell hardness of 80. All tubing fittings used throughout station system (compressor skids, dispensers, storage, and inter-skid connections) will be Parker Seal-lok® o-ring face seal for 1/2 in. and larger diameter and Gyrolok® 316 stainless steel for smaller than 1/2 in. diameters.

D. Piping will be prepared and painted in accordance with manufacturer's standards.

E. ANGI will provide drain lines brought to skid edge and allow draining into a container placed on ground next to skid.

2.14 EQUIPMENT TAGS (provided by ANGI)

A. All equipment, including storage vessels, tanks, heat exchangers, instrumentation (gages, transducers, etc.), all valving (isolation, bleed, check, regulation, solenoid and relief) and panels will be provided with an equipment tag and unique tag number matching equipment ID number on D. Tags will be laminated plastic with black letters on white background or approved equal. They will be attached to flat surfaces of equipment using an epoxy adhesive or wired to equipment with stainless steel wire.

PART 3 EXECUTION

3.01 FACTORY ACCEPTANCE TESTING (By ANGI per OWNER contract with ANGI)

A. Prior to shipment, CNG compressor shall be operated for a minimum of four (4) continuous hours and functionally tested. Test shall include, but not be limited to, following:

1. Operation of compressor control.
2. ESD system test.
3. Load testing.
4. Auto start / stop testing.
5. Safety shutdown testing.
6. Alarm testing.
7. Noise and vibration analysis.
8. Motor testing.
9. Lube oil system testing (pressure and temperature).
10. Fan testing.
11. Compressor interstage pressure and temperature testing.

B. Factory acceptance test parameter data shall be logged with readings, time and date and signed by authorized supplier representative.

C. Acceptance by Owner of witnessed test shall not release Supplier from any of its warranty obligations, or any other obligation, under this Specification.

3.02. DELIVERY

A. Supplier shall ship CNG compressor, dispensers, storage tanks, and all accessories to corresponding CNG vehicle fueling station site.

3.03. FIELD INSTALLATION

A. System equipment shall received, unloaded, set in place, wired, and piped to operate all gas drying, compression, storage, dispensing, control, and fuel management in accordance with manufacturer's shop drawing and installation instructions.

B. Installation shall be completed in accordance and in compliance with all applicable local and national Codes and Standards.

C. All components shall be tested in accordance with NFPA 52, NFPA 54 or other applicable CNG industry standards.

D. Pre-start Pipe Cleaning. All piping sections between packaged components that include piping or tubing shall be blown clean prior to connection to equipment. Blow out shall be achieved by closing the downstream end of pipeline with a 5000 PSI-rated ball valve,

connecting a minimum 1650 PSI-source pressure vessel to the upstream end of the pipeline, opening supply valve at source so that minimum 750 PSI accumulates in pipeline, then opening outlet ball valve to atmosphere. Procedure shall be repeated until no solid or particulate matter is discharged from the pipeline.

1. Personnel opening and closing ball valve at downstream end shall take care to keep clear of the discharge path of the blowout, and shall wear eye and ear protection during procedure.
2. Direction of blowout flow shall be performed in both directions if possible.
3. Contractor shall take care to clear area at pipeline discharge to prevent property damage or injury during procedure.

E. Startup Filtration. 'Witch's hat' or similar strainer devices shall be installed where practical at termination of such piping sections prior to system startup and shall be checked, cleaned and replaced by the Contractor as required until all residual pipe debris has been removed.

3.04. FIELD QUALITY CONTROL

A. Manufacturer's Field Services (By ANGI per Owner contract with ANGI)

1. Supplier's or manufacturer's technician for equipment specified herein shall be present at jobsite for minimum mandays included, travel time excluded, for assistance during plant construction and plant startup:

a. 2 mandays for Installation Support Services to Contractor.
b. 5 mandays to support Field Testing by Contractor and conduct Field Training.
c. 2 mandays for Post Startup Services.

B. Acceptance by Owner of CNG fueling system under this specification shall occur only after following requirements have been met:

1. Demonstrate to satisfaction of Owner that CNG fueling station as a whole meets and conforms to requirements of specification and drawings.
2. Testing required by this specification has been successfully completed and has been accepted by Owner
3. Date of acceptance of fueling stations shall be date of written notice of its acceptance by Owner to Supplier. All warranties and/or guarantees referred to or implied in this Specification shall commence on that acceptance date.
4. Acceptance by Owner of witnessed test shall not release Supplier from any of its warranty obligations, or any other obligation, under this Specification.

3.05. FIELD ADJUSTING, BALANCING AND TESTING BY CONTRACTOR

A. After completion of the installation, start, regulate, calibrate, adjust and test all equipment and devices.

B. Leak and pressure testing in accordance with Section 40 05 00 Process Piping and Tubing.

C. Functional Tests:

1. Test ESD / emergency shutdown at all button/station locations, including required valve closures.
2. Test low suction pressure, each skid (close skid-supply ball valves).

3. Test temperature-compensated dispenser fill for each dispenser, including correct dispenser start on button, auto-stop on fill completion, and verify 'settled' fill pressure vs. ambient temperature two hours following fills. Pressure shall be within 4% of design-fill pressure temperature compensated to 70°F.
4. Test for correct operation of fuel-management system at each fast fill dispenser, and time hose post hose including: authorization of transaction, energizing of dispenser, and recording of transaction data (fill volume, time/date stamp, event ID, and pump number).
5. Test dryer regeneration based alarm on dew point (generate false positive at hygrometer).
6. Test for correct annunciation on controller / PLC shall be required for all test events, as appropriate.
7. Observe compressor operation, including stage pressures and temperatures, and verifying function of controller, including triggering selected faults, such as high interstage temperature.

C. Reliability Test:

1. Reliability test shall consist of fueling under normal-use conditions for five (5) consecutive work days.
2. System shall have no failures of compressor operation, dryer operation, normal dispenser operation, or operation of the fuel-management system during the test period. If any failure occurs, the test shall be repeated in its entirety.
3. Final acceptance of the facility shall only be declared upon successful completion of the test.
4. Contractor shall be responsible for all onsite coordination of troubleshooting and coordination of suppliers and trades during test.
5. Failure shall be defined as the occurrence of any of the following:

    a. Inability of the CNG system to dispense CNG at the pressures and rate specified, including accounting for temperature compensation at settled conditions.
    b. Failure of the dryer to provide dried gas and/or not be able to auto switch or regenerate.
    c. Failure of a compressor to start and run within factory-listed operating pressures and temperatures.
    d. Failure of the controller/PLC, valve panel, fuel-management system and/or dispensers to operate as specified.
    e. Presence of an audible of visible gas or CNG leak.
    f. Occurrence of a auto-fault shutdown of either or both CNG compressors, except those caused by ESD-button activation, gas-detection system outside of skids, variations in gas supply pressure, or damage to facility beyond the Contractor's control.

6. Contractor may take equipment offline for scheduled maintenance during the test period, provided maintenance is consistent with manufacturer's recommendations, and does not impinge on Owner's ability to fuel vehicles during the normal daily fueling window between 7:00AM and 11:00PM.
7. Contractor shall be responsible for maintenance through successful completion of test, including provision of consumables.
8. Corrective work conducted by the Contractor and all subcontractors and suppliers preceding and during performance test shall be documented at time of repair by technician performing repair. If technician suspects a cause of fault that is beyond scope of his respective firm or responsibility, technician shall notify Owner immediately and shall not implement repairs until condition of failure has been documented and other firm(s) have been notified and been provided

documentation of condition.

9. Owner shall not pay Contractor for any work or repair that is implemented during testing above contract amount, unless work or condition is beyond control of Contractor, Contractor's subcontractors, or Contractor's suppliers.
10. Contractor shall notify Owner in writing of intent to perform any work that Contractor deems to be outside of contract scope, prior to performance of any such work.
11. Any discrepancies in Contractor's materials or workmanship found as a result of these inspections and test shall be corrected by Contractor at no cost to Owner (including cost for making all corrections and repeating test within two (2) weeks.

3.06 CNG FUELING OPERATION & MAINTENANCE TRAINING (By ANGI per Owner contract with ANGI)

A. On-Site Training:

1. General:

a. At least 60 days prior to scheduled date for commencement of training, submit training syllabus with time allotments per topic and instructional materials to Owner for review and approval. Upon review of syllabus, Owner may require additional time be allotted to certain training topics.
b. Develop and conduct a program to train ten (10) Owner personnel in the safe operating procedures, and maintenance of equipment and systems furnished during hours required by Owner. Also include in training program key hazards and their protectors, and corrective actions for violation of safety rules.
c. Furnish instructors, instructional materials and audio-visual aids and equipment.
d. Owner shall furnish physical facilities and equipment.
e. Begin instruction upon successful completion of field testing.

2. Program content: At a minimum, instruction will include material covered in operation and maintenance manuals as well as following:

a. Theory of operation of CNG system.
b. Practical aspects of operation.
c. Description of system, equipment and components.
d. Functional characteristics of system, equipment and components.
e. Emergency operating procedures.
f. Maintenance procedures.
g. Servicing intervals and schedules.

B. Duration:

1. Training for maintenance, facility operation and troubleshooting shall be eight (8) total hours (minimum).

ATTACHMENT 1
PRODUCT DATA – GENERAL ARRANGEMENT DRAWINGS – SUBMITTALS
(TO BE FURNISHED WITH ADDENDUM NO.1 AT PRE-BID MEETING

END OF SECTION

SECTION 40 02 00
CNG FUELING SYSTEM EQUIPMENT – NORTHWEST GARAGE

PART 1 GENERAL

1.01 SUMMARY

A. This specification covers installation of compressed natural gas (CNG) fueling system equipment (furnished by others) for the City of Milwaukee Department of Public Works (DPW) Northwest Garage at 3025 W. Ruby Ave., Milwaukee, WI 53209.

B. The City of Milwaukee is awarding purchase order for supply of equipment in this section to:

1. ANGI Energy Systems, Inc. (ANGI)
   15 Plumb Street
   Milton, WI 53563
   (800) 955-4626
   Dan Hicks
   DHicks@angienergy.com
   www.angiinternational.com

2. AssetWorks
   998 Old Eagle School Road
   Wayne, PA, 19087
   Joseph A Basile
   VP Fueling Technologies
   Joseph.Basile@assetworks.com
   610-228-0120

   Jill Coffin
   Jill.Coffin@assetworks.com
   (610) 228-0126

C. CNG fueling system equipment furnished by ANGI shall consist of following components and services:

1. Tag Nos. 02-CMP-01: Gas Compressor in enclosure.
2. Tag No. 02-GD-01: Gas Dryer.
3. Tag Nos. 02-TK-01 thru -03: CNG Storage Vessels.
4. Tag Nos. 02-FD-01, -02: CNG Fast-Fill Dispensers.
5. Tag No. 02-PDP-01: Power Distribution- Motor Starter Panel.
6. Tag No. 02-PVP-01: Priority Valve Panel for CNG Dispensing.
7. Tag No. 02-FMS-01,-02 Fuel Management System.
8. Factory acceptance testing by ANGI in Milton, WI.
9. Delivery of equipment to site.
10. Field testing support services.
11. Operation and maintenance manuals and record drawings.
12. Operation and maintenance training in field.

D. Equipment information to be issued as Attachment 1 to Section 40 012 00 at Pre-Bid Meeting will include:

1. General arrangement drawings with equipment weights.
2. Product data.
3. Shop drawings (as available).
4. Installation and maintenance instructions.
5. Equipment delivery schedules.

1.02 PROJECT CONDITIONS

A. Natural Gas – pipeline quality from WE Energies:

1.	Specific gravity:	0.59 (assumed).
2.	Temperature:	70 deg F (assumed).
3.	Heating value:	varies – assume 1015 Btu/SCF.
4.	Moisture content:	<7 lb/MM SCF.
5.	Gas pressure at station inlet:	65 psig (nominal).

