GE Energy

LS2100 Static Starter Product Description

GEI-100539

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imagination at work

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Introduction

The LS2100 static power converter is available in two power ratings (8.5 and 14 MVA) designed to provide an optimal match to the starting power requirements for both GE 7 and 9 gas turbine-generator sets, respectively.

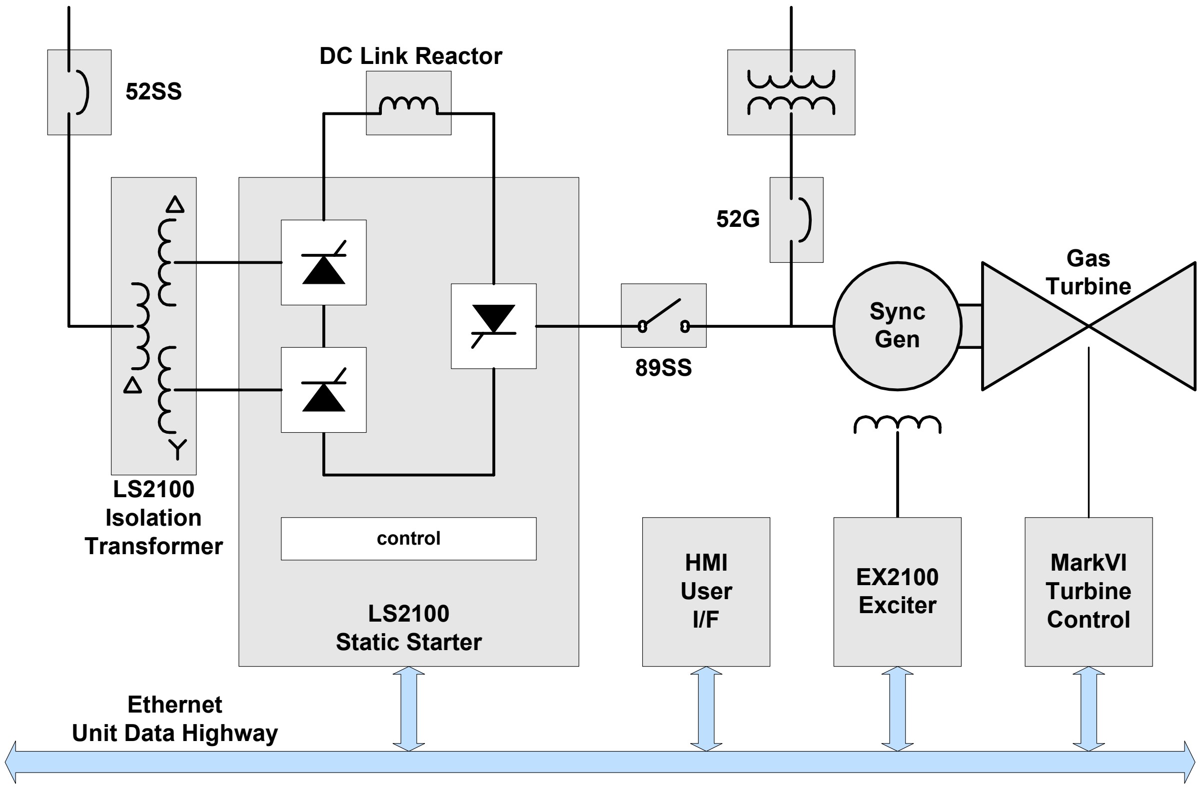
The LS2100 Static Starter is an adjustable speed ac drive system specifically designed to start a gas turbine-generator set. By operating the generator as a synchronous motor, the Static Starter accelerates the turbine set according to a specific speed profile that provides optimum starting conditions for the gas turbine. The LS2100 eliminates the need for separate starting hardware, such as an electric motor or diesel engine, torque converters, and associated auxiliary equipment, thus opening up critical space around the turbine base.

The LS2100 has a digital control that interfaces seamlessly with the Mark VI gas turbine control, the EX2100 excitation control, the Human-Machine Interface (HMI), and the PI Historian. These devices communicate with each other over an Ethernet®- based data highway to form a fully integrated control system. The GE Control Systems Toolbox (toolbox) is used to configure the LS2100 control. This is the same toolbox used to configure the Mark VI gas turbine control and EX2100 excitation control.

8.5 MVA Static Starter

System Architecture

A simplified one-line diagram for the Static Starter system is shown in following figure:



Static Starter System

Power **magnetics** are used in the system to provide isolation, voltage transformation, and impedance. These include:

The isolation transformer feeds 3-phase ac input power to the Static Starter power converters. The transformer provides isolation from the ac system bus and provides the correct voltage and phasing to the static converters.

Optional ac line reactors are available.

The dc link reactor is an air core inductor that provides inductance to smooth the current delivered by the static power converters.

Various **circuit breakers** and motor operated disconnect **switches** are used in the system to make the appropriate power connects required for a static start operation. The 52SS is a circuit breaker used to connect the primary side of the LS2100 isolation transformer to the system auxiliary bus. Depending on the application, either the Static Starter or the Customer DCS controls this breaker and it must be closed during starting. It may optionally be left closed after the start is complete.

The 89SS is a motor operated disconnect switch used to connect the Static Starter load inverter output bus to the generator stator. The MarkVI controls this switch and it must be closed during starting and opened after the start is complete.

The 52G is an optional circuit breaker used to connect the generator stator to the system bus. The Mark VI Turbine Control controls this breaker and it must be open during startup.

Cabinets

The enclosure is painted ANSI-70 light gray.

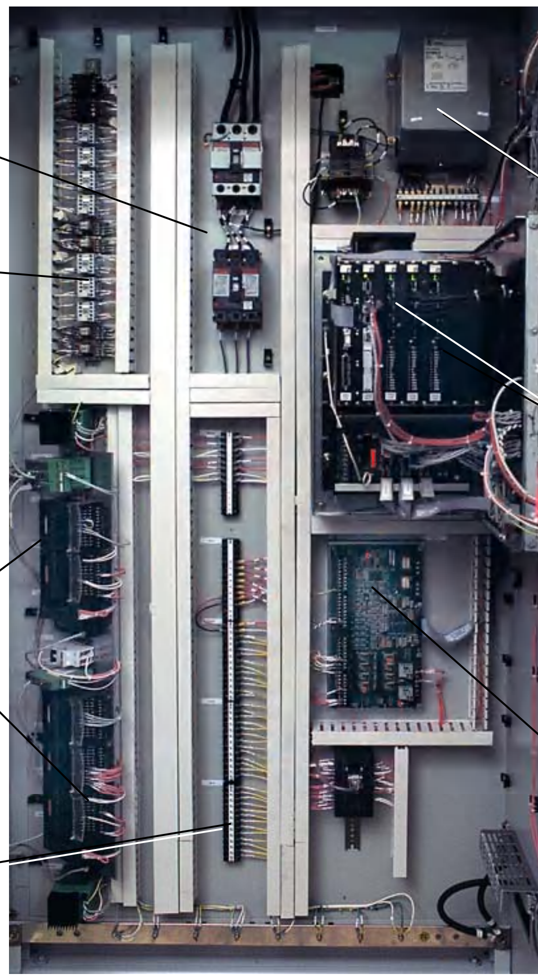
The Static Starter is supplied in a factory assembled and tested, freestanding enclosure. The isolation transformer, dc link inductor, and heat exchanger are supplied separately from the drive enclosure. The Static Starter is supplied in a NEMA Type 1 ventilated enclosure for indoor mounting. The enclosure has a rigid steel frame enveloped by sheet steel with a minimum 12-gauge thickness.

