SECTION 26 60 00 – DYNAMIC VAR COMPENSATION

1.01 SUMMARY:

A. **Basic Function**: Dynamic VAR compensation (DVC) equipment is used to keep the electrical system free from harmonics spikes and voltage sags.

B. [A17]**Scope of Work**: The Contractor shall provide the design and specifications for the purchase and installation by others, of dynamic VAR compensation equipment as specified below for every motor control center (MCC) that controls a frequency driver motor system and where there is installed equipment capable to produce harmonic distortions in the electrical distribution system The VAR compensator shall be dimensioned according to the reactive power and harmonics expected. The Contractor shall leave space provisions for future installation of the VAR compensation equipment by others. [A17]

1.02 [A16]REFERENCES: [A16]

A. **American National Standards Institute (ANSI) Standards**:

C37.015 – 94	Application Guide for Shunt Reactor Switching

B. **Information Technology Industry Council (ITI), formerly known as Computer & Business Equipment Manufacturing Association (CBEMA) Publications**:

ITI (CBEMA) curve	Revised 2000

C. **Institute of Electrical and Electronics Engineers (IEEE) Standards**:

18 – 06	Standard for Shunt Power Capacitors
519 – 92	Recommended Practice and Requirements for Harmonic Control in Electrical System
1036 – 02	Application of Shunt Power Capacitors
1303 – 00	Guide for Static VAR Compensator Field Tests
C57.12.29 -- 05	Standard for Pad-Mounted Equipment Enclosure Integrity for Coastal Environment

D. **National Electrical Manufacturer Association (NEMA) Standards**:

250 – 03	Enclosures for Electrical Equipment (1000 Volts Maximum)

1.03 REQUIREMENTS:

A. [A17]The dynamic VAR compensation (DVC) equipment shall provide VAR compensation in low voltage systems in less than 1 cycle. [A17]

1. DVC Systems shall keep harmonics to a level that meets standard IEEE 519.

2. DVC Systems shall keep voltage level within the ranges established in ITI (CBEMA) curve revised in year 2000, for voltage fluctuations over 1 cycle.

3. [A5]In addition, DVC Systems shall be voltage regulated while maintaining lagging power factor at a level between 0.90 and 1.0; and, in no situation, shall the power factor fall on the capacitive zone. [A5]

B. [A17]**Location**: The dynamic VAR compensation (DVC) Systems will be installed on every motor control center where a frequency driver or harmonic source equipment is installed.[A17]

C. **Capacities**: Capacities of equipment and material shall be not less than those indicated on these specifications.

D. **Modularity**: DVC System shall be modular type system with easy access or replacement of the different modules or elements.

E. **Accessibility of components**: Cabinets shall house all elements of the equipment and the microprocessor based controller that shall be conspicuously mounted on the main cabinet in a way that operators shall have immediately access to the display and buttons.

F. [A16]**Corrosion Resistance**: All interior and exterior ferrous metal shall be specified to be cleaned and painted with corrosion protective coating system as per IEEE C57.12.29 and Section 09 96 00 (*Corrosion Control Coatings*).

G. Reserved

H. **Standard Products**: Materials and equipment specified shall be standard products of concerns regularly engaged in the commercial production of these products and shall be the latest standard design that conforms to the specifications. [A16]

I. **Marking**: Internal equipment wiring marking shall be as per Section 26 05 53 (*Identification for Electrical Systems*).

1.04 [A7]DESIGN CRITERIA/SYSTEM DESCRIPTION AND PERFORMANCE:[A7]

A. **Dynamic VAR Compensator**: The DVC equipment shall have a capacitor/inductance circuit switched on the network by solid-state power electronics without any moving parts. It shall have a microprocessor-based computer that shall calculate and switch the amount of capacitors or inductances required and switch them on or off, in less than 1 cycle. Equipment shall also have an algorithm for voltage control. Equipment enclosure shall meet NEMA 250.

B. **General Requirements**:

1. **Dynamic VAR Compensator (DVC) System**: The DVC Systems shall be a modular type system with easy access or replacement of the different modules or elements.

a. The enclosure shall be sized to accommodate all related elements, such as switching module, controller, reactors, and capacitors.

b. It shall have lifting provisions.

c. It shall be suitable for either top or bottom cable entrance.

d. It shall be assembled to form a rigid, self-supporting, metal enclosed structure.

e. Minimum steel gauge shall be 12

f. Enclosure shall be type NEMA 12 with forced ventilation, as required, in accordance with NEMA 250.

2. **Switching Module**:

a. It shall be a full electronic switching device.

b. It shall avoid switching transients performing connections to the network during capacitors current zero-crossings for smooth connection and disconnection of capacitor or reactor groups.

c. The electronic switching element shall be IGBT's (Isolated-Gate Bi-Polar Transistors), Thyristors or SCR's (Silicone-Controlled Rectifiers) subject to being able to meet the "time for operation" constrain.

d. The modules shall be air-cooled, except that forced air is acceptable with a dust control system.

e. Modules shall be protected from short circuit by very high-speed fuses and from heat by breaker or high temperature protection device.

f. Modules shall be high efficiency with a maximum loss of 2.5 Watts per kVAR and able to withstand at least 3.6 kV peak voltage.

