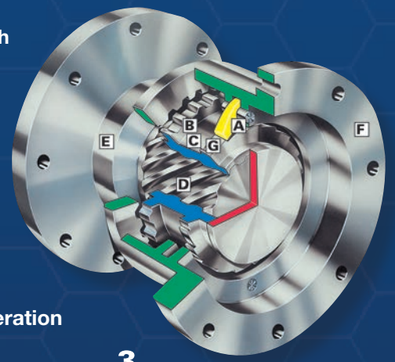
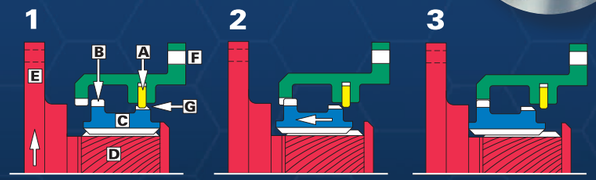
Dual Driven Equipment Applications for SSS® Clutches

Elements of Basic SSS® Clutch

A. Pawl
B. Clutch Teeth
C. Sliding Component
D. Helical Splines
E. Input Shaft
F. Output Clutch Ring
G. Ratchet Teeth



SSS® Clutch Principle of Operation



Power Applications

Single-Shaft, Combined-Cycle Plant
Cogeneration Plant
Synchronous Condensing using the Generator of Peak Load Turbines
Combined Heat and Power Plant (CHP)
Rotating Uninterruptible Power System (UPS)
Pumped Hydro
Auxiliaries: Gas and Steam Turbine Turning Gears, Gas Turbine Starting

Petrochemical/Process/Refinery/Pipeline Applications

Compressors: Air, Gas, Refrigeration, Process, Pipeline, etc.
Fans: ID, FD, Gas Recirculation, etc.
Pumps: Amine, Water, etc.
Hydraulic Power Recovery Turbines
PTA Mixers
Expander Turbines: FCC, Gas, etc.
Steam Turbines: HP, LP, Back Pressure, Condensing, etc.
Gas Turbines

Seventy Plus Years of Designing and Building High Power Clutches
36,000+ SSS® Clutches Supplied Worldwide

400 MW	Highest Power SSS® Clutch
17,000 rpm	Highest Speed SSS® Clutch
1,100+	SSS® Clutches for Power Plants (Synchronous Condensing and Combined Cycle)
100+	SSS® Clutches for Combined Heat and Power (CHP) in 14 Countries
25,000+	SSS® Clutches for Starting and Turning Gear Systems
1,500+	SSS® Clutches for Uninterruptible Power Supplies
4,000+	SSS® Clutches for Naval and Marine Applications
700+	SSS® Clutches for Pumps
275+	SSS® Clutches for Fans
300+	SSS® Clutches for Compressors

SSS Clutch Company, Inc.

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Sales and Aftermarket Service in North and South America

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SSS Gears Limited

All clutches are designed, built and tested in the UK Factory.

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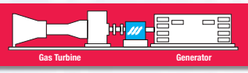
SSS® Clutch

Reference Number: NR2479 11/17 (Rev. 0)

SSS® Clutch

Synchronous Condensing
Spinning Reserve
Grid Inertia

Gas Turbine Generators

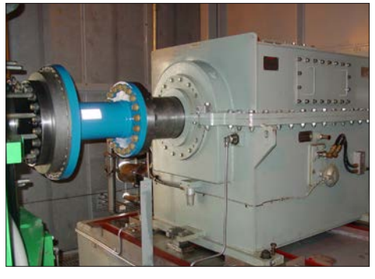


GE Frame 9E Synchronous Condensing

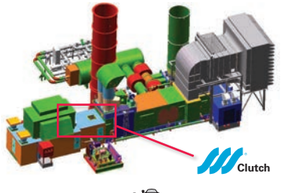
Size 360FT SSS® Encased Clutch was installed in 1995 in a GE Frame 9E peak load gas turbine generator at Indian Queens, England, to provide vars and voltage support for the 400 kV transmission line for the UK's National Grid Company in Cornwall, England.

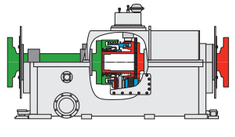
GE LM6000 Synchronous Condensing

Seven Size 260T SSS® Clutches in Saskatchewan on LM6000 Gas Turbines.



