STATE OF DELAWARE

This Copy is for information only.
You must request a CD from
DelDOT in order to bid.

DEPARTMENT OF TRANSPORTATION

BID PROPOSAL

for

CONTRACT T201507602.02

FEDERAL AID PROJECT NO. EBHOS-S018(13)

CFDA NO. 20.205

BR 3-154 on US9 Savannah Road and BR 3-153 on SR1A Rehoboth Avenue over Lewes-Rehoboth Canal

RE-ADVERTISEMENT
This Contract Was Previously Advertised & Not Awarded

Sussex County

ADVERTISEMENT DATE: October 1, 2018

COMPLETION TIME: 494 Calendar Days

SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION
DELAWARE DEPARTMENT OF TRANSPORTATION
AUGUST 2016

Bids will be received in the Bidder's Room at the Delaware Department of Transportation's Administration Building, 800 Bay Road, Dover, Delaware prior to 2:00 P.M. local time **October 30, 2018**

Contract No.T201507602.02
Federal Aid Project No. EBHOS-S018(13)

BR 3-154 on US9 Savannah Road and BR 3-153 on SR1A Rehoboth Avenue over Lewes-Rehoboth Canal
Sussex County

GENERAL DESCRIPTION

LOCATION

These improvements are located in Sussex County more specifically shown on the Location Map(s) of the enclosed Plans.

DESCRIPTION

The improvements consist of furnishing all labor and materials for this contract. This project involves the following but not limited to: Control House renovations, substructure repairs and coating, repair and replacement of select steel members and joints, cleaning and painting of existing steel members, sidewalk reconstruction, rehabilitation of existing bridge mechanical systems, replacement of existing bridge electrical systems, new walkway platforms (BR 3-154 only), coordination with utility service upgrades and it installation, and other incidental construction in accordance with the location, notes and details shown on the plans and as directed by the Engineer.

COMPLETION TIME

All work on this contract must be complete within 494 Calendar Days. The Contract Time includes an allowance for 94 Weather Days. It is the Department's intent to issue a Notice to Proceed such that work starts on or about December 22, 2018.

PROSPECTIVE BIDDERS NOTES:

1. BIDDERS MUST BE REGISTERED with DelDOT and request a cd of the official plans and specifications in order to submit a bid. Contact DelDOT at dot-ask@state.de.us, or (302) 760-2031. Bids will be received in the Bidder's Room at the Delaware Department of Transportation's Administration Building, 800 Bay Road, Dover, Delaware prior to 2:00 P.M. local time October 30, 2018 unless changed via addendum.
2. QUESTIONS regarding this project are to be e-mailed to dot-ask@state.de.us no less than six business days prior to the bid opening date in order to receive a response. Please include T201507602.02 in the subject line. Responses to inquiries are posted on-line at http://www.bids.delaware.gov.
3. THE BID PROPOSAL incorporates a cd containing **Expedite**, **version 5.9a** and its installation file. Bidders are to use the cd provided to enter their bid amounts into the Expedite file. The Expedite bid file must be printed and submitted in paper form along with the cd and other required documents prior to the Bid due date and time.
4. SURETY BOND - Each proposal must be accompanied by a deposit of either surety bond or security for a sum equal to at least 10% of the bid.
5. DRUG TESTING - Regulation 4104; The state Office of Management and Budget has developed regulations that require Contractors and Subcontractors to implement a program of mandatory drug testing for Employees who work on Large Public Works Contracts funded all or in part with public funds pursuant to 29 Del.C. §6908(a)(6). **Refer to the full REVISED requirements at the following link:** http://regulations.delaware.gov/register/december2017/final/21 DE Reg 503 12-01-17.htm

   Note a few of the requirements;

   * At bid submission - Each bidder must submit with the bid a signed affidavit certifying that the bidder and its subcontractors has in place or will implement during the entire term of the contract a Mandatory Drug Testing Program that complies with the regulation, *form is attached*;
   * At least Two business days prior to contract execution - The awarded Contractor shall provide to DelDOT copies of the Employee Drug Testing Program for the Contractor, each participating DBE firm, and all other listed Subcontractors;
   * Subcontractors - Contractors that employ Subcontractors on the job site may do so only after submitting a copy of the Subcontractor's Employee Drug Testing Program along with the standard required subcontractor information. A Subcontractor shall not commence work until **DelDOT** has approved the subcontractor in writing.

6. DBE PROGRAM REQUIREMENTS (49CFR §26.53(b)(3)(i)(B)) require submission of DBE participation information from the apparent low bidder no later than five (5) calendar days **after bid opening**,
7. No RETAINAGE will be withheld on this contract.
8. EXTERNAL COMPLAINT PROCEDURE can be viewed on DelDOT's Website at; http://regulations.delaware.gov/AdminCode/title2/2000/2500/2501.shtml or you may request a copy by calling (302) 760-2555.
9. AUGUST 2016 STANDARD SPECIFICATIONS apply to this contract. The Contractor shall make himself aware of any revisions and corrections (Supplemental Specifications, if any) and apply them to the applicable item(s) of this contract. The 2016 Standard Specifications can be viewed here.

9a. FLATWORK CONCRETE TECHNICIAN CERTIFICATION TRAINING:
Section 501.03, 503.03, 505.03, 610.03, 701.03 and 702.03 of the 2016 Standard Specifications require contractor's to provide an American Concrete Institute (ACI) or National Ready Mix Concrete Association (NRMCA) certified concrete flatwork technician to supervise all finishing of flatwork concrete. Concrete flatwork certification will be effective starting on June 1, 2018.

10. BREAKOUT SHEETS MUST be submitted either with your bid documents; or within seven (7) calendar days following the bid due date by the lowest apparent bidder. Refer to instructions adjacent to the Breakout Sheets in this document.
11. PROPOSSED TRAINEE PLANS - The number of trainees to be trained will be **1**, as listed in the Training Special Provisions within Contract General Notices. The program(s) must be submitted online at https://deldotojt.com as soon as possible by the apparent low bidder. Award of the Contract will not take place until acceptable On-the-Job (OJT) program plans are received and approved by the Department's Civil Rights Section. Failure of the apparent low bidder to submit acceptable OJT Trainee Programs within ten (10) calendar days of bid opening shall create a rebuttable presumption that the bid is not responsive.
12. This project is a Re-Advertisement and a Pre-Bid Meeting was held on July 16, 2018. The Transcript of that meeting along with the Attendance Sign-in Sheet will be posted.
13. **No** Subcontractor Categories will be used for this project.
14. The Contractor is advised that the rehabilitation work on BR 3-153, Rehoboth Avenue Bridge, shall be coordinated with and scheduled around the upcoming SR1 Bridge Re-decking project (T201407602 - BR 3-150). The SR1 work is expected to begin in the fall of 2019. Lane restrictions and detours shall not be permitted on BR 3-153 after August 31, 2019.
15. The Contractor is advised that their scheduling of engineering and construction activities will have a significant impact on the success of this project. The rehabilitation of the mechanical and electrical systems on the movable bridges includes specialized components that may require significant time to design, fabricate, shop test and install within the restrictions contained in this Contract. The Contractor is strongly encouraged to begin their construction engineering, planning and shop drawing process immediately upon receiving their Notice to Proceed (NTP). After the NTP is issued, it is anticipated that a 30 day period will be provided to the Contractor to prepare shop drawings before the first chargeable day of the contract commences.
16. The prospective bidders are advised that the City of Lewes has an ongoing construction contract for water and sewer improvements along Gills Neck Road, Front Street and Savannah Road. The ongoing upgrades to the water and sewer lines are in the vicinity of Bridge 3-154 carrying Savannah Road over the canal. Phase 2 of this contract is expected to start in January 2019 and be completed in May 2019. Periodic detours and MOT will be in place while the road(s) are closed to accommodate the improvements. Access to BR 3-154 may be limited during this period. The movable bridge contractor is responsible for coordinating any planned work activities on the bridge with DelDOT and the City's contractor. No additional lane closures or detours are permitted for bridge work while the adjacent contract is active, unless approved in writing by DelDOT.

Contract No.T201507602.02

CONSTRUCTION ITEMS UNITS OF MEASURE

English Code	English Description	Multiply By	Metric Code	Metric Description	Suggested CEC Metric Code
ACRE	Acre	0.4047	ha	Hectare	HECTARE
BAG	Bag	N/A	Bag	Bag	BAG
C.F.	Cubic Foot	0.02832	m^3	Cubic Meter	M3
C.Y.	Cubic Yard	0.7646	m^3	Cubic Meter	M3
EA-DY	Each Day	N/A	EA-DY	Each Day	EA-DY
EA-MO	Each Month	N/A	EA-MO	Each Month	EA-MO
EA/NT	Each Night	N/A	EA-NT	Each Night	EA/NT
EACH	Each	N/A	EA	Each	EACH
GAL	Gallon	3.785	L	Liter	L
HOUR	Hour	N/A	h	Hour	HOUR
INCH	Inch	25.4	mm	Millimeter	MM
L.F.	Linear Foot	0.3048	m	Linear Meter	L.M.
L.S.	Lump Sum	N/A	L.S.	Lump Sum	L.S.
LA-MI	Lane Mile	1.609	LA-km	Lane-Kilometer	LA-KM
LB	Pound	0.4536	kg	Kilogram	KG
MFBM	Thousand Feet of Board Measure	2.3597	m^3	Cubic Meter	M3
MGAL	Thousand Gallons	3.785	kL	Kiloliter	KL
MILE	Mile	1.609	km	Kilometer	KM
S.F.	Square Foot	0.0929	m^2	Square Meter	M2
S.Y.	Square Yard	0.8361	m^2	Square Meter	M2
SY-IN	Square Yard-Inch	0.8495	m^2-25 mm	Square Meter-25 Millimeter	M2-25 MM
TON	Ton	.9072	t	Metric Ton (1000kg)	TON
N.A.*	Kip	4.448	kN	Kilonewton	N.A.*
N.A.*	Thousand Pounds per Square Inch	6.895	MPa	Megapascal	N.A.*

*Not used for units of measurement for payment.

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GENERAL NOTICES

SPECIFICATIONS:

The specifications entitled "Delaware Standard Specifications for Road and Bridge Construction, August, 2016", hereinafter referred to as the Standard Specifications; Supplemental Standard Specifications; the Special Provisions; notes on the Plans; this Bid Proposal; and any addenda thereto, shall govern the work to be performed under this contract.

CLARIFICATIONS:

Under any Section or Item included in the Contract, the Contractor shall be aware that when requirements, responsibilities, and furnishing of materials are outlined in the details and notes on the Plans and in the paragraphs preceding the " Basis of Payment" paragraph in the Standard Specifications or Special Provisions, no interpretation shall be made that such stipulations are excluded because reiteration is not made in the "Basis of Payment" paragraph.

ATTESTING TO NON-COLLUSION:

The Department requires as a condition precedent to acceptance of bids a sworn statement executed by, or on behalf of, the person, firm, association, or corporation to whom such contract is to be awarded, certifying that such person, firm, association, or corporation has not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive bidding in connection with such contract. The form for this sworn statement is included in the proposal and must be properly executed in order to have the bid considered.

QUANTITIES:

The quantities shown are for comparison of bids only. The Department may increase or decrease any quantity or quantities without penalty or change in the bid price.

EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS:

Delaware Code, Title 29, Chapter 69, Section 6962, Paragraph (d), Subsection (7) states;

a. As a condition of the awarding of any contract for public works financed in whole or in part by State appropriation, such contracts shall include the following provisions:

   During the performance of this contract, the contractor agrees as follows:

   1. The contractor will not discriminate against any employee or applicant for employment because of race, creed, color, sex, sexual orientation, gender identity or national origin. The contractor will take positive steps to ensure that applicants are employed and that employees are treated during employment without regard to their race, creed, color, sex, sexual orientation, gender identity or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places available to employees and applicants for employment notices to be provided by the contracting agency setting forth this nondiscrimination clause.

   2. The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, sex, sexual orientation, gender identity or national origin.

   3. The contractor will ensure employees receive equal pay for equal work, without regard to sex. Employee pay differential is acceptable if pursuant to a seniority system, a merit system, a system which measures earnings by quantity or quality of production, or if the differential is based on any other factor other than sex.

TAX CLEARANCE:

As payments to each vendor or contractor aggregate $2,000, the Division of Accounting will report such vendor or contractor to the Division of Revenue, who will then check the vendor or contractor's compliance with tax requirements and take such further action as may be necessary to insure compliance.

LICENSE:

A person desiring to engage in business in this State as a contractor on a project designated to include federal funds, shall obtain a Delaware business license upon making application to the Division of Revenue. Proof of said license compliance to be made prior to, or in conjunction with, the execution of a contract to which he has been named.

SUBCONTRACTOR LICENSE: 29 DEL. C. §6967:

(c) Any contractor that enters a public works contract must provide to the agency to which it is contracting, within 30 days of entering such public works contract, copies of all occupational and business licenses of subcontractors and/or independent contractors that will perform work for such public works contract. However, if a subcontractor or independent contractor is hired or contracted more than 20 days after the contractor entered the public works contract the occupational or business license of such subcontractor or independent contractor shall be provided to the agency within 10 days of being contracted or hired.

DIFFERING SITE CONDITIONS,

SUSPENSIONS OF WORK and SIGNIFICANT CHANGES IN THE CHARACTER OF WORK:

Differing site conditions: During the progress of the work, if subsurface or latent physical conditions are encountered at the site differing materially from those indicated in the contract of if unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the work provided for in the contract are encountered at the site, the party discovering such conditions shall promptly notify the other party in writing of the specific differing conditions before they are disturbed and before the affected work is performed.

Upon written notification, the engineer will investigate the conditions, and if he/she determines that the conditions materially differ and cause an increase or decrease in the cost or time required for the performance of any work under the contract, an adjustment, excluding loss of anticipated profits, will be made and the contract modified in writing accordingly. The engineer will notify the contractor of his/her determination whether or not an adjustment of the contract is warranted.

No contract adjustment which results in a benefit to the contractor will be allowed unless the contractor has provided the required written notice.

No contract adjustment will be allowed under their clause for any effects caused on unchanged work.

Suspensions of work ordered by the engineer: If the performance of all or any portion of the work is suspended or delayed by the engineer in writing for an unreasonable period of time (not originally anticipated, customary or inherent to the construction industry) and the contractor believes that additional compensation and/or contract time is due as a result of such suspension or delay, the contractor shall submit to the engineer in writing a request for adjustment within 7 calendar days of receipt of the notice to resume work. The request shall set fourth the reasons and support for such adjustment.

Upon receipt, the engineer will evaluate the contractor's request. If the engineer agrees that the cost and/or time required for the performance of the contract has increased as a result of such suspension and the suspension was caused by conditions beyond the control of and not the fault of the contractor, its suppliers, or subcontractors at any approved tier, and not caused by weather, the engineer will make an adjustment (excluding profit) and modify the contract in writing accordingly. The engineer will notify the contractor of his/her determination whether or not an adjustment of the contract is warranted.

No contract adjustment will be allowed unless the contractor has submitted the request for adjustment within the time prescribed.

No contract adjustment will be allowed under this clause to the extent that performance would have been suspended or delayed by any other cause, or for which an adjustment is provided for or excluded under any other term or condition of this contract.

Significant changes in the character of work: The engineer reserves the right to make, in writing, at any time during the work, such changes in quantities and such alterations in the work as are necessary to satisfactorily complete the project. Such changes in quantities and alterations shall not invalidate the contract nor release the surety, and the contractor agrees to perform the work as altered.

If the alterations or changes in quantities significantly change the character of the work under the contract, whether or not changed by any such different quantities or alterations, an adjustment, excluding loss of anticipated profits, will be made to the contract. The basis for the adjustment shall be agreed upon prior to the performance of the work. If a basis cannot be agreed upon, then an adjustment will be made either for or against the contractor in such amount as the engineer may determine to be fair and equitable.

The term "significant change" shall be construed to apply only to the following circumstances:

(A) When the character of the work as altered differs materially in kind or nature from that involved or included in the original proposed construction or

(B) When a major item of work, as defined elsewhere in the contract, is increased in excess of 125 percent or decreased below 75 percent of the original contract quantity. Any allowance for an increase in quantity shall apply only to that portion in excess of 125 percent of original contract item quantity, or in case of a decrease below 75 percent, to the actual amount of work performed.

CONFLICT WITH FEDERAL STATUTES OR REGULATIONS:

Delaware Code, Title 29, Chapter 69, Section 6904, Paragraph (a):

"If any provision of this subchapter conflicts or is inconsistent with any statute, rule or regulation of the federal government applicable to a project or activity, the cost of which is to be paid or reimbursed in whole or in part by the federal government, and due to such conflict or inconsistency the availability of federal funds may be jeopardized, such provision shall not apply to such project or activity."

FEDERAL LABOR AND EMPLOYMENT REQUIREMENTS

Federal Regulation 23 CFR § 635.117(b) Labor and employment, states:

"No procedures or requirement shall be imposed by any State which will operate to discriminate against the employment of labor from any other State, possession or territory of the United States, in the construction of a Federal-aid project."

CONVICT PRODUCED MATERIALS:

(a) Materials produced after July 1, 1991, by convict labor may only be incorporated in a Federal-aid highway construction project if such materials have been:

(1) Produced by convicts who are on parole, supervised release, or probation from a prison or

(2) Produced in a qualified prison facility and the cumulative annual production amount of such materials for use in Federal-aid highway construction does not exceed the amount of such materials produced in such facility for use in Federal-aid highway construction during the 12-month period ending July 1, 1987.

(b) Qualified prison facility means any prison facility in which convicts, during the 12-month period ending July 1, 1987, produced materials for use in Federal-aid highway construction projects.

TO REPORT BID RIGGING ACTIVITIES:

The U. S. Department of Transportation (DOT) operates the below toll-free "hotline" Monday through Friday, 8:00 a.m. to 5:00 p.m. eastern time. Anyone with knowledge of possible bid rigging, bidder collusion, or other fraudulent activities should use the "hotline" to report such activities.

The "hotline" is part of the DOT's continuing effort to identify and investigate highway construction contract fraud and abuse and is operated under the direction of the DOT Inspector General. All information will be treated confidentially and caller anonymity will be respected.

TO REPORT BID RIGGING ACTIVITIES
CALL 1-800-424-9071

NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE ORDER 11246)

1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Specifications" set forth herein.

2. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate work force in each trade on all construction work in the covered area, are as follows:

Goals for Minority Participation In Each Trade	Goals for Female Participation In Each Trade
12.3% (New Castle County) 14.5% (Kent & Sussex Counties)	6.9% (Entire State)

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area. If the contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the contractor also is subject to the goals for both its federally involved and non-federally involved construction.

The Contractor's compliance with the Executive Order and the Executive Order and the regulations in CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order, and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction subcontract in excess of $10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address, and telephone number of the subcontractor; employer identification number of the subcontractor; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed.

4. As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is Sussex County.

REV. 11-3-80

STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY
CONSTRUCTION CONTRACT SPECIFICATIONS (EXECUTIVE ORDER 11246)

1. As used in these specifications:

   a. "Covered area" means the geographical area described in the solicitation from which this contract resulted;
   b. "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;
   c. "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.
   d. "Minority" includes:
      i. Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
      ii. Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);
      iii. Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and
      iv. American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

2. Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of $10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.

3. If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved plan does not excuse any covered Contractor's or Subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

4. The Contractor shall implement the specific affirmative action standards provided in paragraphs 7a through 7p of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered Construction contractors performing construction work in geographical areas where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the Federal Register in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Program Office or from the Federal procurement contracting offices. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.

5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

6. In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

   a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.
   b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.
   c. Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefor, along with whatever additional actions the Contractor may have taken.
   d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.
   e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 7b above.
   f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.
   g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with on-site supervisory personnel such as Superintendents, General Foreman, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.
   h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and Subcontractors with whom the Contractor does or anticipates doing business.
   i. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.
   j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a Contractor's work force.
   k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.

l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.

m. Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.

n. Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

o. Document and maintain a record of all solicitations of offers for subcontractors from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

p. Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

8. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (7a through p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the Contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under 7a through p of these Specifications provided that the Contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female work force participating, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is under utilized).

10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

11. The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Order of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

13. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.

14. The Contractor shall designate a responsible official to monitor all employment-related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government, and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate

of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

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TRAINING SPECIAL PROVISIONS

This Training Special Provision supersedes subparagraph 7b of the Special Provision entitled "Specific Equal Employment Opportunity Responsibilities", (Attachment 1), and is in implementation of 23 U.S.C. 140(a). As part of the contractor's equal employment opportunity affirmative action program, training shall be provided as follows:

The contractor shall provide on-the-job training aimed at developing full journeyman in the type of trade or job classification involved.

The number of trainees to be trained under the special provision will be **1**. In the event the contractor subcontracts a portion of the contract work, he shall determine how many, if any, of the trainees are to be trained by the subcontractor, provided however, that the contractor shall retain the primary responsibility for meeting the training requirements imposed by this special provision. The contractor shall also insure that this Training Special Provision is made applicable to such subcontract. Where feasible, 25 percent of apprentices or trainees in each occupation shall be in their first year apprenticeship or training.

The number of trainees shall be distributed among the work classification on the basis of the contractor's needs and the availability of journeymen in the various classifications within a reasonable area of recruitment. Prior to commencing construction, the contractor shall submit to the Department of Highways and Transportation for approval the number of trainees to be trained in each selected classification and training program to be used. Furthermore, the contractor shall specify the starting time for training in each of the classifications. The contractor will be credited for each trainee employed by him on the contract work who is currently enrolled or becomes enrolled in an approved program and will be reimbursed for such trainees as provided hereinafter.

Training and upgrading of minorities and women toward journeyman status is a primary objective of this Training Special Provision. Accordingly, the contractor shall make every effort to enroll minority trainees and women (e.g., by conducting systematic and direct recruitment through public and private sources likely to yield minority and women trainees) to the extent that such persons are available within a reasonable area of recruitment. The contractor will be responsible for demonstrating the steps that he has taken in pursuance thereof, prior to a determination as to whether the contractor is in compliance with this Training Special Provision. This training commitment is not intended, and not be used, to discriminate against any applicant for training, whether a member of a minority group or not.

No employee shall be employed as a trainee in any classification in which he has successfully completed a training course leading to journeyman status or in which he has been employed as a journeyman. The contractor should satisfy this requirement by including appropriate questions in the employee application or by other suitable means. Regardless of the method used the contractor's records should document the findings in each case.

The minimum length and type of training for each classification will be as established in the training program selected by the contractor and approved by the Department of Highways and Transportation and the Federal Highway Administration. The Department of Highways and Transportation and the Federal Highway Administration shall approve a program if it is reasonably calculated to meet the equal employment opportunity obligations of the contractor and to qualify the average trainee for journeyman status in the classification concerned by the end of the training period. Furthermore, apprenticeship programs registered with the U.S. Department of Labor, Bureau of Apprenticeship and Training, or with a State apprenticeship agency recognized by the Bureau and training programs approved but not necessarily sponsored by the U.S. Department of Labor, Manpower Administration, Bureau of Apprenticeship and Training shall also be considered acceptable provided it is being administered in a manner consistent with the equal employment

obligations of Federal-aid highway construction contracts. Approval or acceptance of a training program shall be obtained from the State prior to commencing work the classification covered by the program. It is the intention of these provisions that the training is to be provided in the construction crafts rather than clerk-typists or secretarial-type positions. Training is permissible in lower level management positions such as office engineers, estimators, timekeepers, etc., where the training is oriented toward construction applications. Training in the laborer classification may be permitted provided that significant and meaningful training is provided and approved by the division office. Some off-site training is permissible as long as the training is an integral part of an approved training program and does not comprise a significant part of the overall training.

Except as otherwise noted below, the contractor will be reimbursed 80 cents per hour of training given an employee on this contract in accordance with an approved training program. As approved by the engineer, reimbursement will be made for training persons in excess of the number specified herein. This reimbursement will be made even though the contractor receives additional training program funds from other sources, provided such other sources does not specifically prohibit the contractor from receiving other reimbursement. Reimbursement for off-site training indicated above may only be made to the contractor where he does one or more of the following and the trainees are concurrently employed on a Federal-aid project; contributes to the cost of the training; provides the instruction of the trainee; or pays the trainee's wages during the off-site training period.

No payment shall be made to the contractor if either the failure to provide the required training, or the failure to hire the trainees as a journeyman, is caused by the contractor and evidences a lack of good faith on the part of the contractor in meeting the requirements of this Training Special Provision. It is normally expected that a trainee will begin his training on the project as soon as feasible after start of work utilizing the skill involved and remain on the project as long as training opportunities exist in his work classification or until he has completed his training program. It is not required that all trainees be on board for the entire length of the contract. A contractor will have fulfilled his responsibilities under this Training Special Provision if he has provided acceptable training to the number of trainees specified. The number trained shall be determined on the basis of the total number enrolled on the contract for a significant period.

Trainees will be paid a least 60 percent of the appropriate minimum journeymen's rate specified in the contract for the first half of the of the training period, 75 percent for the third quarter of the training period, and 90 percent for the last quarter of the training period, unless apprentices or trainees is an approved existing program are enrolled as trainees on this project. In fact case, the appropriate rates approved by the Department of Labor or Transportation in connection with the existing program shall apply to all trainees being trained for the same classification who are covered by this Training Special Provisions.

The contractor shall furnish the trainee a copy of the program he will follow in providing the training.

The contractor shall provide each trainee with a certification showing the type and length of training satisfactorily completed.

The contractor will provide for the maintenance of records and furnish periodic reports documenting his performance under this Training Special Provision.

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INTERMODAL SURFACE TRANSPORTATION EFFICIENCY ACT & TRANSPORTATION EQUITY ACT

Recipients of Federal-aid highway funds authorized under Titles I (other than Part B) and V of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), or Titles I, III, and V of the Transportation Equity Act for the 21st Century (TEA-21) are required to comply with the regulations of 49 Code of Federal Regulations (CFR) Part 26 - Participation by Disadvantaged Business Enterprises in Department of Transportation Financial Assistance Programs.

DISADVANTAGED BUSINESS ENTERPRISE (DBE) PROGRAM SPECIFICATION

The U.S. Department of Transportation (DOT) requires that the Delaware Department of Transportation continue the established Disadvantaged Business Enterprise (DBE) Program for participation in U.S. DOT programs and that the program follow the final rules as stated in 49 CFR Part 26 and the Department's approved DBE Program plan.

The following definitions apply to this subpart:

Disadvantaged Business Enterprise or DBE means a for-profit small business concern (1) that is at least 51 percent owned by one or more individuals who are both socially and economically disadvantaged or, in the case of a corporation, in which 51 percent of the stock is owned by one or more such individuals; and, (2) whose management and daily business operations are controlled by one or more of the socially and economically disadvantaged individuals who own it.

DOT-assisted contract means any contract between a recipient and a contractor (at any tier) funded in whole or in part with DOT financial assistance, including letters of credit or loan guarantees, except a contract solely for the purchase of land.

Good Faith Efforts means efforts to achieve a DBE goal or other requirement of this part which, by their scope, intensity, and appropriateness to the objective, can reasonably be expected to fulfill the program requirement.

Joint Venture means an association of a DBE firm and one or more other firms to carry out a single, for-profit business enterprise, for which the parties combine their property, capital, efforts, skills and knowledge, and in which the DBE is responsible for a distinct, clearly defined portion of the work of the contract and whose share in the capital contribution, control, management, risks, and profits of the joint venture are commensurate with its ownership interest.

Race-conscious measure or program is one that is focused specifically on assisting only DBEs, including women-owned DBEs.

Race-neutral measure or program is one that is, or can be, used to assist all small businesses. For the purposes of this part, race-neutral includes gender neutrality.

Small Business concern means, with respect to firms seeking to participate as DBEs in DOT-assisted contracts, a small business concern as defined pursuant to section 3 of the Small Business Act and Small Business Administration regulations implementing it (13 CFR part 121) that also does not exceed the cap on average annual gross receipts specified in 49 CFR §26.65(b).

Socially and economically disadvantaged individuals means any individual who is a citizen (or lawfully admitted permanent resident) of the United States and who is - (1) any individual who a recipient finds to be a socially and economically disadvantaged individual on a case-by-case basis; (2) any individual in the following groups, members of which are rebuttably presumed to be socially and economically disadvantaged:

(i) Black Americans which includes persons having origins in any of the Black racial groups of Africa;
(ii) Hispanic Americans which includes persons of Mexican, Puerto Rican, Cuban, Dominican, Central or South American, or other Spanish or Portuguese culture or origin, regardless of race;
(iii) Native Americans which includes persons who are American Indians, Eskimos, Aluets, or Native Hawaiians;
(iv) Asian-Pacific Americans which includes persons whose origins are from Japan, China, Taiwan, Korea, Burma (Myanmar), Vietnam, Laos, Cambodia (Kampuchea), Thailand, Malaysia, Indonesia, the Philippines, Brunei, Samoa, Guam, the U.S. Trust Territories of the Pacific Islands (Republic of Palau), the Commonwealth of the Northern Marianas Islands, Macao, Fiji, Tonga, Kirbati, Juvalu, Nauru, Federated States of Micronesia, or Hong Kong;
(v) Subcontinent Asian Americans which includes persons whose origins are from India, Pakistan, Bangladesh, Bhutan, the Maldives Islands, Nepal or Sri Lanka;
(vi) Women;
(vii) Any additional groups whose members are designated as socially and economically disadvantaged by the SBA, at such time as the SBA designation becomes effective.

DelDOT will establish specific goals for each particular DOT-assisted project which will be expressed as a percentage of the total dollar amount of contract bid. The specific contract goals for this contract are:

Disadvantaged Business Enterprise 8 % Percent

DelDOT continues to reserve the right to approve DBE subcontractors and all substitutions of DBE subcontractors prior to award and during the time of the contract.

Bidders are required to submit with their bids the completed DBE Program Assurance portion of the Certification document which will state the bidders intent of meeting the goals established for this contract; or in the instance where a contractor cannot meet the assigned DBE Goals for this contract, he/she shall at the time of bid submit documentation required to verify that he/she has made a Good Faith Effort to meet the DBE Goals. Guidance for submitting a Good Faith Effort is identified in the next section and in the DBE

Program Plan. Further, the apparent low bidder must submit to DelDOT within five (5) calendar days after the bid opening, executed originals of each and every DBE subcontract to satisfy contract goals consistent with the DBE Program Assurance submitted as part of the bid package.

No contract work shall be performed by a DBE subcontractor until the executed DBE subcontract is approved in writing by DelDOT and the Department has issued the required Notice to Proceed. Any DBE subcontract relating to work to be performed pursuant to this contract, which is submitted to DelDOT for approval, must contain all DBE subcontractor information, the requirements contained in this contract, and must be fully executed by the contractor and DBE subcontractor.

Each contract between the prime contractor and each DBE subcontractor shall at the minimum include the following:

1. All pertinent provisions and requirements of the prime contract.
2. Description of the work to be performed by the DBE subcontractor.
3. The dollar value of each item of work to be completed by the DBE subcontractor and the bid price of each item of work to be completed by the DBE subcontractor.

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CRITICAL DBE REQUIREMENTS

A bid may be held to be non-responsive and not considered if the required DBE information is not provided. In addition, the bidder may lose its bidding capability on Department projects and such other sanctions as the Department may impose. It is critical that the bidder understands:

1. In the event that the bidder cannot meet the DBE goal as set forth in this specification, he/she shall at the time of bid submit to the Department that percentage of the DBE Goal that will be met, if any, on the written and notarized assurance made a part of this contract. The contractor shall also at the time of bid submit all documentation that the contractor wishes to have the Department consider in determining that the contractor made a Good Faith Effort to meet contract DBE Goals. The Department will not accept Good Faith Effort documentation other than on the scheduled date and time of the bid opening. However, the Department may ask for clarification of information submitted should the need arise.
2. A bid which does not contain either a completely executed DBE Program Assurance and/or Good Faith Effort documentation, where appropriate, shall be declared non-responsive and shall not be considered by the Department.
3. Failure of the apparent low bidder to present originals of all DBE subcontracts to substantiate the volume of work to be performed by DBE's as indicated in the bid within five (5) calendar days after the bid opening shall create a rebuttable presumption that the bid is not responsive.
4. Bidders are advised that failure to meet DBE Goals during the term of the contract may subject them to Department sanctions as identified in the DBE Program Plan.
5. In the execution of this contract, the successful bidder agrees to comply with the following contract clauses:

   Prompt Payment: The prime contractor/consultant receiving payments shall, within 30 days of receipt of any payment, file a statement with the Department on a form to be determined by the Department that all subcontractors furnishing labor or material have been paid the full sum due them at the stage of the contract, except any funds withheld under the terms of the contract as required by Chapter 8, Title 17 of the Delaware Code, annotated and as amended. Any delay or postponement of payment from the above referenced time frame may occur only for good cause following written approval of DelDOT. This clause applies to both DBE and non-DBE subcontractors.

   Retainage: The prime contractor agrees to return retainage to each subcontractor within 15 calendar days after the subcontractor's work is satisfactorily completed. Any delay or postponement of payment from the above referenced time frame may occur only for good cause following written approval of DelDOT. This clause covers both DBE and non-DBE subcontractors. As guidance, once a subcontractor has satisfactorily completed the physical work, and has given to the prime contractor a certified statement that all laborers, lower tier contractors, and materialmen who have furnished labor and materials to the subcontractor have been paid all monies due them, the prime contractor shall return retainage to the subcontractor within 15 calendar days.

6. In the execution of this contract, the successful bidder agrees to comply with the following contract assurance and will include this same language in each subcontractor contract:

   "The contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such remedy as the recipient deems appropriate." 49 CFR Section 26.13

7. In addition to this specification, bidders must comply with all provisions of the rules and regulations adopted by the U.S. Department of Transportation for DBE participation in U.S. DOT and DelDOT Programs (49 CFR Part 26) and the Delaware Department of Transportation Disadvantaged Business Enterprise Program Plan; each of which is hereby incorporated and made part of this specification. Bidders are also reminded that they must be responsible and responsive bidders in all other aspects aside from the DBE Program in order to be awarded the contract.

8. In accordance with 49 CFR 26.53(f)(1), DelDOT requires that a prime contractor not terminate a DBE subcontractor without prior written consent from the DelDOT Civil Rights Office. This includes, but is not limited to, instances in which a prime contractor seeks to perform work originally designated for a DBE subcontractor with its own forces or those of an affiliate, a non-DBE firm, or with another DBE firm.

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GUIDANCE FOR GOOD FAITH EFFORT

When the DBE Goals established for a contract by DelDOT are not met, the contractor shall demonstrate good faith efforts to meet the DBE contract goals. The contractor shall demonstrate that the efforts made were those that a contractor actively and aggressively seeking to meet the goals established by DelDOT would make, given all relevant circumstances. Evidence of this good faith effort will be submitted with the bid at the time of the bid opening.

The contractor is expected to demonstrate good faith efforts by actively and aggressively seeking out DBE participation in the project to the maximum extent, given all relevant circumstances. Following are the kinds of efforts that may be taken but are not deemed to be exclusive or exhaustive and DelDOT will consider other factors and types of efforts that may be relevant:

1. Efforts made to select portions of the work proposed to be performed by DBEs in order to increase the likelihood of achieving the stated goal. Selection of portions of work are required to at least equal the goal for DBE utilization specified in this contract.

2. Written notification at least ten (10) calendar days prior to the opening of a bid soliciting DBE interest in participating in the contract as a subcontractor or supplier and for specific items of work.

3. Efforts made to obtain and negotiate with DBE firms for specific items of work:

   a. Description of the means by which firms were solicited (i.e. by telephone, e-mail, written notice, advertisement).
   b. The names, addresses, telephone numbers of DBE's contacted, the dates of initial contact; and whether initial solicitations of interest were followed-up by contacting the DBEs to determine with certainty whether the DBEs were interested.
   c. A description of the information provided to DBE firms regarding the plans, specifications and estimated quantities for portions of the work to be performed.
   d. A statement of why additional agreements with DBE's were not reached in order to meet the projected goal.
   e. Listing of each DBE contacted but not contracted and the reasons for not entering a contract.

4. Efforts made to assist DBEs that need assistance in obtaining bonding, insurance, or lines of credit required by the contractor.

5. Reasons why certified DBEs are not available or not interested.

6. Efforts to effectively use the services of available disadvantaged community organizations; disadvantaged contractor's groups; local, state and federal DBE assistance offices; and other organizations that provide assistance in recruitment and placement of DBEs.

The following are examples of actions that may not be used as justification by the contractor for failure to meet DBE contract goals:

1. Failure to contract with a DBE solely because the DBE was unable to provide performance and/or payment bonds.
2. Rejection of a DBE bid or quotation based on price alone.
3. Rejection of a DBE because of its union or non-union status.
4. Failure to contract with a DBE because the contractor normally would perform all or most of the work in the contract.

Administrative reconsideration:

Within five (5) days of being informed by DelDOT that it is not responsive because it has not documented sufficient good faith efforts, a bidder may request administrative reconsideration. Bidder should make this request in writing to the following reconsideration official: Director of Finance, DelDOT,800 Bay Road, Dover, Delaware 19901, and Email a copy to dot-ask@state.de.us. The reconsideration official will not have played any role in the original determination that the bidder did not document sufficient good faith efforts.

As part of this reconsideration, the bidder will have the opportunity to provide written documentation or argument concerning the issue of whether it met the goal or made adequate good faith efforts to do so. The bidder will have the opportunity to meet in person with the reconsideration official, explaining the basis for finding that the bidder did or did not meet the goal or make adequate good faith efforts to do so. The final decision made by the reconsideration official will be communicated to the bidder in writing. The result of the reconsideration process is not administratively appealable to the U.S. Department of Transportation.

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REQUIRED CONTRACT PROVISIONS - FEDERAL-AID CONSTRUCTION CONTRACTS
(Exclusive of Appalachian Contracts)

FHWA-1273 -- Revised May 1, 2012 http://www.fhwa.dot.gov/programadmin/contracts/1273/1273.docx

I. General
II. Nondiscrimination
III. Nonsegregated Facilities
IV. Davis-Bacon and Related Act Provisions
V. Contract Work Hours and Safety Standards Act Provisions
VI. Subletting or Assigning the Contract
VII. Safety: Accident Prevention
VIII. False Statements Concerning Highway Projects
IX. Implementation of Clean Air Act and Federal Water Pollution Control Act
X. Compliance with Governmentwide Suspension and Debarment Requirements
XI. Certification Regarding Use of Contract Funds for Lobbying

I. GENERAL

1. Form FHWA-1273 must be physically incorporated in each construction contract funded under Title 23 (excluding emergency contracts solely intended for debris removal). The contractor (or subcontractor) must insert this form in each subcontract and further require its inclusion in all lower tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services).

   The applicable requirements of Form FHWA-1273 are incorporated by reference for work done under any purchase order, rental agreement or agreement for other services. The prime contractor shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

   Form FHWA-1273 must be included in all Federal-aid design-build contracts, in all subcontracts and in lower tier subcontracts (excluding subcontracts for design services, purchase orders, rental agreements and other agreements for supplies or services). The design-builder shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

   Contracting agencies may reference Form FHWA-1273 in bid proposal or request for proposal documents, however, the Form FHWA-1273 must be physically incorporated (not referenced) in all contracts, subcontracts and lower-tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services related to a construction contract).

2. Subject to the applicability criteria noted in the following sections, these contract provisions shall apply to all work performed on the contract by the contractor's own organization and with the assistance of workers under the contractor's immediate superintendence and to all work performed on the contract by piecework, station work, or by subcontract.

3. A breach of any of the stipulations contained in these Required Contract Provisions may be sufficient grounds for withholding of progress payments, withholding of final payment, termination of the contract, suspension / debarment or any other action determined to be appropriate by the contracting agency and FHWA.

4. Selection of Labor: During the performance of this contract, the contractor shall not use convict labor for any purpose within the limits of a construction project on a Federal-aid highway unless it is labor performed by convicts who are on parole, supervised release, or probation. The term Federal-aid highway does not include roadways functionally classified as local roads or rural minor collectors.

II. NONDISCRIMINATION

The provisions of this section related to 23 CFR Part 230 are applicable to all Federal-aid construction contracts and to all related construction subcontracts of $10,000 or more. The provisions of 23 CFR Part 230 are not applicable to material supply, engineering, or architectural service contracts.

In addition, the contractor and all subcontractors must comply with the following policies: Executive Order 11246, 41 CFR 60, 29 CFR 1625-1627, Title 23 USC Section 140, the Rehabilitation Act of 1973, as amended (29 USC 794), Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The contractor and all subcontractors must comply with: the requirements of the Equal Opportunity Clause in 41 CFR 60-1.4(b) and, for all construction contracts exceeding $10,000, the Standard Federal Equal Employment Opportunity Construction Contract Specifications in 41 CFR 60-4.3.

Note: The U.S. Department of Labor has exclusive authority to determine compliance with Executive Order 11246 and the policies of the Secretary of Labor including 41 CFR 60, and 29 CFR 1625-1627. The contracting agency and the FHWA have the authority and the responsibility to ensure compliance with Title 23 USC Section 140, the Rehabilitation Act of 1973, as amended (29 USC 794), and Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The following provision is adopted from 23 CFR 230, Appendix A, with appropriate revisions to conform to the U.S. Department of Labor (US DOL) and FHWA requirements.

1. Equal Employment Opportunity: Equal employment opportunity (EEO) requirements not to discriminate and to take affirmative action to assure equal opportunity as set forth under laws, executive orders, rules, regulations (28 CFR 35, 29 CFR 1630, 29 CFR 1625-1627, 41 CFR 60 and 49 CFR 27) and orders of the Secretary of Labor as modified by the provisions prescribed herein, and imposed pursuant to 23 U.S.C. 140 shall constitute the EEO and specific affirmative action standards for the contractor's project activities under this contract. The provisions of the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et seq.) set forth under 28 CFR 35 and 29 CFR 1630 are incorporated by reference in this contract. In the execution of this contract, the contractor agrees to comply with the following minimum specific requirement activities of EEO:

    a. The contractor will work with the contracting agency and the Federal Government to ensure that it has made every good faith effort to provide equal opportunity with respect to all of its terms and conditions of employment and in their review of activities under the contract.

    b. The contractor will accept as its operating policy the following statement:
    "It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, color, national origin, age or disability. Such action shall include: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship, pre-apprenticeship, and/or on-the-job training."

2. EEO Officer: The contractor will designate and make known to the contracting officers an EEO Officer who will have the responsibility for and must be capable of effectively administering and promoting an active EEO program and who must be assigned adequate authority and responsibility to do so.

3. Dissemination of Policy: All members of the contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, will be made fully cognizant of, and will implement, the contractor's EEO policy and contractual responsibilities to provide EEO in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:

    a. Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the contractor's EEO policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer.

    b. All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer, covering all major aspects of the contractor's EEO obligations within thirty days following their reporting for duty with the contractor.

    c. All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer in the contractor's procedures for locating and hiring minorities and women.

d. Notices and posters setting forth the contractor's EEO policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.

e. The contractor's EEO policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

4. Recruitment: When advertising for employees, the contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be placed in publications having a large circulation among minorities and women in the area from which the project work force would normally be derived.

   a. The contractor will, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minorities and women. To meet this requirement, the contractor will identify sources of potential minority group employees, and establish with such identified sources procedures whereby minority and women applicants may be referred to the contractor for employment consideration.

   b. In the event the contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, the contractor is expected to observe the provisions of that agreement to the extent that the system meets the contractor's compliance with EEO contract provisions. Where implementation of such an agreement has the effect of discriminating against minorities or women, or obligates the contractor to do the same, such implementation violates Federal nondiscrimination provisions.

   c. The contractor will encourage its present employees to refer minorities and women as applicants for employment. Information and procedures with regard to referring such applicants will be discussed with employees.

5. Personnel Actions: Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race, color, religion, sex, national origin, age or disability. The following procedures shall be followed:

   a. The contractor will conduct periodic inspections of project sites to insure that working conditions and employee facilities do not indicate discriminatory treatment of project site personnel.
   b. The contractor will periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.

   c. The contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.

   d. The contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with its obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the contractor will inform every complainant of all of their avenues of appeal.

6. Training and Promotion:

   a. The contractor will assist in locating, qualifying, and increasing the skills of minorities and women who are applicants for employment or current employees. Such efforts should be aimed at developing full journey level status employees in the type of trade or job classification involved.

   b. Consistent with the contractor's work force requirements and as permissible under Federal and State regulations, the contractor shall make full use of training programs, i.e., apprenticeship, and on-the-job training programs for the geographical area of contract performance. In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision. The contracting agency may reserve training positions for persons who receive welfare assistance in accordance with 23 U.S.C. 140(a).

c. The contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.

d. The contractor will periodically review the training and promotion potential of employees who are minorities and women and will encourage eligible employees to apply for such training and promotion.

7. Unions: If the contractor relies in whole or in part upon unions as a source of employees, the contractor will use good faith efforts to obtain the cooperation of such unions to increase opportunities for minorities and women. Actions by the contractor, either directly or through a contractor's association acting as agent, will include the procedures set forth below:

   a. The contractor will use good faith efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minorities and women for membership in the unions and increasing the skills of minorities and women so that they may qualify for higher paying employment.

   b. The contractor will use good faith efforts to incorporate an EEO clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their race, color, religion, sex, national origin, age or disability.

   c. The contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the contractor, the contractor shall so certify to the contracting agency and shall set forth what efforts have been made to obtain such information.

   d. In the event the union is unable to provide the contractor with a reasonable flow of referrals within the time limit set forth in the collective bargaining agreement, the contractor will, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, national origin, age or disability; making full efforts to obtain qualified and/or qualifiable minorities and women. The failure of a union to provide sufficient referrals (even though it is obligated to provide exclusive referrals under the terms of a collective bargaining agreement) does not relieve the contractor from the requirements of this paragraph. In the event the union referral practice prevents the contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such contractor shall immediately notify the contracting agency.

8. Reasonable Accommodation for Applicants / Employees with Disabilities: The contractor must be familiar with the requirements for and comply with the Americans with Disabilities Act and all rules and regulations established there under. Employers must provide reasonable accommodation in all employment activities unless to do so would cause an undue hardship.

9. Selection of Subcontractors, Procurement of Materials and Leasing of Equipment: The contractor shall not discriminate on the grounds of race, color, religion, sex, national origin, age or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment. The contractor shall take all necessary and reasonable steps to ensure nondiscrimination in the administration of this contract.

   a. The contractor shall notify all potential subcontractors and suppliers and lessors of their EEO obligations under this contract.

   b. The contractor will use good faith efforts to ensure subcontractor compliance with their EEO obligations.

10. Assurance Required by 49 CFR 26.13(b):

    a. The requirements of 49 CFR Part 26 and the State DOT's U.S. DOT-approved DBE program are incorporated by reference.

    b. The contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the contracting agency deems appropriate.

11. Records and Reports: The contractor shall keep such records as necessary to document compliance with the EEO requirements. Such records shall be retained for a period of three years following the date of the final payment to the contractor for all contract work and shall be available at reasonable times and places for inspection by authorized representatives of the contracting agency and the FHWA.

    a. The records kept by the contractor shall document the following:

        (1) The number and work hours of minority and non-minority group members and women employed in each work classification on the project;

        (2) The progress and efforts being made in cooperation with unions, when applicable, to increase employment opportunities for minorities and women; and

        (3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minorities and women;

    b. The contractors and subcontractors will submit an annual report to the contracting agency each July for the duration of the project, indicating the number of minority, women, and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on Form FHWA-1391. The staffing data should represent the project work force on board in all or any part of the last payroll period preceding the end of July. If on-the-job training is being required by special provision, the contractor will be required to collect and report training data. The employment data should reflect the work force on board during all or any part of the last payroll period preceding the end of July.

III. NONSEGREGATED FACILITIES

This provision is applicable to all Federal-aid construction contracts and to all related construction subcontracts of $10,000 or more.

The contractor must ensure that facilities provided for employees are provided in such a manner that segregation on the basis of race, color, religion, sex, or national origin cannot result. The contractor may neither require such segregated use by written or oral policies nor tolerate such use by employee custom. The contractor's obligation extends further to ensure that its employees are not assigned to perform their services at any location, under the contractor's control, where the facilities are segregated. The term "facilities" includes waiting rooms, work areas, restaurants and other eating areas, time clocks, restrooms, washrooms, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing provided for employees. The contractor shall provide separate or single-user restrooms and necessary dressing or sleeping areas to assure privacy between sexes.

IV. DAVIS-BACON AND RELATED ACT PROVISIONS

This section is applicable to all Federal-aid construction projects exceeding $2,000 and to all related subcontracts and lower-tier subcontracts (regardless of subcontract size). The requirements apply to all projects located within the right-of-way of a roadway that is functionally classified as Federal-aid highway. This excludes roadways functionally classified as local roads or rural minor collectors, which are exempt. Contracting agencies may elect to apply these requirements to other projects.

The following provisions are from the U.S. Department of Labor regulations in 29 CFR 5.5 “Contract provisions and related matters” with minor revisions to conform to the FHWA-1273 format and FHWA program requirements.

1. Minimum wages

    a. All laborers and mechanics employed or working upon the site of the work, will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph 1.d. of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph 1.b. of this section) and the Davis-Bacon poster (WH–1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

b. (1) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

   (i) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

   (ii) The classification is utilized in the area by the construction industry; and

   (iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

   (2) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

   (3) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Wage and Hour Administrator for determination. The Wage and Hour Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

   (4) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs 1.b.(2) or 1.b.(3) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

c. Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

d. If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

2. Withholding

The contracting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract, or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the contracting agency may, after written notice to the contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

3. Payrolls and basic records

a. Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

b. (1) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the contracting agency. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g. , the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH–347 is available for this purpose from the Wage and Hour Division Web site at http://www.dol.gov/esa/whd/forms/wh347instr.htm or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the contracting agency for transmission to the State DOT, the FHWA or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the contracting agency.

(2) Each payroll submitted shall be accompanied by a “Statement of Compliance,” signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(i) That the payroll for the payroll period contains the information required to be provided under §5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under §5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(ii) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(3) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH–347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph 3.b.(2) of this section.

(4) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

c. The contractor or subcontractor shall make the records required under paragraph 3.a. of this section available for inspection, copying, or transcription by authorized representatives of the contracting agency, the State DOT, the FHWA, or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the FHWA may, after written notice to the contractor, the contracting agency or the State DOT, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

4. Apprentices and trainees

a. Apprentices (programs of the USDOL).

Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice.

The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed.

Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination.

In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

b. Trainees (programs of the USDOL).

Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration.

The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration.

Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed.

In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

c. Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

d. Apprentices and Trainees (programs of the U.S. DOT).
Apprentices and trainees working under apprenticeship and skill training programs which have been certified by the Secretary of Transportation as promoting EEO in connection with Federal-aid highway construction programs are not subject to the requirements of paragraph 4 of this Section IV. The straight time hourly wage rates for apprentices and trainees under such programs will be established by the particular programs. The ratio of apprentices and trainees to journeymen shall not be greater than permitted by the terms of the particular program.

5. Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

6. Subcontracts. The contractor or subcontractor shall insert Form FHWA-1273 in any subcontracts and also require the subcontractors to include Form FHWA-1273 in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

7. Contract termination: debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

8. Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

9. Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

10. Certification of eligibility.

    a. By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

    b. No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

    c. The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

V. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT

The following clauses apply to any Federal-aid construction contract in an amount in excess of $100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by 29 CFR 5.5(a) or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

1. Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

2. Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (1.) of this section, the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1.) of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1.) of this section.

3. Withholding for unpaid wages and liquidated damages. The FHWA or the contacting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2.) of this section.

4. Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (1.) through (4.) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (1.) through (4.) of this section.

VI. SUBLETTING OR ASSIGNING THE CONTRACT

This provision is applicable to all Federal-aid construction contracts on the National Highway System.

1. The contractor shall perform with its own organization contract work amounting to not less than 30 percent (or a greater percentage if specified elsewhere in the contract) of the total original contract price,

excluding any specialty items designated by the contracting agency. Specialty items may be performed by subcontract and the amount of any such specialty items performed may be deducted from the total original contract price before computing the amount of work required to be performed by the contractor's own organization (23 CFR 635.116).

a. The term "perform work with its own organization" refers to workers employed or leased by the prime contractor, and equipment owned or rented by the prime contractor, with or without operators. Such term does not include employees or equipment of a subcontractor or lower tier subcontractor, agents of the prime contractor, or any other assignees. The term may include payments for the costs of hiring leased employees from an employee leasing firm meeting all relevant Federal and State regulatory requirements. Leased employees may only be included in this term if the prime contractor meets all of the following conditions:

   (1) the prime contractor maintains control over the supervision of the day-to-day activities of the leased employees;

   (2) the prime contractor remains responsible for the quality of the work of the leased employees;

   (3) the prime contractor retains all power to accept or exclude individual employees from work on the project; and

   (4) the prime contractor remains ultimately responsible for the payment of predetermined minimum wages, the submission of payrolls, statements of compliance and all other Federal regulatory requirements.

b. "Specialty Items" shall be construed to be limited to work that requires highly specialized knowledge, abilities, or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid or propose on the contract as a whole and in general are to be limited to minor components of the overall contract.

2. The contract amount upon which the requirements set forth in paragraph (1) of Section VI is computed includes the cost of material and manufactured products which are to be purchased or produced by the contractor under the contract provisions.

3. The contractor shall furnish (a) a competent superintendent or supervisor who is employed by the firm, has full authority to direct performance of the work in accordance with the contract requirements, and is in charge of all construction operations (regardless of who performs the work) and (b) such other of its own organizational resources (supervision, management, and engineering services) as the contracting officer determines is necessary to assure the performance of the contract.

4. No portion of the contract shall be sublet, assigned or otherwise disposed of except with the written consent of the contracting officer, or authorized representative, and such consent when given shall not be construed to relieve the contractor of any responsibility for the fulfillment of the contract. Written consent will be given only after the contracting agency has assured that each subcontract is evidenced in writing and that it contains all pertinent provisions and requirements of the prime contract.

5. The 30% self-performance requirement of paragraph (1) is not applicable to design-build contracts; however, contracting agencies may establish their own self-performance requirements.

VII. SAFETY: ACCIDENT PREVENTION

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

1. In the performance of this contract the contractor shall comply with all applicable Federal, State, and local laws governing safety, health, and sanitation (23 CFR 635). The contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions as it determines, or as the contracting officer may determine, to be reasonably necessary to protect the life and health of employees on the job and the safety of the public and to protect property in connection with the performance of the work covered by the contract.

2. It is a condition of this contract, and shall be made a condition of each subcontract, which the contractor enters into pursuant to this contract, that the contractor and any subcontractor shall not permit any employee, in performance of the contract, to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his/her health or safety, as determined under construction safety and health standards (29 CFR 1926) promulgated by the Secretary of Labor, in accordance with Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704).

3. Pursuant to 29 CFR 1926.3, it is a condition of this contract that the Secretary of Labor or authorized representative thereof, shall have right of entry to any site of contract performance to inspect or investigate the matter of compliance with the construction safety and health standards and to carry out the duties of the Secretary under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C.3704).

VIII. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

In order to assure high quality and durable construction in conformity with approved plans and specifications and a high degree of reliability on statements and representations made by engineers, contractors, suppliers, and workers on Federal-aid highway projects, it is essential that all persons concerned with the project perform their functions as carefully, thoroughly, and honestly as possible. Willful falsification, distortion, or misrepresentation with respect to any facts related to the project is a violation of Federal law. To prevent any misunderstanding regarding the seriousness of these and similar acts, Form FHWA-1022 shall be posted on each Federal-aid highway project (23 CFR 635) in one or more places where it is readily available to all persons concerned with the project:

18 U.S.C. 1020 reads as follows:

"Whoever, being an officer, agent, or employee of the United States, or of any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of the work performed or to be performed, or the cost thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction on any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever knowingly makes any false statement, false representation, false report or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to material fact in any statement, certificate, or report submitted pursuant to provisions of the Federal-aid Roads Act approved July 1, 1916, (39 Stat. 355), as amended and supplemented;

Shall be fined under this title or imprisoned not more than 5 years or both."

IX. IMPLEMENTATION OF CLEAN AIR ACT AND FEDERAL WATER POLLUTION CONTROL ACT

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

By submission of this bid/proposal or the execution of this contract, or subcontract, as appropriate, the bidder, proposer, Federal-aid construction contractor, or subcontractor, as appropriate, will be deemed to have stipulated as follows:

1. That any person who is or will be utilized in the performance of this contract is not prohibited from receiving an award due to a violation of Section 508 of the Clean Water Act or Section 306 of the Clean Air Act.
2. That the contractor agrees to include or cause to be included the requirements of paragraph (1) of this Section X in every subcontract, and further agrees to take such action as the contracting agency may direct as a means of enforcing such requirements.

X. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

This provision is applicable to all Federal-aid construction contracts, design-build contracts, subcontracts, lower-tier subcontracts, purchase orders, lease agreements, consultant contracts or any other covered transaction requiring FHWA approval or that is estimated to cost $25,000 or more – as defined in 2 CFR Parts 180 and 1200.

1. **Instructions for Certification – First Tier Participants:**

   a. By signing and submitting this proposal, the prospective first tier participant is providing the certification set out below.

   b. The inability of a person to provide the certification set out below will not necessarily result in denial of participation in this covered transaction. The prospective first tier participant shall submit an explanation of why it cannot provide the certification set out below. The certification or explanation will be considered in connection with the department or agency's determination whether to enter into this transaction. However, failure of the prospective first tier participant to furnish a certification or an explanation shall disqualify such a person from participation in this transaction.

   c. The certification in this clause is a material representation of fact upon which reliance was placed when the contracting agency determined to enter into this transaction. If it is later determined that the prospective participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the contracting agency may terminate this transaction for cause of default.

   d. The prospective first tier participant shall provide immediate written notice to the contracting agency to whom this proposal is submitted if any time the prospective first tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

   e. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. “First Tier Covered Transactions” refers to any covered transaction between a grantee or subgrantee of Federal funds and a participant (such as the prime or general contract). “Lower Tier Covered Transactions” refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). “First Tier Participant” refers to the participant who has entered into a covered transaction with a grantee or subgrantee of Federal funds (such as the prime or general contractor). “Lower Tier Participant” refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

   f. The prospective first tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency entering into this transaction.

   g. The prospective first tier participant further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transactions," provided by the department or contracting agency, entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the $25,000 threshold.

   h. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (https://www.epls.gov/), which is compiled by the General Services Administration.

   i. Nothing contained in the foregoing shall be construed to require the establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and

information of the prospective participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

j. Except for transactions authorized under paragraph (f) of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause or default.

* * * * *

2. **Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – First Tier Participants**:

a. The prospective first tier participant certifies to the best of its knowledge and belief, that it and its principals:

(1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency;

(2) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (a)(2) of this certification; and

(4) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

b. Where the prospective participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

2. Instructions for Certification - Lower Tier Participants:

(Applicable to all subcontracts, purchase orders and other lower tier transactions requiring prior FHWA approval or estimated to cost $25,000 or more - 2 CFR Parts 180 and 1200)

a. By signing and submitting this proposal, the prospective lower tier is providing the certification set out below.

b. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department, or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

c. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous by reason of changed circumstances.

d. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations. “First Tier Covered Transactions” refers to any covered transaction between a grantee or subgrantee of Federal funds and a participant (such as the prime or general contract). “Lower Tier Covered Transactions” refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). “First Tier Participant” refers to the participant who has entered into a covered transaction with a grantee or subgrantee of Federal funds (such as the prime or general contractor).

"Lower Tier Participant" refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

e. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.

f. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the $25,000 threshold.

g. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (https://www.epls.gov/), which is compiled by the General Services Administration.

h. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

i. Except for transactions authorized under paragraph e of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

* * * * *

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier Participants:

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency.

2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

* * * * *

XI. CERTIFICATION REGARDING USE OF CONTRACT FUNDS FOR LOBBYING

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts which exceed $100,000 (49 CFR 20).

1. The prospective participant certifies, by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

   a. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

b. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

2. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.
3. The prospective participant also agrees by submitting its bid or proposal that the participant shall require that the language of this certification be included in all lower tier subcontracts, which exceed $100,000 and that all such recipients shall certify and disclose accordingly.

* * * * *

CARGO PREFERENCE ACT
Requirements in the Federal-aid Highway Program

(a) Agreement Clauses. "Use of United States-flag vessels:
(1) Pursuant to Pub. L. 664 (43 U.S.C. 1241(b)) at least 50 percent of any equipment, materials or commodities procured, contracted for or otherwise obtained with funds granted, guaranteed, loaned, or advanced by the U.S. Government under this agreement, and which may be transported by ocean vessel, shall be transported on privately owned United States-flag commercial vessels, if available.

(2) Within 20 days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, 'on-board' commercial ocean bill-of-lading in English for each shipment of cargo described in paragraph (a)(1) of this section shall be furnished to both the Contracting Officer (through the prime contractor in the case of subcontractor bills-of-lading) and to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590.

(b) Contractor and Subcontractor Clauses. "Use of United States-flag vessels: The contractor agrees—
(1) To utilize privately owned United States-flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to this contract, to the extent such vessels are available at fair and reasonable rates for United States-flag commercial vessels.

(2) To furnish within 20 days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, 'on-board' commercial ocean bill-of-lading in English for each shipment of cargo described in paragraph (b) (1) of this section to both the Contracting Officer (through the prime contractor in the case of subcontractor bills-of-lading) and to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590.

(3) To insert the substance of the provisions of this clause in all subcontracts issued pursuant to this contract.

NOTE:
This requirement applies to material or equipment that is acquired for a specific Federal-aid highway project. It is not applicable to goods or materials that come into inventories independent of an FHWA funded-contract.

* * * * *

BUY AMERICA
Requirements in the Federal-aid Highway Program

By signing and submitting this proposal, the bidder certifies that:

In accordance with 23 U.S.C, 313 and 23 CFR 635.410, all iron and steel materials permanently incorporated into this project will be produced in the United States and that all manufacturing processes involving these materials will occur in the U.S, except that a minimal amount of foreign steel or iron materials may be used, provided the cost of the foreign materials does not exceed 0.1 percent of the total Contract cost or $2,500.00, whichever is greater. If such minimal amount of foreign steel is used, the Contractor shall maintain a record of the costs to ensure that the allowable limit is not exceeded. This documentation shall be presented to the Department upon request.

At the Department's request, I/we will provide manufacturer's/supplier's documentation verifying domestic origin as defined in the Specifications. All Materials accepted on the basis of such Certificate of Compliance may be sampled by the Department and tested at any time. Use of Material on the basis of Certificate of Compliance shall not relieve the Contractor of responsibility for incorporating Material in the Project conforming to the requirements of the Contract. Any Material not conforming to such requirements will be subject to rejection whether in place or not. The Department reserves the right to refuse to permit the use of Material on the basis of Certificate of Compliance.

* * * * *

APPENDICES TO THE TITLE VI ASSURANCE

APPENDIX A

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the "contractor") agrees as follows:

1. Compliance with Regulations: The contractor (hereinafter includes consultants) will comply with the Acts and the Regulations relative to Non-discrimination in Federally-assisted programs of the U.S. Department of Transportation, (Federal Highway Administration (FHWA), or Federal Transit Authority (FTA), as they may be amended from time to time, which are herein incorporated by reference and made a part of this contract.
2. Non-discrimination: The contractor, with regard to the work performed by it during the contract, will not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The contractor will not participate directly or indirectly in the discrimination prohibited by the Acts and the Regulations, including employment practices when the contract covers any activity, project, or program set forth in Appendix B of 49 CFR Part 21.
3. Solicitations for Subcontracts, Including Procurements of Materials and Equipment: In all solicitations, either by competitive bidding, or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials, or leases of equipment, each potential subcontractor or supplier will be notified by the contractor of the contractor's obligations under this contract and the Acts and the Regulations relative to Non-discrimination on the grounds of race, color, or national origin.
4. Information and Reports: The contractor will provide all information and reports required by the Acts and the Regulations, and will permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Recipient or the Federal Highway Administration (FHWA), or Federal Transit Authority (FTA) to be pertinent to ascertain compliance with such Acts, Regulations, and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish the information, the contractor will so certify to the Recipient or the Federal Highway Administration (FHWA), or Federal Transit Authority (FTA), as appropriate, and will set forth what efforts ithas made to obtain the information.
5. Sanctions for Noncompliance: In the event of a contractor's noncompliance with the Non-discrimination provisions of this contract, the Recipient will impose such contract sanctions as it or the Federal Highway Administration (FHWA), or Federal Transit Authority (FTA) may determine to be appropriate, including, but not limited to:
   withholding payments to the contractor under the contract until the contractor complies;
   and/or cancelling, terminating, or suspending a contract, in whole or in part.
6. Incorporation of Provisions: The contractor will include the provisions of paragraphs one through five in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts and the Regulations . The contractor will take action with respect to any subcontract or procurement as the Recipient or the Federal Highway Administration (FHWA), or Federal Transit Authority (FTA) may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if the contractor becomes involved in, or is threatened with litigation by a subcontractor, or supplier because of such direction, the contractor may request the Recipient to enter into any litigation to protect the interests of the Recipient. In addition, the contractor may request the United States to enter into the litigation to protect the interests of the United States.

APPENDIX E

During the performance of this contract, the contractor or consultant, for itself, its assignees, and successors in interest (hereinafter referred to as the "contractor") agrees to comply with the following nondiscrimination statutes and authorities; including but not limited to:

Pertinent Non-Discrimination Authorities:

Title VI of the Civil Rights Act of 1964 (42 U.S.C. $ 2000d et seq., 78 stat. 252), (prohibits discrimination on the basis of race, color, national origin); and 49 CFR Part 21.

The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970,(42 U.S.C. $ 460 I), (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);

Federal-Aid Highway Act of 1973, (23 U.S.C. $ 324 et seq.), (prohibits discrimination on the basis of sex);

Section 504 of the Rehabilitation Act of 1973, (29 U.S.C. $ 794 et seq.), as amended, (prohibits discrimination on the basis of disability); and 49 CFR Part27;

The Age Discrimination Act of 1975, as amended, (42 U.S.C. $ 6101 et seq.), (prohibits discrimination on the basis of age);

Airport and Airway Improvement Act of 1982,(49 USC $471, Section 47123), as amended, (prohibits discrimination based on race, creed, color, national origin, or sex);

The Civil Rights Restoration Act of 1987,(PL 100-209), (Broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of l964,The AgeDiscrimination Act of 1975and Section 504 of the Rehabilitation Act of l973,by expanding the defrnition of the terms "programs or activities" to include all of the programs or activities of the Federal-aid recipients, sub-recipients and contractors, whether such programs or activities are Federally funded or not);

Titles II and III of the Americans with Disabilities Act, which prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities (42 U.S.C. $$ 12131 - 12189) as implemented by Department of Transportation regulations at 49 C.F.R. parts 37 and 38;

The Federal Aviation Administration's Non-discrimination statute (49 U.S.C. S 41123) (prohibits discrimination on the basis of race, color, national origin, and sex);

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which ensures nondiscrimination against minority populations by discouraging programs; policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations;

Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to ensure that LEP persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100);

Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 U.S.C. 1681 et seq).

* * * * *

PREVAILING WAGES

Included in this proposal are the minimum wages to be paid various classes of laborers and mechanics as determined by the Department of Labor of the State of Delaware in accordance with Title 29 Del.C. §6960, relating to wages and the regulations implementing that Section.

REQUIREMENT BY DEPARTMENT OF LABOR FOR SWORN PAYROLL INFORMATION

Title 29 Del.C. §6960 stipulates;

> (b) Every contract based upon these specifications shall contain a stipulation that the employer shall pay all mechanics and laborers employed directly upon the site of the work, unconditionally and not less often than once a week and without subsequent deduction or rebate on any account, the full amounts accrued at time of payment, computed at wage rates not less than those stated in the specifications, regardless of any contractual relationship which may be alleged to exist between the employer and such laborers and mechanics. The specifications shall further stipulate that the scale of wages to be paid shall be posted by the employer in a prominent and easily accessible place at the site of the work, and that there may be withheld from the employer so much of accrued payments as may be considered necessary by the Department of Labor to pay to laborers and mechanics employed by the employer the difference between the rates of wages required by the contract to be paid laborers and mechanics on the work and rates of wages received by such laborers and mechanics to be remitted to the Department of Labor for distribution upon resolution of any claims.
>
> (c) Every contract based upon these specifications shall contain a stipulation that sworn payroll information, as required by the Department of Labor, be furnished weekly. The Department of Labor shall keep and maintain the sworn payroll information for a period of 6 months from the last day of the work week covered by the payroll.

Bidders are specifically directed to note the Department of Labor's prevailing wage regulations implementing §6960 relating to the effective date of the wage rates, at Part VI., Section C., which in relevant part states:

> "Public agencies (covered by the provisions of 29 Del.C. §6960) are required to use the rates which are in effect on the date of the publication of specifications for a given project. In the event that a contract is not executed within one hundred twenty (120) days from the date the specifications were published, the rates in effect at the time of the execution of the contract shall be the applicable rates for the project."

PREVAILING WAGE REQUIREMENTS

It is DelDOT's understanding that the Davis-Bacon Act is not a preemptive statute in the broad sense, and does not preempt or displace State of Delaware prevailing wage requirements.

When a contract for a project contains both Federal Davis-Bacon and State of Delaware prevailing wage standards because of concurrent Federal and State coverage, the employer's minimum wage obligations are determined by whichever standards are higher.