MVA Static Starter Enclosure

Control Cabinet

The control cabinet has two front access hinged doors held in the closed position with a three-point latch and a handle that can be padlocked. Located inside the control cabinet are:

- Control power circuit breaker
- Control power transformer and power supply
- VME card rack
- Panel mounted relays
- I/O terminal boards
- VersaMax I/O modules
- Customer terminal boards

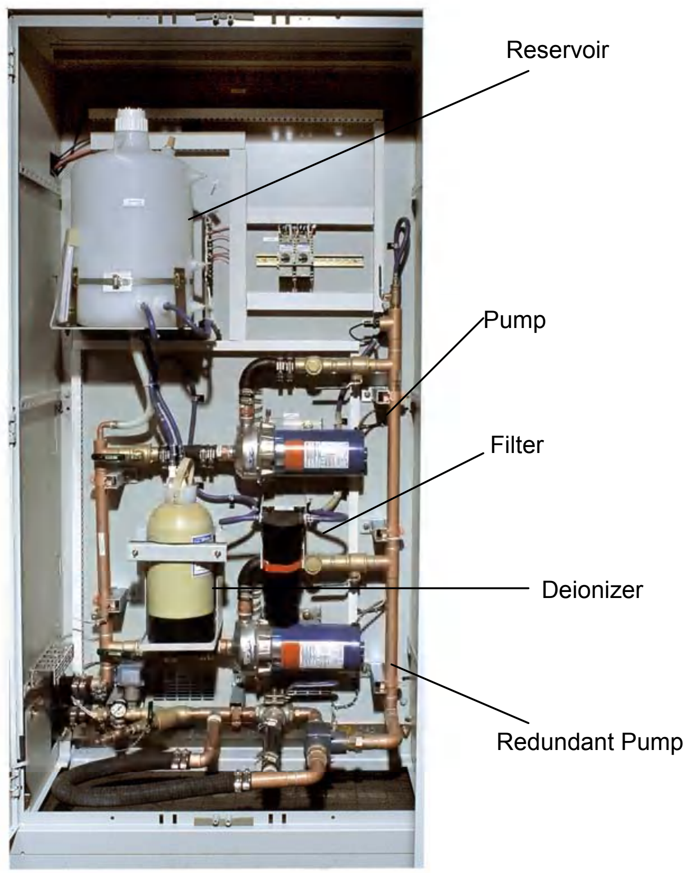


Control Cabinet

Cooling System Cabinet

The cooling system cabinet is located behind the control cabinet and is accessed from the rear of the lineup. The cabinet has two hinged doors that require a tool for opening and are equipped with a padlock hasp for locking in the closed position. Located inside the cooling system cabinet are:

- Reservoir
- Deionizer
- Filter
- Pumps (2)
- Temperature regulating valve
- Pressure switch and pressure gauge
- Resistivity / temperature sensor
- Level switches

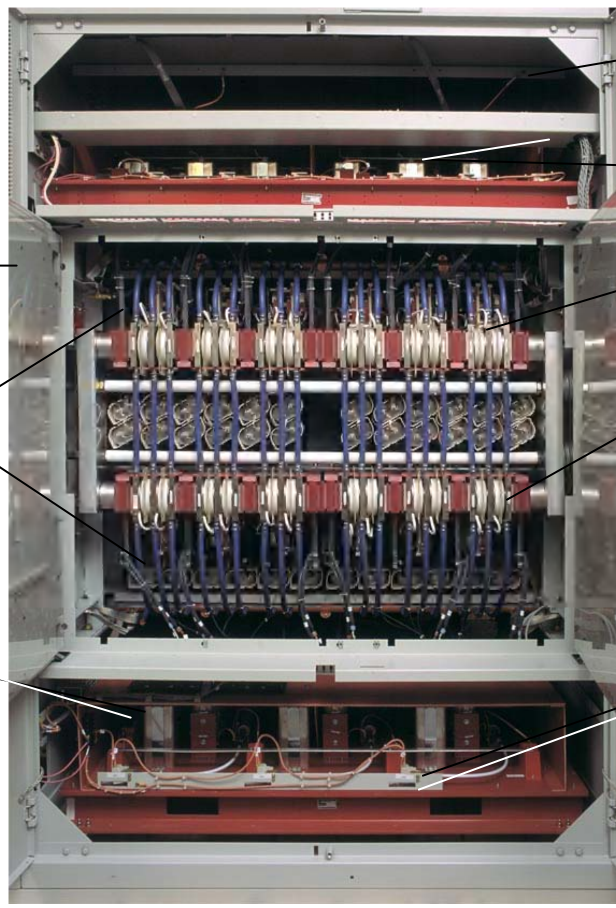


Cooling System Cabinet

Power Conversion Cabinets

Power conversion cabinets have hinged covers that require a tool for opening and are equipped with a padlock hasp for locking the cover in the closed position. Bolted-on panels cover rear sections requiring access only for high voltage bus connections. Located inside the power conversion cabinets are:

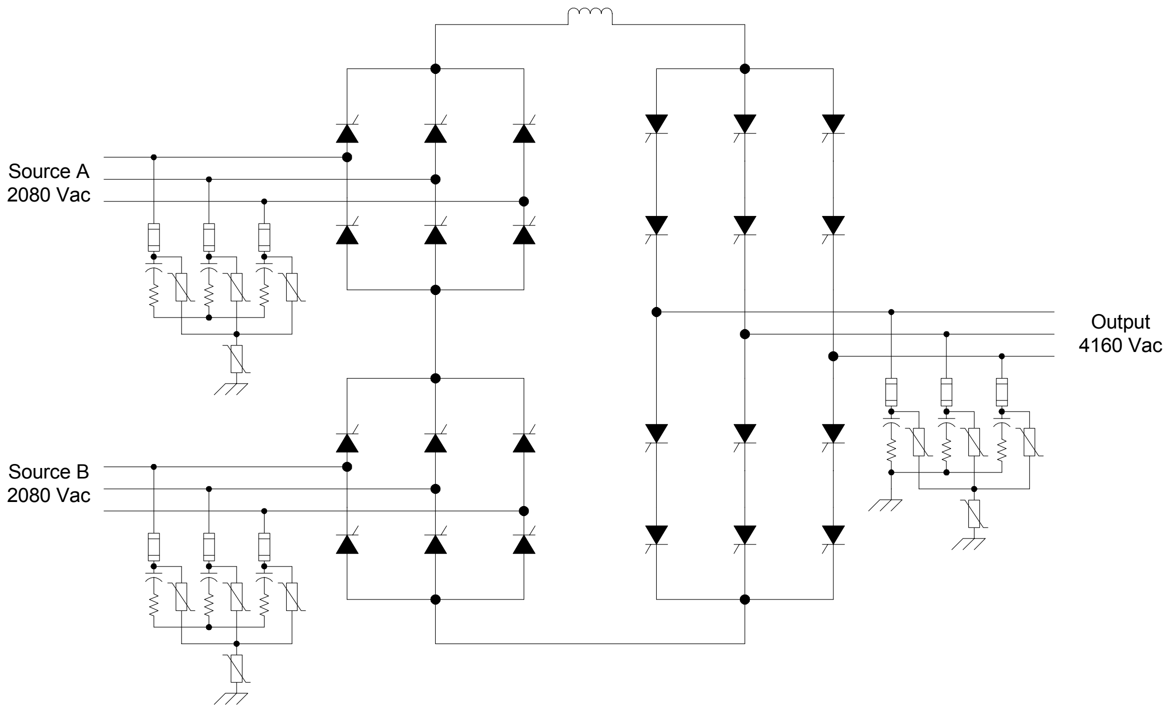
- Source thyristor converters
- Source ac line filters
- Load thyristor converter
- Load ac line filter
- FGPA gate pulse amplifier boards
- FHVA/B high voltage gate interface boards
- NATO voltage feedback boards
- FCSA current feedback boards



Power Conversion Cabinet

Power Converter

The Static Starter power converter consists of two series connected line-commutated phase controlled thyristor source converters that feed a load-commutated thyristor load inverter through a dc link reactor.



8.5 MVA Power Circuit One-Line

The source converter gating is digitally controlled to produce the required current through the dc link and the load. The dc link reactor is sized to keep the dc link current continuous over the system's operating range. The load inverter gating is digitally controlled to produce a variable frequency ac output current to the generator stator terminals.

Input Power

The main input power to the source converters is provided through the Static Starter isolation transformer. The isolation transformer is designed for rectifier service and is either oil filled or dry type, as required by the customer.

Consequently, the harmonic distortion imposed on the power system is cut almost in half over what is produced by a conventional 6-pulse unit.

The transformer has two sets of 3-phase secondary windings, each rated at 2080 V ac (half the rated load inverter voltage). One source converter is fed from a delta-connected transformer secondary. The other source converter is fed from a wye-connected transformer secondary. This arrangement phase shifts one converter's 3-phase ac input voltages by 30º compared to the other converter's 3-phase ac input voltages. This configuration results in elimination of nearly half the harmonic currents generated by the drive, most notably the 5th and 7th harmonics.

Output Power

Due to the high fault current capacity of the generator, the static starter load inverter output is connected to the starting bus through current limiting fuses. These fuses are required to protect the power converter and interconnecting cables in the event of an inverter fault during the starting operation.

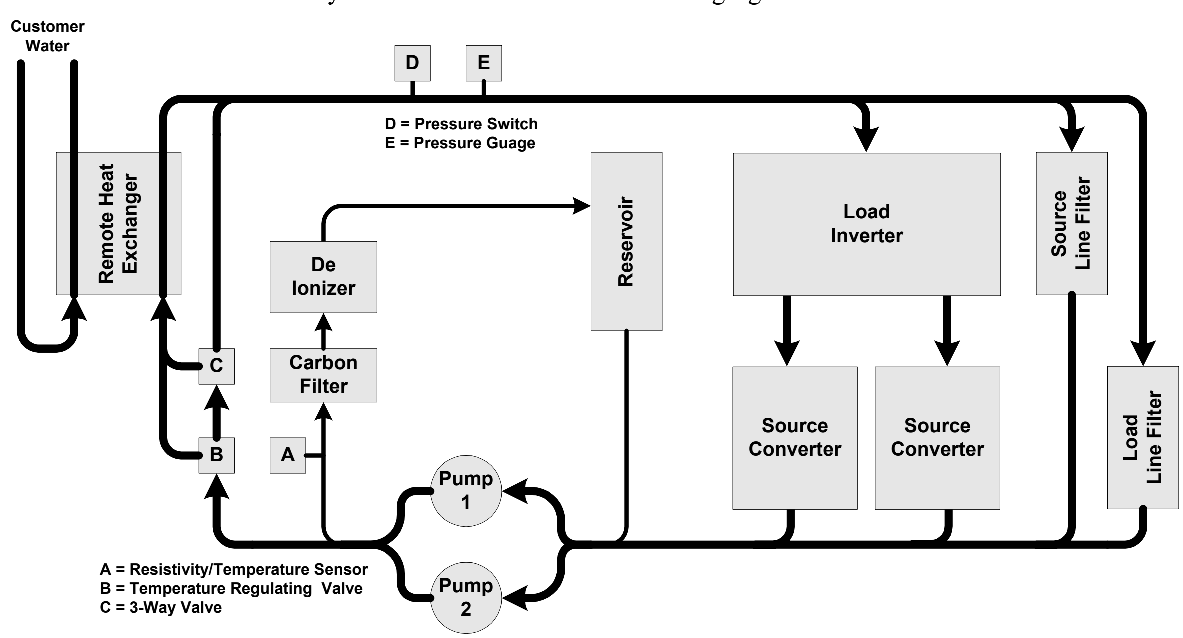
7FA and 7FB turbine applications do not require the ac reactors while 9FA and 9H turbine applications do require them.

An ac reactor is sometimes connected between the current limiting fuses and the starting bus in order to increase the commutating reactance for proper operation of the inverter. The ac reactors are used when the phase-to-ground capacitance on the ac or dc buses exceeds 0.125 mfd.

The output starting bus is connected to the generator stator by a motor operated disconnect switch (89SS). The switch is rated based on generator terminal voltage and Static Starter full load current. The switch is electrically interlocked with the generator main breaker (52G) to prevent operation of the switch when the generator is connected to the system bus.

Cooling System

The Static Starter power converter uses a liquid cooling system to transfer heat from heat producing devices (such as SCRs and high wattage resistors) to a remote heat exchanger. The cooling system is closed-loop with a covered reservoir for makeup coolant. Coolant circulates from the pump discharge to the remote heat exchanger to the power conversion bridges, and returns to the pump. A portion of the coolant bypasses to a de-ionizer system to maintain the coolant resistivity. This cooling system flow is shown in the following figure.