Minimum "float" of compressor suction shall be from 40 psig to 80 psig.

B. Electrical Service (See Drawings and Division 26 Specifications):

1. Electrical power supplied to compressor's motor starter panel shall be 480VAC to 10%, 3-phase, 60 hertz.
2. Electrical power supplied to dispensers shall be 120VAC, single-phase, 60 hertz.
3. Electrical power supplied at other voltages shall be furnished as shown on drawings

C. Design Conditions:

1. Compressor System:

a.	Compressor suction gas pressure:	40 psig (min) 60 psig (design flow rate) 80 psig (max)
b.	Discharge pressure from compressor:	4,500 psig.
c.	Design flow rate:	500 scfm per compressor.
d.	Max gas discharge temperature:	20 deg F above ambient.

2. Site:

a.	Ambient temperature:	-20 deg F to 95 deg F.
b.	Elevation above MSL:	659 ft.

1.03 REFERENCES

A. All equipment and entire packaged fueling system shall comply with latest revisions of applicable codes and standards and Wisconsin Department of Commerce Chapter Comm. 40. All materials shall be new and unused. As a minimum, equipment shall comply with following codes and standards:

1. American Gas Association (AGA):

a. 2-93 – Requirements for Manually Operated Valves for High Pressure Natural Gas.

2. American Petroleum Institute (API):

   a. 520 – Sizing, Selection, and Installation of Pressure-relieving Devices.

3. American Society of Mechanical Engineers (ASME):

   a. Boiler and Pressure Vessel (B&PV) Code:

      (1) Section VIII, Division I – Pressure Vessels.
      (2) Section IX – Welding and Brazing Qualifications.

4. American Welding Society (AWS):

   a. D1.1 – Structural Welding Code.

5. National Fire Protection Association (NFPA):

   a. 52 – Vehicular Gaseous Systems Code – 2002 (per WI Comm. 40).
   b. 52 – Vehicular Gaseous Systems Code – 2010 (for future).
   c. 54 – National Fuel Gas Code – 2009.
   d. 70 – National Electrical Code (NEC) – 2008.

6. Underwriters Laboratories Inc. (UL):

   a. 508 – Industrial Control Equipment.
   b. 508A – Industrial Control Panels.

7. American National Standards Institute (ANSI):

   a. B31.3 – Process Piping (ASME Code for Pressure Piping).

8. Occupational Safety and Health Act (OSHA):

   a. 29 CFR1910.95 – Occupational Noise Exposure.

1.04 QUALITY ASSURANCE

A. Paint, coatings, and priming products shall be lead, chromium, and cadmium free. In addition, products and all other materials used shall comply with local, regional, state, and federal air quality rules and regulations.

B. Materials and surfaces exposed to exterior, unless pre-finished or otherwise treated with a corrosion-resistant finish, shall receive a minimum of a two-coat, shop-applied, epoxy coating system with surface preparation in accordance with SSPC standards and coating manufacturer recommendations.

PART 2 – PRODUCTS

(Furnished by Owner per Contract with ANGI; Received, Unloaded, Set, and Installed by Contractor)

2.01 CNG COMPRESSOR SYSTEM PACKAGE (02-CMP-01 and 02-PDP-01)

A. Natural Gas Compressor System (furnished by ANGI):

1. CNG Compressor Manufacturer:

a. Ariel Model JGQ.

2. Each compressor system has been sized to handle quoted capacity with gas analysis and conditions specified in Article 1.02, paragraphs A and C.

3. System will be a self-contained electric-driven package, consisting of an electric motor driven compressors, control panel with PLC controls, auxiliary systems, and safety devices. Each compressor will be designed specifically to compress natural gas.

4. Compressor will be of multi-stage, reciprocating design. Compressor will be air-cooled trunk piston or cross head design.

5. Compressor cylinders will be splash or pressure lubricated with pressure lubricated crankcase running gear. Compressor lubrication shall be ISO150 grade synthetic oil or as approved by compressor manufacturer.

6. CNG compressor system enclosure by ANGI:

a. Totally enclosed weatherproof and sound attenuating enclosure (75 dBA at 10 ft outside of enclosure) shall be provided for compressor skid.
b. Enclosure will be of welded steel construction.
c. One (1) 150W minimum light fixture suitable for Class 1, Division 2, Group D location will be provided complete with explosion-proof wall mounted manual switch.
d. Exterior surface will be weatherproof, rain-tight, and factory coated with manufacturer's recommended coating system.
e. All doors will be either swing out; shall be lockable; and shall have hold-open devices with means to open at least one door from inside.
f. ESD Push-button will be located inside system enclosure near primary access door and outside skid enclosure.

7. Compressor system will be furnished by ANGI with following items skid mounted inside enclosure (EXCEPT for item a. which shall be installed by Contractor):

a. Inlet line assembly including a particulate filter, check valve, fail-closed actuated valve, isolation valve, flexible hose, and relief valve for field installation by Contractor as shown on Drawings.
b. Direct compressor drive.
c. Interstage gas coolers, gauges, separators, and relief valves.
d. Piston rings shall have a guaranteed minimum life of 4,000 hours. Supplier shall provide manufacturer's written guarantee of compliance.
e. Compressor valves shall have a minimum life of 3,000 hours.
f. Compressor shall have a guaranteed maximum oil carryover after final discharge filtration system of no more than 0.5 lb/MMscf of natural gas.
g. Fan belts if required shall be V-belt, cogged type.

h. Guards for drive belts and hot surfaces that provide protection in conformance with OSHA and other safety regulations.
i. Automatic condensate drain system.
j. Discharge line assembly including pre-coalescing and coalescing filters, relief valve, check valve, and isolation valve.
k. Parker-type zero tolerance o-ring face seal fittings for tubing sized 1/2 in. to 1-1/2 in.
l. Service vent valves to depressurize line for servicing.

8. Equipment vibrations shall not exceed following displacement measured with a three-component measuring system (see paragraph 2.02D):

Frequency (cycles per second)	Displacement (inches)
0 - 10	0.0020
10 - 20	0.0010
20 - 30	0.0006
30 - 40	0.0004
40 - 50	0.0003
50+	0.0001

9. Electric Motor:

a. Manufacturer:

1) A.O. Smith.
2) Baldor.
3) GE.
4) Regal Beloit (Leeson, Lincoln, or Marathon).
5) WEG Electric Motors.

b. Constant speed, NEMA Premium®, TEFC motor.
c. 250 HP / 480 VAC / 3-phase /60 Hz / 1800 rpm.
d. Rated for continuous duty with minimum 1.15 service factor.
e. Rated for Class 1 Division 2 Group D location.

B. Motor Starter Panel (02-PDP-01) (furnished by ANGI):

1. Shipped separately for installation by Contractor off compressor skid in a non-hazardous area as shown on Drawings.
2. Stainless steel enclosure.
3. Acceptable Manufacturers for AC motor controller products:

a. Square D.
b. Cutler Hammer / Westinghouse.
c. Allen Bradley Co.

4. Lockable main breaker sized to adequately handle compressor horsepower.
5. SCR solid-state type reduced voltage starter.
6. Over-current protection on all circuits.
7. Minimum "Interrupting Rating" rating of 65,000 amp SCCR.
8. Exterior indicating lights shall include "Power On" and "Compressor Running."
9. Provision for 480VAC supply.
10. Transformer(s) for control circuit power, inputs, and outputs.

C. CNG Cooling System (provided by ANGI on compressor skid)

1. Gas cooler suitable for service in ambient temperatures of between -20°F and 120°F and designed to deliver gas at a maximum temperature of ambient plus 20°F.
2. Forced draft air circulation will be used to cool CNG from effects of compression. Fan drive may be either derived from prime mover or separate electric motor.
3. Tube material will be seamless Type 316SS; manufactured and labeled according to ASTM A213.
4. Cooler intake and exhaust sections will be oriented so as to minimize introduction of exhaust air into enclosure. Coolers will include sound attenuating louvers at intake and exhaust sections.

D. Gas Recovery System (provided by ANGI on compressor skid):

1. Gas recovery system will recover any gas that is vented during compressor shutdown.
2. Upon compressor shutdown, gas within compressor system will be routed to recovery system to allow unloaded compressor starting.
3. All oil separators will drain to a single manual drain piped to edge of enclosure (contractor shall provide elbow discharge off skid for open vessel collection by owner- NOT hard piped to drain).
4. Gas recovery vessel will be ASME-rated and have necessary capacity and pressure rating to accumulate blowdown gas without relieving gas to atmosphere or to station inlet line.
5. Gas recovery vessel will have a relief valve and manual service vent valve.

E. Vibration Monitoring System (provided by ANGI)

1. Manufacturer:

   a. Wilcoxon Research.

2. Vibration monitoring system (sensor/transmitter, monitor, software) with output to station control PLC and SCADA system for following applications on compressor:

   a. Cross-head vibration (cross-head looseness) for each compressor.
   b. Compressor frame vibration (shaft imbalance) for each compressor.

3. Factory pre-wired to PLC installed in CNG station PLC control system.

4. Tested during factory acceptance test and log data.

F. Filters (provided by ANGI):

1. Acceptable Manufacturers:

   a. Parker / Finite.
   b. Nowata.

2. Inlet Gas Suction Filter:

   a. Sized to filter particulate of 50 micron diameter or greater at maximum compressor flow rate.
   b. Manual drain valve with differential pressure gauge.

3. Interstage Coalescing Filters:

   a. Coalescer downstream of each cylinder between interstage cooler and next-stage compressor inlet.
   b. Sized to eliminate 95% entrained liquids and liquid accumulation from up to 8 hours of continuous operation.

4. Discharge Coalescing Filters:

   a. Two filters (pre-coalescer and coalescer) for compressor.
   b. Coalescing filters (in-series) as far as possible downstream of final stage aftercooler but before priority/direct fill valve panel.
   c. Filters sized for discharge not to exceed 50 ppm liquid hydrocarbon or oil.
   d. Pressure drop shall not exceed 2% at compressor's maximum flow rate over gas pressures ranging from 2,000 to 4,500 psig.

5. Automatic Condensate Drain System:

   a. Actuated drain valve for each coalescing filter piped to system blowdown tank and controlled by programmable controller adjustable at controller user interface.
   b. ASME-rated condensate blowdown tank(s) with sufficient volume for maximum system condensate flow, tank relief valve, and tank drain piped to edge of skid with manual isolation ball valve.

2.02 NATURAL GAS DRYER (02-GD-01) (Furnished by ANGI)

A. Xebec Adsorption, Inc. Model STR30NGX Duplex Dryer – Manual Regeneration.

   1. Shop drawing submittals from ANGI to be furnished when available.
   2. Refer to XEBEC installation manual.

B. Maximum Allowable Discharge-Moisture Content:

   1. Discharge gas will comply with SAE standard J-1616, base on inlet natural gas with up to 9 lb moisture per MMSCF, and a design low ambient temperature of minus 20°F.

C. Adsorbent:

   1. Adsorbent will be 3A molecular sieve and shall not affect character and odor of incoming gas.
   2. Dryer design shall be such that adsorbent shall have a minimum useful life of five years.

D. Design:

   1. Dryer will utilize a manual-simplex design consisting of one desiccant vessel.
   2. Dryer will be pre-assembled on a skid and shall include common connection at system inlet and outlet.
   3. Piping, vessels and valves will be sized, configured and ported so that pressure drop between inlet and outlet flanges of dryer does not exceed 5 psig at design supply pressure from WE Energies.

4. MAWP of vessels, piping and complete assembly will be based on final dryer-supply pressure plus allowance as required to accommodate for pressure rise during regeneration-heating and plus an additional 10% safety factor.