STATE OF DELAWARE
DEPARTMENT OF LABOR
DIVISION OF INDUSTRIAL AFFAIRS
OFFICE OF LABOR LAW ENFORCEMENT
PHONE: (302) 761-8200

Mailing Address:
4425 North Market Street
3rd Floor
Wilmington, DE 19802

Located at:
4425 North Market Streer
3rd Floor
Wilmington, DE 19802

PREVAILING WAGES FOR **HIGHWAY CONSTRUCTION** EFFECTIVE MARCH 15, 2018

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
BRICKLAYERS	53.89	53.89	53.89
CARPENTERS	54.62	54.81	43.57
CEMENT FINISHERS	34.63	34.85	27.71
ELECTRICAL LINE WORKERS	24.02	46.36	22.69
ELECTRICIANS	68.70	68.70	68.70
IRON WORKERS	63.68	25.48	27.06
LABORERS	43.30	40.70	39.95
MILLWRIGHTS	17.20	16.69	14.41
PAINTERS	68.79	68.79	68.79
PILEDRIVERS	70.92	25.36	28.77
POWER EQUIPMENT OPERATORS	45.46	42.29	38.73
SHEET METAL WORKERS	24.30	21.68	19.64
TRUCK DRIVERS	36.49	30.14	36.72

CERTIFIED: 09/13/2018 BY: Francis on behalf of Julie Rehoff
ADMINISTRATOR, OFFICE OF LABOR LAW ENFORCEMENT

NOTE: THESE RATES ARE PROMULGATED AND ENFORCED PURSUANT TO THE PREVAILING WAGE REGULATIONS ADOPTED BY THE DEPARTMENT OF LABOR ON APRIL 3, 1992.

CLASSIFICATIONS OF WORKERS ARE DETERMINED BY THE DEPARTMENT OF LABOR. FOR ASSISTANCE IN CLASSIFYING WORKERS, OR FOR A COPY OF THE REGULATIONS OR CLASSIFICATIONS, PHONE 302 761 8200

NON-REGISTERED APPRENTICES MUST BE PAID THE MECHANIC'S RATE.

PROJECT: T201507602.02 BR 3-154 On US9 Savannah Road and BR3-153 on SR1A Rehobth Avenue over lewis rehoboth Canal, Sussex County

General Decision Number: DE180004 07/27/2018 DE4

STATE: Delaware

Construction Type: Highway

COUNTY: Sussex County in Delaware

HIGHWAY CONSTRUCTION PROJECTS

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.35 for calendar year 2018 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.35 per hour (or the applicable wage rates listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2017. The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1 (a) (2) - (60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	07/27/2018

SUDE2018-001 03/15/2018

	Rates	Fringes
Bricklayer	53.89	
Carpenter	43.57	
Cement Mason/Concrete Finisher	27.71	
ELECTRICIAN		
Electrician	68.70	
Line Worker	22.69	
Ironworker	27.06	
Laborer	39.95	
Millwright	14.41	
Painter	68.79	
Power Equipment Operator:		
Piledriver	28.77	
Power Equipment Operators	38.73	
Sheet Metal Worker	19.64	
Truck Driver	36.72	

WELDERS: Receive rate prescribed for craft performing operation to which welding is incidental.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any soliticitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29 CFR 5.5(a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under an "SU" identifier indicated that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U. S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION

APPLICABILITY OF DAVIS-BACON LABOR STANDARD PROVISIONS TO FLAGGERS

The U.S. Department of Labor has established that the duties of flaggers working on contracts covered by the Davis-Bacon Act, are manual and physical in nature. Accordingly, all employees performing the work of flaggers on Davis-Bacon covered contracts shall be entitled to receive applicable prevailing wage rates.

* * * * *

ALL AGENCY MEMORANDUM NO. 130
U.S. DEPARTMENT OF LABOR
EMPLOYMENT STANDARDS ADMINISTRATION
WAGE AND HOUR DIVISION
WASHINGTON, DC 20210

GUIDELINES

HIGHWAY CONSTRUCTION

Highway projects include the construction, alteration, or repair of roads, streets, highways, runways, taxiways, alleys, trails, paths, parking areas, and other similar projects not incidental to building or heavy construction.

EXAMPLES: Alleys, Base Courses, Bituminous treatments, Bridle Paths, Concrete pavement, Curbs, Excavation and embankment (for road construction), Fencing (highway), Grade crossing elimination (overpasses and underpasses), Guard rails on highway, Highway signs, Highway bridges (overpasses, underpasses, grade separation), Medians, Parking lots, Parkways, Resurfacing streets and highways, Roadbeds, Roadways, Runways, Shoulders, Stabilizing courses, Storm sewers incidental to road construction, Street paving, Surface courses, Taxiways, and Trails.

ANY QUESTIONS REGARDING THE APPLICATION OF THE GUIDELINES ABOVE TO A PARTICULAR PROJECT OR ANY DISPUTES REGARDING THE APPLICATION OF THE WAGE SCHEDULES ARE TO BE REFERRED TO THE WAGE AND HOUR DIVISION, U.S. DEPARTMENT OF LABOR FOR RESOLUTION, AND THE INSTRUCTIONS OF THE WAGE AND HOUR DIVISION ARE TO BE OBSERVED IN ALL INSTANCES.

* ALL AGENCY MEMORANDUM NO. 130
U.S. DEPARTMENT OF LABOR
EMPLOYMENT STANDARDS ADMINISTRATION
WAGE AND HOUR DIVISION
WASHINGTON, DC 20210

SPECIAL PROVISIONS

401502 - ASPHALT CEMENT COST ADJUSTMENT

For Sections 401, 402, and 403, payments to the Contractor shall be adjusted to reflect increases or decreases in the Delaware Posted Asphalt Cement Price when compared to the Project Asphalt Cement Base Price, as defined in these Special Provisions.

The Delaware Posted Asphalt Cement Price will be issued monthly by the Department and will be the industry posted price for Asphalt Cement, F.O.B. Philadelphia, Pennsylvania. The link for the posting is http://www.deldot.gov/information/business/bids/asphalt_cement_english.shtml.

The Project Asphalt Cement Base Price will be the Delaware Posted Asphalt Cement Price in effect on the date of advertisement.

All deviations of the Delaware Posted Asphalt Cement Price from the Project Asphalt Cement Base Price are eligible for cost adjustment. No minimum increases or decreases or corresponding percentages are required to qualify for cost adjustment.

Actual quantity of asphalt cement qualifying for any Asphalt Cement Cost Adjustment will be computed using the weight of eligible asphalt that is shown on the QA/QC pay sheets as a percentage for the delivered material.

If the mix was not inspected and no QA/QC pay sheet was generated, then the asphalt percentage will be obtained from the job mix formula for that mix ID.

The asphalt percentage eligible for cost adjustment shall only be the virgin asphalt cement added to the mix.

There shall be no separate payment per ton cost of asphalt cement. That cost shall be included in the various unit prices bid per ton for those bid items that contain asphalt cement (mentioned above).

The Asphalt cement cost adjustment will be calculated on grade PG 64-22 asphalt regardless of the actual grade of asphalt used. The Project Asphalt Cement Base Price per ton for the project will be the Delaware Posted Asphalt Cement Price in effect on the date of project advertisement.

If the Contractor exceeds the authorized allotted completion time, the price of asphalt cement on the last authorized allotted work day, shall be the prices used for cost adjustment during the time liquidated damages are assessed. However, if the industry posted price for asphalt cement goes down, the asphalt-cement cost shall be adjusted downward accordingly.

NOTE:

Application of Asphalt Cement Cost Adjustment requirements as indicated above shall apply only to those contracts involving items related to bituminous base and pavements, and with bitumen, having a total of 1,000 tons or more of hot-mix bid quantity in case of Sections 401, 402 and 403.

5/05/15

401699 - QUALITY CONTROL/QUALITY ASSURANCE OF BITUMINOUS CONCRETE

.01 Description

This item shall govern the Quality Assurance Testing for supplying bituminous asphalt plant materials and constructing bituminous asphalt pavements and the calculation for incentives and disincentives for materials and construction. The Engineer will evaluate all materials and construction for acceptance. The procedures for acceptance are described in this Section. Include the costs for all materials, labor, equipment, tools, and incidentals necessary to meet the requirements of this specification in the bid price per ton for the bituminous asphalt. Payment to the Contractor for the bituminous asphalt item(s) will be based on the Contract price per ton and the pay adjustments described in this specification.

.02 Bituminous Concrete Production – Quality Acceptance

(a) Material Production - Tests and Evaluations.

All acceptance tests shall be performed by qualified technicians at qualified laboratories following AASHTO or DelDOT procedures, and shall be evaluated using Quality Level Analysis. The Engineer will conduct acceptance tests. The Engineer will directly base acceptance on the acceptance test results, the asphalt cement quality, the Contractor's QC Plan work, and the comparisons of the acceptance test results to the QC test results. The Engineer may elect to utilize test results of the Contractor in some situations toward judging acceptance.

Supply and capture samples, as directed by the Engineer under the purview of the Engineer from delivery trucks before the trucks leave the production plant. Hand samples to the Engineer to be marked accordingly. The sample shall represent the material produced by the Contractor, and shall be of sufficient size to allow the Engineer to complete all required acceptance tests. The Engineer will direct the Contractor when to capture these samples, on a statistically random, unbiased basis, established before production begins each day based upon the anticipated production tonnage. The captured sample shall be from the Engineer specified delivery truck. The Contractor may visually inspect the specified delivery load during sampling and elect to reject the load. If the contractor elects to reject the specified delivery truck, each subsequent load will be inspected until a visually acceptable load is produced for acceptance testing. All visually rejected loads shall not be sent to a Department project.

The first sample of the production day will be randomly generated by the Engineer between loads 0 and 12 (0-250 tons). Subsequent samples will be randomly generated by the Engineer on 500-ton sub-lots for the production day. Samples not retrieved in accordance with the Contractor's QC plan will be deemed unacceptable and may be a basis for rejection of material produced. Parallel tests or dispute resolution tests will only be performed on material captured at the same time and location as the acceptance test sample. Parallel test samples or Dispute Resolution samples will be created by splitting a large sample or obtaining multiple samples that equally represent the material. The Engineer will perform all splitting and handling of material after it is obtained by the Contractor.

The Contractor may retain dispute resolution samples or perform parallel tests with the Engineer on any acceptance sample.

The Engineer will evaluate and accept the material on a lot basis. All the material within a lot shall have the same JMF (mixture ID). The lot size shall be targeted for 2000 tons or a maximum period of three days, whichever is reached first. If the 2000th ton target lot size is achieved during a production day, the lot size shall extend to the end of that production day. The Contractor may interrupt the production of one JMF in order to produce different material; this type of interruption will not alter the determination of the size or limits of material represented by a lot. The Engineer will evaluate each lot on a sublot basis. The size for each sublot shall be 100 to 500 tons and testing for the sub lots will be completed on a daily basis. For each sublot, the Engineer will evaluate one sample.

The target size of sub-lots within each lot, except for the first sample of the production day, is equal-sized 500 ton sub lots and will be based upon anticipated production, however, more or fewer sublots, with differing sizes, may result due to the production schedule and conditions. If the actual production is less than anticipated, and it's determined a sample will not be obtained (based upon the anticipated tonnage), a new sample location will be determined on a statistically random, unbiased basis based upon the new actual

production. If the actual production is going to be 50 tons or greater over the anticipated sub lot production, a new sample location will be determined on a statistically random, unbiased basis based upon the new actual production. The Engineer will combine the evaluation and test results for all of the applicable sublots in order to evaluate each individual lot.

If the Engineer is present, and the quantity exceeds 25 tons, a statistically random sample will be used for analysis. When the anticipated production is less than 100 tons and greater than 25 tons, and the Engineer is not present, the contractor shall randomly select a sample using the Engineer's random location program. The captured sample shall be placed in a suitable box, marked to the attention of the Engineer, and submitted to the Engineer for testing. A box sample shall also be obtained by the contractor at the same time and will be used as the Dispute Resolution sample if requested by the Engineer. The Contractor shall also obtain one liquid asphalt sample (1 pint) per grade of asphalt used per day and properly label it with all pertinent information.

The Engineer will conduct the following tests in order to characterize the material for the pavement compaction quality and to judge acceptance and the pay adjustment for the material:

- AASHTO T312 - Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
- AASHTO T166, Method C (Rapid Method) - Bulk Specific Gravity of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface Dry Specimens
- AASHTO T308 - Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
- AASHTO T30 - Mechanical Analysis of Extracted Aggregate
- AASHTO T209 - Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt (HMA)
- ASTM D7227 - Standard Practice for Rapid Drying of Compacted Asphalt Specimens using Vacuum Drying Apparatus

(b) Pavement Construction - Tests and Evaluations.

The Engineer will directly base acceptance on the compaction acceptance test results, and on the inspection of the construction, the Contractor's QC Plan work, ride smoothness as referenced in the contract documents, lift thickness as referenced in the contract documents, joint quality as referenced in the contract documents, surface texture as referenced in the contract documents, and possibly the comparisons of the acceptance test results to the independent test results. For the compaction acceptance testing, the Engineer will sample the work on a statistically random basis, and will test and evaluate the work based on daily production.

Notify the Engineer of any locations within that road segment that may not be suitable to achieve minimum (93%) compaction due to existing conditions prior to paving the road segment. Schedule and hold a meeting in the field with the Engineer in order to discuss all areas that may potentially be applicable to Table 5a before paving starts. Areas that will be considered for Table 5a will be investigated in accordance to the method described in Appendix B. If this meeting is not held prior to paving, no areas will be considered for Table 5a. Areas of allowable exemptions that will not be cored include the following: partial-depth patch areas, driveway entrances, paving locations of less than 100 tons, areas around manholes and driveway entrances, and areas of paving that are under 400 feet in continuous total length and/or 5 feet in width.

The exempt areas around manholes will be a maximum of 4 feet transversely on either side from the center of the manhole, and 20 feet longitudinally on either side from the center of the manhole. The exempt areas around driveway entrances shall be the entire width of the driveway, and 3 feet from the edge of the longitudinal joint next to the driveway. Areas of exemption that will be cored for informational purposes only include: areas where the mat thickness is less than three times the nominal maximum aggregate size as directed by the Engineer, violations of Section 401.08 in the Standard Specifications as directed by the Engineer, and areas shown to contain questionable subgrade properties as proven by substantial yielding under a fully legally loaded truck. Failure to obtain core samples in these areas will result in zero payment for compaction regardless of the exempt status. The Engineer will evaluate and accept the compaction work on a daily basis. Payment for the compaction will be calculated by using the material production lots as referenced in **.02 Acceptance Plan (a) Material Production - B Tests and Evaluation** and analyzing the compaction results over the individual days covered in the material production lot. The compaction results will be combined with the material results to obtain a payment for this item.

The minimum size of a compaction lot shall be 100 tons. If the compaction lot is between 101 and 1000 tons, the Engineer shall randomly determine four compaction acceptance test locations. If the compaction lot is between 1001 and 1500 tons, the Engineer shall randomly determine six compaction acceptance test locations. If the compaction lot is between 1501 and 2000 tons, the Engineer shall randomly determine eight compaction acceptance test locations. If the compaction lot is greater than 2000 tons, the Engineer shall randomly determine two compaction acceptance test locations per 500 tons.

If a randomly selected area falls within an Engineer approved exemption area, the Engineer will select one more randomly generated location to be tested per the requirements of this Specification. If that cannot be accomplished, or if an entire location has been declared exempt, the compaction testing shall be performed as per these Specifications but a note will be added to the results that the location was an Engineer approved exempt location.

Testing locations will be a minimum of 1.0 feet from the newly placed longitudinal joint and 50 feet from a new transverse joint.

Cut one six (6) inch diameter core through the full lift depth at the exact location marked by the Engineer. Cores submitted that are not from the location designated by the Engineer will not be tested and will be paid at zero pay.

Notify the Engineer prior to starting paving operations with approximate tonnage to be placed. The Contractor is then responsible for notifying the appropriate Engineer test personnel within 12 hours of material placement. The Engineer will mark core locations within 24 hours of notification. After determination of locations, the Contractor shall complete testing within two operational days of the locations being marked. If the cores are not cut within two operational days, the area in question will be paid at zero pay for compaction testing.

Provide any traffic control required for the structural number investigation, sampling, and testing work at no additional cost to the Department.

Commence coring of the pavement after the pavement has cooled to a temperature of 140°F or less. Cut each core with care in order to prevent damaging the core. Damaged cores will not be tested. Label each core with contract number, date of construction, and number XX of XX upon removal from the roadway Place cores in a 6-inch diameter plastic concrete cylinder mold or approved substitute for protection. Separate cores in the same cylinder mold with paper. Attach a completed QC test record for the represented area with the corresponding cores. The Engineer will also complete a test record for areas tested for the QA report and provide to Materials & Research. Deliver the cores to the Engineer for testing, processing, and report distribution at the end of each production day.

Repair core holes per Appendix A, Repairing Core Holes in Bituminous Asphalt Pavements. Core holes shall be filled immediately. Failure to repair core holes at the time of coring will result in zero pay for compaction testing for the area in question.

The Engineer will conduct the following tests on the applicable portion of the cores in order to evaluate their quality:

- AASHTO T166, Method C (Rapid Method) – Bulk Specific Gravity of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface Dry Specimens
- AASHTO T209 - Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt
- ASTM D7227 - Standard Practice for Rapid Drying of Compacted Asphalt Specimens using Vacuum Drying Apparatus

The Engineer will use the average of the last five test values of the same JMF (mixture ID) material at the production plant in order to calculate the average theoretical maximum specific gravity of the cores. The average will be based on the production days test results and as many test results needed from previous days production to have an average of five samples. If there are less than five values available, the Engineer will use the JMF design value in addition to the available values to calculate the average theoretical maximum specific gravity.

.03 Payment and Pay Adjustment Factors.

The Engineer will determine pay adjustments for the bituminous asphalt item(s) in accordance with this specification. The Engineer will determine a pay adjustment factor for the material produced and a pay adjustment factor for the pavement construction. Pay adjustments for material and construction will be calculated independently. When the pay adjustment calculation for either material or construction falls to zero payment per tables 4, 5, or 5a, the maximum pay adjustment for the other factor will not exceed 100.

Pay Adjustment factors will only be calculated on in place material. Removed material will not be used in payment adjustment calculations.

Material Production Pay Adjustments will be calculated based upon 70% of the contract unit price and calculated according to section .03(a) of this specification. Pavement construction Pay Adjustments will be calculated based upon 30% of the contract unit price and calculated according to section .03(b) of this specification.

(a) Material Production - Pay Adjustment.

Calculate the material pay adjustment by evaluating the production material based on the following parameters:

Table 2 - Material Parameter Weight Factors

Material Parameter	Single Test Tolerance (+/-)	Weight Factor
Asphalt Content	0.4	0.30
#8 Sieve (>=19.0 mm)	7.0	0.30
#8 Sieve (<=12.5 mm)	5.0	0.30
#200 Sieve (0.075mm Sieve)	2.0	0.30
Air Voids (4.0% Target)	2.0	0.10

Using the JMF target value, the single test tolerance (from Table 2), and the test values, the Engineer will use the following steps to determine the material pay adjustment factor for each lot of material:

1. For each parameter, calculate the mean value and the standard deviation of the test values for the lot to the nearest 0.1 unit.
2. For each parameter, calculate the Upper Quality Index (QU):
   QU = ((JMF target) + (single test tolerance) - (mean value)) / (standard deviation).
3. For each parameter, calculate the Lower Quality Index (QL):
   QL = ((mean value) - (JMF target) + (single test tolerance)) / (standard deviation).
4. For each parameter, locate the values for the Upper Payment Limit (PU) and the Lower Payment Limit (PL) from Table 3 - Quality Level Analysis by the Standard Deviation Method. (Use the column for "n" representing the number of sublots in the lot. Use the closest value on the table when the exact value is not listed).
5. Calculate the PWL for each parameter from the values located in the previous step:
   PWL = PU + PL - 100.
6. Calculate each parameter's contribution to the payment adjustment by multiplying its PWL by the weight factor shown in Table 2 for that parameter.
7. Add the calculated adjustments of all the parameters together to determine the Composite PWL for the lot.
8. From Table 4, locate the value of the Pay Adjustment Factor corresponding to the calculated PWL. When all properties of a single test are within the single test tolerance of Table 2, Pay Adjustment factors shall be determined by Column B. When any property of a single test is outside of the Single Test Tolerance parameters defined in Table 2, the Material Pay Adjustment factor shall be determined by Column C.
9. For each lot, determine the final material price adjustment:

Final Material Pay Adjustment =
(Lot Quantity) x (Item Bid Price) x (Pay Adjustment Factor) x 70%. This final pay calculation will be paid to the cent.

In lieu of being assessed a pay adjustment penalty, the Contractor may choose to remove and replace the material at no additional cost to the Department. When the PWL of any material parameter in Table 2 is below 60, the Engineer may require the removal and replacement of the material at no additional cost to the Department. Test results on removed material shall not be used in calculation of future PWL calculations for Mixture ID.

The test results from the Engineer on production that is less than 100 tons will be combined with the two most recently completed Engineer tests with the same Mixture ID to calculate payment for the lot encompassing the single test. If that cannot be accomplished, the approved JMF will be used to calculate payment for the lot encompassing the single test. Payment for previously closed lots will not be affected by the analysis.

When a sample is outside of the allowable single test tolerance for any Materials criteria in Table 2, that sample will be isolated. For payment purposes, the test result of the out of acceptable tolerance sample will be combined with the two previous acceptable samples of the same JMF and analyzed per this specification. The material that is considered out of the acceptable tolerance will only include the material within the represented sub-lot (i.e., a maximum of 500 tons). If the previous acceptable test result is from the previous production day, only the material produced on the second production day will be considered out of tolerance. All future sub lots will not include the isolated test. The pay factors for the out of tolerance sample lot will be calculated using column C of table 4.

If, during production, a QA sample test result does not meet the acceptable tolerances and the Contractors QC sample duplicates the QA sample test result, the Contractor can make an appropriate change to the mixture (within the JMF boundaries), and request to have that sample further isolated. After the Contractor has made appropriate changes, the Contractor will visually inspect each produced load. The first visually acceptable load will be sampled and tested. If that sample test result shows compliance with the specifications, the material that is considered out of the acceptable tolerance will include the material from the previous acceptable test result to the third load after the initially sampled and tested sample. If the sample does not meet the specification requirements, the Engineer will no longer accept material. Production may resume when changes have been made and an acceptable sample and test result is obtained.

Table 3 – Quality Level Analysis by the Standard Deviation Method

PU or PL	QU and QL for "n" Samples						
	n = 3	n = 4	n = 5	n = 6	n = 7	n = 8	n = 9
100	1.16	1.50	1.79	2.03	2.23	2.39	2.53
99	-	1.47	1.67	1.80	1.89	1.95	2.00
98	1.15	1.44	1.60	1.70	1.76	1.81	1.84
97	-	1.41	1.54	1.62	1.67	1.70	1.72
96	1.14	1.38	1.49	1.55	1.59	1.61	1.63
95	-	1.35	1.44	1.49	1.52	1.54	1.55
94	1.13	1.32	1.39	1.43	1.46	1.47	1.48
93	-	1.29	1.35	1.38	1.40	1.41	1.42
92	1.12	1.26	1.31	1.33	1.35	1.36	1.36
91	1.11	1.23	1.27	1.29	1.30	1.30	1.31
90	1.10	1.20	1.23	1.24	1.25	1.25	1.26
89	1.09	1.17	1.19	1.20	1.20	1.21	1.21
88	1.07	1.14	1.15	1.16	1.16	1.16	1.17
87	1.06	1.11	1.12	1.12	1.12	1.12	1.12
86	1.04	1.08	1.08	1.08	1.08	1.08	1.08
85	1.03	1.05	1.05	1.04	1.04	1.04	1.04

84	1.01	1.02	1.01	1.01	1.00	1.00	1.00
83	1.00	0.99	0.98	0.97	0.97	0.96	0.96
82	0.97	0.96	0.95	0.94	0.93	0.93	0.93
81	0.96	0.93	0.91	0.90	0.90	0.89	0.89
80	0.93	0.90	0.88	0.87	0.86	0.86	0.86
79	0.91	0.87	0.85	0.84	0.83	0.82	0.82
78	0.89	0.84	0.82	0.80	0.80	0.79	0.79
77	0.87	0.81	0.78	0.77	0.76	0.76	0.76
76	0.84	0.78	0.75	0.74	0.73	0.73	0.72
75	0.82	0.75	0.72	0.71	0.70	0.70	0.69
74	0.79	0.72	0.69	0.68	0.67	0.66	0.66
73	0.75	0.69	0.66	0.65	0.64	0.63	0.63
72	0.74	0.66	0.63	0.62	0.61	0.60	0.60
71	0.71	0.63	0.60	0.59	0.58	0.57	0.57
70	0.68	0.60	0.57	0.56	0.55	0.55	0.54
69	0.65	0.57	0.54	0.53	0.52	0.52	0.51
68	0.62	0.54	0.51	0.50	0.49	0.49	0.48
67	0.59	0.51	0.47	0.47	0.46	0.46	0.46
66	0.56	0.48	0.45	0.44	0.44	0.43	0.43
65	0.52	0.45	0.43	0.41	0.41	0.40	0.40
64	0.49	0.42	0.40	0.39	0.38	0.38	0.37
63	0.46	0.39	0.37	0.36	0.35	0.35	0.35
62	0.43	0.36	0.34	0.33	0.32	0.32	0.32

Table 3 – Quality Level Analysis by the Standard Deviation Method

PU or PL	QU and QL for "n" Samples						
	n = 3	n = 4	n = 5	n = 6	n = 7	n = 8	n = 9
61	0.39	0.33	0.31	0.30	0.30	0.29	0.29
60	0.36	0.30	0.28	0.27	0.27	0.27	0.26
59	0.32	0.27	0.25	0.25	0.24	0.24	0.24

Table 4 - PWL Pay Adjustment Factors

PWL	Pay Adjustment Factor (%) Column B	Pay Adjustment Factor (%) Column C
100	+5	0
99	+4	-1
98	+3	-2
97	+2	-3
96	+1	-4
95	0	-5
94	-1	-6
93	-2	-7

92	-3	-8
91	-4	-9
PWL<91	PWL - 100	PWL - 100

(b) Pavement Construction - Pay Adjustments.

The Engineer will determine the pavement construction pay adjustment by evaluating the construction of the pavement, based on the following parameter:

- Degree of compaction of the in-place material

Using the test values for the cores, the Engineer will use the following steps to determine the pavement construction pay adjustment for each lot of work.

1. Calculate the core bulk specific gravity values from the sublot tests values, to the nearest 0.001 unit. Obtain the Theoretical maximum Specific Gravity values from the corresponding laboratory sublot tests.
2. Calculate the Degree of Compaction:
   Degree of Compaction =
   ((Core Bulk Specific Gravity) / (Theoretical Maximum Specific Gravity)) x 100% recorded to the nearest 0.1%.
3. The average compaction for the sublots shall be averaged together for the compaction level of the lot. The lots compaction test level shall be averaged and recorded to the nearest whole percent.
4. Locate the value of the Payment Adjustment Factor corresponding to the calculated degree of compaction from Table 5 or Table 5a.
5. Determine the pavement construction price adjustment by using the following formula:
   Construction Pay adjustment = (Lot Quantity) x (Bid Price) x (Pay Adjustment Factor) x 30%.

Table 5: Compaction Price Adjustment Highway Locations

Degree of Compaction (%)	Range	Pay Adjustment Factor (%)
>= 97.0	>= 96.75	-100*
96.5	96.26 – 96.74	-5
96.0	95.75 – 96.25	-3
95.5	95.26 – 95.74	-2
95.0	94.75 – 95.25	0
94.5	94.26 – 94.74	0
94.0	93.75 – 94.25	1
93.5	93.26 – 93.74	3
93.0	92.75 – 93.25	5
92.5	92.26 – 92.74	3
92.0	91.75 – 92.25	0

91.5	91.26 – 91.74	0
91.0	90.75 – 91.25	-5
90.5	90.26 – 90.74	-15
90.0	89.75 – 90.25	-20
89.5	89.26 – 89.74	-25
89.0	88.75 – 89.25	-30
88.5	88.26 – 88.74	-50
=<88.0	=<88.25	-100*

* or remove and replace it at Engineer's discretion

Table 5A: Compaction Price Adjustment Other[1] Locations		
Degree of Compaction	Range	Pay Adjustment Factor (%)
>= 97.0	>= 96.75	-100*
96.5	96.26 – 96.74	-5
96.0	95.75 – 96.25	-3
95.5	95.26 – 95.74	-2
95.0	94.75 – 95.25	0
94.5	94.26 – 94.74	0
94.0	93.75 – 94.25	0
93.5	93.26 – 93.74	1
93.0	92.75 – 93.25	3
92.5	92.26 – 92.74	1
92.0	91.75 – 92.25	0
91.5	91.26 – 91.74	0
91.0	90.75 – 91.25	0
90.5	90.26 – 90.74	0
90.0	89.75 – 90.25	0
89.5	89.26 – 89.74	0
89.0	88.75 – 89.25	-1
88.5	88.26 – 88.74	-3
88.0	87.75 – 88.25	-5
87.5	87.26 – 87.74	-10
87.0	86.75 – 87.25	-15
86.5	86.26 – 86.74	-20

86.0	85.75 – 86.25	-25
85.5	85.26 – 85.74	-30
85.0	84.75 – 85.25	-40
84.5	84.26 – 84.74	-50
=< 84.0	=<84.25	-100*

* or remove and replace at Engineer's discretion

[1] This chart is to be used for areas where the structural value of the area to be paved is less than 1.75 as determined by the Engineer. See Appendix B - Method for Obtaining Cores for Determination of Roadway Structure. This chart is applicable to rehabilitation work only; full depth construction will not be considered for Table 5a.

.04 Dispute Resolution.

Disputes or questions about any test result shall be brought to the attention of the Contractor and the Engineer within two operational days of reported test results. The following dispute resolution procedures will be used.

The Engineer and the Contractor will review the sample quality, the test method, the laboratory equipment, and the laboratory technician. If these factors are not the cause of the dispute, a third party dispute resolution will be used.

Third party resolution testing can be performed at either another Contractor's laboratory, the Engineer's laboratory, or an independent accredited laboratory. Unless otherwise mutually agreed upon by DAPA and the Engineer, the Engineer's qualified laboratory in Dover and qualified personnel shall conduct the necessary testing for third party Dispute Resolution after the Engineer has provided reasonable notice to allow the Contractor to witness this testing.

When disputes over production testing occur, the samples used for Dispute Resolution testing will be those samples the properly captured, labeled, and stored, as described in the second paragraph of the section of these specifications titled **.02 Acceptance Plan, (a) Material Production - Tests and Evaluations**. If no samples are available, the original testing results will be used for payment calculations.

Dispute Resolution samples for air void content will be heated by a microwave oven.

If there is a discrepancy between the Engineer's acceptance test result and the Contractor's test result, the Contractor may ask for the Dispute Resolution sample to be tested. The Contractor may request up to two dispute resolution samples be tested per calendar year without charge. Any additional Dispute Resolution samples run at the Contractors request where the results substantiate the acceptance test result will be assessed a fee of $125. Any additional Dispute Resolution samples that substantiate the Contractors test result will not be assessed the fee.

When disputes over compaction core test results occur, the Engineer's acceptance core will be used for the dispute resolution sample. The Contractor will be advised on when the testing will occur as referenced above to witness the testing. The results of the dispute resolution testing shall replace all of the applicable disputed test results for payment purposes.

Appendix A - Repairing Core Holes in Bituminous Asphalt Pavement

Description.

This appendix describes the procedure required to repair core holes in a bituminous concrete pavement.

Materials and Equipment.

The following material shall be available to complete this work:

- Patch Material - DelDOT approved High Performance Cold Patch material shall be used.

The following equipment shall be available to complete this work:

- Sponge or other absorbent material - Used to extract water from the hole.
- Compaction Hammer - mechanical (electrical, pneumatic, or gasoline driven) tamping device with a flat, circular tamping face smaller than 6 inches in diameter.

Construction Method.

After core removal from the hole, remove all excess water from within the hole, and prevent water from re-entering the hole.

Place the patch material in lifts no greater than 3 inches and compact with mechanical tamping device. If the hole is deeper than 3 inches, use two lifts of approximately equal depths so that optimum compaction is achieved. Make sure that the patch surface matches the grade of the existing roadway. Make every effort to achieve the greatest possible compaction

Performance Requirements.

The Engineer will judge the patch on the following basis:

- The patch shall be well compacted
- The patch surface shall match the grade of the surrounding roadway surface.

Basis of Payment.

No measurement or payment will be made for the patching work. The Contractor must gain the Engineer's acceptance of the patching work before the Engineer will accept the material represented by the core.

Appendix B - Method for Obtaining Cores for Determination of Roadway Structure

The Contractor is responsible for obtaining cores in areas that they propose are eligible for compaction price adjustments according to Table 5a in this specification. Table 5a is not applicable for new full-depth pavement box construction. Cores submitted for this process shall be obtained according to the following process.

1. Contact Materials & Research (M&R) personnel to determine if information about the area is already available. If M&R has already obtained cores in the location that is being investigated, the contractor may opt to use the laboratory information for the investigation and not core the area on their own.

2. If M&R does not have information concerning the section of the roadway, the contractor needs to contact M&R to arrange for verification of coring operations. Arrangements shall be made to allow for an individual from M&R to be on the site when the cores are obtained. Cores will be turned over to M&R for evaluation.

3. The Contractor is responsible for providing all traffic control and repairing core holes in accordance to 401699 Appendix A - Repairing Core Holes in Bituminous Asphalt Pavements.

4. Cores are to be taken throughout the entire project for the area in question. Cores will be spaced, from the start of the project in increments determined based on field and project specifics. Cores will be evenly distributed throughout the project location. The cores will be taken in the center of the lane in question.

5. Additional cores may be taken at other locations, if surface conditions indicate that there may be a substantial difference in the underlying section. The location of these cores should be documented and submitted to M&R.

6. Cores shall be full depth and include underlying materials. If there is a stone base included in the pavement section, at a minimum 1 core must have information concerning the thickness of the base. This is determined by augering to the subgrade surface.

7. The calculations used to determine the structural capacity of the roadway is as follows. If the contractor finds, upon starting the coring process, that the areas are of greater thickness than applicable to Table 5a, they may terminate the coring process on their own and retract the request.

Structural Number Calculations

Each pavement box material is assigned a structural coefficient based upon AASHTO design guides. The structural coefficient is used to determine the total strength of the pavement section.

Materials used in older pavement sections are assigned lower structural coefficients to compensate for aging of the materials. The coefficients used to determine the structural number of an existing pavement are:

Existing Material	Structural Coefficient
HMA	0.32
Asphalt Treated Base	0.26
Soil Cement	0.16
Surface Treatment (Tar & Chip)	0.10
GABC	0.14
Concrete	0 - 0.7*

* The Structural Coefficient of Concrete is dependent upon the condition of the concrete. Compressive strengths & ASR analysis are used to determine condition - contact the Engineer if this situation arises.

Newly placed materials use a different set of structural coefficients. They are as follows:

New Material	Structural Coefficient
HMA	0.40
Asphalt Treated Base (BCBC)	0.32
Soil Cement	0.20
GABC	0.14

Example:

Location includes placement of a 1.25" Type C overlay on 2.25" Type B. Existing roadway is cored and is shown to consist of 2" HMA on 7" GABC.

Calculation:

For the Type B lift the calculation would be:

Existing HMA	2 * 0.32 =	0.64
GABC	7 * 0.14 =	0.98
		1.62

For the Type C lift the calculation would be:

Newly Placed B	2.25 * 0.4 =	0.90
Existing HMA	2 * 0.32 =	0.64
GABC	7* 0.14 =	0.98
		2.52

11/3/14

613500 - CONCRETE ACRYLIC PRIMER, SEALER AND TEXTURED TOP COAT

Description:

This item shall consist of the furnishing and application of concrete coatings on Bridge 3-153 Rehoboth Avenue and Bridge 3-154 Savannah Road. The two part coating system shall include the application of the acrylic primer and sealer coat followed by the application of the textured concrete top coat. The top coat shall be such that it matches the color of the existing concrete structures. Refer to contract drawings for limits of concrete coatings.

Submittals shall include names and addresses of all proposed manufacturers and suppliers. Product certificates shall be signed by the manufacturers of the coating materials certifying that their product complies with the requirements specified in this section. Deliver all materials and fixtures in manufacturer's protective packing, crating, and covering and stored in a dry location.

Materials:

The primer and sealer and textured top coat shall be chosen to be compatible with each other and preferably made by the same manufacturer.

Primer and Sealer: The primer and sealer shall be an acrylic coating engineered for exterior application on above grade concrete surfaces with a pH between 6 and 13. A two coat, touch and re-touch, system shall be utilized. The selected product shall satisfy the following standard test methods:

- ASTM D1308 for Alkali Resistance
- ASTM D522, Method B, 180° bend, 1/8" mandrel for Flexibility

Top Coat: The top coat shall be a textured acrylic aggregate filled coating engineered for exterior application. A two coat, touch and re-touch, system shall be utilized and it shall match the color of the existing concrete structure as approved by the Engineer. The selected product shall satisfy the following standard test methods:

- ASTM D1308 for Alkali Resistance
- ASTM D522, Method B, 180° bend, 1/8" mandrel for Flexibility
- ASTM D6904-03 (2013) for Wind Driven Rain
- ASTM D2794 for Impact Resistance
- ASTM D3359, Method B for Adhesion
- ASTM D2243 for Freeze/Thaw Resistance

Construction Methods:

The concrete acrylic primer, sealer and textured top coats shall be applied at temperatures above 50° Fahrenheit. The coatings shall be applied out of direct sunlight on surfaces that are neither hot nor wet. Prepare the surface to receive the primer and sealer with a latex, oil, or water based epoxy or solvent based epoxy according to manufacturer's recommendations. After preparing the surface, the Contractor shall caulk all windows, doors, and other through wall openings prior to applying the concrete coatings. For more information on pre-installation and surface preparation of the concrete to receive the concrete textured coating, refer to Section 613.03 of the Standard Specification.

At the beginning of this work at each bridge, a technical representative from the coating manufacturer shall be on site to provide technical assistance and guidance to the Contractor to ensure that the preparation and application of the primer, sealer and textured top coat are in accordance with the material requirements and recommendations.

Method of Measurement:

Contractor shall field verify quantity of concrete to be covered with the acrylic primer, sealer and textured top coat. Quantity of concrete coatings shall be measured as the actual number of square feet of concrete surface area coated and accepted. Multiple coats will not be measured more than once. The unit cost will

include all necessary materials for all coats, surface preparation, installation, inspection and disposal of material required per this specification.

Basis of Payment:

Payment for the concrete acrylic primer, sealer and textured top coat will be paid under "Item 613500 - Concrete Acrylic Primer, Sealer and Textured Top Coat". Price and payment of concrete acrylic primer, sealer and textured top coat will constitute full compensation for technical representative, furnishing and installing all materials, surface preparation, application of coating material, the removal and subsequent disposal of all materials, and all labor, tools, equipment and necessary incidentals to complete the work.

4/12/2018

615503 - BRIDGE MECHANICAL SYSTEM

Description:

The Contractor shall provide all required materials, equipment, and labor to complete the work indicated on the Contract Drawings and as specified herein.

Basis of Design.

The design of new span lock machinery conforms to the applicable requirements of the American Association of State Highway and Transportation Officials, AASHTO LRFD Movable Highway Bridge Design Specifications, 2007 with 2008, 2010, 2011, 2014 and 2015 interim revisions, except as otherwise noted on the Contract Plans or otherwise specified herein.

BR 3-153, Rehoboth Avenue Bridge

M1. Span Drive Machinery Rehabilitation

The span drive machinery rehabilitation shall include the following items:

1. Remove existing motor and install, align, and adjust new motor. Note the new motor shall be furnished and tested under Item 615504 - Bridge Electrical System.
2. Furnish and replace motor coupling hub, coupling grid, seals, gaskets, and lubricant.
3. Remove existing motor brakes and install, align, and adjust new motor brakes. Note the new motor brakes shall be furnished and tested under Item 615504 - Bridge Electrical System.
4. Furnish and replace all floating shaft coupling seals, gaskets, and lubricant.
5. Seal leaking differential and secondary reducers and replace breathers.
6. Drain oil from the differential and secondary reducers, flush internal surfaces and remove all contaminants from the bottom of the reducer housing, and fill reducers with new oil.
7. Furnish and install one missing coupling fastener.
8. Reposition and secure coupling key at one location.
9. Furnish and replace main pinion bearing seals and lubricant.
10. Furnish and install machinery guards over motor coupling and brakes.
11. Remove existing lubricant and corrosion and furnish and apply new lubricant at the racks and pinions.
12. Remove existing span position transmitter and install, align, and adjust new span position resolver. New resolver to be furnished under Item 615504 - Bridge Electrical System.
13. Install, align, and adjust new speed switch. New speed switch to be furnished under Item 615504 - Bridge Electrical System.
14. Perform field testing of machinery components.

M2. Span Lock Machinery and Centering Guide Rehabilitation

The span lock machinery and centering guide rehabilitation shall include the following items:

1. Remove existing motors and install, align, and adjust new motors. Note the new motors shall be furnished and tested under Item 615504 - Bridge Electrical System.
2. Replace motor coupling hub, coupling grid, gaskets, seals, and lubricant.
3. Replace all reducer output gear coupling seals, gaskets, and lubricant.
4. Remove south span lock speed reducer for shop inspection and rehabilitation.
5. Shop paint south speed reducer. Reinstall and align south span lock speed reducer.
6. Seal leaking oil at north span lock speed reducer.
7. At each span lock speed reducer, replace the inspection cover gasket, modify the inspection cover and install the new breather.
8. Drain oil from the speed reducers, flush internal surfaces and remove all contaminants from the bottom of the reducer housing, and fill reducers with new oil.
9. Replace span lock bearing seals and lubricant.
10. Realign north rotary cam limit switch to shaft.
11. Remove north receiving socket for machining. Reinstall receiving socket and replace turned bolts.
12. Replace and adjust shims under the receiving socket shoes.

13. Adjust shims at the centering guide wear plates and replace wear plate turned bolts.
14. Provide means to temporarily hold down each side of span when receiving socket, speed reducer, or motors are removed or when couplings are disassembled. Contractor shall disengage and re-engage temporary hold down as needed for bridge openings throughout construction.
15. Perform field testing of machinery components.

M3. Machinery Paint

The machinery painting shall include the following items:

1. Furnish the paint system for the bridge machinery. Coordinate the shop painting with the top coat paint system requirements for new material.
2. Prepare existing bridge trunnion bearings, span drive machinery, span lock machinery, and centering guide component surfaces for painting.
3. Field paint existing bridge trunnion bearings, span drive machinery, span lock machinery, and centering guide components.

M4. Strain Gauge Balance Testing & Maintaining Span Balance

The strain gauge balance testing and maintaining span balance shall include the following items:

1. Balance testing performed using the dynamic strain gauge procedure described in this provision.
2. Preparation of balance calculations prior to and during construction based on reviewed shop drawings and material tests.
3. The development and documentation of the span balance procedure and methods.
4. All other work required to complete the span balancing, including furnishing and installing anchor bolts on top of the counterweight and placing and adjusting the balance blocks, balance plates, and other balance material within the counterweight pockets, bascule pier, and/or on top of the counterweight. This also includes repeated readjustment of balance material as necessary until the span is balanced as specified in below in "Final Span Balance Requirements". Documentation is required for all balancing work, including temporary balancing during construction.
5. Balancing the bridge as required throughout construction.

M5. Balance Material

The balance material shall include the following items:

1. Fabricating and furnishing temporary and permanent balance blocks for balancing the bascule leaf as shown on the Contract Drawings.

BR 3-154, Savannah Road Bridge

M6. Span Drive Machinery Rehabilitation

The span drive machinery rehabilitation shall include the following items:

1. Remove existing span drive motors and install, align, and adjust new motors. Note the new motors shall be furnished and tested under Item 615504 - Bridge Electrical System.
2. Replace motor coupling hubs, coupling grids, seals, gaskets, and lubricant. Furnish and install machinery guard at the motor coupling.
3. Replace motor and motor brake supports.
4. Install, align, and adjust new motor brakes and brakewheels. Note the new motor brakes and brakewheels shall be furnished and tested under Item 615504 - Bridge Electrical System.
5. Remove existing machinery brakes. Install, align, and adjust new machinery brakes. Note the new machinery brakes shall be furnished and tested under Item 615504 - Bridge Electrical System.
6. Replace gaskets and lubricant at lower floating shaft gear couplings.
7. Install lock washers at differential bevel pinion fasteners.
8. Replace missing bearing thrust face fastener and upper roller retainer plate fastener.
9. Remove existing lubricant from open gearing. Clean corrosion from gear teeth with hand tools. Furnish and apply new lubricant to the gearing teeth.

10. Remove existing span position instrumentation components including bearings, gears, rotary cam limit switch, and transmitter. Install, align, and adjust new span position equipment including rotary cam limit switch, resolver, couplings, floating shaft, and support. New Span position rotary cam limit switches and resolvers shall be furnished and tested under Item 615504 - Bridge Electrical System.
11. Remove existing tachometer and overspeed switch assembly and support. Install, align, and adjust new speed switch, shaft adapter, support, and machinery guard. New speed switches shall be furnished and tested under Item 615504 - Bridge Electrical System.
12. Furnish, install, and remove segmental girder chocks as needed throughout construction.
13. Perform field testing of machinery components

M7. Center Lock Machinery Replacement and Rehabilitation of Tail Locks

The span lock machinery rehabilitation shall include the following items:

1. Furnish, install, align, and adjust new center lock actuators, supports, lock bars, rear guides, front guides, receiving sockets, and machinery guards.
2. Remove existing center lock machinery components.
3. Replace tail lock reducer inspection hatch gaskets and breathers.
4. Replace east leaf tail lock reducer shaft seals.
5. Drain oil from the tail lock speed reducers, flush internal surfaces and remove all contaminants from the bottom of the reducer housing, and fill reducers with new oil.
6. Furnish, install, and adjust shims at the tail lock strut strike plates and live load bearings. Install new turned bolts where shims are adjusted.
7. Remove the existing tail lock motors and install, align, and adjust new tail lock motors. Note the new motors shall be furnished and tested under Item 615504 - Bridge Electrical System.
8. Replace tail lock motor coupling hubs, coupling grids, seals, gaskets and lubricant.
9. Remove existing tail lock rotary cam limit switches, and mounting angles. Remove the instrumentation pinions from the existing rotary cam limit switches and install on new rotary cam limit switch shaft adapters. Install new supports and install, align, and adjust new tail lock rotary cam limit switch. Note the new tail lock rotary cam limit switches shall be furnished and tested under Item 615504 - Bridge Electrical System.
10. Perform field testing of machinery components.

M8. Machinery Paint

The machinery painting shall include the following items:

1. Furnish the paint system for the bridge machinery. Coordinate the shop painting with the top coat paint system requirements for new material.
2. Prepare existing component surfaces affected by the rehabilitation scope items at the span drive machinery, tail lock machinery, and live load bearings.
3. Prepare new component surfaces at the span drive machinery, center lock machinery, and tail lock machinery.
4. Field paint new bridge machinery and existing bridge machinery affected by the rehabilitation scope for the span drive machinery, center lock machinery, tail lock machinery, and live load bearings.

M9. Strain Gauge Balance Testing & Maintaining Span Balance

The strain gauge balance testing and maintaining span balance shall include the following items:

1. Balance testing performed using the dynamic strain gauge procedure described in this provision.
2. Preparation of balance calculations prior to and during construction based on reviewed shop drawings and material tests.
3. The development and documentation of the span balance procedure and methods.
4. All other work required to complete the span balancing, including furnishing and install fasteners at the bascule girders for balance plates and placing and adjusting the balance blocks, balance plates, and other balance material within the bascule pier, counterweight pockets, and at the bascule girder. This also includes repeated readjustment of balance material as necessary until the span is balanced as specified below. Documentation is required for all balancing work, including temporary balancing during construction.

5. Balancing bridges as required throughout construction.

M10. Balance Material

The balance material shall include the following items:

1. Fabricating and furnishing temporary and permanent balance blocks for balancing the bascule leafs as shown on the Contract Drawings.

M11. Instruction Book

The instruction books shall include the following items:

1. Preparing the instruction book for the new center lock machinery components in accordance with Section 105.04 of the DelDOT Standard Specifications for Road and Bridge Construction (2016 Edition). The instruction book shall also include the following items:
   a. Final as-built drawings with the Instruction Book.
   b. Lubrication schedule charts and diagrams with the recommended lubricants and frequencies defined for the new center lock machinery with the Instruction Book.
   c. Any manufactured components operation, installation and maintenance manual with the Instruction Book.

Submittals.

Submittals shall comply with Section 105 of the DelDOT Standard Specifications for Road and Bridge Construction (2016 Edition) and the following:

1. The Contractor shall coordinate the work of the machinery component manufacturers where components interface. The Contractor shall review and approve all shop and working drawings prepared by those manufacturers for coordination prior to submittal of shop drawings to the Engineer for review.
2. Shop drawings shall show all parts completely detailed and dimensioned. Reproduction of the Plans shall be permitted provided all references to the design are removed and independent nomenclature specific to the project is used and coordinated with all other related shop and erection drawings.
3. Materials and material specifications shall be stated for each part. Where ASTM or the standard specifications are used, the applicable numbers of such specifications shall be given.
4. Required finish machining shall be shown including grade of finish in accordance with ANSI B46.1, Surface Texture, and dimensional tolerances and allowances for specific fits in accordance with ANSI B4.1, Preferred Limits and Fits for Cylindrical Parts.
5. Submittals for each manufactured item shall be manufacturer's descriptive literature, drawings, diagrams, performance and characteristic curves, and catalog cuts, and shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size, certified layout dimensions, capacity, specification reference, including ASTM, ANSI, Federal Military Specification and any other applicable references, and all other information necessary to establish Contract compliance.
6. Complete Shop, Erection, Working and Assembly drawings shall be furnished and show all external dimensions and clearances necessary for installation and operation of all new bridge structural, mechanical, and electrical components. These drawings shall give part numbers, match marks, and essential dimensions for locating each part or assembled unit with respect to the bridge structure or foundation.
7. For all assemblies and parts, the Contractor shall furnish complete assembly drawings or diagrams showing each part contained therein and the manufacturer's part number assigned to each part. The drawings or diagrams shall be sufficient to enable complete disassembly and reassembly of the assemblies covered. In the event that any part is modified in any manner from the way it is described or delivered by its original manufacturer, the Contractor shall furnish a drawing which details each modification and the part shall be assigned a unique part number to assure the furnishing of replacement parts modified in similar fashion.
8. Certified prints of each manufactured assembly shall be furnished. Certified prints are manufacturer's drawings of proprietary products on which the manufacturer or supplier states mounting dimensions, ratios, speeds, ratings, and any other critical parameters for use on this specific project. In addition to identifying and describing each part, they shall show:

a. Dimensions of all principal parts comprising the assembly.
b. Certified external dimensions affecting clearances and required for installation.
c. Capacity and normal operating ratings.
d. Recommended lubrication, including location of lubrication fittings and provisions for adding, draining and checking the level of lubricants.
e. Inspection openings, seals and vents.
f. Details or description of all fasteners required to mount the assembly.
g. Gross weight.

9. Certified prints shall be signed by an officer of the manufacturing company.
10. Complete shop bills of materials shall be made for all machinery parts. If the bills are not shown on the shop drawings, prints of the bills shall be furnished for approval in the same manner as specified for the shop drawings.
11. The weight of each piece of machinery shall be stated on the shop drawing upon which it is detailed or billed.
12. Marks or indentations of any type shall be clearly shown and detailed on the drawings. In general, die-stamping or scoring shall be avoided unless otherwise called for on the plans. All components and assemblies shall be detailed separately to assure correct fabrication, assembly, and erection. Use of mirror image or opposite hand erection drawings will not be allowed.
13. Each shop drawing shall be given a suitable title to describe the parts detailed thereon and shall state any applicable shop assembly or testing procedures to be performed.
14. As used herein, factory tests refer to tests required to be performed on the actual materials or equipment proposed for use. Test results shall be submitted for review and approval.
15. If any departures from the Contract Documents are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Engineer in writing as soon as practicable for his approval. No departures from Contract Drawings shall be made without the Engineer's approval.
16. If the Contractor has any objection to any feature of the machinery as designed or required by the Plans, he shall state his objection in writing to the Engineer at the time of submitting shop drawings or prior thereto; otherwise his objection will not be considered if offered later as an excuse for malfunctioning, defective or broken machinery or for improper or inadequate operation or functioning of machinery.
17. It is the Contractor's responsibility to manufacture and install suitable functioning machinery. Review of shop drawings by the Engineer does not relieve the Contractor of this responsibility.

The following list of submittals is intended as a guide and does not relieve the Contractor from furnishing the required information and working drawings as described within this Contract or as otherwise required for a successful project. Any additional submittals not included in the list below shall be at no extra cost to the Department.

BR 3-153, Rehoboth Avenue Bridge

M1. Span Drive Machinery Rehabilitation

1. Submit all catalog cuts, shop drawings, etc. defined within the scope of work.
2. Construction sequence for rehabilitating the span drive machinery. Submittal shall include the installation tolerances required to align the new motor to the existing differential reducer and the resolver to the instrumentation gearbox.
3. Differential reducer and secondary reducer oil leak repair procedure from the manufacturer.
4. Final motor to differential reducer alignment and the resolver to the instrumentation gearbox alignment measurements.
5. Field testing procedure.

M2. Span Lock Machinery and Centering Guide Rehabilitation

1. Submit all catalog cuts, shop drawings, etc. defined within the scope of work.
2. Construction sequence for rehabilitating the span lock machinery and centering guide. Submittal shall include the installation tolerances required to align the new motor to the existing speed reducer, the south speed reducer to the existing crank shaft, and the north span lock rotary cam limit switch to the crank shaft.
3. Speed reducer oil leak repair procedure from the manufacturer.

4. Speed reducer shop inspection results and spin test measurements.
5. Temporary hold down system work plan, procedure, calculations, and materials.
6. Final motor to speed reducer alignment measurements, south speed reducer to crank shaft alignment measurements, the north span lock rotary cam limit switch to the crank shaft alignment measurements, the final receiving socket clearances at both lock bars, and the final clearances at the centering guide.
7. Field testing procedure.

M3. Machinery Paint

1. Submit all catalog cuts, shop drawings, etc. of the proposed paint system.

M4. Strain Gauge Balance Testing & Maintaining Span Balance

1. Initial counterweight pocket inventory.
2. Proposed span balance spreadsheet.
3. Preparation of balance calculations prior to construction based on reviewed shop drawings and material tests.
4. Strain gauge testing qualifications, testing procedure, equipment to be used, and sample calculations.
5. Initial and the combined semi-final and final strain gauge span balance test report.
6. Span balance spreadsheet shall be updated and submitted throughout the project.

M5. Balance Material

1. Shop drawings of all proposed balance material.

BR 3-154, Savannah Road Bridge

M6. Span Drive Machinery Rehabilitation

1. Submit all catalog cuts, shop drawings, etc. defined within the scope of work.
2. Construction sequence for rehabilitating the span drive machinery. Submittal shall include the installation tolerances required to align the new motor to the primary gear frame, the rotary cam limit switch to the secondary gear frame, and the resolver to the rotary cam limit switch.
3. Final motor to primary gear frame input shaft alignment measurements, rotary cam limit switch to secondary gear frame alignment measurements, and resolver to rotary cam limit switch alignment measurements.
4. Field testing procedure.

M7. Span Lock Machinery Rehabilitation

1. Submit all catalog cuts, shop drawings, etc. defined within the scope of work.
2. Construction sequence for rehabilitating the span lock machinery. Submittal shall include the installation tolerances required to align the new tail lock motors to the existing speed reducers.
3. Final tail lock motor to speed reducer alignment measurements, tail lock instrumentation gear set alignment measurements, center lock guide and receiving clearances at both lock bars, and clearances between the tail lock strike plates and sole plates.
4. Field testing procedure.

M8. Machinery Paint

1. Submit all catalog cuts, shop drawings, etc. of the proposed paint system.

M9. Strain Gauge Balance Testing & Maintaining Span Balance

1. Initial counterweight pocket inventory.
2. Proposed span balance spreadsheet.
3. Preparation of balance calculations prior to construction based on reviewed shop drawings and material tests.
4. Strain gauge testing qualifications, testing procedure, equipment to be used, and sample calculations.
5. Initial and the combined semi-final and final strain gauge span balance test report.
6. Span balance spreadsheet shall be updated and submitted throughout the project.

M10. Balance Material

1. Shop drawings of all proposed balance material.

M11. Instruction Book

1. Sample format and outlines of content in draft form 90 days prior to the earliest of final inspection, acceptance tests, or return of span operation to the State. The submittal shall include the proposed methods of binding, printing and reproduction.
2. Completed manuals in final form 30 days prior to the earliest of final inspection, acceptance tests, or return of span operation to the State.
3. Accepted final manuals ten days after final inspection and acceptance testing. The final submission shall also include the final accepted manuals in an electronic format.

Materials:

General.

Work as described shall comply with, but not be limited to, all applicable requirements of the following codes and standards and their abbreviations used in this Special Provision shall be as shown:

1. American Association of State Highway and Transportation Officials (AASHTO)
2. American Gear Manufacturers Association (AGMA)
3. American Bearing Manufacturers Association (ABMA)
4. American Iron and Steel Institute (AISI)
5. American National Standards Institute (ANSI)
6. American Society for Testing and Materials (ASTM)
7. American Welding Society (AWS)
8. National Lubricating Grease Institute (NLGI)
9. Steel Structures Painting Council (SSPC)

The work shall meet the requirements of all other codes and standards as specified elsewhere in these Special Provisions. Where codes and standards are mentioned for any pay item, it is intended to call particular attention to them; it is not intended that any other codes and standards shall be assumed to be omitted if not mentioned.

Quality Assurance and Facilities.

Products used in the work described shall be produced by manufacturers regularly engaged in the manufacture of the specified products.

Provide adequate plant facilities and all necessary tools and instruments required for the proper performance of the personnel engaged in the execution of the specified work.

Fasteners.

High strength turned bolts and turned studs shall have turned shanks and cut threads. Turned bolts shall have semi-finished, washer faced, hexagonal heads and nuts. All finished shanks of turned fasteners shall be 1/16-inch larger in diameter than the diameter of the thread, which shall determine the head and nut dimensions. Unless noted otherwise, the shanks of all turned fasteners shall have a Class LC6 fit in the finished hole in accordance with ANSI Standard B4.1. The material shall meet the requirements of ASTM A449.

Finished body high strength bolts shall meet the requirements of ASTM A449 Type 1.

Bolts and studs shall be secured with heavy hex nuts meeting the requirements of ASTM A563 Grade DH or ASTM A194 Grade 2H.

High strength turned bolts shall be installed with a hardened plain washer at each end meeting ASTM F436 Type 1.

All fasteners shall be of United States manufacture and shall be clearly marked with the manufacturer's designation.

The dimensions of all bolt heads and nuts shall be in accordance with ANSI Standard B18.2, Square and Hexagon Bolts and Nuts.

Threads for bolts, nuts and cap screws shall conform to the coarse thread series and shall have a Class 2 tolerance for bolts and nuts or Class 2A tolerance for bolts and Class 2B tolerance for nuts in accordance with the ANSI Standard B1.1, Unified Inch Screw Threads.

Bolt holes through unfinished surfaces shall be spot faced for the head and nut, square with the axis of the hole.

Unless otherwise called for, all bolt holes in machinery parts or connecting these parts to the support steel work shall be subdrilled at least 1/8-inch smaller in diameter than the bolt diameter and shall be reamed assembled for the proper fit at assembly or at erection with the steel work after the parts are correctly assembled and aligned.

If double nuts are used, they shall be used for all connections requiring occasional opening or adjustment.

Keys and Keyways.

Keys and keyways shall conform to the dimensions and tolerances for parallel and tapered keys of ANSI Standard B17.1, Keys and Keyseats, unless otherwise specified. All keys shall be effectively held in place, preferably by setting them into closed-end keyways milled into the shaft. The ends of all such keys shall be rounded to a half circle equal to the width of the key. Keyways shall have a radius in the inside corners. Keyways shall not extend into any bearing. If two keys are used in a hub, they shall be located 120 degrees apart and in line with wheel arms where practicable. The fit between key and keyways shall be as shown on the drawings.

Unless otherwise specified herein or in the drawings, keys shall be machined from alloy steel forgings, ASTM A668, Class K.

Hubs and Bores.

The hubs of all couplings and brakewheels shall be bored concentric with the outside of couplings or brakewheel. All hubs shall have an ANSI Class FN2 shrink fit on the shafts, unless otherwise specified. Assembly shall be accomplished by heating the hub, cooling the shaft and moving the parts to the correct position without force. The use of liquid nitrogen for cooling and/or oil for sliding the hub onto the shaft is prohibited.

Shims.

Where shown, all machinery shims required for leveling and alignment of equipment shall be stainless steel, neatly trimmed to the dimensions of the assembled parts. In general, sufficient thicknesses shall be furnished to secure 1/64-inch variations of the shim allowance plus one shim equal to the full allowance. Shims shall be Stainless Steel ASTM A240 Type 316. Shim stacks greater than ½ inch shall include one solid plate of thickness equal to ½ inch less than total shim thickness.

Shims shall be shown and fully dimensioned on the shop drawings. Shims with open side or U-shaped holes for bolts will not be permitted. No shims shall have less than two holes for bolts. Plastic or other non-metallic shims will not be permitted.

Shims shall be provided with bolt holes 1/16" in diameter larger than shank of the specified bolt. Holes shall not be punched.

Coatings.

The bolt shanks and threads of turned bolts shall be coated with an anti-seize compounds before assembly of the nuts to prevent corrosion and allow for future removal if necessary.

Speed Reducers.

M1. Span Drive Machinery Rehabilitation

The Contractor shall contact the reducer manufacturer for procedures to eliminate oil leaking from the differential reducer and secondary speed reducer housing split line and intermediate shaft cover plates in the field. The Contractor shall submit the procedure to the Engineer for review prior to proceeding with the repairs. The Contractor shall furnish the necessary material needed and have a representative of the reducer manufacturer on-site to perform the repairs.

The Contractor shall furnish new inspection hatch gaskets and replace the existing breathers with new desiccant breathers.

M2. Span Lock Machinery and Centering Guide Rehabilitation

The Contractor shall remove the south span lock speed reducer for disassembly and inspection by the reducer manufacturer. The shop inspection shall at a minimum include a visual inspection of the gear teeth, bearings, and shafts to identify any unusual wear or damage that was causing an unusual noise during operations. The Contractor shall submit a report for review with the inspection results. If no deficiencies are found, the reducer shall be reassembled with new bearings, shaft seals, and gaskets. The inspection cover shall be modified to allow for the installation of a new desiccant breather. After reassembly of the unit, the contractor shall perform a spin test of the reducer for 1 hour in each direction.

The Contractor shall supply all testing equipment required for the spin test, which shall include the test motor. The contractor shall align the test motor to the sped reducer as per the coupling manufacturer's requirements. The spin test shall be run with the reducer filled to the correct level with new oil as specified as specified under the "Speed Reducer Oil" section of this special provision. Immediately before the start of the test, and at ten minute intervals thereafter, the following measurements shall be made and recorded and records shall be submitted to the Engineer for review:

1. Temperature of ambient air.
2. Temperature of oil near bottom of crankcase.
3. Surface temperature of each shaft extension adjacent to the shaft seal.
4. Motor speed.

The temperature of the oil shall at no time exceed its published acceptable operating range. The temperature of the shaft extension shall at no time exceed the published acceptable operating range of the seals.

During testing, the speed reducer shall be checked for unusual noise (thumping or any non-uniformity) and any other unusual operating characteristics. The units shall operate smoothly, and without excessive vibration or temperature rise. All malfunctions shall be recorded and corrected, and the units re-tested if necessary before release from the Contractor's shop.

The Contractor shall contact the reducer manufacturer for procedures to eliminate oil leaking from the north span lock speed reducer housing split line and intermediate shaft cover plates in the field. The Contractor shall submit the procedure to the Engineer for review prior to proceeding with the repairs. The Contractor shall furnish the necessary material needed and have a representative of the reducer manufacturer on-site to perform the repairs. The speed reducer inspection cover shall be modified to allow for the installation of the new desiccant breather and a new inspection hatch gasket installed.

Speed Reducer Oil.

M1. Span Drive Machinery Rehabilitation

Furnish Mobil Mobilgear 600 XP 220 or an approved equal for the differential speed reducer.

Furnish Mobil Mobilgear 600 XP 320 or an approved equal for the secondary speed reducers.

Furnish flushing oil that is compatible with the final oil used to fill the speed reducers.

The estimated quantity of oil to fill the differential speed reducer to the proper level is approximately 10 gallons. The estimated quantity of oil to fill each secondary speed reducer to the proper level is approximately 400 gallons.

M2. Span Lock Machinery and Centering Guide Rehabilitation

Furnish Mobil Mobilgear 600 XP 320 or an approved equal for the span lock speed reducers.

Furnish flushing oil that is compatible with the final oil used to fill the speed reducers.

The estimated quantity of oil to fill each span lock speed reducer to the proper level is approximately 10 gallons.

M7. Span Lock Machinery Rehabilitation

Furnish Mobil Mobilgear 600 XP 320 or an approved equal for the tail lock speed reducers.

Furnish flushing oil that is compatible with the final oil used to fill the speed reducers.

The estimated quantity of oil to fill each tail lock speed reducer to the proper level is approximately 15 gallons.

Bearing Seals.

M1. Span Drive Machinery Rehabilitation

Furnish bearing seals as shown on the Plans. The Contractor shall verify with the bearing manufacturer the bearing seals specified on the Plans are equivalent replacements prior to submitting shop drawings. The span drive machinery bearings were manufactured by SKF and are model number SDAF 58064 KA/12.

M2. Span Lock Machinery and Centering Guide Rehabilitation

Furnish bearing seals as shown on the Plans. The Contractor shall verify with the bearing manufacturer the bearing seals specified on the Plans are equivalent replacements prior to submitting shop drawings. The span lock bearings were manufactured by SKF and are model number SDAFS 58622.

Center Lock Actuators.

M7. Span Lock Machinery Rehabilitation

All center lock actuators shall be Acme screw type linear actuators meeting the following operational requirements:

Thrust Capacity:	8,000 lbs
Stroke:	15 inches
Speed:	1.5 inches/second
Horsepower	2HP
Nominal Voltage	240/480 VAC, 60 Hertz, 3 Phase
Duty	30 or 15 minute
Speed	1725 RPM
Frame Size	Per Manufacturer
Insulation	HHH
Service Factor	1.0

Each center lock actuator shall be trunnion mounted to a base.

Each center lock actuator shall contain four single pole, single throw internal limit switch contacts to control the travel of the actuator. Limit switch contacts shall be rated for 120 VAC, 10 Amps.

Center lock actuator motors shall be the marine duty rated, NEMA Design "D", weatherproof, totally enclosed, non-ventilated type, ball bearing, squirrel cage motor capable of withstanding instant reversal when running at full speed. Each motor shall be provided with a 15 minute duty rating and equipped with a 6 ft-lb marine duty brake with manual release. Each unit shall be equipped with a disengaging manual hand crank and disengaging mechanism with an electrical interlock switch. Refer to Item 615504 - Bridge Electrical System for general limit switch requirements. Center lock actuator motors shall have high starting torque.

Each motor shall be provided with a single-phase, 120-volt, space heater installed in the lower frame beneath the windings. The manufacturer shall determine the wattage of the heater.

Brakes for the center lock actuator motors shall be provided with a motor-mounted, totally enclosed, spring-set, 480-volt, magnetically released disc brake with rated torque approximately equal to, but not less than, motor full-load torque. Each brake shall be of dust-tight, self-adjusting, weatherproof, cast-iron construction, except modified for marine duty to comply with IEEE Standard 45, "Recommended Practice for Electrical Installations on Shipboard". The marine duty modification includes the use of brass internal parts. Each brake shall be provided with a 120-volt, 15-watt internal strip heater and a single-voltage operating coil. Each brake shall be approved equal to the Stearns 87,000 Series brake with M-Mod for marine duty, equivalent as manufactured by Harnischfeger or Dings, or approved equal.

All anti-friction bearings shall be sized for a B-10 life of 10,000 hours as defined by ABMA for the loads and ratings established by the lock bar operator manufacturer.

The center lock actuator cylinder shall be weather-proof.

All center lock actuators shall be identical and from the same manufacturer.

Center lock actuators shall be manufactured by Duff Norton or approved equal.

Balance Block Material.

Temporary and permanent balance material, as necessary, to include concrete balance blocks and steel plates as detailed in the Contract Plans.

Paint for Machinery Components.

The paint system of machinery components shall consist of a modified aluminum epoxy mastic primer and an aliphatic urethane finish coat. The following manufacturers and paint systems shall be used or an approved equal submitted for review.

1. Manufacturer: Carboline Company - Carbomastic 15 Primer, Carbothane No. 134 VOC Finish Coat
2. Manufacturer: Sherwin Williams - Epoxy Mastic Aluminum II Primer, Hi-Solids Polyurethane 250 Finish Coat
3. Manufacturer: PPG Protective and Marine Coatings - Amerlock 400 Primer, Amercoat 450H Finish Coat

<u>Construction Methods:</u>

Personnel.

For the fabrication, installation, cleaning, aligning, testing and all other work required as described, use adequate numbers of skilled, trained, and experienced mechanics and millwrights who are thoroughly familiar with the requirements and methods specified for the proper execution of the specified work. Provide personnel, including a supervisory millwright, who have a minimum of three movable bridge jobs as previous experience in the installation of bridge machinery. The installation of the machinery shall be directly supervised by a representative of the machinery manufacturer and supplier having at least ten years of similar experience.

Verification of Dimensions.

Dimensions shown on Plans are nominal and are intended for guidance only. Dimensions shall be field verified prior to fabrication of new components. All variations from the nominal dimensions shown shall be noted on the shop drawings.

Navigation Restriction.

BR 3-153, Rehoboth Avenue Bridge

It is anticipated that the work required within this Special Provision will be performed within the existing United States Coast Guard (USCG) regulations of a 24 hour notice for any bridge openings. If the Contractor requires longer notice to perform the work, a temporary deviation must be requested from the USCG. The Contractor will need to request and receive approval from the USCG prior to starting work requiring the temporary deviation at no extra cost to the Department.