Cooling System Flow Diagram

The coolant is a water/glycol mixture that prevents freezing with lower outside ambient temperatures. The system should initially be charged with a mixture of distilled, de-mineralized, or de-ionized water and pure glycol. Makeup coolant must be a similar mixture to maintain the desired freeze protection. Although both propylene and ethylene glycol are approved for use, propylene glycol is preferred because of higher electrical resistance, longer de-ionizer life, and non-toxicity.

Redundant pumps circulate the coolant. The pressure switch and interlocking pump motor starters provide automatic transfer to the back-up pump in the event of coolant pressure loss. Isolation valves allow the pumps to be changed online without draining the system.

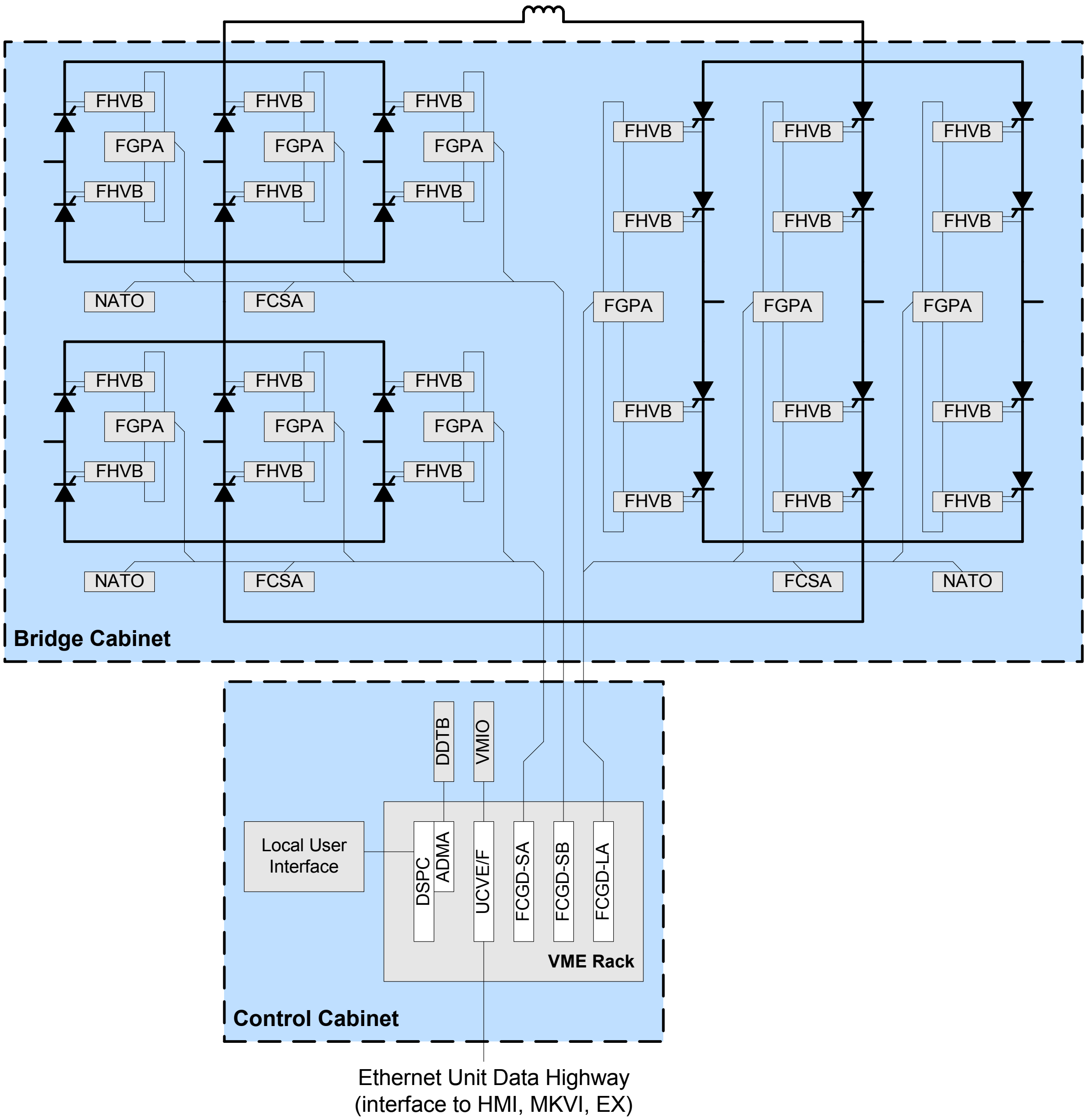
A remote mounted liquid-to-liquid heat exchanger is used to remove heat from the closed loop system. A remote mounted liquid-to-air heat exchanger may be supplied as an option. The liquid-to-air heat exchanger includes redundant cooling blowers. A coolant temperature switch and interlocking blower motor starters provide automatic transfer to the back-up blower.

A temperature-regulating valve prevents the coolant temperature from falling below a minimum of approximately 27°C (80 °F) by allowing some of the coolant to bypass the heat exchanger.

Control Hardware/Software

Control Hardware

A VME rack in the control cabinet holds the circuit boards that make up the heart of the DSP-based digital control. The circuit boards contain all the control and protection features for the Static Starter. The VME rack control cards interface to circuit cards in the bridge cabinet to provide gating signals for the thyristors and to collect voltage, current, and status feedbacks. A one-line diagram for the control for an 8.5 MVA Static Starter is as follows.



Static Starter Control One-Line Diagram

The functions of each circuit board are summarized in the following table:

Static Starter Circuit Card Descriptions

Name	Qty	Location	Description
DSPC	1	Control cabinet (vme rack)	Digital signal processor control board
UCVE/F	1	Control cabinet (vme rack)	Network interface and customizable application control board
FCGD	3	Control cabinet (vme rack)	Bridge interface board
ADMA	1	Control cabinet (vme rack)	I/o interface board
DDTB	1	Control cabinet	I/o terminal board board
VMIO	1	Control cabinet	Versamax i/o modules
FGPA	9	Bridge cabinet	Gate pulse amplifier board
FHVA/B	24 / 60	Bridge cabinet	High voltage gate interface board
NATO	3	Bridge cabinet	Voltage feedback board
FCSA	3	Bridge cabinet	Current feedback board

The local user interface is a keypad/display module mounted on the door of the control panel.

