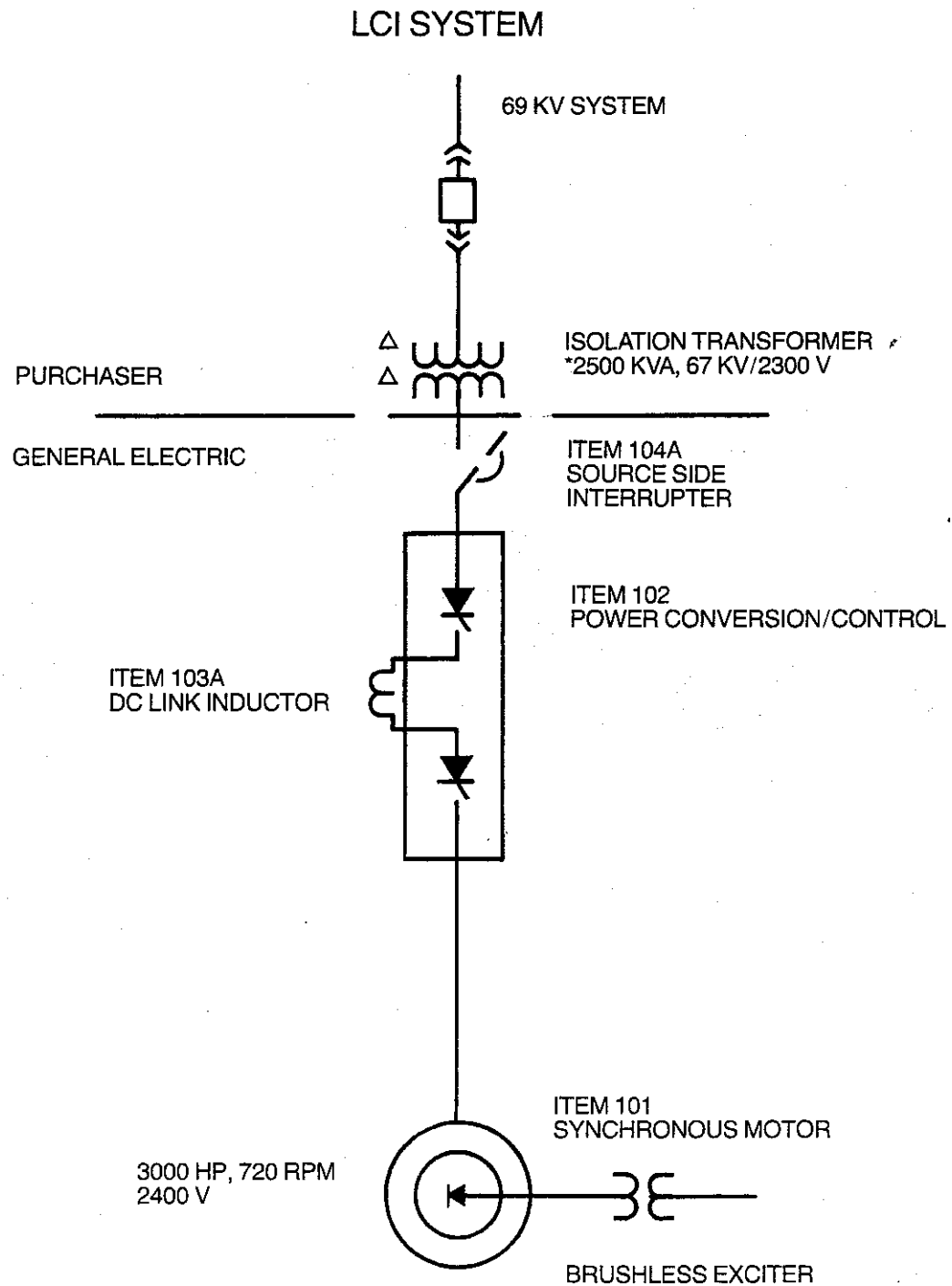




*2500 KVA IS OA RATING
TRANSFORMER TO BE FORCED COOLED BY PURCHASER

Figure 1

Drive System One-Line Diagram

DRIVE SYSTEM RATING1- Drive rating:

3000 Hp, 720 RPM, 2400 volt, 60 Hertz

2- Drive Suitable for Operation at:

3000 Hp, 792 RPM, 2400 volts, 60 Hertz

3- Speed Range

Normal continuous speed range from 50 to 110 percent on the ventilation fan application

Acceleration is typically set in factory for one percent per second.

4- Torque Requirements

The load torques vary with the square of speed with a breakaway torque of approximately 10 percent.

Deceleration adjustable to current limit of 115 percent of motor rating.

Deceleration typically set in factory for one percent of motor rating.

(See Speed - Torque Curve, Figure 2)

5- Altitude and Temperature

The proposed equipment is suitable for operation in the following environment:

Temperature ambient specified below, 0 to 95 percent relative humidity with frequent interchange of air. Temperature and humidity conditions, including their relative rate of change, should be controlled so there is no moisture condensation in or on the equipment. A reasonably clear atmosphere is expected.

Control

Ambient Temperature

Between 0°C to 40°C

Relative Humidity

5 to 95 percent

Elevation

Not to exceed 5300 feet

Conditions

Indoor, controlled environment

Transformer

Existing

Inductor

Ambient Temperature

-30°C to 40°C Maximum

Elevation

Not to exceed 5300 feet

Conditions

Outdoor

Motor

Ambient Temperature

0°C to 40°C Maximum

Elevation

Not to exceed 5300 feet

Conditions

Indoor

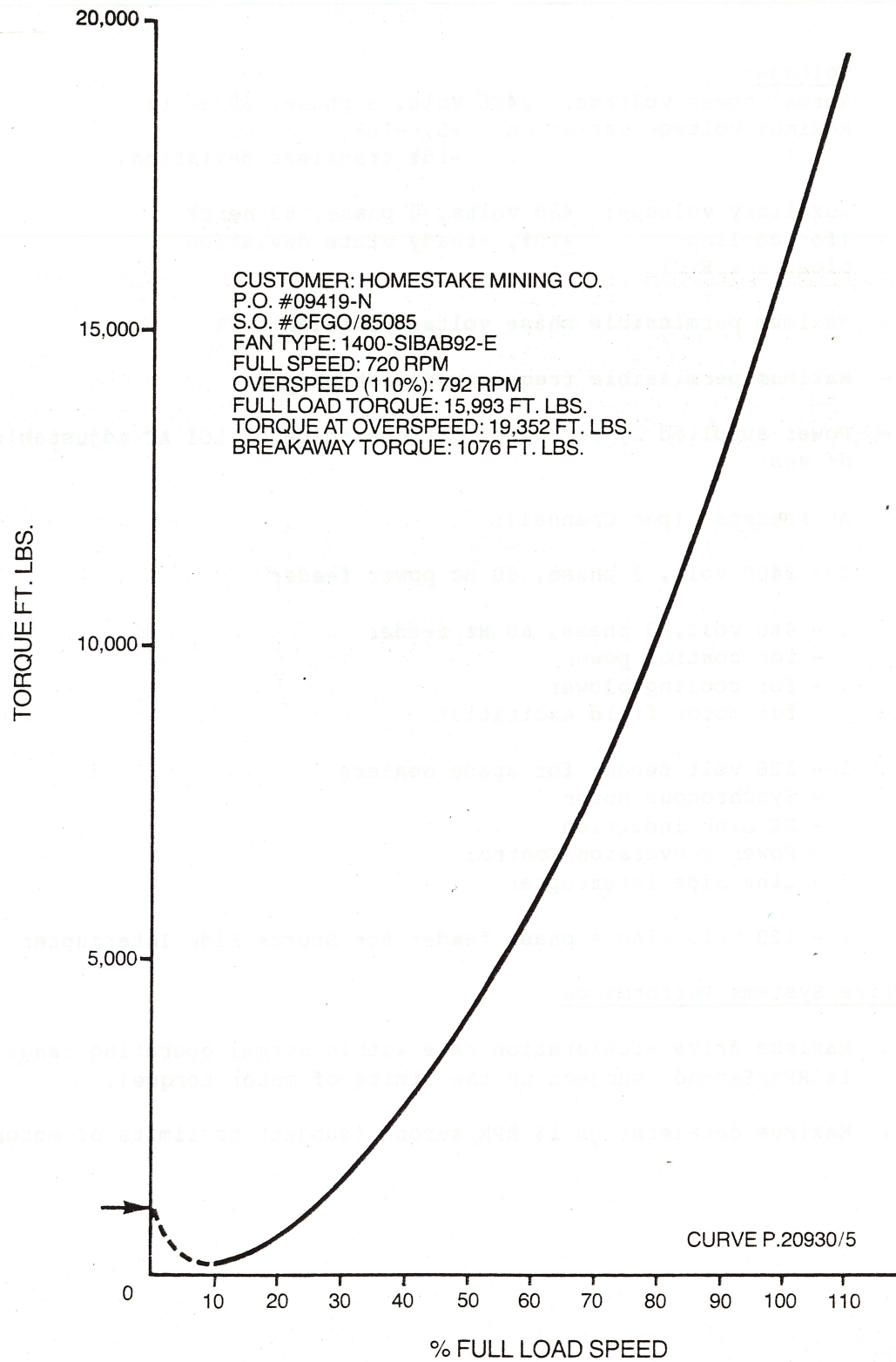


Figure 2

Ventilating Fan Speed Torque Curve

ID Fan Motor DataSynchronous Drive Motor

Type and Frame:	Frame TS8610 Dripproof Guarded Stator Model 271R206 S/N 270777