E. Capacity:

1. Dryer vessel will be sized so that regeneration shall be required after no less than 40 hours of full gas throughput during normal operation of compressor system, based on an inlet gas-moisture content of 9 lb/MMSCF.
2. Dried gas shall pass through an after filter.

F. Instrumentation and Control:

1. Regeneration heating and cooling cycles will be controlled by programmable logic controller (PLC).
2. Dryer system will be equipped with controls, instrumentation, status indication and alarms as follows:

   a. ASME-certified vessel pressure relief valves
   b. 2.5-inch dial locally mounted chamber pressure gauge at inlet piping to each desiccant chamber.
   c. 2.5-inch dial regeneration loop pressure gauge.
   d. Regeneration heater outlet gas temperature thermocouple.
   e. Regeneration cooler inlet gas temperature thermocouple.
   f. Regeneration cooler outlet gas temperature thermocouple.
   g. Heater sheath temperature alarm and shutdown.
   h. Heater outlet temperature alarm and shutdown.
   i. Blower motor overload tripped alarm and shutdown.
   j. Cooler motor overload tripped alarm and shutdown.
   k. Cooler outlet temperature alarm and shutdown.
   l. Regeneration heater “fail to heat” alarm and shutdown.
   m. Power ON/OFF switch.
   n. Keyed REGENERATION START switch.
   o. REGENERATION STOP push-button.
   p. Hygrometer (ceramic-type moisture sensor) coupled with dewpoint monitor.
   q. Text display for dryer/dew point status.
   r. Independent form “C” relays for dryer and dew point alarms.
   s. Compressor contact.
   t. Alarm light.

3. Precision dewpoint monitor (with digital dewpoint indication in degrees F.) will be installed at dryer control panel.

   a. Hygrometer will annunciate dew point data on a text display located on a NEMA 4 enclosure.
   b. Moisture sensor will be installed at dryer outlet to verify gas dew point on a continuous basis.
   c. Two hygrometer setpoints will be factory set with dry contacts (SAE J1616) for remote alarm:

      1) AL-1: first to signal deteriorating dew point performance.
      2) AL-2: second when regeneration is required. A set of form "C" dry contacts shall be provided for remote signal.

4. Differential pressure gauges will be provided on inlet and outlet filters.

G. Manual Regeneration:

1. Regeneration of desiccant bed will be by temperature swing with closed loop gas circulation, and shall be initiated manually and terminate automatically.
2. Maximum regeneration and cooling time will be eight (8) hours.

H. Bypass Capability:

1. Dryer bypass and isolation manual valves will be provided so that compressors may operate while entire dryer is off line.

I. Gas Blower Assembly:

1. Gas blower will be a vane- or lobe-type with an electric motor rated in accordance with NFPA 70.
2. Blower/motor will be installed in an ASME "U" or "UM" stamped carbon steel pressure vessel with same pressure rating as dryer vessel.
3. Horizontal blower bell housing will be fitted with stainless steel glides mating stainless steel runners fitted to support skid to permit removal from blind flange with minimal effort by one person.
4. Suitable anchoring of blower housing will be provided to support blower housing once installed.

J. Gas Heater Assembly:

1. Gas heater will use incoloy sheathed, low-Watt-density electric heating elements mounted inside an insulated heating chamber.
2. Heater bundle will be furnished with a thermocouple and temperature switch for heater sheath over-temperature alarm and shutdown.
3. A heater high outlet temperature switch will be furnished at heater outlet.
4. Heater vessel will be an ASME "U" or "UM" stamped carbon steel pressure vessel with same pressure and temperature rating as desiccant chamber.

K. Aftercooler Assembly:

1. An air-to-gas fin tube aftercooler complete with electric motor and non-sparking fan blades with motor in compliance to Class 1, Div. 2, Group D electrical class will be provided.
2. A high-efficiency coalescing-separator with two-piece aluminum bowl and head construction will be provided.

    a. Carbon steel condensate reservoir and a manual drain valve piped to skid edge. Reservoir will have a liquid capacity for at least two regeneration cycles.

2.03 CNG-STORAGE VESSELS (02-TK-01,-02,-03) (Furnished by ANGI)

A. Manufacturer: CP Industries or FIBA

1. Two (2) 3-Pack storage assemblies with ASME-rated CNG storage vessels will be provided (nominal 36,000 scf at 5,000 psig). Each vessel shall be 20 in. dia. x 23 ft. long with capacity of 11,500 scf at 4,500 psig, and MAWP of 5,500 psig, and shall include framing and bracing.
2. Each 3- Pack Vessel Assembly weighs approximately 21,000 lbs.

B. Arrangement:

1. Tube-type vessel shall be bolted to their foundation by Contractor by structural steel rack per Drawings.
2. Vent Risers shall be provided by Contractor per Drawings.

C. Valves and Drains:

1. Each vessel will include a full-port 3/4 in. pressure relief valve (PRV) set at vessel MAWP with a full-port 3/4 in. ball valve locked open between PRV and vessel.
2. Each vessel will include a 3/4 in. service ball valve, a drain port at its low point with a needle type drain valve.

2.04 FAST-FILL DISPENSERS (02-FD-01,-02 (Furnished by ANGI)

A. Manufacturer: ANGI Energy Systems

1. One (1) dual-hose medium-duty 3,600 psig CNG dispensers with internal fill-control logic for DPW fast-fill system.
2. One (1) dual-hose medium-duty 3,600/3,000 psig CNG dispenser with internal fill-control logic and display on both sides of dispenser (one hose at 3,600 psig / one hose at 3,000 psig).

B. Specifications:

1. Dispensers will be capable of delivering fills of specified CNG temperature compensated to 70°F, based on control logic housed in dispenser.
2. Dispensers will include two MicroMotion CNG-050 meters, mechanical vehicle pressure gauge for each hose inside cabinet, and shall have a backlit data display.
3. All CNG tubing and fittings will be 1/2 in. x .065 in., grade 304/316 SS.
4. Vent tubing will be 3/8 in. x .049 in., grade 304/316 SS.
5. A means of preventing escape of CNG from fast-fill system in case dispenser is knocked off of its base shall be provided.
6. Dispenser-control valves will use actuated ball valves.

C. Filters:

1. Dispensers will include one inline oil-coalescing filter for each of three sequence-bank feed lines and a block and bleed valve arrangement to facilitate servicing of filters. Three total filters will be housed in Parker-Hannifin J2 housings and will include a grade-4 coalescer element. Filters will be located upstream of meter and control valves in dispenser cabinet.

D. Hose and Nozzle:

1. Hoses will be 3/8 in. x 12 ft. long with 5,000 psig MAWP.
2. Inline breakaways mechanisms with check valves, which will be electrically conductive.
3. Nozzle will be NGV-1 type-2.
4. Hose will not contact ground when nozzle is in its keeper.

E. Operation:

1. Dispenser will be controlled by internal logic controller.
2. Dispenser will include internal 3-bank sequencing with 3/8 in. tubing connections to storage array.

F. Interface with Fuel-Management Terminal:

1. Dispensers shall be configured for connection to CNG industry standard fuel-management terminal, so that terminal must authorize dispensing of fuel, and so that CNG fuel consumption mass is recorded by terminal, along with user ID, time of day and vehicle ID.

2. Pulse-Count Output:

   a. Dispenser will generate 100 pulse-count per mass of CNG dispensed (i.e. 100 pulses per gasoline-gallon equivalent of CNG).
   b. Actual mass-calibration rate shall be diesel gallon equivalent for DPW Fast Fill and Gasoline Gallon Equivalent for Public Access Dispenser.

3. Contractor shall install connections between each dispenser and fuel management terminal for following signals:

   a. Handle switch.
   b. Low-voltage meter pulser.
   c. "Authorize" signal.
   d. Conductors of different voltages shall be routed in separate conduits.

2.05 CNG STATION PLC CONTROL PANEL IN ENCLOSURE (furnished by ANGI)

A. PLC:

1. Programmable logic controller (PLC) will be provided to control compressor operation, priority / time-fill valve panels, and an emergency shutdown system.

2. PLC Manufacturer: Horner

3. Local Display:

   a. Touch-type LCD display.
   b. Fault annunciation.
   c. Operating conditions.
   d. Interface for modifying setpoints by authorized operator.

4. Programmability:

a. Owner will have unimpeded access to modify setpoints and operating parameters upon completion of work.
b. Supplier will provide PC-host software (or similar) as required to modify controller program, including any specialized PC interface connector.

B. Control Panel:

1. NEMA 3R type (outdoor use) enclosure.
2. Located on compressor skid.
3. Compressor keyed on/off switch.
4. Exterior indicating lights will include "Compressor Running" and "Compressor Fault."
5. Emergency shutdown push-button and keyed alarm reset accessible from exterior of panel.
6. All 120VAC wiring shall be terminated at a single, clearly labeled terminal strip ready for field termination by Contractor.
7. Additional termination points for remote emergency shutdown push-button stations (remote push-button stations shall be provided by Contractor except for push-button at compressor which shall be provided by Supplier).
8. Incorporate with SCADA system.

C. Performance Specification

1. Compressor Starting:

a. Logic in base controller shall prohibit a second compressor from starting within 10 seconds of primary starting compressor but shall allow both compressors to operate concurrently based on demand from time-fill/fast fill dispensers and storage pressure, which shall be adjustable.
b. Controller shall facilitate incremental compressor startup based on threshold storage pressure.
c. Incremental compressor start sequence shall be associated with storage-bank pressure; i.e. first compressor starts when bank falls to 3,600 psig. and second compressor starts when mid-bank falls to 3,300 psig. Both setpoints shall be adjustable.
d. Second compressor shall be prohibited from starting based on field programmable time of day.

2. Storage Bypass:

a. Controller shall control and prioritize compressor discharge to time-fill header, priority storage banks, fast-fill direct supply to DPW fast-fill dispensers, or supply to public area storage banks.

D. Shutdowns, Alarms, and Annunciations:

1. Compressors (minimum requirement):

a.	High/low suction gas pressure:	shutdown
b.	High interstage pressure (all stages):	shutdown
c.	High gas discharge pressure:	shutdown
d.	Low lube oil pressure:	shutdown
e.	High interstage temperature (each stage):	shutdown
f.	High discharge temperature:	shutdown
g.	High compressor/cooler vibration:	shutdown
h.	High oil temperature:	shutdown
i.	Lubricator failure:	shutdown

j. Excessive motor starts: shutdown

2. System:

a. High storage pressure, each bank: shutdown
b. High blowdown pressure (95% MAWP): shutdown

E. Emergency Shutdown System:

1. An emergency shutdown (ESD) system shall be provided. When ESD system is activated:

a. Power to PLC outputs, gas supply to compressors, and dispenser(s) are shut off.
b. Signal shall be available to activate optional visual warning devices.

2. ESD system shall be activated by:

a. CNG station shutdown push-buttons (various locations).
b. Loss of station electrical power.

3. System shall not allow station to resume operation without a manual reset and station returning to normal.

2.06 SCADA (Supervisory Control and Data Acquisition) SYSTEM (furnished by ANGI)

A. Summary:

1. SCADA system will provide centralized monitoring and recording of programmable controllers for compressors, dryers, priority panels, storage, and dispensers.
2. SCADA system will include computer and program software.
3. SCADA will monitor devices and display natural gas process.
4. Motors, pumps, valves, pressures, temperatures, switches, vibration monitors, etc., shall have a graphical representation.
5. SCADA will manage and monitor CNG processes and facilities management.
6. Graphics, controls, configuration data and programming associated with SCADA installation will be configured and implemented based on representation of infrastructure equipment deployed at CNG site, allowing entire system to be monitored and controlled in real-time.

B. Screens:

1. Screens shall properly display CNG equipment as process piping schematic.
2. Main menu screen shall include a general arrangement representing CNG site.
3. Sub menu screens shall display specific CNG equipment.

