

DESCRIPTION

This work shall consist of removing motors and secondary resistors, furnishing and installing new main drive gearmotors and new variable speed motor controllers in accordance with the contract documents and as directed by the Engineer.

This work shall comply with the requirements of the following codes and standards:

1. National Fire Protection Association, National Electrical Code (NEC), latest edition
2. New York State Department of Transportation, Standard Specifications, latest edition
3. National Electrical Contractors Association, NECA 1, Standard Practices for Good Workmanship in Electrical Contracting

MATERIALS

A. *Flux Vector Type Motor Speed Controllers (Drives).* Speed regulating and static contactorless reversing control for raising and lowering the bridge shall be of the flux vector type with dynamic braking. The control system development is based on using flux vector drives in an encoderless (no external feedback signal) configuration. The Contractor shall provide all necessary system development details and control system interfacing, prepared in advance and submitted for approval, as one complete package.

One complete speed controller for each drive gearmotor (total of two) shall be furnished and installed in floor-mounted control cabinets. The components of each set shall be sized for speed regulation of the AC squirrel-cage, three-phase, 60-Hertz, inverter duty type motors.

Drives shall be capable of delivering 180 percent rated motor full load torque for no less than 30 seconds, and 150 percent rated motor full load torque for no less than one minute, without shutting down in a fault mode.

Each drive may be fed via a non-reversing combination starter in the motor control center, or directly from the bus, with all combination starter components in each drive cabinet. The control functions shall provide automatic stepless acceleration, regulated running, and stepless deceleration with dynamic braking. The Operator will initiate span motion by switching a momentary contact selector switch to "Raise" or "Lower" to obtain raising or lowering the span, through automatic acceleration, uniform speed, and deceleration until either the "fully open" or "fully seated" position is reached.

The drives shall be properly interfaced with the control circuit through discrete (contacts) inputs. Digital data type interconnections shall not be utilized between the PLC and the drives. Indicator lights shall be provided in parallel with each of the mode inputs below, (a) through (e), for visual indication of when the respective mode is active.

Each drive shall be provided with internal diagnostics, fault indication and trouble-shooting charts.

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Each drive within its control cabinet shall be factory-wired, with each wire identified to agree with connection diagrams furnished by the control manufacturer and terminated on pre-labeled terminal blocks for external wiring. Each major component of the drives and their cabinet enclosure(s) shall have engraved nameplates affixed.

Independent digital adjustments shall be provided in each drive for:

- (a) Creep Speed – Initial setting approximately 5 percent of motor nameplate speed.
- (b) Reduced Speed - Initial setting approximately 35 percent of motor nameplate speed.
- (c) Running Speed – Initial setting of approximately 90 percent of motor nameplate speed.
- (d) Reduced Torque Limit – Initial setting of approximately 75 percent of rated motor full load torque (this value to be used only at bridge seating).
- (e) Normal Torque Limit – Initial setting of approximately 150 percent of motor nameplate full load torque. (This current limiting shall be in effect at all times of motor operation, except when reduced torque is in effect at seating).
- (f) Acceleration/Deceleration Ramp Time - Initial setting of 10 seconds (adjustment range of at least 0.5 second to 20 seconds).

The performance test of each drive assembly shall be made in conjunction with the PLC and control console and witnessed by the Engineer at the control system vendor's facilities before shipment to the project site. Two weeks written advance notice of the test date shall be given by the Contractor.

B. Span Drive Gearmotor. Each span main drive gearmotor shall be an AC squirrel-cage type inverter duty motor, suitable for use with a flux vector drive, face-mounted to a gear reducer. The motor shall be NEMA Design B torque characteristic, totally-enclosed non-ventilated (TENV), weatherproof housing with re-greaseable ball or roller bearings, internal space heaters. Each motor shall have straight shaft extension at each end, modified as required to accommodate couplings for the brake wheel and the gear reducer. The Contractor shall furnish manufacturer's templates and certified detail information for mounting purposes. Each span drive motor shall be rated as follows:

Electrical:

- Horsepower rated as shown on plans, 1800 RPM (nominal)
- 600 RPM (approximate) output from gear reducer
- 230 volts, three-phase, 60-hertz, 30 minutes (minimum) service
- Full load rated current within 10% of NEC Table 430.250
- Class H insulation, voltage spike-resistance per NEMA MG1-31.40.4.2 (1600 V peak at 0.1 us or larger rise time)

- 40 Degrees C ambient temperature rise

Mechanical:

- Helical gear reducer with parallel shaft output
- Ratio shown on plans
- Efficiency – 95% (minimum)
- Service Factor – 2.5 (minimum)
- Gears carburized to hardness 58-62 Rc.