Rated Horse power	3000 HP
Rated Top Speed	720 RPM(10 poles)
Speed Range	
Normal operation	360 to 792 RPM (50% to 110%)
Rated Stator Volts: (dual stator winding)	2400
Rated Stator Amperes:	616 Amperes
Temperature Rise	85°C by RTD - stator
Service Factor	1.0
Insulation Class:	
Stator	F
Rotor	F
Rotation	CCW, ODE
Stator RTDs	Qty 6, 10 ohms @ 25°C copper
Space Heaters	2400 watts, 120 volts, 1 phase
Bearing Temperature Detectors	RTD, 100 ohms @ 0°C (one per bearing)

ID Fan Motor Data (Cont'd)

Brushless exciter(6 pole) Nameplate rated 17KW, 720 RPM, 460 volts, 3 phase,
60 hertz

Rated excitation amps: 38 amps AC (with 218 volts at AC terminals of
brushless exciter)

Exciter Temperature Rise: 85° by RTD stator

Exciter insulation class

Stator	F
Rotor	F

Exciter stator RTDs Qty 6, 10 ohms @ 25°C copper

Motor Armature WK² 12740 lb ft²

Net Total Motor Weight 29700 lbs

Rotor Weight 12785 lbs

Exciter armature 395 lbs

Exciter Rotor WK² 91 lbs ft²

LOAD COMMUTATED INVERTER
DRIVE SYSTEMSLIST OF APPARATUS

<u>Item</u>	<u>Description</u>
101	Synchronous Motor
102	LCI Power Conversion/Control
103A	DC Link Inductor
103B	Isolation Transformer (Provided by Purchaser)
104A	Incoming Line Interrupter
105	Maintenance and Installation Terminal
106	Operating Manuals
107	Damped Coupling (Provided by Purchaser)

<u>ITEM</u>	<u>QTY.</u>	
101	1	<u>Synchronous Motor</u>

GE horizontal synchronous motor rated 3000 HP, 2400 volts, 720 RPM, 3 phase, 60 hertz, class F insulation suitable for non-reversing service and will have the following ratings with rated voltage and frequency at the stator terminals.