Static Starter Local User Interface

The local user interface provides the following functions:

- Display of Static Starter operating status
- Cooling pump and blower selection
- Access the diagnostic lists and help screens
- Diagnostic reset
- Tune-up parameter display and modification

Protection

The Static Starter has internal protection that conforms to the Integrated Control System (ICS) protection philosophy of relying on the emergency external system protection only when there is a failure of the primary internal protection. This allows the Static Starter control to attempt corrective action on partial faults resulting in more graceful handling of error conditions, such as initiating a controlled shutdown on loss of feedback rather than letting external over-current emergency protection activate. Some of the protections provided by the Static Starter control include:

- Instantaneous overcurrent
- Bridge differential current
- Generator overvoltage
- Source bridge undervoltage, overvoltage
- Ground fault
- Bridge coolant over temperature, low resistivity, low pressure, low/high level
- Shorted thryistor
- No generator field at start

Faults and Alarms

The Static Starter control continually tests for abnormal conditions and generates a diagnostic whenever a problem is found. A diagnostic is either a Trip or Alarm. A Trip indicates an abnormal condition that shuts the Static Starter off or prevents it from starting. An Alarm indicates an abnormal condition that requires attention but does not shut down the Static Starter.

All diagnostics are time tagged with system time obtained from the Ethernet Unit Data Highway (UDH). The diagnostics are viewable through the local user interface. Additionally, any PC connected to the Ethernet UDH can view the Static Starter's diagnostics using the toolbox. For operator viewing, summary diagnostics are provided to the HMI alarm screens via the Ethernet unit data highway.

Self Test

When power is applied to the drive, the following control hardware checks are performed to ensure proper drive operation:

- CPU test
- PROM check sum
- RAM test
- Writing/ reading to each board on the VME backplane

The control is designed with test features that are able to isolate problems to a replaceable unit. Control cards feature loop-back test capability that allows the processor to test the board operation without requiring generator operation. All cables are monitored for continuity.

Only the 14 MVA Static Starter will have redundant thyristors.

All thyristors are individually monitored for proper conduction status. In drives with redundant thyristors, this allows safe operation of the drive to continue with one shorted thyristor until maintenance is performed.

The control is capable of running a test on the entire drive in which current is circulated through the bridges but bypasses the generator. This allows proof of drive readiness without requiring power on the generator.

Software Configuration

The Static Starter control is configured with the Control System Toolbox (toolbox). The toolbox is a Microsoft Windows® based software package that typically resides on the HMI and communicates to the Static Starter through Ethernet.

Tuning changes are seldom necessary during commissioning.

Having a digital control system permits fast field tune-up by allowing regulator gains and time constants to be changed by changing a parameter in non-volatile memory. The factory settings are specific to the site application. Control tune-up constants that may be changed include:

- Current regulator
- Speed regulator
- Flux regulator
- System protection
- Scaling factors
- Data logging list

Communications

The LS2100 supports Ethernet local area network (LAN) communication to:

- Mark VI, Mark VI ICS, EX2100 Static Exciter, Changeover Panel, and HMI using the Ethernet global data (EGD) protocol
- GE Control System Toolbox
- The Onsite Center℠ for remote monitoring and diagnostics

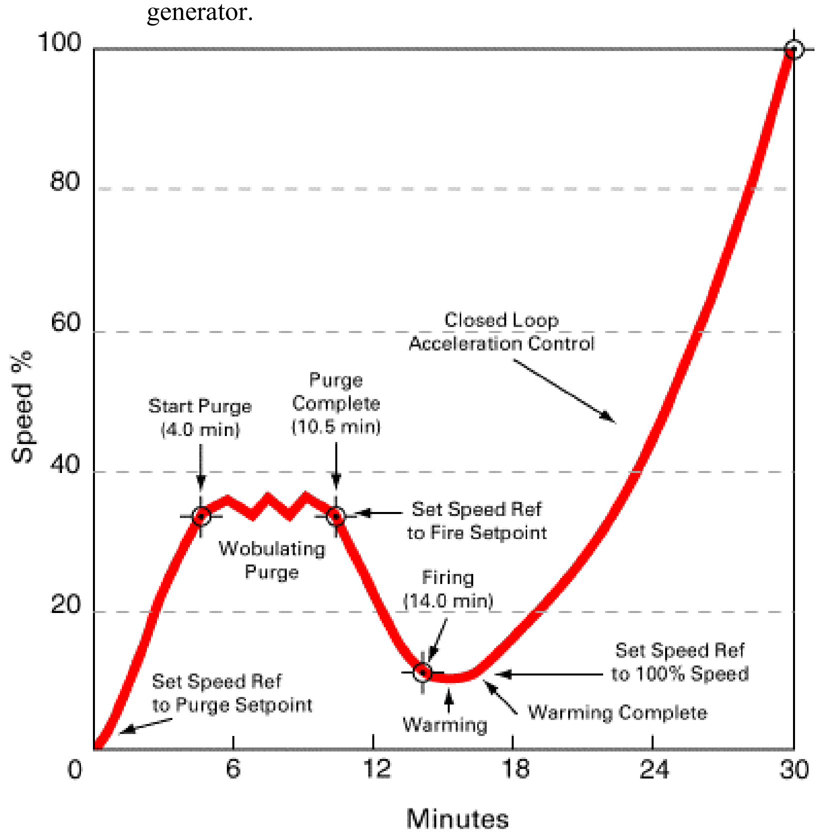
Applications

Also, during starting, the field voltage setpoint for the exciter is provided by the Static Starter control to regulate generator stator terminal voltage.

During startup, the Mark VI turbine control supplies the run command and speed setpoint signals to the Static Starter control. The Static Starter control operates the power converter in a closed loop mode to deliver variable frequency current to the generator stator. By controlling generator field voltage and stator current, the Static Starter is able to adjust the torque produced by the generator and thus control the acceleration and speed of the turbine-generator set.

Gas Turbine Startup Sequence

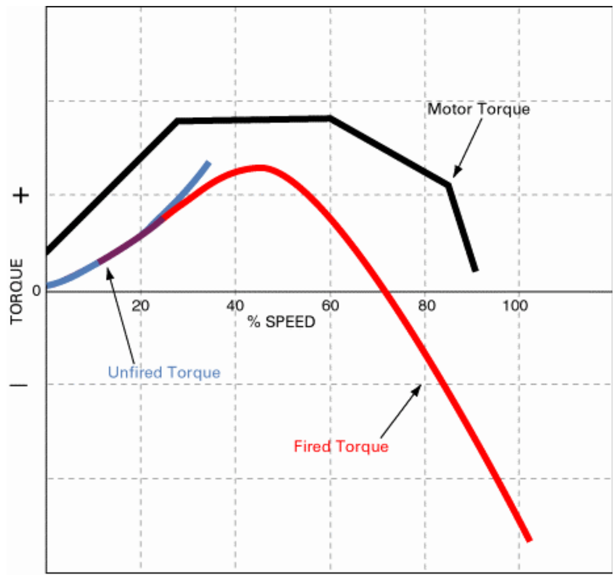
Initially, the gas turbine-generator set is spinning at turning gear speed, typically 3 to 6 rpm. At startup, the Static Starter connects to the generator stator and assumes control of the exciter field voltage reference. The Static Starter then accelerates the turbine to the purge speed setpoint (typically 25% of synchronous speed). The turbine is held at purge speed for approximately six minutes. Following the purge, the Static Starter output is turned off and the turbine is allowed to coast down to the firing speed of 15%. Once at firing speed, the output is turned on again and the turbine is fired. The turbine is briefly held at constant speed to allow for warming. Once the warming period is completed the Static Starter accelerates the turbine to its self-sustaining speed, at which point the is turned off and disconnected from the generator.