BR 3-154, Savannah Road Bridge

It is anticipated that the work required within this Special Provision will be performed within the existing United States Coast Guard (USCG) regulations of a 4 hour notice for any bridge openings. If the Contractor requires longer notice to perform the work, a temporary deviation must be requested from the USCG. The Contractor will need to request and receive approval from the USCG prior to starting work requiring the temporary deviation at no extra cost to the Department.

Delivery and Storage; Protection for Shipment.

Machined surfaces shall be cleaned of dirt, chips, grit, and all other injurious materials prior to shipping and shall be given a coat of corrosion-inhibiting preservative.

Finished metal surfaces and unpainted metal surfaces that would be damaged by corrosion shall be coated as soon as practicable after finishing with a rust-inhibiting preservative. Excepting unfinished metal surfaces inside of gear reducers, this coating shall be removed from all surfaces prior to painting, after erection, and prior to operation.

Any interface between stainless steel and structural steel shall receive a coat of zinc-chromate primer prior to assembly.

New and rehabilitated components shall be completely protected from weather, dirt, and all other injurious conditions during manufacture, shipment, and storage.

Assembled units shall be mounted on skids or otherwise crated for protection during handling and shipment.

Machinery Installation Tolerances.

Machinery installation tolerances shall be in accordance with the motor, coupling, or reducer manufacturer requirements, whichever installation requirements are more stringent. The Contractor shall submit an installation procedure with the installation tolerances specified within the procedure. After installation of the components is complete, the Contractor shall document the final alignment and submit the measurements to the Engineer for review.

Welding.

Welding required for machinery shall be done in accordance with the requirements for AASHTO/AWS D.15M/D1.5:2015 Bridge Welding Code. At a minimum, the center lock guides, receiving sockets, actuator supports, and span motor and motor brake support weldment shall be stress relieved prior to final machining. Completely test all full penetration welds used to fabricate machinery by ultrasonic inspection (ASTM E164-13) according to AASHTO/AWS D.15M/ D1.5:2015 Bridge Welding Code unless noted otherwise. Testing of fillet welds shall be performed in accordance with the testing specified within AWS D1.5 for main members. Perform all machining after welding and stress relieving.

Welding joint types, sizes and details shall be shown on shop, assembly and/or working drawings.

Distortion during fabrication shall be kept to a minimum by the use of welding fixtures and proper welding procedures.

Temporary Hold Down.

M2. Span Lock Machinery and Centering Guide Rehabilitation

The Contractor shall provide means to temporarily hold down the toe end of each bascule girder when any of the span lock components (including motors, speed reducer, receiving socket, and couplings) are disconnected from the span lock machinery assembly. The contractor is required to remove the temporary hold down prior to each opening and reinstall it prior to allowing any traffic on the bridge. The temporary hold down must be capable of resisting an uplift of 22 kips at the toe of each bascule girder. The Contractor shall submit their work plan, procedures, calculations, and materials needed for the temporary hold down system to the Engineer for review. The submitted calculations shall be stamped by a Professional Engineer licensed in the State of Delaware.

Segmental Girder Chocks.

M6. Span Drive Machinery Rehabilitation

At BR 3-154, the Contractor shall furnish and install chocks at the segmental girders or another approved method to hold the leafs in the seated position when the span drive motor or any of the brakes are disconnected from the span drive machinery assembly. The chocks or approved components shall be removed prior to a bridge opening and shall be reinstalled prior to allowing traffic to cross the span. The Contractor shall submit their work plan, procedures, and materials needed to hold the leaf in the seated position to the Engineer for review.

Brake Replacement.

BR 3-153, Rehoboth Avenue Bridge

M1. Span Drive Machinery Rehabilitation

Only one motor brake may be disassembled, hand released, or removed from service at any given time.

BR 3-154, Savannah Road Bridge

M6. Span Drive Machinery Rehabilitation

The motor brake at either leaf may not be removed or disassembled unless both machinery brakes at that leaf are in service. Neither machinery brake on a leaf may be disassembled or removed unless the motor brake is in service. If one machinery brake is removed from service, the other machinery brake on that leaf must be hand released, disassembled, or removed. If any brake is removed or disassembled, chocks must be installed under each segmental girder at that leaf prior to allowing traffic to cross the bridge.

Field Testing.

Prepare a field testing procedure and submit for review to the Engineer. The testing procedure shall be coordinated with tests required for the electrical equipment and shall include measurements of power and current drawn by the motors when operating under load as required hereinafter. Do not exceed the electrical design rating of any component during testing. Field testing shall include operating the machinery utilizing the main electrical system through at least ten complete cycles.

When new equipment is ready for testing, schedule the testing with the Engineer and keep available a complete crew of mechanics and electricians to make all adjustments and corrections which shall be required to complete the tests.

During the test operations, inspect the entire mechanical system to determine whether everything is in proper working order and fully meets the requirements of the Plans and Special Provisions. The temperature

rise of all electrical components shall not exceed design ratings. If any tests show that any components are defective, inadequate, or function improperly, make all corrections, adjustments, or replacements required before the final acceptance at no additional cost to the Department. The field testing shall be repeated until no deficiencies are observed during the testing.

Baseline Testing.

Prior to commencing field work at either bridge location, the contractor shall perform baseline inspection and testing of the bridge machinery and submit findings to the Engineer for review. The inspection and testing shall include observation of the machinery during operation, a visual inspection of the components, and photographing the components. Any operational issues or observed defects that will not be repaired during the contract shall be brought to the Engineer's attention. Upon completion of the Contract, mechanical components that are not replaced shall be in equal or better condition than documented in the baseline testing report.

Shop Painting.

All unfinished machinery external surfaces shall be cleaned with final surface preparation to meet the requirements of SSPC-SP1 and SSPC-SP2.

After all proper surface preparation, all unfinished machinery surfaces except for the interior of gear reducer housings, flexible couplings, etc. shall be given one shop coat of primer by hand brushing. The primer shall be compatible with the paints selected for subsequent field coats. Coordination between the shop paint and field paint is required to utilize the same paint system.

Preparing Machinery for Field Painting.

The existing and new machinery to be painted shall be cleaned in accordance with SSPC-SP1 to remove all dirt, debris, and oil on the machinery components prior to field painting. The existing machinery components shall be prepared in accordance with SSPC-SP2 to prepare the machinery steel for field painting. At the discretion of the Engineer, power hand tools may be used to remove corrosion from mechanical components.

Field Painting.

At each bridge, prior to field painting the machinery, the contractor shall test the proposed paint system primer to ensure proper adhesion to the existing paint system. The test surface shall be selected by the Engineer and will be an approximately 1 square foot area of the machinery where the existing paint system is in good condition and tightly adhered to the component. The test surface shall be prepared for painting and a coat of the proposed primer shall be applied. After the test area has fully cured per the manufacturer's recommended duration, the area shall be inspected by the Engineer to ensure proper adhesion. If the proposed paint system does not adhere to the test area to the satisfaction of the Engineer, the testing shall be repeated with a different paint system until the paint system is approved.

After preparing the machinery component surfaces, one field coat of the primer shall be applied after all mechanical work is completed. Where necessary, apply a second touch up coat of the primer where the primer was damaged. Apply two field coats of the finish coat. The first finish coat shall be completed after all mechanical work is complete. The second finish coat shall be applied after field testing but prior to final acceptance of the machinery.

The prime and finish coats shall be applied by hand brushing, which shall color code the machinery to distinguish between fixed and moving parts. Paint for the finish coat shall be high gloss and conform to OSHA color requirements of the Safety Color Code for Marking Physical Hazards, ANSI Z53.1. The following colors shall be used:

Federal Safety Orange: For all moving parts of the machinery such as couplings, shafting, and the side of gears and brakewheels.

Federal Safety Green: For all stationary parts of the machinery including fasteners except as noted below.

Federal Standard 595 Color 33448 Dark Yellow: For all new center lock guides, receiving sockets, and stationary parts of the actuators including fasteners installed at bridge BR 3-154.

The Contractor shall take special care to avoid painting of machinery surfaces which are in normal rubbing contact, including but not limited to gear teeth, bearing journals, and shaft seals. All nameplates, legend plates, seals, etc. on machinery shall be masked for protection from paint. Motor and machinery brake frames and thrusters shall only be coated with the manufacturer's recommended paint which shall be applied by the manufacturer. Component lubricants that are contaminated with paint or cleaning material shall be replaced by the Contractor prior to operation of the machinery.

M3. Machinery Paint

The following machinery items at bridge BR 3-153 are expected to have the primer coat of paint and both finish coats applied in the shop. Areas on the shop painted machinery items where the paint is damaged prior to completion of the project shall be touched up in the field. The machinery items include but are not limited to the span drive machinery motor, span lock machinery motors, and the south span lock speed reducer housing.

M8. Machinery Paint

The following machinery items at bridge BR 3-154 are expected to have the primer coat of paint and both finish coats applied in the shop. Areas on the shop painted machinery items where the paint is damaged prior to completion of the project shall be touched up in the field. The machinery items include but are not limited to the span drive machinery motors, span drive motor brakewheels, center lock actuator, center lock machinery guides and receiving sockets, and tail lock machinery motors.

Counterweight Pocket Inventory.

Prior to performing any construction work, the counterweight pockets shall be inventoried and the results submitted for the Engineer for review. This work shall include inspecting each counterweight pocket and organizing balance material that has fallen out of position, or not neatly stacked, and as directed by the Engineer, in order to accurately determine location of each block. The following table shall be completed for each of the bascule leafs as per the Span Balance plans shown on the Contract Drawings.

CTWT Pocket	# of Blocks	Weight of Block	X	Y	Z	X-Moment	Y-Moment	Z-Moment
1								
2								
3								
4								
Total								

This table shall be modified and/or expanded as necessary to account for the different bridge counterweight pockets, variation in balance material size, weight and location of blocks that may be encountered.

Span Balance Calculations.

A Professional Engineer licensed in the State of Delaware shall perform the balance calculations. The quantity and location of balance material required within the counterweight pockets and other span balancing locations - including concrete balance blocks, balance plates, and other balance material - based on the specified balance requirements and the weight and center of gravity of each bascule leaf shall be computed. These calculations shall be based on weights of final reviewed shop details and material tests for the actual material installed on the bascule span. The balance calculations shall incorporate the distributions of leaf weight in the vertical, longitudinal and transverse directions. Balance calculations are required to develop balance summary tables required for all phases of work, as specified herein.

Balance summary tables shall be developed and shown on the shop drawings. The format of these tables shall be in accordance with the balance tables shown in the Drawings. Summary tables shall be developed for all phases of the balance and the proposed imbalances. Temporary and permanent balance material shall be accounted for in the summary tables.

For all balance summary table submittals, a narrative shall be included with the outline of the proposed balance phasing, the duration of the imbalance condition, and all other aspects of the work in accordance with the accepted construction schedule. This information shall be coordinated with the Contractor's scheduling requirements. The balance calculations and summary tables shall be updated by the Contractor throughout construction and be submitted to the Engineer periodically as required to meet the requirements in these Specifications and in the Plans.

Span Balancing.

The Contractor shall place and adjust the balance blocks and other balance material within the counterweight pockets. This includes repeated readjustment of balance material, as necessary, until the span is balanced as required.

Engineer review of the balance calculations and quantity and location of balance material does not relieve the Contractor from making such changes in the counterweights and balance material as deemed necessary to balance each leaf. All changes shall be submitted for review.

The contractor shall balance each bridge throughout the duration of the Contract to account for weight added or removed from each bascule leaf. The Contractor shall notify the Engineer in writing two (2) weeks prior to any significant weight addition or removal from the bascule leaf(s). Tasks considered to result in significant weight addition or removal include replacement of span lock machinery, sidewalk replacement, installation of floorbeam cover plates, or other similar work. At the Engineer's discretion, the Contractor shall make all necessary calculations and balance adjustments necessary to balance the leaf(s) in all directions.

Strain Gauge Testing.

The Contractor shall perform strain gauge balance testing to measure the actual imbalance moment and determine the location of the leaf center of gravity at least three times:

1. Initial Balance Test - Prior to starting work, the span balance shall be determined by use of the strain gauge method.
2. Pre-Final Balance Test - After all construction work has been performed and after balance block adjustments have been made.
3. Final Balance Test - After the Pre-Final balance test was completed, the span balance spreadsheet was adjusted, and the final balance block adjustments have been made.

The imbalance of the movable span shall be measured using the dynamic strain gauging technique. The Contractor shall furnish and install all equipment, materials, instruments and labor necessary to determine the imbalance by dynamic strain gauging.

1. The Contractor shall employ the services of an established testing company experienced in dynamic strain gauge measurement of movable bridge imbalance, subject to review by the Engineer. Such experience shall be demonstrated by identifying a minimum of six movable bridges, including at least two trunnion bascule bridges and two rolling lift bascule bridges, for which the company has provided complete and satisfactory dynamic strain gauge measurements and reporting. The measurements shall be made under the immediate direction of a Professional Engineer registered in the State of Delaware who has had hands-on experience measuring movable span imbalance by the dynamic strain gauge procedure.

2. The strain gauge testing company shall furnish and install the required strain gauges, all cabling and transmission equipment, data acquisition equipment and produce fully documented reports detailing the results of the measurements.

3. The testing company shall submit the following items to the Engineer for review:
   a. Description of experimental procedure including type and method of installation of strain gauge rosettes, method of transmission of low level signals, and data acquisition equipment.

b. Layout of span drive machinery showing proposed location of strain gauges, amplifiers, cable or radio links, data acquisition equipment and all associated cabling.
c. Details of method of transmission of signals from shafting to data acquisition units.
d. Elementary wiring diagrams of interconnection of strain gauges, amplifiers, and data acquisition equipment.
e. Sample computations of: shaft torque from measured strains, span imbalance, curve fitting and basis for friction correction.

Strain gauge and equipment installation, strain measurement, torque calculations, and span imbalance presentation shall be in accordance with the following:

1. Two foil resistance strain gauge rosettes shall be affixed to each of the main drive shafts, in accordance with the strain gauge manufacturer's installation instructions. The strain gauge rosettes shall be comprised of 2-arm 90 degree gauges mounted such that the grids are oriented at 45 degrees with the shaft axis and the two rosettes shall be affixed "back-to-back", spaced 180 degrees apart circumferentially. The gauges shall be connected such that any bending strains in the shafts will be canceled and only torsional shearing strains will be measured on each drive shaft. The areas of the shafts where the gauges are to be mounted shall be sufficiently cleaned to remove all contaminants.

2. The strain gauge leads on each shaft shall be connected to a four arm amplifier. Transmission of signals from the gauges to the data acquisition equipment shall be either through cable links or amplified and then through wireless transmitters.

3. Output leads from each channel of the amplifiers shall be connected to a computer-based data logger provided with a two-channel strain gauge module streaming the amplified data to disk at a minimum 50-Hz sample rate. An inclinometer shall be provided to provide continuous leaf angle to the datalogging equipment.

4. The strains in both shafts shall be recorded simultaneously versus span opening angle during opening and closing operations to a suitable scale. The readings for all shafts shall be recorded at the same strain scale. At least 3 opening/closing runs shall be made for each leaf, when the wind speed is less than 5 MPH and the bridge deck is visibly dry. Wind-up torque in the operating machinery shall be released prior to each run as verified by space between the faces of the engaged teeth of main pinion and gears.

5. The strains induced in the shafts shall be numerically converted to torque by applying fundamental stress-strain relationship calculations for each strain plot for both opening and closing. This data shall be processed to give leaf imbalance (kip-feet) versus opening angle, corrected for friction, at each center of rotation. Plots of total span imbalance shall be prepared from the data.

The Contractor shall submit the report documenting the results of the initial strain gauge measurements. The reports shall contain the following:

1. Description of experimental procedure and equipment used.
2. Span drive diagram showing location at which strain gauges were attached and all applicable gear ratios.
3. Torque data plots for the full range of bridge openings. They shall be annotated with a title, axis labels with units, angle of opening, etc.
4. Description of relationships and sample calculations for obtaining shaft torque from strains, span imbalance from shaft torque, curve fitting and basis for friction correction.
5. Plots of the following parameters versus degree of opening during each opening/closing run and fitted to balance curves corrected for friction:
   a. Total imbalance (kip-feet) for span.
   b. Frictional moment (kip-feet) for span.
6. Tabulation of imbalance moment at seated position for each leaf/run including the average value for each leaf.
7. The location of the leaf center of gravity.

The reports shall include an introductory section giving the name of the bridge, the date of the measurements, weather conditions during measurements and any other information requested by the Engineer.

The Contractor shall submit the combined Pre-Final and Final balance report together in a single report, similar in content to the initial report.

Temporary Span Balance Requirements During Construction.

The span balance for each bridge shall remain acceptable during construction if the span remains within the following conditions.

Bridge BR 3-153

The span balance shall be maintained throughout construction within the following range:

1. Toe Reaction: 1,000 to 5,000 lb
2. Angle of the Center of Gravity: -50 degrees to +50 degrees

Bridge BR 3-154

The span balance shall be maintained throughout construction within the following range:

1. Toe Reaction: 500 to 3,000 lb
2. Angle of the Center of Gravity: -40 degrees to +50 degrees

Final Span Balance Requirements.

The final span balance for each bridge shall meet the following conditions.

Bridge BR 3-153

1. Toe Reaction: 2,000 to 4,000 lb
2. Angle of the Center of Gravity: 0 degrees to +20 degrees

Bridge BR 3-154

1. Toe Reaction: 800 to 2,500 lb
2. Angle of the Center of Gravity: 0 degrees to +50 degrees

Guarantee and Warranties.

1. **Manufacturers' Warranties.** Manufacturer's warranties or guarantees on equipment, materials or products purchased for use under this Contract which are consistent with those provided as customary trade practice, shall be obtained by the Contractor and, upon acceptance of the Contract, the Contractor shall assign to the State, all manufacturer's warranties or guarantees on all such equipment, material or products furnished for or installed as part of the Work.
2. **Contractor's Warranty.** The Contractor's warranty for all machinery work within this Item shall extend for a period of one year following the date of final acceptance of the Project.

Method of Measurement:

Item 615503, BRIDGE MECHANICAL SYSTEM, will not be measured.

Basis of Payment:

The work will be paid for at the contract bid price for lump sum for Item 615503 - BRIDGE MECHANICAL SYSTEM. This price shall include all labor, tools, equipment, material, strain gauge balancing, maintaining span balance, and incidentals necessary to satisfactorily complete the work in accordance with the Contract Plans and Special Provisions. The lump sum bid for Item 615503 shall be the sum of the cost associated with the work performed at each bridge listed. The completed Breakout Sheets shall be submitted with the bid documents or within seven (7) calendar days following the bid due date by the lowest apparent bidder as specified in the "Breakout Sheet Instructions" page included in the "Bid Proposal Forms" section. Failure to submit the breakout sheets will result in the Bid Proposal being declared non-responsive and rejected.

615504 - BRIDGE ELECTRICAL SYSTEM

Description:

The work under this Section shall consist of furnishing all labor, materials, plant and equipment, and performing all work necessary to furnish and install electrical equipment and controls for operation of the bascule span and its auxiliaries, all as specified herein and indicated on the Contract Drawings.

Any incidental apparatus, appliance, material, or labor not specifically mentioned or included in the Contract Documents that may be found necessary to comply with the requirements of the related documents and referenced standards or codes shall be furnished by the Contractor at no additional cost to the Delaware Department of Transportation (DelDOT).

Standards

All electrical equipment and its installation shall conform to the requirements of the latest revision of the following codes and standards, except as may be otherwise provided herein:

1. American Association of State Highway and Transportation Officials (AASHTO)
2. National Electrical Code (NEC)
3. American Society for Testing and Materials (ASTM)
4. American National Standards Institute (ANSI)
5. National Electrical Manufacturers Association (NEMA)
6. National Electrical Contractors Association (NECA)
7. InterNational Electrical Testing Association (NETA)
8. Underwriters Laboratories, Inc. (UL)
9. National Fire Protection Association (NFPA)
10. Institute of Electrical and Electronic Engineers (IEEE)
11. Occupational Safety and Health Administration (OSHA).
12. Insulated Power cable Engineers Association (IPCEA).

BR 3-153, Rehoboth Avenue Bridge

E1. Control Cabinets

The work under control cabinets shall include the following:

1. Furnish and install new components on a new back panel(s) as specified and shown on the plans and mount in the existing enclosures.
2. Furnish and install a new enclosure to house the PLC (Programable Logic Controller) and associated equipment and install in the Switchboard Room as specified and as shown on the plans.
3. Program and make adjustments to the PLC system as specified herein and submit ladder logic for review and approval.
4. Furnish spare parts as specified herein and deliver to DelDOT.
5. Develop shop drawings related to the new back panel and new cabinet including component cut sheets and submit for review and approval.

E2 Control Desk

The work under control desk shall include the following:

1. Develop shop drawings including component cut sheets related to the new control desk and submit for review and approval.
2. Furnish and install new control desk in the Control Room as specified and shown on the plans.
3. Furnish spare parts as specified and deliver to DelDOT.
4. Coordination of the PLC system with the TMC network.

E3 Flux Vector Drive

The work under flux vector drive shall include the following:

1. Develop shop drawings including component cut sheets related to the new drive system and submit for review and approval.
2. Furnish and install new flux vector drive and associated accessories on a new back panel(s) and mount in the existing enclosure as specified and shown on the plans.
3. Perform drive load testing as specified using a dynometer prior to factory control system testing.
4. Program and make adjustments to the drive system as specified herein and submit key programing parameters.
5. Furnish spare parts as specified herein and deliver to DelDOT.

E4 Automatic Transfer Switch (ATS)

The work under automatic transfer switch shall include the following:

1. Develop shop drawings including component cut sheets related to the ATS system and submit for review and approval.
2. Furnish and install new Automatic Transfer Switch (ATS) and associated equipment in a new enclosure in the Generator Room as specified and shown on the plans.
3. Furnish spare parts as specified herein and deliver to DelDOT.

E5 Limit Switches

The work under limit switches shall include the following:

1. Furnish and install the following limit switches and sensors as specified and shown on the plans: resolver, fully closed, over travel, speed switch, span manual operation, span locks interlocking, span lock manual operation.
2. Adjust all limit switches with the settings as shown on the plans. Readjustment will be required for proper operation during final testing.
3. Furnish spare parts as specified herein and deliver to DelDOT.
4. Develop shop drawings including component cut sheets and mounting details related to the limit switches and submit for review and approval.

E6 Motors

The work under motors shall include the following:

1. Develop shop drawings including component cut sheets related to the motors and submit for review and approval.
2. Furnish span motor and span lock motors as specified.
3. Perform motor shop testing as specified for all motors supplied.
4. Furnish spare parts as specified herein and deliver to DelDOT.

E7 Motor Brakes and Machinery Brakes

The work under brakes shall include the following:

1. Develop shop drawings including component cut sheets related to the brakes and submit for review and approval.
2. Furnish two new motor brakes to replace the existing units as shown on the plans.
3. Furnish and install new brake released, brake hand released, and brake set limit switches as specified and connect as shown on the plans.
4. Furnish spare parts as specified and deliver to DelDOT.

E8 Modifications to Warning and Barrier Gates

The work under modifications to warning and barrier gates shall include the following:

1. Develop shop drawings including component cut sheets and mounting details related to the warning and barrier gate modifications and submit for review and approval.
2. Reconnect existing and new equipment for the gates as shown and indicated on the plans.
3. Replace all existing wiring within the gate housing with single conductor No. 12 AWG.
4. Furnish and install flashers for each barrier and warning gate as specified inside the housing of each gate and connect as shown on the plans.
5. Furnish and install new flexible cables for gate arm lights to accommodate 2 flashing circuits and one steady circuit plus a ground conductor.
6. Reconnect existing warning and barrier gate motor for 480VAC, 3 phase operating voltage.
7. Furnish and install new door switches as specified and connect as shown on the plans.
8. Furnish and install disconnect switch as specified and connect as shown on the plans.
9. Connect existing heater and receptacle circuits to the new panelboards.
10. Furnish spare parts as specified herein and deliver to DelDOT.

E9 Motor Disconnect Switches

The work under motor disconnect switches shall include the following:

1. Develop shop drawings including component cut sheets and mounting details related to the motor disconnect switches and submit for review and approval.
2. Furnish and install motor disconnect switches in sight of each motor as specified and connect as shown on the plans.
3. Furnish spare parts as specified herein and deliver to DelDOT.

E10 Electrical Cable, Wire and Connections

The work under electrical cable, wire and connections shall include the following:

1. Develop shop drawings including component cut sheets and mounting details related to the electrical wire and cable and submit for review and approval.
2. Furnish and install new wiring inside conduit, wireways and other raceways as specified and shown on the plans.
3. Furnish and install ground systems and conductors as specified and shown on the plans.
4. Furnish and install new flexible droop cables as specified and shown on the plans.
5. Install security system wiring furnished by others in coordination with DelDOT's contractor for security and camera systems (only where installed in common raceways).
6. Coordinate with DelDOT's security contractor on their installation of wiring where not installed in common raceways.
7. Test, tag and connect each conductor at termination points inside control enclosures, the control desk, and termination boxes.

E11 Electrical Conduit, Fittings and Boxes

The work under electrical conduit, fittings and boxes shall include the following:

1. Furnish and install new conduit, wireways, troughs, boxes, vaults, junction wells and fittings as specified and shown on the plans. Remove and dispose of existing conduit, wire, junction wells, etc as shown on the plans.
2. Furnish and install new conduit and box supports as specified and shown on the plans.
3. Clean the interior of each section of new and existing conduit prior to installation of wire.
4. Core drill through walls and floors to accommodate new conduit and associated equipment.
5. Patch existing holes and openings after removal of existing conduit and raceways systems.
6. Saw cut existing sidewalk and repair to accommodate new conduit or roadway equipment.
7. Furnish and install trenches as required to accommodate new conduit.
8. Furnish and install new back panels in the specified terminal boxes as specified and shown on the plans.
9. Tag each conduit with a designation number noted in the approved conduit shop drawings
10. Develop shop drawings including component cut sheets, mounting and installation details, and conduit block diagram related to the electrical conduit, fittings, and boxes and submit for review and approval.

11. Coordinate with DelDOT's security contractor for installation of conduit associated with the security system.

E12 Incoming Service and Generator Modifications

The work under incoming service and generator modifications shall include the following:

1. Develop shop drawings including component cut sheets related to the incoming service and generator modifications and submit for review and approval.
2. Coordination with local electrical utility company, Delmarva Power & Light (DPL) to furnish, install, connect and energize new 480VAC incoming service.
3. Provide DPL with access to the bridge, roadway and surrounding areas to furnish and install conduit, wire and other related incoming service equipment which may include road closures, MOT and other safety measures and equipment.
4. Coordination with stand-by generator manufacturer and reconnection of generator and all accessories with 480VAC, 3 phase system.
5. Adjustment of all generator control parameters to meet new requirements.
6. Furnish and install the generator fuel sensor and connect to PLC.
7. Replace fuel lines in-kind between the generator, fuel tank, overflow tank and fuel supply fill location.
8. Fill the generator fuel tank with a minimum of 225 gallons of diesel fuel at project completion and provide fuel as required to maintain generator operation.

E13 Field Measuring

The work under field measuring shall include the following:

1. Field verification and measurements of dimensions, sizes, and/or features to achieve the proper fit-up of new and/or existing components and equipment.
2. Note any existing dimensions or features which in the opinion of the Contractor deviate from the contract documents or as-built drawings and which may impact the installation or alignment of machinery or electrical components.
3. At the direction of the Engineer, note any existing dimensions or features which deviate from the contract documents or as-built drawings and which may impact the installation or alignment of machinery or electrical components.
4. Measure and verify locations for lights, switches and receptacles.
5. Measure and verify locations for control cabinets and back panels, supports, and boxes.
6. Measure and verify entry pathways for installing equipment.
7. Measure and verify locations for conduit runs and boxes.
8. Measure and verify locations for disconnect switches, cabinets, control desk, AC unit, heating units, panels, and other enclosures.
9. Measure and verify submarine cable conductors, terminal cabinets, and support locations.
10. Measure and verify locations for droop cables, support and boxes.
11. Measure and verify locations for limit switches.
12. Measure and verify locations for motors, brakes, disconnect switches, panels, and other enclosures.
13. Measure and verify fender locations for conduit, navigation lights, marker and air horn
14. Measure and verify locations for roadway equipment and operation.
15. Measure and verify locations of incoming service, pole, meter and disconnect switch.
16. Measure and verify existing warning gates and barrier gates for proposed modifications.

E14 Bridge Operation during Construction

The work under bridge operation during construction shall include the following:

1. Develop shop drawings related to the bridge operation during construction including component cut sheets for any temporary equipment along with operation and maintenance procedures and submit for review and approval.
2. Coordination with all trades and work throughout the duration of the contract to maintain operability of the bridge.
3. Furnish and install mechanical and electrical equipment required to operate the bridge in a temporary fashion as specified.

4. Provided qualified and trained bridge operators and other personnel to operate the bridge in accordance with USCG requirements.
5. Testing of temporary bridge operations using approved methods and equipment in the presence of DelDOT and the Engineer.
6. Maintenance of new and existing mechanical and electrical equipment per manufacturers recommendations and DelDOT's latest Operation and Maintenance Manuals for the bridge until completion of the contract.

E15 Miscellaneous Equipment

The work under miscellaneous equipment shall include the following:

1. Develop shop drawings including component cut sheets related to the miscellaneous equipment noted below and submit for review and approval.
2. Furnish and install receptacles, switches, lights, hot water heater, electric heaters, panelboards, and transformers as specified and shown on the plans.
3. Furnish and install electronic thermostats, as specified for each room to control the heating system.
4. Reconnect existing roadway lighting to new power system at 277V. Verify whether existing LED ballasts or drivers are configured for 277V operation and make adjustments as needed (setting DIP switches, rewiring, etc.).
5. Furnish and install photo cells for roadway lighting and navigation lighting.
6. Furnish and install new span and fender navigation lights to replace existing units.
7. Furnish and install marine air horn on the control house.
8. Furnish and install fire alarm system, as shown on the plans, and specified herein.
9. Furnish spare parts, as specified herein, and deliver to DelDOT.

E16 Testing

The work under testing shall include the following:

1. Submit for review and approval test procedures and forms to be used during factory and field testing. Following successful testing, submit all completed forms and procedures.
2. Perform the specified factory inspection and testing on the control system, including drives, control enclosures, PLC's and motors.
3. Perform insulation resistance testing on all motors, wires and cables
4. Perform factory load testing using actual motors and drives connected to a dynamometer.
5. Perform field acceptance testing on the completed mechanical and electrical system as specified.
6. Perform testing of the PLC alarms with the TMC network.

E17 Technical Manuals and Training

The work under technical manuals and training shall include the following:

1. Perform training as specified on operational, maintenance and troubleshooting of mechanical and electrical equipment.
2. Compile cut sheets, manufacturer's literature, maintenance instructions, test data, shop drawings, contact information for mechanical and electrical equipment and submit for review and approval.
3. Develop an operational manual covering all modes of operation and submit for review and approval.
4. Develop and compile as-built drawings for mechanical and electrical equipment and systems and submit for review and approval.

E18 Removal of Electrical Equipment

The work under removal of electrical equipment shall include the following:

1. Removal and disposal of existing electrical equipment which is designated to be replaced in these contract documents and where removal may not be explicitly noted.
2. Removal and disposal of indicated existing electrical equipment noted in the plans or specifications to be removed.
3. Travel to and from disposal sites by the Contractor to dispose of equipment
4. Shipping and/or travel cost to deliver indicated equipment to DelDOT.

5. Disposal costs to deliver and unload existing equipment .
6. All equipment and access means to properly remove indicated equipment.

BR 3-154, Savannah Road Bridge

E19. Control Cabinets

The work under control cabinets shall include the following:

1. Develop shop drawings including component cut sheets related to the new cabinets and submit for review and approval.
2. Furnish and install new control enclosures in the Switchboard Room as specified and shown on the plans.
3. Program and make adjustments to the PLC system as specified herein and submit ladder logic for review and approval.
4. Furnish spare parts as specified herein and deliver to DelDOT.

E20 Control Desk

The work under control desk shall include the following:

1. Furnish and install new control desk in the Control Room as specified and shown on the plans.
2. Furnish spare parts as specified and deliver to DelDOT.
3. Develop shop drawings including component cut sheets related to the new control desk and submit for review and approval.
4. Coordination of the PLC system with the TMC network.

E21 Flux Vector Drive

The work under flux vector drive shall include the following:

1. Develop shop drawings including component cut sheets related to the new drive system and submit for review and approval.
2. Furnish and install new flux vector drives and associated accessories in a new enclosure in the Switchboard Room as specified and shown on the plans.
3. Perform drive load testing as specified using a dynometer prior to factory control system testing.
4. Program and make adjustments to the drive system as specified herein and submit key programming parameters.
5. Furnish spare parts as specified herein and deliver to DelDOT.

E22 Automatic Transfer Switch (ATS)

The work under automatic transfer switch shall include the following:

1. Develop shop drawings including component cut sheets related to the ATS system and submit for review and approval.
2. Install existing/new Automatic Transfer Switch (ATS) in a new enclosure in the West Machinery Room with new associated equipment as specified and shown on the plans.
3. Modify the existing ATS to operate with 480VAC, 3 phase system or provide new ATS switch as specified.
4. Furnish spare parts as specified herein and deliver to DelDOT.

E23 Limit Switches

The work under limit switches shall include the following:

1. Develop shop drawings including component cut sheets and mounting details related to the limit switches and submit for review and approval.
2. Furnish and install the following limit switches and sensors as specified and shown on the plans: resolver, span position, fully closed, over travel, speed switch, span manual operation, tail lock manual operation, tail lock interlocking.

3. Adjust all limit switches to achieve the settings as shown on the plans. Readjustment will be required for proper operation during final testing.
4. Furnish spare parts as specified herein and deliver to DelDOT.

E24 Motors

The work under motors shall include the following:

1. Develop shop drawings including component cut sheets related to the motors and submit for review and approval.
2. Furnish span motor and tail lock motors as specified.
3. Perform motor shop testing as specified for all motors supplied.
4. Furnish spare parts as specified herein and deliver to DelDOT.

E25 Motor Brakes and Machinery Brakes

The work under motor brakes and machinery brakes shall include the following:

1. Develop shop drawings including component cut sheets related to the brakes and submit for review and approval.
2. Furnish new motor brakes and machinery brakes as specified and shown on the plans.
3. Furnish and install new brake released, brake hand released and brake set limit switches as specified and as shown on the plans.
4. Furnish spare parts as specified and deliver to DelDOT.

E26 Modifications to Warning Gates

The work under modifications to warning gates shall include the following:

1. Develop shop drawings including component cut sheets and mounting details related to the warning and barrier gate modifications and submit for review and approval.
2. Reconnect existing and new equipment for the gates as shown and indicated on the plans.
3. Replace all existing wiring within the gate housing with single conductor No. 12 AWG.
4. Furnish and install one flasher unit for each warning gate inside the housing of each gate as specified and as shown on the plans.
5. Furnish and install new flexible cables for gate arm lights to accommodate 2 flashing circuits and one steady circuit plus a ground conductor.
6. Furnish and install new traffic signal supports, signage and signal heads as shown on the plans.
7. Furnish and install new door switches as specified and as shown on the plans.
8. Furnish and install disconnect switches as specified and as shown on the plans.
9. Furnish and install new traffic stop lines at the traffic signals as specified.
10. Connect existing heater and receptacle circuits to the new panelboards.
11. Furnish spare parts as specified herein and deliver to DelDOT.

E27 Motor Disconnect Switches

The work under motor disconnect switches shall include the following:

1. Develop shop drawings including component cut sheets and mounting details related to the motor disconnect switches and submit for review and approval.
2. Furnish and install motor disconnect switches in sight of each motor as specified and as shown on the plans.
3. Furnish spare parts as specified herein and deliver to DelDOT.

E28 Electrical Cable, Wire and Connections

The work under electrical cable, wire and connections shall include the following:

1. Develop shop drawings including component cut sheets and mounting details related to the electrical wire and cable and submit for review and approval.

2. Furnish and install new wiring inside conduit, wireways and other raceways as specified and shown on the plans.
3. Furnish and install ground systems and conductors as specified and shown on the plans.
4. Furnish and install new flexible droop cables as specified and shown on the plans.
5. Install security system wiring furnished by others in coordination with DelDOT's contractor for security and camera systems (only where installed in common raceways).
6. Coordinate with DelDOT's security contractor on their installation of wiring where not installed in common raceways.
7. Test, tag and connect each conductor at termination points inside control enclosures, the control desk, and termination boxes.

E29 Electrical Conduit, Fittings and Boxes

The work under electrical conduit, fittings and boxes shall include the following:

1. Furnish and install new conduit, wireways, troughs, boxes, vaults, junction wells and fittings as specified and shown on the plans. Remove and dispose of existing conduit, wire, junction wells, etc as shown on the plans.
2. Furnish and install new conduit and box supports as specified and shown on the plans.
3. Clean the interior of each section of new and existing conduit prior to installation of wire.
4. Core drill through walls and floors to accommodate new conduit and associated equipment.
5. Patch existing holes and openings after removal of existing conduit and raceways systems.
6. Furnish and install trenches as required to accommodate new conduit.
7. Furnish and install new back panels in the specified terminal boxes as specified and shown on the plans.
8. Tag each conduit with a designation number noted in the approved conduit shop drawings
9. Develop shop drawings including component cut sheets, mounting and installation details, and conduit block diagram related to the electrical conduit, fittings, and boxes and submit for review and approval.
10. Coordinate with DelDOT's security contractor for installation of conduit associated with the security system.

E30 Incoming Service and Generator Modifications

The work under incoming service and generator modifications shall include the following:

1. Develop shop drawings including component cut sheets related to the incoming service and submit for review and approval.
2. Coordination with local electrical utility company, Lewes BPW to connect and energize new 480VAC incoming service.
3. Provide Lewes BPW with access to the bridge, roadway and surrounding areas to furnish and install conduit, wire and other related incoming service equipment which may include road closures, MOT and other safety measures and equipment.
4. Coordination with stand-by generator manufacturer and reconnection of generator and all accessories with 480VAC, 3 phase system.
5. Adjustment of all generator control parameters to meet new requirements.
6. Fill the generator fuel tank such that it is 75% full of propane fuel at project completion and provide fuel as required to maintain generator operation.

E31 Field Measuring

The work under field measuring shall include the following:

1. Field verification and measurements of dimensions, sizes, and/or features to achieve the proper fit-up of new and/or existing components and equipment.
2. Note any existing dimensions or features which in the opinion of the Contractor and/or the Engineer deviate from the contract documents or as-built drawings and which may impact the installation or alignment of machinery or electrical components.
3. Measure and verify locations for lights, switches and receptacles.
4. Measure and verify locations for control and back panels, supports, and boxes.
5. Measure and verify entry pathways for installing equipment.
6. Measure and verify locations for conduit runs and boxes.

7. Measure and verify locations for disconnect switches, cabinets, control desk, AC unit, heating unit, panels, and other enclosures.
8. Measure and verify submarine cable conductors, terminal cabinets, and support locations.
9. Measure and verify locations for droop cables, support and boxes.
10. Measure and verify locations for limit switches.
11. Measure and verify locations for motors, brakes, disconnect switches, panels, and other enclosures.
12. Measure and verify fender locations for conduit, navigation lights, marker and air horn
13. Measure and verify locations for roadway equipment and operation.
14. Measure and verify locations incoming service, pole, meter and disconnect switch
15. Measure and verify existing warning gates and barrier gates for proposed modifications

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E32 Bridge Operation during Construction

The work under bridge operation during construction shall include the following:

1. Develop shop drawings including component cut sheets and procedures related to the bridge operation during construction and submit for review and approval.
2. Coordination with all trades and work throughout the duration of the contract to maintain operability of the bridge.
3. Furnish and install mechanical and electrical equipment required to operate the bridge in a temporary fashion as specified.
4. Provided qualified and trained bridge operators and other personnel to operate the bridge in accordance with USCG requirements.
5. Testing of temporary bridge operations using approved methods and equipment in the presence of DelDOT and the Engineer.
6. Maintenance of new and existing mechanical and electrical equipment per manufacturers recommendations and DelDOT's latest Operation and Maintenance Manuals for the bridge until completion of the contract.

E33 Miscellaneous Equipment

The work under miscellaneous equipment shall include the following:

1. Develop shop drawings including component cut sheets and procedures related to miscellaneous equipment and submit for review and approval.
2. Furnish and install receptacles, switches, lights, hot water heater, electric heaters, panelboards, and transformers as specified and shown on the plans.
3. Reconnect existing roadway lighting to new power system at 277V. Verify whether existing LED ballasts or drivers are configured for 277V operation and make adjustments as needed (setting DIP switches, rewiring, etc.).
4. Furnish and install photo cells for roadway lighting and navigation lighting.
5. Furnish and install new span and fender navigation lights to replace existing units.
6. Reconnect existing lighting and other miscellaneous equipment to remain.
7. Furnish and install marine air horn on the control house.
8. Furnish and install fire alarm system as shown on the plans and specified herein.
9. Furnish spare parts as specified herein and deliver to DelDOT.

E34 Testing

The work under testing shall include the following:

1. Perform the specified factory inspection and testing on the control system including drives, control enclosures, PLC's and motors.
2. Perform insulation resistance testing on all motors, wires and cables
3. Perform factory load testing using the actual motors and drives using a dynamometer.
4. Perform field acceptance testing on the completed mechanical and electrical system as specified.
5. Submit, for review and approval, test procedures and forms to be used during factory and field testing. Following successful testing submit all completed forms and procedures.
6. Perform testing of the PLC alarms with the TMC network.

E35 Technical Manuals and Training

The work under technical manuals and training shall include the following:

1. Perform training as specified on operation, maintenance, and troubleshooting of mechanical and electrical equipment.
2. Compile cut sheets, manufacturer's literature, maintenance instructions, test data, shop drawings, and contact information for mechanical and electrical equipment and submit for review and approval.
3. Develop operational manual covering all modes of operation and submit for review and approval.
4. Develop and compile as-built drawings for mechanical and electrical equipment and systems and submit for review and approval.

E36 Removal of Electrical Equipment

The work under removal of electrical equipment shall include the following:

1. Removal and disposal of existing electrical equipment which is designated to be replaced in these contract documents and where removal may not be explicitly noted.
2. Removal and disposal of indicated existing electrical equipment noted in the plans or specifications to be removed.
3. Travel to and from disposal sites by the Contractor to dispose of equipment.
4. Shipping and/or travel cost to deliver indicated equipment to DelDOT.
5. Disposal costs to deliver and unload existing equipment.
6. All equipment and access means to properly remove indicated equipment.

Materials:

General Requirements

All equipment and materials to be furnished shall be new unless otherwise specified elsewhere. All equipment, materials, and workmanship shall be first class in every particular and shall be manufactured and erected to the satisfaction of the Engineer. Any piece of equipment which is found to be defective or damaged in any way must be replaced at no additional cost to DelDOT.

The Contractor shall warrantee the in service working of the electrical installations for one year or the manufacturer's warranty period, whichever is greater, following project acceptance by DelDOT. If the Contractor has any objection to any feature of the electrical equipment as designed or arranged, he must state his objection in writing to the Engineer prior to submittal of shop drawings, otherwise his objection will not be accepted if offered as an excuse for malfunctioning of the equipment or for defective or broken apparatus. Changes shall be made at the discretion of the Engineer.

Prior to installation, electrical equipment shall be stored in a temperature and humidity controlled environment. Damage to electrical equipment caused by moisture and/or weather conditions will require replacement. Once the equipment is installed but prior to acceptance of the bridge by DelDOT the Contractor will be responsible for maintaining the equipment in like-new condition and follow all manufacturer maintenance requirements. Equipment which is damaged in any way at the Engineers discretion shall require replacement at no additional cost to DelDOT.

Each piece of electrical equipment and apparatus shall have a corrosion resistant nameplate screwed in place on which is stamped the name of the manufacturer, rating or capacity of the equipment or apparatus, catalog number, serial number, etc.

All metal parts of the installation, except structural steel, shall be of corrosion resisting material, such as bronze or stainless steel. Cast iron, malleable iron or steel with a hot-dip galvanized finish shall be used where specified herein.

In general, all mounting hardware and all wire and cable terminals shall be vibration resistant. If any departures from the Contract Plans or Specifications are deemed necessary by the Contractor, details of such departures, and the reasons for such departures shall be submitted for approval as soon as practicable. No such departures shall be made nor work started without the written approval of the Engineer.

Sole Source Equipment

The Contractors attention is directed to the various sole source items for PLC equipment (Allen Bradley Control Logix), span drive equipment (Allen Bradley Power Flex 753 or Control Techniques M700) and general control equipment (Square D). Information regarding sole source products are specified elsewhere. No substitutions shall be granted for these items other than alternate part and model numbers that may be required due to obsolescence of equipment or to adjust the specified equipment for proper operation.

Bridge Control System Vendor.

All apparatus and equipment comprising the bridge control system, including, but not limited to, motor brakes, motors, motor encoders, speed switches, limit switches, back panels, cabinets, drives, control desk, resolvers, PLC equipment, transformers and other apparatus required to provide a complete functioning system, shall be manufactured and/or furnished, assembled and integrated by a single qualified control system vendor. The vendor shall assemble all panels and cabinets at an Underwriters Laboratory approved facility in accordance with UL 508.

The control system vendor shall have experience in providing electrical control systems for movable highway bridges of various types, including bascule, vertical lift, and/or swing bridges with PLC control systems, including flux vector control of vector-duty motors and HMI touchscreen-controlled systems. Such experience shall be demonstrated by identifying a minimum of five (5) movable bridges for which the system vendor has provided ans fabricated similar systems within the past five (5) years. Pre-approved vendors are listed below who are known to meet these requirements.

(a) Panatrol Corporation (630-655-4700)
(b) EHM (954-981-0023)
(c) TSR Electric (410-355-8700)
(d) Faith Technologies (631-793-4019)

The control system vendor shall assume complete system responsibility for the integrated functioning of all components to provide a satisfactory assembled system operating in accordance with specified requirements. The control system vendor shall be responsible for the detailed schematics and fabrication of the total control and power distribution system to ensure compatibility of equipment and suitability for the intended system functionality, including testing and tuning portions of the existing electrical system which must interface with the new equipment. The vendor shall provide supervisory assistance in the installation of equipment at the bridge site to ensure correct field wiring, maximum reliability, and ease of maintenance.

The system vendor shall provide a field service staff having the capability of providing services for field coordination of construction and final adjustments to the bridge control systems. Upon final acceptance of the bridge by DelDOT, the system vendor's staff shall provide on call warranty service for a period of one year.

The Contractor shall provide written certification of compliance with specified requirements for his control system vendor who are not listed on the pre-approved vendor list above. Include documentation of conformance with these requirements. Provide references as needed to allow the Engineer to verify conformance with these requirements. This certification shall be submitted immediately after award of the contract and shall be subject to approval by the Engineer. No payments to the Contractor shall be made prior to submission and approval of the certification of compliance for the control system vendor.

Control Apparatus and Miscellaneous Equipment

Circuit Breakers: All branch circuits from the buses shall be protected by molded case circuit breakers and meet the requirements of UL 489. All breakers shall be compact and have quick-make, quick-break contacts and the mechanism shall be trip-free and trip indicating. Frame sizes shall be not less than 100 amperes. The breakers shall be equipped with thermal-magnetic trips or adjustable instantaneous magnetic trip units. Circuit breakers shall have a minimum interrupting capacity rating of 35 kAIC. The circuit breakers shall be Powerpact model manufactured by Square D. Minatare Circuit Breakers: Circuit breakers for control circuits shall be single pole miniature type and meet the requirements of UL 489. The miniature circuit breakers shall be din railed mounted in the control panels and shall have a trip curve of D. The miniature circuit breakers shall be multi 9 model manufactured by Square D.

Motor Starters and Magnetic Contactors: The continuous current rating of contactors and starters shall be adequate for the connected inductive loads, and no starter shall be smaller than the size specified. All contact poles shall be provided with arc chutes, and contactors rated 150-amperes and above shall be equipped with magnetic blowouts. Motor protective circuit breakers shall be provided for motor protection. The motor protective circuit breakers shall function as an overload and circuit breaker as one combined unit with plug in trip block modules. The motor protective units shall be of the automatic reset type unless otherwise specified. Contactors and circuit breakers, overload modules shall be provided with the required auxiliary contacts as shown on the Contract Plans. Reversing contactors shall be electrically and mechanically interlocked. All motor starters and circuits breakers shall be connectable to a bus bar system, both manufactured by a single manufacturer. All contactors shall be provided with surge suppressors. Motor protective circuit breakers and contactors shall be type GV2P03 and LC1/LC2 as manufactured by Schneider Electric.

Industrial Control Relays shall be multi-contact magnetic relays with contacts rated at 10 amperes, 600 volts on a continuous basis. All relays shall be provided with surge suppressors. Time delay relays shall be provided through a delay attachment to the specified control relays. The time delays shall be electronic type providing time delay intervals as required with a linear timing range in the ratio of 1:10. The number and type of poles shall be as shown on the Contract Plans. Relays shall be type CAD as manufactured by Square D.

Safety Control Relays: Industrial control safety relays shall be multi-contact magnetic machine tool relays with contacts rated at 10 amperes, 600 volts on a continuous basis. Relays shall feature mechanically linked double break contacts on each pole and shall be specifically designed for safety applications. Tamper resistant covers shall be provided on each relay. Each safety control relay shall be equipped with surge suppression. Safety relays shall be type 700S as manufactured by Allen Bradley or approved equal.

Terminal Blocks: Terminal blocks for conductors of Size No. 2 AWG and smaller shall be screw type din rail mountable terminals rated for a maximum voltage of 690 VAC/115 Amperes. Each terminal requiring a splice or jumper shall be provided with pin jumper connectors which are mountable to the terminal block. The terminal blocks assembly shall be provided with ground terminals, screw terminals, din rail, end plates, separators, pin connectors and any other required accessory. The terminal blocks shall wire connections for use insulated wire ferrule connectors. Factory printable corrosion resistant marking strips shall be provided for conductor identification. At least ten percent spare terminals shall be provided. Terminal blocks shall be Phoenix Contact UT4 or approved equal.

Power Distribution Terminal Blocks: Power distribution blocks shall be used for conductor sizes No. 6 and larger and shall be UL listed. Terminal blocks shall be suitable for use with copper wire and shall provide a withstand voltage rating of 750 volts per IEEE switchgear standards. Corrosion resistant marking strips shall be provided for conductor identification. At least ten percent spare terminals shall be provided. Terminal blocks shall be Gould Shawmut Power Distribution Blocks - Heavy Duty Series 68000 or approved equal.

Terminal Connectors: Connectors shall be seamless, heavy-duty insulated wire ferrules or flanged fork terminal lugs where specified. Terminal lugs shall be installed per lug manufacturer recommendations using the proper tools approved by the manufacturer. Under no circumstance will splicing of wires be permitted without the use of a terminal block.

Nameplates: Nameplates, where required, shall be made of laminated phenolic plastic with white front and back and black core and shall be not less than 0.094 inches thick. The lettering shall be etched through the front layer to show black engraved letters on a white background. Lettering shall be not less than ¼ inch high, unless otherwise detailed on the Contract Plans. Nameplates shall be securely fastened to the equipment with stainless steel screws.

Control Desk Key Operated Selector Switches, Selector Switches, Indicating lights and Push-buttons: Control switches, key operated switches, selector switches, indicating lights and push-buttons on the control desk shall be heavy-duty NEMA type, 1.2 inch diameter base (30mm), oil-tight contact blocks operated by glove handle (pistol grip) selector knobs or push-buttons as indicated in the Plans. All switches, indicating lights and pushbuttons shall be equipped with escutcheon plates as shown on the plans. All lenses shall be glass, with color as shown on the plans. Lamps for indicating lights shall be LED type. Contacts shall be fine silver, capable of interrupting 6 amperes at 120 volts AC and of continuously carrying 10 amperes. Key operated switches shall be wired and configured such that the key can only be removed in the off position. Pilot devices for the control desk shall be Square D 9001 series.

Local Control Switches, Key Operated Switches, Selector Switches and Push-buttons: Control switches, key operated switches, selector switches and push-buttons on the front of the drive enclosure for local operation shall be heavy-duty NEMA type, 0.866 inch diameter base (22mm), oil-tight contact blocks operated by selector knobs or push-buttons as indicated in the Plans. All switches and pushbuttons shall be equipped with escutcheon plates as shown on the plans. Contacts shall be fine silver, capable of interrupting 6 amperes at 120 volts AC and of continuously carrying 10 amperes. Key operated switches shall be wired and configured such that the key can only be removed in the off position. Pilot devices for the control desk shall be Square D Harmony XB4 Series.

Emergency Stop Push-button: Emergency stop push-buttons shall be heavy-duty, 1.2 inch diameter base, 2.25 inch diameter mushroom head, oil-tight contact blocks operated by pushing in and pulling out the button mushroom head as indicated in the Plans. The Emergency Stop button shall illuminate when the button mushroom head is pulled out to clearly indicate the emergency stop button has been de-activated. Pulling out the button mushroom head shall deactivate the emergency stop condition. The pushbutton shall be equipped with an escutcheon plate as shown on the plans. Contacts shall be fine silver, capable of interrupting 6 amperes at 120 volts AC and of continuously carrying 10 amperes. The quantity of contacts shall be as shown on the plans. The push-button shall be equipped with surge suppression. Emergency Stop push-buttons shall be Square D 9001 series.

24VDC Power Supplies: All 24V DC power supplies shall be rated for 120VAC input at 60 hertz, and 10A, 24V DC output. The power supplies shall be single output, regulated linear DC power supply. The power supply shall be convection cooled, constant voltage, short circuit proof, current limiting (automatic reset) unit with an output voltage adjustment of +/- 5%, and input/output isolation of 1,000 mega-ohms DC. The power unit shall operate over a temperature range of 0° Celsius through 55° Celsius. Units shall be DIN rail mountable and finger safe. Power supplies shall be Square D Phaseo Easy power supplies.

Control Transformers: Control transformers shall be 2-KVA, 480-volt primary, 120-volt secondary, low impedance with copper windings and high voltage regulation. The control transformer shall be located as shown on the plans in the ATS enclosure. The transformer shall be Square D Type T, 60 HZ, 2 KVA Class 9070 Industrial Control Transformer.

Enclosed Control Cabinet

Freestanding Control Cabinets and back panels shall be furnished and installed in the control house where shown on the Plans. Circuit breakers, switches, contactors, starters, relays, buss bar system, PLC system, touchscreen, UPS and other apparatus as shown on the Plans shall be mounted and enclosed in free standing cabinets. The arrangement and line-up of the individual control cabinets shall be as shown on the Plans.

All equipment in each control cabinet shall be mounted on sheet-steel bases, and each device shall be front-connected, front-wired, and removable from the front. The equipment in all cabinets shall be arranged for ease of access and for safety and convenience of operation. Special care shall be taken to obtain a systematic and neat arrangement of the equipment. Each device shall be suitably named and plainly marked by a laminated nameplate mounted near the device on the panel. Each nameplate shall show an approved descriptive title for the apparatus, together with the device designation appearing on the schematic wiring diagrams. Nameplates shall meet the requirements as specified under Control Apparatus and Miscellaneous Equipment. Each relay shall be identified with letter designations shown on the plans and numerically as installed in the cabinet from left to right starting at the upper left corner of the cabinet. The vendor shall provide a typewritten, laminated directory with relay number associated alphanumeric designation and descriptive function listed in alphabetical order such that relays can be located by numerical position.

Each new control cabinet shall be a NEMA Type 12 enclosure where installed indoors and NEMA 4X stainless steel when installed outside the control house. Enclosures shall be constructed of No. 12 gauge sheet-steel or stainless steel and shall be reinforced with steel angles or channels so as to provide a rigid, freestanding structure. The control cabinets shall be provided with continuous stainless steel door hinges on the front of each panel section. Each door cabinets shall be gasketed and shall be provided with three-point, vault-type latches. Ventilating louvers shall be provided at the top of each enclosure. All hardware shall be corrosion resistant. Thermostatically controlled strip heaters shall be provided in each cabinet to prevent build-up of excess moisture. Each panel shall be provided with suitable interior light fixtures and a duplex receptacle.

Each Cabinet enclosure and back panel shall be as shown on the plans. The Contractor shall modify the dimensions shown on the plans to accommodate the required equipment at no additional cost to DelDOT. The dimensions of each cabinet and back panel shall be such as to permit mounting in the available space along the walls of the control house as shown on the Plans. If the final cabinet dimensions, as established by the manufacturer, should necessitate rearrangement or modification of the equipment in order to fit in the available space, such rearrangement or modifications shall be made at no additional cost. The final arrangement of all equipment in the Control House shall be subject to the approval of the Engineer.

The cabinet enclosures (for NEMA 12 enclosures) and all metal reinforcing shall be painted inside with two coats and outside with three coats, consisting of one coat of primer followed by one coat of gray or white enamel on the inside surfaces and two coats of gray enamel outside. The finish exterior coat shall be ANSI 61 light gray enamel.

All contactors, relays, and other devices shall be of required current carrying and interrupting capacity. All wiring installed within each cabinet shall be flame-retardant, ethylene-propylene insulated, switchboard wire, Type SIS. Conductors shall be stranded copper not smaller than No. 14 American Wire Gauge.

For each assembled control cabinet and back panel, all outgoing wire, No. 8 AWG or smaller, shall be connected to terminal blocks installed at the sides of the cabinet. The control cabinets and back panels shall also provide sufficient extra terminals to allow connection of all wires coming from limit switches and other devices that go on to the bridge control desk and other locations as required, even though these wires do not connect to apparatus on the control cabinet. Spare terminals totaling at least 10 percent for power conductors and 20 percent for control conductors of those actually used shall be provided. Each terminal shall be identified per wire number shown on the Contractor's schematic wiring diagrams.

All cabinet and back panel wiring shall be arranged systematically so that circuits can be readily traced. The wiring shall be installed in a network of troughs consisting of horizontal and vertical sections securely bolted to the cabinets and back panels. The troughs shall be fabricated from heavy-duty Noryl plastic shaped into a channel cross-section. After installation of the wiring, an insulated, flanged cover shall be fitted over the open side of each trough section.

PLC Equipment

Bridge control logic functions shall be performed by a programmable logic controller system, which shall provide for operation of the bridge and its auxiliaries in accordance with the system functioning specified herein and the control logic shown on the Plans. The programmable logic controller (PLC) shall be an Allen Bradley (AB) ControlLogix brand PLC with components, hardware and remote input/output drops. No substitutions shall be accepted. The PLC shall be of modular construction, provide high-speed peer-to-peer networking, and be programmable with ladder logic.

The PLC system will consist of two redundant 1756-L72 CPU's. Only one CPU will be in use at a time, and the other CPU will be offline and de-energized. The remote PLC equipment furnished inside the control desk shall be of the same make and manufacturer as that provided for the PLC Cabinet. A selector switch mounted on the control desk, specified elsewhere will select the CPU in use.

HMI (Touchscreens) shall be furnished and installed as shown on the plans and meet the minimum requirements specified below. Each touchscreens shall be a 15" display (12" for Rehoboth Avenue switchboard room) with solid state hard drive and be of the same manufacturer as the PLC system. Each touchscreen shall be identical make/model and used to display alarms, equipment status and be capable of operating the bridge via password. The HMI panel PC display shall have an Ethernet interface and the following minimum features:

- Windows 10 IoT with Intel® 6th Gen. Core i3 CPU processor SoC system chipset.
- 4GB RAM, 1x 260 Pin SO-DIMM DDR4, 128GB SSD.
- I/O ports: 2 USB 3.0 Type A, 2 serial DB9 RS-232/422/485, 1 Audio Line Out, 2 GbE LAN RJ-45.
- Operate at 120VAC or 9~36VDC (provide with external power supply).
- 15" TFT LCD
- Maximum resolution of 1280 x 1024, 16.7M maximum colors, a luminance of 350 cd/m^2, a 170 degree viewing angle and a contrast ration of 1000:1.
- Resistive touchscreen. with aluminum or stainless-steel bezel and shall be rated IP 67 or NEMA 4X.

HMI displays known to meet these requirements include the Panelview Plus (Bulletin 2711) as manufactured by Allen Bradley, G15 Graphite Modular Display a manufactured by Redlion or PHM flat panel as manufactured by Parker.

For each control desk, the lower touchscreen shall be the primary control for the bridge and shall include buttons to operate each component as specified. The PLC system shall be capable of operating the bridge should either or both touchscreens fail using hardwired push-buttons and selector switches located as shown on the plans.

All PLC equipment for the control desk including power supplies, I/O cards, modules, switches and all accessories shall be mounted inside the control desk base on a back panel

1. The PLC shall be provided with the following features:
   a. 1.5M of battery backed static RAM.
   b. 1.5M of Nonvolatile RAM.
   c. Ethernet communication
2. Each PLC remote input/output rack will be connected to both CPUs by means of a communication bus that will use Ethernet as the method of communication.
3. Each PLC rack shall be supplied with a ControlLogix chassis as shown on the plans.
4. Each input and output card shall be equipped with cage clamp removable terminal blocks wiring arms, oversized housings, and covers. The contractor shall provide terminal blocks as needed.
5. Each PLC chassis shall be provided with an Allen Bradley power supply.
6. All parts shall be as shown on the plans.
7. The Contractor shall furnish and install active line filters as shown on the plans to protect the PLC equipment and controls. The noise filter shall be a series connected high frequency noise filter with transient protection. It shall offer hard wired connection to all critical loads and be rated for use in an industrial environment. It shall reduce mode transients to +/- 2 volts, have a surge capacity of 45,000 amps, provide transient protection in all modes (line to neutral, line to ground, and neutral to ground), have an LED power indication, and be UL approved. The 120VAC MCOV shall be rated 150 VRMS. The line frequency response time shall be less than 0.5 nanoseconds. The operating temperature shall be -40°C to 45°C at full load. The unit shall be capable of protecting against a peak surge current of 15,000 amps in all modes.
8. Furnish and install Ethernet switches as required in the control enclosures. The switches shall be Rockwell Automation Allen Bradley Stratix Switch with fiber optic connections and a minimum of 10 Ethernet ports or approved equal.
9. Furnish and install a touchscreen as part of the PLC equipment to be mounted in the switchboard room. The touchscreen shall be a 15" display (12" for Rehoboth Avenue Drive Cabinet) with solid state hard drive and be of the same manufacturer as the PLC system. The switchboard room touchscreen shall be used to display alarms, equipment status and be capable of operating the bridge as a back-up to the control desk equipment.

Computer and Software

Provide a laptop computer with specified software suitable for programming the PLC, PanelView, and variable frequency drive systems. The computer shall be the latest commercially available unit and contain, as a minimum requirement, an IBM compatible Intel Core i5 processor operating at 3 GHz or better. The random access memory (RAM) shall contain a minimum capacity of 4 GByte and be expandable to 8 GByte. The hard disk drive shall have a storage capacity of 512 GBytes or more. The DVD/CD drive shall be a 40x RW/DVD +/-R/+/-RW dual layer combo drive. The unit shall have 15 inch class color display, 2 USB ports, and programming cables for the PLC, Panel View, and drive. The unit shall serve as an intelligent terminal, functioning both as a PLC/vector drive programming and data monitoring terminal. It shall permit PLC programming, including loading, editing, and monitoring ladder diagram programs in memory by entering through the keyboard and track pad and monitoring on the display. PLC program instructions shall be in ladder logic.

The Contractor shall include two licenses for each software application that is provided. The following software applications shall be loaded onto the computer and made fully operational by the Contractor:

The latest version Windows compatible operating system supported by the PLC, PanelView, and drive programming software. Contractor shall verify all software can operate properly on the operating system and coordinate with the software vendors and the operating platform requirements to select the proper software version.

Studio 5000 Logix Designer - Latest programming software for Allen Bradley ControlLogix Processors. Software shall be compatible with the Contractor supplied version of Microsoft Windows.

RSNetworks for ControlNet - 32-bit graphical network management configuration tool for the ControlNet network. Configures network-wide parameters such as network update time (NUT), schedules I/O data transfers and peer-to-peer messaging for PLC processors. Software shall be compatible with the Contractor supplied version of Microsoft Windows.

FactoryTalk View - Panel View programming software. Software shall be compatible with the Contractor supplied version of Microsoft Windows.

Variable Frequency Drive monitoring software to program and monitor the warning and barrier gate variable frequency drives. Software shall be compatible with the Contractor supplied version of Microsoft Windows.

Power Monitor software to program the Automatic Transfer Switch and monitor the incoming power at the Automatic Transfer Switch. Software shall be compatible with the Contractor supplied version of Microsoft Windows.

The Contractor shall demonstrate operation and use of the software as part of the personnel training.

Control Desk

Each control desk shall be of neat, substantial construction. The desk shall be fabricated from No. 11 gauge sheet-steel, properly formed and suitably reinforced to provide adequate strength. The desktop shall be fabricated of No. 10 gauge, Type 304, stainless steel sheet with a non-glare, satin finish. Removable doors shall be provided in the front and side panels of the desk, pivoted on 90-degree hinges, and secured with flush type, three-point latches. The desk shall be neatly fitted up with close joints, all rough edges or corners shall be ground off smooth, and all projecting edges rounded off. All metal hardware shall be of substantial construction and shall have a satin-chrome plate finish. All equipment mounting screws and bolts shall be stainless steel.

The sheet-steel portions of the desk and all metal reinforcing shall be painted inside with two coats and outside with three coats of paint, consisting of one coat of primer followed by two coats of enamel on the outside surfaces and one coat of white enamel inside. The finish coat shall be of a color to match the house interior. Color samples shall be submitted for approval to the Engineer. The stainless steel desktop shall not be painted.

The control desk interior shall be suitably lighted and controlled by a switch mounted near the front doors. One duplex receptacle shall be mounted in the desk's interior and one duplex receptacle shall be flush mounted exterior to the desk. The light and receptacles shall be powered from the lighting panel board as shown on the drawings.

The control desk shall be provided with selector switches, push-buttons, indicating lights and touchscreens as shown on the plans. The primary control method shall be performed through the lower touchscreen which shall include buttons to operate the equipment. The upper touchscreen shall be for monitoring purposes only and shall match the function and operation of the switchboard touchscreen as specified herein.

All contact blocks for control switches, pushbuttons, and other control devices shall be mounted within the body of the desk. The operators for these devices shall protrude through the desktop. The indicating lights for each operation shall be mounted as shown on the plans.

Indicating lights shall be mounted on the control desk to show that the various steps in the sequence of operation have taken place so that the operator may proceed to subsequent steps at the proper time. The functions to be indicated and the color of the lenses shall be as shown on the Plans.

Flux Vector Drive

The Contractor shall furnish Flux Vector-Controlled Variable Frequency Drives (FVD's) with operating voltages and current rating as shown on the plans. FVD Systems shall be UL508 listed. The complete control system as specified including the FVD must be assembled and warranted by a single manufacturer. Third party assemblers are not acceptable.

It is the intent of this specification to describe the minimum performance requirements the FVD systems. Any deviation shall be detailed in writing and submitted to the Engineer for approval at least two weeks prior to bid time.

The flux vector drives shall be sized as part of a span drive system for each bridge. The motor, drive, and dynamic braking resistor system shall meet the following torque, braking, and overload requirements:

	Rehoboth Avenue	Savannah Road
Normal Running Torque	358.5 ft lb	115 ft lb
Overload Torque Capacity	150% for 60 seconds	150% for 60 seconds
Never to Exceed Capacity	180%	180%
Motor Full Load Speed	875 RPM	685 RPM
Motor Creep Speed	50 RPM	50 RPM
Worst Case Dynamic Braking	100% for 90 seconds	100% for 90 seconds
Input Voltage	480 VAC	480 VAC
Drive Minimum HP	60 HP	20 HP*
Typical Duty Cycle (On/OFF)	90 seconds/5 minutes**	90 seconds/5 minutes**

*The Contractor shall oversize the drive to meet the breakaway torque requirements for the new motor and to be capable of operating the load in sensorless vector mode.
**The duty cycle includes 90 seconds of operation for raise and 5 minutes until the lower operation is initiated. The average time between bridge openings is typically measured in weeks and months although repeated operations is plausible during inspections and other non-typical openings.

The FVD system shall be sized for a normal bridge operation as follows:

	Rehoboth Avenue	Savannah Road
Fully Closed to Fully Open	90 seconds	77 seconds
Full Open to Fully Closed	90 seconds	77 seconds
Ramp from Zero to Full Speed:	10 seconds	10 seconds
Ramp from Full to Creep Speed:	10 seconds	15 seconds

The above ratings shall be the minimum drive ratings for the system equipment. During start-up the Contractor shall tune the drive, but may use lower settings for initial drive start up. The Contractor shall then tune the drive to meet these standards in the field.

The FVD System shall be compatible with the squirrel-cage type, phasor-type construction, induction leaf motor and shall be sized to ensure the motor full load amps (FLA) do not exceed the FVD's continuous current rating, with an overload capability of 150% for 60 seconds. The FVD drive shall be capable to provide 180% starting torque capability. If the FVD manufacturer's standard product is current rated at 8khz carrier frequency or below, a derating factor of 20% minimum shall be used to derive the maximum continuous current rating of the FVD.

The FVD's shall be IEEE 519 compliant for allowable harmonic distortion at the power distribution point of service, including line notching and transients. In the event that the FVD's produce Total Harmonic Distortion (THD) in excess of the prescribed limits of the utility company, the Contractor shall provide additional active or passive line-side filtration devices to reduce such harmonics to the allowable limits at no additional expense to the Owner.

To minimize the impact during construction and make optimum use of training and spare parts resources, supply responsibility shall be as follows:

1. One manufacturer shall supply specified FVD's.
2. Like components of all FVD Systems, although for different services, shall be interchangeable products of one manufacturer.
3. All FVD Systems shall be the same model series of one manufacturer. The complete FVD system must be manufactured and warranted by the FVD manufacturer. Third party assemblers are not acceptable.

