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SSS CLUTCHES

TECHNICAL SPECIFICATION

SIZE 272T SSS ENCASED CLUTCH FOR LMS100 DRIVEN GENERATOR/SYNCHRONOUS CONDENSER

Notes Ref: **NR2295**
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I N D E X

SECTION

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SIZE 272T SSS ENCASED CLUTCH FOR LMS100 DRIVEN GENERATOR/SYNCHRONOUS CONDENSER

1. INTRODUCTION

The Size 272T SSS Encased Clutch is fitted between the generator and the power turbine of the LMS100 gas turbine where its purpose is to allow the turbine to be automatically connected to or disconnected from the generator. This enables the turbine to be stopped whilst the generator continues to rotate at full speed for spinning reserve or acting as a synchronous condenser. When power generation is again required, the turbine can be accelerated to full speed and automatically reconnected to drive the generator.

The SSS Clutch is supplied in a fabricated steel casing complete with the clutch input and output shafts each with their two tilting pad type journal bearings. The SSS shaft system is axially located by the customer's flexible couplings.

A geared turning gear drive capable of driving the power turbine at low speed is included in this clutch package. The generator is turned by a separate turning gear not included in SSS supply. The turning gear drive is coupled to the main shaft line by an SSS Pinion Clutch to permit connection at rest and automatic disconnection at speed.

This specification covers various projects with different documents. For details of which documents refer to each project, please see Appendix B.

2. GENERAL DESCRIPTION, SEE DRAWING NO. 19797/19989

2.1. SSS CLUTCH DESCRIPTION

The basic SSS Clutch operating principle is described in leaflet "SSS Principle No. 1A". Clutch engagement automatically occurs whenever the speed of the power turbine tends to overtake that of the generator.

Engagement of the SSS Clutch is initiated by a pawl and ratchet mechanism. Two rows of pawls are used, termed Primary and Secondary Pawls, to ensure that no pawl operation occurs when there is a high relative speed between the clutch input and output. Primary and Secondary Pawls are described in "SSS Principle No.2".

At synchronism the pawls align and then engage the teeth of a small lightweight Relay Clutch. When these teeth are fully engaged, the teeth initiate engagement of the main clutch teeth. The relay clutch is described in "SSS Principle No.5".

In order to cushion the engagement of the clutch, an oil dashpot is used. The operation of this dashpot is described in "SSS Principle No.4".

The SSS Clutch incorporates an internal thrust bearing to axially position the output of the clutch from the input, thus making the clutch assembly of fixed length.

2.2. SSS CLUTCH CASING

The SSS Clutch described in section 2.1 is contained within a fabricated steel casing which is split on the horizontal joint. Each end of the clutch casing is fitted with a labyrinth type shaft seal.

Both the input and output shafts of the SSS Clutch are each supported by two journal bearings within the casing. The clutch casing incorporates on one side of the lower half a separate cover on which the turning gear is mounted.

2.3 <u>POWER TURBINE BRAKE, SEE DRAWING NO. 19556/19970</u>

A pneumatically operated brake is incorporated within the top cover of the clutch casing to hold the power turbine at rest whilst the generator is rotating as a synchronous condenser.

The brake must only be applied when the clutch is disengaged, the turbine fuel control is fully closed and the turbine is rotating below 500 rpm due to clutch drag and not being rotated by the turning gear.

Two switches are provided to indicate that the brake is in the off position. SSS supply includes a solenoid operated valve for brake operation (see attached datasheet) together with the piping between the valve and the brake cylinders. The valve will be 'fail-set' so that in the event of electrical failure, the brake will remain in the last selected position and visual indication of when the brake is off, when it is on and when the brake shoe is worn and needs to be replaced. SSS will also supply and fit the wiring from the valve and from the brake switches to a terminal box. The brake will be applied by air pressure and will be spring released, i.e. in the event of air pressure failure the brake will release.

SSS supply includes a cooling oil spray adjacent to the brake shoe.

2.4. <u>SSS PINION CLUTCH TURNING GEAR, SEE DRAWING NO. 19802/19971</u>

The turning gear consists of an SSS Pinion Clutch which engages with a gear wheel mounted between the clutch input and the input shaft. The SSS pinion shaft is mounted on a cover attached to an opening on the side of the main casing.

See Appendix A for more details.

3. OPERATING SEQUENCE

3.1. <u>POWER GENERATION REQUIRED FROM STANDSTILL</u>

Start the gas turbine.