Typical Gas Turbine Startup Sequence

Torque vs. Speed Curves

A typical gas turbine torque-speed curve shown below, shows the turbine load torque (unfired torque and fired torque) and the generator output torque (motor torque). The acceleration torque is determined by the difference between the generator output torque and the turbine load torque. The acceleration torque and the inertia of the shaft determine the acceleration rate. As the accelerating torque becomes larger the turbine is accelerated faster. The Static Starter adjusts the generator output torque to have the turbine follow the startup sequence.

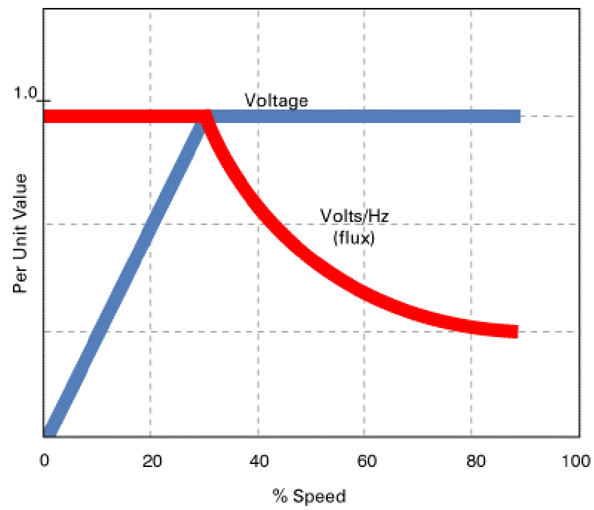


Torque vs. Speed Curves

Notice that the turbine is accelerated in an unfired mode up to approximately 25% speed and is fired at 15% speed. The period between these two points is the wobulating purge and the coast down. At 90% speed the torque produced by the turbine is sufficient to accelerate to top speed and the Static Starter is disabled.

Generator Voltage vs. Speed Curve

The following figure shows a typical generator starting voltage profile. During startup the generator field current is controlled so that the generator stator flux does not exceed allowable limits. The Static Starter output voltage increases linearly from 0 to its rated value of 4160 V ac as the speed increases from near 0 to 18 Hz (for 7F turbine applications), providing constant volts/hertz (flux) on the generator. Above 18 Hz, the Static Starter output voltage is held constant and volts/hertz falls off inversely with speed.



Generator Voltage/Flux vs. Speed Curves

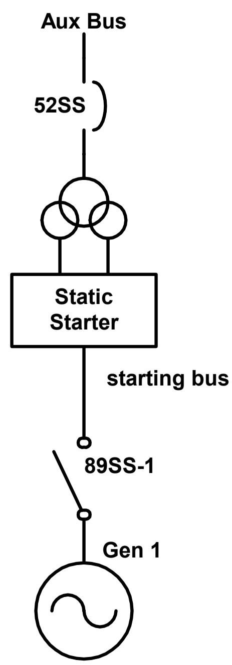
System Configurations

The starting system configuration should be chosen to provide the best optimization of cost and starting availability. The following sections illustrate the various starting system configurations that are available and define the benefits associated with each.

One Starter for One Turbine

The one-on-one configuration has the advantage of simplicity. There are no provisions for redundancy with this system.

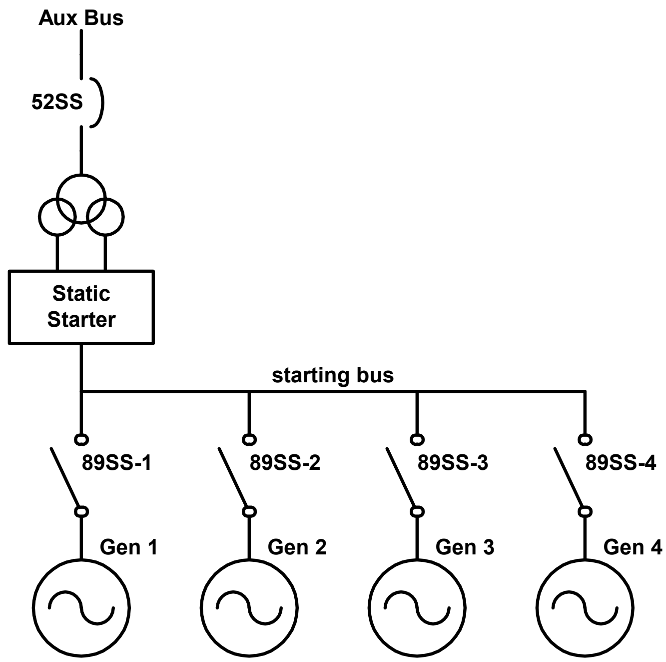
In this starting system configuration, one Static Starter is responsible for starting only one turbine-generator set. This is the simplest system, both in terms of physical layout and implementation. There is a single starting bus associated with the one Static Starter. The generator has an 89SS motor operated switch that is used to connect the generator stator to the starting bus. The one-line diagram for this one-on-one configuration is shown in the following diagram.



One-on-One Configuration

One Starter for Multiple Turbines

In this starting system configuration, one Static Starter is responsible for starting two, three or four turbine-generator sets. There is a single starting bus associated with the one Static Starter. Each generator has an 89SS motor operated switch that is used to connect the generator stator to the starting bus. The one-on-four configuration is shown in the following diagram.