FVD Systems shall include but not be limited to the following features:

1. Be 32 bit microprocessor based, closed loop, fully transistorized with a conservatively rated 3 phase, full wave diode bridge input and a PWM sine coded output waveform. The input diode bridge shall offer complete immunity against voltage dips, line noise and harmonics. The output transistors must be of the IGBT type (Insulated Gate Bipolar Transistor) to facilitate noiseless motor operation.
2. FVD shall be capable to run in speed and torque mode with adjustable torque limits in all four quadrants. FVD will be supplied with an encoder feedback card compatible with the supplied encoder and the phasor-type construction, induction leaf motor. The drive shall be capable of auto-tuning to the actual motor without any unwarranted service interruption during normal drive operation.
3. The Savannah Road Bridge FVDs shall operate in sensor-less vector mode and operate as noted without the use of a motor encoder. The Rehoboth Avenue Bridge FVD shall operate in closed loop vector control with a connected motor mounted encoder.
4. The FVD shall not "cog" at any frequencies with a 1,000:1 speed regulation. There shall be no sudden frequency shifts and associated acoustical noise shifts as the output frequency is varied between 0 and 60Hz. Motor and FVD shall be able to produce full torque at zero speed.
5. The FVD's input displacement power factor shall be 0.95 or better over the entire operating frequency and load range. Efficiency shall be measured 97% minimum at rated load.
6. Solid state output ground fault protection shall be provided.
7. Adaptive electronic motor overload protection shall be provided which shall protect both the motor and the FVD at all frequencies. This overload must be UL approved. Electronic thermal overload circuits, which only protect the motor at full speed, shall not be acceptable. The FVD shall sense the load and speed and shall recalibrate the thermal trip curve to insure low speed motor protection. The initial trip point shall be adjustable from at least 40% of the FVD continuous rating to account for motor magnetizing current.
8. Input surge protection shall be provided by MOVs (metal oxide varistors) in accordance with ANSI Specification C63.41 1980.
9. Input and output phase loss detection must be provided and protect the FVD.
10. Output short circuit protection must be provided.
11. Provide ethernet communication and compatibility with the Rockwell Automation Allen Bradley PLC Control Logix equipment. The drive shall communicate with and be fully compatible with the Control System as described in the specification section regarding the Bridge Control System.
12. Provide programmable Ethernet inputs for Open, Close, Full Speed, Enable, Reduced Speed, Creep Speed, Reduced Torque, Drive Fault and Spare. Provide one dry contact input for Emergency Stop
13. Provide five programmable digital Ethernet outputs for Drive Trouble, Drive Running, Drive Ready, Proof of Torque, and a Spare.
14. Programmable current limit
15. Remote drive reset contact
16. Minimum of 1,000:1 controllable constant torque speed range. Speed regulation shall be 0.01% or better over the entire speed range.
17. Minimum of 2 second power loss ride-through capability. In the event of a loss of three-phase power lasting 2 seconds or less, the FVD must maintain operation and prevent nuisance trips upon return of power.
18. Provide digital ammeters and voltmeters on the panels and control desk, as shown on the contract plans.

19. The 'Drive Trouble' fault condition shall cause the FVD to shut off and shall be annunciated to the PLC control system through the Ethernet communication network (as described above). The conditions that shall cause a fault condition are as follows:
    a. Blown fuse.
    b. Instantaneous overcurrent trip.
    c. DC bus overvoltage.
    d. DC bus undervoltage.
    e. Excessive ambient FVD heatsink overtemperature.
    f. External fault input.
    g. Internally diagnosed, control failure.
    h. Motor thermal overload.
    i. FVD thermal overload.
20. FVD operation options shall be programmable via a door mounted digital keypad and custom pilot devices, and include as a minimum the following functions:
    a. Password security
    b. Local/Remote for selecting operation either from the digital operators control station or from a remote location. Both start/stop and speed reference signals shall be selected by a single switch.
    c. Jog push button.
    d. Reset push button.
    e. Start push button.
    f. Stop push button
    g. Non-auto raise push button
    h. Non-auto lower push button
    i. Emergency stop
21. The drive shall be capable of local operation from the pilot devices located on the front of the drive cabinet door. The switches shall be lockable and prevent normal usage. When manual mode is selected the Ethernet control of the drive shall be disabled. Similarly when in automatic mode the manual control of the drive shall be disabled.
22. Red LED's shall be supplied as a standard on the digital operators station for indication of Hand, Auto, Running, stopped, and drive running with no speed reference signal applied (zero speed). All drive functions shall be programmable from the door mounted keypad. The keypad shall be equipped with non-volatile EEPROM and be removable permitting the parameters to be downloaded into another drive.
23. The FVD's shall be supplied with AC input line reactors with a minimum impedance of 5% to smooth the input current waveform and reduce harmonics. Typically this is provided as part of the drive internally.
24. The FVD shall be provided with a dV/dT filter mounted and wired in the FVD enclosure or the FVD must have a dV/dT internal circuit. The manufacturer must guarantee the motor/drive system with motor cable lengths of 700 feet.
25. The FVD shall be provided with an output contactor to disconnect the load from the drive when the drive is not running and to allow an emergency stop. The output contactor and drive system shall be rated to disconnect the motor while shutting off the drive instantaneously. Contactors must be NEMA rated for across the line motor starting.
26. The FVD drive system shall be capable of being used with a local motor disconnect switch. The FVD drive shall be rated to safely shutdown when the disconnect switch is opened and sense when the disconnect switch is open in order to not operate. An auxiliary contact in the disconnect switch shall be provided to the PLC to prevent the PLC from operating the drive with the disconnect switch in the disconnected position.
27. The drive shall be equipped with a minimum of three pre-set speeds and each shall have a unique speed ramp. The speed shall be identified as Full Speed, Reduced Speed, and Creep Speed. Full speed and creep speed shall be as listed above. Reduced speed shall be available, but not initially required. All control set points, logical control and connections with the PLC control system shall be coordinated with requirements and equipment specified under "Control Cabinets" and as shown on the Plans. The drives shall be equipped with speed ramps from full speed to creep speed and zero speed to full speed as shown on the drive sizing table. The drive shall be equipped with a speed ramp of one second from either creep speed or reduced speed to full stop.
28. The FVD shall be capable of operating in two distinct torque limiting modes as dictated by PLC Ethernet inputs. The motor torque shall be either limited by the capability of the drive or the torque of the motor shall be limited to zero torque output of the rated motor HP. The reduced torque setting shall initially be set to zero and shall be adjusted in the field at the direction of the Engineer. This reduced torque limit shall be field adjustable from zero percent to 100% of motor output.

The drive manufacturer shall provide all hardware and programming necessary to provide reduced torque function.

29. The FVD shall be capable of handling and controlling overhauling loads on the leaf motors. Independent speed and torque controls shall be provided for each of the four quadrants of motor operation. Dynamic braking resistors and associated interface cards shall be provided by the drive manufacturer such that the drive can operate in the regenerative mode for the entire open or close cycle at full speed and may last for approximately 90 seconds. The dynamic brakes shall be sized for operation and cooling. If additional cooling, such as fans, are required then fan starting contactors and controls shall be provided as part of the FVD system.
30. The drive shall be provided with a programmable digital Ethernet output for proof of torque which shall not release the brakes until torque in the motor shaft has been verified.

FVD Systems shall be furnished with the options as shown on the contract drawings and as specified herein. FVD Systems shall be either Allen-Bradley Heavy Duty Powerflex 753 or Control Techniques M700 Unidrive. No substitutions are permitted.

Automatic Transfer Switch

An automatic transfer switch shall be furnished and installed in each ATS enclosure. The unit for Rehoboth Avenue Bridge shall be a new unit as specified below. For Savannah road the existing unit may be reused with modifications as shown on the plans and specified herein or a new unit furnished as specified below. All work required for the fabrication of the ATS and enclosure shall be performed by the control system vendor which includes shipping on existing components to the control system vendors facility.

Each automatic transfer switch shall consist of an inherently double throw power transfer switch unit and a microprocessor controller, interconnected to provide complete automatic operation. The entire transfer switch assembly shall be the product of the same manufacturer.

Each unit shall be electrically operated and mechanically locked without the use of hooks, latches, magnets or springs. The electrical operator shall be a single-solenoid mechanism, momentarily energized. Main operators which include overcurrent disconnect devices will not be accepted. The switch shall be mechanically interlocked to ensure only one of two possible positions, normal or emergency.

The switch shall be positively locked and unaffected by momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.

All main contacts shall be of silver composition. Switches shall have segmented, blow-on construction for high withstand current capability and be protected by separate arcing contacts.

Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. A manual operating handle shall be provided for maintenance purposes. The handle shall permit the operator to manually stop the contacts at any point throughout their entire travel to inspect and service the contacts when required.

Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.

Where neutral conductors must be switched, the ATS shall be provided with fully-rated neutral transfer contacts.

Where neutral conductors are to be solidly connected, a neutral terminal plate with fully-rated AL-CU pressure connectors shall be provided.

Each ATS shall be provided with a controller, which shall direct the operation of the transfer switch. The controller's sensing and logic shall be controlled by a built-in microprocessor for maximum reliability, minimum maintenance, and inherent serial communications capability. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.

The controller shall be enclosed with a protective cover and be mounted separate from the transfer switch unit for safety and ease of maintenance. Sensing and control logic shall be provided on printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers.

Voltage and Frequency Sensing shall be provided on each ATS as follows:

1. Single-phase voltage and frequency sensing of the emergency or alternate source shall be provided.
2. The voltage of each phase of the normal source shall be monitored, with pickup adjustable to 95% of nominal and dropout adjustable from 70% to 90% of pickup setting.

Each ATS shall have time delays as follows:

1. An adjustable time delay shall be provided to override momentary normal source outages and delay all transfer and engine starting signals.
2. An adjustable time delay shall be provided on transfer to emergency, adjustable from 0 to 5 minutes for controlled timing of transfer of loads to emergency.
3. A generator stabilization time delay shall be provided after transfer to emergency.
4. An adjustable time delay and interlocking feature shall be provided on retransfer to normal. The time delay shall be adjustable from 0 to 30 minutes. Time delay shall be automatically bypassed if emergency source fails and normal source is acceptable.
5. A 5-minute cooldown time delay shall be provided on shutdown of engine generator.
6. All adjustable time delays shall be field adjustable without the use of special tools.

Each ATS shall have the following additional features:

1. A set of contacts rated 5 amps, 32 VDC shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
2. A push-button type test switch located on the front of the enclosure door shall be provided to simulate a normal source failure. This function shall be able to be locked out.
3. A push-button type switch located on the enclosure door shall be provided to bypass the time delay on transfer to emergency, the engine exerciser period on the retransfer to normal time delay whichever delay is active at the time the push-button is activated. This function shall be able to be locked out.
4. Terminals shall be provided for a remote contact as follows
   a. Remote contacts which opens to signal the ATS to transfer to the emergency source.
   b. Remote contacts which open to inhibit transfer to emergency and/or retransfer to normal.
5. Auxiliary contacts shall be provided on the transfer mechanism and connected to the PLC. The auxiliary contacts shall be rated 10 amps, 250 VAC and provided two contacts, closed when the ATS is connected to the normal source and two contacts, closed, when the ATS is connected to the emergency source.
6. Indicating lights shall be provided, one to indicate when the ATS is connected to the normal sources (green) and one to indicate when the ATS is connected to the emergency sources (red).
7. Auxiliary contacts shall be provided for signal availability from the 11BG accessory module (Normal Available, Normal Failure, Generator Available and Generator Failure). The terminals from the module shall be connected to the source as shown on the plans.

The ATS shall be furnished and installed in the ATS enclosure as shown on the plans. Each Controller shall be a flush-mounted display with LED indicators for switch position and source availability mounted to the front of the enclosure door. Each Automatic Transfer Switch shall be a four-pole, 200-ampere, 480-volt switch and approved equal to Automatic Transfer Switch Co., Model 300.

Surge Suppression Device (SSD)

The Contractor shall furnish and install the Transient Voltage Surge Suppression Device (SSD) equipment having the electrical characteristics, ratings and modifications as specified herein and as shown on the contract drawings. The SSD shall be sized as a service entrance application and located on the load side of the nearest disconnect switch. To maximize performance and reliability, the AC surge protection shall be integrated into the ATS enclosure as shown on the plans. All surge suppression shall meet the latest requirements and UL standards.

Electrical Requirements for the system are as follows:

1. Unit Operating Voltage - Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) - The MCOV shall be greater than 115% of the nominal system operating voltage.
3. The suppression system shall incorporate a hybrid designed Metal-Oxide Varistors (MOV) surge suppressor for the service entrance and other distribution level. The system shall not utilize silicon avalanche diodes, selenium cell, air gaps or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes - For a wye configured system, the device must have directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For a delta-configured system, the device must have suppression elements between line to line (L-L) and line to ground (L-G).
5. UL 1449 Suppressed Voltage Rating (SVR) - The maximum UL 1449 SVR for the device must not exceed 800V for L-N, L-G, N-G modes and 1800V for L-L mode.

SSD Design for the system shall be as follows:

1. Balanced Suppression Platform - The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating TVSS modules shall not be acceptable.
2. Electrical Noise Filter - Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be 50 dB at 100 kHz using the MIL-STD-220A insertion loss test method. Products not able to demonstrate noise attenuation of 50 dB @ 100 kHz shall be rejected.
3. Extended Range Filter -The Surge Protective Device shall have a High Frequency Extended Range Tracking Filter in each Line to Neutral mode with compliance to UL 1283 and NEMA LS1. The filter shall have published high frequency attenuation rating in the attenuation frequencies.
4. Internal Connections - No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.
5. Standard Monitoring Diagnostics - Each SSD shall provide integral monitoring options:
   a. Each unit shall provide a green / red solid state indicator light shall be provided on each phase. The absence of a green light and the presence of a red light, shall indicate which phase(s) have been damaged.
   b. Remote Status Monitor - The TVSS device must include form C dry contacts (one NO and one NC) for remote annunciation of unit status. The remote alarm shall change state if any of the three phases detect a fault condition.
   c. Audible Alarm - The TVSS shall provide an audible alarm with a reset pushbutton that will be activated under any fault condition.
   d. Event Counter - The TVSS shall be equipped with an LCD display system designed to indicate to the user how many surges, sags, swells and outages have occurred at the location. The event counter triggers each time under each respective category after significant event occurs. A reset pushbutton shall also be standard allowing all counters to be zeroed.
   e. Push to Test - The TVSS shall be equipped with push-to-test feature, designed to provide users with real time testing of the suppressor's monitoring and diagnostic system. By depressing the test button, the diagnostic system initiates a self test procedure. If the system is fully operational, the self test will activate all indicator lights.
   f. Voltage Monitoring - The TVSS shall display true Root Mean Square (RMS) on three L-N voltage protection mode on Wye configuration and three L-L voltage on delta configuration.

Rotary Cam Limit Switch

Straight drive combination rotary limit switches shall be furnished and installed in the machinery rooms as shown on the plans for Savannah Road Bridge. Each limit switch enclosure shall contain a cam-operated limit switch. Gearing furnished with the operating machinery, which shall rotate the input shaft, shall drive the combination unit. An integral reducer shall be provided with each unit, which shall provide an overall reduction as specified on the mechanical plans.

Each unit shall have the number of circuits as shown on the Plans. The rotary limit switches shall be individually micro-adjustable and have provisions for internal vernier adjustments. The limit switch shall allow for a one-quarter (¼) degree contact operation repeatability. Each contact of the limit switch shall be single-pole, double-throw, precision-type, snap-action switches. The resolver portion of the unit shall be used in conjunction with the position display and shall meet the requirements for resolvers as stated under "Resolvers".

Each unit shall be installed within a NEMA 4X stainless steel enclosure, and shall be Gemco Series 1980 or approved equal. The switch contacts shall have a minimum AC inductive continuous current carrying rating of 15A and a minimum DC resistive continuous current carrying rating of 15A.

The span limit switches shall be provided as required with a shaft extension for connection of the position resolver.

Each switch shall be preset at the factory to the settings shown on the Contract Plans. It shall be the Contractor's responsibility to determine the proper direction of rotation of each switch and to advise the manufacturer accordingly.

Manual Operation Limit Switch

Emergency operation limit switches for the span drive machinery, tail lock motors, center lock motors, span lock motors and gates motors shall be furnished and installed for the Rehoboth Avenue and Savannah Road Bridges as shown in the Plans. The switches shall trip when the mechanical clutch is activated.

Each limit switch shall meet the following requirements:

1. Track type, lever actuated, spring return, two circuit limit switch
2. 1 NC safety contact and 1 NO ancillary contact
3. Rated 600V, 10A
4. NEMA 4/6P watertight enclosure
5. Meet requirements of EN 954-1, ISO 13849-1,NFPA 79, ANSI B11.19

The length of the arm and size roller on each switch shall be to allow for the limit switch to be activated with the clutch system. Each limit switch shall be installed in such a way to permit field adjustment of the trip point in order to optimally sense the clutch position. Manual operation limit switches shall be the Allen Bradley 802T Direct Opening Safety Limit Switch or approved equal.

Position Resolver

Each resolver shall send a signal to the PLC and touchscreens mounted on the control desk and control enclosures as specified herein to indicate absolute leaf angular position.

The position resolver shall produce an analog signal via a brushless resolver. This signal shall be converted into a 4-20 mA signal format by a ratiometric-tracking converter. The position resolver shall retain positional information, even in the event of a power failure to provide a fully absolute position resolver system. The position resolver shall be a single turn, heavy-duty, Size 40, and mounted in a NEMA-4X stainless steel enclosure. The outputs shall be furnished with short-circuit proof PNP transistors. The unit shall be furnished with a lockable, external toggle switch to allow changing of count direction without opening the housing. The unit shall be powered by a separately protected 24-volt DC source, located in the PLC cabinets. The unit shall provide a 4-20 mA output with end mount connector and multiconductor cable as provided by the manufacturer.

Each resolver shall be scaled to equate resolver shaft rotation to actual span travel in angular degrees.

	Resolver shaft rotation	Bridge Angular Position
Rehoboth Avenue	346.5°	50 Degrees
Savannah Road	270°	80 Degrees

Position resolver shall be the AMCI DC25 Absolute Single Turn Analog Rotary Shaft Encoder with integral cable or approved equal.

Speed Switch

A speed switch, associated magnet, hardware and supports shall be furnished and installed in the machinery rooms as shown on the plans. The speed switch shall send a 4-20mA signal to the PLC as specified herein to indicate span motor operating speed on the touchscreens. A separate alarm contact shall provide a failsafe alarm contact to be used to monitor the deceleration speed at each bridge. The unit shall be rated NEMA-4X and connect as shown on the plans.

The speed switch shall be a self-contained system with sensor and adjustable failsafe relay contact. The 4-20 mA signal shall be directly proportional to the rotational speed of a monitored shaft and shall have a 4 digit LCD display capable of displaying from 0.000 to 9,999 rpm or from 4 to 20 mA.

The speed switch shall be the FB420 as manufactured by Electro Sensors or approved equal.

Proximity Limit Switch

Unless otherwise shown and detailed on the plans, proximity limit switches shall be furnished and installed for the fully closed, span over travel, tail lock pulled, tail lock driven, span lock pulled and span lock driven at Rehoboth Avenue and Savannah Road bridges.

The proximity limit switches shall be inductive type, barrel type, stainless steel and rated NEMA 4X. Each limit switch shall be provided with mounting brackets, hardware and supports as shown on the plans and required for proper operation. The sensing range shall be a minimum of 40mm unless otherwise noted.

The switch shall include a conduit NPT hub and adapter for connection to 3/4" conduit. Each unit shall include a LED indicating light and shall be 120VAC and connected as a PLC input. Proximity limit switches shall be the Turk NI40-G47SR or approved equal.

Span Drive Motors

Each span drive motor shall be AC induction type, squirrel cage, vector duty. Each motor shall be built in strict accordance with NEMA publication MG 1 and designed for use with a Variable Frequency Drive AC closed loop vector controller (Rehoboth Avenue) and AC open loop sensorless vector (Savannah Road). Each span motor shall be 3 phase 60 Hertz, NEMA Design A with moisture resistance insulation, 40° C temperature rise, and capable of instant reversing. Motor frame shall be constructed of cast aluminum. Ratings shall be as follows:

	Rehoboth Avenue	Savannah Road
Horsepower	60HP	15HP
Nominal Voltage	480 VAC, 3 Phase	480 VAC, 3 Phase
Duty	30 minute	30 minute
Speed	900 RPM	720 RPM
Frame Size	445T*	365T*
Insulation	HHH	HHH
Service Factor	1.0	1.0

* Frame size shall be coordinated with the motor and drive manufacturer for accuracy.

The motors shall be totally enclosed non ventilated (TENV) construction, with re greaseable ball bearings, moisture resistant insulation and internal space heater sized by the manufacturer. The space heater shall operate at 120 VAC. The motor shall have a special extended shaft as shown on the mechanical contract

drawings to accommodate the motor coupling on one end and a rear mounted encoder on the other. The motor shafts shall be cadmium plated. A drain hole of not less than ½ inch diameter shall be provided at the bottom of the motor, fitted with a suitable drain plug.

The motor encoder shall be industrial type, marine duty, heavy mill duty, fully sealed and contain a diagnostic LED indicator. The unit shall be fabricated of stainless steel and be compatible with the motor drive system as specified under "Drive Cabinets." The encoder shall be the Avtron AV56 thin-line II or approved equal.

All windings shall be copper. The motor shall be capable of having a minimum breakdown torque of 300% of full load torque. The motor must have a speed range of 1000:1 and be capable of providing full torque at zero speed. Motor design shall be low inertia and slip design. A normally closed temperature sensor shall be embedded in the windings.

Each motor junction box mounted to the motor shall be liberally sized and located to avoid interference with the machinery. The conduit boxes shall be sized in accordance with the requirements of the NEMA MG 1 2003 PART 11. The junction box shall be provided with terminal blocks, sized by the manufacturer to terminate all cables routed to the motor. A suitable ground lug shall also be provided.
Each motor shall be provided with an output shaft as shown on the drawings.

The motors shall be designed and manufactured in the United States of America.

All motors shall be manufactured to the following standards:

1. IEEE Marine Standards No. 45.
2. American Bureau of Shipping (A.B.S.).
3. U.S. Coast Guard Inspection Service
4. NEMA MG-1

Span drive motors shall also be provided with the following features in order to meet the requirements of these Specifications.

1. All aluminum parts chemical film and zinc chromate primer.
2. Cadmium plate shaft and hardware (FED QQ P 416).
3. Double Sealed ball bearings.
4. Seal all joints and eye bolt holes.
5. Sealed leads in terminal box.
6. Shaft seals.
7. Removable drain plugs.
8. Final coat of epoxy paint.
9. Corrosion resistant coating rotor and stator laminations.
10. Stainless steel nameplate.
11. Super 'H' insulation including protection against fungus growth.

The motor frame shall be finished with a corrosion resistant paint or coating. Exposed unpainted metal surfaces shall be of a corrosion resistant material.

An in-sight disconnect switch shall be provided within view of each motor as specified under "Disconnect Switches." The 120-volt strip heater in each motor frame shall be wired to the normally open auxiliary contact in the corresponding motor disconnect switch.

Motors must be designed to operate at carrier frequencies up to 30 kHz. All motors shall be dynamically balanced. The Contractor shall ensure that the span motor is electrically and mechanically compatible with the span drive as approved by the span drive manufacturer.

Motors shall be manufactured by Reuland Electric Company or approved equal.

Lock Motors

Each motor for the span lock and tail locks shall be fabricated per NEMA publication MG 1 and designed for high-slip, high-starting torque, NEMA Design D, weatherproof, totally-enclosed, non-ventilated (TENV),

ball-bearing, squirrel-cage motor, capable of withstanding instant reversal when running at full speed. It shall be rated on a basis of 30 minutes at 40 degrees Celsius ambient. Each motor shall be provided with a single-phase, 120-volt, space heater installed in the lower frame beneath the windings. The wattage of the heater shall be determined by the manufacturer. Ratings shall be as follows:

	Rehoboth Avenue	Savannah Road
Horsepower	3HP	3HP
Nominal Voltage	480 VAC, 3 Phase	480 VAC, 3 Phase
Duty	30 minute	30 minute
Speed	900 RPM	900 RPM
Frame Size	215*	215*
Insulation	HHH	HHH
Service Factor	1.0	1.0

*Frame size shall be coordinated with the motor manufacturer for accuracy.

Each lock motor junction box mounted to the motor shall be sized in accordance with the requirements of the NEMA MG 1 2003 PART 11. The junction box shall be provided with terminal blocks, sized by the manufacturer to terminate all cables routed to the motor. A suitable ground lug shall also be provided.

Each lock motor shall be provided with a motor-mounted, totally enclosed, spring-set, 480-volt, magnetically released disc brake with rated torque approximately equal to, but not less than, motor full-load torque.

Each brake shall be of dust-tight, self-adjusting, weatherproof, cast-iron construction, except modified for marine duty to comply with IEEE Standard 45, "Recommended Practice for Electrical Installations on Shipboard". The marine duty modification includes the use of brass internal parts.

Each brake shall be provided with a 120-volt, 15-watt internal strip heater and a single-voltage operating coil. Each brake shall be approved equal to the Stearns 87,000 Series brake with M-Mod for marine duty, equivalent as manufactured by Harnischfeger or Dings, or approved equal.
Each lock motor shall be controlled by magnetic reversing contactors, electrically and mechanically interlocked.

Manual operation limit switches shall be furnished and installed under this item and assembled with the lock motors. The manual operation limit switches shall meet the requirements specified under "Manual Operation Limit Switch." The manual operation limit switches shall be mounted in a similar arrangement to the existing span lock hand crank limit switches at Rehoboth Avenue and include a custom fabricated lever to cover the shaft on each motor.

The locks shall be operated from selector switches and touchscreens located on the control console. The switches shall have spring-return to center drive and pull positions, with circuitry arranged such that the lock will stop immediately when the lock rod is fully driven or pulled.

Each existing tail lock at Savannah Road Bridge shall be provided with a new rotary cam limit switch and two new individual proximity sensors. Each new center lock at Savannah Road shall be provided with new limit switches as part of the actuator assembly. Each existing span lock at Rehoboth Avenue shall be provided two new individual proximity sensors. The limit switches shall be as specified and shall provide contacts to control the limit of travel in each direction and for indication and sequence interlocking.

New center lock motor for the actuator assembly shall be specified under the item "615503 - Bridge Mechanical System."

Adjustment of center lock crank arms, supports, strike plates and limit switches for proper operation shall be done under the item "615503 - Bridge Mechanical System."

Motors shall be manufactured by Reuland Electric Company or Engineer approved equal.

Motor Brakes and Machinery Brakes

Three (3) thrustor-type electric brakes shall be furnished and installed in each machinery room on the Savannah Road Bridge (6 total). One brake shall be located on the output shaft of the span motor and designated as a motor brake and the other two shall be located on the secondary gear frame input shafts and designated as machinery brakes.

Two (2) thrustor-type electric brakes shall be furnished and installed in the machinery room at the Rehoboth Avenue Bridge (2 total). One brake shall be located on each input shaft of the primary speed reducer and shall be designated as the north and south motor brakes.

Each brake shall be a spring set, thrustor released, shoe type, open brake and shall be provided with corrosion resisting fittings.

Motor and machinery brakes shall be provided with enclosures as shown on the plans for both Savannah Road and Rehoboth Avenue.

The Savannah Road Bridge motor brakes shall be rated on a 60-minute basis and shall be set to exert an actual retarding torque of 160 ft-lbf. Each motor brake shall be a Mondel heavy duty drum brake 10" MBT/E-ED23 or approved equal with corrosion resistant hardware and other options specified herein.

The Savannah Road Bridge machinery brakes shall be rated on a 60-minute basis and shall be set to exert an actual retarding torque of 380 ft-lbf. Each machinery brake shall be an 11" Mondel ST/E-ED50/6 heavy duty drum brake with corrosion resistant hardware and other options specified herein.

The Rehoboth Avenue Bridge motor brakes shall be rated on a 60-minute basis and shall be set to exert an actual retarding torque of 350 ft-lbf. Each motor brake shall be 11" Mondel ST/E-ED50/6 heavy duty drum brake or approved equal with corrosion resistant hardware and other options specified herein.

For both the motor and machinery brakes an approved equal manufacturer shall be considered with additional modifications as needed for proper operation and alignment. The Contractor shall be responsible for these modifications if an alternate manufacturer is selected and approved by the Engineer at no additional cost to DelDOT.

The existing brakewheels shall be reused at the Rehoboth Avenue Bridge motor brakes and the Savannah Road Bridge machinery brakes. For the Savannah Road Bridge motor brakes, the brake manufacturer shall furnish new brakewheels with the brakes. The friction surfaces of the new brakewheels shall be chrome plated. The bores shall be left undersized and the wheels shall be shipped to the motor manufacturer who shall finish bore and keyseat the wheels and fit them onto the designated shafts.

The down stroke time delays of the thrustors shall be set in such a manner that the brakes will not be applied simultaneously should electric power fail while the span is in motion. For Savannah Road Bridge, the motor brake shall be set with a 1-second down stroke time delay, while the machinery brakes shall be set with a 4 second time delay. For the Rehoboth Avenue Bridge, one motor brake shall be set with a 1-second down-stroke time delay, while the other brake shall be set with a 4-second time delay.

The oil used in the thrustor operating chambers of the brakes shall be of a grade as recommended by the manufacturer. It shall have a free operating temperature range between -40º F and 150ºF.

The thrustors shall be actuated by 480 volt, three phase, 60 Hertz, totally enclosed, squirrel cage motors controlled by magnetic contactors. The rated stalled thrust of each thrustor shall be not less than 135 percent of the thrust actually required to release the brake with the torque adjusted to the continuous rated value.

Each bridge brake motor shall be installed with approved sizes and types of wire terminals and splice fittings for the connection of the motors to the circuit wiring. Connections between the rigid conduit system and the motors and brakes shall be made with approved flexible conduit.

The brakes shall include a 16 gauge stainless steel cover enclosing the entire brake assembly. Provide a 120-volt strip heater positioned near the brake wheel in each brake shall to prevent condensation and moisture from freezing the drum and brake pads. Wire the normally open auxiliary contact in the corresponding motor disconnect switch to disconnect the heaters when the switch is in the off position.

An in-sight disconnect switch as specified under "Disconnect Switches" shall be provided within range view of each brake motor.

Brake Limit Switches

Each brake shall be furnished with three lever type limit switches (brake set, brake released, and brake hand released) for interlock and indication of the span brakes as specified herein.

Each brake hand released limit switch shall have the number of contacts as shown on the plans and shall not change the torque setting or require removable levers or wrenches. Each hand release shall be provided with a lever type limit switch for interlocking purposes. It shall not be possible to set the hand release of the brakes without tripping these switches.

Each brake set limit switch and released limit switch shall have number of contacts as shown on the plans. Each position shall be provided with a lever type limit switch for interlocking purposes. The brake released limit switch shall trip when the brake is electrically released or hand released. The brake set limit switch shall trip when the brake is fully set.

Each limit switch shall be installed with an SOW cable of sufficient length and conductor quantity to connect the limit switch to the brake terminal boxes.

The limit switches shall be heavy duty industrial, rated for 10A, 120VAC and shall be Square D 9007C with 1NO/1NC contact.

Gate and Traffic Flashers

The four warning gates and two barrier gates at Rehoboth Avenue and the four warning gates at Savannah Road shall be modified as shown on the plans and specified herein.

The Contractor shall furnish and install a new flasher assembly inside the existing gate electrical enclosures as well as the two new west side traffic signals on Savannah Road. The flashers shall have connections for steady and alternating flashing circuits which shall be connected to the new flexible cables. The flashers shall be B&B Roadway FL-120 VAC or approved equal.

Gate Door Limit Switches

New door switches shall be furnished and installed on each access door to open the control circuit and de-energize the motor controls when the door is open. The door switches shall be lever type limit switches and shall be mounted to the existing housing. The limit switches shall be heavy duty industrial, rated for 10A, 120VAC and shall be Square D 9007C with 1NO/1NC contact.

Traffic Signals

The Contractor shall furnish and install new traffic signals as shown on the plans.

The two new traffic signals on the west side shall have a R10-6A "Stop Here on Red" signage with 12" Red flashing beacons on a steel pole and shall be furnished and installed as indicated on the plans at Savannah Road. The assembly shall include a control enclosure to house the fuses and flasher. The flasher shall be as specified herein.

12" Red/amber/green signal heads shall be furnished and installed on the new mast arm assembly on the west side of the bridge at Rehoboth Canal.

All signals and signage shall meet the requirements of MUTCD, AASHTO and DelDOT standards.

Disconnect Switches

Motor disconnect switches shall be unfused safety switches, for use as disconnects, and shall be installed in-sight to each warning gate motor, barrier gate motor, span lock motor, center lock motor, tail lock motor, brake motor, and span motors. Each unit shall be capable of being locked in the off position.

The switches shall be 3 pole, non-fusible, heavy-duty, safety switches in watertight and dust-tight NEMA 4X, stainless-steel enclosures with a rating of 30 amperes for the tail locks, span locks, center locks and brakes and 60 amperes for the Savannah Road span motors and 200 amperes for the Rehoboth Ave span motor. Each disconnect shall be furnished with two N.O. auxiliary contacts and phenolic nameplate to identify the corresponding motor. Size shall be based on the actual full load current of each motor.

New motor disconnect switches shall be furnished and installed to replace the existing units within the warning and barrier gate housings. The new units shall be 3 pole with two auxiliary contacts. Each disconnect switch shall be installed in a location that is easily seen and accessible. The disconnect switches shall be furnished in an enclosure rated NEMA 4 or 3R.

A new fused disconnect switch shall be furnished and installed for the new incoming service as shown on the plans for each bridge. The new service disconnect switch shall be a 200A, 600VAC, NEMA 4X, S.S. unit. The location, type and installation shall be coordinated with Delmarva and Lew BPW.

Wire and Cable

Except where otherwise noted, wiring in conduits shall be single conductor. All wire and cable shall conform to the requirements of NEMA Pub. No. WC70-1999. The minimum number of conductors provided in each cable shall be as shown on the Contract Plans. The cable installation in conduit, wireway and troughs shall conform to the latest edition of NEC and according to any other applicable code under local jurisdiction.

All conductors shall be soft annealed copper wire conforming to the requirements of NEMA Pub. No. WC70. All conductors shall have Class K stranding.

The insulation shall be a chemically cross linked polyethylene compound conforming to the requirements of Part 3.6 of NEMA Pub. No. WC70. The wire type for all conductors except shop wiring installed within the confines of the control cabinets or control desk shall be XHHW-2 as listed under NEC Table 310-13. "Conductor Application and Insulations". The wire type for all shop-wired conductors installed within the confines of the control cabinets and control desk shall be SIS as listed under NEC Table 310-13. "Conductor Application and Insulations".

All wire and cable shall be of a nationally recognized brand, acceptable to the Engineer, and shall have marks always used on the particular brand for identifying it. Acceptable manufacturers are as follows Houston Wire and Cable, Service Wire Company, Clifford of Vermont, Alpha Wire Company, Allied Wire and Cable, Okonite Company, General Wire and Cable, and Draka USA.

Equipment ground conductors shall be bare, stranded, coated copper conforming to the requirements of NEMA Pub. No. WC70, Part 2. When required by the National Electrical Code (NEC), equipment ground conductors shall be provided with approved insulation.

Flexible cable for specified connections shall be rubber insulated, multiple-conductor portable cords conforming to the requirements of NEMA Pub. No. WC3, Part 7.7 or NEMA Pub. No.WC8, Part 7.4 for hard service. Each cable shall be provided with a heavy-duty neoprene jacket conforming to the requirements NEMA Pub. No. WC3, Part 7.7.5.1 or NEMA Pub. No.WC8, Part 7.4.5.1. Flexible cables shall conform to the National Electrical Code, Article 400 for hard service.

The flexible control cables shall be Type SOOW -A portable cord rated 600 volts, 90-degree C. Conductors shall be flexible stranded bare annealed copper provided with ethylene propylene rubber (EPR) insulation. Cable jacket shall be chlorinated polyethylene (CPE).

New fiber optic and industrial Ethernet cables shall meet or exceed the following. The Contractor shall ensure system compatibility with all cables, equipment and systems.

Fiber optic Cables: Multi-mode, 62.5 microns core size, 125 micron cladding, less than 3.4 dB/km at 850nm and less than 1.0 dB/km at 1300 mm attenuation, greater than 200 MHz/km at 850 nm and greater than 500 MHz/km at 1300 nm bandwidth.

Industrial Ethernet Cables: Cat 6 shielded cable for use in high noise environment, 600 Volt rated PVC jacket rated for -4°F to 176°F.

Fiber optic cables and Ethernet cables shall be installed and connected per manufactures recommendations. Splices for fiber optic cables shall be made with fiber optic splice kits inside an isolated enclosure and with necessary connectors.

Wire markings and tags shall be provided for all the conductors and shall be factory-applied heavy duty, waterproof, permanently marked, and resistant to ultraviolet light deterioration. Numbers and letters shall be black or blue on a white background. Each wire and cable shall be preprinted with labels for each wire and/or cables entire length. Each preprinted label should match the interconnection diagram shop drawing. The Contractor shall submit the proposed wire marking system and a sample of the wire markers to be installed to the Engineer for approval. The labels shall be polyolefin heat shrink tubing, approved equal to Panduit LS5 labeling system.

With the exception of the submarine cable conductors where flanged forks shall be used, when it becomes necessary to connect a cable and/or wire No. 8 AWG or smaller insulated wire ferrules shall be used. The ferrules shall be attached to the wire using the manufacturers approved tool.

Strain relief bushings shall grip the cable jacket to provide a watertight seal at the point of cable entry. Strain relief bushings shall be OZ Gedney Type SR or approved equal.

Strain relief devices shall grip the cable jacket with an entwining cable mesh to support the weight of the cable where it enters the terminal box. Strain relief devices shall be Kellem cable grips or approved equal.

Conduit System

All new conduits and fittings as shown on the plans shall be as noted herein. Where installed indoors (within the control house) or where the conduit is encased in dirt or through concrete the conduit shall be rigid steel galvanized conduit. All other conduit shall be PVC coated rigid galvanized steel conduit including those which transition indoors from outside the control house.

In general, conduits shall not be less than ¾ inches in diameter. Sections of conduit shall be connected to each other with screw couplings made up so that the ends of both conduits will butt squarely against each other inside of the coupling. Where conduit is routed to hubs and connectors that will not accept ¾" conduit a reducer/enlarger fitting shall be furnished and installed to connect to a minimum of ¾" conduit.

All PVC coated galvanized steel conduit, associated fittings, and associated supporting products shall be provided by the same manufacturer to ensure that a five-year product warranty is achieved. Conduit systems from different manufacturers to make up the completed raceway system will not be permitted.

The PVC coated galvanized rigid conduit must be UL Listed and ETL Verified. Both the PVC and Zinc coating must have been investigated by UL as providing primary corrosion protection for the rigid metal conduit. Ferrous fittings for general service locations must be UL Listed with PVC as the primary corrosion protection. Hazardous location fittings, prior to plastic coating must be UL listed. All conduit and fittings must be new, unused material.

The PVC coated galvanized rigid conduit must be ETL Verified to the Intertek ETL High Temperature H2O PVC Coating Adhesion Test Procedure for 200 hours. The PVC coated galvanized rigid conduit must bear the ETL Verified PVC-001 label to signify compliance to the adhesion performance standard. The conduit shall be hot dip galvanized inside and out with hot galvanized threads.

A PVC sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit. The PVC coating on the outside of conduit couplings shall have a series of longitudinal ribs 40 mils in thickness to protect the coating from tool damage during installation.

Urethane coating of nominal 2 mil thickness shall be uniformly and consistently applied to the interior of all conduit and fittings. Conduit or fittings with thin or no coating shall be unacceptable.

The PVC exterior and urethane interior coatings applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperatures above 30°F (-1°C).

All female threads on fittings and couplings shall be protected by urethane coating. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameter of the coated conduit. All U bolts will be supplied with plastic encapsulated nuts that cover the exposed portions of the thread.

PVC coated conduit and fittings shall be Perma-Cote Coated galvanized rigid conduit and Fittings as manufactured by Perma-Cote, Gilmer, Texas or approved equal.

Flexible conduit where required shall be liquid tight steel conduit conforming to the requirements of UL 360. Fitting and connectors used in conjunction with flexible conduit shall also be steel liquid tight fitting with hot dipped galvanized finish when used with rigid conduit and PVC coated steel when used with PVC coated steel conduit.

Unless otherwise noted the conduit supports shall consist of PVC coated U-bolts attached to hot dipped galvanized steel supports (after fabrication) connected to the steel members, surrounding structure or concrete. All references to galvanized steel conduit and limit switch supports as shown in the plans shall be hot dipped galvanized after fabrication, field cuts will not be permitted. All U-bolts and bracket hangers shall be provided with medium-series lock washers and hexagonal nuts. Type 316 stainless steel strut conduit supports may be used as a contractor-initiated substitution at no additional cost for specific areas to meet the construction schedule with the exception of on the spans (to the center locks, span locks, navigation lights, traffic equipment and on the rest pier). The contractor shall submit cut sheets and installation drawings for such supports for review and approval.

In general, conduit fittings shall be of the same type and material as the associated conduit. Where used with PVC coated conduit the fittings shall be PVC coated.

Conduit expansion fittings shall be PVC coated and shall be provided with flexible bonding jumpers to maintain the electrical continuity across the joints. The fittings shall permit a total conduit movement of 4 or 8 inches as may be required.

Conduit expansion/deflection fittings shall permit a movement of ¾ inch from the normal in any direction. Flexible bonding jumpers shall be required to maintain bonding integrity whenever expansion fittings are required.

Install drain/breather fittings in all enclosures and conduit systems. Fittings shall be fabricated of stainless steel and shall be capable of passing 25 cc of water per minute.

Conduit hubs shall be provided with a ground bushing to connect the equipment ground conductors and enclosure ground lugs. The hubs shall be PVC coated when used in conjunction with PVC coated conduit.

Conduit tags for new and existing conduit shall be 1/8" thick flexible acrylic white nametag with black lettering. Each tag shall be a minimum of 1 ¼" x 3 ¾" with space for three lines of text. Engraving shall include the conduit reference number which can be referred back to the as-built documents, conduit size, wire size and quantity. Conduit tags shall be connected to each end of conduit with two plastic ties.

For core drill penetrations, the contractor shall core drill the required hole size and seal the conduit hole/penetration with a fireproof foam sealer intended to be used with conduit systems. The sealer shall be installed per manufacturer recommendations.

Wireway and Troughs

Wireways or troughs shall be furnished and installed in the control house as shown on the plans or as otherwise required to facilitate the installation of wiring. The Wireways shall be NEMA 12, inside the control house unless otherwise noted and constructed of No. 14 gauge steel, suitably reinforced with structural steel angles, and welded continuously at all seams and joints.

Wireways and troughs for below the switchboard room at Savannah Road and in areas outside the control house shall be NEMA 4X stainless steel and constructed of 14-gauge type 316 stainless steel, suitably reinforced with structural steel angles, and welded continuously at all seams and joints.

Wireways and troughs shall have a sealed removable hinged cover on one side to provide access to the interior. Stainless steel screw clamps spaced no more than 8 inches apart shall secure the cover. Intermediate steel barriers shall be provided to separate power and control wiring when possible.

Boxes

All junction boxes, pull boxes, terminal boxes, and cabinets shall be NEMA 4X, 14-gauge, stainless steel enclosures with hinged, 14 gauge, stainless steel doors supported by a continuous stainless steel hinge with removable pin unless otherwise noted on the plans. Seams shall be continuously welded and ground smooth. Each enclosure shall be provided with stainless steel fast operating door clamp assemblies and oil resistant gasket to insure a watertight seal. No box shall be drilled for more conduits or cables than actually enter it.

Boxes and cabinets shall be Bulletin A51S and A4S with clamp assemblies A L23SS as manufactured by Hoffman Engineering Company, equivalent manufactured by Henessey or Wiegmann or approved equal.

Terminal boxes shall be of sufficient size to provide ample room for the terminal blocks and interior wiring, and for the installation of conduit terminations and multi-conductor cable fittings. Interior mounting buttons with tapped holes shall be provided for mounting the terminal blocks.

Terminal blocks shall be feed-through type screw connection or lug type modular terminals sized for the required conductor being terminated and shall be din rail mounted. Double stack terminals are not permitted. Each terminal shall be suitably marked using factory printed terminal markers with the associated wire number. Hand written markers are not acceptable. Screw type terminals connections to the associated conductor shall be achieved using insulated wire ferrules. Lug type bolt on connections to the associated conductor shall be achieved using insulated flanged fork connectors. Bare wire connections are not acceptable. At least ten percent spare terminals shall be provided. Terminal blocks shall be Phoenix Contact, UT4 or approved equal.

Power distribution blocks shall be used for conductor sizes No. 6 and larger and shall be UL listed. Terminal blocks shall be suitable for use with copper wire and shall provide a withstand voltage rating of 750 volts per IEEE switchgear standards. Corrosion resistant marking strips shall be provided for conductor identification. At least ten percent spare terminals shall be provided. Terminal blocks shall be Gould Shawmut Power Distribution Blocks - Heavy Duty Series 68000 or approved equal.

The interior of all boxes shall be provided with insulated supports from which bundled cables may be supported.

Hardware and Supports.

Mounting bolts, nuts, washers and other detail parts used for fastening boxes, disconnect switches, limit switches, conduit clamps, cable/conduit supports, brackets and other electrical equipment shall be of stainless steel conforming to the requirements of ASTM A276, Type 316. Bolt heads and nuts shall be hexagonal, and shall be provided with medium series lock washers. Bolts smaller than ½ inch in diameter shall not be used except as may be necessary to fit the mounting holes in small limit switches, boxes and similar standard devices.

Unless fabricated from type 316 stainless steel, which has a minimum thickness of 5/16 inch, supports for conduits, cables, boxes, cabinets, disconnect switches, limit switches and other separately mounted items of electrical equipment shall be fabricated from structural steel not less than 3/8 inch in thickness. Channels, angles, bent plates, clip angles, other structural steel supporting members, hardware and gaskets for supporting electrical equipment shall be paid for under this item. Structural steel supporting members detailed under this item shall conform to the requirements specified elsewhere in this Contract.

Full neoprene gasket shall be furnished and installed for each box not less than 1/8-inch thick, between the equipment and the surface of the concrete.

Anchoring system for fastening equipment or brackets to concrete surfaces shall consist of stainless steel threaded rods and adhesive epoxy. All parts of the anchors shall be of Type 316 stainless steel. The Contractor is also responsible for furnishing any installation tools as required by the manufacturer to properly install the anchoring system. Threaded rods shall be HAS type 316 stainless steel threaded rods as manufactured by Hilti Corporation or approved equal, epoxy shall be HIT RE 500 Adhesive Epoxy as manufactured by Hilti Corporation or approved equal.

Receptacles:

All indoor receptacles shall be 20-ampere, 125-volt, three-wire, grounding type, polarized, duplex convenience outlets. Ground fault receptacle outlets shall be installed in locations as shown on the drawings or as required by the National Electrical Code. Each indoor receptacle shall be flush mounted in new outlet boxes and shall be provided with a Type 304 stainless steel cover plate. Outdoor receptacles shall be similar except each receptacle shall be a GFCI outlet and shall be provided with a watertight cast iron cover plate. Receptacles shall be specification grade manufactured by Hubbell, Arrow Hart, Leviton, or approved equal.

Switches:

All lights shall be controlled from tumbler switches located in a convenient, accessible location. All tumbler switches shall be specification grade, 20-ampere, 125-volt switches. Indoor switches shall be flush mounted in new outlet boxes and shall be provided with Type 304 stainless steel plates. Outdoor switches shall be mounted in waterproof, cast-iron, hot-dipped galvanized, surface mounted boxes. Switches shall be mounted 4 feet above the adjacent floor or platform. Switches shall be Specification Grade switches manufactured by Hubbell, Arrow Hart, Leviton or approved equal.

Indoor Recessed LED Light Fixture (Type A):

Indoor recessed mount light fixture shall be furnished and installed in the control room where shown on the plans. Each fixture shall be long life LED fixture with high efficiency drivers. Housing shall be recessed mounted and formed from cold rolled steel and painted after fabrication. The unit shall be 2'X2' rated for 120 VAC with 4000 lumens (35 watts) controlled from a wall switch. Fixtures shall be Lithonia Lighting Model 2ACL or approved equal.

Indoor Surface Mount LED Lighting Fixture (Type B):

Indoor surface mount light fixture shall be furnished and installed where shown on the plans. Each fixture shall be long life LED fixture with high efficiency drivers. Housing shall be surface mounted and formed from cold rolled steel and painted after fabrication. The unit shall be rated for 120 VAC with 4000 lumens (35 watts). Fixtures shall be Lithonia Lighting model 2ACLX2 (2' X 2') or 2ACL4 (2' X 4') or approved equal.

Industrial LED Lighting Fixture (Type D):

Each industrial light fixture located as shown on the plans shall be wall mounted explosion proof type, sealed marine outdoor rated NEMA 4X units designed for wet locations. Each fixture housing shall have be aluminum with electrostatically applied, baked gray epoxy clad finish. Globes shall be made of explosion proof glass, gaskets are silicone, all hardware, catch assemblies and guard shall be stainless steel. Each lamp shall be LED and equivalent to a pulse start metal halide 175W light level. The light assembly shall be Appleton Code Master LED Factory Installed Luminaire or approved equal.

Emergency lights (Type E):

Emergency Lighting units and illuminated exit signs shall consist of three 12-watt, H-lamp, halogen lamps with a solid-state dropout circuit for instantaneous load transfer on A-C failure. The emergency power source shall consist of two sealed, long-life, 10-year minimum, lead-acid batteries that shall be kept at full charge by a solid-state, pulse type battery charger. The battery shall have sufficient capacity to operate the specified lamps for a period of not less than 5 hours. All components shall be furnished in a sheet-steel housing suitable for wall mounting and provided with a permanent conduit connection. Outdoor units shall be rated NEMA 4X. Emergency lighting and exit signs shall conform to the specified requirements and manufactured by Exide Electronics, Emergi-Lite, Dual-Lite, or Engineer approved equal.

Outdoor LED Light (Type F):

Each exterior light fixture shall be wall mounted above each entrance door and outdoor rated with cast aluminum housing. Each fixture shall be gasketed with swing out door for maintenance. Each lamp shall be rated for 120VAC with 3400 lumens (33 watts). The light assembly shall be Appleton LED Wall Luminaire Model TWR1with 33 watt bulb or approved equal.

Hot Water Heater

Tankless instantaneous hot water heater where required shall be installed on the bridge below the sink in the control house. The water heater shall be on demand type with no delay when activated by a flow switch. The water heater shall be suitable for sanitary use and shall be rated at 4.1 kilowatts, 14.8 amps with a 56 degree Fahrenheit rise at 0.5 GPM. The Contractor shall supply all necessary supports, piping and fitting to properly install the unit. The water heat shall be Eemax model SP4277 or approved equal.

Air Conditioner

A wall mounted air conditioning unit shall be furnished and installed to replace the existing unit in the control room. The unit shall be rated for 208VAC and 12,000 BTU's minimum and shall be installed with a new NEMA 6-15R receptacle mounted near the unit.

Generator Diesel Fuel Lines

Diesel fuel piping shall be replaced in-kind where specified. In general, new fuel lines shall be black iron or flexible fuel hose rated for this service. No galvanized piping will be permitted. Flexible fuel lines shall be minimally rated for 300 degrees F and 100 psi.

Coupling and fitting shall be welded to the tank for connections to vent line, tank fill, low level fuel alarm, high level fuel alarm, engine fuel supply, engine fuel return, basin alarm, control sensor and fuel gauge.

The end of the suction line in the tank shall be provided with a double-poppet, brass foot valve and strainer located 3 inches clear above the bottom of the tank. Connection of both lines at the engine shall be made with bronze, flexible fuel hose with brazed-on brass couplings and threaded terminal fittings. The hose shall be approved equal to Anaconda Type S-1-H, Atlantic Metal Hose Type A-IP or Flexonics Series 300.

The connection in the fuel suction line shall be made with forged steel, plain-faced, slip-on welding flanges conforming to the requirements of ANSI B16.5-1968. The flanges shall be welded back and front to the connecting pipes. Gaskets shall be suitable for the intended use.

A fuel gauge and ultrasonic sensor shall be furnished and mounted on the storage tank to show in gallons the amount of fuel oil contained therein. The fuel sensor shall be furnished and installed in the existing fuel tank at Rehoboth Avenue. The sensor shall provide the PLC with a 4-20ma signal to indicate the level of fuel in the tank. The unit shall be rated NEMA 4X, fabricated from S.S and designed for submersible applications and capable of continuous monitoring of diesel fuel up to 30 feet. The sensor shall be manufactured by innovative components, model ULS, Ultrasonic level sensor or approved equal.

The fuel gauge shall have a weather proof, vertical direct reading, liquidometer suitable for use with diesel fuel oil. It shall have a 6 inch dial graduated every 25 gallons up to the full tank capacity of 800 gallons. The gauge shall be operated by direct mechanical linkage to a leverage float and arm, which shall be transmitted through a metal below seal assembly to isolate the gauge from the tank liquid and vapor.

Standard steel piping shall conform to the requirements of the current ASTM A53, Type S-Grade A. All piping shall be complete with all valves, fitting, supports, supports and clamps necessary for a complete installation. Drain plugs shall be provided at all low points in the fuel lines.

At the final completion of the Contract, the fuel tanks shall contain not less than 225 gallons of diesel fuel or 75% full for the propane tank.

Electric Heaters

New control house comfort heaters shall be furnished and installed on each level of the control house including the control rooms (operator's rooms), bathrooms, utility rooms, switchboard rooms and generator rooms.

Heating units shall either be baseboard type or wall mounted comfort heaters as specified in the plans or required per the room layouts. Heaters shall be located and positioned as to not interfere with new and existing equipment. The wall mounted units shall be forced air heaters as shown on the Plans and shall be rated 480/277 volt, three-phase, five-kilowatt electric heaters.

The baseboard style heaters shall be convection style heaters fabricated from heavy 18 gauge galvanized steel with heating elements constructed of rugged steel brazed fins. The length and size of baseboard heaters shall fit in the allowable space. The baseboard units shall be rated 277/120 volt, single phase, five-kilowatt electric heaters (control room) and 500 watts (for bathrooms).

Each heater shall be provided for a remote thermostat connection and contain an internal field terminal block(s) and built in contactor and transformer. Units without the internal contactor and transformer shall be provided by the contractor externally in a separate enclosure or included in the panel layout.

The Contractor shall also furnish and install new panelboards under this item as specified and shown on the plans to power the new and existing heaters. The panelboard shall be provided with a contactor to de-energize the heaters during bridge operation.

Thermostats shall be provided to control the heaters and shall have a setting range from 55 degrees to 90 degrees Fahrenheit and a differential of 3 degrees Fahrenheit and shall be provided with snap action contacts for actuation of the remote-controlled switch coils.

The thermostats shall be standalone controllers with LCD digital displays with graphical interface, internal clock scheduler, and independent relay outputs as well as an analog 4-20ma/0-10ma outputs. The relay contact outputs shall be used to control the heaters whereas the analog outputs shall be connected to the PLC for monitoring purposes. Thermostats shall be Honeywell T775M or approved equal electronic standalone controllers.

Panelboards

New panelboards shall be furnished and installed as shown on the plans for distribution of the bridge lighting, heating, and distribution circuits. The panelboards shall be of the dead-front type and shall be provided with quick-make, quick-break, thermal-trip, E-frame, both-on branch circuit breakers. Each breaker shall trip free of the operating handle, and the handle shall indicate the position of the breaker..

Each panelboard shall be provided with a circuit breaker in the mains and with a full-sized neutral bar. All branch circuits shall be numbered, and a typewritten directory shall be provided on the inside of each door. Circuit breakers shall meet the requirements of UL Standard 489. Panelboards shall be provided with number of spaces and spare breakers as indicated on the Plans.

Panelboard circuits breakers shall be rated for the connected operating voltage and have a interrupting rating of at least 35KAIC. Each circuit breaker shall be bolt on type units and shall be connected to the panelboard as shown on the plans. Bridge lighting and distribution panelboards shall be 120/208-Volt, 3-phase, 4-wire panel. The panelboard shall be code-gauge galvanized steel with ANSI 61 light gray enamel finish unless otherwise noted.

The bridge heating panelboard shall be 480/277-Volt, 3-phase, 4-wire panel. The panelboard shall be code-gauge galvanized steel with ANSI 61 light gray enamel finish. The heating panelboard shall be provided with internal multipole lighting contactor controlled from a PLC output to de-energize the bus when the bridge is in operation.

Panelboards installed in a non-climate controlled environment shall be rated NEMA 4X Stainless Steel designed for outdoor use. Panelboards installed in a climate controlled environment shall be rated NEMA 12. Panelboards and circuit breakers shall be NQ/NF and QOH type as manufactured by Square D with ratings and number of circuits as shown on the plans.

Lighting Transformer

The lighting transformer shall be a three phase, four-wire 30-KVA, 480-volt primary, 208/120-volt secondary, epoxy resin encapsulated, non-ventilated transformer with copper windings. The Lighting Transformer shall be located as shown on the plans in a NEMA 3R enclosure.

Marine Air Horn

Air horns shall be electrically operated units and capable of providing a klaxon sound of 110dB or greater at 10 feet. Each unit shall be marine rated with a NEMA 4X or IP65 rating. The air horns shall be connected to the new lighting panelboard and operated at 120VAC. The air horn shall be provided with required mounting supports and hardware.

Navigation Lights

Fender Navigation Lights: Vandal resistant fender lights shall be mounted on the existing fender system as shown on the Plans. Each pile cluster light shall be a dual unit, 8-inch outside diameter, 180 degree, red fresnel lens and shall be mounted on a short section of 1 ½" stainless steel pipe with a flange at the bottom and bronze castings. Each pile cluster light housing shall be cast-bronze, securely bolted in position with bronze or stainless steel lag screws not less than 3/8 inch in diameter. Each pile cluster light shall be equipped with 120 volt, 100,000-hour LED lamp. New fender light shall be the PL pier light as manufactured by B&B-Roadway. No substitutions are permitted.

Red/Green Span Navigation Lights: At the outboard toe of each bascule girder, there shall be mounted a new double-unit navigation light. Each unit shall have a green light mounted above a red light. The red light shall have an 8-inch, 180-degree, red fresnel lens. The green light shall have an 8-inch, 180-degree, green fresnel lens. Each bascule span light shall be suspended by a stainless steel pipe hanger from a pivot bracket mounted on the steel work. The pivot assembly shall be provided with an anti-swing brake to prevent oscillation under windy conditions. The retriever chains shall be arranged to allow the lights to swing freely and so that the unit can be readily withdrawn for lamp replacement. The connections to the span lights shall be made with four-conductor, No. 10 AWG, flexible cable. One conductor shall ground the span light housing. New red/green navigation lights shall be the BS bascule span light as manufactured by B&B-Roadway. No substitutions are permitted.

All bascule span navigation lights shall have gasketed doors and lenses, and each entire unit shall be completely weatherproof. Fittings shall be non-corroding, and the sockets shall be porcelain mounted on shock absorbers. The housings for all units shall be cast-bronze, and a 100-watt 120-volt, 5 year lamp with brass base shall be installed in each socket. A dual lamp and transfer relay kit shall be provided in each navigation light housing. A bronze retriever chain shall be provided for each pivoted bascule span light.

All navigation lights shall be provided in accordance with the rules and regulations of the United States Coast Guard.

Roadway Lighting

The existing LED roadway lights shall be reconnected as shown on the plans to the new incoming service with a new photocell. The photocell shall be mounted on the control house roof designed for LED lighting and shall be rated for 277 VAC and have a built in time delay. The unit shall be weatherproof, outdoor rated and shall be a turn/lock type provided with associated 15 ampere receptacle.

Fire Alarm System

A new fire alarm system shall be furnished and installed as shown on the plans and required in accordance with NFPA 502 and NFPA 72. The Contractor shall supplement the details specified and shown on the plans to meet all necessary standards and codes. All work in this section shall be approved by the fire marshal prior to installation.

The fire alarm system shall be furnished and installed in each level of the control house and machinery room(s) on each bridge. The system shall include but not be limited to: fire alarm control panel, manual pull station, rapid keyless entry box, alarms/beacons, smoke detectors, key pad, wireless hubs, primary and back-up communication, etc.

To ensure that there is one source of supply and one responsibility, the fire alarm system (fire alarm control panel, pull stations, smoke detectors, alarms, key pad, etc.) shall be built, tested, and shipped by the same manufacturer. The proposed manufacturer shall be completely responsible for furnishing, testing and placing in proper operating condition the fire alarm system. Independent vendors that buy the control panel, fire alarms, pull stations, smoke detectors, key pad and auxiliary equipment from various manufacturers and assemble the components together relying on the individual manufacturers for their supply of spare parts and engineering expertise do not meet the criteria of this Specification and will not be acceptable.

Fire Alarm Control Panel: The Fire alarm control panel shall be microprocessor based capable of providing at minimum of five hardwired zones including one wireless zone and meet the requirements of UL864/NFPA72. The unit shall support four wire smoke detectors on all five circuits and is capable of continually monitoring system status of AC, standby battery, and zone inputs. The control panel shall be capable of connecting to two phone lines as well as the DelDOT TMC network located on the bridge.

Manual Pull Station: Each Manual Fire Alarm Stations shall be non-code, with a key-operated reset lock in order that they may be tested, and so designed that after actual Emergency Operation, they cannot be restored to normal except by use of a key. Each station shall automatically condition itself so as to be visually detected as activated. Manual stations shall be constructed of red colored LEXAN® (or polycarbonate equivalent) with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in white letters, 1.00 inches (25.4 mm) or larger. Each station shall be suitable for surface mounting on matching back-box; or semi-flush mounting on a standard single-gang, double-gang, or 4" (10.16 cm) square electrical box, and shall be installed within the limits defined by the Americans with Disabilities Act (ADA) or per national/local requirements. Manual Stations shall be Underwriters Laboratories listed.

Smoke/CO Detector: Each smoke detector shall be a direct 4-wire ionization type unit. Detector will have a visible LED, which will blink in standby and latch on in alarm. The detector shall have a sensitivity of 1.9±0.6%/ft. as measured in the UL smoke box. The detector screen and cover should be easily removable for cleaning. It shall be possible to sensitivity and functional test on the detector need of generating smoke. The detector shall have mounting bracket that allows for mounting to a 3 1/2" or 4" octagon box or 4" square electrical box. Each detector shall be furnished and installed with Model EOL end of line power supervision relays.

Heat Detector: Each heat detector shall be a combination fixed temperature/rate-of-rise thermal sensor. The rate-of-rise element shall be activated by a rapid rise in temperature. The detector shall include a reversible mounting bracket for mounting to 3½-inch and 4-inch octagonal, single gang, and 4-inch square back boxes with a square to round plaster ring. The detector shall contain alphanumeric markings on the exterior of the housing to identify its temperature rating and activation method. The rate-of-rise element of combination fixed temperature/rate-of-rise models shall be restorable, to allow for field-testing. The detectors shall include an external collector that shall drop upon activation to identify the unit in alarm.

Alarms: Horn/Strobe alarms shall be listed to UL 1971 and UL 464 and shall be approved for fire protective service. Horn/strobe shall be wired as a primary signaling notification appliance and comply with the Americans with Disabilities Act requirements for visible signaling appliances, flashing at 1Hz over the strobe's entire operating voltage range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. The horn shall have two-tone options, two audibility options (at 24 volts) and the option to switch between a temporal 3 pattern and a non-temporal continuous pattern. Strobes shall be powered independently of the sounder with the removal of factory installed jumper wires. The horn on horn/strobe models shall operate on a coded or non-coded power supply (the strobe must be powered continuously).

Rapid Keyless Entry Box: The rapid entry keyless entry enclosure shall be located outside the control house near the keyless entry access point. The enclosure shall be outdoor rated, surface mountable and capable of holding keys a keyless access cards. The enclosure shall include a lock cover, tamper seal, shall be gasketed, and UL listed. The rapid keyless entry box shall be approved equal to the Know Box 3200 or approved equal.

Technical Manuals

Maintenance Manuals shall contain descriptive material, catalog cuts with non-pertinent data blocked out, as-built drawings, spare parts list, troubleshooting techniques and any and all information necessary for successful maintenance of the bridge functional systems and each piece of equipment furnished by the

Contractor. Bridge functional systems shall be understood to include all operating machinery, lock machinery, electrical service equipment, electrical and control systems, and all other equipment for which periodic maintenance and operation is desirable. Subsequent to acceptance of the bridge by DelDOT following successful completion of acceptance testing, errata or addenda to the manuals should address any revisions required.

Operations Manuals shall contain written descriptions of the functional systems of the movable bridge, step-by-step operating instructions for each of these systems and any and all information and directions required for their successful operation. Subsequent to the break-in period, errata or addenda to the manuals should address any revisions required.

All printed matter, data, drawings, diagrams, etc., shall be accurate, distinct and clearly and easily legible. Illustrations shall be clear; and printed matter, including dimensions and lettering on drawings, shall be legible. If reduced drawings are incorporated to manuals, the original lines and letters shall be darkened as necessary to retain their legibility after reduction. Larger drawings may be folded into manuals to page size.

Operating and maintenance manuals shall be bound in heavy-duty nickel-plated three-hole binders with three trigger positions: lock, unlock and open. Binder shall have metal hinges. Locking mechanism shall allow sheets to lie flat (i.e. channel lock). Covers shall be stiff heavy-duty plastic or other approved material.

The printed material shall be bound into each manual between rigid covers. The manuals shall be approximately 9 inches by 12 inches to contain the drawings without excessive folding so that they may be easily opened. The books shall be neatly entitled with a descriptive title, the name of the project, the location, year of installation, the name of the manufacturer, the engineering firm and the Contractor. Copies of drawings shall be in black on white background and shall be legible. The arrangements of the books, the method of binding, material to be included, and the text shall all be submitted to and approved by the Engineer.

Paper used in these manuals shall be 20-pound, punched paper, water resistant, and acid free of a quality suitable for archival use. Paper shall have 5/16-inch minimum diameter holes, reinforced with plastic or cloth at the standard three (3)-hole spacing. The paper shall be standard 8½"x11", or, in the case of larger foldout diagrams and illustrations, folded to approximately 8½"x11" size. No paper or other material shall extend beyond the manual covers.

In additional, the approved manuals shall be scanned into PDF files, which will then be placed on a CD and handed over to the Delaware Department of Transportation after final acceptance by the Engineer

Spare Parts

Spare parts shall be as specified below and include the specified quantity for each bridge and item number. For common items supplied on both bridges the spare parts shall be isolated and separately packaged and shall be not be shared. The below list of spare parts is for each bridge.

Control Cabinets and Desks (E1, E2, E19, E20)

1. One fully programmed touchscreen display for each size provided.
2. One spare PLC card and module for each type/size furnished including processors, I/O, power and communication cards.
3. One spare PCMCIA card of each type supplied.
4. One spare Ethernet switch for each type supplied.
5. One spare power supply for each size and type installed.
6. Six fuses of each kind and size installed.
7. One circuit breaker of each type installed.
8. One complete set of contacts and one operating coil for each size and type of magnetic contactor and motor starter. For units that do not incorporate replaceable contacts, furnish one complete unit with coil.
9. One completely assembled and wired Reversing and one completely assembled Non-reversing contactor for each type installed.
10. One control relay and two extra sets of contacts for every ten installed (minimum of 1 relay and two sets of contacts).

11. One complete relay timer and time delay relay for every ten installed (minimum of 1 relay and two sets of contacts).
12. Two spare lamps for the interior lighting.
13. One door switch.
14. One selector switch and push-button for each type supplied.
15. One indicating light for each type and color supplied.
16. Three indicating light covers for each type supplied

Flux Vector Drive (E3, E21)

1. One fully programmed touchscreen display for each size provided.
2. Six fuses of each kind and size installed.
3. One circuit breaker of each type installed.
4. One complete set of contacts and one operating coil for each size and type of magnetic contactor and motor starter. For units that do not incorporate replaceable contacts, furnish one complete unit with coil.
5. One completely assembled and wired Non-reversing contactor for each type installed.
6. One control relay and two extra sets of contacts for every ten installed (minimum of 1 relay and two sets of contacts).
7. One complete relay timer and time delay relay for every ten installed (minimum of 1 relay and two sets of contacts).
8. All the internal components of one complete, calibrated FVD system for each size drive system. Power and control wiring, terminations and mounting hardware shall not be included.
9. Two spare lamps and door switches for the interior lighting.
10. One door switch.

Automatic Transfer Switch (E4, E22)

1. Six fuses of each kind and size installed.
2. One circuit breaker of each type installed.
3. Two spare lamps for the interior lighting.
4. One door switch.

Limit Switches (E5, E23)

1. Two completely assembled mechanical limit switch for each type supplied.
2. One speed switch for each type supplied.
3. Four proximity sensors for each type supplied including cord sets.
4. Four contacts for each rotary cam limit switch supplied.

Motors (E6, E24)

1. Two spare motor encoders for E23 only

Motor and Machinery Brakes (E7, E25)

1. One limit switch for each brake provided per bridge.
2. One thrustor motor for each type/size of brake supplied per bridge.

Modifications to Warning and Barrier Gates (E8, E26)

1. Two door switches for each type supplied.
2. Two flashers for each type supplied.

Miscellaneous Equipment (E15, E33)

1. Two panelboard circuit breakers for each type and size supplied
2. Six bulbs for each type of light fixture supplied.
3. One spare generator fuel sensor.

The Contractor shall arrange the spare parts in uniform size cartons of substantial construction, with typed and clearly varnished labels to indicate their contents, and store them where directed by the Engineer. Large spare parts shall be provided with moisture-proof wrapping. The Contractor shall also provide a directory of permanent type, describing the parts. The directory shall state the name of each part, the manufacturer's number thereof, and the rating of the device.

The Contractor shall be responsible for maintaining spare parts during construction and shall include charging the spare drives as directed by the manufacturer until final acceptance of the project from DelDOT.

Construction Methods:

Working Drawings, Samples and Submittals.