Ratings

Temperature rise	80°C (85°C by detector)
Service factor	1.0
At ambient temp.	40°C
And altitude	5300 Feet
Maximum torque	115% with LCI system
Power factor	0.9 leading
Rotation	CCW, ODE
Continuous Operation	
speed range	50% to 100% of base speed
Load Torque	Variable Torque (Fan Characteristics)

Note: Fan $Wk^2 = 201,900 \text{ Lb-Ft}^2$, fan breakaway torque 1076 Lb-Ft.

Suitable of operation at the following ratings:

Single Channel, 6-pulse rating
3000 HP, 720RPM, 60 Hz, 2400 V, 1.0 S.F., power factor 0.90,
85°C temperature rise by detector

or

Single Channel, 6-pulse rating
3000 HP, 792 RPM, 66 Hz, 2400 V, 1.0 S.F., power factor 0.90,
85°C temperature rise by detector

or

Single Channel, 6-pulse rating
1710 HP, 597 RPM, 49.8 Hz, 2400 V, 1.0 S.F., power factor 0.95,
85°C temperature rise by detector

Construction

Mounting	Horizontal
Shaft	Single-extendion
Bearings	Sleeve
Enclosure	Dripproof (with inlet & outlet Screen)
Frame Size	(later)
Hardware	Corrosion-resistant

<u>ITEM</u>	<u>QTY.</u>	
101	1	<u>Synchronous Motor (Cont'd)</u>
		<u>Accessories and Modifications</u>
		Space heaters - 120 Volts, 1-phase space heater
		6 (2 per phase) cooper resistance staor RTD, 10 Ohms @ 25°C
		Bearing resistance temperature detector, RTD 100 Ohms @ 0°C (one RTD per bearing)
		Two ground pads - (on diagonal corners of motor)
		Oversize main terminal box to be located on left side ODE. (Top entrance) Power cable 2-500MCM/phase
		Auxiliary terminal boxes to be located on right side ODE (Top entrance)
		<u>Bearings</u>
		Split-sleeve with end bearing opposite drive bearing insulated. Also, to facilitate assembly, indicate on outline minimum end play, mark rotor end play limits on shaft.
		Self-ring lubrication with provisions for future flood lubrication.
		Oil level sight gage.
		Port to view oil rings.
		<u>Controlled Exciter - 6-Pole Exciter</u>
		The LCI dfrive will provide adjustaable-voltage input to the rotating exciter. The rotating exciter will be brushless type - contra-connected.
		Exciter winding insulation system shall be Class F with Class B temperature rise.
		Input to exciter will be adjustable voltage 0 to 460 V ($\pm$ 10%), 3 phase.
		Stator exciter RTDs 10 Ohm (@ 25°C).

<u>ITEM</u>	<u>QTY.</u>
101	1

Synchronous Motor (Cont'd)Additional Mechanical and Electrical Features

Motor vibration amplitudes per NEMA MG-1-21.53.

Maximum sound power level measured at a distance of 1 meter shall not exceed 85 dBA (measured at no load and rated speed).

Natural frequency at least 25 percent above rated speed.

Lifting lugs or provision for attachment of lifting sling.

Motor color - medium gray..

ITEM QTY.102 1 POWER CONVERSION/CONTROL PANELS

The power conversion and control equipment is mounted in NEMA I ventilated panels with space heaters.

Power Conversion Panel:

- 1-AC line converter using series redundant thyristor cells to rectify AC line power to controlled voltage DC power.
- 1-DC link circuit with provision for connection to remote-mounted inductor.
- 1-Inverter using series redundant thyristor cells to convert DC link power to controlled frequency AC power.
- 1-Fan and line filter compartment(8700 CFM air required).
- 1-Control panel, described below, includes microprocessor based control, diagnostics, and field excitation.