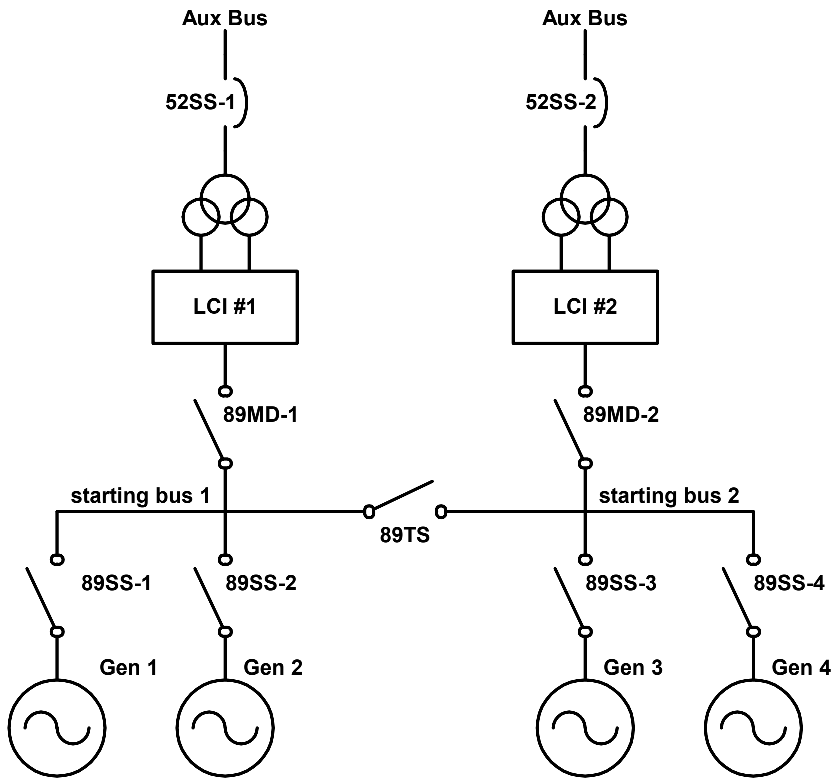
One-on-Four Configuration

The operator can select the turbine-generator set that is to be started from the graphic screen on the HMI.

This starting system configuration is only slightly more complex than the one-on-one system and it provides the economy of sharing a single Static Starter amongst multiple turbine-generator sets. The Static Starter may start any one of the available turbines at any time. There are no provisions for redundancy.

Two Starters for Multiple Turbines

In this starting system configuration, two Static Starters are responsible for starting from two to eight turbine-generator sets. There are two starting busses, one associated with each Static Starter. Each Static Starter has an 89MD motor operated switch that is used to connect to the respective starting bus. Each generator has an 89SS motor operated switch that is used to connect the generator stator to one of the two starting busses. An 89TS motor operated switch is used to connect the two starting busses. The two-on-four configuration is shown in the following diagram.

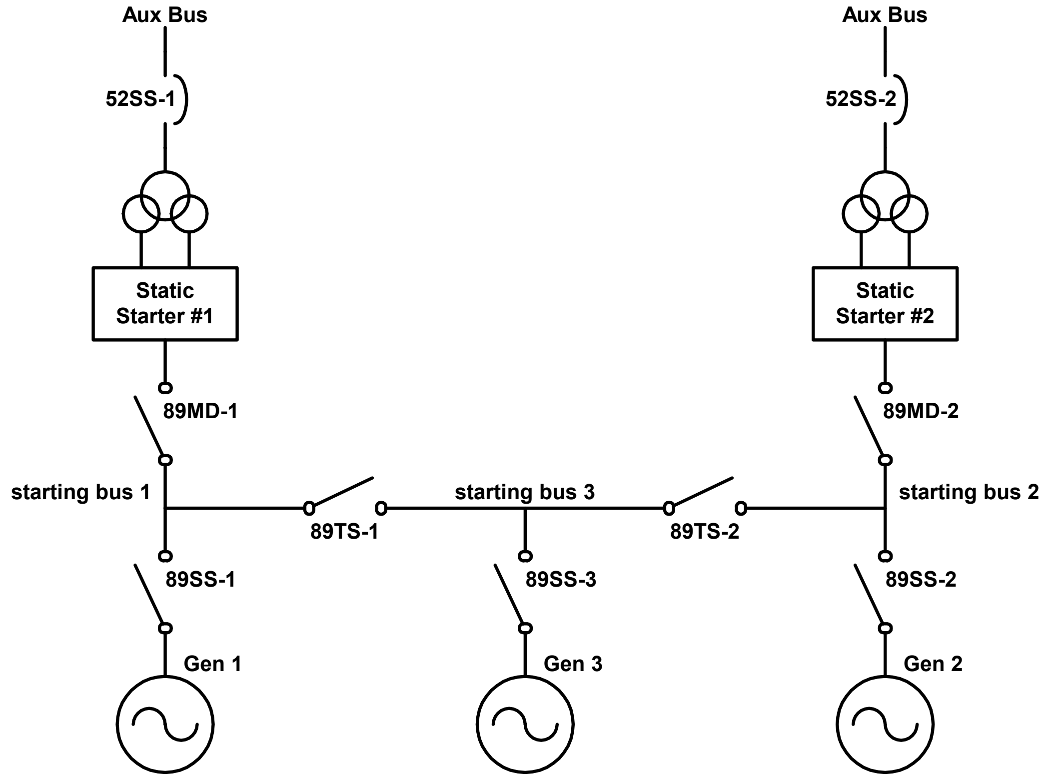


Two-on-Four Configuration

The operator can select the turbine-generator set that is to be started using the graphic screen on the HMI.

This starting system configuration provides redundancy using two Static Starters. By configuring the 89MD and 89TS switches appropriately, either Static Starter can start any of the turbines. By closing the 89TS switch to connect the two starting busses, a Static Starter is able to start a turbine-generator set connected to the other Static Starter's starting bus. Additionally, by leaving the 89TS switch open to isolate the two starting busses, both Static Starters can be used to simultaneously start two turbine-generator sets provided the power system is capable of tandem starts. This allows generating capacity to be brought on-line faster.

Another starting system configuration using two Static Starters uses three starting buses and two 89TS switches. The one-line for a two-on-three with two tie switch configuration is shown in the following diagram.



Two-on-Three with Two Tie Switch Configuration

The operator can select the turbine-generator set that is to be started using a graphical selection screen on the HMI.

Again, by appropriately configuring the 89MD and 89TS switches, either Static Starter can start any of the turbines. One or both of the 89TS switches must be closed for a Static Starter to be able to start a turbine-generator set connected to one of the other starting buses. Additionally, both Static Starters can be used to simultaneously start two turbine-generator sets provided the power system is capable of tandem starts. In this case, one or both of the 89TS switches must be opened to isolate the two starting busses.

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Quality Assurance

The following sections describe the quality assurance tests performed on the LS2100 Static Starter equipment prior to shipment

GE manufacturing facilities are ISO-9001 certified. GE is also certified according to ISO-9000-3 Quality Management and Quality Assurance Standards, Part 3: Guidelines for the Application of ISO 9001 to Development Supply and Maintenance of Software.

Bridge Tests

Each Static Starter bridge assembly is subjected to routine factory tests, including but not restricted to the following:

- Complete electrical and mechanical inspection
- Hydrostatic coolant pressure
- Component impedance check to verify all SCRs and passive components
- Hipot and corona
- Gate pulse and cell firing
- Current and voltage feedback
- Thyristor voltage sharing
- Rated voltage operation
- High current, low voltage

Final Assembly Tests

Each Static Starter lineup is subjected to routine factory tests, including but not restricted to the following:

- Hydrostatic coolant pressure
- Cooling system
- Processor and I/O
- Fiber optics
- Bridge current and voltage feedback

Customer Witness Testing

Our customers are always welcome to visit the Salem factory to see how their equipment is engineered and manufactured.