The Contractor shall have the ability to created and produce working installation drawings in accordance with the requirements below and herein in CAD format. The reproduction of the contract drawings will not be acceptable as part of any submitted shop drawings and will be immediately rejected and returned to the Contractor for revision. The required drawings will be submitted in as a hard copy or electronic pdf as required by the DelDOT standard specifications and shall have the Contractor border on each submitted drawing.

Within 30 days after the award of the Contract a completed schedule of electrical submissions that outline when all of the electrical submittals will be made. No more than 90 days shall pass between the award of the contract and the Contractor's first submission.

Certified dimension prints of the apparatus shall be provided and state in the certification the name of the job, the application of the apparatus, device designation, number required, right hand or left hand assembly, electrical rating, number of poles or contacts, material, finish, and any other pertinent data to show that the apparatus meets the specified requirements.

Upon completion of the work, the Contractor shall correct all electrical shop or working drawings to show the work as constructed and provide one (1) set of 11X17 pdf drawings, as well as the associated CAD files.

The Contractor shall submit for inspection and test, if directed by the Engineer, samples of any apparatus or device that he proposes to use as a part of the electrical installation.

As a minimum the Contractor shall supply the following shop drawings and submittals prior to the start of associated field work.

(a) Control System Vendor Submittals:
  (1) Certified dimension prints of all limit switches, proximity sensors, motor encoders, control cabinets, PLC cabinet, drive cabinets, control desk, back panels, panelboards and other electrical apparatus external to the control desk, are required. All pertinent electrical data, ratings, drive-programmed parameters, calculations and mounting details are to be included on the prints. The vendor must schedule a site visit with Delaware Department of Transportation to perform drive analysis.
  (2) A complete schematic diagram and wiring diagram, including all power, and control connections. Each electrical device and each wire between devices shall be identified by an individual designation of letters, numbers, or a combination of both; and such designations shall be used wherever the devices or wires appear on other drawings.
  (3) Layout drawings and internal connection wiring diagrams of the control desk, control cabinet, back panels, PLC cabinets and flux vector drive cabinets.
  (4) A schedule of electrical apparatus for each cabinet or panel which shall list each electrical device by its manufacturers designation as shown on the schematic wiring diagram and shall state for each device its rating, number of poles or contacts, function, catalog number, and location. A complete set of catalog cuts for materials furnished shall be included for each piece of apparatus.
  (5) A point-to-point complete interconnection diagram(s) for all bridge control electrical apparatus and equipment used in the operation of the span. The diagram(s) shall be of the elementary type and shall show the external connections of all devices and equipment from all terminal blocks installed. Computer-generated inter-connection lists will not be acceptable in lieu of a true interconnection diagram.
  (6) Shop and field testing procedures, including test forms with acceptance criteria, and schedule of testing of all equipment shall be furnished by the vendor.

(b) Contractor Installation Work Submittals: The Contractor shall be fully responsible for developing all point-to-point electrical conduits and wiring runs for the entire electrical system. Coordination with all other disciplines is required as part of the development of the drawings. The required drawings shall include, but not be limited, to:

(1) A complete schematic conduit diagram showing the interconnection of all devices and equipment, including terminal and junction boxes. The size of each conduit, and the wire number and size of each conductor in conduit, shall be shown on the diagrams. Each conduit shall be suitably numbered or lettered, and percent wire fill shall be shown.

(2) Prior to the start of field work, a complete set of layout and installation drawings for the electrical work shall be submitted for review and approval. The drawings shall include and detail the location of equipment, installation procedures/methods, support and mounting details of equipment, electrical apparatus and equipment. These drawings shall be made to scale and shall show the exact location of all conduits, supports, cables, boxes, motors, brakes, limit switches, disconnect switches, and other electrical equipment and the method of supporting them on the structure. No work shall proceed without the approval of these drawings by the Engineer.

(3) Construction drawings of all multi conductor droop and flexible cables, including the sizes of conductors, type and thickness of insulation, jackets and other components, and giving the outer diameter of each finished cable.

(4) Detail drawings showing the construction of cabinets, brackets, and special supports required for the installation of the droop cables for circuit connections between the movable span and fixed pier including conduit installation and expansion/deflection conduit fittings.

(5) Test results from all factory and field test specified.

(6) Outline drawings, catalog cut sheets and mounting details shall be submitted for the following equipment:

i. Control Cabinets
ii. Motor Control Cabinet / Auxiliary Cabinet
iii. Back Panels
iv. Control Desk
v. Drive Cabinets
vi. Automatic Transfer Switch
vii. Wiring Devices
viii. Panelboards
ix. Circuit Breakers, Relays, Contacts, etc.
x. PLC system and equipment
xi. Transformers
xii. Safety Disconnect Switches
xiii. Grounding Equipment
xiv. Conduit
xv. Wireway
xvi. Boxes
xvii. Wire and Cable
xviii. Lugs
xix. Wire and Conduit Tags
xx. Limit Switches and Proximity Sensors
xxi. Motor Encoders
xxii. Lock Motors
xxiii. Leaf Motors
xxiv. Motor and Machinery Brakes
xxv. Traffic Gate Equipment
xxvi. Speed Switch Assemblies
xxvii. Service Lighting and Heating Fixtures
xxviii. Fire Alarm System
xxix. Marine Horn
xxx. Any new equipment required for the temporary operating system.

(7) Any other drawings, which may, in the opinion of the Engineer, be necessary to show the electrical work.

Factory Inspection and Testing of Bridge Control System. The enclosed motor control cabinet equipment, drive cabinets, control desk, back panels, and other apparatus supplied, assembled or fabricated by the vendor of the electrical control system shall be subjected to shop inspections to demonstrate compliance with all

specified requirements. The complete factory inspection and testing of the bridge control system shall be as specified and paid for under the item "Testing."

Factory tests for equipment other than the bridge control system shall be as specified in the various materials sections throughout these specifications.

Field Testing. Upon completion of the electrical work for the bridge, the Contractor shall arrange for and provide all the necessary field tests, as directed and approved by the Engineer, to demonstrate that proper operation of the entire electrical system for the bridge is achieved and in accordance with the Contract Plans and Specifications. The complete acceptance testing procedure and requirements shall be as specified and paid for under the "Acceptance Testing and Functional Checkout"

Manufacturer's Field Start-up Service. In addition to furnishing the major items of electrical equipment, the system vendor shall furnish all necessary field supervisory start up material and labor to facilitate proper adjustment of all the electrical equipment so as to achieve functioning of the span to the satisfaction of the Engineer.

The systems vendor's field service engineering personnel shall be experienced in the adjustment and functioning of the particular control equipment furnished under this item. The personnel shall be capable of locating and correcting faults or defects and of obtaining from the manufacturer, without delay, new parts or replacements for apparatus that, in the opinion of the Engineer, does not perform satisfactorily.

Suggested Sequence of Construction. The Contractor shall sequence the construction and coordinate the various activities such that the contract is satisfactorily completed in accordance with the scheduling requirements of the Contract including maintaining vehicular traffic and navigation. The Contractor shall submit the proposed sequence of construction to the Engineer for approval, and construction shall not commence without the approval of the Delaware Department of Transportation.

Delivery and Storage; Protection for Shipment.

The specified electrical equipment shall be shipped from the manufacturer's facility once all test results have been approved. A portion of the equipment such as motors, drives, control cabinets, ATS, etc. shall be shipped to the drive manufacturer and control system vendor's facility for testing.

Equipment shall be stored in a humidity and temperature controlled environment. Damage to any of the equipment caused by moisture and/or weather conditions will require replacement. The Contractor will be responsible for maintaining the equipment in like-new condition. Equipment which is damaged in any way shall require replacement at the Engineers discretion at no additional cost to the Delaware Department of Transportation.

Fabrication of Control Cabinets and Back Panels

The Contractor shall follow the testing guidelines as specified herein and paid for under this item, and all applicable paragraphs under this Section. For general material and installation requirements the Contractor is directed to the general requirements herein. All work performed for fabrication and testing as specified shall be performed by an acceptable control system vendor. Requirements for the control system vendor shall be as specified under "Bridge Control System Vendor."

The Contractor shall install the assembled back panel and enclosures in the switchboard rooms as shown on the plans for the Flux Vector Drive Cabinets, Control Cabinets and ATS Cabinet. Adjustments to the positions and layout of the back panels and enclosures shall be made by the Contractor for proper fit at no additional cost to DelDOT.

The wiring within the control desks, drive cabinets, motor control cabinets, auxiliary cabinets and PLC cabinets shall be insulated switchboard wire conforming to the requirements hereinbefore specified for wiring in the control cabinets. The wiring shall be arranged systematically so that all circuits can be readily traced. All conductors shall be terminated on easily accessible terminal blocks mounted inside the desk at the rear. Spare terminals totaling at least 10 percent for power conductors and 20 percent for control conductors of those actually used shall be provided. Wiring shall be identified at equipment terminals by marking the adjacent area with bright yellow painted numbers to correspond to conductor designations appearing on the Contractor's wiring diagrams.

E1 Control Cabinets

The back panel for the existing drive cabinet located in the switchboard room shall be removed and replaced with a new back panel as shown on the plans. The new back panel and existing drive cabinet enclosure shall be relabeled 'Auxiliary Cabinet.'

The auxiliary cabinet shall include contactors, starters, relays, circuit breakers, etc. as shown on the plans. The layout shall be modified as required to fit within the existing cabinet and based on the routing and cables and wiring.

The existing fan blower and assembly shall be removed to the existing cabinet and repaired as required.

The PLC enclosure shall be wall mounted as shown on the plans in the switchboard room. The existing entrance door to the switchboard room shall be modified to swing outboard to accommodate the enclosure. The modifications to the entrance door shall be paid for elsewhere.

The Contractor shall coordinate locations of the equipment with existing utilities, water piping, and other existing equipment. Adjustments to the back panels, enclosures and equipment shall be made by the contractor for proper fit and installation at no additional cost to DelDOT.

E2 Control Desk

The existing control desk shall be removed and replaced with a new control desk as shown on the plans. Modifications shall be made to the locations of the new enclosure to accommodate the existing conduit penetrations and routing through the floor to the end devices.

The control desk shall include PLC equipment, network switches, circuit breakers, relays, etc. as shown on the plans. The layout shall be modified as required to fit and be installed in the allowable space and based on the routing and cables and wiring.

Special attention shall be made to minimize the size of the new control desk to carry into the control room without major disassembly of the windows.

The Contractor shall coordinate locations of the equipment with existing utilities, water piping, and other existing equipment. Adjustments to the back panels, enclosures and equipment shall be made by the contractor for proper fit and installation at no additional cost to DelDOT.

E3 Flux Vector Drive

The back panel in the existing auxiliary cabinet located in the switchboard room shall be removed and replaced with a new back panel as shown on the plans. The new back panel and existing auxiliary cabinet enclosure shall be relabeled 'Span Drive Cabinet'.

The drive cabinet shall include VFD assemblies, touchscreen, manual controls, contactors, starters, relays, circuit breakers, etc. as shown on the plans. The layout shall be modified as required to fit within the existing cabinet and based on the routing and cables and wiring.

The existing doors on the existing auxiliary cabinet (new drive cabinet) shall be removed and modified at the control system vendor's facility. Modifications shall include installation of manual controls, drive key pad, indicators, etc. as shown on the plans.

The Contractor shall coordinate locations of the equipment with existing utilities, water piping, and other existing equipment. Adjustments to the back panels, enclosures and equipment shall be made by the contractor for proper fit and installation at no additional cost to DelDOT.

Each drive shall be tested at the drive manufacturer's facility with the actual bridge motor or other approved facility prior to shipping to the control system vendor for control system testing. The drives shall be full load tested in the presence of the Engineer using the actual span motors and a dynamometer up to a maximum of 150% full load torque of the span motor. The Contractor shall submit, at least two weeks prior to the test date, the anticipated schedule and location of testing as well as test forms and/or procedures to be used for the testing of each drive.

Test results shall be documented at various loads, durations and intervals and submitted to the Engineer for approval prior to shipment to the control systems vendors' facility. During testing the motor temperature shall be monitored, if the observed exceed manufacturers recommended values testing shall stop until the temperature reached a safe value at which point testing shall resume.

Certified factory start-up at the bridge site shall be provided for each drive by a factory authorized service center. In addition, a minimum of 24 hours of classroom training shall be provided for the facilities maintenance personnel.

E4 Automatic Transfer Switch (ATS)

The existing ATS and power cabinet shall be removed and replaced with a new enclosure installed in the generator room as shown on the plans. The new enclosure shall include a new ATS, circuit breakers, fuses, control transformer, etc. as specified and other equipment shown on the plans.

Special attention shall be made to minimize the size of the new enclosure to carry and fit into the generator room without major disassembly and modifications of the windows, doors or walls.

A new conduit run from the new DPL service to the ATS enclosure shall be furnished and installed as shown on the plans. The contractor shall coordinate the location of the cabinet with the new location and adjust as required.

The Contractor shall coordinate locations of the equipment with existing utilities, water piping, and other existing equipment. Adjustments to the back panels, enclosures and equipment shall be made by the contractor for proper fit and installation at no additional cost to DelDOT.

E19 Control Cabinets

New control enclosures shall be located in the switchboard room as shown on the plans. All work required for the control enclosures under this item shall be similar to item E1 unless otherwise noted.

E20 Control Desk

The existing control desk shall be removed and replaced with a new control desk as specified and shown on the plans. All work required for the control desk shall on this item shall be similar to item E2 unless otherwise noted.

E21 Flux Vector Drive

The existing drive cabinets located in the switchboard room shall be removed and replaced with a new enclosure as shown on the plans. All work required for the flux vector drives on this item shall be similar to item E3 unless otherwise noted.

The new doors on the drive cabinet shall modified at the control system vendor's facility. Modifications shall include installation of manual controls, drive key pad, indicators, etc. as shown on the plans.

The drive equipment for this item shall be sized to operate in sensorless vector mode and without a motor mounted encoder. All equipment and work required to operate as specified shall be provided by the Contactor at no additional cost.

E22 Automatic Transfer Switch (ATS)

An existing/new ATS shall be removed from the existing enclosure and modified to operate with the existing generator which will be reconnected for 480VAC, three phase power source. Once modified the existing ATS shall be re-installed in a new outdoor rated NEMA 4X enclosure with accessories as shown on the plans.

The existing/new ATS shall be shipped and delivered for modifications and shop assembled by the control system vendor. The completed ATS enclosure shall be made available for shop inspection and testing as specified herein.

A new conduit run from the Lewes BPW service to the ATS enclosure shall be furnished and installed as shown on the plans. The contractor shall coordinate the location of the cabinet with the new location and adjust as required.

The Contractor shall coordinate locations of the equipment with existing utilities, water piping, and other existing equipment. Adjustments to the back panels, enclosures and equipment shall be made by the contractor for proper fit and installation at no additional cost to DelDOT

PLC Programing and Sequence of Operation

(a) Software Programing
- (1) The control system vendor shall be fully responsible to generate a complete operating system and develop the PLC program and alarm messages using:
  - (i) The Software Programming, Sequence of Operation, Other PLC Functions, and Alarm sections provided in this section.
  - (ii) All logic and wiring shown on the plans
  - (iii) The testing requirements shown in Start Up and Commissioning Requirements.
  - (iv) Allowing for specific requirements of the Allen-Bradley PLC as supplied, the program ladder logic shall follow the above items and this Specification as closely as possible.
- (2) The control system vendor shall furnish a laptop computer, interconnection cables, power supplies, software, PanelView programming, and PLC programming to accomplish the specified operation of the bridge and its auxiliaries. Software for the PLC, touchscreen, drives, and laptop computer shall be loaded and coordinated by the Contractor to achieve the correct designed operation of all software.
- (3) The control system vendor shall be fully responsible for developing the PLC, and touchscreen, and desktop computer software and software programming to accomplish the specified operation of the bridge and its associated equipment. The Contractor shall assume software debugging will occur in the shop as well as in the field during start-up and subsequent testing. No additional payment shall be made for software debugging due to logic changes made in the field.
- (4) The control system vendor shall be responsible for coordination with DelDOT's TMC department for testing an integration of the remote monitoring system.
- (5) The PLC program shall be in accordance with the following items:
  - (i) The ladder logic shall be easy to understand and troubleshoot.
  - (ii) The ladder logic shall be fully documented, including rung comments and address comments.
  - (iii) The ladder logic shall be written with regards to the operational sequence of the bridge, containing separate sections for each of the major equipment areas such as gates, locks, etc.
  - (iv) From the Operator's standpoint, the bridge shall operate as before in terms of sequence of operation.
  - (v) The ladder logic shall not utilize or contain the following flaws:
    - (1) Latched coils: PLC logic shall be based upon real world conditions and reset when required. When the PLC loses power, and then power is returned, the PLC will determine the position of the leaves and other electrical equipment, but not expect the bridge to be in the exact same position. If any equipment was operated manually, the PLC program will determine the new position of the equipment and operate normally.
    - (2) Unnecessary internal coils: PLC logic shall be as simplified as possible and not use multiple relays for a single function. The intent of this is to make the program easy to troubleshoot and understand.
    - (3) Improper bypass logic: When the bypass switch is utilized the bypass will bypass only the required interlocks. The intent of this item is to provide programming that will utilize the bypasses and only bypass the correct interlock, but does not remain active in the logic or bypass other interlocks in the program.
    - (4) Loss of alarms: PLC logic shall be written to record and store the alarms and display on the touchscreen.

(5) Switch and Push button time delays: PLC logic shall not add time delays to control desk switches and pushbuttons.
(6) Problems transferring between automatic and manual modes of operation: PLC logic shall allow simple transfer from automatic and manual modes without generating unnecessary alarms for causing failures in the program. The intent of this item is to provide programming that transfers between manual and automatic mode without problems or inaccurate alarms.
(7) Faulty timing logic: The intent of this item is to provide programming that does not have internal timers to determine when problems occur or provide inaccurate alarms.

(vi) All timer settings shown in the sequence of operation shall be clearly documented in the program. They shall be adjusted to match the selected equipment and adjusted during shop and field testing for proper operation.
(vii) Modify and add alarm messages and associated alarm ladder logic as required.
(viii) The PLC shall communicate information through the Ethernet connections with multiple pieces of equipment, such as drives and overload relays. The information shall be identified as an Ethernet input into the PLC.

(6) Contractor shall submit a fully documented and cross-referenced copy of the new PLC program for review and approval.
(7) The touchscreen alarm panel shall be programmed to timestamp, print, and store each PLC alarm. The alarms shall be stored in chronological order and the operator shall be able to scroll through the alarm screen to review alarms. The alarms shall be stored in the touchscreen and being identified by a numerical identifier. When the PLC processor transmits the numerical identifier alarm bit to the touchscreen, the touchscreen shall display the alarms, send the alarms to the printer, and store the alarms in an alarm history screen stored in chronological order.
(8) In the event of CPU failure, all outputs shall turn off.

(b) Sequence of Operation

The sequence of operation for each bridge shall be as described below. Interlocking shall be achieved in correct sequence to permit safe operation of the bridge and ancillary equipment. The normal sequence of operation shall be achieved through buttons located on the control desk touchscreen. As a back-up to the touchscreens, selector switches and push-buttons can be used should the screens fail to operate.

A selector switch on the control desk shall select the mode of operation: either through the touchscreen or the hard-wired control devices on the control desk. In touchscreen mode, the positions of the push-buttons and switches shall be ignored for the traffic signals, gates, locks and span motor. Indicators on the desk shall illuminate in either mode.

The touchscreen display located in the switchboard room shall mimic the alarm and status display of the touchscreen on the upper portion of the control desk. Parameters such as incoming service voltage, drive amperes, angle of opening, span motor speed, alarms, and status indication shall be viewable from this screen.

When the PLC is required to generate an alarm, it shall send a bit from the defined bit array to the touchscreen. When the touchscreen receives the alarm bit numeric identifier, the touchscreen will display the alarm, provide the time and date of the alarm, print the alarm, and store the alarm in an alarm history screen. A screen will be provided to allow the operator to scroll down the alarm history.

The following operation examples are for a complete bridge operation. It is the intent of the control logic that the operator can stop the operation at any time while attempting to open the bridge and 'back out' of the operation to safely allow vehicular traffic on the bridge. To 'back out' of an operation means to change the operation from opening to closing the bridge. For example, after lowering the on-coming traffic gate, the operator could 'back out' of the operation by raising the on-coming traffic gate and turning the red traffic warning signal off to release vehicular traffic.

The PLC system shall be programmed to send information to DelDOT via a remote server. As part of this work the Contractor shall coordinate the required information with DelDOT and add these features to the PLC program. DelDOT will be responsible for the remote monitoring system off site (at DelDOT TMC), the contractor will be responsible for all equipment on the bridge and vicinity including but not limited to the PLC system, communication, Ethernet and fiber cable and connections.

(1) Fault/Reset
  (i) At any point where an alarm message is generated, the fault/reset illuminated push-button shall be turned on and remain on until the fault is cleared and the reset push-button is pressed.
  (ii) For critical faults including emergency stops, opening of specified electrical enclosure doors, and over travel, the main circuit breaker to the motor control enclosure shall be turned off through the UV circuit as shown on the plans.

(2) Control Power Selector Switch (CS-CP)
  (i) The operator shall turn the control desk Control Power (CS-CP) switch to the 'On' position.
  (ii) Control Power switch in the 'On' position is provided as an energized input 'Control Power On' to the PLC.
  (iii) The Control Power switch (CS-CP) activates bridge control relay as long as there is no power or if a fault condition exists in the service power.
  (iv) When the PLC has control power, the PLC shall verify all PLC Input card circuit breaker check inputs are energized.
  (v) If at any time during an operation, if a single or multiple PLC inputs of the above are de-energized while the 'Control Power On' PLC input is energized, the PLC shall de-energize all outputs, generate and provide an alarm, and shall not attempt any bridge operation until the PLC inputs are energized.
  (vi) The PLC input Power Fault Alarm shall be energized if there is a power fault. If there is a power fault the PLC shall de-energize all outputs, generate and provide an alarm, and shall not attempt any bridge operation until the PLC input is de-energized.

(3) Emergency Stop Push-Buttons (PB-ES1 and PB-ES2) and Safety Relays
  (i) If at any time during an operation, the 'Control Power On' PLC input is energized and the 'Emergency Stop' push-buttons or safety relay inputs de-energized (the 'Emergency Stop' button is pressed), the PLC shall de-energize all outputs, generate an alarm, and shall not attempt any bridge operation until the Emergency Stop inputs are energized.
  (ii) If any Emergency Stop push-button is depressed or safety relays are energized, or the emergency stop push-buttons are depressed during bridge operation, then the PLC input 'Emergency Stop' from PB-ES or safety relay inputs shall de-energize. The PLC shall stop all bridge operations and generate an alarm. The PLC shall not allow any other operation until all the Emergency Stop push-buttons are pulled out to the not depressed position.
  (iii) If any Emergency Stop push-button is depressed, the hardwired Master Control Relays will de-energize the control output power busses and the PLC shall verify that the emergency stop inputs are de-energized.
  (iv) If any of the inputs are not de-energized when the 'Emergency Stop' PLC inputs are de-energized, then the PLC shall generate an alarm.

(4) Bridge Status Indication - Upon the 'Control Power On' PLC input energizing, the PLC will scan the bridge for the status of the following items to illuminate or de-energize the touchscreen indicators as follows:
  (i) Indication Lights
    (1) The PLC shall verify the span, warning gate, barrier gates, span locks, alarms, and other status indications and positions and illuminate the appropriate indicators on the touchscreen.
  (ii) Brake Hand Release Status and Indication
    (1) The PLC shall verify that both Motor Brakes are not hand released. If either motor brake is hand released before or during span motor operation a warning message shall be displayed on the touchscreen and stored.
    (2) If both brakes are hand released an alarm shall be displayed on the touchscreen and stored.
    (3) If the span motor is in operation and both brakes are hand released the span drive shall decelerate the motor to an immediate stop and hold it there until at least one motor brake is no longer hand released.
  (iii) Ethernet Communication on Span Motor Drives:
    (1) The PLC shall verify the Ethernet inputs to determine the status of the main motor drive. If there are any alarms or fault then the PLC shall prevent span operation, send an alarm to the touchscreen, store the alarm and illuminate the fault/reset illuminated push-button.
    (2) The PLC shall continuously monitor the equipment and scan for issues.

(iv) Circuit Breaker - The PLC shall monitor the inputs for each circuit breaker auxiliary contact. If any circuit breaker trips, the PLC shall prevent span operation, send an alarm to the touchscreen and store the alarm.

Bypass Operation: If there is a circuit breaker failure, the circuit breaker operated interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used the PLC shall generate an alarm.

(v) Bypass Operation

(1) If an interlock does not function, the interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual bypass switch.

(2) Whenever a bypass is used, the PLC shall generate an alarm. When any bypass switch is active the PLC shall send an alarm message to the HMI display screen describing the bypass used.

(3) No more than two bypass switches shall be operated at any given time. If more than two are active an alarm message shall be displayed of the HMI display screen.

(vi) Drive Trouble Status Indication

(1) The PLC shall verify that the Span Drive does not have a Trouble alarm. If the drive does have a trouble alarm, then the PLC shall illuminate the fault/reset indicating light on the control desk, prevent drive operation with that drive, send an alarm to the touchscreen and store the alarm. (Refer to the span operation for the requirements of a Drive Trouble Alarm during an operation and the hard stop requirements).

(vii) Position Transmitter Status Indication

(1) The PLC input 'Position Resolver' shall receive an analog input from the resolver (position transmitter). The PLC located in the switchboard room shall transmit the analog signal position information to the control desk PLC and all touchscreens. The PLC shall transmit the resolver signal to the control desk touchscreen Span Position Indicator. The display shall provide the span position in degrees, from zero degrees while fully closed to 43 degrees when fully open. The PLC shall continually update the position information while control power is on.

(2) The PLC shall monitor the resolver analog input and internally monitor the span position in degrees. The PLC shall compare the resolver position to the PLC inputs for span rotary limit switch contacts. If the PLC resolver analog degree is more than 3 degrees off from the rotary limit switch contacts (as shown on the Plans) the PLC shall generate an alarm.

(3) If no analog signal is received from a position transmitter, then the PLC shall generate an alarm.

(viii) Non-Automatic Control

(1) The PLC shall verify that no equipment is being operated in non-automatic mode. The PLC shall verify that the PLC inputs from the manual-off-auto switch are in the 'auto' position. If the switches are not in the 'auto' position and are in the 'hand' or 'off' position, then the PLC shall de-energize all outputs, generate an alarm, and shall not attempt any bridge operation until the PLC inputs are energized.

(ix) Manual Operation Limit Switches

(1) When any hand crank limit switch is open, the PLC shall disable control of the associated motor and send an alarm message to the HMI display screen.

(2) When any hand crank limit switch is engaged the PLC shall disable motor operation for three (3) minutes unless bypassed on the HMI screen.

(x) Disconnect Switch Status for All Motors

(1) The PLC shall verify that no motors are disconnected.

(2) At any time, if any of the PLC disconnect switch inputs are de-energized, the PLC shall de-energize all outputs, generate an alarm identifying the specific motor that has had its disconnect operated, and shall not attempt any bridge operation until the PLC inputs are energized.

Bypass Operation:

If there is a motor disconnect switch operated, the disconnect operated interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used the PLC shall generate an alarm.

(xi) Drive Ready Status Indication

(1) The PLC shall verify that all drives are ready. If the motor drive is ready and the motor is not disconnected, then the PLC shall illuminate the drive ready indicator on the touchscreen.

(2) If the drive is not ready, the PLC program shall generate an alarm.

(xii) Span Auxiliary System Operation
(1) The span can be operated with the auxiliary system. A limit switch provides indication this system has been activated. When the system is activated the PLC shall provide an alarm and prevent automatic operation of the associated equipment while manual operation is under way.
(2) When any hand crank limit switch is engaged the PLC shall disable motor operation for three (3) minutes unless bypassed on the HMI screen.

(xiii) Span Drive Ammeters and Voltmeters
(1) Span Drive Motor and voltage values for motor load shall be transmitted to the control desk touchscreen and switchboard room touchscreen through the ethernet connection. The PLC shall transmit the values to the remote rack in the control desk. The PLC shall continually update the information while control power is on

(xiv) Temperature Control
(1) The PLC shall verify and display the temperature level and heating set point from each electronic thermostat. The operator shall be able to control each thermostat from the touchscreen on the control desk or remotely from an off-site location. If the temperature in any room reaches a specified threshold an alarm message shall be generated and stored.

(xv) Stand-by Generator
(1) When low fuel, high fuel, low battery and any other generator fault is detected, the PLC shall send an alarm message to the touchscreen and disable operation of the generator.
(2) When the generator is energized and the PLC receives a generator running status signal the PLC shall send an alarm to the touchscreen and store the alarm.
(3) When the generator is running or any generator fault is detected, the PLC shall disable bridge operation and send an alarm to the touchscreen and store the alarm.

(xvi) ATS
(1) When the ATS changes positions, the PLC shall send an alarm to the touchscreen and store the alarm.
(2) When the ATS has a fault, the PLC shall disable operation of the bridge, send an alarm to the touchscreen and store the alarm.

(xvii) Emergency Stop
(1) When any of the emergency stop push-buttons are activated or safety relays de-energized, the PLC shall prevent operation and send an alarm to the touchscreen and store the alarm.
(2) When any of the emergency stop push-buttons are activated, the PLC shall prevent operation and send an alarm to the touchscreen and store the alarm.
(3) When any of the emergency stop push-buttons are activated, the PLC shall check the associated safety relays and send an alarm message to the display screen if the contacts are not in the correct state.

(xviii) Span Drive Faults
(1) When any of the braking resistors temperature sensor detects a high temperature, the PLC shall disable operation of the associated span drive and send an alarm to the touchscreen and store the alarm.
(2) When a deceleration failure occurs in the span drives, the PLC shall immediately disable operation of the associated span drive and set all brakes. An alarm shall be sent to the touchscreen and store the alarm.
(3) When a span drive warning alarm is detected, the PLC shall send an alarm message to the HMI display screen and ramp the drive down to a stop and set all brakes.
(4) When a span drive fault alarm is detected, the PLC shall disable operation of the associated span drive, set all brakes and send an alarm to the touchscreen and store the alarm.
(5) When a span drive communication alarm is detected, the PLC shall disable operation of the associated span drive, set all brakes and send an alarm to the touchscreen and store the alarm.
(6) When an overcurrent is detected on any of the span drives, the PLC shall send an alarm to the touchscreen and store the alarm.
(7) When an encoder fault is detected, the PLC shall send an alarm message to the touchscreen and ramp the drive down to a stop and all brakes shall set. The drive, through the HMI display, shall be capable of changing to sensorless operation allowing the PLC to restart operation of the bridge through operator input.
(8) When the drive drift selector switch is set to On and the span angular position is within 10 degrees of the full open or full closed positions the PLC shall send an alarm message to the touch screen and the drive shall decelerate to a stop and set the brakes.

(xix) Phase Failure
(1) When the phase monitor/phase failure relay has tripped, the PLC shall send an alarm to the touchscreen and store the alarm.
(xx) Limit Switch Failure
(1) When the two fully closed limit switches do not activated within 20 seconds (to be field verified) of each other, the PLC shall send an alarm to the touchscreen and store the alarm..
(2) When any span lock, barrier gate or warning gate limit switch does not activate within 30 seconds (to be field verified) of the opposing contact, the PLC shall send an alarm to the touchscreen and store the alarm.
(3) When any span rotary cam limit switch contact does not change state as the correct angular setting when compared to the resolver, the PLC shall send an alarm to the touchscreen and store the alarm.
(4) When any over travel limit switches or manual operation limit switch is activated, the PLC shall send an alarm to the touchscreen and store the alarm. The over travel limit switch once activated shall not reset until the fully closed limit switch is engaged.
(xxi) Warning or Barrier Gate Door Switch
(1) When any door switch is open, the PLC shall disable control of the associated motor and send an alarm to the touchscreen and store the alarm.

(5) Traffic Signal Selector (Switch or Touchscreen)
(i) When the selector switch for the traffic signals is in the 'Go' position the PLC shall:
(1) Energize the touchscreen traffic signal green indicator if control power is on, all gates are raised, all barriers are open, the span locks are driven, and the span is fully closed.
(2) De-energize the touchscreen traffic signal red indicator if all gates are raised, all barriers are open, the span locks are driven, and the span is fully closed.
(3) De-energize the PLC outputs feeding the traffic signals and gongs.
(ii) When the selector switch for the traffic signals is placed in the 'Stop' position the PLC shall:
(1) De-energize the touchscreen traffic signals green indicator.
(2) Energize the touchscreen traffic signal red indicator.
(3) Energize the PLC outputs to activate the gongs by energizing the associated relay.
(4) The timing for the traffic signals shall be operated by control relays to ensure safe operation when the equipment is operated without PLC control.
(5) The PLC shall monitor the inputs from CR-RSR and CR-ASR as shown on the plan to verify proper operation of the traffic signals. The PLC shall generate an alarm if the relays operate out of sequence.
(iii) Interlocks:
(1) The only interlock to prevent the operator from activating the traffic siganls is that bridge control power is on and the timing relay is closed.
(iv) Bypass Operation:
(1) If there is a failure with the timing relay the interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used the PLC shall generate an alarm.

(6) On-coming Warning Gate Selector (Switch or Touchscreen)
(i) When the PLC input 'NE Warning Gate Raised' is energized, the NE gate is fully raised and the PLC shall energize the touchscreen indicator.
(ii) When the PLC input 'SW Warning Gate Raised' is energized, the SW gate is fully raised and the PLC shall energize the touchscreen indicator.
(iii) When the PLC input 'NE Warning Gate Lowered' is energized, the NE gate is fully lowered and the PLC shall energize the touchscreen indicator.
(iv) When the PLC input 'SW Warning Gate Lowered' is energized, the SW gate is fully lowered and the PLC shall energize the touchscreen indicator.
(v) When both PLC inputs 'NE Warning Gate Lowered' and 'NE Warning Gate Raised' are de-energized, the PLC shall flash alternately the touchscreen indicators.
(vi) When both PLC inputs 'SW Warning Gate Lowered' and 'SW Warning Gate Raised' are de-energized, the PLC shall flash alternately the touchscreen indicators.
(vii) The PLC shall monitor the inputs for the gate door open, disconnect switch open and hand crank inputs for the gate. If any gate door is open, disconnect switch is open or the hand crank activated, then the PLC shall prevent gate operation, send an alarm to the touchscreen and store the alarm.

(viii) When the selector switch or touchscreen buttons are in the 'Off' position, both PLC inputs 'NE Warning Gate Raise' and 'NE Warning Gate Lower' shall be de-energized. While both inputs are de-energized, the PLC shall not attempt to operate the on-coming gate. The position of the hard-wired selector switch shall only be checked when the mode selector switch is not in touchscreen mode.
  (1) De-energize the PLC output NE Warning Gate Lower
  (2) De-energize the PLC output NE Warning Gate Raise
(ix) When the selector switch or touchscreen buttons are in the 'Off' position, both PLC inputs 'SW Warning Gate Raise' and 'SW Warning Gate Lower' shall be de-energized. While both inputs are de-energized, the PLC shall not attempt to operate the on-coming gate. The position of the hard-wired selector switch shall only be checked when the mode selector switch is not in touchscreen mode.
  (1) De-energize the PLC output SW Warning Gate Lower
  (2) De-energize the PLC output SW Warning Gate Raise
(x) Turn On-Coming Warning Gate Selector Switch to the Lower Position (Switch or Touchscreen)
(xi) When the selector switch or touchscreen On-Coming Warning Gate is held in the 'Lower' position, PLC inputs 'NE Warning Gate Lower' and 'SW Warning Gate Lower' shall be energized.
(xii) While PLC input 'NE Warning Gate Lower' is energized and the PLC input 'NE Warning Gate Lower Stop' is energized, the PLC shall:
  (1) Energize the PLC output 'NE Warning Gate Lower'
  (2) De-energize the PLC output 'NE Warning Gate Raise'
(xiii) While PLC input 'SW Warning Gate Lower' is energized and the PLC input 'SW Warning Gate Lower Stop' is energized, the PLC shall:
  (1) Energize the PLC output 'SW Warning Gate Lower'
  (2) De-energize the PLC output 'SW Warning Gate Raise'
(xiv) Note: If PLC input 'NE Warning Gate Lower' is energized continuously for more than 15 seconds and the PLC input 'NE Warning Gate Lower Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'NE Warning Gate Lower'
(xv) Note: If PLC input 'SW Warning Gate Lower' is energized continuously for more than 15 seconds and the PLC input 'SW Warning Gate Lower Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'SW Warning Gate Lower'
(xvi) Lower Interlocks:
  (1) The NE Warning Gate shall be interlocked such that it cannot be lowered unless there is bridge control power and the traffic signals are red.
  (2) The SW Warning Gate shall be interlocked such that it cannot be lowered unless there is bridge control power and the traffic signals are red.
(xvii) Lower Bypass Operation: There is no bypass operation for the loss of control power or traffic signals red.
(xviii) Turn On-Coming Warning Gate Selector Switch to the Raise Position (Switch or Touchscreen)
(xix) When the selector switch or touchscreen On-Coming Warning Gate is held in the 'Raise' position, PLC inputs 'NE Warning Gate Raise' and 'SW Warning Gate Raise' shall be energized.
(xx) While PLC input 'NE Warning Gate Raise' is energized and the PLC input 'NE Warning Gate Raise Stop' is energized, the PLC shall:
  (1) Energize the PLC output 'NE Warning Gate Raise'
  (2) De-energize the PLC output 'NE Warning Gate Lower'
(xxi) While PLC input 'SW Warning Gate Raise' is energized and the PLC input 'SW Warning Gate Raise Stop' is energized, the PLC shall:
  (1) Energize the PLC output 'SW Warning Gate Raise'
  (2) De-energize the PLC output 'SW Warning Gate Lower'
(xxii) Note: If PLC input 'NE Warning Gate Raise' is energized continuously for more than 15 seconds and the PLC input 'NE Warning Gate Raise Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'NE Warning Gate Raise'
(xxiii) Note: If PLC input 'SW Warning Gate Raise' is energized continuously for more than 15 seconds and the PLC input 'SW Warning Gate Raise Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'SW Warning Gate Raise'
(xxiv) Raise Interlocks:

(1) The NE Warning Gate shall be interlocked such that it cannot be raised unless there is bridge control power, the traffic signals are red, off-going gates are raised, barrier gates are open, span locks are pulled, and the span is seated.

(2) The SW Warning Gate shall be interlocked such that it cannot be raised unless there is bridge control power, the traffic signals are red, off-going gates are raised, barrier gates are open, span locks are pulled, and the span is seated..

(xxv) Raise Bypass Operation: If there is a failure with either off-going gate, barrier gate or span seated limit switch, the on-coming gate raised interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used, the PLC shall generate an alarm.

(7) Off-Going Warning Gate Selector Switch (Switch or Touchscreen)

(i) When the PLC input 'NW Warning Gate Raised' is energized, the NW gate is fully raised and the PLC shall energize the touchscreen indicator.

(ii) When the PLC input 'SE Warning Gate Raised' is energized, the SE gate is fully raised and the PLC shall energize the touchscreen indicator.

(iii) When the PLC input 'NW Warning Gate Lowered' is energized, the NW gate is fully lowered and the PLC shall energize the touchscreen indicator.

(iv) When the PLC input 'SE Warning Gate Lowered' is energized, the SE gate is fully lowered and the PLC shall energize the touchscreen indicator.

(v) When both PLC inputs 'NW Warning Gate Lowered' and 'NW Warning Gate Raised' are de-energized, the PLC shall flash alternately the touchscreen indicators.

(vi) When both PLC inputs 'SE Warning Gate Lowered' and 'SE Warning Gate Raised' are de-energized, the PLC shall flash alternately the touchscreen indicators.

(vii) The PLC shall monitor the inputs for the gate door open, disconnect switch open and hand crank inputs for the gate. If any gate door is open, disconnect switch is open or the hand crank activated, then the PLC shall prevent gate operation, send an alarm to the touchscreen and store the alarm.

(viii) When the selector switch or touchscreen buttons are in the 'Off' position, both PLC inputs 'NW Warning Gate Raise' and 'NW Warning Gate Lower' shall be de-energized. While both inputs are de-energized, the PLC shall not attempt to operate the off-going gates. The position of the hard-wired selector switch shall only be checked when the mode selector switch is not in touchscreen mode.

(1) De-energize the PLC output NW Warning Gate Lower

(2) De-energize the PLC output NW Warning Gate Raise

(ix) When the selector switch or touchscreen buttons are in the 'Off' position, both PLC inputs 'SE Warning Gate Raise' and 'SE Warning Gate Lower' shall be de-energized. While both inputs are de-energized, the PLC shall not attempt to operate the off-going gates. The position of the hard-wired selector switch shall only be checked when the mode selector switch is not in touchscreen mode.

(1) De-energize the PLC output SE Warning Gate Lower

(2) De-energize the PLC output SE Warning Gate Raise

(x) Turn Off-Going Warning Gate Selector Switch to Lower (Switch or Touchscreen)

(xi) When the selector switch or touchscreen Off-Going Warning Gate is held in the 'Lower' position, PLC inputs 'NW Warning Gate Lower' and 'SE Warning Gate Lower' shall be energized.

(xii) While PLC input 'NW Warning Gate Lower' is energized and the PLC input 'NW Warning Gate Lower Stop' is energized, the PLC shall:

(1) Energize the PLC output 'NW Warning Gate Lower'

(2) De-energize the PLC output 'NW Warning Gate Raise'

(xiii) While PLC input 'SE Warning Gate Lower' is energized and the PLC input 'SE Warning Gate Lower Stop' is energized, the PLC shall:

(1) Energize the PLC output 'SE Warning Gate Lower'

(2) De-energize the PLC output 'SE Warning Gate Raise'

(xiv) Note: If PLC input 'NW Warning Gate Lower' is energized continuously for more than 15 seconds and the PLC input 'NW Warning Gate Lower Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'NW Warning Gate Lower'

(xv) Note: If PLC input 'SE Warning Gate Lower' is energized continuously for more than 15 seconds and the PLC input 'SE Warning Gate Lower Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'SE Warning Gate Lower'

(xvi) Lower Interlocks:
(1) The NW Warning Gate shall be interlocked such that it cannot be lowered unless there is bridge control power, traffic signals are red and both on-coming gates are lowered.
(2) The SE Warning Gate shall be interlocked such that it cannot be lowered unless there is bridge control power, traffic signals are red and both on-coming gates are lowered.
(xvii) Lower Bypass Operation: If there is a failure with either oncoming gate, the off-going gate lowered interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used, the PLC shall generate an alarm.
(xviii) Turn Off-Going Warning Gate Selector Switch to the Raise Position (Switch or Touchscreen)
(xix) When the selector switch or touchscreen Off-Going Warning Gate is held in the 'Raise' position, PLC inputs 'NW Warning Gate Raise' and 'SE Warning Gate Raise' shall be energized.
(xx) While PLC input 'NW Warning Gate Raise' is energized and the PLC input 'NW Warning Gate Raise Stop' is energized, the PLC shall:
(1) Energize the PLC output 'NW Warning Gate Raise'
(2) De-energize the PLC output 'NW Warning Gate Lower'
(xxi) While PLC input 'SE Warning Gate Raise' is energized and the PLC input 'SE Warning Gate Raise Stop' is energized, the PLC shall:
(1) Energize the PLC output 'SE Warning Gate Raise'
(2) De-energize the PLC output 'SE Warning Gate Lower'
(xxii) Note: If PLC input 'NW Warning Gate Raise' is energized continuously for more than 15 seconds and the PLC input 'NW Warning Gate Raise Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'NW Warning Gate Raise'
(xxiii) Note: If PLC input 'SE Warning Gate Raise' is energized continuously for more than 15 seconds and the PLC input 'SE Warning Gate Raise Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'SE Warning Gate Raise'
(xxiv) Interlocks for Raise:
(1) The NW Warning Gate shall be interlocked such that it cannot be raised unless there is bridge control power, the traffic signals are red, barrier gates are open, span locks are driven, and the span is seated.
(2) The SE Warning Gate shall be interlocked such that it cannot be raised unless there is bridge control power, the traffic signals are red, barrier gates are open, span locks are driven, and the span is seated.
(xxv) Raise Bypass Operation: If there is a failure with the span locks, barrier gates or span seated limit switch, the barrier gate raised interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used, the PLC shall generate an alarm.

(8) Barrier Gate Selector Switch (Switch or Touchscreen)
(i) When the PLC input 'SW Barrier Gate Raised' is energized, the SW barrier gate is fully raised and the PLC shall energize the touchscreen indicator.
(ii) When the PLC input 'NW Barrier Gate Raised' is energized, the NW barrier gate is fully raised and the PLC shall energize the touchscreen indicator.
(iii) When the PLC input 'SW Barrier Gate Lowered' is energized, the gate is fully lowered and the PLC shall energize the touchscreen indicator.
(iv) When the PLC input 'NW Barrier Gate Lowered' is energized, the NW barrier gate is fully lowered and the PLC shall energize the touchscreen indicator.
(v) When both PLC inputs 'SW Barrier Gate Lowered' and 'SW Barrier Gate Raised' are de-energized, the PLC shall flash alternately the touchscreen indicators.
(vi) When both PLC inputs 'NW Barrier Gate Lowered' and 'NW Barrier Gate Raised' are de-energized, the PLC shall flash alternately the touchscreen indicators.
(vii) The PLC shall monitor the inputs for the gate door open, disconnect switch open and hand crank inputs for the gate. If any gate door is open, disconnect switch is open or the hand crank activated, then the PLC shall prevent gate operation, send an alarm to the touchscreen and store the alarm.
(viii) When the touchscreen buttons are in the 'Off' position, both PLC inputs 'SW Barrier Gate Raise' and 'SW Barrier Gate Lower' shall be de-energized.
(ix) While both inputs are de-energized, the PLC shall not attempt to operate the SW barrier gate.
(1) De-energize the PLC output SW Barrier Gate Lower

(2) De-energize the PLC output SW Barrier Gate Raise

(x) While both inputs are de-energized, the PLC shall not attempt to operate the NW barrier gate.

(1) De-energize the PLC output NW Barrier Gate Lower

(2) De-energize the PLC output NW Barrier Gate Raise

(xi) Turn the Barrier Gate Selector Switch to Lower (Switch or Touchscreen)

(xii) When the selector switch SW Barrier Gate is held in the 'Lower' position, PLC inputs 'SW Barrier Gate Lower' shall be energized. While PLC input 'SW Barrier Gate Lower' is energized and the PLC input 'SW Barrier Gate Lower Stop' is energized, the PLC shall:

(1) Energize the PLC output 'SW Barrier Gate Lower'

(2) De-energize the PLC output 'SW Barrier Gate Raise'

(xiii) When the selector switch NW Barrier Gate is held in the 'Lower' position, PLC inputs 'NW Barrier Gate Lower' shall be energized. While PLC input 'NW Barrier Gate Lower' is energized and the PLC input 'NW Barrier Gate Lower Stop' is energized, the PLC shall:

(1) Energize the PLC output 'NW Barrier Gate Lower'

(2) De-energize the PLC output 'NW Barrier Gate Raise'

(xiv) Note: If PLC input 'SW Barrier Gate Lower' is energized continuously for more than 15 seconds and the PLC input 'SW Barrier Gate Lower Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'SW Barrier Gate Lower'

(xv) Note: If PLC input 'NW Barrier Gate Lower' is energized continuously for more than 15 seconds and the PLC input 'NW Barrier Gate Lower Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'NW Barrier Gate Lower'

(xvi) Lower Interlocks:

(1) The SW Barrier Gate shall be interlocked such that it cannot be lowered unless there is bridge control power, traffic signals are red, NW barrier gate is lowered and all warning gates are lowered.

(2) The NW Barrier Gate shall be interlocked such that it cannot be lowered unless there is bridge control power, traffic signals are red and all warning gates are lowered.

(xvii) Lower Bypass Operation: If there is a failure with any warning gate or opposing barrier gate, the barrier gates lowered interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used, the PLC shall generate an alarm.

(xviii) Turn the Barrier Gate Selector Switch to Raise (Switch or Touchscreen)

(xix) When the selector switch SW Barrier Gate is held in the 'Raise' position, PLC inputs 'SW Barrier Gate Raise' shall be energized. While PLC input 'SW Barrier Gate Raise' is energized and the PLC input 'SW Barrier Gate Raise Stop' is energized, the PLC shall:

(1) Energize the PLC output 'SW Barrier Gate Raise'

(2) De-energize the PLC output 'SW Barrier Gate Lower'

(xx) When the selector switch NW Barrier Gate is held in the 'Raise' position, PLC inputs 'NW Barrier Gate Raise' shall be energized. While PLC input 'NW Barrier Gate Raise' is energized and the PLC input 'NW Barrier Gate Raise Stop' is energized, the PLC shall:

(1) Energize the PLC output 'NW Barrier Gate Raise'

(2) De-energize the PLC output 'NW Barrier Gate Lower'

(xxi) Note: If PLC input 'SW Barrier Gate Raise' is energized continuously for more than 15 seconds and the PLC input 'SW Barrier Gate Raise Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'SW Barrier Gate Raise'

(xxii) Note: If PLC input 'NW Barrier Gate Raise' is energized continuously for more than 15 seconds and the PLC input 'NW Barrier Gate Raise Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'NW Barrier Gate Raise'

(xxiii) Raise Interlocks:

(1) The SW Barrier Gate shall be interlocked such that it cannot be raised unless there is bridge control power, traffic signals are red and all warning gates are lowered.

(2) The NW Barrier Gate shall be interlocked such that it cannot be lowered unless there is bridge control power, traffic signals are red, SW barrier gate is raised and all warning gates are lowered.

(xxiv) Lower Bypass Operation: If there is a failure with any barrier gate, the barrier gates lowered interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used, the PLC shall generate an alarm.

(9) Span Lock Selector Switch (Switch or Touchscreen)

(i) When the PLC input 'NW Span Lock Pulled' is energized, the NW span lock is fully pulled and the PLC shall energize the touchscreen indicator.
(ii) When the PLC input 'NW Span Lock Driven' is energized, the NW span lock is fully driven and the PLC shall energize the touchscreen indicator.
(iii) When the PLC input 'SW Span Lock Pulled' is energized, the SW span lock is fully pulled and the PLC shall energize the touchscreen indicator.
(iv) When the PLC input 'SW Span Lock Driven' is energized, the SW span lock is fully driven and the PLC shall energize the touchscreen indicator.
(v) When both PLC inputs 'NW Span Lock Pulled and 'NW Span Lock Driven' are de-energized, the PLC shall flash alternately the touchscreen indicators.
(vi) When both PLC inputs 'SW Span Lock Pulled and 'SW Span Lock Driven' are de-energized, the PLC shall flash alternately the touchscreen indicators.
(vii) The PLC shall monitor the inputs for the disconnect switch open and hand crank inputs for any span lock. If any disconnect switch is open or the hand crank activated, then the PLC shall prevent automatic span lock operation, send an alarm to the touchscreen and store the alarm.
(viii) When the touchscreen buttons are in the 'Off' position, PLC inputs 'NW Span Lock Pull', 'NW Span Lock Drive' shall be de-energized. While these inputs are de-energized, the PLC shall not attempt to operate the NW Span Lock.
(1) De-energize the PLC output NW Span Lock Drive
(2) De-energize the PLC output NW Span Lock Pull
(ix) When the touchscreen buttons are in the 'Off' position, PLC inputs 'SW Span Lock Pull', 'SW Span Lock Drive' shall be de-energized. While these inputs are de-energized, the PLC shall not attempt to operate the SW Span Lock or SW Span Lock.
(1) De-energize the PLC output SW Span Lock Drive
(2) De-energize the PLC output SW Span Lock Pull
(x) Turn the Span Lock Selector Switch to Pull (Switch or Touchscreen)
(xi) When the Span Lock selector switch is turned to the 'Pull' position, PLC input 'NW Span Lock Pull' shall be energized. While PLC input 'NW Span Lock Pull' is energized and the PLC input 'NW Span Lock Pull Stop' is energized, the PLC shall:
(1) Energize the PLC output 'NW Span Lock Pull'
(2) De-energize the PLC output 'NW Span Lock Drive'
(xii) Note: If PLC input 'NW Span Lock Pull' is energized continuously for more than 15 seconds and the PLC input 'NW Span Lock Pull Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'NW Span Lock Pull'
(xiii) When the Span Lock selector switch is turned to the 'Pull' position, PLC input 'SW Span Lock Pull' shall be energized. While PLC input 'SW Span Lock Pull' is energized and the PLC input 'SW Span Lock Pull Stop' is energized, the PLC shall:
(1) Energize the PLC output 'SW Span Lock Pull'
(2) De-energize the PLC output 'SW Span Lock Drive'
(xiv) Note: If PLC input 'SW Span Lock Pull' is energized continuously for more than 15 seconds and the PLC input 'SW Span Lock Pull Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'SW Span Lock Pull'
(xv) Pull Interlocks:
(1) The Span Locks shall be interlocked such that either span lock cannot be pulled unless there is bridge control power, traffic signals are red, all warning gates are lowered, both barrier gates are lowered, and the span is seated.
(xvi) Pull Bypass Operation: If there is a failure with any warning or barrier gate or the span seated limit switch, the span lock pull interlocks can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used, the PLC shall generate an alarm.
(xvii) Turn the Span Lock Selector Switch to Drive (Switch or Touchscreen)
(xviii) When the Span Lock selector switch is turned to the 'Drive' position, PLC input 'NW Span Lock Pull' shall be energized. While PLC input 'NW Span Lock Drive' is energized and the PLC input 'NW Span Lock Drive Stop' is energized, the PLC shall:
(1) Energize the PLC output 'NW Span Lock Drive'
(2) De-energize the PLC output 'NW Span Lock Pull'

(xix) Note: If PLC input 'NW Span Lock Drive' is energized continuously for more than 15 seconds and the PLC input 'NW Span Lock Drive Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'NW Span Lock Drive'

(xx) When the Span Lock selector switch is turned to the 'Drive' position, PLC input 'SW Span Lock Drive' shall be energized. While PLC input 'SW Span Lock Drive' is energized and the PLC input 'SW Span Lock Drive Stop' is energized, the PLC shall:

(1) Energize the PLC output 'SW Span Lock Drive'

(2) De-energize the PLC output 'SW Span Lock Pull'

(xxi) Note: If PLC input 'SW Span Lock Drive' is energized continuously for more than 15 seconds and the PLC input 'Span Lock Drive Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'SW Span Lock Drive'

(xxii) Drive Interlocks:

(1) The Span Locks shall be interlocked such that either span lock cannot be driven unless there is bridge control power, traffic signals are red, all warning gates are lowered, both barrier gates are lowered, and the span is seated.

(xxiii) Drive Bypass Operation: If there is a failure with any warning, barrier gate or the span seated limit switch, the span lock pull interlocks can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used, the PLC shall generate an alarm.

(10) Drive Fault/Reset Illuminated Push Button (PB-RE)

(i) The operator may attempt to reset a drive by pressing the Drive Reset push button (PB-RE). When the operator presses Drive Reset push button (PB-RE), the PLC input 'Reset Drive' shall energize momentarily. When the PLC input 'Reset Drive' energizes momentarily, the PLC use the Ethernet connection to the drive to reset the drive (coordinate with the drive manufacturer).

(ii) When a fault of the drive is energized the PLC shall receive a signal from the Ethernet connection and the PLC output 'Drive Reset' shall energize. The PLC output for "Drive Reset" shall remain energized until the fault on the drive system is no longer active. At any time when a fault of the drive is active an alarm message shall be displayed on the touchscreen and stored.

(11) Span Control Selector Switch (Switch or Touchscreen)

(i) The PLC shall verify it is safe to operate the span and energize the load contactor and enable the drive if all the following criteria are met: The span shall not be operated if the auxiliary system is engaged, more than one motor brake is hand released, either motor brake or the span motor has its motor disconnected, the motor temperature sensor indicates a high temperature, the motor load contactor is off, the braking resistor temperature sensor is open, the speed switch/sensor is not indicating correctly, the span lock is not pulled, the barrier gates are not closed, the warning gates are not lowered, and the traffic signals are green. (See prior steps for details.)

(ii) When the span control selector switch is in the 'Off' position, both PLC inputs 'Span Raise' and 'Span Lower' shall be de-energized. While both inputs are de-energized, the PLC shall ensure the drive is in stop, not attempt to operate the drive and use the Ethernet connection to monitor the drive status.

(iii) When the PLC input 'Fully Closed' is energized, the span is fully closed and the PLC shall energize the touchscreen indicator.

(iv) When the PLC input 'Nearly Closed' is energized, the span is nearly closed and the PLC shall energize the touchscreen indicator.

(v) When the PLC input 'Nearly Open' is energized, the span is nearly open and the PLC shall energize the touchscreen indicator.

(vi) When the PLC input 'Fully Open' is energized, the span is fully open and the PLC shall energize the touchscreen indicator.

(vii) The PLC shall monitor the inputs for the disconnect switch open and hand crank inputs. If any disconnect switch is open or the hand crank activated, then the PLC shall prevent automatic span operation, send an alarm to the touchscreen and store the alarm.

(viii) Stop - If the operator presses the Stop push-button while the span is in operation, both PLC inputs 'Span Raise' and 'Span Lower' shall be de-energized. When both inputs are de-energized during a raising operation, the PLC shall continue to open the span and decelerate (ramp down) to stop in 5 seconds. Then the PLC shall de-energize all the brake contactors to set all brakes. De-energizing the brake motor contactors shall cause all the brakes to set. The PLC shall verify that all the motor brakes are set, by verifying the corresponding PLC limit switch inputs are

de-energized. If any brake does not set within 2 seconds, the PLC shall generate and store an alarm. The span operation can be restarted by following the procedure as shown above.

(ix) Drive Trouble Operation - If at any time during an operation (both opening and closing) the Drive generates a Trouble Alarm, continue to open the span and decelerate (ramp down) to stop in 5 seconds. Then the PLC shall de-energize all the brake contactors to set all brakes. De-energizing the brake motor contactors shall cause all the brakes to set. The PLC shall verify that all the motor brakes are set, by verifying the corresponding PLC limit switch inputs are de-energized. If any brake does not set within 5 seconds, the PLC shall generate and store an alarm.

(x) Turn the span control selector switch to Raise (Switch or Touchscreen)

(1) When Span control selector switch is in the Raise position, the PLC input 'Span Raise' will energize. The PLC shall command the drive to energize the motor and verify proof of torque feedback from the motor drive, and then the PLC will release all motor brakes by energizing the PLC outputs for 'Motor Brake 1 Release' and 'Motor Brake 2 Release.'

(2) The PLC shall verify that all the motor brakes are released, by verifying the following PLC inputs for their associated limit switches are energized. If any brake does not release within 2 seconds, the PLC shall not continue span operation and shall generate and store an alarm on the touchscreen.

(3) When the PLC input 'Span Raise' is energized and all brakes are released, the PLC shall use the Ethernet connection to command the drive to raise the span, ramp in ten seconds to full operating speed. Command the drive to raise shall initiate the drive to rotate the motor in the direction that opens the span. The PLC shall verify that the drive is operating through the Ethernet communication and that the speed switch is operational and has changed states. The motor encoder shall be hardwired to the drive to provide speed control feedback. The PLC shall monitor the drive to verify proper motor control through the Ethernet communication with the drive. An analog signal input to the PLC from the speed switch shall also provide speed information throughout operation and display motor speed on the touchscreen. At any point if a fault occurs, key parameters such as speed, position, fault identifier, motor current, and motor voltage shall be stored to the touchscreen.

(4) The drive will continuous monitor the motor encoder during operation. If the motor encoder fails, the PLC shall receive a signal through the ethernet connection and shall command the span motor to decelerate to a stop and set the brakes. An alarm message will be displayed through the HMI and an option to restart operation of the bridge in sensorless mode shall be selectable through the HMI screen.

(5) Note: If PLC command to raise the span is sent continuously for more than 15 seconds and the PLC Ethernet monitoring does not indicate the drive is running or the encoder or speed switch does not provide a signal that the motor is rotating, the PLC shall generate and store an alarm on the touchscreen.

Span Position - The PLC shall continuously monitor the PLC analog input for 'Span Position' and compare the rotary cam limit switch contacts inputs for 'Raise Stop', 'Nearly Closed', 'Nearly Open', 'Fully Open', 'Raise Decel Check', 'Lower Decel Check'. If the PLC detects a variation between the limit set points and the span position angular value, then the PLC shall command the drive to decelerate (ramp down) to stop in 5 seconds and the PLC shall generate and store an alarm.

When the drive has stopped, the PLC shall de-energize all the brake contactors to set all brakes. De-energizing the brake motor contactors shall cause all the brakes to set. The PLC shall verify that all the motor brakes are set, by verifying the corresponding PLC limit switch inputs are de-energized. If any brake does not set within 5 seconds, the PLC shall generate and store an alarm.

(6) Open the Span to Nearly Open - The PLC shall maintain the full speed raise operation of the span until the span reaches the nearly open position. When PLC input rotary limit switch contact 'Nearly Open' is energized, then the span is nearly open. When the span is nearly open the PLC shall command the drive to continue opening the span and reduce speed to creep speed. Once the span is at creep speed the PLC shall continue in raise creep until the full open limit switches are activated. Once the fully open limit switches activate, the drive shall command the motor to enter reduced torque in the raise direction.

The PLC shall monitor the drive through the Ethernet connection and monitor the motor speed to verify the drive motor speed is reduced to creep speed. After the PLC input for "Nearly Open is energized, the PLC shall monitor the analog input 'Span Motor Speed' as well as the auxiliary contact "Speed Switch." If the motor speed does not begin to decelerate within 5 seconds or if the auxiliary contact does not open/close when the PLC input for Raise Decel Check' de-energizes, then the PLC shall immediately stop the span motor and set the brakes (emergency stop).

When the drive has stopped, the PLC shall de-energize all the brake contactors to set all brakes. De-energizing the brake motor contactors shall cause all the brakes to set. The PLC shall verify that all the motor brakes are set, by verifying the corresponding PLC limit switch inputs are de-energized. If any brake does not set within 5 seconds, the PLC shall generate and store an alarm.

(7) Open the Span to Fully Open - The PLC shall maintain creep speed until the span reaches the fully open position of 45 degrees. When PLC input for the span rotary limit switch contacts 'Fully Open' is de-energized, then the span is fully open.

When the span is fully open the PLC shall command the Drive to ramp from creep speed to zero RPM in less than one second. After one second the PLC shall de-energize the motor contactor to isolate the motor from the drive. The PLC shall de-energize all the brake contactors to set all brakes. De-energizing the brake motor contactors shall cause all the brakes to set. The PLC shall verify that all the motor and machinery brakes are set, by verifying the corresponding PLC limit switch inputs are de-energized. If any brake does not set within 5 seconds, the PLC shall generate and store an alarm.

(8) Span Overtravel Proximity Limit SwitchIf the span open overtravel proximity limit activates during a raise operation, the PLC shall command the Drive to ramp to a stop of zero (0) RPM in less than one second, and the PLC shall generate and store an alarm on the HMI screen. After one second the PLC shall de-energize the motor contactor to isolate the motor from the drive. The PLC shall de-energize all the brake contactors to set all brakes. De-energizing the brake motor contactors shall cause all the brakes to set. The PLC shall verify that all the motor brakes are set, by verifying the corresponding PLC limit switch inputs are de-energized. If any brake does not set within 5 seconds, the PLC shall generate and store an alarm.

Once the over travel limit switch is activated it shall stay activated and disable raise operation. An alarm shall be generated indicating the over travel condition is present and the span must be lowered. The alarm and message shall only be reset when the full closed limit switches are activated.

(xi) Turn the span control selector switch to Lower (Switch or Touchscreen)

(1) When Span control selector switch is in the Lower position, the PLC input 'Span Lower' will energize. The PLC shall command the drive to energize the motor and verify proof of torque feedback from the motor drive, and then the PLC will release all motor brakes by energizing the PLC outputs for 'Motor Brake 1 Release' and 'Motor Brake 2 Release.'

(2) The PLC shall verify that all the motor brakes are released, by verifying the following PLC inputs for their associated limit switches are energized. If any brake does not release within 2 seconds, the PLC shall not continue span operation and shall generate and store an alarm on the touchscreen.

(3) When the PLC input 'Span Lower' is energized and all brakes are released, the PLC shall use the Ethernet connection to command the drive to lower the span, ramp in ten seconds to full operating speed. Command the drive to lower shall initiate the drive to rotate the motor in the direction that closes the span. The PLC shall verify that the drive is operating through the Ethernet communication and that the speed switch is operational and has changed states. The motor encoder shall be hardwired to the drive to provide speed control feedback. The PLC shall monitor the drive to verify proper motor control through the Ethernet communication with the drive. An analog signal input to the PLC from the speed switch shall also provide speed

information throughout operation and display motor speed on the touchscreen. At any point if a fault occurs, key parameters such as speed, position, fault identifier, motor current, and motor voltage shall be stored to the touchscreen.

(4) The drive will continuous monitor the motor encoder during operation. If the motor encoder fails, the PLC shall receive a signal through the ethernet connection and shall command the span motor to decelerate to a stop and set the brakes. An alarm message will be displayed through the HMI and an option to restart operation of the bridge in sensorless mode shall be selectable through the HMI screen.

(5) Note: If PLC command to lower the span is sent continuously for more than 15 seconds and the PLC Ethernet monitoring does not indicate the drive is running or the encoder or speed switch does not provide a signal that the motor is rotating, the PLC shall generate and store an alarm on the touchscreen.

Span Position - The PLC shall continuously monitor the PLC analog input for 'Span Position' and compare the rotary cam limit switch contacts inputs for 'Lower Stop', 'Nearly Closed', 'Nearly Open', 'Fully Open', 'Raise Decel Check', 'Lower Decel Check'. If the PLC detects a variation between the limit set points and the span position angular value, then the PLC shall command the drive to decelerate (ramp down) to stop in 5 seconds and the PLC shall generate and store an alarm.

When the drive has stopped, the PLC shall de-energize all the brake contactors to set all brakes. De-energizing the brake motor contactors shall cause all the brakes to set. The PLC shall verify that all the motor brakes are set, by verifying the corresponding PLC limit switch inputs are de-energized. If any brake does not set within 5 seconds, the PLC shall generate and store an alarm.

(6) Close the Span to Nearly Closed - The PLC shall maintain the full speed lower operation of the span until the span reaches the nearly closed position. When PLC input rotary limit switch contact 'Nearly Closed' is energized, then the span is nearly closed.

When the span is nearly closed the PLC shall command the drive to continue closing the span and reduce speed to creep speed. Once the span is at creep speed the PLC shall continue in lower creep until the full closed limit switches are activated. Once the fully closed limit switches activate, the drive shall command the motor to enter reduced torque in the lower direction.

The PLC shall monitor the drive through the Ethernet connection and monitor the motor speed to verify the drive motor speed is reduced to creep speed. After the PLC input for "Nearly Closed is energized, the PLC shall monitor the analog input 'Span Motor Speed' as well as the auxiliary contact "Speed Switch." If the motor speed does not begin to decelerate within 5 seconds or if the auxiliary contact does not open/close when the PLC input for Lower Decel Check' de-energizes, then the PLC shall immediately stop the span motor and set the brakes (emergency stop).

When the drive has stopped, the PLC shall de-energize all the brake contactors to set all brakes. De-energizing the brake motor contactors shall cause all the brakes to set. The PLC shall verify that all the motor brakes are set, by verifying the corresponding PLC limit switch inputs are de-energized. If any brake does not set within 5 seconds, the PLC shall generate and store an alarm.

(7) Close the Span to Fully Closed - The PLC shall maintain creep speed until the span reaches fully closed. When both PLC inputs for the fully closed position are energized, the PLC and drive shall reduce the maximum torque setting of the drive to 75% and shall monitor the speed of the motor until no movement of the motor shaft is detected. When no movement is detected the PLC shall de-energize all the brake contactors to set all brakes and continue close the span for 3 seconds (to be field adjusted). De-energizing the brake motor contactors shall cause all the brakes to set. The PLC shall verify that all the motor brakes are set, by verifying the corresponding PLC limit switch inputs are de-energized. If any brake does not set within 5 seconds, the PLC shall generate and store an alarm.

(8) When the span is fully closed and the 3 second delay has ended, the PLC shall command the Drive to ramp from creep speed to zero RPM in less than one second. After one second the PLC shall de-energize the motor contactor to isolate the motor from the drive.

(xii) Interlocks:

(1) The span shall be interlocked such that the span cannot be opened unless the span locks are pulled, both barrier gates are closed, all warning gates are fully lowered, the traffic signals are red, and there is bridge control power.

(2) Bypass Operation: The PLC shall check the number of interlocks bypassed during an opening and limit the amount to a maximum of two interlocks bypassed.

If the span lock fails to pull, the span lock pulled interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used the PLC shall generate an alarm.

If either barrier gates fails to lower, the barrier gates lowered interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used the PLC shall generate an alarm.

If any of the warning gates fails to lower, the warning gates lowered interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used the PLC shall generate an alarm.

The span position failure can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used the PLC shall generate an alarm.

(12) Hardwired Switch Only

(i) The PLC shall operate in the same manner as noted above while using the hardwired switch with exceptions noted below.

(ii) When the PLC input 'Screen Operation' is energized the PLC shall disable touchscreen operation from any location on the bridge.

(iii) Before operation of any piece of equipment using the hardwired switches and push-buttons the PLC shall check the PLC input "Control Desk Operation" prior to each component being operated.

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(1) Fault/Reset

(i) At any point where an alarm message is generated, the fault/reset illuminated push-button shall be turned on and remain on until the fault is cleared and the reset push-button is pressed.

(ii) For critical faults including emergency stops, opening of specified electrical enclosure doors, and over travel, the main circuit breaker to the motor control enclosure shall be turned off through the UV circuit as shown on the plans.

(2) Control Power Selector Switch (CS-CP)

(i) The operator shall turn the control desk Control Power (CS-CP) switch to the 'On' position.