As soon as the power turbine begins to rotate, the SSS Clutch automatically engages to drive the generator.

When the power turbine/generator reaches full speed it is connected electrically to the grid and the power from the turbine can be increased to the power level required.

3.2. <u>SPINNING RESERVE/SYNCHRONOUS CONDENSING FROM GENERATING</u>

Reduce the fuel to the turbine and thus the generating load. If, before shutdown, a high speed cooling period is required for the turbine, this should be with the power turbine at full speed and transmitting a small power to ensure that the clutch remains engaged.

As soon as the power turbine slows down relative to the generator, the SSS Clutch automatically disengages and the turbine decelerates to low speed while the generator remains in operation. NOTE: due to oil drag within the clutch, the turbine normally continues to turn at slow speed but it is assumed to be below 500 rpm.

After the low speed cooling period with the turbine being rotated by clutch drag, the turbine can be stopped if required by the brake (see Section 2.3).

3.3. <u>GENERATING FROM SPINNING RESERVE/SYNCHRONOUS CONDENSING</u>

Start the gas turbine and accelerate to full speed. The acceleration rate of the power turbine alone should not generally exceed about 150 rpm/sec and about 20 rpm/sec when approaching full speed.

As soon as the power turbine attempts to rotate faster than the generator, the SSS Clutch engages automatically.

The turbine power can then be increased as required.

SSS should be informed of the detailed start sequence and any prolonged turbine operation at more than 50% of generator speed should be avoided.

3.4. STOP FROM GENERATING

After any full speed cool down period, the generator is disconnected from the grid and the turbine is shutdown. The clutch will probably disengage because of the higher deceleration rate of the power turbine than of the generator.

When the turbine speed decelerates to zero rpm and remains at rest for say ten seconds minimum, the pinion turning gear is started by the turbine control system and the SSS Pinion Clutch will engage. The turbine and generator will then rotate on their respective turning gears with the 272T SSS Clutch disengaged. When the generator side decelerates to low speed, the turning gear (not of SSS supply) maintains the generator side at 6.3 rpm.

3.5. STOP FROM SPINNING RESERVE/SYNCHRONOUS CONDENSING

The generator is disconnected from the grid and it decelerates. The power turbine will usually already be at rest and being held by the brake. If turning gear operation is then required for the generator, the generator side turning gear can be run to rotate the power turbine and the 272T SSS Clutch will remain disengaged and the power turbine stationary.

4. CONTROL INTERLOCKS

4.1. Turbine Stopping Brake

As stated in section 2.3, the brake must only be applied under the following conditions:-

1. The power turbine is not rotating above 500 rpm.
2. The turbine fuel control is fully closed.

Neither the turbine nor the turning gear should be started if the brake switches do not confirm that the brake is off.

When the brake is activated, both switches must show ‘brake on’. In the event that one switch incorrectly indicated ‘brake off’, the switch must be corrected as soon as possible. Neither the turbine or turning gear should be started unless both switches confirm the brake is off.

A vertical cutout on the side of the brake housing allows you to see the brake piston rod and it is marked to show the position of brake off, brake on and when the brake shoe is worn and needs replacement.

4.2 Turbine Start

The turbine will not be accelerated above 5 rpm unless both the turning gear disengaged switches show disengaged.

4.3. Turning Gear Interlocks

See Appendix A.

5. INSTRUMENTATION

5.1 SSS will provide junction boxes into which all instrumentation and other electrical connections will be wired with flexible conduit. The terminal boxes will be as section 6.4.1 and as shown on 19797/19989.

5.2 Clutch Position Indication

5.2.1 Three switches will be provided to indicate when the clutch is engaged. The switches will be mounted inside of the casing but accessible through covers in the casing top cover.

5.3 Vibration Measurement

5.3.1 At each end of the casing there will be a suitable mounting point for velocity transducers of the Bentley Nevada type 350900. These transducers will be wired into an SSS junction box and continuously monitored by the plant control system.

5.3.2 The SSS casing will include eight mounting bosses for X-Y proximity probes; two located adjacent to each bearing. Optionally SSS can supply these probes which would only be used for investigation purposes in the event of problems.

5.4. Temperature Measurement

5.4.1 One 100 Ohm platinum duplex RTD will be provided in each of the lower pads in each bearing. These RTD's will be wired to a terminal box on the exterior of the clutch casing.