C. Ethernet:

1. CNG equipment PLC will include a built in Ethernet Port with standard TCP/IP.
2. Each controller will have a unique IP Address and be configured to site specifications.
3. Ethernet Port will support 10/100BaseT.
4. Ethernet protocol to be finalized by Owner with ANGI.

D. Alarms:

1. Alarm functions shall display alarms (and related alarm help pages), and acknowledge, disable, and enable alarms.
2. SCADA will provide information about alarms and allow operators to add comments to alarm records.
3. Alarms will be logged with a time and date stamp.

E. Mapping:

1. SCADA program will have a tag configurable database that polls CNG stations and tells software which parameters within station are to be accessed.
2. Database will schedule frequency at which parameters of station are accessed.
3. Parameters will include measured values, data points, and alarm setpoints.

F. Logging and Trending Data:

1. Trend graphs.
2. Trending will provide dynamic visual analysis (trend and graphs), production records, and status of equipment, efficiency and preventive maintenance.

G. Messages:

1. SCADA PC software shall provide messaging for SMS or E-mails that report status and alarm condition reported to external personal.

H. Web Browser: to be finalized by ANGI in submittals.

2.07 PRIORITY VALVE PANEL (02-PVP-01) (furnished by ANGI)

A. Manufacturer: ANGI Energy Systems.

1. Priority valve panel will direct flow of CNG from DPW CNG fueling station to fueling dispensers (02-FD-01 and-02).

2. Storage will be accessed first in event of a demand for vehicle fast filling. If storage pressure drops to set point, station control system will start compressor and shall run until fast filling demands have been met. If there are no further fast fill demands, compressor shall replenish storage.

3. Priority valve panel control system will direct compressor discharge gas to dispensers or to storage. Control logic is from system PLC priority for compressor flow summarized as follows:

   a. First priority: Direct flow to DPW fast-fill dispenser.
   b. Second priority: Replenish DPW fast-fill storage high to mid to low bank.

4. In addition to I/O signals required under paragraph CNG Station Control, PLC shall interface with following I/O signals from:

   a. ESD push-buttons (provided by Contactor as shown on Drawings).
   b. Storage pressure.
   c. Actuated valves in valve panel.

5. ESD valves shall fail closed.

2.08 INSTRUMENTATION AND CONTROLS (provided by ANGI on pre-wired skids)

A. All pressure gauges shall conform to following requirements:

1. All gauges will read at least 1.2 times system design pressure (NFPA 52).
2. Accuracy, including hysteresis, will be +0.5% of full scale or better.
3. Rear blowout protection will be provided.
4. All gauges will be waterproof and liquid-filled.
5. Dial will have a minimum diameter of 2-1/2 inches.

B. Instrument components interfacing with natural gas will be made of material compatible with odorized natural gas. No copper metal or alloys containing more than 70% copper shall be used in natural gas service.

C. Gauges and manually operated valves shall be located no higher than five (5) feet above grade.

D. Pressure gauges will be installed at following locations as a minimum:

1. Suction pressure downstream of suction filter.
2. Inter-stage pressures at filters and cooler.
3. Oil pressure on compressor frame oil filter.
4. Final discharge pressure at discharge filters.
5. Blowdown vessel pressure.
6. Control gas pressure (if installed) downstream of regulator.

2.09 FUEL MANAGEMENT SYSTEM (02-FMS-01) (furnished by Owner)

A. Manufacturer: AssetWorks

B. Equipment details to be provided with Attachment 1 to this section at Pre-Bid Meeting

2.10 PIPING / TUBING ON SKIDS FURNISHED BY ANGI

A. Piping and tubing systems will be rated for maximum pressure and temperature to which they will be subjected under normal operating conditions and be properly supported and protected to prevent damage from vibration during shipment, operation, and maintenance. Piping and tubing systems shall be installed in a neat and orderly arrangement, adapting to contours of skid package. Piping and tubing systems shall not obstruct access openings. Supports shall not be welded directly to piping or tubing.

B. Piping design, inspection and testing shall be in accordance with ANSI/ASME B31.3. Piping shall be seamless, minimum Schedule 40 (standard weight), and conforming to ASTM A53 or A106, Gr. B. Cast iron or semi-steel piping will not be used. Testing shall be pneumatic.

C. Gas tubing on compressor skid will be seamless stainless steel ASTM A269, Type 316. Hardness of stainless steel tubing shall be no more than Rockwell hardness of 80. All tubing fittings used throughout station system (compressor skids, dispensers, storage, and inter-skid connections) will be Parker Seal-lok® o-ring face seal for 1/2 in. and larger diameter and Gyrolok® 316 stainless steel for smaller than 1/2 in. diameters.

D. Piping will be prepared and painted in accordance with manufacturer's standards.

E. ANGI will provide drain lines brought to skid edge and allow draining into a container placed on ground next to skid.

2.11 EQUIPMENT TAGS (provided by ANGI)

A. All equipment, including storage vessels, tanks, heat exchangers, instrumentation (gages, transducers, etc.), all valving (isolation, bleed, check, regulation, solenoid and relief) and panels will be provided with an equipment tag and unique tag number matching equipment ID number on D. Tags will be laminated plastic with black letters on white background or approved equal. They will be attached to flat surfaces of equipment using an epoxy adhesive or wired to equipment with stainless steel wire.

PART 3 EXECUTION

3.01 FACTORY ACCEPTANCE TESTING (By ANGI per OWNER contract with ANGI)

A. Prior to shipment, CNG compressor shall be operated for a minimum of four (4) continuous hours and functionally tested. Test shall include, but not be limited to, following:

1. Operation of compressor control.
2. ESD system test.
3. Load testing.
4. Auto start / stop testing.
5. Safety shutdown testing.
6. Alarm testing.
7. Noise and vibration analysis.
8. Motor testing.
9. Lube oil system testing (pressure and temperature).
10. Fan testing.
11. Compressor interstage pressure and temperature testing.

B. Factory acceptance test parameter data shall be logged with readings, time and date and signed by authorized supplier representative.

C. Acceptance by Owner of witnessed test shall not release Supplier from any of its warranty obligations, or any other obligation, under this Specification.

3.02. DELIVERY

A. Supplier shall ship CNG compressor, dispensers, storage tanks, and all accessories to corresponding CNG vehicle fueling station site.

3.03. FIELD INSTALLATION

A. System equipment shall received, unloaded, set in place, wired, and piped to operate all gas drying, compression, storage, dispensing, control, and fuel management in accordance with manufacturer's shop drawing and installation instructions.

B. Installation shall be completed in accordance and in compliance with all applicable local and national Codes and Standards.

C. All components shall be tested in accordance with NFPA 52, NFPA 54 or other applicable CNG industry standards.

D. Pre-start Pipe Cleaning. All piping sections between packaged components that include piping or tubing shall be blown clean prior to connection to equipment. Blow out shall be achieved by closing the downstream end of pipeline with a 5000 PSI-rated ball valve,

connecting a minimum 1650 PSI-source pressure vessel to the upstream end of the pipeline, opening supply valve at source so that minimum 750 PSI accumulates in pipeline, then opening outlet ball valve to atmosphere. Procedure shall be repeated until no solid or particulate matter is discharged from the pipeline.

1. Personnel opening and closing ball valve at downstream end shall take care to keep clear of the discharge path of the blowout, and shall wear eye and ear protection during procedure.
2. Direction of blowout flow shall be performed in both directions if possible.
3. Contractor shall take care to clear area at pipeline discharge to prevent property damage or injury during procedure.

E. Startup Filtration. 'Witch's hat' or similar strainer devices shall be installed where practical at termination of such piping sections prior to system startup and shall be checked, cleaned and replaced by the Contractor as required until all residual pipe debris has been removed.

3.04. FIELD QUALITY CONTROL

A. Manufacturer's Field Services (By ANGI per Owner contract with ANGI)

1. Supplier's or manufacturer's technician for equipment specified herein shall be present at jobsite for minimum mandays included, travel time excluded, for assistance during plant construction and plant startup:

   a. 2 mandays for Installation Support Services to Contractor.
   b. 5 mandays to support Field Testing by Contractor and conduct Field Training.
   c. 2 mandays for Post Startup Services.

B. Acceptance by Owner of CNG fueling system under this specification shall occur only after following requirements have been met:

1. Demonstrate to satisfaction of Owner that CNG fueling station as a whole meets and conforms to requirements of specification and drawings.
2. Testing required by this specification has been successfully completed and has been accepted by Owner
3. Date of acceptance of fueling stations shall be date of written notice of its acceptance by Owner to Supplier. All warranties and/or guarantees referred to or implied in this Specification shall commence on that acceptance date.
4. Acceptance by Owner of witnessed test shall not release Supplier from any of its warranty obligations, or any other obligation, under this Specification.

3.05. FIELD ADJUSTING, BALANCING AND TESTING BY CONTRACTOR

A. After completion of the installation, start, regulate, calibrate, adjust and test all equipment and devices.

B. Leak and pressure testing in accordance with Section 40 05 00 Process Piping and Tubing.

C. Functional Tests:

1. Test ESD / emergency shutdown at all button/station locations, including required valve closures.
2. Test low suction pressure, each skid (close skid-supply ball valves).

3. Test temperature-compensated dispenser fill for each dispenser, including correct dispenser start on button, auto-stop on fill completion, and verify 'settled' fill pressure vs. ambient temperature two hours following fills. Pressure shall be within 4% of design-fill pressure temperature compensated to 70ºF.
4. Test for correct operation of fuel-management system at each fast fill dispenser, and time hose post hose including: authorization of transaction, energizing of dispenser, and recording of transaction data (fill volume, time/date stamp, event ID, and pump number).
5. Test dryer regeneration based alarm on dew point (generate false positive at hygrometer).
6. Test for correct annunciation on controller / PLC shall be required for all test events, as appropriate.
7. Observe compressor operation, including stage pressures and temperatures, and verifying function of controller, including triggering selected faults, such as high interstage temperature.

C. Reliability Test:

1. Reliability test shall consist of fueling under normal-use conditions for five (5) consecutive work days.
2. System shall have no failures of compressor operation, dryer operation, normal dispenser operation, or operation of the fuel-management system during the test period. If any failure occurs, the test shall be repeated in its entirety.
3. Final acceptance of the facility shall only be declared upon successful completion of the test.
4. Contractor shall be responsible for all onsite coordination of troubleshooting and coordination of suppliers and trades during test.
5. Failure shall be defined as the occurrence of any of the following:

    a. Inability of the CNG system to dispense CNG at the pressures and rate specified, including accounting for temperature compensation at settled conditions.
    b. Failure of the dryer to provide dried gas and/or not be able to auto switch or regenerate.
    c. Failure of a compressor to start and run within factory-listed operating pressures and temperatures.
    d. Failure of the controller/PLC, valve panel, fuel-management system and/or dispensers to operate as specified.
    e. Presence of an audible of visible gas or CNG leak.
    f. Occurrence of a auto-fault shutdown of either or both CNG compressors, except those caused by ESD-button activation, gas-detection system outside of skids, variations in gas supply pressure, or damage to facility beyond the Contractor's control.

6. Contractor may take equipment offline for scheduled maintenance during the test period, provided maintenance is consistent with manufacturer's recommendations, and does not impinge on Owner's ability to fuel vehicles during the normal daily fueling window between 7:00AM and 11:00PM.
7. Contractor shall be responsible for maintenance through successful completion of test, including provision of consumables.
8. Corrective work conducted by the Contractor and all subcontractors and suppliers preceding and during performance test shall be documented at time of repair by technician performing repair. If technician suspects a cause of fault that is beyond scope of his respective firm or responsibility, technician shall notify Owner immediately and shall not implement repairs until condition of failure has been documented and other firm(s) have been notified and been provided

documentation of condition.