Power Conversion Features:

- Converter and inverter with duplicate construction.
 - Each thyristor will have a status indicating light visible during drive operation (light ON for normal condition).
 - Cell stacks are of modular design, requiring no special tools for removal/disassembly
 - Fuseless power circuits
 - Uninsulated copper ground bus the length of conversion panels.
 - Line surge protection
- Thyristor cells are applied to have 2.47 times voltage margin under normal conditions and 1.65 times voltage margin with one cell per leg faulted at normal input voltage.

Control Panel:

Each control panel incorporates the following:

All customer input/output signals;

- inputs, (for example drive speed, start, and stop)
- outputs, (for example drive status and breaker control)
- RS232 port for remote customer communication, including retrieval of data logging information (see next page)

Software based regulation of speed, current, thyristor gating, motor flux and field excitation.

Protective hardware and software capable of alarms, (operator notification), and faults, (operator notification and orderly drive shutdown) listed on next page.

Metering and diagnostics, description on following pages.

Control Panel Features:

In addition to system control, the following pages describe the metering, protection and diagnostics performed by the LCI control.

Data Logging

A Data Logging feature assists the metering, protection, and diagnostic schemes. The proposed drive is equipped with a 24 column printer mounted on the control panel. The printer will record the information on command, or at timed intervals. The following will be available:

Metering

- Speed
- Speed reference
- Motor amps
- Field amps
- Horsepower
- DC Link volts
- DC Link amps
- Motor Phase Volts
- Source amps
- Source volts
- Source Converter gating angle
- Load Inverter gating angle
- Motor power factor
- Source power factor
- Source KVAR
- Current Limit set point
- Voltage Limit set point

Protective/Status Messages:

- "Ready" indicating drive ready to run status
 - "Alarm" indicating which of the following alarm conditions exist
 - Loss of speed reference
 - Loss of speed control
 - Reactor overtemperature
 - Filter fuse blown
 - Failure to start
 - "Fault" indicating which of the following fault conditions exist
 - Source overvoltage
 - Source overcurrent
 - Source-load differential current
 - Load overvoltage
 - Load overcurrent
 - Overspeed
 - Ground fault
 - Fan loss
 - Exciter current unbalance
 - Field loss
 - Field overcurrent
 - Source and Load phase locked loop fault
 - Shorted winding detection for motor
 - Fan door open
 - Microprocessor stall
 - Open Phase/Source undervoltage
 - Gating power undervoltage
 - A user supplied fault, optional
-

Diagnostics; The Data Logging feature provides an English language message to the door mounted printer to aid in trouble shooting. Upon successful completion of each diagnostic test, a "Healthy" message will be outputted. If the test is not successful, a complete list of any problems uncovered will be outputted. This list will provide maintenance personnel with the specific fault or alarm conditions, (including time and date of occurrence), that need to be corrected. In the event that the fault or alarm condition is not unique, an ordered "first fault" list will be outputted along with solutions for maintenance personnel to follow. This information is also remotely available via the RS232 communication port provided with each drive.

Two types of diagnostic tests can be performed;

- 1 Self diagnostics which check the CPU, "I'M OK" LEDs on circuit boards, memory, and internal logic functions. If, for example, a circuit board has failed, this test will identify which circuit board needs to be replaced. This capability means quick problem identification and minimal downtime. Test execution time is approximately 3 seconds.
- 2 Extended diagnostics to check panel hardware can also be performed. This test will include checking ribbon cables to determine that they are plugged into the correct slot, EVC (gating, current, and voltage signals), input/output relays and contacts, printer, and meters. Once again, any problems, for example misconnection of a ribbon cable, will be uniquely identified for maintenance personnel. Test execution time is approximately 10 seconds.