(ii) Control Power switch in the 'On' position is provided as an energized input 'Control Power On' to the PLC.

(iii) The Control Power switch (CS-CP) activates Bridge Control relay as long as there is no power fault condition in the service power.

(iv) When the PLC has control power, the PLC shall verify all PLC Input card circuit breaker check inputs are energized.

(v) If at any time during an operation, a single or multiple of the above PLC inputs are de-energized while the 'Control Power On' PLC input is energized, the PLC shall de-energize all outputs, generate and provide an alarm, and shall not attempt any bridge operation until the PLC inputs are energized.

(vi) The PLC input Power Fault Alarm shall be energized if there is a power fault. If there is a power fault the PLC shall de-energize all outputs, generate and provide an alarm, and shall not attempt any bridge operation until the PLC input is de-energized.

(3) Emergency Stop Push-Buttons (PB-ES1 and PB-ES2) and Safety Relays

(i) If at any time during an operation, the 'Control Power On' PLC input is energized and the 'Emergency Stop' push-buttons or safety relay inputs de-energized (the 'Emergency Stop' button

is pressed), the PLC shall de-energize all outputs, generate an alarm, and shall not attempt any bridge operation until the Emergency Stop inputs are energized.

(ii) If any Emergency Stop push-button is depressed or safety relays are energized, or the emergency stop push-buttons are depressed during bridge operation, then the PLC input 'Emergency Stop' from PB-ES or safety relay inputs shall de-energize. The PLC shall stop all bridge operations and generate an alarm. The PLC shall not allow any other operation until all the Emergency Stop push-buttons are pulled out to the not depressed position.

(iii) If any Emergency Stop push-button is depressed, the hardwired Master Control Relays will de-energize the control output power busses and the PLC shall verify that the emergency stop inputs are de-energized.

(iv) If any of the inputs are not de-energized when the 'Emergency Stop' PLC inputs are de-energized, then the PLC shall generate an alarm.

(4) Bridge Status Indication - Upon the 'Control Power On' PLC input energizing, the PLC will scan the bridge for the status of the following items to illuminate or de-energize the touchscreen indicators as follows:

(i) Indication Lights

(1) The PLC shall verify the span, warning gate, tail locks, center locks, alarms, and other status indications and positions and illuminate the appropriate indicators on the touchscreen.

(ii) Brake Hand Release Status and Indication

(1) The PLC shall verify that all motor brakes and machinery brakes are not hand released. If any brake is hand released before or during span motor operation a warning message shall be displayed on the touchscreen and stored.

(2) If any brakes are hand released an alarm shall be displayed on the touchscreen and stored.

(3) If the span motor is in operation and more than one motor (two machinery brakes set) or one machinery brake (one motor brake and one machinery brake set) is hand released the span drive shall decelerate the motor to an immediate stop and hold it there until at least two machinery brakes are not hand released or one motor brake and one machinery brake are not hand released.

(iii) Ethernet Communication on Span Motor Drives:

(1) The PLC shall verify the Ethernet inputs to determine the status of the main motor drive. If there are any alarms or fault then the PLC shall prevent span operation, send an alarm to the touchscreen, store the alarm and illuminate the fault/reset illuminated push-button.

(2) The PLC shall continuously monitor the equipment and scan for issues.

(iv) Circuit Breaker - The PLC shall monitor the inputs for each circuit breaker auxiliary contact. If any circuit breaker trips, the PLC shall prevent span operation, send an alarm to the touchscreen and store the alarm.

Bypass Operation: If there is a circuit breaker failure, the circuit breaker operated interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used the PLC shall generate an alarm.

(v) Bypass Operation

(1) If an interlock does not function, the interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual bypass switch.

(2) Whenever a bypass is used, the PLC shall generate an alarm. When any bypass switch is active the PLC shall send an alarm message to the HMI display screen describing the bypass used.

(3) No more than two bypass switches shall be operated at any given time. If more than two are active an alarm message shall be displayed of the touch screen.

(vi) Drive Trouble Status Indication

(1) The PLC shall verify that either Span Drive does not have a Trouble alarm. If the drive does have a trouble alarm, then the PLC shall illuminate the fault/reset indicating light on the control desk, prevent drive operation with that drive, send an alarm to the touchscreen and store the alarm. (Refer to the span operation for the requirements of a Drive Trouble Alarm during an operation and the hard stop requirements.)

(vii) Position Transmitter Status Indication

(1) The PLC inputs for 'Position Resolver' shall receive an analog input from the resolvers (position transmitters). The PLC located in the switchboard room shall transmit the analog signal position information to the control desk PLC and all touchscreens. The PLC shall transmit the resolver signals to the control desk touchscreen Span Position Indicator. The

display shall provide the span position in degrees, from zero degrees while fully closed to 73 degrees when fully open. The PLC shall continually update the position information while control power is on.

(2) The PLC shall monitor the resolver analog inputs and internally monitor the span position in degrees for each leaf. The PLC shall compare the resolver position to the PLC inputs for span rotary limit switch contacts. If the PLC resolver analog degree is more than 3 degrees off from the rotary limit switch contacts (as shown on the Plans) the PLC shall generate an alarm.

(3) If no analog signal is received from the position transmitters, then the PLC shall generate and print an alarm.

(viii) Non-Automatic Control

(1) The PLC shall verify that no equipment is being operated in non-automatic mode. The PLC shall verify that the PLC inputs from the manual-off-auto switch are in the 'auto' position. If the switches are not in the 'auto' position and are in the 'hand' or 'off' position, then the PLC shall de-energize all outputs, generate an alarm, and shall not attempt any bridge operation until the PLC inputs are energized.

(ix) Manual Operation Limit Switches

(1) When any hand crank limit switch is open, the PLC shall disable control of the associated motor and send an alarm message to the touchscreen.

(2) When any hand crank limit switch is engaged the PLC shall disable motor operation for three (3) minutes unless bypassed on the HMI screen.

(x) Disconnect Switch Status for All Motors

(1) The PLC shall verify that no motors are disconnected.

(2) At any time, if any of the PLC disconnect switch inputs are de-energized, the PLC shall de-energize all outputs, generate an alarm identifying the specific motor that has had its disconnect operated, and shall not attempt any bridge operation until the PLC inputs are energized.

Bypass Operation:

If there is a motor disconnect switch operated, the disconnect operated interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used the PLC shall generate an alarm.

(xi) Drive Ready Status Indication

(1) The PLC shall verify that all drives are ready. If the motor drive is ready and the motor is not disconnected, then the PLC shall illuminate the drive ready indicator on the touchscreen.

(2) If the drive is not ready, the PLC program shall generate an alarm.

(xii) Span Auxiliary System Operation

(1) The span can be operated with the auxiliary system. A limit switch provides indication this system has been activated. When the system is activated the PLC shall provide an alarm and prevent automatic operation of the associated equipment while manual operation is under way.

(xiii) Span Drive Ammeters and Voltmeters

(1) Span Drive Motor and voltage values for motor loads shall be transmitted to the control desk touchscreen and switchboard room touchscreen through the ethernet connection. The PLC shall transmit the values to the remote rack in the control desk. The PLC shall continually update the information while control power is on.

(xiv) Temperature Control

(1) The PLC shall verify and display the temperature level and heating set point from each electronic thermostat. The operator shall be able to control each thermostat from the touchscreen on the control desk or remotely from an off-site location. If the temperature in any room reaches a specified threshold an alarm message shall be generated and stored.

(xv) Stand-by Generator

(1) When low fuel, high fuel, low battery and any other generator fault is detected, the PLC shall send an alarm message to the touchscreen and disable operation of the generator.

(2) When the generator is energized and the PLC receives a generator running status signal the PLC shall send an alarm to the touchscreen and store the alarm.

(3) When the generator is running or any generator fault is detected, the PLC shall prevent operation and send an alarm to the touchscreen and store the alarm.

(4) When the generator is running and the ATS is transferred to the emergency position, the PLC shall limit operation of the bridge to one span motor at a time. When in this condition the PLC shall provide a warning alarm and store the alarm.

(xvi) ATS

(1) When the ATS changes positions, the PLC shall send an alarm to the touchscreen and store the alarm.

(2) When the ATS has a fault, the PLC shall send an alarm to the touchscreen and store the alarm.

(xvii) Emergency Stop

(1) When any of the emergency stop push-buttons are activated or safety relays de-energized, the PLC shall prevent operation and send an alarm to the touchscreen and store the alarm.

(2) When any of the emergency stop push-buttons are activated, the PLC shall prevent operation and send an alarm to the touchscreen and store the alarm.

(3) When any of the emergency stop push-buttons are activated, the PLC shall check the associated safety relays and send an alarm message to the display screen if the contacts are not in the correct state.

(xviii) Span Drive Faults

(1) When any of the braking resistors temperature sensor detects a high temperature, the PLC shall disable operation of the associated span drive and send an alarm to the touchscreen and store the alarm.

(2) When a deceleration failure occurs in any of the span drives, the PLC shall immediately disable operation of the associated span drive and send an alarm to the touchscreen and store the alarm.

(3) When a span drive warning alarm is detected, the PLC shall send an alarm message to the touchscreen and ramp the drive down to a stop and set all brakes.

(4) When a span drive fault alarm is detected, the PLC shall disable operation of the associated span drive, set all brakes and send an alarm to the touchscreen and store the alarm.

(5) When a span drive communication alarm is detected, the PLC shall disable operation of the associated span drive, set all brakes and send an alarm to the touchscreen and store the alarm.

(6) When an overcurrent is detected on any of the span drives, the PLC shall send an alarm to the touchscreen and store the alarm.

(7) When the drive drift selector switch is set to On and the span angular position is within 10 degrees of the full open or full closed positions the PLC shall send an alarm message to the touch screen and the drive shall decelerate to a stop and set the brakes.

(xix) Phase Failure

(1) When the phase monitor/phase failure relay has tripped, the PLC shall send an alarm to the touchscreen and store the alarm.

(xx) Limit Switch Failure

(1) When the two fully closed limit switches do not activated within 20 seconds (to be field verified) of each other, the PLC shall send an alarm to the touchscreen and store the alarm.

(2) When any span lock, barrier gate or warning gate limit switch does not activate within 30 seconds (to be field verified) of the opposing contact, the PLC shall send an alarm to the touchscreen and store the alarm.

(3) When any span rotary cam limit switch contact does not change state as the correct angular setting when compared to the resolver, the PLC shall send an alarm to the touchscreen and store the alarm.

(4) When any over travel limit switch or manual operation limit switch is activated, the PLC shall send an alarm to the touchscreen and store the alarm. The over travel limit switch once activated shall not reset until the fully closed limit switch is disengaged.

(xxi) Warning Gate Door Switch

(1) When any door switch is open, the PLC shall disable control of the associated motor and send an alarm to the touchscreen and store the alarm.

(5) Traffic Signal Selector (Switch or Touchscreen)

(i) When the selector switch for the traffic signals is in the 'Go' position the PLC shall:

(1) Energize the touchscreen traffic signal green indicator if control power is on, all gates are raised, all barriers are open, the span locks are driven, and the span is fully closed.

(2) De-energize the touchscreen traffic signal red indicator if all gates are raised, all barriers are open, the span locks are driven, and the span is fully closed.

(3) De-energize the PLC outputs feeding the traffic signals and gongs.

(ii) When the selector switch for the traffic signals is placed in the 'Stop' position the PLC shall:
  (1) De-energize the touchscreen traffic signals green indicator.
  (2) Energize the touchscreen traffic signal red indicator.
  (3) Energize the PLC outputs to activate the gongs by energizing the associated relay.
  (4) The timing for the traffic signals shall be operated by control relays to ensure safe operation when the equipment is operated without PLC control.
  (5) The PLC shall monitor the inputs from CR-RSR and CR-ASR as shown on the plan to verify proper operation of the traffic signals. The PLC shall generate an alarm if the relays operate out of sequence.
(iii) Interlocks:
  (1) The only interlock to prevent the operator from activating the traffic signals is that bridge control power is on and the timing relay is closed.
(iv) Bypass Operation:
  (1) If there is a failure with the timing relay the interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used the PLC shall generate an alarm.

(6) On-Coming Gate Selector (Switch or Touchscreen)
(i) When the PLC input 'NE Warning Gate Raised' is energized, the NE gate is fully raised and the PLC shall energize the touchscreen indicator.
(ii) When the PLC input 'SW Warning Gate Raised' is energized, the SW gate is fully raised and the PLC shall energize the touchscreen indicator.
(iii) When the PLC input 'NE Warning Gate Lowered' is energized, NE the gate is fully lowered and the PLC shall energize the touchscreen indicator.
(iv) When the PLC input 'SW Warning Gate Lowered' is energized, the SW gate is fully lowered and the PLC shall energize the touchscreen indicator.
(v) When both PLC inputs 'NE Warning Gate Lowered' and 'NE Warning Gate Raised' are de-energized, the PLC shall flash alternately the touchscreen indicators.
(vi) When both PLC inputs 'SW Warning Gate Lowered' and 'SW Warning Gate Raised' are de-energized, the PLC shall flash alternately the touchscreen indicators.
(vii) The PLC shall monitor the inputs for the gate door open, disconnect switch open and hand crank inputs for the gate. If any gate door is open, disconnect switch is open or the hand crank activated, then the PLC shall prevent gate operation, send an alarm to the touchscreen and store the alarm.
(viii) When the selector switch or touchscreen buttons are in the 'Off' position, both PLC inputs 'NE Warning Gate Raise' and 'NE Warning Gate Lower' shall be de-energized. While both inputs are de-energized, the PLC shall not attempt to operate the oncoming gate. The position of the hard-wired selector switch shall only be checked when the mode selector switch is not in touchscreen mode.
  (1) De-energize the PLC output NE Warning Gate Lower
  (2) De-energize the PLC output NE Warning Gate Raise
(ix) When the selector switch or touchscreen buttons are in the 'Off' position, both PLC inputs 'SW Warning Gate Raise' and 'SW Warning Gate Lower' shall be de-energized. While both inputs are de-energized, the PLC shall not attempt to operate the oncoming gate. The position of the hard-wired selector switch shall only be checked when the mode selector switch is not in touchscreen mode.
  (1) De-energize the PLC output SW Warning Gate Lower
  (2) De-energize the PLC output SW Warning Gate Raise
(x) Turn the On-Coming Selector Switch to the Lower Position (Switch or Touchscreen)
(xi) When the selector switch NE Warning Gate is held in the 'Lower' position, PLC inputs 'NE Warning Gate Lower' shall be energized.
(xii) While PLC input 'NE Warning Gate Lower' is energized and the PLC input 'NE Warning Gate Lower Stop' is energized, the PLC shall:
  (1) Energize the PLC output 'NE Warning Gate Lower'
  (2) De-energize the PLC output 'NE Warning Gate Raise'
(xiii) When the selector switch SW Warning Gate is held in the 'Lower' position, PLC inputs 'NE Warning Gate Lower' shall be energized.
(xiv) While PLC input 'SW Warning Gate Lower' is energized and the PLC input 'SW Warning Gate Lower Stop' is energized, the PLC shall:

(1) Energize the PLC output 'SW Warning Gate Lower'
(2) De-energize the PLC output 'SW Warning Gate Raise'

(xv) Note: If PLC input 'NE Warning Gate Lower' is energized continuously for more than 15 seconds and the PLC input 'NE Warning Gate Lower Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'NE Warning Gate Lower'

(xvi) Note: If PLC input 'SW Warning Gate Lower' is energized continuously for more than 15 seconds and the PLC input 'SW Warning Gate Lower Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'SW Warning Gate Lower'

(xvii) Lower Interlocks:
(1) The NE Warning Gate shall be interlocked such that it cannot be lowered unless there is bridge control power and the traffic signals are red.
(2) The SW Warning Gate shall be interlocked such that it cannot be lowered unless there is bridge control power and the traffic signals are red.

(xviii) Lower Bypass Operation: There is no bypass operation for the loss of control power or traffic signals red.

(xix) Turn the On-Coming Selector Switch to the Raise Position (Switch or Touchscreen)

(xx) When the selector switch NE Warning Gate is held in the 'Raise' position, PLC inputs 'NE Warning Gate Raise' shall be energized.

(xxi) While PLC input 'NE Warning Gate Raise' is energized and the PLC input 'NE Warning Gate Raise Stop' is energized, the PLC shall:
(1) Energize the PLC output 'NE Warning Gate Raise'
(2) De-energize the PLC output 'NE Warning Gate Lower'

(xxii) When the selector switch SW Warning Gate is held in the 'Raise' position, PLC inputs 'NE Warning Gate Raise' shall be energized.

(xxiii) While PLC input 'SW Warning Gate Raise' is energized and the PLC input 'SW Warning Gate Raise Stop' is energized, the PLC shall:
(1) Energize the PLC output 'SW Warning Gate Raise'
(2) De-energize the PLC output 'SW Warning Gate Lower'

(xxiv) Note: If PLC input 'NE Warning Gate Raise' is energized continuously for more than 15 seconds and the PLC input 'NE Warning Gate Raise Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'NE Warning Gate Raise'

(xxv) Note: If PLC input 'SW Warning Gate Raise' is energized continuously for more than 15 seconds and the PLC input 'SW Warning Gate Raise Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'SW Warning Gate Raise'

(xxvi) Raise Interlocks:
(1) The NE Warning Gate shall be interlocked such that it cannot be Raised unless there is bridge control power, the traffic signals are red, off-going gates are raised, center locks are driven and tail locks are driven.
(2) The SW Warning Gate shall be interlocked such that it cannot be Raised unless there is bridge control power, the traffic signals are red, off-going gates are raised, center locks are driven and tail locks are driven.

(xxvii) Raise Bypass Operation: If there is a failure with either off-going gate, center lock limit switch, tail lock limit switch, span seated limit switch, the on-coming gate raised interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used, the PLC shall generate an alarm.

(7) Off-Going Warning Gate Selector Switch (Switch or Touchscreen)

(i) When the PLC input 'NW Warning Gate Raised' is energized, the NW gate is fully raised and the PLC shall energize the touchscreen indicator.

(ii) When the PLC input 'SE Warning Gate Raised' is energized, the SE gate is fully raised and the PLC shall energize the touchscreen indicator.

(iii) When the PLC input 'NW Warning Gate Lowered' is energized, the gate is fully lowered and the PLC shall energize the touchscreen indicator.

(iv) When the PLC input 'SE Warning Gate Lowered' is energized, the SE gate is fully lowered and the PLC shall energize the touchscreen indicator.

(v) When both PLC inputs 'NW Warning Gate Lowered' and 'NW Warning Gate Raised' are de-energized, the PLC shall flash alternately the touchscreen indicators.

(vi) When both PLC inputs 'SE Warning Gate Lowered' and 'SE Warning Gate Raised' are de-energized, the PLC shall flash alternately the touchscreen indicators.

(vii) The PLC shall monitor the inputs for the gate door open, disconnect switch open and hand crank inputs for the gate. If any gate door is open, disconnect switch is open or the hand crank activated, then the PLC shall prevent gate operation, send an alarm to the touchscreen and store the alarm.

(viii) When the selector switch or touchscreen buttons are in the 'Off' position, both PLC inputs 'NW Warning Gate Raise' and 'NW Warning Gate Lower' shall be de-energized. While both inputs are de-energized, the PLC shall not attempt to operate the oncoming gate. The position of the hard-wired selector switch shall only be checked when the mode selector switch is not in touchscreen mode.

(1) De-energize the PLC output NW Warning Gate Lower

(2) De-energize the PLC output NW Warning Gate Raise

(ix) When the selector switch or touchscreen buttons are in the 'Off' position, both PLC inputs 'SE Warning Gate Raise' and 'SE Warning Gate Lower' shall be de-energized. While both inputs are de-energized, the PLC shall not attempt to operate the oncoming gate. The position of the hard-wired selector switch shall only be checked when the mode selector switch is not in touchscreen mode.

(1) De-energize the PLC output SE Warning Gate Lower

(2) De-energize the PLC output SE Warning Gate Raise

(x) Turn the Off-Going Warning Gate Selector Switch to Lower (Switch or Touchscreen)

(xi) When the selector switch NW Warning Gate is held in the 'Lower' position, PLC inputs 'NW Warning Gate Lower' shall be energized.

(xii) While PLC input 'NW Warning Gate Lower' is energized and the PLC input 'NW Warning Gate Lower Stop' is energized, the PLC shall:

(1) Energize the PLC output 'NW Warning Gate Lower'

(2) De-energize the PLC output 'NW Warning Gate Raise'

(xiii) When the selector switch SE Warning Gate is held in the 'Lower' position, PLC inputs 'SE Warning Gate Lower' shall be energized.

(xiv) While PLC input 'SE Warning Gate Lower' is energized and the PLC input 'SE Warning Gate Lower Stop' is energized, the PLC shall:

(1) Energize the PLC output 'SE Warning Gate Lower'

(2) De-energize the PLC output 'SE Warning Gate Raise'

(xv) Note: If PLC input 'NW Warning Gate Lower' is energized continuously for more than 15 seconds and the PLC input 'NW Warning Gate Lower Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'NW Warning Gate Lower'

(xvi) Note: If PLC input 'SE Warning Gate Lower' is energized continuously for more than 15 seconds and the PLC input 'SE Warning Gate Lower Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'SE Warning Gate Lower'

(xvii) Lower Interlocks:

(1) The NW Warning Gate shall be interlocked such that it cannot be lowered unless there is bridge control power, traffic signals are red, and both on-coming gates are lowered.

(2) The SE Warning Gate shall be interlocked such that it cannot be lowered unless there is bridge control power, traffic signals are red, and both on-coming gates are lowered.

(xviii) Bypass Operation: If there is a failure with either oncoming gate, the on-coming gate lowered interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used, the PLC shall generate an alarm.

(xix) Turn the Off-Going Warning Gate Selector Switch to Raise (Switch or Touchscreen)

(xx) When the selector switch NW Warning Gate is held in the 'Raise' position, PLC inputs 'NW Warning Gate Raise' shall be energized.

(xxi) While PLC input 'NW Warning Gate Raise' is energized and the PLC input 'NW Warning Gate Raise Stop' is energized, the PLC shall:

(1) Energize the PLC output 'NW Warning Gate Raise'

(2) De-energize the PLC output 'NW Warning Gate Lower'

(xxii) When the selector switch SE Warning Gate is held in the 'Raise' position, PLC inputs 'SE Warning Gate Raise' shall be energized.

(xxiii) While PLC input 'SE Warning Gate Raise' is energized and the PLC input 'SE Warning Gate Raise Stop' is energized, the PLC shall:
(1) Energize the PLC output 'SE Warning Gate Raise'
(2) De-energize the PLC output 'SE Warning Gate Lower'
(xxiv) Note: If PLC input 'NW Warning Gate Raise' is energized continuously for more than 15 seconds and the PLC input 'NW Warning Gate Raise Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'NW Warning Gate Raise'
(xxv) Note: If PLC input 'SE Warning Gate Raise' is energized continuously for more than 15 seconds and the PLC input 'SE Warning Gate Raise Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'SE Warning Gate Raise'
(xxvi) Raise Interlocks:
(1) The NW Warning Gate shall be interlocked such that it cannot be Raised unless there is bridge control power, traffic signals are red, tail locks are driven and center locks are driven.
(2) The SE Warning Gate shall be interlocked such that it cannot be Raised unless there is bridge control power, traffic signals are red, tail locks are driven and center locks are driven.
(xxvii) Bypass Operation: If there is a failure with the center lock limit switches, tail lock limit switches or span seated limit switches, the off-going gates raised interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used, the PLC shall generate an alarm.

(8) Center Lock Selector Switch (Switch or Touchscreen)
(i) When the PLC input 'Center Lock 1 Pulled' is energized, Center Lock 1 is fully pulled and the PLC shall energize the touchscreen indicator.
(ii) When the PLC input 'Center Lock 2 Pulled' is energized, Center Lock 2 is fully pulled and the PLC shall energize the touchscreen indicator.
(iii) When the PLC input 'Center Lock 1 Driven' is energized, Center Lock 1 is fully driven and the PLC shall energize the touchscreen indicator.
(iv) When the PLC input 'Center Lock 2 Driven' is energized, Center Lock 2 is fully driven and the PLC shall energize the touchscreen indicator.
(v) When both PLC inputs 'Center Lock 1 Pulled and 'Center Lock 1 Driven' are de-energized, the PLC shall flash alternately the touchscreen indicators.
(vi) When both PLC inputs 'Center Lock 2 Pulled and 'Center Lock 2 Driven' are de-energized, the PLC shall flash alternately the touchscreen indicators.
(vii) The PLC shall monitor the inputs for the disconnect switch open and hand crank inputs for any center lock. If any disconnect switch is open or the hand crank activated, then the PLC shall prevent automatic center lock operation, send an alarm to the touchscreen, and store the alarm.
(viii) When the touchscreen buttons are in the 'Off' position, PLC inputs 'Center Lock 1 Pull', 'Center Lock 1 Drive' shall be de-energized. While these inputs are de-energized, the PLC shall not attempt to operate Center Lock 1.
(1) De-energize the PLC output Center Lock 1 Drive
(2) De-energize the PLC output Center Lock 1 Pull
(ix) When the touchscreen buttons or selector switch are in the 'Off' position, PLC inputs 'Center Lock 2 Pull', 'Center Lock 2 Drive' shall be de-energized. While these inputs are de-energized, the PLC shall not attempt to operate Center Lock 2.
(1) De-energize the PLC output Center Lock 2 Drive
(2) De-energize the PLC output Center Lock 2 Pull
(x) Turn the Center Lock Selector Switch to Pull (Switch or Touchscreen)
(xi) When the Center Lock selector switch or touchscreen is turned to the 'Pull' position, PLC input 'Center Lock 1 Pull' shall be energized. While PLC input 'Center Lock 1 Pull' is energized and the PLC input 'Center Lock 1 Pull Stop' is energized, the PLC shall:
(1) Energize the PLC output 'Center Lock 1 Pull'
(2) De-energize the PLC output 'Center Lock 1 Drive'
(xii) Note: If PLC input 'Center Lock 1 Pull' is energized continuously for more than 15 seconds and the PLC input 'Center Lock 1 Pull Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'Center Lock 1 Pull'
(xiii) When the Center Lock selector switch or touchscreen is turned to the 'Pull' position, PLC input 'Center Lock 2 Pull' shall be energized. While PLC input 'Center Lock 1 Pull' is energized and the PLC input 'Center Lock 2 Pull Stop' is energized, the PLC shall:

(1) Energize the PLC output 'Center Lock 2 Pull'
(2) De-energize the PLC output 'Center Lock 2 Drive'

(xiv) Note: If PLC input 'Center Lock 2 Pull' is energized continuously for more than 15 seconds and the PLC input 'Center Lock 2 Pull Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'Center Lock 2 Pull'

(xv) Pull Interlocks:
(1) The Center Locks shall be interlocked such that either center lock cannot be pulled unless there is bridge control power, traffic signals are red, all warning gates are lowered, all tail locks are driven and the span(s) are seated.

(xvi) Bypass Operation: If there is a failure with any warning gate, tail locks or span seated limit switches, the span lock pull interlock can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used, the PLC shall generate an alarm.

(xvii) Turn the Center Lock Selector Switch to Drive Position (Switch or Touchscreen)

(xviii) When the Center Lock selector switch or touchscreen is turned to the 'Drive' position, PLC input 'Center Lock 1 Drive' shall be energized. While PLC input 'Center Lock 1 Drive' is energized and the PLC input 'Center Lock 1 Drive Stop' is energized, the PLC shall:
(1) Energize the PLC output 'Center Lock 1 Drive'
(2) De-energize the PLC output 'Center Lock 1 Pull'

(xix) Note: If PLC input 'Center Lock 1 Drive' is energized continuously for more than 15 seconds and the PLC input 'Center Lock 1 Drive Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'Center Lock 1 Drive'

(xx) When the Center Lock selector switch or touchscreen is turned to the 'Drive' position, PLC input 'Center Lock 2 Drive' shall be energized. While PLC input 'Center Lock 1 Drive' is energized and the PLC input 'Center Lock 2 Drive Stop' is energized, the PLC shall:
(1) Energize the PLC output 'Center Lock 2 Pull'
(2) De-energize the PLC output 'Center Lock 2 Drive'

(xxi) Note: If PLC input 'Center Lock 2 Drive' is energized continuously for more than 15 seconds and the PLC input 'Center Lock 2 Drive Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'Center Lock 2 Drive'

(xxii) Drive Interlocks:
(1) The Center Locks shall be interlocked such that either center lock cannot be driven unless there is bridge control power, traffic signals are red, all warning gates are lowered, tail locks are driven and the span(s) are seated.

(xxiii) Bypass Operation: If there is a failure with any warning gate, tail locks or span seated limit switches, the span lock drive interlock can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used, the PLC shall generate an alarm.

(9) Tail Lock Selector Switch (Touchscreen and Switch)

(i) When the PLC input 'West Tail Lock Pulled' is energized, the West Tail Lock is fully pulled and the PLC shall energize the touchscreen indicator.

(ii) When the PLC input 'West Tail Lock Driven' is energized, the West Tail Lock is fully driven and the PLC shall energize the touchscreen indicator.

(iii) When the PLC input 'East Tail Lock Pulled' is energized, the East Tail Lock is fully pulled and the PLC shall energize the touchscreen indicator.

(iv) When the PLC input 'East Tail Lock Driven' is energized, the East Tail Lock is fully driven and the PLC shall energize the touchscreen indicator.

(v) When both PLC inputs 'West Tail Lock Pulled and 'West Tail Lock Driven' are de-energized, the PLC shall flash alternately the touchscreen indicators.

(vi) When both PLC inputs 'East Tail Lock Pulled and 'East Tail Lock Driven' are de-energized, the PLC shall flash alternately the touchscreen indicators.

(vii) The PLC shall monitor the inputs for the disconnect switch open and hand crank inputs for any tail lock. If any disconnect switch is open or the hand crank activated, then the PLC shall prevent automatic tail lock operation, send an alarm to the touchscreen, and store the alarm.

(viii) When the touchscreen buttons or selector switch are in the 'Off' position, PLC inputs 'West Tail Lock Pull', 'West Tail Lock Drive' shall be de-energized. While these inputs are de-energized, the PLC shall not attempt to operate the West Tail Lock.
(1) De-energize the PLC outputs West Tail Lock Drive

(2) De-energize the PLC outputs West Tail Lock Drive

(ix) When the touchscreen buttons or selector switch are in the 'Off' position, PLC inputs 'East Tail Lock Pull', 'East Tail Lock Drive' shall be de-energized. While these inputs are de-energized, the PLC shall not attempt to operate the West Tail Lock.

(1) De-energize the PLC outputs West Tail Lock Drive

(2) De-energize the PLC outputs West Tail Lock Drive

(x) Turn the Tail Lock Selector Switch to the Pull Position (Switch or Touchscreen)

(xi) When the Tail Lock selector switch or touchscreen is turned to the 'Pull' position, PLC input 'West Tail Lock Pull' shall be energized. While PLC input 'West Tail Lock Pull' is energized and the PLC input 'West Tail Lock Pull Stop' is energized, the PLC shall:

(1) Energize the PLC output 'West Tail Lock Pull'

(2) De-energize the PLC output 'West Tail Lock Drive'

(xii) Note: If PLC input 'West Tail Lock Pull' is energized continuously for more than 15 seconds and the PLC input 'West Tail Lock Pull Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'West Tail Lock Pull'

(xiii) When the Tail Lock selector switch is turned to the 'Pull' position, PLC input 'East Tail Lock Pull' shall be energized. While PLC input 'East Tail Lock Pull' is energized and the PLC input 'East Tail Lock Pull Stop' is energized, the PLC shall:

(1) Energize the PLC output 'East Tail Lock Pull'

(2) De-energize the PLC output 'East Tail Lock Drive'

(xiv) Note: If PLC input 'East Tail Lock Pull' is energized continuously for more than 15 seconds and the PLC input 'East Tail Lock Pull Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'East Tail Lock Pull'

(xv) Pull Interlocks:

(1) The Tail Locks shall be interlocked such that either tail lock cannot be pulled unless there is bridge control power, traffic signals are red, all warning gates are lowered, center locks are driven and the span(s) are seated

(xvi) Pull Bypass Operation: If there is a failure with any warning gate, center locks or span seated limit switches, the center locks pull interlock can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used, the PLC shall generate an alarm

(xvii) Turn the Tail Lock Selector Switch to the Drive Position (Switch or Touchscreen)

(xviii) When the Tail Lock selector switch or touchscreen is turned to the 'Drive' position, PLC input 'West Tail Lock Drive' shall be energized. While PLC input 'West Tail Lock Drive' is energized and the PLC input 'West Tail Lock Drive Stop' is energized, the PLC shall:

(1) Energize the PLC output 'West Tail Lock Drive'

(2) De-energize the PLC output 'West Tail Lock Pull'

(xix) Note: If PLC input 'West Tail Lock Drive' is energized continuously for more than 15 seconds and the PLC input 'West Tail Lock Drive Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'West Tail Lock Drive'

(xx) When the Tail Lock selector switch is turned to the 'Drive' position, PLC input 'East Tail Lock Drive' shall be energized. While PLC input 'East Tail Lock Drive' is energized and the PLC input 'East Tail Lock Drive Stop' is energized, the PLC shall:

(1) Energize the PLC output 'East Tail Lock Drive'

(2) De-energize the PLC output 'East Tail Lock Pull'

(xxi) Note: If PLC input 'East Tail Lock Drive' is energized continuously for more than 15 seconds and the PLC input 'East Tail Lock Drive Stop' has not been de-energized, the PLC shall generate an alarm and de-energize input 'East Tail Lock Drive'

(xxii) Drive Interlocks:

(1) The Tail Locks shall be interlocked such that either tail lock cannot be driven unless there is bridge control power, traffic signals are red, all warning gates are lowered, center locks are pulled and the span(s) are seated

(xxiii) Drive Bypass Operation: If there is a failure with any warning gate, center locks or span seated limit switches, the center locks drive interlocks can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used, the PLC shall generate an alarm

(10) Drive Fault/Reset Illuminated Push Button (PB-RE)

(i) The operator may attempt to reset a drive by pressing the Drive Reset push button (PB-RE). When the operator presses Drive Reset push button (PB-RE), the PLC input 'Reset Drive' shall energize momentarily. When the PLC input 'Reset Drive' energizes momentarily, the PLC uses the Ethernet connection to the drive to reset the drive (coordinate with the drive manufacturer).

(ii) When a fault of the drive is energized the PLC shall receive a signal from the Ethernet connection and the PLC output 'Drive Reset' shall energize. The PLC output for "Drive Reset" shall remain energized until the fault on the drive system is no longer active. At any time when a fault of the drive is active an alarm message shall be displayed on the touchscreen and stored.

(11) Span Control Selector Switches (Touchscreen and Switch)

(i) The PLC shall verify it is safe to operate the span and energize the west and east load contactors and enable the drives if all the following criteria are met: The span motors shall not be operated if either associated auxiliary system is engaged, more than one associated brake is hand released per leaf, the brake thrusters or span motors are disconnected, the motor temperature sensor indicates a high temperature, the motor load contactor is off, the braking resistor temperature sensor is open, the speed switch/sensor is not indicating correctly, the center locks are not pulled, the associated tail locks are not pulled, the warning gates are not lowered, and the traffic signals are green. (See prior steps for details.)

(ii) Under generator operation, PLC shall allow only one drive at a time to operate. When the PLC inputs "Generator Running" and "ATS in Emergency Position" are energized the PLC shall send an alarm message to the touchscreen and allow the operator to select which span motor to operate.

(iii) When the leaf control selector switch is in the 'Off' position, PLC ethernet inputs 'West Span Raise', 'West Span Lower', 'West Span Raise' and 'West Span Lower shall be de-energized. While the inputs are de-energized, the PLC shall ensure both drives are in stop, not attempt to operate the drive and use the Ethernet connection to monitor the drive status.

(iv) Turn the span control selector switch to Raise (Touchscreen Only)

(1) When Leaf control selector switch is in the Raise position, the PLC ethernet input 'West Leaf Raise' will energize for the associated leaf. The PLC shall command the drive to energize the motor and verify proof of torque feedback from the motor drive, and then the PLC will release all brakes by energizing the associated PLC outputs.

(2) The PLC shall verify that all brakes are released by verifying the PLC inputs for their associated limit switches are energized. If any brake does not release within 2 seconds, the PLC shall not continue span operation and shall generate and store an alarm on the touchscreen.

(3) When the PLC ethernet input 'West Span Raise' or 'East Span Raise' is energized for the associated leaf and all brakes are released, the PLC shall use the Ethernet connection to command the drives to raise each leaf, ramping up ten seconds to full operating speed. Commanding the drives to raise shall initiate the drives to rotate each span motor in the direction that opens the leaf. The PLC shall verify that the drives are operating through the Ethernet communication and that the speed switches are operational and has changed states. The PLC shall monitor the drives to verify proper motor control through the Ethernet communication with each drive. An analog signal input to the PLC from the speed switch shall also provide speed information for each span motor throughout operation and display motor speed on the touchscreen. At any point if a fault occurs, key parameters such as speed, position, fault identifier, motor current, and motor voltage shall be stored to the touchscreen.

(4) Note: If the PLC command to raise either span is sent continuously for more than 15 seconds and the PLC Ethernet monitoring does not indicate the specific drive is running or the speed switch does not provide a signal that the specific motor is rotating, the PLC shall generate and store an alarm on the touchscreen.

Span Position - The PLC shall continuously monitor the PLC analog input for 'West Leaf Position' and 'East Leaf Position' and compare the rotary cam limit switch contacts inputs for 'Raise Stop', 'Nearly Closed', 'Nearly Open', 'Fully Open', 'Raise Decel Check', 'Lower Decel Check' for each leaf. If the PLC detects a variation between the limit set points and the span position angular value, then the PLC shall command the drive to decelerate (ramp down) to stop in 5 seconds and the PLC shall generate and store an alarm.

When the either drive has stopped, the PLC shall de-energize all the brake contactors to set all brakes. De-energizing the brake motor contactors shall cause all the brakes to set. The PLC

shall verify that all the brakes are set, by verifying the corresponding PLC limit switch inputs are de-energized. If any brake does not set within 5 seconds, the PLC shall generate and store an alarm.

(5) Stop - If the operator presses either West or East Stop push-button on the touchscreen while the span is in operation, the respective PLC ethernet inputs 'West Span Raise' and/or 'East Span Lower' shall be de-energized. When the inputs are de-energized during a raising operation, the PLC shall continue to open the respective span and decelerate (ramp down) to stop in 5 seconds. Then the PLC shall de-energize all the brake contactors to set all brakes on the respective leaf. De-energizing the brake motor contactors shall cause all the brakes to set on that leaf. The PLC shall verify that all the brakes are set by verifying the corresponding PLC limit switch inputs are de-energized. If any brake does not set within 5 seconds, the PLC shall generate and store an alarm. The span operation can be restarted by following the procedure as shown above.

(6) Drive Trouble Operation - If at any time during an operation (both opening and closing) either Drive generates a Trouble Alarm, continue to open the respective span and decelerate (ramp down) to stop in 5 seconds. Then the PLC shall de-energize all the brake contactors to set all brakes on that specific leaf. De-energizing the brake motor contactors shall cause all the brakes to set. The PLC shall verify that all the brakes are set, by verifying the corresponding PLC limit switch inputs are de-energized. If any brake does not set within 5 seconds, the PLC shall generate and store an alarm.

(7) Open the Leaf to Nearly Open - The PLC shall maintain the full speed raise operation of each leaf until it reaches the nearly open position. When PLC input rotary limit switch contact 'West Nearly Open' is energized, then the west leaf is nearly open. When PLC input rotary limit switch contact 'East Nearly Open' is energized, then the east leaf is nearly open.

When the west leaf is nearly open the PLC shall command the west drive to continue opening the west leaf and reduce speed to creep speed. Once the west leaf is at creep speed the PLC shall command the west drive to enter reduced torque in the raise direction.

When the east leaf is nearly open the PLC shall command the east drive to continue opening the east leaf and reduce speed to creep speed. Once the east leaf is at creep speed the PLC shall command the east drive to enter reduced torque in the raise direction.

The PLC shall monitor west drive through the Ethernet connection and monitor the motor speed throughout operation. After the PLC input for "West Nearly Open is energized, the PLC shall monitor the analog input 'West Leaf Motor Speed'. If the motor speed does not begin to decelerate within 5 seconds, then the PLC shall continue to open the command the west drive to decelerate (ramp down) to stop in 5 seconds.

The PLC shall monitor east drive through the Ethernet connection and monitor the motor speed throughout operation. After the PLC input for "East Nearly Open is energized, the PLC shall monitor the analog input 'East Leaf Motor Speed'. If the motor speed does not begin to decelerate within 5 seconds, then the PLC shall continue to open the command the east drive to decelerate (ramp down) to stop in 5 seconds.

If the PLC input for 'West Speed Switch' does not de-energize when the PLC input for 'West Raise Decel Check' de-energizes, then the PLC shall immediately stop the west leaf motor and set the west brakes (emergency stop).

If the PLC input for 'East Speed Switch' does not de-energize when the PLC input for 'East Raise Decel Check' de-energizes, then the PLC shall immediately stop the east leaf motor and set the east brakes (emergency stop). When either drive has stopped, the PLC shall de-energize the brake contactors to set the brakes on the re. De-energizing the brake motor contactors shall cause all the brakes to set on that respective leaf. The PLC shall verify that all the brakes are set, by verifying the corresponding PLC limit switch inputs are de-energized. If any brake does not set within 5 seconds, the PLC shall generate and store an alarm.

(8) Open the Leaf to Fully Open - The PLC shall maintain opening each leaf in creep speed until the respective span reaches the fully open position of 73 degrees. When PLC input for the leaf rotary limit switch contacts 'West Fully Open' is de-energized, then the leaf is west fully open. When PLC input for the leaf rotary limit switch contacts 'East Fully Open' is de-energized, then the leaf is east fully open.

When either leaf is fully open the PLC shall command the respective drive to ramp from creep speed to zero RPM in less than one second. After one second the PLC shall de-energize the respective motor contactor to isolate the motor from the drive. The PLC shall de-energize all the brake contactors to set all brakes on that leaf. De-energizing the brake motor contactors shall cause all the brakes to set. The PLC shall verify that all the motor and machinery brakes are set, by verifying the corresponding PLC limit switch inputs are de-energized. If any brake does not set within 5 seconds, the PLC shall generate and store an alarm.

(9) Leaf Overtravel Proximity Limit Switch

If either leaf open overtravel proximity limit activates, the PLC shall command the associated drive to ramp to a stop of zero (0) RPM in less than one second, and the PLC shall generate and store an alarm. After one second the PLC shall de-energize the motor contactor to isolate the motor from the drive. The PLC shall de-energize all the brake contactors to set all brakes on that leaf. De-energizing the brake motor contactors shall cause all the brakes to set. The PLC shall verify that all the motor and machinery brakes are set, by verifying the corresponding PLC limit switch inputs are de-energized. If any brake does not set within 5 seconds, the PLC shall generate and store an alarm.

(10) Interlocks:

The span shall be interlocked such that either span cannot be opened unless the center and tail locks are pulled, all warning gates are fully lowered, the traffic signals are red, and there is bridge control power.

(11) Bypass Operation: The PLC shall check the number of interlocks bypassed during an opening and limit the amount to a maximum of two interlocks bypassed.

If any center lock fails to pull, the center lock pulled interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used the PLC shall generate an alarm.

If any tail lock fails to pull, the tail lock pulled interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used the PLC shall generate an alarm.

If any of the warning gates fails to lower, the warning gates lowered interlock ONLY can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used the PLC shall generate an alarm.

The span position failure can be bypassed by using the touchscreen bypass in conjunction with the manual key operated bypass switch CS-BP. Whenever a bypass is used the PLC shall generate an alarm.

(12) Hardwired Switch Only

(i) The PLC shall operate in the same manner as noted above for the Center Locks, Tail Locks, and Span Motors while using the hardwired switch with exceptions noted below.
(ii) When the PLC input 'Screen Operation' is energized the PLC shall disable touchscreen operation from any location on the bridge.

(iii) Before operation of any piece of equipment using the hardwired switches and push-buttons the PLC shall check the PLC input "Control Desk Operation" prior to each component being operated.

Touchscreen Operation

General programing and operating requirements for each HMI touchscreen display screen is specified below. Each display screen shall consist of multiple selectable screens which are also noted below that are activated via the touchscreen. The Contractor shall adjust and add to the HMI screen program as directed by the Engineer during HMI and network testing as specified herein.

1. Operation Screen
   a. Includes general layout of selector switches, push-buttons, and indicators to mimic the layout of the hardwired switches on the control desk unless otherwise specified.
   b. Each device on the bridge shall have an individual button or switch represented pictorially which when selected shall operate the device as specified.
   c. Time and date stamp
   d. Angle of opening display
   e. Active alarm message display
   f. Selection tabs of alternate screens
   g. Time of traffic stopped display

2. Main Display Screen:
   a. Includes general imagine of the bridge including pictorial imagine of gates, locks, signals, brakes, etc. and their status (green for open to traffic, red for closed to traffic).
   b. Time and date stamp
   c. Angle of opening display
   d. Active alarm message display
   e. Selection tabs of alternate screens
   f. Time of traffic stopped display
   g. Includes status of incoming service, generator and ATS
   h. Includes voltage and current values for each phase on the incoming service

3. Traffic and Gates Screen:
   a. Includes general imagine traffic gates and signals and their status (green for open to traffic, red for closed to traffic).
   b. Time and date stamp
   c. Angle of opening display
   d. Active alarm message display
   e. Selection tabs of alternate screens
   f. Time of traffic stopped display
   g. Operational status of each gate when selected including limit switch contact set point and status (open or closed) and activate alarms.

4. Locks Screen:
   a. Includes general imagine center locks and tail locks and their status (green for open to traffic, red for closed to traffic).
   b. Time and date stamp
   c. Angle of opening display
   d. Active alarm message display
   e. Selection tabs of alternate screens
   f. Time of traffic stopped display
   g. Operational status of each lock when selected including limit switch contact set point and status (open or closed) and activate alarms.

5. Span and Brakes Screen:
   a. Includes general imagine span operating machinery and their status (green for open to traffic, red for closed to traffic).
   b. Time and date stamp

c. Angle of opening display
d. Active alarm message display
e. Selection tabs of alternate screens
f. Time of traffic stopped display
g. Operational status of each set of operating machinery when selected including voltage, limit switch contact set point and status (open or closed) current and activate alarms.
h. Operational status of each drive when selected including speed, command, voltage, limit switch contact set point and status (open or closed) current, angle of opening, etc.

6. Alarm Screen:
   a. Includes alarm history page with last 12 alarms with date and time stamps and active or inactive status.
   b. Acknowledge alarm button
   c. Silence alarm button

7. Maintenance and Bypass Screen
   a. Directions screen when selected
   b. Password protected bypass operation for manual operation, warning gate door switches, deceleration failure
   c. Password protected manual operation of ATS and Generator
   d. Any other operator commended which only intended for maintenance staff.

8. Temperature
   a. Active and set temperature of each room in the control house.
   b. Status of each heating units (On or OFF).
   c. Alarms for heating system (high temperature alarm, low temperature alarm, fault)

Limit switches

Fabrication and installation for the "Limit Switches" and all associated equipment shall be paid for under items E5 and E23 "Limit Switches" unless otherwise noted. The Contractor shall follow the testing guidelines as specified and paid for under the item "Testing," and all applicable paragraphs under this Section. For general material and installation requirements the Contractor is directed to the requirements as listed herein.

All work to properly install and adjust new and existing limit switches shall be covered under this item in accordance with the plans and specified herein. All work performed for fabrication and testing as specified shall be performed by an acceptable control system vendor.

Field work for installation of the limit switches including mounting and adjustments shall be performed by the Contractor as well as fabrication of targets and mounting brackets. The alignment and fastening of the rotary cam limit switches, speed switch and resolvers shall conform to and be paid for under the requirements specified under the item 615503-Bridge Mechanical System.

Motors

Fabrication of the "Motors" and all associated equipment shall be paid for under items E6 and E25 of section. The Contractor shall follow the testing guidelines as specified and paid for under the item "Testing", and all applicable paragraphs under this Section. For general material and installation requirements the Contractor is directed to the requirements as listed herein.

All work performed for fabrication and testing as specified shall be performed by an acceptable control system vendor unless otherwise noted.

A complete set of speed torque current curves for one motor of each type and size provided shall be prepared and submitted by the manufacturer to the Engineer for approval. Curves corresponding to full load speed shall be provided. The curves shall cover the interval from breakaway torque to breakdown driving torque, referred to full load motor torque. All motors shall be subjected to a standard routine test including a full load heat run test.

All motors shall be subjected to an insulation resistance test per NEMA standard MG 1, Section Nos. 12.02 and 12.03. Insulation resistance values and test voltage shall be included on the test reports.

Tests shall be reported on the standard forms for induction motors of the National Electrical Manufacturers Association. All test reports and curve sheets shall be certified by the manufacturer, and three copies of each shall be submitted. Motors shall not be shipped from the plant of the manufacturer until the test reports have been approved by the Engineer.

Motors shall also be full load tested on a dynometer as specified under "Flux Vector Drives" with the span drive system.

Motor and Machinery Brakes

The existing motor and machinery brakes on Savannah Road Bridge and Rehoboth Avenue shall be replaced as shown on the plans including all limit switches. Fabrication, adjustment and modifications for the "Motor and Machinery Brakes" and all associated equipment shall be paid for under items E7 and E25. The alignment and fastening of the motor brakes and machinery brakes shall be as specified and paid for under section 615503. The Contractor shall follow the testing guidelines as specified and paid for under the item "Testing", and all applicable paragraphs under this Section. For general material and installation requirements the Contractor is directed to the requirements as listed herein.

Modifications to Traffic Control Equipment

The existing warning and barrier gates shall be modified as shown on the plans and specified herein. Under item E8 and E26, the barrier gates and warning gates shall be modified to include new arm light flashers, new motor disconnect switches and new door limit switches. The motor shall be reconnected as 480VAC, 3 phase and other modifications as noted.

The same items, shall also include installation of new traffic stop lines in accordance with MUTCD, installation of traffic signal heads, and flashing red warning beacons with "Stop Here On Red" sign on Savannah Road as part of item E26. The Contractor shall follow the testing guidelines as specified and paid for under the item "Testing," and all applicable paragraphs under this Section. For general material and installation requirements the Contractor is directed to the requirements as listed herein.

Disconnect Switches

New motor and service disconnect switches shall be furnished and installed as shown on the plans and specified herein. Under item E9, the contractor shall furnish and install new disconnect switches for the span motor, brakes and span locks motors. Under item E27, the contractor shall furnish and install new disconnect switches for the span motors, brakes, center lock motors and tail locks motors. Under items E12 and E30, the contractor furnish and install new service disconnects witch for the new incoming service.

The Contractor shall follow the testing guidelines as specified and paid for under the item "Testing," and all applicable paragraphs under this Section. For general material and installation requirements the Contractor is directed to the requirements as listed herein.

Wire and Cable

Under the items E10 and E28, the size of all conductors shall be as indicated on the Contract Plans. If no size is indicated or the conductor size and number as shown on the approved electrical schematics vary from that shown on the Contract Plans, conductors of sufficient size and number shall be provided to accommodate the circuits to be installed. These conductors shall be sized in conformance with the National Electrical Code and any other applicable codes. The Contractor shall provide wiring and cables of sufficient ampacity and number as may be required for the installation in accordance with the wiring diagrams on his approved working drawings and these specifications without extra cost to Delaware Department of Transportation.

In each conduit and multi-conductor cable, at least two spare conductors shall be provided for every ten conductors of control wire and at least one conductor shall be provided for every ten conductors of power (or fraction thereof) actually used.

Internal shop wiring for control cabinets and the control stations shall not be smaller than No. 14 AWG. External control wiring shall not be smaller than No. 12 AWG.

Wiring shall not be installed in any conduit before all joints are made up tightly and the conduits rigidly secured in place. The drawing of conductors into conduits shall be done without injury to the wire, insulation or jacket.

For all conductors No. 8 AWG or smaller, approved wire ferrules terminal lugs shall be installed on each end of said conductors in all locations except for the submarine cable terminal cabinets, where flanged fork terminals shall be used. Where connections to pilot devices are required, either flanged forks or wire ferrules shall be used at the Contractor's discretion.

Terminal lugs shall be installed per lug manufacturer recommendations using the proper tools approved by the manufacturer. The terminal lugs for all outgoing wires (No. 8 AWG or smaller) in terminal boxes, control cabinets, control stations and other enclosures shall be connected to terminal blocks herein after specified. Each terminal of all terminal blocks shall be permanently marked to show the same number or designation as appears on the wire connected thereto. Under no circumstance will splicing of wires be permitted without the use of a terminal block. Wherever it becomes necessary to join or branch conductors, terminal blocks shall be used and wires shall be clearly tagged.

The existing submarine cables routed across the channel shall be connected as shown on the plans and specified herein. The existing ring tongue terminals and terminal blocks shall be reused. New wire and terminal block tags shall be furnished installed with the numbers noted on the as-built schematic wiring diagrams.

Fiber optic cables and Ethernet cables shall be installed and connected per manufactures recommendations. Splices for fiber optic cables shall be made with fiber optic splice kits inside an isolated enclosure.

Sufficient slack shall be left in all cables to permit proper connections in boxes, cabinets and enclosures. Conductors inside terminal boxes, control cabinets, control stations and other enclosures shall be neatly formed into cables and laced with approved cable ties with the individual conductors leaving the bundled cable at their respective termination points. Each conductor shall be looped to allow not less than three (3) inches of free conductor when disconnected from its respective terminal. The bundled cables shall be held securely away from the terminals and from contact with the enclosure by means of approved insulating supports and ties.

Equipment ground conductors shall be installed in all conduits and multi-conductor cables per the National Electrical Code latest edition, and all other applicable local codes.

Both ends of every single length of conductor shall be permanently and clearly tagged in accordance with the same numbers or designations appearing on the approved wiring diagrams.

All wiring shall be carefully tested after installation. The Contractor shall administer continuity tests, insulation resistance tests and any other required test for any conductor run as directed by the Engineer at no additional cost to the Delaware Department of Transportation.

All droop cables shall be provided with sealing bushings where they enter terminal cabinets or junction boxes.

Fabrication and installation for the "Electrical Cable Wire and Connectors" and all associated equipment shall be paid for under this Section. The Contractor shall follow the testing guidelines as specified and paid for under the item "Testing", and all applicable paragraphs under this Section. For general material and installation requirements the Contractor is directed to the requirements as listed herein.

Conduit Systems

Under items E11 and E28, all conduits to be installed in outdoor locations and/or corrosive environments such as the machinery rooms, access platforms, outside the control house and other said locations shall be plastic coated as hereinafter specified. Conduit fittings, including couplings, unions, elbows, expansion and deflection fittings, and other items, shall also be plastic coated.

Unions to connect sections of conduit that cannot be joined to each other or to boxes in the regular manner shall be the same type as the installed conduit systems.

The interior surfaces shall have a smooth finish and be free of burrs or projections, which might cause injury to the cables. All conduits shall be free from blisters, cracks, or injurious defects and shall be reamed at each end after being threaded. Conduits shall be installed to be continuous and watertight between boxes or equipment. Conduits shall be protected at all times from the entrance of water or other foreign matter by being well-plugged overnight or when the work is temporarily suspended.

All bends shall be made with factory-bent, standard or large radius conduit elbows. When approved by the Engineer, bends and offsets can be made with a hydraulic or power pipe bender, provided with standard shoes for conduit as required. Field bends shall be made without kinking or damaging the exterior surface or smooth bore of the conduit. The radius of curvature of pipe bends made in the field shall not be less than eight times the inside diameter of conduit. All bends shall be long sweep, free from kinks, and of such easy curvatures as to permit the drawing of conductors without injury. The use of a pipe tee or vise for bending conduit will not be permitted. Conduit that has been crushed, deformed or damaged shall be discarded. Conduit runs shall be made with as few couplings as standard lengths will permit, and the total angle of all bends between any two boxes or cabinets shall not exceed 270 degrees, unless otherwise approved by the Engineer. Long running threads will not be permitted. Pull boxes shall be used whenever necessary to facilitate the installation of the wire.

Installation of the Perma-Cote Conduit System or approved equal shall be performed in accordance with the Perma-Cote or approved equal Installation Manual. To assure correct installation, the installer shall be certified by Perma-Cote or approved equal manufacturer prior to installing coated conduit. The Contractor shall submit certification two weeks prior to any start of conduit work. In no case shall the Contractor use a chain vise or other equipment without protection means on the PVC coated conduit. Any damage to the PVC coating on the conduit is subject to removal of the damaged section and re-installation of a new section at no additional cost to DelDOT.

The use of condulets or conduit bodies for pulling conductors, for making turns in conduit runs, or for branching conductors shall only be permitted for lighting and heating conduit.

All conduits in the control house, wherever practicable, shall be concealed. Where conduits pass through the floors or walls of the control house, they shall be cast-in-place, or they shall be provided with galvanized pipe sleeves for free passage of the conduits. After the conduits are installed, the openings shall be caulked with an elastic compound and escutcheon plates provided on the interior walls, ceilings, and floors. Conduits shall be securely clamped and supported at intervals not exceeding 5 feet in length.

Conduit runs exposed on the steel structure shall be securely clamped to the steelwork. Supports shall be arranged so that conduits rest on top of the support and conduit U-bolts rest on top of the conduits. The use of J-bolts to fasten structural supports or to clamp conduits will not be permitted.

Where conduits are to be mounted exposed on non-steel surfaces, they shall be securely clamped to the surface using bent plate pipe supports with back spacers held by not less than two bolts.

Exposed conduits shall be installed parallel to, or at right angles to ceilings, walls and partitions. Where changes in direction of exposed conduit cannot be made with neat and orderly bends, pull boxes shall be used. Exposed conduits shall be securely clamped and supported at intervals not exceeding five (5) feet in length. All boxes and fixtures shall be provided with structural supports independent of associated conduit. No boxes nor fixtures shall be cantilevered from nor supported by conduit. The conduit supports shall be as specified elsewhere under this item.

At any point where a conduit crosses an expansion joint longitudinally or where movement between adjacent sections of conduit can be expected, conduit expansion fittings shall be installed. The fittings shall be bronze expansion fittings and shall be provided with flexible bonding jumpers to maintain the electrical continuity across the joints. The fittings shall permit a total conduit movement of 8 inches.

At any point where a conduit crosses a joint laterally or where an offsetting type movement between adjacent sections of conduit can be expected, expansion and deflection fittings shall be installed. The fittings shall permit a movement of ¾ inch from the normal in any direction. Flexible bonding jumpers shall be required to maintain bonding integrity whenever expansion fittings are required.

Flexible conduits for the connections between the rigid conduit system and all limit switches, motors, and other equipment subject to vibration shall be made with sections of approved flexible conduit. Approved liquid-tight connectors shall be provided for connections between rigid and flexible conduit. Each flexible, liquid-tight conduit section shall not exceed eighteen (18) inches in length without prior approval of the Engineer.

All conduit embedded in concrete, insofar as possible, shall be completely encased by concrete of not less than 3 inches, measured in any direction, and shall be securely held in place during pouring and construction operations. A group of conduits terminating together shall be held in place by a template.

All cutting and threading of conduit shall be performed as recommended by the conduit manufacturer. After being threaded, conduits shall be reamed at each end. All threads shall be degreased and then liberally coated with a zinc-rich sealer/de-oxidizer before connection. The sealer/de-oxidizer shall not damage the specified conductor insulation. All field cut threads shall be National Pipe Taper. Running threads will not be permitted.

Conduit lengths shall be connected to each other with approved screw couplings assembled hand-tight and then, using strap wrenches, tightened two more turns. Wrench marks or chuck marks shall be touched up with the appropriate touch up compound. Conduit runs shall be made with as few couplings as standard lengths will permit. No conduit runs with a total angle of bends between any two boxes shall exceed (270) two hundred and seventy degrees, unless otherwise approved by the Engineer.

Ends of conduits left empty including stubs shall be capped during construction, and care shall be taken to ensure that no moisture or other matter is in or enters the conduits.

All conduits shall be pitched where feasible to allow for water drainage. Where conduits cannot be drained to pull boxes, a drain "T" with drain/breather fitting shall be installed at the low point and drained. Drain/breather fittings shall be of stainless steel and shall be capable of passing 25 cc of water per minute.

Conduit hubs shall be provided at the ends of all conduits entering boxes and enclosures furnished with slip holes.

The ends of all conduits projecting into boxes and equipment enclosures shall be provided with insulated grounding bushings or hubs. All bushings or hubs in any box or enclosure shall be bonded together to the ground lugs in each box with No. 8 AWG bare copper wire.

All conduit, enclosures, and fittings shall be mechanically joined and electrically bonded together to form a continuous electrical conductor to provide effective electrical continuity. An equipment ground conductor shall be provided in every conduit and enclosure throughout the raceway. Conduits shall be installed so as to be continuous and watertight between boxes or equipment. All conduits shall be pitched not less than one (1) inch in ten feet (except by special permission) and drained to pull boxes where feasible. Conduits shall be protected at all times from the entrance of water or other foreign matter by being well plugged overnight or when the work is temporarily suspended. End of abandon conduits, spare conduits, and empty conduits and stubs shall be capped during and after construction, and care shall be taken to ensure that no moisture or other matter is in or enters the conduit.

Both ends of each conduit run shall be provided with conduit tags as specified.

All conduits and fittings shall be carefully examined and cleaned both before and after installation. Upon completion of the conduit and box installation, the Contractor shall clear each conduit by snaking with a nonabrasive mandrel of a diameter not less than 85 % of the nominal inside diameter of the conduit, and shall then draw in the cables. All conduits shall be free from blisters, cracks, deformations and defects. Conduits with any damage or injurious defects as judged by the Engineer shall be removed from the site and replaced by the Contractor at no extra cost to DelDOT.

The minimum size of conduits shall be as indicated on the Contract Plans. If no size is indicated or conduit fill varies from that shown on the Plans, conduit shall be sized to accommodate the conductors to be installed therein in conformance with the National Electrical Code. No conduit smaller than ¾ inch shall be installed.

Conduit shall be installed in accordance with the manufacturer's installation manual. The manufacturer's installation manual shall be kept on the job site and made available to the Engineer at all times.

As required under Working Drawings and Samples, layout and installation drawings for the electrical work, which includes the conduit system, shall be submitted prior to pertinent structural and mechanical shop drawings so that the conduit installation details may be incorporated by the structural and mechanical fabricators and erectors. A drawing showing the assembly and complete construction details of the conduit system shall be prepared and submitted for approval prior to fabrication. The Contractor shall follow the assembly and details of the system as shown on the plans.

The Contractor shall be fully responsible for coordination of the raceway installation with all other trades as part of this Contract.

Boxes.

Under items E11 and E29, boxes shall be furnished and installed where required and shown on the plans.

Pull boxes shall be used whenever necessary to facilitate the installation of the wire. Conduit bodies shall not be used for pulling conductors, for making turns in conduit runs, nor for branching conductors, for lighting and heating conduit runs only.

Surface mounted interior and exterior boxes shall be provided with external mounting lugs. No box shall be drilled for more conduits or cables than actually enter it. Exterior boxes shall be provided with ½ inch combination drain and breather fittings.

Terminal blocks shall be provided in each terminal box for the connection of all conductors including spare conductors entering the box plus at least twenty percent spare terminals for any control conductors and ten percent for any power conductors. All terminal blocks and boards shall be mounted on suitable straps or structural steel brackets in such a manner as to permit routing the conductors behind the terminal blocks. Terminal blocks shall be one-piece blocks suitable for use in highly corrosive atmospheres and shall conform to the requirements hereinbefore specified.

Each power distribution block shall be constructed of one-piece molded phenolic compound and shall conform to the requirements hereinbefore specified. A cover of insulating material shall be provided for each block.

Brake junction boxes shall be mounted in the machinery room and conform to the requirements as listed herein to route the flexible conduit or cables carrying control conductors to the brake limit switches. Each brake junction box shall have a PVC coated steel galvanized conduit from the switchboard room entering the box and three individual flexible conduits or cables leaving the box routed to the brake limit switches.

All manholes, junction boxes, pull boxes, and terminal boxes shall be inspected for proper duct entries, terminators, bell ends, pulling-in-irons, concrete seal around ducts, caps or plugs, pull lines, ladders, grout seals between the frame and chimney.

Hardware and Supports.

The Contractor is responsible for developing all conduit details consistent with applicable codes and these specifications. Structural steel brackets, boxes and other equipment mounted on concrete surfaces shall be provided with a full neoprene gasket as specified.

The anchoring system shall be used to fasten all electrical equipment to concrete as specified. The Contractor is required to use all accessories for installing the anchoring system as recommended by the manufacturer including but not limited to wire brush, air nozzle with air compressor and epoxy dispenser.

Motors, brakes, and limit switches shall be fastened to structural steel supports with approved shim packs and fasteners as specified under the machinery specifications.

The Contractor shall prepare and submit details of all electrical equipment supports to the Engineer for approval.

Each electrical device and enclosure shall be provided with a rigid structural steel support. No enclosure or device shall be permitted to cantilever from conduit unless specifically permitted in writing by the Engineer.

All Enclosures shall be mounted to concrete floor using stainless steel bolts as required.

If the Contractor elects to field drill certain electrical supports, the Engineer prior to any installation actually taken place must approve all details and locations.

Pull Wire.

After Installation, all conduit which will be left empty shall have a pull wire or cord installed. Pull wire or cord shall be made of corrosion resistant material with a minimum tensile strength of 400lb.

Incoming Electrical Service

Under items E12 and E30, the Contractor shall furnish and install the new incoming service at each bridge as shown on the plans. All work shall be coordinated with Delmarva and Lewes BPW.

As part of this work Delmarva and Lewes BPW will furnish and install the primary conduit, wire, transformer and transformer pad. The Contractor shall furnish and install the secondary conduit and wire, support stand and disconnect switch. The Contractor will be responsible for any coordination related to the incoming service between the Contractor, DelDOT and Delmarva/Lewes BPW. All fees related to the incoming service shall be paid for directly by DelDOT. The new service shall not be connected and energized by the Contractor until all equipment on the bridge is compatible with the new operating voltage. Any work required to be performed to use either incoming service for bridge operation and construction activities shall be paid for by the Contractor under this item. Adjustment to the incoming service equipment as previous defined shall also be performed under this item.

It shall be the responsibility of the contractor to notify the City of Lewes, Board of Public Works, or Delmarva twenty four (24) hours in advance of performing any work so that the city inspector may be present to witness the work.

Modifications to Stand-By Generator

Under items E12 and E30, the two existing stand-by generators shall remain and shall be reconnected and adjusted by the Contractor to operate at 3 phase, 480/277 Volts. Control and ancillary equipment shall be modified to operate with the available voltages. Adjustments shall include but not be limited to reconnection of the generator windings, connection of all wiring and circuits shown on the plans, adjustment of all settings and parameters, adjustment of louvers and actuators, replacement of block/jacket heaters, battery chargers and all other generator accessories. Coordination with the generator manufacturers shall be paid for under this item.

Also included in item E12, the Contractor shall furnish and install a new fuel sensor to indicate the level of fuel in the existing fuel tank. Installation of the sensor and all modifications to the existing tank to accommodate the new fuel sensor shall be paid for under this item.

The nameplate information for the two existing generators are as follows:

(1) Savannah Road Bridge:
  (i) Cummins Power Generation, Model GGHG-1522753
  (ii) Serial No. I150871812, Spec N
  (iii) 85 KW/106.2 KVA Stand-by, 0.8 Power factor
(2) Rehoboth Avenue Bridge
  (i) Taylor Power Systems, Model DS150M3
  (ii) Serial No. 21581U006848P
  (iii) 145 KW/181 KVA Stand-by, 0.8 Power factor

Fuel Supply System (for Rehoboth Avenue only)

Diesel oil for operation of the engine shall be stored in the existing stand-alone tank outside the generator room. As part of this item, the contractor shall furnish and install fuel lines between the fuel tank, overflow tank and diesel engine as shown on the plans to match the existing. The fuel lines, installation, layout, etc. shall be of the type recommended by the manufacturer.

Field Measuring

Under items E13 and E31, the Contractor shall provide a field survey and field verifications of the existing equipment, bridge structure, layouts, and all other measurements required for the new electrical system as specified. The required field measurements shall be used as a way to avoid errors in fabrication and installation of the new equipment which could result in errors in the shop plans and working drawings, delays in the approval process, impacts to the project schedule, and problems with the assembly and operation of the systems. The work required to obtain measurements of some of the existing components may require temporary disassembly of those components or systems. The Contractor shall submit a Measure and Survey Plan that shall include but not be limited to the following:

(1) The overall sequence and schedule of the systems and components to be measured.
(2) A description and plan of how the Contractor will access all areas where measurements will be taken. Propose temporary platforms/access in accordance with Section Field Measuring.
(3) A description of the methods, procedures and equipment that will be used where it may be necessary to disassemble and reassemble components or systems in order to perform the measurements.
(4) A description of the methods and equipment used to perform the measurements. Identify control points, datum's and plumb lines.
(5) A narrative of the potential impacts to the systems and operation of the bridge. The Contractor shall comply with the Coast Guard requirements that may limit the durations that the bridge can be taken out of service.
(6) Identify the individuals doing the field measuring and provide resumes that show that they are competent and experienced.
(7) A complete list of personnel who will be performing surveys or taking measurements to be used in the preparation of shop/working drawings or for coordinating and verifying the relationship of machined parts.

All measurements affecting elements to be included in the shop plans and working drawings shall be performed by or under the direct supervision of the Contractor who is responsible for preparing the shop plans or working drawings.

The Contractor shall not begin field measuring until the Measurement and Survey Plan for that work item is approved.

Manual Operation/Temporary Operating System

Under items E14, the Contractor shall utilize the air motor system during construction to operate the bridge once the main span motor become inoperable. The contractor shall furnish a portable air compressor and power source for the air motor system. Temporary operation shall occur with at least one motor brake installed and manually operable.