9. Owner shall not pay Contractor for any work or repair that is implemented during testing above contract amount, unless work or condition is beyond control of Contractor, Contractor's subcontractors, or Contractor's suppliers.
10. Contractor shall notify Owner in writing of intent to perform any work that Contractor deems to be outside of contract scope, prior to performance of any such work.
11. Any discrepancies in Contractor's materials or workmanship found as a result of these inspections and test shall be corrected by Contractor at no cost to Owner (including cost for making all corrections and repeating test within two (2) weeks.

3.06 CNG FUELING OPERATION & MAINTENANCE TRAINING (By ANGI per Owner contract with ANGI)

A. On-Site Training:

1. General:

a. At least 60 days prior to scheduled date for commencement of training, submit training syllabus with time allotments per topic and instructional materials to Owner for review and approval. Upon review of syllabus, Owner may require additional time be allotted to certain training topics.
b. Develop and conduct a program to train ten (10) Owner personnel in the safe operating procedures, and maintenance of equipment and systems furnished during hours required by Owner. Also include in training program key hazards and their protectors, and corrective actions for violation of safety rules.
c. Furnish instructors, instructional materials and audio-visual aids and equipment.
d. Owner shall furnish physical facilities and equipment.
e. Begin instruction upon successful completion of field testing.

2. Program content: At a minimum, instruction will include material covered in operation and maintenance manuals as well as following:

a. Theory of operation of CNG system.
b. Practical aspects of operation.
c. Description of system, equipment and components.
d. Functional characteristics of system, equipment and components.
e. Emergency operating procedures.
f. Maintenance procedures.
g. Servicing intervals and schedules.

B. Duration:

1. Training for maintenance, facility operation and troubleshooting shall be eight (8) total hours (minimum).

ATTACHMENT 1
PRODUCT DATA – GENERAL ARRANGEMENT DRAWINGS – SUBMITTALS
(TO BE FURNISHED WITH ADDENDUM NO.1 AT PRE-BID MEETING

END OF SECTION

SECTION 40 05 00
PROCESS MECHANICAL PIPING AND TUBING SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. Piping and tubing work required in installation of Compressed Natural Gas (CNG) Station. Work includes:

a. Supply, installation and hookup of piping and tubing listed herein and shown on Drawings, and as required to accomplish complete and functioning system consistent with Owner's requirements.

b. Complete installation of natural gas fueling equipment and gas control systems and necessary connections.

1.02 RELATED SECTIONS:

A. General Requirements

1.03 REFERENCES

A. Applicable provisions of following standards shall apply to work of this Section, except as modified herein, and are hereby made a part of se Contract Specifications to extent required:

1. ASME Section IX Welding and Brazing Qualifications

1.04 QUALITY ASSURANCE

A. Field and Shop Personnel Qualifications:

1. Tube fitters shall provide a letter from local Swagelok, Hoke or Parker representative certifying training in proper make-up and inspection of vendor's products.
2. Pressure welding shall be performed by certified welders per ASME Section IX to registered welding procedures.

a. Certification and registration shall be by a National Board (N.B.) registered Agency.
b. Shop pipe welding procedures shall be GTAW root pass SMAW, GTAW or a combination for filler passes.
c. Site welding shall be SMAW root and filler passes.
d. Each welder shall permanently stamp welds with welder's identification number and pipe spool weld identification number.

3. Performance test cards shall be copied and submitted to Owner for documentation purposes and shown to Engineer when requested.
4. Welding and piping and tube fitting work on site, regardless of pressure, shall use persons possessing current journeyman qualifications.

B. Installer Qualifications:

1. Piping subcontractor shall submit proof of successful completion of a minimum of three (3) projects in previous three (3) years that required significant process piping and high pressure (5000 psi) stainless steel tubing installation.
2. Piping subcontractor shall be required to provide references and staffing lists for se projects and a proposed staffing list for this project to demonstrate that proposed staff will have required experience.

C. Mill Test Certificates: Gas piping, tubing, and fittings shall be as listed below and shall be ordered with mill test certificates and/or certificates of compliance which shall be submitted to Owner.

D. Regulatory Requirements: Per General Sections, and following:

1. Notify Owner and local plumbing inspection agency at least fourteen 14 days in advance of any on site pressure testing to allow witnessing tests.

1.05 SUBMITTALS

A. Submit in accordance with applicable provisions Section 01300 following:

1. Qualifications:

a. Procedure Qualification Records and Welding Procedure Specification for certified welders.
b. Performance test cards.
c. Tube fitters' qualification letters.
d. Piping subcontractor's qualifications as indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with General Requirements and following:

1. Pipe and tubing shall be handled in a manner to prevent possible damage to walls or ends or scratching of tube O.D. (Outside Dimension) Pipe and tubing shall be unloaded by lifting at both ends of any one length to avoid bending and placing section carefully upon a padded skid such that entire length is uniformly supported to prevent bending or flexure.

PART 2 PRODUCTS

2.01 GENERAL SYSTEM DESCRIPTION AND PERFORMANCE REQUIREMENTS:

A. Piping work specifically listed herein and shown or indicated on Drawings. Work includes supply and installation of following:

1. Installation contractor is responsible for supply of all interconnecting components except components supplied by equipment supplier as noted on drawings.
2. Complete installation of gas piping system and necessary connections to equipment except where noted as supplied by WE Energies.

3. Installation of piping facilities required for proper operation of facilities.
4. Above ground gas piping from meter set to gas dryer inlet—Gas piping shall be minimum 4-inch Schedule 40.
5. Compressor inlet gas piping from gas dryer block and bypass outlet to gas compressor(s). Gas piping shall be minimum 4-inch Schedule 40 with 3-inch reducers at dryer and at compressor 01-CMP-01 and 01-CMP-02. Install 3-inch ANSI 150 regulator, 3-inch x 36-inch ANSI 150 stainless steel flexible connector and 3-inch ANSI 150 lockable ball valve upstream of compressor inlet flange as furnished by Owner (via ANGI).
6. High pressure gas piping and tubing as indicated in specifications and drawings and as required to give a fully operational station. This will include installation of valves, fittings, filter, gages, sleeves and tubing between compressor package and storage and between compressor package and storage and dispensing systems.
7. Provide 2-inch Schedule 80 vent piping and required supports and bracketing from Pressure Safety Relief Valves (PSV) on CNG Dryer to a minimum of 12 feet above grade. Pipe unions shall be provided at each SRV to allow for easy removal and replacement of PSV. Vent stack shall have a vertical discharge with rain cap (tack welded to stack and weighted for closure) and be equipped with a drip pocket with drain valve located approximately 24 inches above grade.
8. Provide 2-inch Schedule 80 vent pipe manifold and required supports and bracketing from PSVs on each CNG storage assembly to a minimum of 10 feet above grade. Pipe unions shall be provided at each PSV to allow for easy removal and replacement of PSV. Vent stack shall have a vertical discharge with rain cap (tack welded to stack and weighted for closure) and be equipped with a drip pocket with drain valve located approximately 24 inches above grade.
9. Provide 2-inch Schedule 80 vent piping and required supports and bracketing from Priority Valve and Time Fill panels to a minimum of 10 feet above grade. Vent stack shall have a vertical discharge with rain cap (tack welded to stack and weighted for closure) and be equipped with a drip pocket with drain valve located approximately 24 inches above grade.
10. Interconnecting tubing and piping shall be installed as required by installation and manufacturer's drawings, as indicated in Specifications and as required to give a fully operational station. Tubing shall be installed with expansion offsets and —U bends as required to allow for differential heaving and settlement of equipment pads and trench. All above ground tubing and piping shall be laid out/configured and connected in a manner that allows each section to be removed without disassembly of adjacent piping, tubing or equipment.
11. All tubing installed in underground sleeves is to be coiled continuous lengths— no fittings or welded connections are permitted on underground tubing. Sleeves are to be 4-inch (as per drawings) HDPE SDR 11 smooth wall (or Schedule 40 Rigid PVC electrical conduit) with ends that are dry fitted (not cemented) with 1/2-inch holes drilled to allow tubing to enter tube but limit possibility of dirt and moisture. All above ground tubing is to be installed using sticks—no attempt to straighten coiled tubing will be permitted.
12. Signs and labels as specified in Drawings.

2.02 MANUFACTURERS AND PRODUCTS

A. Gas and CNG Tube Fittings: Shall be from same manufacture 316 Stainless Steel (SS) Swagelok, Hoke Gyrolok or Parker A-lok.

B. Screwed pipe fittings may be SA 105 or carbon steel or 316 SS, as manufactured by Swagelok or Hoke.

C. Tapered Thread Sealant: Crawford "SWAK" anaerobic liquid Teflon thread sealant, Crawford "Strip-Tease" Teflon tape, or approved.

D. Gages: Supplied by Swagelok, Ashcroft, or WIKA.

E. Low Pressure (less than 500 psig) Ball Valves (including actuated ball valves): 3-piece, carbon steel ball valves with stainless steel trim manufactured by one of following: Worchester, Watts, or SVF.

F. High Pressure (more than 500 psig) Ball Valves (including actuated ball valves): Stainless steel ball valves with stainless steel trim as manufactured by Worchester, Watts, SVF, or Swagelok.

1. Valves up to and including 3/4-inch: Swagelok (SS-AFS series) or equal.

G. Check Valves: 316 stainless steel Hoke Series 691F.

H. Drain Valves on Filters, Vessels and Throttling Valves: Stainless steel Swagelok Rising Plug series SS-4PD or SS-5PD with replaceable seats.

I. PSVs: Pressure Safety Valve (pressure relief / safety relief valves) Carbon steel or stainless steel bodies with stainless steel trim and —UV stamped N.B. rated. PSVs shall be as manufactured by Anderson Greenwood or Mercer.

J. Bleed Valves Required for Service: Swagelok BV series bleed valves or Swagelok Rising Plug series SS-4PD with replaceable seats.

2.03 MATERIALS

A. Valves, fittings, instrumentation and or mechanical components that are not specifically called out in this Section, shall be non-proprietary, third party supplied.

B. Gas Flow Piping and Tubing:

1. Components containing gas shall be carbon steel or stainless steel as indicated below. Vehicle filling hoses are considered to be only exception to this rule.
2. Above ground Natural Gas Service Piping (NG) between meter set assembly, dryer and compressor shall be:

   a. Carbon Steel: ASME SA106B seamless pipe, Grade B, Schedule 40.
   b. Fittings 2" or less: socket weld fittings
   c. Fittings 2-1/2" or greater: butt welded or forged class 150 raised face flanged, ASTM A105 conforming to ANSI B16.5.

3. Underground Natural Gas Piping: NOT IN SCOPE OF CONTRACT (WE Energies providing service)
4. High Pressure Gas Piping- Compressed Natural Gas (CNG) where shown as carbon steel on plans:

    a. Carbon Steel: ASME SA106B seamless pipe , Grade B, Schedule 160 for 1" pipe size or less and Schedule XXS for 1-1/2" or 2" pipe size.
    b. Fittings shall be Class 6000, forged steel, ASTM A 105 butt weld.
    c. Flanges shall be Class 2500 forged steel, ASTM A105 weld neck, RTJ or RF, conforming to ANSI B16.5 with bore matching inside diameter of pipe.
    d. Flange bolts and studs shall be ASME SA193 Grade B7, with heavy hex nuts, ASTM A194, Grade 2H, and shall show minimum of 2 through backing nut when fully tightened.