5.5. Brake Switches

5.5.1 The brake unit will be fitted with two switches, each to indicate that the brake is off and provide the necessary interlock with the turbine control system, as described in section 2.3. The brake will be positioned on the top cover of the clutch casing and will be wired to a small junction box mounted on the brake unit and that box is wired to a main casing junction box as shown on 19797/19989.

5.6. Pinion Switches

5.6.1 The pinion clutch will fitted with three switches, one to indicate pinion clutch engaged and two to indicate disengaged. These switches must also be interfaced with the turbine control system as described in section 4.2

6. INTERFACES

6.1. Input and Output Flanges

6.1.1 The holes for the coupling bolts in the clutch input and output shaft flanges will be machined to dimensions provided by the customer to suit their flexible coupling.

6.1.2 The driving bolts and nuts for connecting the SSS flanges to the turbine and generator flexible coupling flanges will be supplied by the customer.

6.2. Foundation Interfaces

6.2.1 It is assumed that the clutch casing will be mounted on the customer's steel foundation plates on a concrete plinth. A pin and key device supplied by SSS is provided at the centre-line of the clutch casing base to maintain good alignment.

After achieving the correct alignment during installation, parts of the pin and key device should be welded to the customer's foundation plates.

Shim for height adjustment will be provided but the casing holding-down bolts are not supplied by SSS.

6.3. Lubrication Interfaces

6.3.1 The clutch housing will be provided with two oil inlet connections and two oil drain connections to interface with the customer's oil supply piping. Identical flange connections will be provided on each side of the casing and one will be fitted with a blanking flange for which SSS will provide the necessary bolts. These connections will be fitted with ANSI Standard B16.5, 150 lb. RF flanges. The connecting flanges and bolts for connecting to the customer's oil system should be provided by the customer. All other piping etc required to distribute oil within the housing is provided by SSS.

6.3.2 The SSS casing will supplied with provision for shaft jacking oil as described in section 11.7. The casing will be provided with eight connections of size 1/2" SAE 3000 PSI code 61. The connecting flanges and bolts, pressure gauges and non-return valves for connecting to the customer's jacking oil system should be provided by the customer. Piping required to distribute jacking oil within the housing is provided by SSS.

6.4. Electrical Interfaces

6.4.1 SSS will provide terminal boxes per the attached specification on the exterior of the clutch housing to contain all electrical connections to equipment of SSS supply, including the 272T clutch and pinion clutch position indicator switches, the pinion and brake solenoids, the brake switches and the RTD's. There are at least 20% extra connections provided. The switches are proximity switches of SSS supply for which an amplifier may be required, not of SSS supply.

6.5. Pneumatic Interface

6.5.1 Customer to connect directly to brake solenoid valve, see drawing no. 19556/19970.

6.5.2 Casing labyrinth seals have provision for customer sealing air if required.

6.6. Turning Gear Interfaces

SSS supply includes the SSS Pinion Clutch and wormdrive assembly, the chain drive connecting these, also the turning gear motor and flexible coupling. SSS provides the solenoid valve controlling pinion engagement but the control logic to operate this valve and start the motor would be provided from the turbine control.

For details, see Appendix A.

7. SCOPE OF SUPPLY

7.1. The unit is supplied as a complete assembly as shown on drawing no. 19797/19989, and described in this specification. All parts of SSS supply are shown in full lines on the drawing.

8. SCREW THREADS

All threads used in SSS equipment for screws are normally of imperial UNF type, but larger sizes may be UNC. All internal screws are normally locked by a plastic locking patch (see attached leaflet). It is recommended that such screws are replaced after five removals.

9. PAINTING

The external surfaces of the SSS casing will be painted in accordance with GE specification 95953, rev T.

10. QUALITY SYSTEM, TESTING AND CERTIFICATION

10.1. Quality System

The quality procedures used would conform with the SSS Quality Manual (current issue). These procedures are generally comparable to the requirements of BS5750, Part 1 (ISO 9001). An extract from the SSS Quality Manual (NR2199) is attached, but it is not SSS policy to release the complete manual.

The Quality Plan will be to SSS standard NR2068 (copy attached).

10.2. Material Testing

10.2.1 The SSS shafts are made in AISI 4430 and all the main torque carrying parts of the SSS Clutch are in nitriding steel to BS970:1970:722M24.

10.2.2 All forged materials of the 272T SSS Clutch and shafts will be tested and certified as outlined in attached Notes Ref 0880/2. This is SSS standard procedure used for all SSS Clutches.