Under items E32, the Contractor shall utilize hand crank system during construction to operate the bridge once the main span motor become inoperable. The contractor may at his cost furnish a portable air compressor, power source, and air motor system to connect to the hand crank manual system. During the motor or machinery brake replacement, temporary operation shall be permitted when steady wind speeds are 25 mph or less with either both machinery brakes manually operable or the motor brake manually operable.

The warning gates, barrier gates, span locks and brakes shall be manually operated once electrical controls and power are removed. When the warning and barrier gates become manually inoperable a separate traffic barricade shall be used.

The contractor shall assume 20 bridge openings (for vessels only) per bridge for estimating purposes, any required additional opening for vessels shall be negotiated with DelDOT. Any required openings as a result of construction activities shall be incidental to the relevant pay items and shall not be of any additional cost to DelDOT.

Bridge Operator

During the construction period, from the first day work is performed at the specific bridge until acceptance of the bridge by DelDOT, the Contractor shall provide and train personnel to operate the bridge, during scheduled bridge openings.

Each Bridge Operator shall be familiar with the bridge layout as well as be trained in the operation and maintenance of the bridge. Included in the Contractor's training program shall be subjects such as troubleshooting, repair of electronic motor controls, drive circuit logic, maintenance and adjustment of all new, existing, and temporary electrical equipment and hardware, and other items required for full bridge operation and maintenance.

Upon completion of training, each of the Operators will be required to demonstrate safe operation of the Bascule spans, in the presence of the Engineer, prior to being assigned to duty as a Bridge Operator.

Bridge Opening Delay

Upon a call from a vessel to open the bridge per the USCG requirements 33 CFR 117.239, the Contractor must open the bridge as scheduled. The time to operate the bridge shall not exceed 20 minutes which includes the time to stop traffic, stop conflicting construction activities, and operate bridge equipment. The Contractor may need to operate the bridge utilizing temporary controls and drives or manual devices such as hand cranks, etc. while equipment is being removed and installed.

Historical Bridge Opening Logs.

The Contractor is provided the following information showing the frequency of bridge openings for marine vessels.

BR 3-153 in REHOBOTH							
	APR	MAY	JUN	JUL	AUG	SEP	OCT
2006	0	4	11	15	14	9	3
2007	0	7	11	15	19	3	1
2008	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2009	2	2	2	3	7	4	6
2010	0	0	0	4	8	4	1
2011	0	2	5	2	11	1	0
2012	0	0	0	6	1	8	0
2013	0	0	0	5	0	0	0
2014	0	2	3	1	2	0	2
2015	0	2	3	1	2	0	2
2016	0	2	3	N/A	N/A	N/A	N/A

BR 3-154 in LEWES							
	APR	MAY	JUN	JUL	AUG	SEP	OCT
2006	0	3	13	10	14	8	10
2007	0	2	5	5	8	5	1
2008	0	4	22	14	4	0	0
2009	2	1	7	7	8	6	6
2010	0	0	0	6	7	6	1
2011	0	1	4	2	10	1	0
2012	0	0	2	4	1	5	2
2013	0	0	0	3	0	0	0
2014	0	3	1	7	0	0	0
2015	0	0	0	6	1	0	2
2016	2	1	1	N/A	N/A	N/A	N/A

Demonstration of Temporary Bridge Operating System

The Contractor shall perform a demonstration of the Temporary Bridge Operating System in the presence of the Engineer in which interlocking and operating procedure will be verified.

The Contractor shall prepare a procedure for demonstration, which shall be submitted at a minimum of 14 days prior to the test date for review and approval. The procedure shall list in numbered steps each device to be demonstrated, the action required by the operator and the expected results.

Bridge Maintenance

The Contractor shall maintain all operating equipment on the bridge throughout the duration of construction. This shall include but not be limited to; inspection, lubrication, general maintenance and servicing of all newly installed equipment as well as existing equipment. Maintenance of equipment shall be performed in accordance with manufacturer's recommendations, and bridge maintenance manuals.

Technical Manuals

The following are suggested tables of contents for each of the manuals. They are not intended to be complete tables of contents and the Contractor shall include all information which may be helpful in maintaining the bridge functional systems, in the case of the Maintenance Manual, or in operating the bridge functional systems, in the case of the Operating Manual. The tables of contents are given here are in general terms and include information and material on items provided under mechanical and electrical pay items. This is done intentionally to call attention to the need for coordination between the Contractor and all mechanical and electrical sub-contractors in the preparation of these manuals.

Maintenance Manual - Suggested Table of Contents:

(1) Description of all bridge functional systems and sub-systems.
(2) Layout of all bridge functional systems and sub-systems.
(3) Listing of any warnings, cautions, or safety issues or procedures that must be followed as a part of any maintenance work, either specific or general.
(4) Listings of all parts suppliers' local representatives, including suppliers' and representatives' names, addresses, telephone and fax numbers, and websites, if any. The names, addresses, telephone and fax numbers, and websites of the Contractor, all subcontractors installing any of the bridge functional systems or subsystems, and the Engineer shall also be provided.
(5) Listing of all spare parts and components provided by the Contractor.
(6) Preventative maintenance procedures, including the frequency at which the various procedures should be done.
(7) Lubrication schedule charts and diagrams.
(8) Maintenance testing and procedure equipment lists.
(9) Troubleshooting procedures and checklists.
(10) Repair procedures and repair procedure equipment lists, including suggested procedures for installation and removal of machinery, electrical and control items.
(11) Description of the proper theoretical approach to installing and aligning machinery and installing and testing electrical and control systems.
(12) As-Built Drawings
(13) Conduit and electrical equipment layout and installation drawings, including mounting details.
(14) Control desk, motor control panels and drive panel layouts and wiring diagrams.
(15) Schematic-wiring diagrams
(16) Certified Drawings
(17) Manufacturers' brochures, literature and composite schedule of apparatus, including any suggested installation, alignment, maintenance, troubleshooting and repair procedures.
(18) Any and all other material or information which in the opinion of the Engineer may be desirable to include in order to assist in maintaining the bridge functional systems and sub-system.

Operating Manual - Suggested Table of Contents:

(1) Description of all bridge functional systems and sub-systems.
(2) Description of functional relationships between bridge functional systems and sub-systems.
(3) Listing of any warnings, cautions, or safety issues or procedures that must be followed as a part of any bridge functional system or sub-system operation, either specific or general.
(4) Theory of operation, detailed operating instructions, which shall cover in full the step-by-step sequence of normal operation of the movable bridge functional systems, all precautions required for the correct and safe operation of all bridge functional systems, adjustment instructions, and operational limits and restrictions.
(5) A similar description for the use of the bypass switches, noting all precautions for their correct and safe operation.

(6) Description of control, which shall describe in full the functions of all protective devices, limit switches, contactors, relays, and all other equipment used in all bridge functional systems, in connection with each step in the operating sequence. Wire and apparatus numbers appearing on the wiring diagrams shall be used in this description for identifying the various devices and circuits.
(7) Block diagrams illustrating the sequencing and operation of and functional relationships between all bridge functional systems and sub-systems.
(8) Any and all other material or information which in the opinion of the Engineer may be desirable to include in order to assist in the operation the bridge functional systems and sub-systems.

A preliminary submittal of the technical manuals shall include, two copies of sample formats and outlines of contents in draft form 90 days prior to final inspection, acceptance tests, or return of span operation to the Department, showing proposed methods of binding, methods of printing and reproduction.

A draft submittal of the technical manuals shall include two copies of completed manuals in final form 30 days prior to the final inspection, acceptance tests or return of span operation to the Department. At the Engineers discretion, additional submittals of the draft technical manuals may be required as a result of inaccurate information or omitted information.

A final submittal of seven (7) copies of approved manuals and (1) electronic copy in pdf format ten days after final inspection and acceptance tests. One of the seven copies shall become the property of the Engineer; the remaining copies shall become the property of the Department. The final submittal of technical manuals shall only be made once the draft version as noted about has been review and approved.

Training

After submission of copies of the manuals in their final form and prior to the return of span operation to DelDOT, the Contractor shall provide instruction and training for DelDOT Maintenance Personnel for a period of 15 days.

The instructors shall be skilled persons competent to operate the bridge and be completely familiar with the operating equipment of the bridge. They shall be able to make any adjustments required to the electrical and mechanical equipment.

During the 15-day training period specified above, the instructor(s) shall be in attendance at the bridge during bridge opening and maintenance procedures.

Included in the 15-day training and instruction period, there shall be an on-site training of DelDOT electricians, maintenance workers, and other personnel as indicated by the Department on subjects such as troubleshooting, repair of electronic motor controls, drive circuit logic, maintenance and adjustment of all electrical equipment and hardware, and other items required for full bridge operation and maintenance. Three 8-hour sessions shall be devoted to hardware and maintenance related topics. In addition, two 8-hour sessions shall be devoted to software requirements.

Instruction pertaining to hardware and maintenance shall be offered on two separate occasions to allow bridge personnel to coordinate the course with their normal activities. The Contractor shall furnish all necessary instruction sheets, student training aids, books, paper, and booklets to supplement training. The Contractor shall submit to DelDOT, a minimum of 2 weeks prior to training session, an outline of topics to be covered and training material for review. It shall also be the Contractor's responsibility to coordinate with DelDOT the location where training sessions will be held. Supplying of visual aid equipment and other miscellaneous items required for training shall be the responsibility of the Contractor.

Lighting and Heating Systems

Under items E15 and E33, the Contractor shall furnish and install floor or wall mounted lighting and distribution transformers, panelboards, hot water heater, light fixtures, receptacles, etc. as shown on the plans.

The existing hot water heaters at both Rehoboth Avenue and Savannah Road Bridge shall be replaced with a new instantaneous unit as specified. The new units shall be installed below the sinks at both locations. The existing unit at Savannah Road Bridge shall be delivered to DelDOT under this item.

New lighting and heating panelboards shall be furnished and installed as shown on the plans. The new panelboards shall be connected to new and existing fixtures as specified. The heaters shall be de-energized by the self-contained contactors in the heaters.

New lighting and heating fixtures shall be furnished and installed in the control house on each floor and room. The lighting shall be located based on the final location of the new equipment. Where no new equipment is installed the light fixture shall be located in the same location.

The existing roadway lights shall be connected to operate with the new 480/277 VAC incoming service. The Contractor shall make all necessary adjustments and changes to the existing fixture under this item.

The Contractor shall coordinate locations of the specified equipment with existing utilities, water piping, and other existing equipment Adjustments to the final locations and equipment shall be made by the contractor for proper fit and installation at no additional cost to DelDOT.

General Testing Requirements

The Contractor shall arrange for and provide all the necessary field tests, as directed by the Engineer and specified herin, to demonstrate that the entire electrical system is in proper working order and in accordance with the Plans and Specifications. The tests shall include, but not be limited to continuity and insulation resistance testing of wire and cables, duct test for all conduit, operational and interlock testing of the bascule leafs, span locks, center locks, tail locks, brakes, navigation lights and signals, warning gates, barrier gates traffic signals, standby generator and the automatic transfer switch.

The Contractor shall also be responsible for coordination of the bride PLC system with the TMC center's network and all associated testing to confirm proper operation.

Should the tests show that any piece of equipment or cable or wiring connection, in the judgment of the Engineer, is defective or functions improperly, such adjustments and/or replacements shall be made by the Contractor as to make the installation satisfactory to the Engineer and at no extra cost.

The bridge field tests are intended to confirm each major sub-component acceptance factory tests, and that the subsystem is operational prior to conditional acceptance functional checkout. Confirmation of correct operation of sub-components will be demonstrated through successful operation of the particular component. However, the Contractor is still responsible for the factory acceptance tests as required per contract specifications. Examples of subsystems are the span drive systems, control and power wiring, limit switches, starters, relay systems, etc.

Upon completion of the installation of the entire control system, the Contractor shall perform motor operating tests for each main span motor and drive under each mode of operation to demonstrate that the motors function properly and provides the specific operating characteristics as specified in the contract documents. The data, which is to be recorded using data logging equipment, shall include but not be limited to motor speed (RPM), motor KW, Motor Current, time of operation, and angular position of the span. The data shall be submitted in table and graph form and shall show acceleration, deceleration, full speed, reduced speed and creep speed. Test data shall be included in the "Technical Manuals".

Stage 1 - Contractors Field Testing

The Contractor shall adjust, calibrate and test all equipment, place the integrated system in service, and test the integrated system. The Contractor shall provide verification that all inputs and outputs and all signals have been properly installed and tested.

The Contractor shall demonstrate that the completed system functions properly by performing at least 10 consecutive complete bridge operations for each location (Savannah Road and Rehoboth Avenue) including

both PLC A and B control, each without failure or any adjustments to the satisfaction of the Engineer. (A complete bridge operation shall be defined as starting from turning control power on, operating all equipment up to completely opening the span, operating all equipment up to completely closing the span, and ending by turning control power off.) The Contractor shall demonstrate the operation of all bypass functions. The Contractor shall demonstrate the operation of the ATS and generator and provide at least 3 complete operations under generator power. The Contractor shall deliver a report describing results of the contractor's field tests, diagnostics, and calibrations including written certification to the Contracting Agency that the installed complete system has been calibrated, tested, and is ready to begin Stage 2 - Conditional Acceptance Functional Checkout. The report shall also include a copy of the approved Stage 1 - Contractor's Field Testing procedure.

Stage 2 - Acceptance Testing Functional Checkout

During this stage, the contractor shall perform a step-by-step demonstration of the bridge operating systems as specified. The demonstration shall not be performed until all construction (including all trades) is completed and the "Technical Manuals" and other documents are submitted and approved by the Engineer.

The Contractor shall prepare a test procedure, which shall be submitted at a minimum of 30 days prior to the test date for review and approval. The test procedure shall list in numbered steps each device to be demonstrated, the action required by the operator and the expected results. The bridge operation shall be performed using the main utility source and the stand-by generator in conjunction with any back-up systems and the main control system. Operation of all interlocks and bypass switches shall be demonstrated. Each step shall be provided with a pass/fail blank.

The conditional acceptance functional checkout test, as specified, shall not commence until receipt by the Contractor of written permission from the Contracting Agency and approved by DelDOT, based on the Contractor's Stage 1 written report. This shall include certification of successful completion of Stage 1-Contractor's Field Testing, as specified above. The Contracting Agency may terminate this portion of the testing at any time when the system fails to perform as specified.

Upon a failure resulting in termination of testing by the Contracting Agency or by the Contractor, the Contractor shall commence an assessment period. The Contractor shall identify all failures, determine the cause of all failures, repair all failures, and deliver a written report to the Contracting Agency. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which the testing should be resumed. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the Contracting Agency. As part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by performing the appropriate portions of the conditional acceptance functional checkout test. Based on the Contractor's report and test review meeting, the Contracting Agency will determine the retest date.

Upon successful completion of the conditional functional checkout testing, the Contractor shall deliver test reports and other documentation specified to the Contracting Agency for approval prior to commencing the endurance test.

Stage 3 - Endurance Period

After successful completion of the field testing and acceptance testing (Stages 1 and 2) including correction of all deficiencies, the Contractor submit a request to DelDOT to start the endurance period. The letter shall include dates of final acceptance testing as well as a signed field test procedure. The start of the endurance period shall not occur until the approval of the record as-built drawings and O&M manuals.

Approval of the letter by DelDOT will start the endurance period in which the Contractor shall witness a minimum of 30 bridge openings per bridge within a two-week period by DelDOT bridge operators for each bridge. At any point during the endurance period should a fault occur the Contractor shall notify DelDOT of the fault and cause as well as actions to be taken to repair or further troubleshoot.

After documentation of the fault is submitted to DelDOT the contractor will enter a conditional testing period not to exceed two weeks. During this period the Contractor will be required to perform additional testing to prove the fault has been repaired. Once conditional testing is accepted by DelDOT the endurance period can continue at which point the Contractor will witness the remaining bridge openings or 12 additional bridge opening whichever is greater.

Following successful completion of the endurance period the Contractor shall submit a letter with the endurance period results. Acceptance of this letter by DelDOT will start the warranty period.

Factory Inspection and Testing of the Bridge Control System

The enclosed motor control cabinets, drive cabinets, back panels, control desk, ATS and other apparatus supplied, assembled or fabricated by the vendor of the electrical control system shall be subjected to shop inspections to demonstrate compliance with all specified requirements. The inspection is intended as a means of facilitating the work and avoiding errors, and it is expressly understood that it will not relieve the Contractor of responsibility for imperfect material or workmanship.

The control cabinets, drive cabinets, PLC cabinets, back panels and control desk shall be completely assembled, wired and connected at the factory, and shall be subjected to the manufacturer's standard inspections and testing. The manufacturer's standard testing for the equipment may comprise at least the following:

(1) Wire continuity tests, either visual or verified with continuity tester.
(2) Operational check of circuits to determine proper interlocking of circuits and operator's devices.
(3) Simulated operational testing to verify proper operation in accordance with the plans and specifications using all modes of operation.
(4) Polarity of connections to instruments and other polarity-sensitive devices.
(5) Inspection of materials, fit of parts, finishes, adjustments, and conformance with catalog cuts.

The enclosed control cabinets, back panels, drives cabinets and control desk shall be completely interconnected and shall be subjected to electrical and operational testing to ensure accuracy of connections and to demonstrate proper functioning of equipment. Limit switch contacts shall be simulated using the actual limit switches if available or by using toggle or knife switches.

The toggle switch or knife switches shall be setup and installed on a fabricated test station. The test station shall be labelled with the limit switch designation being simulated. Actual limit switches can be used in place of the toggle switches provided they can be easily simulated or actuated.

The entire PLC system shall be interconnected as part of these tests including touchscreens. The PLC I/O shall be monitored from a separate laptop computer with the associated programing and monitoring software for the PLC system. As the touchscreen, pilot devices, limit switches, sensors, etc. are activated the associated PLC I/O will be monitored. Alarms and indicators will be tested and monitored during simulated operation. All back-up systems will also be tested.

During the testing, the control system vendor shall be required to adjust the PLC/HMI ladder logic and programing to the satisfaction of the Engineer. After each adjustment the testing shall be repeated as may be required to test all associated equipment.

The factory testing shall also include a complete sequenced, simulated operation of the bridge auxiliaries and span drive, and shall include complete adjustment, verification and testing of the control logic, control relays PLC, and contactors to demonstrate operation in accordance with specified requirements. Testing of the various interlocks as specified herein and shall also be included during the factory tests.

The Engineer or his authorized representative shall witness the factory inspection and special testing required herein, and no equipment shall be shipped from the factory until it has been released for shipment by the Engineer. The Contractor shall provide thirty (30) days notification in advance of the date of tests so that arrangements can be made for DelDOT and the Engineer to be present at the tests. The Contractor shall

submit to the Engineer for review, thirty (30) days prior to the testing date, a copy of all standard and all special tests to be performed, as well as actual test forms to be approved by the Engineer.

During the witnessed inspections, nameplate legends, conductor identifications, instrument scales, escutcheon plate engraving and all other details of construction shall be checked for conformity with specified requirements and approved shop drawings.

Factory tests for equipment other than the bridge control system shall be as specified in the various materials sections throughout these specifications.

The complete control system as specified herein shall not be shipped to the bridge site or other facility until the written approval from DelDOT.

HMI Display Screen and Network Testing

The complete network including HMI, PLC's and Drives shall be connected and tested with the HMI screen for proper operation. The testing shall include emergency stop testing and local operation testing of the drive systems.

The test date for HMI and network testing shall be 30 days or more from the date of the factory testing of the completed control system. During the testing an opportunity shall be provided to review the HMI screen layout with the control system vendor and make adjustments to design of each screen and the overall layout. As part these tests the on-going fabrication of the control system will be visual inspected by the Engineer.

Drive Testing

Under the items E3 and 21, the drives shall be shop assembled and tested by a qualified control system vendor. The Contractor shall follow the testing guidelines as specified and paid for under the item E16 and E34, and all applicable paragraphs under this Section.

Each drive shall be tested at the drive manufacturer's faculty prior to shipping to the control system vendor for control system testing. The drives and motors shall be load tested at 25, 50, 75, 100 and 150% and varying motor speeds in the presence of the Engineer using the actual span motors and a dynamometer. Test results shall be submitted to the Engineer for approval prior to shipment to the control systems vendors' facility.

Field Acceptance Test Data

All test results, parameters; data specified herein to be recorded shall reference the appropriate paragraph number and shall be presented in legible, tabular format, listing associated parameters and conditions. For example, motor current shall reference speed (rpm), span leaf angle (degrees), raise or lower mode, drive control selector position number, etc.

The results of the drive, ancillary and emergency systems tests shall be presented in a matrix form on an Inspection Report Data Sheet. The proposed format of these sheets shall be submitted to the Engineer for acceptance prior to the actual testing. Any parameter value, which falls beyond the recommended range, would require the re-adjustment or replacement of the defective device.

The table of the test results shall have references to the specific sections of the testing procedure. The precision of the results will depend on the accuracy of recording equipment, the observer and weather conditions. For each stage of testing of the bridge control equipment, the name of the person who will perform the test, instruments used with calibration data if required, the exact date, time and weather conditions shall be recorded. Some devices such as the transfer switch, lamps, console indicator lights, brake function indicator lights, console controlled lighting, horn, can be easily tested without performing any bridge opening operation. The bridge main parameters shall also be observed on the drive keypad and a laptop screen, and visually compared to the control console touchscreen and indicators. Any discrepancy between results should be recorded. A discrepancy between critical measurements like span angle indication shall be resolved prior to continuing the tests.

The testing shall be accomplished sequentially, following the bridge operation instructions for normal operation and emergency operation. The major bridge systems shall be monitored while the bridge operates. All safety interlocking shall be verified such that each components can only be operated in the correct sequence. All bypass switch operations shall be verified.

The printout originals of all tests shall be kept for future reference, and a printout copy shall be attached to the Technical Manuals for reference. Another printout copy shall be provided to the Engineer.

Arc Flash Study and Labeling

Once construction of the electrical system is complete but prior to final acceptance, the Contractor shall provide adhesive vinyl arc flash labeling on all new and existing equipment in accordance with applicable codes and requirements. Equipment requiring labels include components that are likely to be opened for maintenance including motor control equipment, drive enclosures, panel boards, disconnect switches, etc. Labeling shall include the arc flash hazard at the location clearly indicating the appropriate level of protection required.

In order to prepare and affix the arc flash labels, the Contractor shall retain the services of a professional engineer registered in the state of Delaware to perform a survey of the existing and newly installed electrical equipment and perform an analysis of the arc flash hazards using industry standard software. Prior to procuring and installing the arc flash labels, submit the results of the arc flash analysis, including calculations and label schedules, and submit for review.

Removal of Existing Equipment

The removal work at the existing equipment under this subsection shall be done in conformance with all requirements governing the sequencing and scheduling of construction. Removal of electrical equipment shall not commence until all new equipment and parts to be installed are delivered to the site or an approved storage facility unless otherwise approved by the Engineer.

The electrical equipment to be removed in stages at each bridge shall include, but not be limited to, the following

(1) Main Control Desk
(2) Control and Drive Cabinets (Savannah Road Only)
(3) Existing Back Panels from Existing Cabinets (Rehoboth Avenue Only)
(4) Panelboards
(5) Motor Resistors
(6) Span Motors
(7) Overspeed Switches and Tachometers
(8) Motor and Machinery brakes
(9) Limit switches which are designated to be replaced
(10) Conduit and wire which are designated to be replaced
(11) Terminal and pull boxes which are designated to be replaced
(12) Span lock motors
(13) Tail Lock Motors
(14) Center Lock Motor
(15) Lighting and Heating Fixtures which are designated to be replaced
(16) Disconnect switches which are designated to be replaced
(17) Remote Control switches for Heating Systems
(18) Panelboards
(19) Any equipment listed herein which requires that the equipment be preserved for future use shall be salvaged as specified.

The Contractor shall protect any piece of equipment associated with the stand-by generator operation which is required to remain in place as specified in the Contract Documents.

Any existing conduit encased in concrete, which are to be abandoned, shall be cut back to the concrete surface, threaded and capped with steel pipe caps.

In general, all apparatus to be removed shall be disconnected by removing existing bolts, nuts and screws. The work shall include removal of all brackets, hangers, clamps, fittings and other hardware no longer needed.

All existing holes in concrete created from the removal of existing equipment including conduit, supports, boxes, water lines, etc. shall be sealed.

All existing facilities, apparatus, cables, wiring and other equipment which are to remain in place on the bridge, shall be protected at all times from damage or defacement caused by the Contractor's operations. Any such damage or defacement shall be promptly repaired or cleaned to the satisfaction of the Engineer at no extra cost. If, in the opinion of the Engineer, the Contactor's operations require the temporary removal of existing equipment for proper protection, such removal and remounting shall be done at no extra cost.

Prior to the actual removal of the electrical equipment the Contractor shall submit to the Engineer a removal plan which states each piece of electrical equipment to be removed during each stage of Construction stage. No piece of electrical equipment shall be removed from the existing operating system until the removal plan has been approved.

Upon completion of the work, the Contractor shall repair all damaged or defaced areas exposed by the removal of equipment, or caused by his operations, in a workmanlike manner satisfactory to the engineer. Small bolt holes in concrete surfaces shall be filled with epoxy mortar. Holes in the walls ceilings or floors of the houses shall be filled with grout and finished to match the existing surfaces. Any damage to windows, window framing, sash, sills, frames or any other architectural trim shall be repaired, and painted surfaces shall be repainted after being repaired. Any holes in the ground shall be filled with earth top soil and suitably landscaped to match the surrounding areas.

All existing materials and equipment removed under this item shall become the property of the Contractor unless otherwise specified, and shall be removed from the site and disposed of properly.

Painting of Electrical Equipment

All new and existing electrical equipment (unless otherwise noted), such as brake frames, conduits, non-stainless boxes/enclosures, device enclosures, supporting clips and brackets, and other devices, shall be given two coats of paint as specified under the requirements for painting structural steel. Before applying the two coats, all surfaces shall be cleaned free of all grease, oil, dirt, and foreign material. Galvanized surfaced shall be etched with copper sulfate solution, after which two coats of paint shall be applied. In lieu of etching, the Contractor may use galvanizing primer as a first coat for galvanized surfaces followed by two coats of paint. The final coat of paint on equipment mounted on the steel work shall be of a color and type of paint to match the structural steel. The final coat of paint on equipment shall be of a color and type of paint to match the bridge.

Stainless steel enclosures, PVC coated conduit, liquid tight conduit, and fittings and die cast zinc limit switch enclosures shall not be field painted. These devices shall be adequately protected from all field-painting operations. Equipment not to be painted shall be carefully masked with polyethylene to prevent accidental paint coverage. If any coating material is applied to the surfaces indicated, as not to be painted, the paint shall be completely removed.

Method of Measurement:

Item 615504, BRIDGE ELECTRICAL SYSTEM, will not be measured.

Basis of Payment:

The work will be paid for at the contract bid price for lump sum for Item 615504, BRIDGE ELECTRICAL SYSTEM. This price shall include all labor, tools, equipment, material and incidentals necessary to satisfactorily complete the work in accordance with the Contract Plans and Special Provisions.

The lump sum bid for Item 615504 shall be the sum of the cost associated with the work performed at each bridge listed. The completed Breakout Sheets shall be submitted with the bid documents or within seven (7) calendar days following the bid due date by the lowest apparent bidder as specified in the "Breakout Sheet Instructions" page included in the "Bid Proposal Forms" section. Failure to submit the breakout sheets will result in the Bid Proposal being declared non-responsive and rejected.

9/11/2018

615506 - WALKWAY GRATING

Description:

This work consists of removal of existing walkway epoxy surface, top plate, support grating and connections and furnishing and installing new top plate, walkway grating, supports and connections on the sidewalks of bascule span of bridges BR 3-153 (Rehoboth Ave. bridge) and BR 3-154 (Savannah Rd. bridge) in accordance with the contract drawings.

Materials:

A. General
1. The prefabricated heavy duty carbon steel gratings shall satisfy ASTM A-36 Carbon steel and ANSI/NAAMM- MBG-532-09 Heavy Duty Metal Bar Grating Manual specifications.
2. The top plates shall satisfy ASTM A-36 Carbon steel specifications.
3. Epoxy shall be as specified in 625500 - Epoxy Overlay System

B. The following manufacturers of heavy duty bar grating are preferred and shall be submitted to the engineer for approval.
1. Ohio Gratings Inc.
2. AMICO
3. Interstate Gratings LLC
4. or approved equal

C. Submittals
1. Product Data: The contractor shall submit the manufacturer's catalog pages including load tables, anchor details and standard installation details.
2. Shop drawings: The contractor shall submit for approval shop drawings for the fabrication and erection of all gratings and connections to supports, top plates and associated connections to the grating. Include plans, elevations, and details of sections and connections as required. Show type and location of all fasteners.
4. Samples of grating and anchorage system shall be submitted for approval.
5. All miscellaneous installation hardware and accessories.
6. Work plans, showing staged construction and sequential work activities shall be submitted for review. All work to be coordinated with MOT setups and other ongoing work activities, such as painting, steel repairs, center lock rehabilitation, concrete sidewalk rehabilitation, etc.

D. Quality Control and Quality Assurance
1. Manufacturer Qualification: A company specializing in the manufacture of metal bar gratings with not less than 10 years of documented experience.
2. Fabrication tolerances shall be in accordance with applicable provisions and recommendations of ANSI/NAAMM-MBG-532-09 Heavy Duty Metal Bar Grating Manual.

E. Manufactured Units
1. Grating for BR 3-153 (Rehoboth Ave. bridge):
   a. Type 38-W-4 Heavy Duty Carbon Steel Grating.
   b. Main Bearing Bar depth: 3-1/2 inch as shown on the drawings
   c. Main Bearing Bar thickness: 3/8 inch as shown on the drawings
   d. Main Bearing Bar spacing: 2-3/8 inch
   e. Cross bar spacing: 4 inch on center
   f. Top surface of all bars: Plain/Smooth
   g. Weight: Not to exceed 26 pounds per square foot

2. Grating for BR 3-154 (Savannah Rd. bridge):
   a. Type 38-W-4 Heavy Duty Carbon Steel Grating.
   b. Main Bearing Bar depth: 1-3/4 inch as shown on the drawings

c. Main Bearing Bar thickness: 1/4 inch as shown on the drawings
d. Main Bearing Bar spacing: 2-3/8 inch
e. Cross bar spacing: 4 inch on center
f. Top surface of all bars: Plain/Smooth
g. Weight: Not to exceed 9 pounds per square foot

3. Top plates for BR 3-153 and BR 3-154 bridges: The 1/4 inch top plate shall be welded to the top of the grating to ensure adequate strength and stability under construction condition, during epoxy overlay pour on top of the plate and during service life of the bascule span. The top plate shall also be able to hold the final epoxy overlay thickness of 1/4 inch to 1/2 inch within the boundaries of the individual grating panel during epoxy curing period.

F. Finish: Gratings, top plates, all fasteners and connections shall be Hot-Dip Galvanized per ASTM A123. Contractor shall ensure that the top surface of the top plate shall be prepared as per "Surface Preparation" subsection of the special provisions for Epoxy Overlay System prior to placement of the epoxy overlay.

Construction:

A. Demolition
1. Remove all existing top plate, grid deck and supports/attachment in the sidewalks of the bascule spans at BR 3-153 and BR 3-154 while taking precaution to avoid any damage to the existing bascule girders, sidewalk railing elements and grid deck supports to remain.
2. Any damage shall be remedied to the satisfaction of the Engineer at no additional cost to the owner.
3. No sections of the sidewalk shall be removed and left open, as a potential hazard to the public, when the contractor is not actively working in that area.

B. Prior to grating installation, contractor shall inspect supports for correct alignment and conditions for proper attachment of the new anchor blocks and support of the gratings. Any inconsistencies between contract drawings and supporting structure deemed detrimental to grating placement shall be reported in writing to the Engineer prior to placement.
C. Install attachments and new grating in accordance with approved shop drawings and standard installation clearances as recommended by ANSI/NAAMM MBG-532-09 Heavy Duty Metal Bar Grating Manual.

Method of Measurement:

Walkway Grating will be measured per square foot (SF), complete and fully functional in place and includes all devices, materials, labor, tools, equipment, quality control activities, and incidentals necessary to complete the work in accordance with the Special Provisions and Plans.

Basis of Payment:

All costs associated with the Walkway Grating work including materials, labor, tools and equipment will be paid under the unit price bid per square foot for Item 615506 - Walkway Grating. Such payment is full compensation for furnishing and installing all materials, equipment, labor, and all incidentals required to complete the work as specified.

4/12/2018

625500 - EPOXY OVERLAY SYSTEM

Description:

This work consists of removal of existing epoxy overlay, and furnishing and field application of new epoxy overlay system at the following locations, in accordance with the contract drawings:

a. The new sidewalks at BR 3-153 (Rehoboth Ave. bridge): ¼ to ½ inch thick
b. The new sidewalks at BR 3-154 (Savannah Rd. bridge): ¼ to ½ inch thick
c. The existing floorbeams of BR 3-154 (Savannah Rd. bridge): 2½ to 3 inch thick

The epoxy overlay as the walking surface of the sidewalks and above the floorbeams is for the purpose of providing a non-skid surface and complete waterproofing. The overlay system shall be formulated and applied to withstand continuous use, extreme changes in weather conditions, and deformations due to loading and temperature changes, without delamination from the steel surface. The epoxy overlay system shall be steel-compatible, resistant to UV light, freeze-thaw cycles, moisture, and chemicals.

Materials:

The epoxy overlay system shall be free of any fillers or volatile solvents and shall be formulated to provide a simple volumetric mixing ratio of two components such as one to one or two to one by volume. The epoxy overlay system shall be formulated to provide flexibility in the system without any sacrifice of the hardness, chemical resistance or strength of the system. When the system is mixed at the appropriate ratio, the cured resin shall conform to the following requirements.

Property	Requirement	Test Method
Pot Life	15 to 45 min @ 70°F	ASTM C881/AASHTO T237
Tensile Elongation	45 to 70%	ASTM D638
Max. Water Absorption	0.75%	ASTM D570

The following manufacturers of epoxy overlay system are preferred and shall be submitted to the Engineer for approval.

a. Transpo Industries - T48 overlay system
b. Olin Epoxy
c. DOW Chemicals - Traffideck overlay system
d. or approved equal

The color of the epoxy overlay shall match the existing overlay or as approved by the Engineer. The test patches or other samples may be used for evaluation and selection of color.

Construction:

A. Demolition

1. Remove all existing overlays in the sidewalks of the bascule spans at BR 3-153 and BR 3-154 while taking precaution to avoid any damage to the existing bascule girders and sidewalk railing elements. Any damage shall be remedied at no additional cost to the owner.
2. Remove all existing overlays in the grid deck above floorbeams at BR 3-154 while taking precaution to avoid any damage to the existing or new grid deck elements. Any damage shall be remedied at no additional cost to the owner.

B. Surface Preparation

1. The top plates of new sidewalks (at BR 3-153 and BR 3-154) and existing grid deck above floorbeams (at BR 3-154) which will receive the new epoxy overlay system, shall be cleaned in accordance with SSPC-SP10 to remove all dirt, debris, rust, and scale prior to application of new overlay. Areas of existing grid deck, curb, sidewalk rails and sidewalk posts in the vicinity of the proposed overlay shall be protected from the blast cleaning operation.
2. Prior to placement of epoxy, remove and capture all blast cleaning media, dust, dirt and other loose material from the blasting operation.
3. Upon completion of surface preparation, perform bond testing of the epoxy overlay material on two test patches of 2ft x 2ft area. The tensile rupture strength of both test patches shall meet the manufacturer's recommendations.
4. If the cleaning method, materials and installation procedure do not produce acceptable test result, the contractor must remove failed test patches, make the necessary adjustments, and retest all patches at no additional cost to the owner until satisfactory test results are obtained. Test locations shall be removed to the original steel substrate prior to placement of the final overlay.

C. Equipment

1. Equipment for installing the overlay shall be as per manufacturer's recommendations.

D. Application

1. Handling and mixing of the epoxy resin and other hardening agents shall be performed in a safe manner to achieve the desired result in accordance with manufacturer's recommendations as approved by the engineer. Epoxy overlay materials shall not be placed when weather or surface conditions are such that the material cannot be properly handled, placed, spread and cured within the specified requirements of the manufacturer and traffic control.
2. The application rates of the liquid and grit/stone shall be as recommended by the manufacturer. The manufacturer's application instructions shall be followed for installation of new epoxy overlay.
3. At the sidewalks, the final overlay thickness shall be a ¼ inch over a minimum of 75% of the overlay area. At the floorbeams, the final overlay thickness shall be 2½ inches over a minimum of 75% of the overlay area.
4. Traffic shall not be allowed on the overlay surface during the curing period.
5. In the event the contractor's operations damages the epoxy overlay, the contractor shall remove the damaged areas and replace with new overlay in accordance with this Specification at no additional cost to the Owner.

Method of Measurement:

Epoxy Overlay System will be measured by the square yard per inch (SYIN) thickness as per the nominal specified thickness on the Plans.

Basis of Payment:

Payment for the Epoxy Overlay System will be made at the Contract Unit Price per square yard per inch bid for Item 625500 - Epoxy Overlay System, complete and fully functional in place and includes all devices, materials, labor, tools, equipment, quality control activities, and incidentals necessary to complete the work in accordance with the Special Provisions and Plans.

4/12/2018

711500 - ADJUST AND REPAIR EXISTING SANITARY MANHOLE

Description:

This work consists of adjusting and repairing existing sanitary manholes in accordance with notes and details on the Plans and as directed by the Engineer.

Materials and Construction Methods:

Materials and construction methods shall conform to the applicable requirements of Section 711 of the Standard Specifications, and the Standard Specifications of the owner of the sewer system. If there is a conflict between the Department's Specifications and the Specifications of the owner, the latter will prevail.

Method of Measurement and Basis of Payment:

The method of measurement and basis of payment for the item shall be made in accordance with Subsections 711.04 and 711.05 of the Standard Specifications.

1/4/17

763501 - CONSTRUCTION ENGINEERING

Description:

This work consists of construction lay out including; stakes, lines and grades as specified below. Subsection 105.10 Construction Stakes, Lines and Grades of the Standard Specifications is voided.

Based on contract plans and information provided by the Engineer, the Contractor shall stake out right-of-way and easements lines, limits of construction and wetlands, slopes, profile grades, drainage system, centerline or offset lines, benchmarks, structure working points and any additional points to complete the project.

The Engineer will only establish the following:

(a) Original and final cross-sections for borrow pits.
(b) Final cross-sections: Top and bottom pay limit elevations for all excavation bid items that are not field measured by Construction inspection personnel. The Contractor shall notify the Engineer when these pay limit elevations are ready and allow for a minimum of two calendar days for the Engineer to obtain the information.
(c) Line and grade for extra work added on to the project plans.

Equipment. The Contractor shall use adequate equipment/instruments in a good working order. He/she shall provide written certification that the equipment/instrument has been calibrated and is within manufacturer's tolerance. The certification shall be dated a maximum of 9 months before the start of construction. The Contractor shall renew the certification a minimum of every 9 months. The equipment/instrument shall have a minimum measuring accuracy of [3mm+2ppmxD] and an angle accuracy of up to 2.0 arc seconds or 0.6 milligons. If the Contractor chooses to use GPS technology in construction stakeout, the Contractor shall provide the Engineer with a GPS rover and Automatic Level for the duration of the contract. The GPS rover shall be in good working condition and of similar make and model used by the Contractor. The Contractor shall provide up to 8 hours of formal training on the Contractor's GPS system to a maximum of four Engineer's appointees (DELDOT Construction Inspectors). At the end of the contract, the Engineer will return the GPS rover to the Contractor. If any of the equipment/instruments are found to be out of adjustment or inadequate to perform its function, such instrument or equipment shall be immediately replaced by the Contractor to the satisfaction of the Engineer. Choosing to use GPS technology does not give the contractor authority to use machine control.- Construction Engineering (GPS) Machine Control Grading shall only be used if noted in the General Notes in the plan set outlining the available files that will be provided to the Contractor and "the Release for delivery of documents in electronic form to a contractor" are signed by all parties prior to delivery of any electronic files. Only files designated in the General Notes shall be provided to the contractor. If machine control grading is allowed on the project see the "machine control" section of this specification. GPS technology and machine control technology shall not be used in the construction of bridges.

Engineering/Survey Staff. The Contractor shall provide and have available for the project an adequate engineering staff that is competent and experienced to set lines and grades needed to construct the project. The engineering personnel required to perform the work outlined herein shall have experience and ability compatible with the magnitude and scope of the project. Additionally, the Contractor shall employ an engineer or surveyor licensed in the State of Delaware to be responsible for the quality and accuracy of the work done by the engineering staff. When individuals or firms other than the Contractor perform any professional services under this item, that work shall not be subject to the sub contracting requirements of Subsection 108.01 of the Standard Specifications. The Contractor shall assume full responsibility for any errors and/or omissions in the work of the engineering staff described herein. If construction errors are caused due to erroneous work done under Construction Engineering the Contractor accepts full responsibility, no matter when the error is discovered. Consideration will not be given for any extension of contract time or additional compensation due to delays, corrective work, or additional work that may result from faulty and erroneous construction stakeout, surveying, and engineering required by this specification.

Construction Methods:

Performance Requirements:

(a) Construction Engineering shall include establishing the survey points and survey centerlines; finding, referencing, offsetting the project control points; running a horizontal and vertical circuit to verify the precision of given control points. Establishing plan coordinates and elevation marks for culverts, slopes, subbase, subsurface drains, paving, subgrade, retaining walls, and any other stakes required for control lines and grades; and setting vertical control elevations, such as footings, caps, bridge seats and deck screed. The Contractor shall be responsible for the preservation of the Department's project control points and benchmarks. The Contractor shall establish and preserve any temporary control points (traverse points or benchmarks) needed for construction. Any project control points (traverse points) or benchmarks conflicting with construction of the project shall be relocated by the Contractor. The Contractor as directed by the Engineer must replace any or all stakes that are destroyed at any time during the life of the contract. The Contractor shall re-establish centerline points and stationing prior to final cross-sections by the Engineer. The Vertical Control error of closure shall not exceed 0.035 ft times. The Horizontal Control precision ratio shall have a minimum precision of 1:20,000 feet of distance traversed prior to adjustment.

(b) The Contractor shall perform construction centerline layout of all roadways, ramps and connections, etc. from project control points set by the Engineer. The Contractor using the profiles and typical sections provided in the plans shall calculate proposed grades at the edge of pavement or verify information shown on Grades and Geometric sheets.

(c) The Contractor shall advise the Engineer of any horizontal or vertical alignment revisions needed to establish smooth transitions to existing facilities. The Contractor must immediately bring to the attention of the Engineer any potential drainage problem within the project limits. The Engineer must approve any proposed variation in profile, width or cross slope.

(d) The Contractor shall establish the working points, centerlines of bearings on bridge abutments and on piers, mark the location of anchor bolts to be installed, check the elevation of bearing surfaces before and after they are ground and set anchor bolts at their exact elevation and alignment as per Contract Plans. Before completion of the fabrication of beams for bridge superstructures, the Contractor shall verify by accurate field measurements the locations both vertically and horizontally of all bearings and shall assume full responsibility for fabricated beams fitting and bearing as constructed. After beam erection and concurrently with the Department project surveyors or their designated representative, the Contractor shall survey top of beam elevations at a maximum of 10-ft stations and compute screed grades. These shall be submitted to the Engineer for review and approval before the stay in place forms are set. Construction stakes and other reference control marks shall be set at sufficiently frequent intervals to assure that all components of the structure are constructed in accordance with the lines and grades shown on the plans. The Contractor will be responsible for all structure alignment control, grade control and all necessary calculations to establish and set these controls.

(e) The Contractor, using contract plans, shall investigate proposed construction for possible conflicts with existing and proposed utilities. The Contractor shall then report such conflicts to the Engineer for resolution. All stakes for utility relocations, which will be performed by others, after the Notice to Proceed has been given to the Contractor, shall be paid for under item 763597
- Utility Construction Engineering.

(f) The Contractor shall be responsible for the staking of all sidewalk and curb ramp grades in accordance with the plans and the Departments Standard Construction Details. The Contractor shall review the stakeout with the Engineer prior to construction. The Engineer must approve any deviation from plans, Department Standard Construction Details and Specifications in writing. The Contractor shall be responsible for any corrective actions resulting from problems created by adjustments if they fail to obtain such approval.

(g) If wetland areas are involved and specifically defined on the Plans the following shall apply:

i. It is the intent of these provisions to alert the Contractor, that he/she shall not damage or destroy wetland areas, which exist beyond the construction limits. These provisions will be strictly enforced and the Contractor shall advise his/her personnel and those of any Subcontractor of the importance of these provisions.
ii. All clearing operations and delineation of wetlands areas shall be performed in accordance with these Special Provisions. Before any clearing operation commences the Contractor shall demarcate wetlands at the Limits of Construction throughout the entire project as shown on the Plans labeled as Limits of Construction or Wetland Delineation to the satisfaction of the Engineer.
iii. The material to be used for flagging the limits of construction shall be orange vinyl material with the wording "Wetland Boundary" printed thereon. In wooded areas, the flagging shall be tied on the trees, at approximate 20-foot intervals through wetland areas. In open field and yard areas that have been identified as wetlands, 6 foot posts shall be driven into the ground at approximate 50-foot intervals and tied with the flagging. The flagging shall extend approximately 12 inches in length beyond the post. Posts shall be oak with cross sectional dimensions of 1 ½ inches to 2 inches by 1 ½ inches to 2 inches or ¼ inch rebar.
iv. If the flagging has been destroyed and the Engineer determines that its use is still required, the Contractor shall reflag the area at no cost to the Department. If the Contractor, after notification by the Engineer that replacement flagging is needed, does not replace the destroyed flagging within 48 hours, the Engineer may proceed to have the area reflagged. The cost of the reflagging by the Engineer will be charged to the Contractor and deducted from any monies due under the Contract.
v. At the completion of construction, the Contractor shall remove all posts and flagging.
vi. The Contractor shall be responsible for any damages to wetlands located beyond the construction limits, which occurs from his/her operations during the life of the Contract. The Contractor shall restore all temporarily disturbed wetland areas to their preconstruction conditions. This includes restoring bank elevations, streambed and wetland surface contours and wetlands vegetation disturbed or destroyed. The expense for this restoration shall be borne solely by the Contractor.

(h) Whenever the Engineer will be recording data for establishment of pay limits, the Contractor will be invited to obtain the data jointly with the Engineer's Survey Crew(s) in order to agree with the information. If the Contractor's representative is not able to obtain the same data, then the information obtained by the Engineer shall be considered the information to be used in computing the quantities in question.

Submittals. All computations necessary to establish the exact position of all work from the control points shall be made and preserved by the Contractor. All computations, survey notes, electronic files, and other records necessary to accomplish the work shall be made available to the Department in a neat and organized manner at any time as directed by the Engineer. The Engineer may check all or any portion of the stakeout survey work or notes made by the Contractor and any necessary correction to the work shall be made as soon as possible. The Contractor shall furnish the Engineer with such assistance as may be required for checking all lines, grades, and measurements established by the Contractor and necessary for the execution of the work. Such checking by the Engineer shall not relieve the Contractor of his/her responsibility for the accuracy or completeness of the work. Copies of all notes must be furnished to the engineer at the completion of the project.

The Contractor shall submit any of the following at the Engineer's request:

(a) Proposed method of recording information in field books to ensure clarity and adequacy.
(b) A printout of horizontal control verification, as well as coordinates, differences and error of closure for all reestablished or temporary Control Points.
(c) A printout of vertical control verification, with benchmark location elevation and differences from plan elevation.
(d) Sketch of location of newly referenced horizontal control, with text printout of coordinates, method of reference and field notes associated with referencing control - traverse closure report.
(e) Description of newly established benchmarks with location, elevation and closed loop survey field notes - bench closure report
(f) All updated electronic and manuscript survey records.

(g) Stakeout plan for each structure and culvert.
(h) Computations for buildups over beams, screed grades and overhang form elevations.
(i) A report showing differences between supplied baseline coordinates and field obtained coordinates, including a list of preliminary input data.
(j) Any proposed plan alteration to rectify a construction stakeout error, including design calculations, narrative and sealed drawings.
(k) Baseline for each borrows pit location.
(l) Detailed sketch of proposed overhead ground mounted signs or signals showing obstructions that may interfere with their installation.
(m) Copies of cut sheets.

Machine Control Grading

This Section of the specification shall only be used if machine control is authorized for use on the project.

Description:

This specification contains the requirements for grading operations utilizing Global Positioning Systems (GPS).

Use of this procedure and equipment is intended for grading the subgrade surface; it is not intended for the use in constructing final surface grades.

The Contractor may use any manufacturer's GPS machine control equipment and system that results in achieving the grading requirements outlined in section 202 of the standard specifications. The Contractor shall convert the electronic data provided by the Department into the format required by their system. The Department will only provide the information outlined in this document and no additional electronic data will be provided.

The Contractor shall perform at least one 500 foot test section with the selected GPS system to demonstrate that the Contractor has the capabilities, knowledge, equipment, and experience to properly operate the system and meet acceptable tolerances. The engineer will evaluate and make the determination as to whether additional 500 foot test sections are required. If the Contractor fails to demonstrate this ability to the satisfaction of the Department, the Contractor shall construct the project using conventional surveying and staking methods.

Materials:

All equipment required to perform GPS machine control grading, including equipment needed by DelDOT to verify the work, shall be provided by the Contractor and shall be able to generate end results that are in accordance with the requirements of Division 200 - EARTHWORK of the Standard Specifications.

Construction:

A. DelDOT Responsibilities:

1. The Department will set initial vertical and horizontal control points in the field for the project as indicated in the contract documents, (plans set). If the Contractor needs to establish new control points they shall be traversed from existing control points and verified to be accurate by conventional surveying techniques.

2. The Department will provide the project specific localized coordinate system.

3. The Department will provide data in an electronic format to the Contractor as indicated in the General Notes.

a. The information provided shall not be considered a representation of actual conditions to be encountered during construction. Furnishing this information does not relieve the Contractor from the responsibility of making an investigation of conditions to be encountered including, but not limited to site visits, and basing the bid on information obtained from these investigations, and the professional interpretations and judgments of the Contractor. The Contractor shall assume the risk of error if the information is used for any purpose for which the information is not intended.

b. Any assumption the Contractor makes from this electronic information shall be at their risk. If the Contractor chooses to develop their own digital terrain model the Contractor shall be fully responsible for all cost, liability, accuracy and delays.

c. The Department will develop and provide electronic data to the Contractor for their use as part of the contract documents in a format as indicated in the General

Notes. The Contractor shall independently ensure that the electronic data will function in their machine control grading system.

4. The Files that are provided were originally created with the computer software applications MicroStation (CADD software) and INROADS (civil engineering software). The data files will be provided in the native formats and other software formats described below. The contractor shall perform necessary conversion of the files for their selected grade control equipment. The Department will furnish the Contractor with the following electronic files:

a. CAD files

i. Inroads -Existing digital terrain model (.DTM)
ii. Inroads -Proposed digital terrain model (.DTM)
iii. Microstation -Proposed surface elements - triangles

b. Alignment Data Files:
i. ASCII Format

5. The Engineer shall perform spot checks of the Contractor's machine control grading results, surveying calculations, records, field procedures, and actual staking. If the Engineer determines that the work is not being performed in a manner that will assure accurate results, the Engineer may order the Contractor to redo such work to the requirements of the contract documents, and in addition, may require the Contractor to use conventional surveying and staking, both at no additional cost to the Department.

B . Contractor's Responsibilities

1. The Contractor shall provide the Engineer with a GPS rover and Automatic Level, for use during the duration of the contract. At the end of the contract, the GPS rover and Automatic Level will be returned to the Contractor. The Contractor shall provide a total of 8 hours of formal training on the Contractor's GPS machine control system to the Engineer and up to three additional Department appointees per rover.

2. The Contractor shall review and apply the data provided by the Department to perform GPS machine control grading.

3. The Contractor shall bear all costs, including but not limited to the cost of actual reconstruction of work, that may be incurred due to application of GPS machine control grading techniques. Grade elevation errors and associated corrections including quantity adjustments resulting from the contractor's use of GPS machine control shall be at no cost to the Department.

4. The Contractor shall convert the electronic data provided by the Department into a format compatible with their system.

5. The Contractor's manipulation of the electronic data provided by the Department shall be performed at their own risk.

6. The Contractor shall check and if necessary, recalibrate their GPS machine control system at the beginning of each workday in accordance with the manufacturer's recommendations, or more frequently as needed to meet the requirements of the project.

7. The Contractor shall meet the accuracy requirements as detailed in the Standard Specifications.

8. The Contractor shall establish secondary control points at appropriate intervals and at locations along the length of the project. These points shall be outside the project limits and/or where work is performed. These points shall be at intervals not to exceed 1000 feet. The horizontal position of these points shall be determined by conventional survey traverse and adjustments from the original baseline control points. The conventional traverse shall meet or exceed the Department's Standards. The elevation of these control points shall be established using differential leveling from the project benchmarks, forming a closed loop. A copy of all new control point information including closure report shall be provided and approved by the Engineer prior to construction activities. The Contractor shall be responsible for all errors resulting from their efforts and shall correct deficiencies to the satisfaction of the Engineer and at no additional cost to the Department.

9. The Contractor shall provide stakes at all alignment control points, at every 500 foot stationing, and where required for coordination activities involving environmental agencies and utility companies at the Contractor's expense. Work that is done solely for utility companies and that is beyond the work performed under item 763501 - Construction shall follow and be paid for under item 763597 -Utility Construction Engineering.

10. The Contractor shall at a minimum set hubs at the top of finished grade at all hinge points on the cross section at 500 foot intervals on the main line and at least 4 cross sections on side roads and ramps as directed by the engineer or as shown on the plans. Placement of a minimum of 4 control points outside the limits of disturbance for the excavation of borrow pits, Stormwater Management Ponds, wetland mitigation sites etc. These control points shall be established using conventional survey methods for use by the Engineer to check the accuracy of the construction.

11. The Contractor shall preserve all reference points and monuments that are identified and established by the Engineer for the project. If the Contractor fails to preserve these items the Contractor shall reestablish them at no additional cost to the Department.

12. The Contractor shall provide control points and conventional grades stakes at critical points such as, but not limited to, PC's, PT's, superelevation points, and other critical points required for the construction of drainage and roadway structures.

13. No less than 2 weeks before the scheduled preconstruction meeting, the Contractor shall submit to the Engineer for review a written machine control grading work plan which shall include the equipment type, control software manufacturer and version, and proposed location of the local GPS base station used for broadcasting differential correction data to rover units.

14. The Contractor shall follow the guidelines set forth in the "Geometric Geodetic Accuracy Standards and Specifications for Using GPS Relative Positioning Techniques" and follow a minimum of Second Order Class 1, (2-I) classification standards.

Automated equipment operations have a high reliance on accurate control networks from which to take measurements, establish positions, and verify locations and features. Therefore, a strong contract control network in the field which is the same or is strongly integrated with the project control used during the design of the contract is essential to the successful use of this technology with the proposed Digital Terrain Model (DTM). Consistent and well designed site calibration for all machine control operations (as described below under Contract Control Plan) are required to ensure the quality of the contract deliverables.

The Contract Control Plan is intended to document which horizontal and vertical control will be held for these operations. Continued incorporation of the Base Station(s) as identified in the Contract Control Plan is essential to maintaining the integrity of positional locations and elevations of features. The Contract Control Plan shall be submitted to the Department for review and approval by the Departments Survey Section 3 weeks prior to the start of any machine control work. The Contractor shall operate and maintain all elements of the Machine Grade Control continuously once the operations begin until otherwise approved by the Engineer.

Contract Control Plan:

The Contractor shall develop and submit a Contract Control Plan for all contracts which use Machine Control Grading. Contract control includes all primary and secondary horizontal and vertical control which will be used for the construction contract. Upon the Contractor's completion of the initial survey reconnaissance and control verification, but prior to beginning primary field operations, the Contractor shall submit a Contract Control Plan document (signed and sealed by the Delaware licensed Land Surveyor or Delaware Professional Engineer who oversees its preparation) for acceptance by the
Engineer, which shall include the following:

1. A control network diagram of all existing horizontal and vertical control recovered in the field as contract control.

2. Include a summary of the calculated closures of the existing control network, and which control has been determined to have been disturbed or out of tolerance from its original positioning.

3. An explanation of which horizontal and vertical control points will be held for construction purposes. If necessary include all adjustments which may have been made to achieve required closures.

4. An explanation of what horizontal and vertical control (including base stations) was set to accomplish the required stakeout or automated machine operation. Include how the position of these new control points was determined.

5. Describe the proposed method and technique (technology and quality control) for utilizing the control to establish the existing and/or proposed feature location and to verify the completed feature location and/or measured quantity.

6. A listing of the horizontal and vertical datums to be used and the combined factor to be used to account for ellipsoidal reduction factor and grid scale factor.

7. If the Contractor chooses to use machine control as a method of measuring and controlling excavation, fill, material placement or grading operations as a method of measuring and controlling excavation, fill, material placement or grading operations, the Contractor Control Plan shall include the method by which the automated machine guidance system will initially be site calibrated to both the horizontal and vertical contract control, and shall describe the method and frequency of the calibration to ensure consistent positional results.

8. Issues with equipment including inconsistent satellite reception of signals to operate the GPS machine control system will not result in adjustment to the "Basis of Payment" for any construction items or be justification for granting contract time extension.

Method of Measurement:

The quantity of Construction Engineering will not be measured.

Basis of Payment:

Payment will be made at the Lump Sum price bid for the item "Construction Engineering". The price bid shall include the cost of furnishing all labor, equipment, instruments, stakes and other material necessary to satisfactorily complete the work as herein described under this item for all roads and structures that are a part of the contract. Adjustment in payment will be made for the deletion or addition of work not shown in the contract documents.

Monthly payment will be made under this item in proportion to the amount of work done as determined by the Engineer.

2/28/2018

763503 - TRAINEE

Description:

The item shall consist of providing training in the construction crafts in accordance with the requirements stated in the General Notices of this proposal under the Standard Federal Equal Employment Opportunity Construction Contract Specifications (Executive Order 11246).

Basis of Payment:

The payment for the item shall be made at a fixed rate of $.80 per hour toward the hourly rate of the trainee.

8/15/17

763508 - PROJECT CONTROL SYSTEM DEVELOPMENT PLAN
763509 - CPM SCHEDULE UPDATES AND/OR REVISED UPDATES

Description:

The Contractor shall plan, schedule and construct the Project by using a Critical Path Method Project Schedule (CPM) meeting the requirements of these specifications. Use the CPM for coordinating and monitoring the Work specified in the Contract Documents including all activities of Subcontractors, vendors, suppliers, utilities, railroads, the Department, and all other parties associated with the construction of the Contract. Include all Work in the CPM; including but not limited to submittals, major procurement, delivery, and construction activities. Include all activities, including bid items, quantified in the Contract Documents. Base the CPM upon the entirety of the Contract Documents. Utilize CPM software that generates files compatible with Primavera P6 Project Management Release: 7.0.0.

Scheduling Representative:

Designate a scheduling representative prior to submission of the Original Critical Path Method Project Schedule (OCPM). The scheduling representative is the person primarily responsible for development and maintenance of the CPM schedule; the Contractor's representative in all matters regarding the schedule; and the Contractor's designated attendee for all schedule related meetings. The scheduling representative shall also be knowledgeable of the status of all parts of the Work throughout the duration of the Project. Replacement of the scheduling representative will require written approval from the Engineer.

Submit the qualifications of the scheduling representative to the Engineer for approval. This approval is required before the OCPM will be accepted. The scheduling representative shall have at least three years of verifiable experience for preparing and maintaining CPM project schedules on Contracts of similar size and complexity.

Critical Path, Project Completion Date, and Float:

The critical path is defined as the series of activities in a CPM that has the longest path in time. The submitted activity sequence and durations must generate a CPM with only one critical path. Divide Project wide activities such as Maintenance of Traffic, Construction Engineering, or Temporary Erosion Control that, by their nature, generate long durations and complement other activities into "establish" and "conclude" activities to prevent this type of Work from occupying a significant portion of the critical path.

The project start date, or initial data date, of the original CPM shall be the first chargeable day of Work. Nonproductive Work and administrative activities may begin and/or end prior to the project start date. The Original CPM must use all of the Contract Time and contain a critical path containing exactly zero float. Early completion schedules are not permitted. The schedule ending date of the Original CPM that uses all of the Project Time is the contract completion date.

Total Float is the difference between the schedule's finish date and the contract completion date. Free float is the difference in time between an activity's early finish and late finish. Free float is a shared commodity for the use of the Department and the Contractor and is not for the exclusive use or benefit of either party. Both parties have the full use of free float until depleted.

Submittal of the OCPM; the Start of Work and the Schedule of Record:

Complete and submit the proposed original CPM schedule (OCPM) database and the written narrative (WN) within 30 calendar days after Contract is Awarded. The WN is a description of any elements of the Schedule that deviate from the proposed construction sequence shown in the Contract Documents. Submit the OCPM in CPM format fully compatible with Primavera P6 Project Management Release: 7.0.0 by email or CD ROM as a single compressed database in CPM format.

The Engineer will complete the review of the OCPM within 30 calendar days after submittal. If required, a Joint Review Conference will be convened at which time the Engineer and Contractor may make corrections

and adjustments to the proposed OCPM. If a revision is necessary due to the Engineer's review or the Joint Review Conference, submit the proposed revision within seven calendar days after receiving the Engineer's review comments or within seven calendar days after the date of the Joint Review Conference, whichever is the latest. Make revisions in accordance with the requirements for the OCPM. The Engineer will respond to the revised OCPM within seven calendar days after receipt. Clearly identify each submittal and resubmittal for clarity by labeling "2nd Draft", "3rd Draft", etc.

Do not start any Work until the OCPM is accepted. If the Engineer is ready to issue a Notice to Proceed but the OCPM is not yet accepted, the Engineer may issue the NTP and start Contract Time, but forbid Work to begin until the OCPM is accepted. The Engineer may partially accept a OCPM and allow Work to begin if the required corrections to the OCPM are minor, but the Engineer will not accept submittals that do not show the complete schedule. The Engineer will not pay any estimates until the OCPM is partially accepted. Once the OCPM is partially accepted, the Engineer will pay the first estimate. If the Contractor fails to make a good faith effort to address the Engineer's comments before the second estimate is due for payment, the Engineer will not pay the second estimate until a good faith effort is made by the Contractor to comply. The Engineer may not withhold an estimate payment if, within the estimate period in question, the Engineer has failed to provide timely review comments in response to the Contractor's submittal. The Engineer may, however, withhold the payment of subsequent estimates if the Contractor fails to make a good faith effort to address the Engineer's comments. Upon issuance of the Notice to Proceed, the start date utilized in the OCPM will be adjusted to comply with the first chargeable day of Work. Any delay in starting Work caused by the acceptance of the OCPM by the Engineer will not be considered as a basis for any adjustment in the Contract amount or time. For Contracts that have fast-tracked starts, the Engineer and the Contractor may agree to alter the response times and approval dates listed above. Upon notification that the OCPM has been accepted, the corrected copy will become the CPM of record. The CPM of record shall be the Contractor's work plan for completing the entire Contract as specified in the Contract Documents.

Requirements for the OCPM:

The format of the OCPM database shall be the precedence diagram method with days as the planning unit and shall be based on Calendar Days. Use the Department's partially predetermined coding structure (CS) that is furnished by the Engineer.

Activity Sequencing. Activity sequence must be logical and representative of the Contractor's order of the Work. Successors and predecessors determine the schedule logic or activity sequence. A given activity cannot start until all of the given activity's predecessors have been completed. Use only finish to start dependency relationships (links); do not use lag times without approval from the Engineer. The Engineer may request that the Contractor resequence the activities to reflect realistic job logic. When scheduling using multiple resources, each resource unit shall have a corresponding activity. Durations of activities include all the time necessary to complete the activity including, but not limited to, Contractor's non-work periods (other than those shown on the calendars), reasonably foreseeable inclement weather, weekends and holidays. Base schedule calculations on retained logic, contiguous durations, and total float as finish float.

Activity Resources. Sequence activities to reflect resource apportionment. Logically connect and code each activity to reflect the crew (resource) performing the operation. Submit a summary list of crews, their crew codes, and their operation(s) with each schedule submission, unless unchanged. Identify responsibility for each activity. Identify Subcontractors, DBE's, utilities and Work performed by others that affects the Schedule.

Breakdown and Durations of Activities. An individual activity is required for each construction element or each activity not under the control of the Contractor that affects the sequence or progress of the Work. The Engineer reserves the right to require additional breakdown of the Work activities at any time. Each activity must be identified by a name, symbol and coding, and shall have a duration, sequence, responsibility and resource(s). Choose activity names that are descriptive and identify single construction elements. Activity symbols, or ID's, shall be unique and systematic.

Activity types must be either "task", "start milestone", or "finish milestone". Do not use "hammock" type activities. Date constraints, float and duration constraints, and/or flags for activities are not permitted.

Assign a reasonable duration to each activity representative of its scope. Durations may not exceed 14 calendar days unless approved by the Engineer. Determine the duration of each activity by using productivity rates based on Calendar Days.

Include the preparation and approval of Working Drawings as activities. Include phasing (staging) milestones as activities. Correlate phasing milestones with the sequence of construction provided in the Contract Documents. Use a separate start and finish milestone activity to delineate each phase (stage).

*Utility Work***.** Include all Work performed by utilities on the Project as activities in the OCPM. Include each utility item of Work shown in the Contract's Utility Statement as an activity. Durations for utility activities shall be the same as the durations shown in the Utility statement for each activity unless otherwise approved by the Engineer.

*Calendars***.** Assign a calendar to each activity in the schedule. Use a minimum of 6 calendars, when applicable: (1) Full Schedule; (2) Permit Requirements; (3) Winter Condition; (4) Concrete Work; (5) Asphalt Paving Work; and (6) Nighttime Asphalt Paving Work. Use additional calendars if needed. Calendar non-work periods shall reflect the average Delaware weather history for the jobsite and the restrictions identified in the Contract Documents. The Contractor may choose perform Work during an activity's calendar non-work period at no additional cost to the Department if weather conditions are favorable for such Work and the Work does not violate a set forth in the Contract Documents. The maximum allowable non-work period for each calendar is set forth below. The Contractor may choose to shorten non-work periods at his/her discretion.

CALENDAR	MAXIMUM NON-WORK PERIOD
Full Schedule	None
Winter Condition	December 1 through March 15
Concrete Work	December 1 through March 15
Asphalt Paving	November 15 through March 15
Nighttime Asphalt Paving	October 15 through April 30

Written Narrative (WN). Provide a written narrative (WN) as part of the OCPM explaining the following:

(a) Relationships between activities not obviously identified
(b) Equipment usage and limitations.
(c) Manpower usage and limitations.
(d) Use of additional shifts and overtime.
(e) Activity codes, abbreviations, and activity identification system.
(f) All calendars utilized in the CPM and the basis of determining each non-work period
(g) All abbreviations.
(h) Use of calendars.
(i) Any other conditions that affect the schedule and are not readily discernible in the database.

CPM Updates:

Provide monthly updates to the CPM of record. Meet with the Engineer once a month prior to submitting the update to review the status of the schedule's activities. Prepare an updated list of activities showing all of the actual start and actual finish for each of the schedule's activities so that both parties can agree on the dates. Use the dates that were agreed upon in the meeting to status the CPM of record and submit the updated schedule to the Engineer for approval. Assign a unique file name to each update (Number/version). The data date of the update shall be the next day after the end of the update period. As part of the monthly update, submit a written description that identifies any delays or disruptions to the schedule experienced during the period of an update, any change in manpower or equipment, and any potential delays to the completion date of the schedule.

Do not include any revisions to the CPM without prior approval. Failure to submit complete updates in a timely manner may result in the withholding of estimates by the Engineer. The Engineer agrees to refrain from withholding estimates unless the Contractor is habitually late in providing updates, is more than four weeks late in submitting an update or has failed to submit an update that is part of a resolution to a serious problem that must be addressed immediately.

Revisions to the Schedule of Record:

Revisions are defined as any changes to the database other than status updates, log entries and moving the data date. Discuss any proposed revisions to the CPM verbally with the Engineer. If the revision is minor in nature, the Engineer may allow the revision to be included on the next Update of the CPM. If the Engineer determines that the revision is not minor in nature, submit the proposed revision for review and approval prior to deviating from the approved CPM. When a revision to the CPM is required due to changes in the Contract initiated by the Engineer, immediately contact the Engineer to discuss the changes. The Engineer may allow a deviation from the approved CPM for specific mitigating activities.

The Engineer may direct the Contractor to revise the schedule of record at the Contractor's expense if: the critical path has less than minus ten (-10) Calendar Days of total float due to the Contractor's failure to perform the Work in accordance with the schedule; the Contractor requests to re-sequence the Work; and/or the Contractor has performed a significant amount of Work out of sequence. The Engineer may direct the Contractor to revise the schedule for any other reason; and such a revision will be paid at the unit cost for a CPM Revision.

The Engineer will review and respond to the proposed revision within 7 Calendar Days after receipt. Resubmit, if required, within seven calendar days after receipt of the Engineer's review comments. The Engineer reserves the right to reject any proposed revision that adversely impacts the Department, utilities, or other concerned parties.

Extensions of Contract Time and/or Incentive/Disincentive Dates.

Make requests for extension of Contract time in writing and subject to the notice and timeliness of submission provisions as provided for elsewhere in the Contract. Requests for an extension of Contract time or change in an incentive/disincentive date will be evaluated by the Engineer's analysis of the CPM of record and any proposed revision submitted. Include in the request a written narrative of the events that impacted the schedule and a detailed explanation of why the Contractor cannot meet the requirements of the schedule of record. Only delays to activities that affect the Contract completion date or will be considered for an extension of Contract time. Only delays to activities that affect the completion duration of an incentive/disincentive period will be considered for an extension of an incentive/disincentive completion date. The extension of the specified Contract completion date or incentive/disincentive date will be based upon the number of Calendar Days the Contract completion date or incentive/disincentive date is impacted as determined by the Engineer's analysis. The Engineer and Contractor may agree to defer the analysis of a potential impact to the schedule until the completion of the activities that are affected. Such a deferment does not relieve the Contractor of his/her duty to identify potential impacts to the schedule in the applicable schedule updates.