5. Gas Tubing: ASME SA213 Type 316 seamless, cold drawn stainless steel. This includes gage lines, pressure transducer sensing lines and pilot pressure gas lines. TP316L and TP316N stainless steel tubing is not permitted. Surface hardness shall not exceed Rockwell B90. Diameters and wall thickness as follows:

    a. 1 inch O.D. x 0.120 inch minimum wall
    b. 3/4 inch O.D. x 0.109 inch average wall
    c. 1/2 inch O.D. x 0.065 inch average wall
    d. 3/8 inch O.D. x 0.049 inch average wall
    e. 1/4 inch O.D. x 0.035 inch average wall

6. Compression fittings shall be type 316 SS swaged fittings and shall have minimum working pressure of 6000 psi. Flared fittings will not be permitted.
7. Zero clearance fittings or pipe —U-bends must be used where actuated ball valves, safety relief valves, check valves, and like, need to be removed for servicing. Zero clearance fittings must be verified to meet design pressure of system.
8. Threadolets, flanges, swaged nipples, plugs and bushings shall be ASME SA105. Butt weld pipe fittings including elbows, returns and reducers shall be ASME SA234 WPB. Socket weld fittings are not acceptable.
9. Pipe unions shall only be used on vent lines. Weld neck flanges are approved method of connecting pipe spools to equipment—slip-on flanges are not approved. RF flanges shall be used on ANSI Class 900# and lower flanges as well as on any ANSI Class 1500# and higher flanges requiring a flange isolation kit. Ring Type Joint (RTJ) flanges shall be used on ANSI Class 1500# and higher flanges not requiring a flange isolation kit.
10. Screwed pipe and fittings shall be used only where a transition to tubing is required, or for gas service (2-inch or smaller) with pressures below 15 psig, or for vent lines. Use of stainless steel threaded fittings in combination with compression fittings shall be minimized. Seal welding of threaded fittings is prohibited.
11. Where threaded fittings are necessary on gas piping, fittings shall be selected and arranged such that positioning of fitting is flexible. **Use of tees or elbows with compression ends and threaded ends on same fitting is prohibited.** In such a case, a union tee or elbow shall be used in conjunction with a male or female tube adapter.

    a. Some female pipe thread fittings cannot be used downstream of compressor

since not rated to high enough pressures. In addition, pressure safety relief valves must be installed as can be removed and replaced without having to turn PSV to loosen or tighten it. A flange, compression fitting or zero clearance fitting on inlet and outlet, in compliance with above shall be used. Pipe unions may be used on PSV vent piping only.

12. Tube fittings in all cases, shall all be of same manufacturer and shall be of same material as tubing.

C. Gas Vent Lines:

1. Gas vent lines shall be of same materials as specified for gas flow lines. Each line shall be Schedule 80 minimum and sized to match outlet size or maximum flow capacity of PSV it serves, whichever is greater. Each vent stack shall be sized to match total maximum flow capacity of relief valves it serves. Compressor vent stack is to be a minimum of one pipe size greater than compressor suction piping (2-inch Schedule 80 minimum).
2. Air and gas safety relief valves shall be piped to discharge vertically a minimum of 5 feet above roof of shelter (if applicable) and a minimum of 12 feet above surrounding grade, whichever is greater. Vent pipes shall be provided with a drip pocket to trap liquids and/or solids. This pocket shall be located within enclosure (if applicable) and shall be equipped with a manual drain valve. Vent lines shall be securely fastened and vent stacks shall be given sufficient support to prevent pipe movement during a discharge event. Vent stacks shall also be equipped with rain caps to prevent airborne rain and snow from contaminating vent piping. Note that gas and air vent systems shall be piped such that mixing cannot occur.
3. Compressor packing shall be externally vented and shall be piped separately from safety relief vent piping and provided with a drip pocket to trap liquids and/or solids. This pocket shall be located within enclosure and equipped with a manual drain valve.

D. Instrument Air Lines: IF REQUIRED shall be ASME SA213 TP316 tubing as specified in Subparagraph 2.03 B. 4.above.

1. Use of stainless steel tubing and fittings of same manufacturer selected in Paragraph 2.02 A. above, or minimum 200 psi rated (4:1 safety factor) Teflon air line with fittings of same manufacturer selected in Paragraph 2.02 A. above will be allowed within panels or within equipment skids and shelters or within conduit sleeves; provided sleeve riser enters directly into a pull box where a transition to stainless steel tubing or carbon steel pipe is made. Airlines installed between equipment skids or panels shall be either 316 SS tubing or carbon steel pipe.
2. Above ground fittings shall be threaded, and valves shall be two- piece, 600 pound WOG rated ball valves with steel handles and locking kits.

E. Miscellaneous Piping Components

1. Flange gaskets shall be spiral wound metallic with centering ring (up to ANSI 900# RF, non-isolation), malleable iron (ANSI 1500# RTJ and higher, non-isolation), or phenolic (up to ANSI 2500# RF flange isolation kits only) or a material approved by Engineer. Gasket materials shall be non flammable, non asbestos materials.
2. Insulated Flange Kit for dissimilar metal connections (stainless steel tubing connection to carbon steel pipe where shown on drawings):

a. Kits for raised face flanges shall include insulated full face flange gasket, 1/8" thick, with phenolic retainer and Viton sealing element, Pipeline Seal and Insulator Inc, linebacker type E, or equal kits for ring type joints shall include a type D gasket.
b. Kits shall include following:

1) Full length phenolic sleeve, extending halfway into both steel washers for each flange bolt.
2) Two (2) 1/8" thick phenolic isolating washers for each bolt.
3) Three (3) 1/8" thick zinc plated hot rolled steel washers for each bolt.
4) Inside diameter of washers shall fit over isolating sleeve.
5) Minimum dielectric strength of 400 volts/mil and water absorption <0.10%

3. Threads shall be NPT if tapered, or SAE if straight, unless otherwise specified.
4. Bolts, tubing, piping, and fittings shall be to SAE (i.e. non-metric) standards. Bolts shall be threaded UNF or UNC.
5. Swivel hose ends and fittings shall be 37 degree flare cadmium or zinc plated carbon steel.
6. Gages shall be equipped with stainless steel wetted parts and rated at 4:1 safety factor (minimum). Gages shall be equipped with a blow out disc in case. Gages shall be selected to provide normal operating pressure (at maximum suction and discharge conditions) at approximately 60 percent of range. All gages shall be glycerin filled.
7. Compressor inlet valves, factory installed on compressor skid by ANGI, shall be rated fire safe to API 607. Lever operated valves must be equipped with locking kits capable of securing valve in either an open or closed position. Actuated and manual ball valves shall be equipped with high cycle life stem and seals and shall be positional in any orientation. Actuators shall be mounted to ISO or equivalent standards using a minimum of 1/4-inch wall square steel tubing or valve manufacturer supplied bracket. Mounting bracket shall be fastened to ball valve and actuator with a minimum of 4 stainless steel bolts with split lock washers. Actuator/ball valve assemblies shall be factory tested for proper alignment and operation.
8. PSVs, actuated valves (valve stem vertical, actuator above or below valve), and filters shall be mounted in normal vertical orientation.

PART 3 -EXECUTION

3.01 INSTALLATION

A. Piping and Tubing Bending and Fitting Practices:

1. Piping and tubing shall be installed in a manner consistent with Contract Documents; in straight, evenly spaced, parallel runs and properly insulated if indicated on Drawings. Piping systems shall be built, supported and pitched to provide suitable venting and draining. Piping shall be run true to vertical and horizontal axis of facility wherever possible. If type of installation requires a slope on pipe, slope is to remain even along pipe. Overhead piping shall be installed to provide a minimum of 8 foot headroom in passageways. Valves shall be accessible for ease of operation, maintenance and overhaul/replacement. Bends shall be minimized wherever possible. Pipe bends shall not be permitted. Tubing shall be bent using benders which minimize radial distortion. This distortion shall not exceed code requirements.
2. Underground tubing sleeves shall be HDPE SDR 11, or Schedule 40 PVC conduit. Sleeve risers shall be a minimum of 6 inches above pad or 12: above ground where cap is installed. Caps are to be drilled with 1/2-inch holes for tube penetration and dry fitted not cemented to sleeve.
3. Pipe and tubing shall be cut with a cutter intended for application. Use of a hand hacksaw is prohibited (unless a Swagelok tube vise and guide is used). Use of a power hacksaw or band saw shall be allowed for pipe and 1-inch and larger tubing only, provided cuts are square. Cuts shall be debarred externally and internally. Tubing shall be free of scratches subsequent to cutting and deburring. Filings and cuttings shall be removed prior to assembly. Compression fittings and threaded fittings shall be bench made wherever possible (i.e. factory or field preassembled before installation to minimize leaks due to poor or misaligned connections). A hydraulic swager shall be used for 3/4-inch and larger tubing.
4. All sections of tubing and piping shall be designed to allow safe and controlled depressurization. This will require that bleed valves be installed at various points in system that could be captive. Drain valves on filters are considered to be acceptable depressurization points. Valves shall be identified and tagged with a unique identification number and standard depressurization procedures shall be provided describing in detail by reference to valve numbers how to safety depressurize, purge and re-pressurize all systems in station.

B. Pressure Welding and Fitting Practices:

1. Construction -General Requirements:

a. Provide welding materials, equipment, tools and supplies of a size, grade and quality approved by Engineer.
b. End Preparation and Fit up: End preparation or beveling shall be made by hand filing, machine tool or flame cutting device. Cut surfaces shall be smooth and regular. Free hand torch beveling shall not be permitted unless previously authorized on a case-by-case basis by Engineer. Rust, scale, mill slag, primer, moisture, oil or material which may be detrimental to finished weld shall be completely removed from weld area. Ends of pipe, fittings, and valves shall be

cleaned beyond beveled edges at least 2 inches both internally and externally to assure no foreign material enters weld puddle. Cleaning of weld bevels shall be done with power or hand tools.

c. Line up Clamps: abutting edges of weldments shall be held in alignment by an approved type of line up clamp where practical. When welding fitting to fitting where an approved type of line up clamp is not practical, each fitting shall be properly supported so as to minimize movement and strain during welding. Short runs of station piping or runs of pipe of limited distances shall demand an approved external line up clamp. When using an external line up clamp, clamp shall not be removed until stringer bead segments have been uniformly spaced around circumference of pipe and shall have an accumulative length of at least 50 percent of pipe circumference.

d. Alignment: alignment of abutting ends shall be such as to minimize offset between surfaces. For pipe of same nominal wall thickness, offset shall not exceed 1/16 inch. Any greater offset, provided it is caused by dimensional variations, shall be equally distributed around circumference of pipe or fitting.

2. Electrodes:

a. Size of Electrodes: Welding shall be completed using electrodes according to electrode size and classification listed on certified welding procedure.

b. Electrode Protection: Welding electrodes shall be kept dry and protected from any mechanical damage or deterioration and shall not be used if found or suspected to be defective.

c. Burned or defective electrodes shall not be dropped on ground or in raceway, but shall be discarded in a proper container.

d. Low hydrogen electrodes come in a hermetically sealed container. When a new container is opened, electrodes shall be placed in an electrode heating oven, manufactured and designed for purpose of electrode storage. Electrode shall be heated to 500 deg F for a period of two hours at a temperature of no less than 500 deg F.