10.3. Balancing

10.3.1 The SSS Clutch comprises a number of sub-assemblies each of which will be individually balanced to SSS standard shown in SSS Notes Ref 0585/4 which is better than ISO 1940, Grade 2.5.

10.3.2 Any components normally recommended by SSS as spare parts will be individually balanced.

10.4. Functional Testing

10.4.1 Each complete clutch unit will be tested at light load up to full speed and 10% overspeed by driving each end of the unit by electric motors. The electric motor speeds will be varied to simulate the various operating modes of the actual plant and demonstrate correct functioning of the size 272T SSS Clutch. The pinion-type turning gear clutch, brake and other components will also be tested.

10.5. Certification

10.5.1 A test certificate, generally as per the attached draft copy of a certificate TC335.1, will be supplied for each clutch, confirming that tests have be satisfactorily completed and that all interface dimensions are correct. Each section of the SSS test certificate will only be signed at responsible manager level.

10.5.2 The steel forging test certificates referred to in the attached Notes Ref 0880/2 will be retained on file by SSS and may be inspected if necessary. In accordance with SSS standard policy copies will not be supplied.

11. TECHNICAL DATA

11.1. Speed and Torque

11.1.1 Maximum mechanical rating: 132 MW @ 3600 rpm or 125MW at 3000 rpm. The clutch is designed to be used in both 50 Hz and 60 Hz installations.

11.1.2 The SSS Clutch will accept the maximum fault torque advised of 1,008,333 lb.ft which is 3.9 x full load torque at 132 MW/3600 rpm.

11.1.3 The SSS Clutch will accept an overspeed of 15% but due to test rig limitations, the SSS Clutch will be tested to only 10% overspeed, i.e. 4000 rpm.

11.2 Misalignment

11.2.1 The Size 272T SSS Clutch itself is supported between two shafts, each supported in line with each other by two bearings so the clutch is not subjected to misalignment. The customer's flexible couplings will accept any misalignment between the clutch package and the turbine/generator.

11.3. Generator Axial Location and Axial Movements

11.3.1 The clutch includes an internal thrust bearing. Due to this internal thrust bearing, the entire clutch with input and output shafts, will move axially relative to the casing due to turbine and generator shaft expansions. Note that the SSS internal thrust bearing will accept an axial force of 4800 lbs disengaged or 12000 lbs engaged which exceeds the customer's maximum possible load of 3125 lbs.

11.3.2 The SSS Clutch casing is designed to accommodate +/- 0.125" axial movements of the clutch and shafting including installation tolerances at site and when the turbine transitions from cold to hot condition.

11.3.3 For installation/maintenance purposes, the clutch input flange can be completely disconnected from the turbine and generator flexible coupling shafts and the clutch, with shafts moved approximately 8mm axially towards or away from the turbine to permit the input or output flexible coupling shafts to be disconnected and removed.

11.4. Power Loss and Drag

	3000 rpm	**3600 rpm**
Generating mode		
Power loss:	210 kW	300 kW
Synchronous condensing mode		
Power loss:	215 kW	310 kW
Clutch drag:	200 lbft	300 lbft

Note that the clutch drag is the torque tending to keep the power turbine in rotation produced by the SSS Clutch when the machine is operated as a synchronous condenser. This torque will tend to rotate the power turbine continuously until the brake is applied.

11.5. Lubrication Oil

11.5.1 It is understood that the turbine, generator and their clutch all have their own lubrication systems.

The following temperatures and pressure ranges have been advised:-

Oil type	ISO VG32	
Temperature:	Normal	140°F (60°C)
	Maximum trip	165°F (64°C)
	Normal start temperature	70°F (21°C)
	Minimum start temperature	50°F (10°C)
	Absolute minimum	40°F (5°C)
Pressures:	Normal inlet oil pressure	30 psi
	Alarm pressure	25 psi
	Trip pressure	20 psi
	Trip lockout shut-down	12 psi
	Maximum pressure	38 psi

11.5.2 Oil system vacuum - customer's oil system has 2" water vacuum on tank.

11.5.3 The total required oil flow is about 500 litres/min and should be supplied to the SSS Clutch through one of the two flanged oil inlet connections on the clutch housing. The oil flow must be continuous whenever the generator is rotating.

11.6 Shaft Bearings

The four shaft bearings are four-pad tilting pad type orientated with load between pads. For further details, see attached data sheet.