3. **Controller and Measurement Unit**: Shall be designed to measure the current and voltage of the load continuously and switch the right amount of reactive power to compensate. Total time for performing the measurement, calculating requirements and switching action shall be made in less than 1cycle. It shall have the following features:

a. Shall measure real and reactive power and all other necessary parameters of the load and calculate the steps to be switched on in order to compensate in less that 1 cycle.

b. Shall control at least 10 groups of capacitors/inductors per controller as a minimum

c. Water and dust tight. See enclosure paragraph.

d. Self-Diagnostic of the controller itself and of the switching modules

e. Monitoring of working parameters of all elements of the DVC system such as switching module temperature, reactor and capacitors current, etc.

f. The DVC System shall compensate on any power flow direction, in other words, shall compensate on the four quadrants of the active-reactive power graphic.

g. Full graphic high-resolution display

h. Provision to connect all individual units through a network for monitoring purposes.

i. Communication shall be done through an Ethernet media, according to Section 27 05 28 (*Communications Pathways for Inside Plant*).

j. At least one output for alarm purposes. It shall be a dry contact rated 250 VAC, 2A as a minimum.

k. Shall have a system that switch on different groups every time to uniform engagement of all groups. FIFO (First In First Out)

l. Measurements Capabilities, but not limited to:

1) Voltages.

2) Current.

3) Frequency

4) Power factor

5) Active, Reactive and Apparent Power

6) Voltage Total Harmonic Distortion THD V

7) Current Total Harmonic Distortion THD I

8) Fast Fourier Transform (FFT). For Harmonic Spectrum up to the 63rd

9) Waveform capture with at least 128 samples per cycle.

4. [A17]Microprocessor based full programmable equipment which shall include as a minimum: [A17]

a. Firmware can be upgraded by communication port.

b. All parameters (System [A17]protection, thresholds and firmware [A17]) shall be programmable and stored on a non-volatile memory.

c. At least 2 communication ports shall be provided. One for network connection and another for local PC (notebook) connection. PC cable must be provided.

d. Full remote control through an Ethernet communication interface.

e. Local Human Machine Interface (HMI) for programming and measurement selection.

5. **Inductances and Capacitors**:

a. **Capacitors**: Shall be dry type dielectric. Connected in series with reactor. Capacitors shall comply with IEEE 1036 and IEEE 18. Made from metallized polypropylene film with the following characteristics:

1) Indoor Type, mounted in racks with individually protecting fuses.

2) Delta connected three phase banks.

3) Aluminum can with over-pressure switch.

4) Temperature range from 10°C to 55°C.

5) Ground Insulation of 3 kV.

6) Rated Voltage 800 V minimum.

7) Capacitance tolerance from -5% to +10% maximum and factory tuned for harmonics filtering at 60 Hz.

8) High efficiency low losses 0.5 watts per kVAR maximum

9) Voltage test 2.15 times nominal voltage for 2 sec and 3 kV to ground for 10 seconds, according to IEEE 18 and IEEE 1036.

10) [A7]**Maximum Over Voltages**:[A7]

a) 110% for 8 hours per day
b) 115% for 30 min. per day
c) 120% for 5 min./200 times
d) 130% for 1-min./200 times

11) Maximum over current of 1.3 times nominal current

12) Maximum permissible switching current 100 times nominal current

13) Discharge time fewer than 50 volts after 1 minute, self-healing type.

b. **Inductances**: Dry type, copper winding with iron core. Reactors shall comply with ANSI C37.015. With the following characteristics:

1) Tolerance from 0% to +2% maximum

2) Maximum increase temperature of 60°C

3) Laminated silicone steel core to minimize losses

4) Polyester varnish. Temperature class H, 180°C or better with oven impregnation.

6. **Equipment Capacity**: According to the system design. The DVC units shall be capable to compensate to unity power factor. The equipment shall consist on:

a. Capacitors size and quantities shall be determined by designer

b. Inductors size and quantities shall be determined by designer

c. Contractor shall determine harmonic filtering capacity. Filter size for all odds harmonics shall be based on a previous study of the proposed system. Measurements shall be taken by the Contractor at their own cost, after installation is complete.

7. **Remote Monitoring**: The DVC system shall have capabilities for Ethernet network connection and PC serial communication port.

a. The remote monitoring system shall perform as a minimum the following issues:

1) Remote control.

2) Real-Time measurements.

3) Waveforms and stored data download.

4) Access to data logging and set points

5) Generic reports.

6) Customized reports.

7) DVC Systems programming

b. **Network Design and Installation**: The DVC shall have the capability for network connection. Contractor shall connect DVC's the Ethernet network. Through this network remote monitoring of each unit will be performed.

c. **Software**: The monitoring software shall be developed using at least one of the following programming tools: ActiveX, DDE server (Microsoft), or OPCserver.|

8. **Protection of equipment**: The scheme shall be conform of pre-alarm, alarm and trips. The system shall be protected (failure detection, alarm and isolation) against, but not limited to the following:

a. Electronic switching gate device

b. Loss of cooling

c. Over temperature

d. Over voltage

e. Over pressure protection on capacitors

f. Overcurrent and short circuit

g. Arrester and surge capacitor protection on bus

h. Loss of phase

i. Phase reversal

j. Over load

k. Ground fault

l. Control system

C. **Nameplates**: Equipment shall have the following manufacturer's information in a nameplate securely and conspicuously attached to the equipment. Nameplates for electrical apparatus shall conform to NEMA standards:

1. Name,

2. Address,

3. Catalog number,

4. Model,

5. Style or type identified.

1.05 [A7]**SUBMITTALS**:[A7]

A. Before manufacturing of the Variable Frequency Drive required in Section 26 29 23.

1. DVC and [A17]harmonic[A17] filtering equipment specifications

2. Calculations for harmonics filtering, equipment capacity and expected conformance to IEEE 519

3. Connection diagrams

4. Elementary diagrams

END OF SECTION

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