3. Welding:

a. Manual Shielded Metal Arc Welding: Welding shall be accomplished by use of low hydrogen type electrodes, except for first pass.

b. Root bead and hot pass shall be deposited using conventional electrodes designated for that particular application. All filler and cover passes shall be completed by using low hydrogen electrodes.

c. After a weld has been started, no movement (or than rolling on a fixture) of piping shall be permitted until after weld has been completed.

d. 'Hot pass' or second bead shall be commenced as soon as possible after completion of root bead, and in any case within 5 minutes after completion of root bead. A completed weld shall consist of at least three passes. Under no condition shall a weld of only two passes be acceptable in manual shielded metal arc welding. Each successive pass shall be started at 120 degrees separation from previous two start points.

e. Dirt, scale and slag shall be removed from each bead and groove, between passes, and after weld has been completed with hand or power tools.

f. Unless welding procedure states otherwise, no weld pass shall commence until

preceding pass has been completed.

g. Cover of cap pass shall be raised a maximum of 1/16 inch above pipe wall, with a width sufficient enough to cover at least 1/16 inch on each side of weld groove. A concave cap shall be repaired by addition of another pass.

h. Welds must be spaced a minimum of one and a half nominal pipe diameters away from any adjacent weld.

i. Ground Clamps: Welding of ground clamps to pipe or fittings shall not be permitted. Ground clamps shall be constructed in such a manner as to fit uniformly and securely enough to eliminate any possibility of arc burns on pipe or fittings. Ground clamps shall be kept in a good state of repair, lubricated regularly and cleaned when required of rust, slag, spatter, scale, primer, and coating materials so as to prevent arc burns.

j. Rapid Cooling Control: When temperature falls below 20 deg F, welds shall be protected against rapid cooling by wrapping completed girth weld with an insulated blanket designed for that purpose.

k. Blankets shall be applied after completing first three passes, if remaining fill and cover passes are not applied immediately following completion of hot pass. When welds are protected by this method, and when remaining fill and cover passes are completed at a later time, weld area must again be preheated to proper temperature.

l. Wear Protection: Welding shall be performed within a wear proof enclosure to prevent rain, snow or foreign objects from contaminating work. Glare from arc welding shall be blocked by use of commercially available weld curtains.

m. Exposed Pipe Joints: Pipe joints for buried pipe shall remain exposed until inspected. Where exposed pipe is in an area where vehicles need to cross, inspection process shall be expedited to minimize disruption in traffic flow.

C. Pipe and Tubing Support and Fastening Techniques:

1. Pipe and tubing shall be adequately supported per UPC and ASME requirements to prevent bending, sagging and excessive vibration or damage to threads or flanges. When placing pipe on to supports, care shall be exercised so as not to jerk pipe or impose any stresses that may kink or put a permanent bend or stress in pipe or crack a thread.
2. As a minimum, clamps shall be placed no greater than 60 inches apart and 12 inches from both sides of any bends. Where requirements of any codes or manufacturer are more stringent, that clamping interval shall apply. Pipe and tubing shall not be used to support external devices. Clamps and fasteners shall be adequate for application intended.
3. Clamps and fasteners shall be secured by mechanical means (e.g., welded, bolt with lock washer). Use of adhesives and self-tapping screws shall be subject to Engineer's approval. Use of Swagelok or Stauff Tubing Support Systems (plastic saddle clamp type) is required for tubing and piping.
4. Clamp spacing shall be as per governing code or clamp manufacturer's specifications, whichever is more stringent. Unistrut style conduit clamps will not be acceptable for piping and tubing.

D. Identification:

1. Weld Identification: After completing a weld, welder shall mark it to identify work. Where two or more welders are employed to produce a single weld, joint shall be

marked to identify portion made by each welder. No notch stencils shall be used. Paint sticks are acceptable so long as identification will last until weld has been deemed satisfactory.

2. Pipe and Valve Identification:

   a. Pipe Identification: Permanent labels with 1-inch high lettering indicating pressure and flow direction shall be permanently fastened to piping at 20 foot intervals.
   b. Valve Identification: Manual and automated valves shall be equipped with stainless steel or brass labels with a unique valve number clearly indicated in 1/2-inch high letters and permanently affixed to valve with stainless steel wire or chain.

3.02 FIELD QUALITY CONTROL

A. Non-Destructive Examination of Weld Joints:

1. All welds shall be visually examined for uniform appearance and finish.
2. Butt welds shall be subjected to 10 percent full circumference radiographic testing by a National Board (N.B.) certified agency or as required by governing code, whichever is greater. Acceptability of weld is based on ANSI B31.3. Radiographic test reports and films on shop fabricated piping shall be forwarded to Owner at time of shipping. Testing shall include 10 percent of each welder's welds and 10 percent of each pipe size and thickness.
3. Pipe spool sketches referenced to each X-ray to allow later identification of a particular X-ray to a particular weld must be provided along with X-ray reports and films. Sketches must also identify welder that performed each weld.
4. Thread-o-lets and weld-o-lets must be die penetrant or mag particle tested.

B. Pressure Testing:

1. General:

   a. Gas piping shall be pressure tested to a value of 1.5x (hydrostatic) relief valve setting for 60 minutes, or 1.1x (pneumatic) relief valve setting or as required by local inspection agency. Extreme care shall be used due to inherent risk of a catastrophic failure which could cause serious injury. Nonessential personnel shall leave and protection from injury shall be provided for those left on site. Shop reports shall be signed by a Professional Engineer or piping contractor company executive and shall include:

      1) Spool number
      2) Spool description
      3) PSV pressure relief valve setting
      4) Test pressure(s)
      5) Test duration (starting and ending times)
      6) Test date
      7) Signature of Technician
      8) Calibration data for gages, meters, transducers, and telemetry equipment.
      9) Ambient temperature

   b. Prior to performing tests, PSV's and filter cartridges shall be removed from

system. Subsequent to pressure tests, PSV's and filter cartridges shall be reinstalled.

c. Pressure testing shall be witnessed by Owner to confirm compliance with specified requirements.

2. Hydrostatic Testing:

   a. Pipes shall be removed or isolated to prevent water from entering compressor or piping spools. Hydrostatic test shall be performed with clean water only. Pre-testing to approximately 60 psig is recommended, to locate major deficiencies. Subsequent pressure increases shall be made gradually to prevent "shocking" of pipe system, increasing pressure gradually to full test pressure (1.5 times SRV setting) and holding it for one hour.
   b. At end of test, a visual inspection of all joints (welded, threaded, compression and flanged) shall be made to determine if any visible leakage has occurred. Immediately after water has been fully drained from system, a high velocity dry nitrogen purge shall be made throughout system until no water remains.

3. Tie-Ins: Piping or tubing tie-ins shall be removed from system and pressure tested in accordance with above requirements. After reinstallation, tie-ins shall be leak tested at working pressure of system.
4. Purging and Pressurizing:

   a. Purging and pressurizing shall be performed by Contractor and witnessed by Engineer or Owner's designate.
   b. Before pressurizing with natural gas commences, ESD system shall be tested and fully operational. Natural gas shall not be introduced into system without prior approval of local gas utility and express authorization of Engineer. Air shall be purged from entire system to satisfaction of Engineer prior to pressurizing system.
   c. Before natural gas is introduced into any piping system, fabrication, testing and work requiring flame or sparking devices shall be complete. After natural gas has been introduced, welding or work which could ignite natural gas vapors shall be performed only upon express authorization by Owner on a case-by-case basis.

5. Leak Test:

   a. Subsequent to final field installation and pressure tests, completed piping with valves in place shall be leak tested before being placed in operation to ensure that it does not leak.
   b. piping and tubing shall be pressurized with natural gas to its normal operating pressure (4500 psig downstream of CNG compressors) and tested with a suitable liquid leak detector such as "Snoop" (by Swagelok Company).
   c. following locations shall be tested:

      1) Flanged joints
      2) Threaded joints
      3) Tube joints
      4) Accessible butt joints

3.03 CLEANING

A. Pipe and Tube Cleaning:

1. Subsequent to pipe fabrication and testing, pipe shall be mechanical cleaned with wire brushes and/or swabs or pigs) followed by internal cleaning with a non residual, degreasing and slag removing solution. A high velocity dry nitrogen purge shall be made to remove any loose scale, filings, water or foreign material. Once slag, mill oil and cleaning solution has been removed, piping shall be coated internally (within 24 hours of cleaning) with a light coating of synthetic oil used in compressor. (Dryer piping is exempted from this requirement but must be shipped with 15 psig dry nitrogen charge with a gauge and sealed valve).

2. Subsequent to tubing fabrication a high velocity nitrogen purge shall be made to remove any loose scale, filings, water or foreign material.

SECTION 40 80 10
SYSTEMS DEMONSTRATIONS

PART 1 GENERAL

1.01 DESCRIPTION

A. Before Substantial Completion is considered for entire Work, CONTRACTOR shall test and demonstrate specific items of equipment and systems in operation. Conduct testing and operation demonstrations on following systems:

1. System Site 01 – CNG Fueling System- Lincoln Garage per Section 40 01 00 and 40 05 00.
2. System Site 02 – CNG Fueling System- Northwest Garage per Section 40 02 00 and 40 05 00.

B. Preliminary:

1. Before CONTRACTOR begins testing and system operation demonstrations, Installation Services specified in Section 01 60 10 for each system or equipment shall be completed.

C. Coordination:

1. Designate representative of CONTRACTOR to be responsible for testing and operation demonstration of systems.
2. Notify OWNER and ANGI at least two (2) weeks before tests and system operation demonstrations are to begin so OWNER can make arrangements for witness testing and demonstration.
4. Reschedule cancelled tests and operation demonstrations 5 days in advance.

1.02 SUBMITTALS

A. Reports:

1. Testing of Components and Systems.

a. Prepare report for each system on results and activities encompassing testing as required by this section. Submit report within 2 days of completion of tests.
b. As minimum, report shall describe findings of inspections; revisions, modifications or replacement of equipment; calibrations; test results; dates and names of persons involved and observing inspections, testing, and other activities pertaining to components and systems; and statement regarding operational condition of components and systems.

2. System Operation Demonstration.

a. Prepare report for each system on results of activities encompassing operation demonstration as required by this section. Submit report within 2 days of completion of 120 hr demonstration.
b. Report shall describe operational conditions; daily results of systems operation; dates and names of persons involved and observing operation; and statement regarding system ability to meet operational criteria.

C. Submit in accordance with Section 01300.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 TESTING OF SYSTEM COMPONENTS

A. Subject each system, process, mechanical, instrumentation, and electrical equipment components, including related piping and control systems, to individual inspection and testing by CONTRACTOR and certified by CONTRACTOR to be ready for operations before beginning system operation demonstration.

B. Inspection and tests shall be made to determine if equipment is properly assembled, aligned, adjusted, calibrated, wired or connected. Changes, adjustments or replacements of equipment due to errors or omissions on part of CONTRACTOR, or otherwise necessary to comply with requirements of Contract Documents shall be done without additional cost to OWNER.

3.02 SYSTEM OPERATION DEMONSTRATION

A. Upon completion of inspection and testing of individual components in each system, demonstrate operation and performance of each system for 120 hrs in accordance with requirements of Contract Documents.

1. Where no specific performance requirements are stated in Specifications, demonstrate to show equipment operates in accordance with acceptable industry standards for application of equipment.
2. System operation demonstration shall show equipment operates within manufacturer's tolerances for noise and vibration, equipment is responsive to manual and automatic controls, control and protective devices are properly set, and equipment runs on controlled or intermittent basis when such operation is intended.
3. System operation demonstration shall include checkout from each remote control point. Demonstrate alarm and safety lockout systems for proper function and process instrumentation and control.

B. During testing and system operation demonstration, CONTRACTOR shall arrange for presence of qualified representatives of Suppliers of each piece of equipment and instrumentation included in system necessary to conduct test and demonstration.

C. Temporary facilities and services are CONTRACTOR'S responsibility. Electrical power for equipment inside existing buildings will be supplied by OWNER. CONTRACTOR shall provide temporary connections if necessary.

D. Successful completion of system demonstration for each system will be when performance requirements established in Contract Documents are met while running for 120 consecutive hrs.

E. If during demonstration system is not meeting performance requirements established in Contract Documents, CONTRACTOR shall stop demonstration, adjust, calibrate or replace equipment or instrumentation and re-start and run demonstration until 120 consecutive hrs have been completed.