All equipment goes through extensive testing with appropriate reviews and sign-offs for the tests mentioned above. After that, the customer can select either of two options for a customer witness test.

Option A lets the customer examine the appearance and workmanship of the equipment, then review the engineering and test paperwork. This is a standard service for no additional charge.

Option B lets the customer witness a demonstration of the hardware and software. This is an added-cost item to the customer.

Customers who desire some form of witness test other than Option A or Option B must contact GE Salem upon placing their order to discuss the feasibility and cost of conducting such a test.

Option A – Customer Witness

This normal production inspection, performed immediately prior to shipment, verifies the mechanical integrity, conformance to special purchaser hardware requirements, appearance, and design completeness of the enclosure. The purchaser can elect to participate in this inspection at no charge. This inspection lasts approximately two hours, and includes:

- Inspection of appearance and mechanical integrity
- Review for completion
- Test instructions
- Test log
- Test defect record
- Check Engineering Log
- Inspection defect records
- Shortages
- Audit "T" check (i.e. labeling/nomenclature)
- "As-shipped" prints
- Purchaser special requirements

Generally, the customer reviews the quality of workmanship, looking at paint, wiring, crimping, assembly, etc.

The customer usually inspects the hardware the day before the unit is sent to shipping. At this point, the unit will have been completely tested and inspected. The customer can inspect the unit to ensure that its appearance meets his expectation before it is shipped. The duration of this witness point is two hours.

The second part of this option is a review with the engineer. The customer can review all paperwork relevant to the engineering and testing of the requisition. This would include the elementary, I/O list, alarm list, layouts, outlines, test sign-off sheets, etc. This documentation provides the basis for certification that the customer's hardware and software went through the proper engineering, verification, and test processes. The duration of this witness point is approximately two hours.

The customer should advise GE Salem eight weeks prior to shipment of their intent to visit the factory to inspect his equipment. GE will inform the customer two weeks prior to the inspection date so that the customer can make travel arrangements. There is no additional cost associated with this option.

Option B - Customer Witness

This customer witness option consists of two demonstrations:

- Hardware
- Software

The *hardware* demonstration is an audit of those tests previously performed as described in the section *Routine Factory Tests*. The duration of this witness point is typically two to four hours.

For the *software* demonstration, the customer's application software is downloaded to a simulator panel at a convenient workstation area (not the customer's equipment) to verify its integrity, functionality, and conformance to the specifications. The simulator panel uses the same printed wiring boards and software as are used in the customer's equipment to model the specific application, or a typical generator and its field.

The software simulates a normal startup and control sequence by:

- Emulating the necessary contactor(s) and relays
- Checking feedback echoes for closing verifications
- Activating regulators in both the manual and automatic modes
- Displaying any faults

The engineer uses the simulation method to check out the integrity of the system by also exercising any special functions. The duration of this witness demonstration is approximately four hours.

Option B, if selected, should be included as part of the initial purchase order. If a customer decides to purchase this option after the initial ordering drawing release, an amendment to the PO will be required. If option B was not initially purchased, then notification of a change order is required at least eight weeks prior to shipment of the equipment. GE will inform the customer two weeks prior to the test date so that the customer can make travel arrangements. There is an additional cost associated with this customer witness point.

Technical Specifications

General

Rectifier cells	SCR
Source rectifier	12-pulse
Load rectifier	6-pulse
Bridge construction	Heatsink / SCR, dual cell stack
Cooling	Liquid
SCR replacement	Off-line without opening water circuits
SCR average replacement time	4 hours

Power Input

Supply voltage	2080 V ac each bridge, ± 10%
Supply frequency	50 or 60 Hz, ± 5%
Supply phases	3-phase, ± 2% unbalance

Power Output

Nominal output power	8.5 MVA or 14 MVA
Nominal output voltage	0 to 4160 V ac
Nominal output frequency	0 to 50 or 60 Hz

Control Power

Power	7 k VA
Frequency	50 or 60 Hz, ± 5%
Voltage	
50 Hz	400/415 V ac, ± 10%
60 Hz	460 V ac, ± 10%

Enclosure

Type	NEMA-1 Ventilated
Dimensions	W x D x H
8.5 MVA	2800 mm x 1400 mm x 2345 mm (110.2" x 55.1" x 92.4")
14 MVA	4400 mm x 1400 mm x 2345 mm (173.2" x 55.1" x 92.4")
Weights	
8.5 MVA	2630 Kg (5800 lbs)
14 MVA	4082 Kg (9000 lbs)
Paint	ANSI-70 Light Gray

Environmental

Relative humidity	95%, non-condensing
Operating temperature	0°C to 40°C
Storage temperature	-25°C to 70°C
Ambient transient thermal change	5°C per minute
Vibration	
Vertical axis displacement	per EN 50178
Transverse axis displacement	per EN 50178

Codes and Standards

LS2100 Static Starter	UL508C, UL347A
	IEC 146-1-2
	EN50178
	NEMA ICS 7-1993
	CSA C22.2, #14
	CE Mark
	Seismic UBC Zone 4
DC link reactor	ANSI C57.12.01 for construction
	NEMA TR-27 for audible sound
Remote heat exchanger	Zone 4, ASME

DC Link Reactor

Type	Dry-type, Air core
Voltage class	5 kV
Winding conductors	Aluminum (*Optional – Copper)*
Insulation	Class H
BIL ratings	
4160 V	30 kV

Isolation Transformer

Type	Silicon Oil Filled
	Optional – Dry-type, Open coil
	Optional - Dry type, Cast coil
Winding conductors	Copper
BIL	30 kV
Taps	None
	Optional - Primary side 2 x 2.5% above and below nominal voltage
Winding configuration	Delta-Delta-Wye

Cooling System

Type	Liquid, closed loop
Coolant	Water / propylene glycol mixture
Coolant resistivity	De-ionizer system with replaceable cartridge
Heat exchanger	Full capacity liquid to liquid (Optional - Full capacity liquid to air with redundant cooling blowers and auto changeover.)
Circulation pump	Full capacity redundant
Monitors	Resistivity
	Pressure
	Temperature
Local interface	Resistivity indicator
	Temperature indicator
	Pump selection, blower selection
Miscellaneous	Translucent coolant storage reservoir
	Temperature regulating valve

Control Functions

Local interface	Door-mounted keypad and display
Configuration	Control Systems Toolbox (toolbox)
Communication protocols	Ethernet Global Data (EGD)
	Modbus / RTU (optional)
	Modbus / Ethernet (optional)

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