GE LMS100 Synchronous Condensing





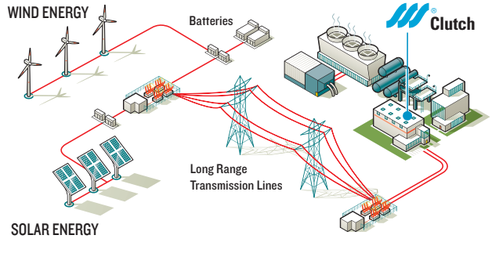
LMS100 Gas Turbine Generator with size 272T SSS® Encased Clutch at Calpine (formerly Conectiv) Cumberland Energy Center, Millville, NJ.

Benefits of Synchronous Condensing/Grid Inertia/Spinning Reserve

- **Provide/absorb vars:** used in small increments to correct lagging/leading power factor.
- **Meet peak var requirements:** without reducing Watts of generators in operation.
- **Power Factor/Voltage Support for Transmission Lines:** used at end of a long transmission lines provides stability and enables more Watts to be transmitted.
- **Power Factor/Voltage Support in Urban Centers and Industrial Areas:** provides stability and enables more Watts to be transmitted.
- **Grid Inertia:** can provide rotating mass and "Dynamic vars" to stabilize grid system, particularly when loads vary quickly.
- **Synchronized Reserve:** generator operating as synchronous condenser could possibly qualify for synchronized reserve/ spinning reserve requirements or credit.
- **Complements Static Capacitors:** by providing infinite adjustments of vars reducing need to switch capacitors off and on, extending their service life.
- **Reactive Power:** Synchronous Condensers provides Reactive Power for both high and low voltage.
- **Correct High Voltage Problems:** can absorb vars at the end of underground cables to correct high voltage problems.
- **Ancillary Service Revenue:** Synchronous Condenser can be an Ancillary Service Revenue in a deregulated market.

Maximizing the Contribution of Renewable Sources of Energy

First SSS® Clutch supplied for Synchronous Condensing approximately 45 years ago

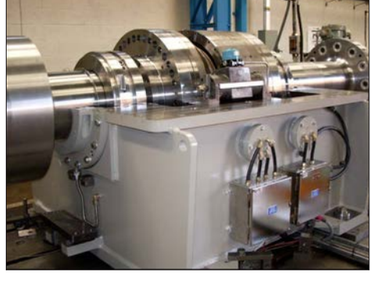


LOAD CENTER: Peaking gas turbines with SSS® Clutches provide quick start real power as well as synchronous condensing for intermittent renewable resources of energy. SSS® Clutches enable generator inertia and reactive power for grid support.

- Number of clutches installed **650+**
- Number of countries **55**
- AERO-type gas turbines **250+**
- Industrial gas turbines **400+**
- Clutches over 100 MW **50+**

Siemens V94.2 and V84.3A Synchronous Condensing

Size 280T SSS® Encased Clutch Rated for 176 MW



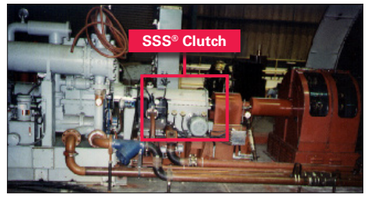
- SGT5-2000E (V94.2) ESKOM
- SGT6-5000F (V84.3A) Kansas City
- 176 MW/3000 rpm
- 7 units supplied in 2006
- Average 4 hours/day generating
- Average 10 hours/day synchronous condensing

Acceleration Systems

Southern California Edison Santiago Substation, Irvine, California

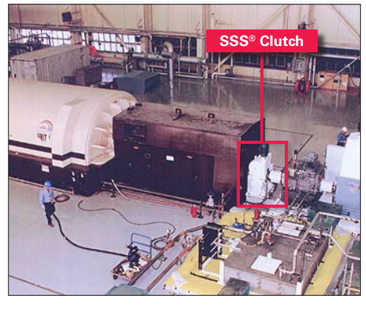
Three Size 68FT SSS® Clutches for Synchronous Condensing

B.C. Hydro Canada

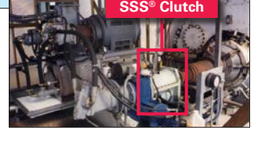


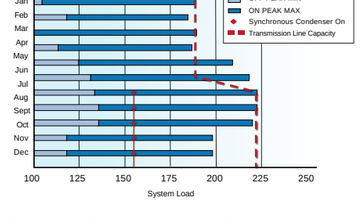
Synchronous condensing starting package. SSS® Encased Clutch contains SSS® Disconnect Clutch, for starting system, turning gear with second SSS® Clutch, and new generator thrust bearing.

Comm. Ed, Zion Nuclear Plant



Keys Energy, Key West, Florida





Stand-Alone Generator Turned Into Synchronous Condenser. Graph of transmission capacity before and after conversion of generator to synchronous condenser. Work was completed in July of 1997.