11.7. Jacking Oil

The journal bearings include two separate oil supplies to the lower half of each bearing for the customer's jacking oil supply (i.e. eight total). All eight jacking oil pipes will have separate external connections (see drawing no. 19543/19989). Non-return valves, external pipework, pressure gauges etc are not included in SSS supply.

11.8. Pneumatic Supply

Customer to supply air for brake actuation and sealing air if required (100 psi +/- 20 psi).

11.9. Direction of Rotation

See drawing no. 19797/19989.

11.10. Mass Elastic Data

Weight, inertia and torsional stiffness details of the complete unit have been added to SSS drawing no. 19543/19989. Although SSS has done a lateral analysis of the clutch shaft system and a casing analysis, it is the customer's responsibility to carry out lateral and torsional analysis of the complete machine configuration incorporating the SSS Clutch.

11.11. Turning Gear Data

The SSS Pinion Turning Gear system has been designed to accept the following conditions:-

Turning gear speed	3 rpm
Normal running torque	121 lb.ft
Breakaway torque	671 lb.ft
Power turbine inertia	14,078 $lb.ft^2$

Note: Turning gear data assumes Size 272T Encased SSS Clutch is disengaged and generator is being turned by its own turning gear.

11.12 Ambient Temperature

GE has specified that the maximum transient air temperature surrounding the clutch is 250^oF, however normal temperature is such that personnel can work in this area.

11.13 Hazardous Area

The SSS Encased Clutch will not be installed in a hazardous area and therefore specifications associated with hazardous areas will not apply.

SSS CLUTCHES

TECHNICAL SPECIFICATION

APPENDIX A

LMS100 PROJECT

SSS PINION CLUTCH

Notes Ref: **NR2295**
Dated: **26 October 2011**

Rev 1 dated: **23 December 2013**

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I N D E X

APPENDIX A
SPECIFICATION FOR SSS PINION TURNING GEAR CLUTCH
LMS100 PROJECT

APPENDIX A
SPECIFICATION FOR SSS PINION TURNING GEAR CLUTCH
LMS100 PROJECT

1. INTRODUCTION

The SSS Pinion Turning Gear (TG) described in this appendix is part of the Size 272T SSS Encased Clutch package shown on drawing no. 19797/19989. The purpose of TG is to turn the Power Turbine shaft (PT) and input side of the SSS Clutch: the generator and output side of the SSS Clutch are turned separately by a turning gear on the free end of the generator.

2. GENERAL DESCRIPTION - See Drawing 19802/19971

The TG is mounted on the lower half of the SSS Clutch casing alongside the Size 272T SSS Clutch.

The engagement and disengagement of the TG is by an SSS Pinion Clutch which slides axially on a helically splined shaft to engage or disengage pinion teeth with a gearwheel on the input side of the Size 272T SSS Clutch. Engaging movement is initiated, whilst the turbine is stationary, by oil pressure in the bore of the pinion from a solenoid controlled valve. Disengagement is automatic whenever the torque reverses on the helical splines (eg due to PT acceleration). For full details of the principle of the engaging mechanism of the SSS Pinion Clutch see SSS Principle 12C.

The SSS Pinion shaft is driven by motor via a double reduction wormgear and a chain drive. SSS Supply also includes a motor soft start, the solenoid valve and switches indicating pinion engaged and disengaged. The motor and valve are controlled by the customer control according to the sequence in section 3.1. The basic interfaces are shown in Figure 1.