All requests for extensions of Contract Time must be supported by the most recent CPM Update. If, within a reasonable period of time, the Contractor fails to make a good faith effort to produce an acceptable CPM update and uses an unacceptable CPM update to support a request for a time extension, the Contractor loses the right to receive that time extension; and/or the right to receive compensation for that delay caused in whole or in part by the Engineer.

Final As Built Schedule.

Submit a final CPM Schedule database within 14 Calendar Days of Substantial Completion. Failure to submit a final CPM Schedule may result in the withholding of estimates by the Engineer.

Method of Measurement:

The Project Control System will be measured in two items. The item, "Project Control System Development Plan" will be lump sum. The item "CPM Schedule Updates and/or Revised Updates" will be measured one each per update that is submitted and accepted.

Basis of Payment:

The item, "763508 – Project Control System Development Plan" will be paid at the Contract's lump sum bid price on the next monthly estimate after completion of the requirements of the Project Control System Development Plan, which includes the approval of the Original CPM Schedule. Price and payment will constitute full compensation for preparing the CPM database, acquiring the necessary software, attending all scheduling meetings with the Department, submitting and resubmitting all documents and for all labor, tools, equipment and incidentals necessary to complete the Work.

The item, "763509 – CPM Schedule Updates and/or Revised Updates" will be paid at the Contract unit price per each approved CPM schedule update as described above. Price and payment will constitute full compensation for preparing, submitting and resubmitting all CPM updates, for attendance at all scheduling meetings with the Department, for preparing and reviewing a list of actual start and actual finish dates with the Engineer, and for all labor, tools, Equipment and incidentals necessary to complete the Work.

2/11/2015

763522 - COAST GUARD SPECIFIC CONDITIONS

Description:

The Contractor shall prosecute his work in accordance with the specific requirements imposed by this Special Provision.

Under this item the contractor will be required to:

1. Prepare and furnish three copies of a plan and schedule for his operations within the waterway, for submission to Commander (AOWB), 5th Coast Guard District, 431 Crawford St., Portsmouth, VA 23704 for approval. The Contractor shall comply with all provisions of the Inland Rules of the Road. The Contractor shall give written notice to the Coast Guard of any planned temporary obstruction to the waterway navigation as well as copies of the plan and schedule of operations at least 30 days in advance of commencement of the work.

The plan and schedule of operations within the waterway shall include:

(a) A sketch of the waterway indicating:

(1) Locations of all restrictions that will be placed in the waterway, such as barges, anchors and anchor lines.

(2) The location and height above high mean water of any scaffolding or netting.

(b) A projected set of dates and length of time each operation will take, hours of each operation and whether or not the equipment will be removed at night.

2. Give immediate notice to the Coast Guard and to the Department, of any material, machinery or equipment lost, dumped, thrown overboard, sunk or misplaced during the progress of the work. The Contractor must remove the object with utmost dispatch. Until removal can be affected, the object or objects shall be properly marked in order to protect navigation. Notices to the Coast Guard and to the Department shall give a description and location of any such object and the action taken or being taken to protect navigation.

3. Furnish and install temporary obstruction lights as may be required by his operation and his permanent construction under this contract. Each temporary light shall consist of battery or power operated slow flashing amber light less than 60 flashes per minutes and visible for a range of 4 nautical miles on 90% of the nights of the year. Generally a lamp of 20 candle power will meet these requirements. If necessary to obtain the coverage required, a light or lights on the upstream and downstream sides shall be installed. Bridge piers shall be so marked until the construction has been completed and permanent navigational lights have been installed and determined to be operating satisfactorily. Four copies of Plans showing the proposed temporary lights during construction shall be submitted to the Department for approval before work is commenced. Deviations from the prescribed temporary lights during periods of construction will be permitted only upon written Coast Guard approval.

In the event the Contractor fails to comply with these foregoing requirements and the Federal Government is required to take action in this matter for the protection of navigation, the Department reserves the right to recover costs for such work from the Contractor.

The Federal Government and the Department assume no responsibility for any damage sustained or caused by the Contractor's plant, equipment or barges being anchored or moored at the aforementioned location and approval by either agency shall not act as a waiver of liability for any damage that may result from the Contractor's operation.

The Contractor shall maintain the temporary obstruction lights on permanent construction until permanent navigational lights have been installed and made operable in accordance with the Coast Guard requirements.

Basis of Payment:

All work and the Contractor's costs in every respect for compliance with the specific conditions imposed by the Coast Guard Commandant and specific under this item, together with the maintenance and removal of the temporary obstruction lights, installing of permanent navigational lights, and all else in connection therewith and incidental thereto which is not provided for under any stipulated pay item "Coast Guard Specific Conditions", which price and payment shall constitute full compensation for furnishing and installing all materials as described herein.

8/21/17

763569 - BUILDING RENOVATION

Description:

Under this Section, the Contractor shall perform all work necessary to complete the following.

A. Removal of existing and installation of new floor tiles in the operator's room of the Control House at BR 3-153 (Rehoboth Ave. Bridge) and BR 3-154 (Savannah Rd. Bridge). Refer to contract drawings for extent of repair and new tile work. This work includes:
   1. Removal of existing floor tiles and proper disposal as per Federal, State and local code regulations
   2. Cleaning and surface preparation of base for new tiles
   3. Installing new quarry floor tiles in operator room
   4. This work shall be coordinated with all other work including replacement of doors and electrical rehabilitation work in the control house. All concrete work associated with removing existing conduits and pedestals as well as all new conduit runs and pedestals shall be completed before the new floor tiles are installed.

B. Installation of new ceiling tiles in the operator room of the Control House at BR 3-153 (Rehoboth Ave. bridge) and BR 3-154 (Savannah Rd. bridge). Refer to contract drawings for extent of repair. This work includes:
   1. Removal of existing damaged ceiling tiles
   2. Installing new ceiling tiles in operator room
   3. Painting all ceiling tiles
   4. This work shall be coordinated with all other work including replacement of roof and electrical rehabilitation of the control house. All work related to the roof replacement shall be completed before the new ceiling tiles are installed.

C. Remove existing door frames at the following locations and provide new fire rated doors (1-hour minimum rating) and frames with all required accessories:
   1. BR 3-153 (Rehoboth Ave. bridge):
      a. Door to the Switchboard room; Swing out type; Approx. size - 7'-0" high x 3'-0" wide
      b. Door to the Generator room; Swing out type; Approx. size - 7'-0" high x 3'-0" wide
   2. BR 3-154 (Savannah Rd. bridge): Door in the wall leading from the switchboard room to the south bascule girder rack and pinion area; Swing out type; Approx. size - 6'-8" high x 2'-8" wide
   3. This work shall be coordinated with all other work including installation of floor tiles, painting of interior walls and electrical rehabilitation work within the control house.

D. Touch up painting the control house interior locations where major electrical work will be done:
   1. This work shall be coordinated with all other work including replacement of doors, installation of floor tiles and electrical rehabilitation work within the control house.

E. Removal of the existing netting and installation of new bird netting on Bridge 3-154 (Savannah Rd. Bridge). The barrier shall be installed at both bascule piers, limiting access to the mechanical bridge components and structural steel. Refer to contract drawings for the limits of the screening.

F. Installation of steel walkway platforms at BR 3-154 (Savannah Rd. Bridge) bascule piers to provide access to the droop cable terminal boxes.

The control house roof shall be replaced in accordance with Special Provisions 763512 - Thermoplastic Polyolefin (TPO) Roofing and 763513 - Sheet Metal Flashing and Trim.

All work involving installation of security cameras and fire alert systems in the control house will be covered under the Bridge Electrical System scope of work.

Materials:

A. Quarry Floor Tile
1. Handbook for Ceramic, Glass & Stone Tile Installation, Tile Council of North America, 2017 Edition
2. Type - Standard grade quarry tile ground four sides
3. Thickness - 0.5 inch
4. Size - 6 inch x 6 inch
5. Colors - Burnt Amber (to match existing)

B. Firedoor Hardware
1. Following manufacturers of 1-hour (minimum) fire rated doors and frames are preferred. The Engineers decision as to conformity of operation, design, finish, quality, and size shall be final.
   a. CecoDoor
   b. DeanSteel
   c. Republic Doors and Frames
   d. Steelcraft, A Allegion Brand
   e. or approved equal

2. Provide all hardware by the same manufacturer as the doors and frames, entirely free of imperfections in manufacture and finish, and guaranteed by the manufacturer to satisfactorily perform the various functions required.

C. Paint, Primer and Sealer
1. Primer, sealer and top coats shall be chosen to be compatible with the existing paint system in the control house.
2. Primer, sealer and top coats shall be compatible with each other and preferably made by the same manufacturer.
3. Touch-up finish coats shall be latex paint in shell white color

D. Submittals shall include the following:
1. Names and addresses of all manufacturers and suppliers to be utilized in this Section
2. Product certificates, signed by manufacturers of equipment, certifying that their products comply with specified requirements.
3. Delivery, Storage and Handling. Deliver all materials and fixtures in manufacturer's protective packing, crating, and covering and stored in a dry location.
4. Field measure and verify the existing dimensions and details of doors with all frames, details, finish hardware requirements, existing door openings, and other related items affecting metal doors, before creating shop drawings.
5. Before ordering materials, carefully examine all scale, full size, and shop drawings of work requiring hardware so that the material ordered will properly fit the work to which it is to be secured and will function as designed.
6. Inserts, bolts and fasteners shall be the manufacturers standard or as recommended by the manufacturer.

E. Bird Netting

1. The netting shall consist of 3/4" x 3/4" heavy duty polypropylene bird netting or approved equal. Items commonly sold as "bird/aquatic cage or trap netting" typically meet these specifications. Netting type, color and mesh size shall be approved by the Engineer prior to installation.
2. The netting shall be attached using manufacturer approved clips and self-taping screws, refer to contract drawings for connection details. Materials used to attach netting shall be appropriate for the type of netting used and as approved by the Engineer.

F. Steel Walkway Platforms and Railing System

1. All structural steel for platform supports shall be ASTM A709 grade with minimum yield strength of Fy = 50ksi. Steel shall be galvanized shall be as per ASTM 123.

2. The new platform grating shall be galvanized steel ASTM A1011 , regular duty, press-locked by AMICO or approved equal, with 1-1/2in. x 3/16in. bearing bars spaced at 1-3/16in. The cross bars shall be spaced at 4 inches maximum.
3. Bolts and fasteners for grating installation to grating supports shall be galvanized and sized as recommended by the manufacturer.
4. All connections of platform supports shall be as shown in the contract drawings. All anchor bolts shall be galvanized as per ASTM F2329.

Construction:

A. Installation of floor tiles
   1. Removals
      a. The existing floor tiles and other flooring elements have to be properly disposed as per local, state and federal regulations.
   2. Existing Conditions
      a. Contractor shall examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
      b. Contractor shall verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products. Contractor shall proceed with installation only after unsatisfactory conditions have been corrected.
   3. Preparation of Substrates
      a. For installation of new floor tiles, the Contractor shall prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products. Contractor shall verify that substrates are dry and free of curing compounds, sealers, and hardeners.
      b. Substrate Coatings: Contractor shall remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Use of solvents will not be permitted.
      c. Filling: Contractor shall use leveling and patching compound to fill cracks, holes, and depressions in substrates.
      d. Cleaning: Contractor shall sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.
   4. Tile Installation
      a. Resilient products and installation materials shall be moved into spaces where they will be installed at least 48 hours in advance of installation. Resilient products shall not be installed until they are same temperatures as space where they are to be installed.
      b. Contractor shall lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter. Tiles shall be laid square with room axis.
      c. Contractor shall match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Broken, cracked, chipped, or deformed tiles shall be discarded. Lay tiles with grain/pattern running in one direction.
      d. Contractor shall scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings. Extend tiles into toe spaces, door reveals, closets, and similar openings. Contractor shall maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
      e. Contractor shall attach tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
      f. After walls have been painted install the wall base tile along the perimeter of the operator room walls. After installation of the base tile, touch-up wall paint shall be applied to the walls along the top of the base tiles.

5. Cleaning and Protection
   a. Contractor shall clean and protect the tiles immediately after completing resilient product installation. Remove adhesive and other blemishes from exposed surfaces. Sweep and vacuum surfaces thoroughly. Damp-mop surfaces to remove marks and soil. Surfaces shall not be washed until after time period recommended by manufacturer.
   b. Contractor shall protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

B. Installation of ceiling tiles
1. Remove damaged and stained ceiling tiles.
2. Install new 12"x12" ceiling tiles to match existing.
3. Paint all ceiling tiles the same color.

C. Installation of fire rated doors and frames
1. Remove existing doors, frames and ensure that no damage to the existing walls has occurred. If there is damage to the walls, then all remedial action shall be contractor's responsibility at no additional cost to the Owner.
2. Install new frame to fit existing wall opening. Set frames accurately in position, plumb, align and brace securely until permanent anchors are set.
3. Installation of doors and frames shall be as per manufacturer's specifications and recommendations.
4. Check and readjust operating finish hardware items prior to final inspection. Remove and replace defective work, including doors or frames which are warped, bowed or otherwise damaged.
5. New doors and frames shall be painted with a multi-coat system that is Shell White in color. Paint and primer shall be chosen to match compatibility with each other and preferably made by same manufacturer. The finish coat shall be touched up after installation. If the doors and frames are only shop primed when they are installed, the finish coat shall be field applied after installation.
6. Install all hardware in compliance with manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, install each item completely and then remove and store in a secure place during the finish application.
7. Door locks and keys shall be handed to the bridge owner as per their preferences.

D. Painting
1. Paint all new doors and frames with a minimum of 1 primer coat and 2 finish coats as per Section C5 above.
2. Touch-up paint at control house interior locations where major electrical work will be done with 1 primer coat 2 finish coats.
3. Paint all ceiling tiles as per Section B3 above. Color to match existing as approved by the Engineer.

E. Bird Netting at BR 3-154
1. The bird netting shall consist of netting that is taut against the floorbeams and lower chord at both bascule piers, with no holes or openings, which limits the access of birds to the mechanical bridge components and structural steel at the bascule piers.
2. Netting shall be installed using methods that are appropriate for the netting. When measuring the netting, a minimum of 6 extra inches shall be added to each side to allow for overlap. The netting shall be attached such that it shall run no more than 5 feet in any direction without support, 2.5 feet is preferred, or as per the manufacture's recommendation. The floorbeam and lower chord shall be used to support the netting where safe and appropriate, refer to contract drawings for further information.
3. The Contractor may install the bird netting at any time during the construction process.
4. The Contractor shall maintain the bird netting in good working order without holes or loose areas during construction, making repairs as necessary or as directed by the Engineer at no additional cost to the Owner. The Contractor shall repair the netting using appropriate repair materials as specified in this item and according to manufacturer's recommendations.

F. Steel Walkway Platforms
   1. The Contractor shall survey the locations of the proposed walkway platforms for sufficient platform support installation space and clearances & headroom. If the field measurements differ from the contract drawings, then the Engineer shall be notified so that minor modifications to the platform layout may be made, prior to creating shop drawings for fabrication of the new platform.
   2. Install new platform supports, new platform grating, connections and handrails as per the contract drawings.

Method of Measurement:

Floor tiles, ceiling tiles, fire rated doors, painting, TPO roofing and flashing, bird netting and steel walkway platforms will not be measured for payment.

Basis of Payment:

All costs associated with furnishing and installing materials, labor, tools and incidentals necessary to satisfactorily complete the work shall be included in the lump sum cost bid for Item 763569 - Building Renovation. Price and payment will constitute full compensation for furnishing and installing all materials and the removal and subsequent disposal of all materials.

The lump sum bid for Item 763569 shall be the sum of the cost associated with the work performed at each bridge listed. The breakout sheet provided in the Bid Proposal shall be completed and attached to the Contractor's bid. Failure to submit the breakout sheet with the Bid Proposal will result in the Bid Proposal being declared non-responsive and rejected.

4/12/2018

763623 - NETTING, MIGRATORY BIRD EXCLUSION

Description:

This item shall consist of the installation, maintenance, and removal of a barrier that will prevent the nesting of migratory birds. The barrier shall be installed to completely encapsulate the sides and understructure of BR 3-153 (Rehoboth Ave Bridge) and BR 3-154 (Savannah Rd Bridge) up to the road without holes or sagging, prohibiting access to the girders upon which migratory birds typically nest.

Materials:

Netting: The netting shall consist of a durable polypropylene mesh of any color. The mesh size shall be no larger than 3/4" by 3/4" square. Items commonly sold as "bird/aquatic cage or trap netting" typically meet these specifications. Netting type and mesh size shall be approved by the Engineer prior to installation.

Netting attachment materials: Materials used to attach netting shall be appropriate for the type of netting used and as approved by the Engineer. Solvent based sealer/adhesive shall not be used on any of the netting, because it can melt the netting on contact. Materials to support and repair the netting shall also be appropriate for the type of netting used and as approved by the Engineer.

Construction Methods:

General: The migratory bird exclusion barrier shall consist of netting that is taut against the underside and sides of BR 3-153 (Rehoboth Ave Bridge) and BR 3-154 (Savannah Rd Bridge), with no holes or openings. To prevent damage to the netting, the netting shall not drape into the tidal waters. After installation, there shall be no area under or on the sides of the bridge accessible to migratory birds and available for migratory bird nesting.

Netting and Netting Attachments: Netting shall be installed using methods that are appropriate for the netting. The use of overhead supports, support cables, netting frames, or any other method as approved by the engineer may be used to attach the netting. When measuring the netting, a minimum of 6 extra inches shall be added to each side to allow for overlap. The netting shall be attached such that it shall run no more than 50 feet in any direction without support, 25 feet is preferred. Stable pipes, beams, and trusses shall be used to support netting where safe and appropriate. Support cables shall be used when there is minimal overhead support. Other methods shall be used as approved by the Engineer.

Construction planning: The migratory bird nesting season begins on April 15 and ends on August 1. During any year construction may occur, all components of the migratory bird exclusion netting, shall be installed prior to April 15 the start of the nesting season. The netting and netting materials shall remain in place and in good working order until the end of the nesting season, or until there is continuous construction on the bridge as per the Engineer. Bridge deck work shall be considered continuous work. The netting shall be removed and properly disposed of after August 1 or once continuous construction begins as stated above.

Maintenance: The Contractor shall inspect the netting on a weekly basis. The Contractor shall maintain the migratory bird exclusion netting in good working order without holes or loose areas, making repairs as necessary or as directed by the Engineer. The Contractor shall repair the netting using appropriate repair materials as specified in this item.

Method of Measurement:

The quantity of netting and netting attachment hardware will not be measured. The unit will include all necessary materials, fittings, accessories required per this specification, installation, inspection, maintenance and disposal of material fitting, accessories required per this specification.

Basis of Payment:

The migratory bird netting will be paid for at the Contract lump sum. Price and payment will constitute full compensation for furnishing and installing all materials; maintenance and repair of the netting; and the removal and subsequent disposal of all materials.

This item is a contingency item and the Department reserves the right to delete from the Contract. The Contractor shall make no claims for additional compensation because of deletion of the item.

4/12/2018

STATE OF DELAWARE
DEPARTMENT OF TRANSPORTATION
800 BAY ROAD
P.O. BOX 778
DOVER, DELAWARE 19903

JENNIFER COHAN
SECRETARY

UTILITY STATEMENT
5 October, 2017
STATE CONTRACT # T201507602
F.A.P. # EBHOS-S018 (13)
P6#15-03018
BR 3-154 on US 9 Savannah Road and BR 3-153 on SR1A Rehoboth Avenue
Over Lewes-Rehoboth Canal
SUSSEX COUNTY

Locations:
BR 3-154 on US 9 Savannah Road over Lewes-Rehoboth Canal
BR 3-153 on SR1A Rehoboth Avenue over Lewes-Rehoboth Canal

The following utility companies maintain facilities within the project limits:

BR 3-154 on US 9 Savannah Road
COMCAST
DELDOT
LEWES BOARD OF PUBLIC WORKS
VERIZON

BR 3-153 on SR1A Rehoboth Avenue
COMCAST
DELDOT
DELMARVA POWER
REHOBOTH WATER DEPARTMENT
SUSSEX COUNTY ENGINEERING
VERIZON

The following is a breakdown of the Utilities involved, adjustments and/or relocations as required:

Comcast:

Comcast owns and maintains overhead and underground facilities within the project limits of both locations. These facilities will remain in place and active during the duration of this project. Should any adjustments to Comcast facilities be needed, they shall be made by Comcast with a minimum of seven (7) calendar days in advance given to Comcast by the State Contractor.

At BR 3-154, Comcast is aerial over the Canal, just south of the bridge on DP&L poles.
At BR 3-153, Comcast does not cross the Canal in the project area.

DelDOT:

Del Dot maintains ITMS, fiber, lighting and/or signal systems throughout the project limits of both locations. These facilities will remain in place and active during the duration of this project. The Contractor must use care when working in these areas. Should any adjustments to Del DOT facilities be needed they shall be performed by the State's contractor in accordance with the Standard Specifications as directed by the District Engineer. The contractor shall report any impacts to any vehicle detection system to the Traffic Management Center (TMC) (Cell #77) (24 HR 302-659-4600), seven (7) calendar days before the loop system is impacted.

Delmarva Power & Light, Electric Distribution:

Delmarva Power & Light, Electric maintains overhead and underground electrical facilities within the project limits of BR3-153 with no anticipated impacts except for the bridge service. A new 3 phase transformer pad will be installed by Delmarva Power on the west side of Canal Street, next to the draw bridge tower. (See the construction plans for exact location and details) All other Delmarva Power & Light, Electric, facilities will remain in place and active during the duration of this project. The contractor must use care when working in these underground areas as well as overhead conductor crossings where Delmarva Power facilities are present. Should any adjustments to Delmarva's manhole risers be needed they shall be made by Delmarva with a minimum fourteen (14) calendar days in advance given to Delmarva by the State Contractor. Delmarva Power has a written requirement regarding working near overhead power lines.

Customer/Contractor Acknowledgement

Performing Work within Dangerous Proximity of High Voltage Lines

"You are hereby notified by Delmarva Power that NO work can be performed at this location within dangerous proximity to Delmarva's overhead lines and that you are required by law to comply with applicable OSHA regulations and the applicable state High Voltage Safety Act. Performance of any activity or causing any person, equipment or things to come within dangerous proximity of Delmarva's overhead lines creates an extreme risk of severe injury or death. You are further notified that no activities may be conducted within dangerous proximity of Delmarva's overhead lines until mutually agreeable measures to prevent contact with overhead lines have been reached with Delmarva and Delmarva has provided you with written authorization to perform the activities.

Additionally any work involving the use of a crane with intentions to remain outside of dangerous proximity, but within 20 feet of the Company's overhead lines, requires an Encroachment Prevention Plan in order to satisfy OSHA"

Lewes Board of Public Works, Electric:

Lewes Board of Public Works, Electric, maintains overhead and underground electrical facilities within the project limits of BR3-154 with no anticipated impacts except for the bridge service. A new 3 phase transformer pad will be installed by Lewes Board of Public Works, Electric, on the corner of First Street/Gills Neck Road and Savannah Road, next to the draw bridge tower. (See the construction plans for exact location and details) All other Lewes Board of Public Works, Electric, facilities will remain in place and active during the duration of this project. The contractor must use care when working in these underground areas as well as overhead conductor crossings where Lewes Board of Public Works, Electric, facilities are present.

Lewes Board of Public Works, Water & Waste Water:

Lewes Board of Public Works, Water & Waste Water, owns and maintains underground facilities within the project limits of BR 3-154. These facilities will remain in place and active during the duration of this project. There are manhole lids and water valve risers in the roadway and unpaved areas that may require elevation adjustments. The Contractor must use care when working in these areas. Should any adjustments to Lewes Board of Public Works, Water & Waste Water, facilities be needed they shall be performed by the State's contractor in accordance with the Specifications as directed by the District Engineer.

Rehoboth Water Department:

Rehoboth Water Department owns and maintains underground facilities within the project limits of BR 3-153. These facilities will remain in place and active during the duration of this project. No relocations are planned as part of this project. Should any adjustments to Rehoboth Water Department water valve risers be needed, they shall be performed by the State's contractor in accordance with the Specifications as directed by the District Engineer.

Sussex County Engineering:

Sussex County Engineering owns and maintains underground facilities within the project limits of BR 3-153. These facilities will remain in place and active during the duration of this project. There are manhole lids in the roadway that may require elevation adjustments. The Contractor must use care when working in these areas. Should any adjustments to Sussex County Engineering facilities be needed they shall be performed by the State's contractor in accordance with the Specifications as directed by the District Engineer. Sussex County Engineering requests 48 hour notice in advance of any sanitary sewer modifications and reserves the right to perform onsite inspection of all work associated with Sussex County Engineering facilities.

Verizon Delaware, LLC:

Verizon owns and maintains overhead and underground facilities within the project limits of both locations. These facilities will remain in place and active during the duration of this project. The contractor must use care when working in these underground areas as well as overhead cable crossings and submerged cable crossings in the Lewes / Rehoboth Canal, where Verizon facilities are present. Should any adjustments to Verizon manhole risers be needed they shall be made by Verizon with a minimum of fourteen (14) calendar days in advance given to Verizon by the State Contractor.

Outside of the companies and facilities discussed above, no additional utility involvement is anticipated. Should any conflicts be encountered as a result of the contractor's means and methods during construction requiring adjustment and/or relocation, the necessary relocation work shall be accomplished by the respective utility company and funded by the State's Contractor as directed by the District Engineer. The State Contractor shall coordinate any potential conflicts with utility companies and provide adequate notice prior to performing work. Any utility conflicts that are not readily discernable shall be coordinated by the State Contractor once the conflict is recognized. The time to complete any relocations/adjustments found to be necessary during construction of the highway project will depend on the nature of the work.

Once the State's contractor has given the Utility the advance notice required above, it is the responsibility of the State's contractor to have the work area prepared and accessible for the Utility to perform the tasks listed above. If the site conditions are not ready and the state contractor has given notice to the utility on when the work is to be accomplished, the State's Contractor shall be responsible for any extra cost incurred by the utility company and the State Contractor shall also be responsible for any time delays. Between

when the required notice is given to the Utility and when the work is performed and completed, the coordination and scheduling of the Utility is the sole responsibility of the State's Contractor. All costs related to the coordination and scheduling of the utilities is incidental to the contract.

Any adjustments and/or relocations of municipally owned sewer or water facilities shall be performed by the State's Contractor in accordance with the respective agency's standard specifications as directed by the District Engineer. The State contractor shall coordinate any potential conflicts of municipally owned sewer or water facilities with facility owners and provide adequate notice to the municipally and to the District Engineer prior to performing work.

General Notes

1. **The Contractor's attention is directed to Section 105.09 Utilities, Delaware Standard Specifications, August 2016. The Contractor shall contact Miss Utility (1-800-282-8555) two working days prior to any excavation. The Contractor is responsible for the support and protection of all utilities when excavating. The Contractor is responsible for ensuring proper clearances, including safety clearances, from overhead utilities for construction equipment. The Contractor is advised to check the site for access purposes for his equipment and, if necessary, make arrangements directly with the utility companies for field adjustments for adequate clearances.**

2. **The information shown in the Contract Documents, including the Utility Statement and the Utility Schedule contained herein, concerning the location, type and size of existing and proposed utilities, their locations, and construction timing has been compiled by the preparer based on information furnished by each of the involved Utility Companies. It shall be the responsibility of the State's Contractor to verify all information and coordinate with the Utility Companies prior to and during construction, as specified in Section 105.09 of the Standard Specifications.**

3. **It is understood and agreed that the Contractor has considered in his bid all permanent and temporary utility appurtenances in their present and relocated positions as shown on the plans or described in the Utility Statement or are readily discernible and that no additional compensation will be allowed for any delays, inconvenience, or damage due to any interference from the utility facilities and appurtenances or the operation of moving them, except that the Contractor may be granted an equitable extension of time. The contractor's means and method of construction are not taken into account when known utility conflicts are identified. If the Contractor's means and method of construction create a utility conflict the Utility Statement will prevail in discussions with the utility and the Contractor. The State's Contract shall be responsible for any costs associated with any temporary outages; holding, bracing and shielding of utility facilities; temporary relocations; or permanent relocations that are not specifically identified in this utility statement or shown in the contract plan set.**

4. **Coordination and cooperation among the Utility Companies and the State's Contractor are of prime importance. Therefore, the Contractor is directed to contact the following Utility Company representatives with any questions regarding this work prior to submitting bids and work schedules. Proposed work schedules should reflect the Utility Companies' proposed relocations. The Utility Companies do not work on weekends or legal holidays.**

Mike Sullivan	**Comcast**	Mike_Sullivan2@Comcast.com	**302-841-6316**

James Bunting	**DelDOT Traffic**	Jim.Bunting@state.de.us	**302-222-5970**
Angel Collazo	**Delmarva Power & Light, Elec.**	angel.collazo@delmarva.com	**302-454-4370**
Bill Whitaker	**Delmarva Power & Light, Elec. South**	william.whitaker@delmarva.com	**302-934-3356**
Darrin Gordon	**Lewes Board of Public Works**	dgordon@lewesbpw.com	**302-645-6228**
Howard Blizzard	**Rehoboth Water Department**	hblizzard@cityofrehoboth.com	**302-227-3194**
Brad Hawkes	**Sussex County Engineering**	bhawkes@sussexcountyde.gov **AFTER HOURS EMERGENCY**	**302-855-7717** **302-855-7379**
George Zang	**Verizon Delaware**	george.w.zang@verizon.com	**302-422-1238**

5. **As outlined in Chapter 3 of the DelDOT Utilities Manual, individual utility companies are responsible for obtaining all required permits from municipal, State and federal government agencies and railroads. This includes but is not limited to water quality permits/DNREC Water Quality Certification, DNREC Subaqueous Lands/Wetlands permits, DNREC Coastal Zone Consistency Certification, County Floodplain permits (New Castle County only), U.S. Coast Guard permits, US Army Corps 404 permits, sediment and erosion permits, and railroad crossing permits.**

6. **Individual utility companies are required to restore any areas disturbed in conjunction with their relocation work. If an area is disturbed by a utility company and is not properly restored, the Department may have the highway contractor perform the necessary restoration. Any additional costs incurred as a result will be forwarded to the utility company.**

7. **16 Del. C. § 7405B requires notification to and mutually agreeable measures from the public utility operating the electric line for the any person intending to carry on any function, activity, work or operation within dangerous proximity of any high voltage overhead electric lines. All contractors/other utilities must also maintain a distance of 10'-0" from all energized lines.**

DIVISION OF TRANSPORTATION SOLUTIONS

UTILITY COORDINATOR
chuck.ferguson@state.de.us

Oct, 2017
DATE

STATE OF DELAWARE
DEPARTMENT OF TRANSPORTATION
PO BOX 778
DOVER, DELAWARE 19903

CERTIFICATE OF RIGHT-OF-WAY STATUS

STATE PROJECT NO. T201507602

F.A.P. NO. EBHOS-S018(13)

3-154 ON US 9 SAVANNAH ROAD AND
BR 3-153 ON SR1A REHOBOTH AVENUE
OVER LEWES-REHOBOTH CANAL

SUSSEX COUNTY

Certificate of Right-of-Way Status – 100%

Level 1

As required by 23 CFR, Part 635, and other pertinent Federal and State regulations or laws, the following certifications are hereby made in reference to this highway project:

All project construction or work shall be performed within existing rights of way and permanent easements; and,

All necessary real property interests, including control of access rights when pertinent, were acquired as part of previous highway projects, and include legal and physical possession; and,

This project does not cause any persons to be displaced as defined in 49 CFR, Part 24; and,

The State has the right to remove, salvage, or demolish any improvements or personal property that may be located within project limits.

RIGHT OF WAY SECTION

Robert Cunningham
Chief, Right of Way

September 20, 2017

STATE OF DELAWARE
DEPARTMENT OF TRANSPORTATION
800 BAY ROAD
P.O. BOX 778
DOVER, DELAWARE 19903

JENNIFER COHAN
SECRETARY

April 10, 2018

ENVIRONMENTAL REQUIREMENTS

FOR
State Contract No. T201507602
Federal Aid No.: EBHOS-S018(13)

Contract Title: BR 3-153 on SR1A & BR 3-154 on Savannah Road over Lewes and Rehoboth Canal

In accordance with the procedural provisions for implementing the National Environmental Policy Act of 1969, as amended, the referenced project has been processed through the Department's Environmental Review Procedures and has been classified as a Level C/ Class II Action.

PERMIT REQUIREMENTS:

The proposed construction work for this project requires permit approval from the agencies listed below. It is the responsibility of the contracting agency -- the Delaware Department of Transportation, Division of Transportation Solutions -- to obtain the necessary permits to ensure that the contractor complies with the requirements and conditions established by the regulatory agencies. Written authorization from the permitting agencies is required and paperwork for on-site posting is anticipated. The proposed work for this project will be authorized under the permits listed below:

REQUIRED PERMITS AND APPROVAL STATUS:

- U.S. Army Corps of Engineers (USACE) – Nationwide Permit #3(a) and (c) no Pre-Construction Notification required – FYI email sent March 6, 2018
- USACE – Section 408 permit exemption – Dated January 23, 2018
- Delaware Department of Natural Resources and Environmental Control (DNREC) Wetlands & Subaqueous Lands Section (WSLS) – Delaware Code Chapter 72, Section 7217, Special Exemption (b) - FYI email sent March 6, 2018

- Delaware Coastal Zone Management (CZM) – Issued – Project is not located in a Critical Resource Water
- DNREC Water Quality Certification (WQC) - Issued – Project is not located in a Critical Resource Water
- U.S. Coast Guard (USCG) – Letter of Approval – Will be issued prior to the start of construction

SPECIFIC REQUIREMENTS:

Compliance with all requirements of the permits is the responsibility of the contractor, who will follow all special conditions or requirements as stated within those permits. The contractor will be subject to penalties, fines, and the risk of shut down as mandated by laws governing permitting agencies if such conditions and requirements are violated or ignored. Therefore, all special conditions, general requirements, and/or other required provisions specified within the permits must be followed. Those obligations are indicated or listed within the permit package, which can be obtained from the DelDOT Contract Administration Office.

Additional requirements by DelDOT not specified within the permits, but listed below, are also the responsibility of the contractor. Noncompliance with these requirements may result in shut down of the project at the contractor's expense.

1. The contractor shall employ measures during construction to prevent spills of fuels or lubricants. If a spill should occur, efforts shall be undertaken to prevent its entry into wetlands, aquatic, or drainage areas. Any spills entering wetlands, aquatic, or drainage areas shall be removed immediately. The Division of Water Resources (DNREC), Wetlands & Aquatic Protection Branch, 302-739-4691, shall be notified of any spill(s) within six (6) hours of their occurrence. That office will determine the effectiveness of spill and contamination removal and specify remediation efforts as necessary.

2. All construction debris, excavated material, brush, rocks, and refuse incidental to the work shall be placed either on shore above the influence of flood waters or on some suitable disposal site approved by the department.

3. The disposal of trees, brush, and other debris in any stream corridor, wetland surface water or any drainage ditch is prohibited.

4. There shall be no stockpiling of construction materials or temporary fills in wetlands or subaqueous lands unless otherwise specified on project plans and approved by permitting agencies that govern them. It is the contractor's responsibility to coordinate and secure those additional permits/amendments in deviating from the plan.

5. Construction debris shall be kept from entering adjacent waterways, wetlands, ground cover, or drainage areas. Any debris that enters these areas shall be removed immediately. Netting, mats, or establishing confined work areas in stages may be necessary to address these issues.

6. Refuse material resulting from routine maintenance of worker equipment and heavy machinery is prohibited from being disposed or deposited onto or into the ground. All used oils and filters must be recycled or disposed of properly.

7. Use of harmful chemical wash water to clean equipment or machinery is discouraged. If undertaken, the residue water and/or material must be collected or contained such that it will be disposed of properly. It shall not be deposited or disposed of in waterways, streams, wetlands, or drainage areas.

8. The contractor shall follow all requirements as indicated in the Environmental Compliance Sheet. It is be the contractor's responsibility to ensure that workers also follow this requirement. As part of the restrictions, please note the timetables reflected in the contract for the in-stream/water work for endangered species protection.

9. Fill material shall be free of oil and grease, debris, wood, general refuse, plaster and other pollutants, and shall contain no broken asphalt.

ENVIRONMENTAL COMPLIANCE SHEET:

The contractor shall pay special attention to specific construction requirements as indicated in the US Army Corps of Engineer and DNREC Subaqueous Lands Permit as well as the Environmental Compliance (EC) Note and Plans (page 162-164).

1. Specifically, please note the environmental requirements as indicated in the following notes:
   - Cultural Resource Issues – See EC sheet note 3.
   - Coast Guard Coordination – See EC sheet note 4.
2. DelDOT Environmental Studies Section (302) 760-2264 must be notified if there are any changes to the project methods, footprint, materials, or designs, to allow the Department to coordinate with the appropriate resource agencies (COE, DNREC, and SHPO), for approval.

STATE OF DELAWARE
DEPARTMENT OF TRANSPORTATION
800 BAY ROAD
P.O. BOX 778
DOVER, DELAWARE 19903

JENNIFER COHAN
SECRETARY

RAILROAD STATEMENT
For

State Contract No.: T201507602

Federal Aid No.: EBHOS-S018(13)

Project Title: BR 3-153 on Rehoboth Avenue & BR 3-154 on Savannah Road over Lewes and Rehoboth Canal

The following railroad companies maintain facilities within the contract limits:

- ☐ Amtrak
- ☐ CSX
- ☐ Delaware Coast Line
- ☐ East Penn
- ☐ Delmarva Central
- ☐ Maryland & Delaware
- ☐ Norfolk Southern
- ☐ Wilmington & Western
- ☑ None

DOT Inventory No.: _____ No. Trains/Day: _____ Passenger Trains (Y / N): _____

In accordance with 23 CFR 635, herein is the railroad statement of coordination (check one):

☑ No Railroad involvement.

☐ Railroad Agreement unnecessary but railroad flagging required. The contractor shall follow requirements stated in the DelDOT Maintenance of Railroad Traffic Item in the Special Provisions. Contractor shall coordinate railroad flagging with DelDOT's Railroad Program Manager at (302) 760-2183.

☐ Railroad Agreement required. The necessary Railroad Agreement is pending. The Contractor cannot begin work untill the Agreement is complete and fully executed. Railroad related work to be undertaken and completed as required for proper coordination with physical construction schedules. The Contractor shall follow requirements stated in the DelDOT Maintenance of Railroad Traffic Item in the Special Provisions. Contractor shall coordinate railroad flagging with DelDOT's Railroad Program Manager at (302) 760-2183.

Approved As To Form:

Robert A. Perrine
DelDOT Railroad Program Manager

17 April, 2017
DATE

BID PROPOSAL FORMS

CONTRACT T201507602.02

FEDERAL AID PROJECT EBHOS-S018(13)

UNLESS OTHERWISE DIRECTED, SUBMIT ALL FOLLOWING PAGES TO:

DEPARTMENT OF TRANSPORTATION
BIDDERS ROOM (B1.11.01)
800 BAY ROAD
DOVER, DELAWARE 19901

Identify the following on the outside of the sealed envelope:

- Contract Number T201507602.02
- Name of Contractor

CONTRACT ID: T201507602.02 PROJECT(S): EBHOS-S018(13)

All figures must be typewritten.

CONTRACTOR :_____

LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS	UNIT PRICE DOLLARS	UNIT PRICE CTS	BID AMOUNT DOLLARS	BID AMOUNT CTS
	SECTION 0001 BR 3-153					
0010	504001 CRACK AND JOINT SEALING LESS THAN 3/4 INCH WIDE	154.000 LF				
0020	613500 CONCRETE ACRYLIC PRIMER, SEALER, AND TEXTURED TOPCOAT	8203.000 SF				
0030	615006 STEEL STRUCTURE REPAIR	LUMP	LUMP			
0040	615506 WALKWAY GRATING	1400.000 SF				
0050	616000 CLEANING AND PAINTING EXISTING STEEL	LUMP	LUMP			
0060	616003 TESTING AND DISPOSAL OF EXISTING HAZARDOUS STEEL COATING	LUMP	LUMP			
0070	624013 COMPRESSION SEAL, 1"	380.000 LF				
0080	624014 COMPRESSION SEAL, 2"	140.000 LF				
0090	625500 EPOXY OVERLAY SYSTEM	43.000 SYIN				

CANNOT BE USED FOR BIDDING

CONTRACT ID: T201507602.02 PROJECT(S): EBHOS-S018(13)

All figures must be typewritten.

CONTRACTOR :_____

LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS		UNIT PRICE DOLLARS	CTS	BID AMOUNT DOLLARS	CTS
0100	628001 REPAIR OF CONCRETE STRUCTURE BY EPOXY INJECTION	26.000	LF				
0110	628020 ROUT AND SEAL CRACKS	416.000	LF				
0120	628040 SHALLOW SPALL REPAIR	45.000	CF				
0130	628041 DEEP SPALL REPAIR	90.000	CF				
0140	763000 INITIAL EXPENSE/DE-MOBILIZATION	LUMP		LUMP			
0150	763501 CONSTRUCTION ENGINEERING	LUMP		LUMP			
0160	763503 TRAINEE	3200.000	HOUR	0.80000		2560.00	
0170	763508 PROJECT CONTROL SYSTEM DEVELOPMENT PLAN	LUMP		LUMP			
0180	763509 CPM SCHEDULE UPDATES AND/OR REVISED UPDATES	13.000	EAMO				
0190	763522 COAST GUARD SPECIFIC CONDITIONS	LUMP		LUMP			

CANNOT BE USED FOR BIDDING

CONTRACT ID: T201507602.02 PROJECT(S): EBHOS-S018(13)

All figures must be typewritten.

CONTRACTOR :_____

LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS	UNIT PRICE DOLLARS	UNIT PRICE CTS	BID AMOUNT DOLLARS	BID AMOUNT CTS
0200	763569 BUILDING RENOVATION	LUMP	LUMP			
0210	763623 NETTING MIGRATORY BIRD EXCLUSION	LUMP	LUMP			
0220	801000 MAINTENANCE OF TRAFFIC	LUMP	LUMP			
0230	802001 ARROW PANELS TYPE A	60.000 EADY				
0240	803001 FURNISH AND MAINTAIN PORTABLE CHANGEABLE MESSAGE SIGN	90.000 EADY				
0250	805001 PLASTIC DRUMS	3840.000 EADY				
0260	810001 TEMPORARY WARNING SIGNS AND PLAQUES	1600.000 EADY				
0270	813001 TEMPORARY BARRICADES, TYPE III	2880.000 LFDY				
0280	817002 PERMANENT PAVEMENT STRIPING, SYMBOL/LEGEND, ALKYD-THERMOPLASTIC	92.000 SF				
0290	817013 PERMANENT PAVEMENT STRIPING, EPOXY RESIN PAINT, WHITE/YELLOW, 5"	1415.000 LF				

CANNOT BE USED FOR BIDDING

CONTRACT ID: T201507602.02 PROJECT(S): EBHOS-S018(13)

All figures must be typewritten.

CONTRACTOR :_____

LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS	UNIT PRICE DOLLARS	UNIT PRICE CTS	BID AMOUNT DOLLARS	BID AMOUNT CTS
0300	817015 PREFORMED RETROREFLECTIVE THERMOPLASTIC MARKINGS, BIKE SYMBOL	4.000 EACH				
0310	817031 REMOVAL OF PAVEMENT STRIPING	500.000 SF				
0320	905001 SILT FENCE	50.000 LF				
0330	905005 INLET SEDIMENT CONTROL, CURB INLET	2.000 EACH				
0340	908014 PERMANENT GRASS SEEDING, DRY GROUND	5.000 SY				
	SECTION 0001 TOTAL					

SECTION 0002 BR 3-153 SPECIALITY ITEMS

0350	615503 BRIDGE MECHANICAL SYSTEM	LUMP	LUMP			
0360	615504 BRIDGE ELECTRICAL SYSTEM	LUMP	LUMP			
	SECTION 0002 TOTAL					

CANNOT BE USED FOR BIDDING

CONTRACT ID: T201507602.02 PROJECT(S): EBHOS-S018(13)

All figures must be typewritten.

CONTRACTOR :_____

LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS	UNIT PRICE DOLLARS	UNIT PRICE CTS	BID AMOUNT DOLLARS	BID AMOUNT CTS
	SECTION 0003 BR 3-154					
0370	202000 EXCAVATION AND EMBANKMENT	29.000 CY				
0380	211001 REMOVAL OF PORTLAND CEMENT CONCRETE PAVEMENT, CURB AND SIDEWALK	143.000 SY				
0390	401005 SUPERPAVE TYPE C, PG 64-22 (CARBONATE STONE)	10.000 TON				
0400	613002 SILANE-BASED CONCRETE DECK SEALER	164.000 SF				
0410	613500 CONCRETE ACRYLIC PRIMER, SEALER, AND TEXTURED TOPCOAT	9880.000 SF				
0420	615006 STEEL STRUCTURE REPAIR	LUMP	LUMP			
0430	615506 WALKWAY GRATING	860.000 SF				
0440	616000 CLEANING AND PAINTING EXISTING STEEL	LUMP	LUMP			
0450	616003 TESTING AND DISPOSAL OF EXISTING HAZARDOUS STEEL COATING	LUMP	LUMP			
0460	624014 COMPRESSION SEAL, 2"	181.000 LF				

CANNOT BE USED FOR BIDDING

CONTRACT ID: T201507602.02 PROJECT(S): EBHOS-S018(13)

All figures must be typewritten.

CONTRACTOR :_____

LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS	UNIT PRICE DOLLARS	UNIT PRICE CTS	BID AMOUNT DOLLARS	BID AMOUNT CTS
0470	625500 EPOXY OVERLAY SYSTEM	69.000 SYIN				
0480	628020 ROUT AND SEAL CRACKS	364.000 LF				
0490	628040 SHALLOW SPALL REPAIR	5.000 CF				
0500	628041 DEEP SPALL REPAIR	5.000 CF				
0510	705002 PORTLAND CEMENT CONCRETE SIDEWALK, 6"	1632.000 SF				
0520	711500 ADJUST AND REPAIR EXISTING SANITARY MANHOLE	1.000 EACH				
0530	762000 SAW CUTTING, BITUMINOUS CONCRETE	20.000 LF				
0540	762001 SAW CUTTING, CONCRETE, FULL DEPTH	139.000 LF				
0550	762002 SAW CUTTING, CONCRETE, VARIABLE DEPTH	25.000 LF				
0560	763000 INITIAL EXPENSE/DE-MOBILIZATION	LUMP	LUMP			

CANNOT BE USED FOR BIDDING

CONTRACT ID: T201507602.02 PROJECT(S): EBHOS-S018(13)

All figures must be typewritten.

CONTRACTOR :_____

LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS	UNIT PRICE DOLLARS	UNIT PRICE CTS	BID AMOUNT DOLLARS	BID AMOUNT CTS
0570	763501 CONSTRUCTION ENGINEERING	LUMP	LUMP			
0580	763508 PROJECT CONTROL SYSTEM DEVELOPMENT PLAN	LUMP	LUMP			
0590	763509 CPM SCHEDULE UPDATES AND/OR REVISED UPDATES	13.000 EAMO				
0600	763522 COAST GUARD SPECIFIC CONDITIONS	LUMP	LUMP			
0610	763569 BUILDING RENOVATION	LUMP	LUMP			
0620	763623 NETTING MIGRATORY BIRD EXCLUSION	LUMP	LUMP			
0630	801000 MAINTENANCE OF TRAFFIC	LUMP	LUMP			
0640	802001 ARROW PANELS TYPE A	40.000 EADY				
0650	803001 FURNISH AND MAINTAIN PORTABLE CHANGEABLE MESSAGE SIGN	160.000 EADY				
0660	804001 FURNISH AND MAINTAIN PORTABLE LIGHT ASSEMBLY (FLOOD LIGHTS)	400.000 EADY				

CANNOT BE USED FOR BIDDING

CONTRACT ID: T201507602.02 PROJECT(S): EBHOS-S018(13)

All figures must be typewritten.

CONTRACTOR :_____

LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS	UNIT PRICE DOLLARS	UNIT PRICE CTS	BID AMOUNT DOLLARS	BID AMOUNT CTS
0670	805001 PLASTIC DRUMS	720.000 EADY				
0680	806001 TRAFFIC OFFICERS	200.000 HOUR	75.00000		15000.00	
0690	810001 TEMPORARY WARNING SIGNS AND PLAQUES	640.000 EADY				
0700	811009 FLAGGER, SUSSEX COUNTY, FEDERAL	800.000 HOUR				
0710	811018 FLAGGER, SUSSEX COUNTY, FEDERAL, OVERTIME	160.000 HOUR				
0720	813001 TEMPORARY BARRICADES, TYPE III	1960.000 LFDY				
0730	817002 PERMANENT PAVEMENT STRIPING, SYMBOL/LEGEND, ALKYD-THERMOPLASTIC	28.000 SF				
0740	817009 TEMPORARY MARKINGS, TAPE, 4"	400.000 LF				
0750	817013 PERMANENT PAVEMENT STRIPING, EPOXY RESIN PAINT, WHITE/YELLOW, 5"	766.000 LF				
0760	817031 REMOVAL OF PAVEMENT STRIPING	63.000 SF				

CANNOT BE USED FOR BIDDING

CONTRACT ID: T201507602.02 PROJECT(S): EBHOS-S018(13)

All figures must be typewritten.

CONTRACTOR :_____

LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS		UNIT PRICE DOLLARS	CTS	BID AMOUNT DOLLARS	CTS
0770	817032 REMOVAL OF PAVEMENT MARKING TAPE	133.000	SF				
0780	818001 SUPPLY OF FLAT SHEET ALUMINUM SIGN PANEL, TYPE IV, RETROREFLECTIVE SHEETING	26.000	SF				
0790	819018 INSTALLATION OR REMOVAL OF TRAFFIC SIGN(S) ON SINGLE SIGN POST	12.000	EACH				
0800	830005 CONDUIT JUNCTION WELL, TYPE 11, PRECAST/POLYMER LID-FRAME	1.000	EACH				
0810	830010 REMOVAL OF EXISTING JUNCTION WELL	1.000	EACH				
0820	832035 REMOVAL OF CABLE FROM CONDUIT OR TRAFFIC /LIGHTING POLE	33.000	LF				
0830	834002 POLE BASE, TYPE 3A	1.000	EACH				
0840	905001 SILT FENCE	50.000	LF				
0850	905005 INLET SEDIMENT CONTROL, CURB INLET	4.000	EACH				

CANNOT BE USED FOR BIDDING

CONTRACT ID: T201507602.02 PROJECT(S): EBHOS-S018(13)

All figures must be typewritten.

CONTRACTOR :_____

LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS	UNIT PRICE DOLLARS	UNIT PRICE CTS	BID AMOUNT DOLLARS	BID AMOUNT CTS
0860	908004 TOPSOIL, 6" DEPTH	55.000 SY				
0870	908014 PERMANENT GRASS SEEDING, DRY GROUND	5.000 SY				
	SECTION 0003 TOTAL					

SECTION 0004 BR 3-154 SPECIALITY ITEMS

0880	615503 BRIDGE MECHANICAL SYSTEM	LUMP	LUMP			
0890	615504 BRIDGE ELECTRICAL SYSTEM	LUMP	LUMP			
	SECTION 0004 TOTAL					
	TOTAL BID					

CANNOT BE USED FOR BIDDING

BREAKOUT SHEET INSTRUCTIONS

BREAKOUT SHEET(S) MUST BE SUBMITTED EITHER WITH YOUR BID DOCUMENTS; OR WITHIN SEVEN (7) CALENDAR DAYS FOLLOWING THE BID DUE DATE BY THE LOWEST APPARENT BIDDER.

BREAKOUT SHEETS ARE TO BE SUBMITTED TO DELDOT'S CONTRACT ADMINISTRATION AS SHOWN BELOW. BREAKOUT SHEETS CANNOT BE CHANGED AFTER AWARD. THE DEPARTMENT WILL REVIEW THE FIGURES SUBMITTED ON THE BREAKOUT SHEET(S) TO ENSURE THEY MATCH THE RESPECTIVE LUMP SUM BID AMOUNT(S). MATHEMATICALLY INCORRECT BREAKOUT SHEETS WILL BE RETURNED FOR IMMEDIATE CORRECTION.

BREAKOUT SHEETS MAY BE SUBMITTED;

VIA E-MAIL TO: DOT-ASK@STATE.DE.US
SUBJECT: **T201507602.02** Breakout Sheet

OR MAILED TO: DELDOT
CONTRACT ADMINISTRATION
PO BOX 778, DOVER, DE 19903

'BREAKOUT SHEET' AND THE PROJECT NUMBER MUST APPEAR ON THE ENVELOPE.

BREAKOUT SHEET - 1 **CONTRACT NO. T201507602.02**

Item 763569 - BUILDING RENOVATION

ITEM NO.	APPROX. QTY.	UOM	DESCRIPTION	UNIT PRICE	AMOUNT
SECTION 0001					
1A	1	LS	FLOOR TILE RENOVATIONS AT BRIDGE 3-153	$	$
1B	1	LS	CEILING TILE RENOVATIONS AT BRIDGE 3-153	$	$
1C	2	EA	DOOR AND FRAME RENOVATIONS AT BRIDGE 3-153	$	$
1D	1	LS	INTERIOR PAINTING RENOVATIONS AT BRIDGE 3-153	$	$
1E	1	LS	ROOFING RENOVATIONS AT BRIDGE 3-153	$	$
1F	10	SF	ROOFING SUBSTRATE REPAIRS AT BRIDGE 3-153	$	$

TOTAL ITEM 763569 - BUILDING RENOVATIONS $_____

(LUMP SUM BID PRICE FOR ITEM 763569 - BUILDING RENOVATIONS)

CANNOT BE USED FOR BIDDING

BREAKOUT SHEET - 2 **CONTRACT NO. T201507602.02**

Item 615503 - BRIDGE MECHANICAL SYSTEM

ITEM NO.	APPROX. QTY.	UOM	DESCRIPTION	UNIT PRICE	AMOUNT
SECTION 0002					
2A	1	LS	SPAN DRIVE MACHINERY REHABILITATION AT BRIDGE 3-153	$	$
2B	1	LS	SPAN LOCK MACHINERY & CENTERING GUIDE REHABILITATION AT BR 3-153	$	$
2C	1	LS	FIELD PAINTING BRIDGE MACHINERY AT BRIDGE 3-153	$	$
2D	1	LS	SPAN BALANCING AT BRIDGE 3-153	$	$
2E	96,245	LBS	SPAN BALANCE STEEL PLATES AT BRIDGE 3-153	$	$

TOTAL ITEM 615503 - BRIDGE MECHANICAL SYSTEM $_____

(LUMP SUM BID PRICE FOR ITEM 615503 - BRIDGE MECHANICAL SYSTEM)

CANNOT BE USED FOR BIDDING

BREAKOUT SHEET - 3 **CONTRACT NO. T201507602.02**

Item 615504 - BRIDGE ELECTRICAL SYSTEM

ITEM NO.	APPROX. QTY.	UOM	DESCRIPTION	UNIT PRICE	AMOUNT
SECTION 0002					
3A	1	LS	ACCEPTANCE TESTING AT BRIDGE 3-153	$	$
3B	1	LS	AUTOMATIC TRANSFER SWITCH AT BRIDGE 3-153	$	$
3C	1	LS	BRIDGE OPERATION DURING CONSTRUCTION AT BRIDGE 3-153	$	$
3D	1	LS	CONTROL CABINETS AT BRIDGE 3-153	$	$
3E	1	LS	CONTROL DESKS AT BRIDGE 3-153	$	$
3F	1	LS	DISCONNECT SWITCHES AT BRIDGE 3-153	$	$
3G	1	LS	ELECTRICAL CABLE, WIRE AND CONNECTORS AT BRIDGE 3-153	$	$
3H	1	LS	ELECTRICAL CONDUIT AND FITTINGS AT BRIDGE 3-153	$	$
3I	1	LS	FIELD MEASURING AT BRIDGE 3-153	$	$
3J	1	LS	FLUX VECTOR DRIVES AT BRIDGE 3-153	$	$
3K	1	LS	INCOMING SERVICE AT BRIDGE 3-153	$	$
3L	1	LS	LIMIT SWITCHES AT BRIDGE 3-153	$	$
3M	1	LS	MISCELLANEOUS EQUIPMENT AT BRIDGE 3-153	$	$
3N	1	LS	MODIFICATIONS TO WARNING AND BARRIER GATES AT BRIDGE 3-153	$	$
3O	1	LS	MOTOR AND MACHINERY BRAKES AT BRIDGE 3-153	$	$
3P	1	LS	MOTORS AT BRIDGE 3-153	$	$
3Q	1	LS	REMOVAL OF ELECTRICAL EQUIPMENT AT BRIDGE 3-153	$	$
3R	1	LS	TECHNICAL MANUALS AT BRIDGE 3-153	$	$

TO TAL ITEM 615504 - BRIDGE ELECTRICAL SYSTEM $_____

(LUMP SUM BID PRICE FOR ITEM 615504 - BRIDGE ELECTRICAL SYSTEM)

CANNOT BE USED FOR BIDDING

BREAKOUT SHEET - 4 **CONTRACT NO. T201507602.02**

Item 763569 - BUILDING RENOVATION

ITEM NO.	APPROX. QTY.	UOM	DESCRIPTION	UNIT PRICE	AMOUNT
SECTION 0003					
4A	1	LS	FLOOR TILE RENOVATIONS AT BRIDGE 3-154	$	$
4B	1	LS	CEILING TILE RENOVATIONS AT BRIDGE 3-154	$	$
4C	1	EA	DOOR AND FRAME RENOVATIONS AT BRIDGE 3-154	$	$
4D	1	LS	INTERIOR PAINTING RENOVATIONS AT BRIDGE 3-154	$	$
4E	1	LS	ROOFING RENOVATIONS AT BRIDGE 3-154	$	$
4F	10	SF	ROOFING SUBSTRATE REPAIRS AT BRIDGE 3-154	$	$
4G	1	LS	BIRD NETTING AT BRIDGE 3-154	$	$
4H	1	LS	WALKWAY PLATFORM & RAILING AT PIERS AT BRIDGE 3-154	$	$

TOTAL ITEM 763569 - BUILDING RENOVATIONS $_____

(LUMP SUM BID PRICE FOR ITEM 763569 - BUILDING RENOVATIONS)

CANNOT BE USED FOR BIDDING

BREAKOUT SHEET - 5 **CONTRACT NO. T201507602.02**

Item 615503 - BRIDGE MECHANICAL SYSTEM

ITEM NO.	APPROX. QTY.	UOM	DESCRIPTION	UNIT PRICE	AMOUNT
SECTION 0004					
5A	1	LS	SPAN DRIVE MACHINERY REHABILITATION AT BRIDGE 3-154	$	$
5B	1	LS	CENTER LOCK MACHINERY REPLACEMENT AND REHABILITATION OF TAIL LOCKS AT BRIDGE 3-154	$	$
5C	1	LS	FIELD PAINTING BRIDGE MACHINERY AT BRIDGE 3-154	$	$
5D	1	LS	SPAN BALANCING AT BRIDGE 3-154	$	$
5E	68,845	LBS	SPAN BALANCE STEEL PLATES AT BRIDGE 3-154	$	$
5F	1	LS	TECHNICAL MANUALS AT BRIDGE 3-154	$	$

TOTAL ITEM 615503 - BRIDGE MECHANICAL SYSTEM $_____

(LUMP SUM BID PRICE FOR ITEM 615503 - BRIDGE MECHANICAL SYSTEM)

CANNOT BE USED FOR BIDDING

BREAKOUT SHEET - 6 **CONTRACT NO. T201507602.02**

Item 615504 - BRIDGE ELECTRICAL SYSTEM

ITEM NO.	APPROX. QTY.	UOM	DESCRIPTION	UNIT PRICE	AMOUNT
SECTION 0004					
6A	1	LS	ACCEPTANCE TESTING AT BRIDGE 3-154	$	$
6B	1	LS	AUTOMATIC TRANSFER SWITCH AT BRIDGE 3-154	$	$
6C	1	LS	BRIDGE OPERATION DURING CONSTRUCTION AT BRIDGE 3-154	$	$
6D	1	LS	CONTROL CABINETS AT BRIDGE 3-154	$	$
6E	1	LS	CONTROL DESKS AT BRIDGE 3-154	$	$
6F	1	LS	DISCONNECT SWITCHES AT BRIDGE 3-154	$	$
6G	1	LS	ELECTRICAL CABLE, WIRE AND CONNECTORS AT BRIDGE 3-154	$	$
6H	1	LS	ELECTRICAL CONDUIT AND FITTINGS AT BRIDGE 3-154	$	$
6I	1	LS	FIELD MEASURING AT BRIDGE 3-154	$	$
6J	1	LS	FLUX VECTOR DRIVES AT BRIDGE 3-154	$	$
6K	1	LS	INCOMING SERVICE AT BRIDGE 3-154	$	$
6L	1	LS	LIMIT SWITCHES AT BRIDGE 3-154	$	$
6M	1	LS	MISCELLANEOUS EQUIPMENT AT BRIDGE 3-154	$	$
6N	1	LS	MODIFICATIONS TO WARNING AND BARRIER GATES AT BRIDGE 3-154	$	$
6O	1	LS	MOTOR AND MACHINERY BRAKES AT BRIDGE 3-154	$	$
6P	1	LS	MOTORS AT BRIDGE 3-154	$	$
6Q	1	LS	REMOVAL OF ELECTRICAL EQUIPMENT AT BRIDGE 3-154	$	$
6R	1	LS	TECHNICAL MANUALS AT BRIDGE 3-154	$	$

TO TAL ITEM 615504 - BRIDGE ELECTRICAL SYSTEM $_____

(LUMP SUM BID PRICE FOR ITEM 615504 - BRIDGE ELECTRICAL SYSTEM)

CANNOT BE USED FOR BIDDING

"ATTENTION"

TO BIDDERS

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PO BOX 778, DOVER, DE 19903

'BREAKOUT SHEET' AND THE PROJECT NUMBER
MUST APPEAR ON THE ENVELOPE.

AFFIDAVIT

OF

EMPLOYEE DRUG TESTING PROGRAM

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors implement a program of mandatory drug testing for Employees who work on Large Public Works Contracts funded all or in part with public funds.

We hereby certify that we have in place or will implement during the entire term of the contract a Mandatory Drug Testing Program for our employees on the jobsite, including subcontractors, that complies with this regulation:

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Contractor Name: _____

Contractor Address: _____

_____

_____

Authorized Representative (typed or printed): _____

Authorized Representative (signature): _____

Title: _____

Sworn to and Subscribed before me this _____ day of _____ 20____.

My Commission expires _____. NOTARY PUBLIC _____.

THIS PAGE MUST BE SIGNED, NOTARIZED, AND RETURNED WITH YOUR BID.

(This form is required from the prime contractor only, not required from subcontractors)

CA 03/2018

LIST OF SUBCONTRACTORS

Contract: T201507602.02

In accordance with 29 Del. C. S6962(d)10a and 10b, a Pre-Bid Meeting was held on July 16, 2018 to select the subcontractor categories to be included in the bids for performing the work required for this contract.

This proposal is based on work to be performed by the Subcontractors listed below for the categories selected at the Pre-Bid Meeting.

A bid submitted in the name of an individual should list the individual's name followed by T/A and the name of the company.

EXAMPLE: John Doe, T/A Doe Contracting Company

In accordance with Title 29, Subsection 6962(d)(10)b of the Delaware Code, a penalty of $2,000.00 will be withheld from the successful bidder for each occurrence for the failure to utilize any or all of the Subcontractors set forth below:

CATEGORIES	SUBCONTRACTOR	CITY AND STATE

No Subcontractor Categories will be used for this project.

CERTIFICATION

Contract No. T201507602.02
Federal Aid Project No. EBHOS-S018(13)

The undersigned bidder, _____

whose address is _____

and telephone number is _____hereby certifies the following:

I/We have carefully examined the location of the proposed work, the proposed plans and specifications, and will be bound, upon award of this contract by the Department of Transportation, to execute in accordance with such award, a contract with necessary surety bond, of which contract this proposal and said plans and specifications shall be a part, to provide all necessary machinery, tools, labor and other means of construction, and to do all the work and to furnish all the materials necessary to perform and complete the said contract within the time and as required in accordance with the requirements of the Department of Transportation, and at the unit prices for the various items as listed on the preceding pages.

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Bidder's Certification Statement [US DOT Suspension and Debarment Regulation (49 CFR 29)]:

NOTICE: All contractors who hold prime contracts (Federal Aid) with DelDOT are advised that the prime contractor and subcontractors are required to submit to DelDOT a signed and notary attested copy of the Bidder Certification Statement for each and every subcontract that will be utilized by the prime contractor. This Certification **must** be filed with DelDOT prior to written approval being granted for each and every subcontractor. Copies of the Certification Form are available from the appropriate District Construction Office.

Under penalty of perjury under the laws of the United States, that I/We, or any person associated therewith in the capacity of (owner, partner, director, officer, principal, investigator, project director, manager, auditor, or any position involving the administration federal funds):

a. am/are not currently under suspension, debarment, voluntary exclusion, or determination of ineligibility by any federal agency;
b. have not been suspended, debarred, voluntarily excluded or determined ineligible by any federal agency within the past 3 years;
c. do not have a proposed debarment pending; and,
d. have not been indicted, convicted, or had a civil judgement rendered against (it) by a court of competent jurisdiction in any matter involving fraud or official misconduct within the past 3 years.

Exceptions will not necessarily result in denial of award, but will be considered in determining bidder responsibility. For any exception noted, indicate below to whom it applies, initiating agency, and dates of action. Providing false information may result in criminal prosection or administrative sanctions.

_____

_____

_____

(Insert Exceptions)

DBE Program Assurance:

NOTICE: In accordance with 49 CFR Part 26 the undersigned, a legally authorized representative of the bidder listed below, must complete this assurance.

By its signature affixed hereto, assures the Department that it will attain DBE participation as indicated:

Disadvantaged Business Enterprise _____ percent (blank to be filled in by bidder)

The foregoing quantities are considered to be approximate only and are given as the basis for comparison of bids. The Department of Transportation may increase or decrease the amount of any item or portion of the work as may be deemed necessary or expedient. Any such increase or decrease in the quantity for any item will not be regarded as a sufficient ground for an increase or decrease in the unit prices, nor in the time allowed for the completion of the work, except as provided in the contract.

Accompanying this proposal is a surety bond or a security of the bidder assigned to the Department of Transportation, for at least ten (10) percentum of total amount of the proposal, which deposit is to be forfeited as liquidated damages in case this proposal is accepted, and the undersigned shall fail to execute a contract with necessary bond, when required, for the performance of said contract with the Department of Transportation, under the conditions of this proposal, within twenty (20) days after date of official notice of the award of the contract as provided in the requirement and specifications hereto attached; otherwise said deposit is to be returned to the undersigned.

By submission of this proposal, each person signing on behalf of the bidder, certifies as to its own organization, under penalty of perjury, that to the best of each signer's knowledge and belief:

1. The prices in this proposal have been arrived at independently without collusion, consultation, communication, or Agreement with any other bidder or with any competitor for the purpose of restricting competition.
2. Unless required by law, the prices which have been quoted in this proposal have not been knowingly disclosed and will not knowingly be disclosed by the bidder, directly or indirectly, to any other bidder or competitor prior to the opening of proposals.
3. No attempt has been made or will be made by the bidder to induce any other person, partnership, or corporation to submit or not to submit a proposal for the purpose of restricting competition.

CANNOT BE USED FOR BIDDING

==========

I/We acknowledge receipt and incorporation of addenda to this proposal as follows:

No. Date No. Date No. Date No. Date No. Date

_____ _____ _____

BIDDERS MUST ACKNOWLEDGE RECEIPT OF ALL ADDENDA

MUST INSERT DATE OF FINAL QUESTIONS AND ANSWERS ON WEBSITE: _____

==========

Sealed and dated this _____ day of _____ in the year of our Lord two thousand _____ (20___).

_____
Name of Bidder (Organization)

Corporate Seal

By: _____
Authorized Signature

Attest _____

_____
Title

SWORN TO AND SUBSCRIBED BEFORE ME this ____ day of _____, 20____.

Notary Seal

_____
Notary

BID BOND

TO ACCOMPANY PROPOSAL
(Not necessary if security is used)

KNOW ALL MEN BY THESE PRESENTS That:_____

of_____ in the County of _____and State of _____ as **Principal**, and _____ of _____ in the County of _____ and State of _____ as **Surety**, legally authorized to do business in the State of Delaware ("**State**"), are held and firmly unto the **State** in the sum of _____ _____Dollars ($_____), or _____ percent not to exceed _

_____ Dollars ($_____) of amount of bid on Contract No. T201507602.02, to be paid to the **State** for the use and benefit of its Department of Transportation ("**DelDOT**") for which payment well and truly to be made, we do bind ourselves, our and each of our heirs, executors, administrators, and successors, jointly and severally for and in the whole firmly by these presents.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH That if the above bounden **Principal** who has submitted to the **DelDOT** a certain proposal to enter into this contract for the furnishing of certain materiel and/or services within the **State**, shall be awarded this Contract, and if said **Principal** shall well and truly enter into and execute this Contract as may be required by the terms of this Contract and approved by the **DelDOT**, this Contract to be entered into within twenty days after the date of official notice of the award thereof in accordance with the terms of said proposal, then this obligation shall be void or else to be and remain in full force and virtue.

Sealed with _____ seal and dated this _____ day of _____ in the year of our Lord two thousand and _____ (20___).

SEALED, AND DELIVERED IN THE presence of

_____
Name of Bidder (Organization)

Corporate Seal

By: _____
Authorized Signature

Attest _____

_____
Title

_____
Name of Surety

Witness:_____

By: _____

_____
Title

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