3.03 DETERMINATION OF SUBSTANTIAL COMPLETION

A. Systems described in Section:

1. Upon successful completion of testing of system components, system operation demonstrations, and delivery of submittals specified in this section, CONTRACTOR shall notify OWNER and ENGINEER in writing that components and system are substantially complete.

B. Other Systems:

1. Other identified systems will be considered for substantial completion when CONTRACTOR considers Work ready for its intended use.
2. Components and systems will be substantially complete after successful completion of testing of components and systems, system operation demonstration, and delivery of submittals.

* * * END OF SECTION * * *

SECTION 40 90 10
GENERAL PROVISIONS FOR INSTRUMENTATION AND CONTROLS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. General requirements for package and non-package Instrumentation and Control Systems unless otherwise specified in other sections.

1.02 DEFINITIONS

A. Selector Switch: When used under panel component description refers to maintained contact type switches. Loss and return of control power to circuit does not change control mode of requirements in switch position.

B. Push-button: When used under panel component description refers to momentary contact type switches which, unless specified otherwise, shall require electrical interlock. Loss of control power shall, unless specified otherwise, result in loss of electrical interlock and stoppage of previous mode of operations.

1.03 SYSTEM DESCRIPTION

A. Design Requirements:

1. Provide run/fail, alarm, and equipment status functions.
2. Unless otherwise specified, "run" signals shall be derived from motor starter normally open auxiliary contacts.
3. Unless otherwise specified, discrete input and output signals shall conform to:

   a. Isolated unpowered (dry) contact closures.
   b. Power contact from panel receiving signal or device receiving signal.

4. Unless otherwise specified, input and output analog signals shall conform to:

   a. 4-20 mAdc.
   b. For 2-wire transmitter, provide isolated type and power with 24 or 48 vdc at panel or device receiving signal.
   c. Where isolation is required to interface with particular equipment furnished, provide necessary I/I converters.

5. For PLC based systems manual control devices, in panel or field, shall be independent from PLC to provide maintenance and redundancy function.
6. Panels, panel devices, and field devices shall meet or exceed NEMA requirements as follows.

   a. NEMA 4X: Wet locations or outdoors.

      1) Instrumentation and control panels shall be 316 stainless steel.
      2) Instruments and device enclosures shall be 316 stainless steel, fiberglass, or ABS plastic.

   b. NEMA 7: Class I, Division 1 or 2 areas.
   c. NEMA 12: Other areas.

7. Design Life: Design control system for min. 10 yr life at following temperatures:

   a. Permit continuous operation with panel external ambient temperatures of up to +40°C (+104°F).
   b. Outdoor Panels: Permit operation with panel external ambient temperatures of down to -29°C (-20°F).
   c. Indoor Panels: Permit operation with panel external ambient temperatures of down to +8°C (+40°F).

8. When motor controller disconnecting means is off, deenergize associated equipment devices powered from panel.
9. Electrical wiring and controls shall conform to Division 26.

B. Identify equipment on panel or screens with indication below:

1. Green Light On: Equipment running.
2. Red Light On: Equipment failure when called to run, but not running due to power failure, overload, breaker, disconnect, or remote switch call for equipment to stop.

   a. Provide parallel "required" contact wired to panel for items such as pumps and valves.
   b. Provide necessary relay logic and adjustable timers to sense discrepancy between "required" and "running" and activate respective "Run" and "Fail" light from these signals. Provide horn when specified.

3. Amber Light On: Indicate equipment status such as valve open or closed.
4. White Light On: Equipment off.

1.04 SUBMITTALS

A. General:

1. Submit following information tabulated in booklet form for each piece of equipment or system furnished under this section.
2. Table of Contents of Submittals: Include for each booklet when more than 1 item of equipment is included in submittal:

   a. ENGINEER'S instrument tag number.
   b. Instrument manufacturer's model number.
   c. Related piping, electrical, and dimension drawings.

B. Product Data:

1. Construction materials.
2. Ranges.
3. Output/Input signals.
4. Accessories.
5. Mounting location.
6. ENGINEER'S tag number on manufacturer's specifications sheets.
7. Interconnect reference for associated field and panel instruments.
8. Component specification sheets.

C. Shop Drawings:

1. Panel fabrication and dimension drawings, nameplate legends, ENGINEER'S tag numbers, and wiring and piping schematic drawings. Project specific drawings are required for each panel, typical are not acceptable.
2. Equipment dimension drawings.

3. Equipment terminal and piping connections.
4. Loop-by-loop system electrical schematic showing terminal-to-terminal interconnections between related panel and field instruments.
5. Front of panel layout.
6. PLC I/O module connection diagram for PLC based systems.
7. Ladder/logic system electrical schematic showing wiring of each component, including ranges and set points. Wiring and ladder diagram shall have reference numbers on every line for cross referencing. Each device on ladder shall be cross-referenced with line number as to wherever it is located.
8. Terminal to terminal interconnection drawings showing wiring for panel to panel/MCC and panel to field equipment.

D. Miscellaneous:

1. Certificate of UL or nationally recognized testing laboratory (NRTL) inspection and approval for each completely assembled panel prior to shipment to Project.
2. Include ENGINEER'S tag number when available on each submittal document or page wherever specific component appears.
3. Extra materials list.

E. Operation and Maintenance (O&M) Data:

1. Include O&M data for each panel and field device specified in Division 40:

   a. PLC ladder logic software (electronic and printed) including tags, comments, operational database values and passwords or pass codes.
   b. Configured software on electronic media to install program on spare PLC processors and programmable controller.
   c. Bill of materials.
   d. Instruction Manual: Includes detailed operating sequence descriptions.
   e. Maintenance Manual: Instructions for maintaining equipment to include calibrating, cleaning, and trouble shooting.
   f. Front and rear panel layout drawings.
   g. Name plate data.

2. Submit 1 package:

   a. Equipment provided under Section 40 90 15.

F. Submit in accordance with Section 01300.

1.05 QUALITY ASSURANCE

A. Standardization:

1. Drawings and Specifications are intended to provide overall system functions. Provide equipment necessary to provide complete and operable system.
2. CONTRACTOR is responsible for costs resulting from deviations from Contract Documents.

B. Items provided under sections referenced to this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

C. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

PART 2 PRODUCTS

2.01 EQUIPMENT MARKERS

A. Furnish equipment markers with ENGINEER'S equipment name and tag number.

2.02 SOURCE QUALITY CONTROL

A. Perform UL inspection and certification for each completely assembled panel before shipment to Project site.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install equipment in locations indicated on Drawings and in accordance with manufacturer's written instructions and approved submittals.

3.02 EQUIPMENT MARKERS

A. Fasten to equipment to be visible.

* * * END OF SECTION * * *

SECTION 40 90 15
INSTRUMENTATION AND CONTROLS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. General provisions and requirements for instrumentation and control equipment and systems.

1.02 DEFINITIONS

A. Systems House: Supplier whose principle function is design, manufacture, and service of instrumentation and control (I&C) systems.

1.03 SYSTEM DESCRIPTION

A. Instrumentation and control package for plant process control. Does not include process equipment package panels.

1.04 QUALITY ASSURANCE

A. Standardization:

1. Instrumentation and Control system shall be provided by single Systems House.
2. Equipment shall be latest model or version available at time bids are opened, unless otherwise noted.
3. When more than one I&C equipment component of like function is required, end products shall be of single manufacturer to achieve standardization for maintenance, spare parts, operation, and service.
4. Maintain consistent front of panel layout for panels.
5. Systems House shall coordinate data highway communication with process package systems.

B. Experience:

1. Systems House shall have at least 5 yrs experience in design, manufacture, installation, and successful operation of instrumentation systems similar to specified.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Equipment provided under this section includes:

1. Panel and Field Devices: Section 40 95 14.
2. Instrumentation and Control Panels: Section 40 90 40. (Included in Addendum No.1)

PART 3 EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with manufacturer's written instructions and approved submittals.

B. Wire instrumentation and control package panels specified in Divisions 40 and 44

C. Wire components specified in Divisions 40 and 44.

3.02 FIELD QUALITY CONTROL

A. System's House/Manufacturer's Field Services:

1. Manufacturer's engineer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system related areas other than process design and philosophy. See Section 01600.
2. Provide services of qualified service engineer to supervise and inspect equipment installation to ensure system is installed in accordance with manufacturer's recommendations.
3. Field calibrate equipment at time of complete system startup on loop-by-loop basis. Document field calibration results for each piece of equipment and provide to OWNER.
4. Make adjustments necessary to place equipment in satisfactory operation.
5. Manufacturer's engineer for equipment specified shall be present at job site or classroom designated by OWNER for mandays indicated, travel time excluded, for assistance during plant construction, plant startup, equipment adjustment, and training of OWNER'S personnel for plant operation. Include minimum of:

   a. Instrumentation and Control Panels, Section 40 90 40:

      1) 1 manday for Installation Services.
      2) 1/2 manday for Instructional Services.
      3) 1 manday for Post Startup Services.

* * * END OF SECTION * * *

SECTION 40 95 14
PANEL AND FIELD DEVICES

PART 1 GENERAL

1.01 SUMMARY

A. Comply with Section 40 90 10.

PART 2 PRODUCTS

2.01 PUSH-BUTTON/SELECTOR SWITCH CONTROL UNITS AND PILOT LIGHTS

A. Manufacturers:

1. Square D.
2. Cutler-Hammer.
3. Allen Bradley.
4. Or equal.

B. Construction:

1. Heavy duty.
2. Oil tight, watertight.
3. Base mounting.
4. Flush panel mounting.
5. Size to mount in 30.5 mm opening without adapter. Smaller units are not acceptable.

C. Emergency Stop Device (ESD) in NEMA 4X Stainless Steel Control Station:

1. Jumbo red mushroom head.
2. Contact Blocks:

   a. Double break silver contacts.
   b. ac Ratings: 7,200 va make, 720 va break.
   c. Single pole, double throw or double pole, single throw.
   d. Up to 2 tandem blocks.

3. Push/Pull.
4. Maintained contact.
5. Non-illuminated.
6. Padlock attachments constructed of metal. Plastic material is not acceptable.
7. Legend Plates:

   a. Extra large.
   b. Red.
   c. Emergency Stop.

E. Nameplates:

1. I&C Panel: Section 40 95 13.
2. Control Stations:

   a. Engraved laminated plastic.
   b. Letters 3/16 in. high.

c. Black letters on white background.
d. Identify per equipment controlled.

2.02 TERMINAL BLOCKS FOR CONTROL WIRING

A. Manufacturers:

1. Phoenix Contact. UK-5N.
2. Allen Bradley, Bulletin 1492.

B. General:

1. 600 v rating.
2. Marker labels on each terminal.
3. Clip-mount on DIN rails.
4. Insulating end caps to support each terminal block assembly.
5. Touchsafe terminal block and accessories.
6. Connection: Captive screw and pressure plate. Connection shall not cause deformation of wire.
7. Contact material and surface: Nickel or tin plated copper alloy. Do not use ferrous metals.

C. Switched Knife Disconnect (when specified):

1. Non-fused.
2. Single-pull, single throw (SPST).
3. Hinged disconnect lever.

D. Fused Indicating (when specified):

1. LED blown fuse indicating light.
2. Hinged disconnect lever.
3. Size fuse for load.
4. 15 amp capacity fuse holder.

2.03 TAGGING

A. Provide Type 316 stainless steel tag on field-mounted units and permanently affix tag to unit.

B. Engrave with process application as listed in Specifications.

C. Include ENGINEER'S tag number as listed in Specifications and on P&ID's.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC, NECA "Standard of Installation," and recognized industry practices.

B. Control Relays:

1. Provide control relays for general purpose logic circuits.
2. Provide motor starter control relays when load exceeds rating of general purpose control relays.

* * * END OF SECTION * * *