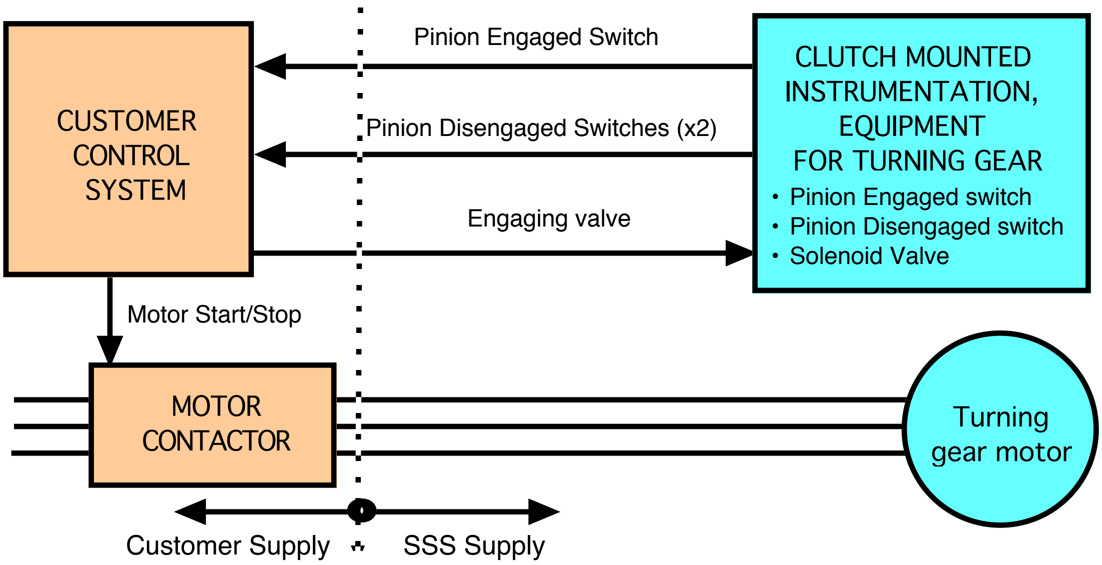

Figure 1

Note:
When the generator is operating at full speed with the GT shutdown the PT side brake will normally be applied. The turning gear should not be operated in this situation. If the brake is not applied the oil drag within the Size 272T SSS Clutch will keep the PT and gearwheel in continuous rotation and therefore the TG cannot be used .

3. PINION CLUTCH OPERATING SEQUENCE

3.1 Pinion Clutch Engagement

In this application the turning gear is arranged to engage and start only when the PT is stationary. The engaging sequence is controlled by the main plant control sytem as follows ...

- Confirm that the PT shaft is stationary, jacking oil is on, the brake is off and that the generator shaft is rotating on its turning gear.
- Energize the pinion solenoid valve to select engagement.
- The pinion will move towards engagement and the teeth will come into end contact and the pinion will cease to move.
- After a timed pause, typically 10 seconds, the plant control activates the turning gear motor contactor.
- The contactor engergizes the motor through a reduced voltage start and the pinion will accelerate slowly. As it rotates the teeth will align with the gearwheel and the oil pressure will cause the teeth to start to mesh.
- Further rotation of the motor will cause torque on the helical splines and complete engagement of the pinion teeth.
- During this movement the Pinion Engaged switch will indicate pinion engaged.
- As soon as the Pinion Engaged switch indicates engaged the main plant control system de-energizes the pinion solenoid valve.
- The engaging sequence is now complete and the turning can continue to rotate the PT or the GT can be started in which case the pinion will automatically disengage (see section 3.2).

3.2 Pinion Clutch Disengagement

Disengagement of the pinion is due to torque reversal on the helical splines and is therefore completely automatic. As soon as the Pinion Disengaged switch shows 'Disengaged' the turbine control system must shutdown the TG motor so that the system is ready for re–engagement when the PT next comes to rest and the turning gear is required.

Pinion clutch disengagement will occur when either ...

- The PT accelerates.

- The Turning Gear Motor is stopped to shutdown the turning gear. Note that if the PT tends to stop faster than the turning gear motor the pinion will remain engaged but will disengage when the PT is next accelerated from the turning gear speed.

While the turning gear is shutdown oil pressure within the pinion applies a small force to keep the pinion in the fully disengaged position to ensure that it will not move towards the gearwheel causing contact and possible damage if there was a high differential speed.

4. OIL SUPPLY

All oil is from the clutch oil system. For details see section 11.5.1 of SSS Clutch Specification NR2295.

There are two oil feeds to the pinion clutch shaft. One feed is used to apply the pressure to engage the clutch the other is for lubrication and to hold the pinion away from engagement whilst the pinion is disengaged.

Additional oil supplies for bearing lubrication and tooth lubrication are arranged within the main casing.

5. INSTRUMENTATION

The following switches are supplied by SSS.

5.1. Pinion Engaged Switch

One engaged switch is provided to indicate when the pinion is partially engaged. This signal is used for the turning gear control sequencing as described in section 3.

5.2. Pinion Disengaged Switch

Two disengaged switches are provided to show that the pinion teeth are disengaged. These switches are used for interlock that the clutch is fully disengaged (see section 4.2 of SSS Clutch Specification NR2295).

6. INTERFACES AND SCOPE OF SUPPLY

SSS Supply includes the pinion shaft line, external teeth on the turbine side of the clutch shaft line and motor driven wormgear and chaindrive assembly.