Control Hardware; In addition to the information available through data logging and relay outputs, the following hardware is also provided with each drive.

-Door mounted devices

Indicating Lights; Meters;

- | | |
|---------|---------------|
| - Run | Motor RPM |
| - Alarm | Motor Volts |
| - Fault | Motor Current |
| - Ready | Drive HP |

Push buttons;

- Reset
- Print (Drive status)

Printer, 24 column, english language, with clock

ITEM QTY
102 (Cont'd)

-Internal mounted devices on I/O module

Local-remote selector switch
Start pushbutton
Stop pushbutton
Speed adjust potentiometer

-Operator Station

SBM switch with slip contact (close after run) mounted
on door for Start-Stop function.
Speed adjust potentiometer (mounted inside)

General Electric will provide Terminal Board connection to accept
the following inputs (contacts)

- Alarm
- Run permissive
- Start permissive

General Electric will provide Terminal Board connection to provide
the following outputs (contact)

- Ready
- Running
- Alarm
- Fault (for tripping Drive)

PC/C equipment will accept 120V - 1-phase power (one feeder)
provided by Purchaser for controlling the following Space Heaters:

- Motor
- DC Link INductor
- Control
- Line Side Interrupter

PC/C equipment will accept 460V - 3-phase power (one feeder)
provided by Purchaser for the following:

- Motor Field
- Cooling Fans
- Control Power

<u>ITEM</u>	<u>QTY.</u>
103A	1

DC Link Inductor for Ventilating FanEach Dry-Type Reactor

Outdoor, dry-type, air-core, convection cooled mounted in NEMA 3R outdoor enclosure. For use in load side of 6 pulse thyristor power converter

Rating of Each Reactor

- DC continuous amperes - 825 amperes
 - Inductance: 7.1 millihenries
 - Volts to ground - 5000 volts
 - Mechanically rated for 15,000 amperes short circuit
 - Reactor volts (1) - 3600 volts
 - DV/DT (2) - 900 volts
 - Insulation class - Class H
 - Temperature rise - 115°C with 40° maximum ambient for rated reactor current.
 - Ambient - 40°C Maximum (-30°C minimum)
 - Tolerance on reactance - 0 percent, +10 percent
 - Humidity: 5 to 95 percent relative humidity, noncondensing
 - Air core construction
 - Sound level shall not exceed NEMA 1 standards TR-27
- (1) Reactor volts is defined as the peak-to-peak voltage of a sawtooth wave at 360 Hz. The value specified is for normal continuous operation. The reactor should be capable of two times this value for occasional disturbances.
- (2) DV/DT is defined as volts per microsecond which is imposed by the voltage defined in (1). Two times this value will be imposed occasionally.

ITEM QTY
103A (CONT)

Construction and Accessories

Construction - The reactor shall be NEMA 3R, outdoor, dry-type, self-cooled (convection), suitable for service in a power plant (flyash laden) atmosphere.

The enclosure to be of aluminum with removable panels and provide for proper cooling.

There shall be adequate clearance between the coil and the enclosure to prevent excessive cabinet heating and between the coil and mounting surface to prevent excessive heat in the reinforcing rod inside the mounting surface.

Aluminum conductors with drilled, plated copper terminals for connecting to purchaser's cables. Copper terminals to be L shaped for cable connection from the side of enclosure. Also provide clamp type terminal lugs for purchasers 2 - 750MCM cables per connection.

Cable entry from side. Purchaser will drill side of enclosure to permit entry of power cable from side.

The reactor base shall be of the fabricated type, have provision for lifting and be suitable for jacking, rolling, or skidding in any direction.

The base shall have two ground pads (at diagonally opposite corners) drilled and tapped for standard NEMA 2 hole pad spacing.

Space heaters shall be provided. The heaters shall be rated 120 volts, 1-phase, 60 hertz (with fused disconnect).