The span drive gearmotors shall be in accordance with requirements of NEMA Standards MG1, Motors and Generators and tested in accordance with the latest requirements of IEEE Standard 112, Standard Test Procedure for Polyphase Induction Motors and Generators. Written verification of dimensional compatibility with existing gearing components, based on field measurements by the Contractor, must accompany any motor submittals for approval for installation.

C. *Dynamic Brake Modules and Resistors.* Each drive shall be provided with a dynamic brake module and braking resistor. Dynamic braking modules and resistors shall be sized to provide 150 percent braking torque at a duty cycle of approximately 40 percent. Resistor elements shall be of stainless steel in ventilated enclosures.

D. *Documentation.* The drives and gearmotors shall be furnished with complete electrical wiring diagrams, part lists with diagrams showing locations and replacement part numbers for all replaceable components, start-up and adjustment instructions, lubrication instructions, maintenance and troubleshooting instructions, recommended spare part lists, and operating instructions.

E. *Spare Parts.* Spare parts for the motor speed controllers shall be furnished as follows:

- a. Two complete relays of each type utilized in the drive cabinet assembly
- b. Three fuses of each type and rating used in the drive cabinet assembly
- c. One complete set of replaceable contacts for each circuit breaker used in the drive cabinet assembly
- d. One complete set of replaceable contacts for each contactor used in the drive cabinet assembly
- e. Six indicator lamps of each type and size used in the drive cabinet assembly
- f. One flux vector drive unit
- g. One dynamic brake module

CONSTRUCTION DETAILS

A. *General.* Wiring diagrams for the power and control circuit connections to each motor speed controller shall be included with the shop drawing submittals of the speed controllers.

The control system vendor shall also acquire the services of the drive manufacturer's field service engineer/technician to be on-site with and in addition to his own personnel during the start-up and adjustment period.

Basis of Acceptance

All shop drawings submitted shall follow the general guidelines and procedures given in the New York State Steel Construction Manual. No installation or rehabilitation work may take place until the shop drawings and procedures have been approved by the Engineer.

Prior to energizing any drive for the first time, the Contractor shall confirm the connections of all drive motor conductors for continuity, freedom from short circuits, and correct phase rotation. The supply voltage shall also be measured and verified correct. All control circuit connections shall be verified. Only after these preliminary checks have been performed may the drives be energized.

Alignment of the motor shafts shall be verified prior to initial operation, and again after all connections and speed controllers have been installed and the bridge has been operated through at least 10 full open-close cycles.

The removal of the existing motors and secondary resistors shall be included in this work. The removed motors and resistors shall become the properties of the Contractor and shall be properly disposed of away from the construction site.

B. Field Adjustments. All initial field adjustments and settings of the drives shall be made by or in the presence of the drive manufacturer's field startup technician as directed by the Engineer and to the satisfaction of the Engineer. As deemed necessary by the Engineer or the drives manufacturer's field technician after observing the motor and drive performance, the drives shall be further adjusted for improvements in operational performance. A process of fine tuning with multiple adjustments shall be assumed by the Contractor.

C. Training. Prior to the final acceptance of the drive system, the Contractor shall furnish the services of competent and experienced instructors to give full and in-depth instruction to NYSDOT personnel in the adjustment, operation, and maintenance of the drives and drive motors, including pertinent safety requirements, as required. The instructor(s) shall be thoroughly familiar with all aspects of the installation and shall be trained in operating theory, as well as practical operation and maintenance work of the drives, and all other control system components. The instruction shall be given during the first regular work week after the tests on equipment or system have been performed prior to final acceptance. This training period shall be coordinated and combined with other required training for the entire electrical and control system of the bridge. The instruction shall be given at the site, on a scheduled approved by the Engineer.

D. Removals. Removal of existing motors, resistors and associated controls and peripheral devices shall be included in this work. All such removed equipment and components shall be properly disposed of by the contractor away from the site.

METHOD OF MEASUREMENT

This work will be measured for payment on a lump sum basis.

BASIS OF PAYMENT

The lump sum price bid shall include the costs of removing existing equipment and furnishing all material, labor and equipment to install a complete, properly operating drive system to provide smooth and satisfactory operation of the bridge as described herein under this item and as shown on the plans. The price bid shall also include all spare parts, documentation, tests, and personnel training as described herein.

This lump sum will be paid in the following installments, with each payment subject to approval of the Engineer:

- Sixty (60) percent of the lump sum price bid will be paid to the Contractor upon satisfactory completion of the installation of the Main Drives and Motors.
- The remaining forty (40) percent of the lump sum price bid will be paid to the Contractor upon satisfactory completion of testing of the Main Drives and Motors and upon final acceptance by the State.