Overtemperature detector with alarm contacts (2 NC isolated contacts which open on alarm).

Accessory leads shall be brought to an auxiliary terminal box which shall be accessible from outside the reactor.

Paint - outdoor light gray ANSI 70

ITEM QTY103B (CONT) Isolation Transformer - Fan Drives

X Qty (1) Outdoor, transformer will be provided by Purchaser.

For service with a six pulse thyristor power converter (rectifier) for an LCI drive:

Rating - 2500 KVA
67000 Primary
2300 Volts Secondary

Note: Primary voltage normally runs high so secondary voltage at motor will be 2400 volts.

Impedance - 7.4 percent on 2500 KVA base.

Available short circuit KVA a transformer secondary = 32000 KVA

Primary - Delta

Secondary - Delta (ungrounded)

Provisions for addition of future forced air cooling equipment. Purchaser plans to add fans to increase rating to 3500 KVA.

4 - 2 1/2% taps - 2 above and 2 below rated.

- * - Overtemperature device - none
- * - Liquid level devices - none
- * - Pressure relief devices - none

<u>ITEM</u>	<u>QTY</u>	
104A	1	<u>Source Side Interrupter</u> Source side interrupter type PCME by McGraw-Edison. See Bulletin 82027 Rating: 2400 volts 800 amp continuous in an enclosure 12000 amps interrupting capability 40°C ambient <u>Standards</u> Interrupter to be designed, built and tested to meet NEMA Standard ICS-324 for Class E1 and E2 controllers and Underwriters Laboratory Specification 347 for high voltage industrial control equipment. <u>Enclosure</u> To comply with ANSI C37.20C. Color ANSI-61 gray. Indoor. <u>Accessories and Features</u> - Front handle operation - Motor operated closing mechanism (120 volts AC) (This will permit local and remote closing and tripping of interrupter) - Trip coil for 120 volt AC, 60 hertz - Top entry and top exit of power cables (2-500MCM cables/phase) - Space heaters, 120 volt, 1 phase - Two N.O. and two N.C. auxiliary interlocks - Provisions for pad locking <u>Application Note</u> Interrupter will be used in the secondary of purchasers 3000 KVA 67KV/2300 volt transformer which supplies power to a load commutated inverter drive. The primary of this transformer will be protected by an appropriate fuse.

ITEM QTY.

105 1

Maintenance and Installation Terminal

Hand-held terminals are provided as a maintenance/installation interface with the microprocessor drive control. The terminal has the capability of:

- Memory communication with
 - RAM Memory
 - Common Memory
 - Alterable Memory
- Memory changes in alterable memory
- Read and manipulate system I/O

The terminal is a hand-held device capable of sending and receiving data in eight bit serial ASCII code. It has a 40-key positive tactile response keyboard comprising two single function and 38 multi-function keys which give internal control of the unit and allow transmission of all 128 ASCII codes, with a maximum rate repeat facility.

The terminal incorporates a memory with capacity for the last 30 characters received. A line of eight consecutive characters in the memory can be accessed for simultaneous display on 16-segment 'starburst' of the LED which can generate all 64 ASCII uppercase alphanumerics and symbols clearly and legibly.

The terminal is for operation with RS232C interface with a 25-pin 'D' type connector. The unit is fitted with an internal 'bleeper' which provides an audible response to reception of the (07) 'bel' code.

ITEM QTY.

106 6

Operating Manual

Operating manuals, six per drive, for use by operating and maintenance personnel, containing the following:

- Operating notes providing explanation of operator devices, diagnostic indicators, and specific operating procedures.
- Theory of operation including correlation to drive/panel components with one-line diagrams and illustrations to support descriptions.
- Maintenance and troubleshooting procedures.

<u>ITEM</u>	<u>QTY</u>
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107	X
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Purchaser to provide a flexible-damped coupling for the fan. The Koppers/Holset type WB coupling is recommended.

Coupling safety guards by Purchaser.