6.1 Motor and Primary Gearing

The free end of the motor includes a manual drive for manual barring the turbine. A cover for the free end of the motor will be arranged but no limit switch is included.

6.2 Solenoid Control Valve

A 4 port double acting, solenoid operated, spring return, control valve will be supplied mounted adjacent to the pinion. The valve is operated to apply oil and move the pinion clutch towards engagement with the shafting stationary. This valve will be controlled from the main control system in accordance with Section 3. It should be de–energised as soon as the pinion engaged signal is received.

In the event of an electrical failure this valve will return, due to the spring force, to the position where the engaging pressure is removed from the pinion clutch.

A key operated manual override valve will be fitted so that the pinion can be driven into mesh for emergency operation or for manual barring.

7. FUNCTIONAL TESTING

The Pinion Clutch will be tested with the Size 272T SSS Clutch, engagements and disengagements will be carried out to confirm the correct function of the Pinion Clutch.

8 MAINTENANCE AND SPARE PARTS

The SSS Pinion Clutch requires negligible maintenance and it is expected that all components will last the life of the power station in normal operation.

However in the event that the engaging valve is operated in error whilst the turbine is not at rest the Phasing Pinion and the Gear may come into end contact with high differential speed. In order to minimise the effect of such an occurrence the Phasing Pinion is ‘soft’ steel material so that this would become damaged before the main gearwheel. The Phasing Pinion is manufactured as a split component so that it can be replaced without dismantling the pinion shaft.

Recommended spare parts are listed in the instruction manual and include a phasing pinion.

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APPENDIX B

PROJECT LIST
SIZE 272T ENCASED SSS CLUTCHES FOR LMS100

<table>
<tr><td>Project</td><td>Cumberland : Connective/Calpine</td><td colspan="2">Haynes, Long Beach : LADWP</td><td colspan="2">Scattergood : LADWP</td></tr>
<tr><td>SSS Technical Specification</td><td>NR2035[1]</td><td colspan="2">NR2295</td><td colspan="2">NR2295</td></tr>
<tr><td>Package Drawing No.</td><td>19543</td><td colspan="2">19797</td><td colspan="2">19989</td></tr>
<tr><td>Clutch Drawing No.</td><td colspan="5">19152</td></tr>
<tr><td>Pinion Drawing No.</td><td>19555</td><td colspan="2">19802</td><td colspan="2">19971</td></tr>
<tr><td>Brake Drawing No.</td><td colspan="3">19556</td><td colspan="2">19970</td></tr>
<tr><td>Clutch Serial No/s.</td><td>R21219</td><td>R24209</td><td>R24210</td><td>R28218</td><td>R28219</td></tr>
<tr><td>Instruction Manual</td><td>IB.1236</td><td colspan="2">IB.1326A</td><td colspan="2">IB.1326B</td></tr>
<tr><td>SSS Gears Reference</td><td>C11277</td><td colspan="2">C12927</td><td colspan="2">C14385</td></tr>
<tr><td>SSS Clutch Company Inc Order No.</td><td>7835</td><td colspan="2">8683</td><td colspan="2">9479</td></tr>
<tr><td>SSS Inc Ref No.</td><td>A6137</td><td>A7048</td><td>A7036</td><td>A7733</td><td>A7931</td></tr>
<tr><td>GE Order No.</td><td>410060569</td><td>410130378</td><td>410128763</td><td>410218172</td><td>410219166</td></tr>
</table>

[1] 272T Encased Clutch for Cumberland Station is described in Technical Specification NR2035 but for completeness is shown here.

SSS Principle No.1a
Basic SSS clutch

The initials SSS denote the 'Synchro-Self-Shifting' action of the clutch, whereby the clutch driving and driven teeth are phased and then automatically shifted axially into engagement when rotating at precisely the same speed. The clutch disengages as soon as the input speed slows down relative to the output speed.

The basic operating principle of the SSS clutch can be compared to the action of a nut screwed on to a bolt. If the bolt rotates with the nut free, the nut will rotate with the bolt. If the nut is prevented from rotating while the bolt continues to turn, the nut will move in a straight line along the bolt.

In an SSS clutch the input shaft has helical splines which correspond to the thread of the bolt. Mounted on the helical splines is a sliding component which simulates the nut. The sliding component has external clutch teeth at one end, and external ratchet teeth at the other (see Figure 1).

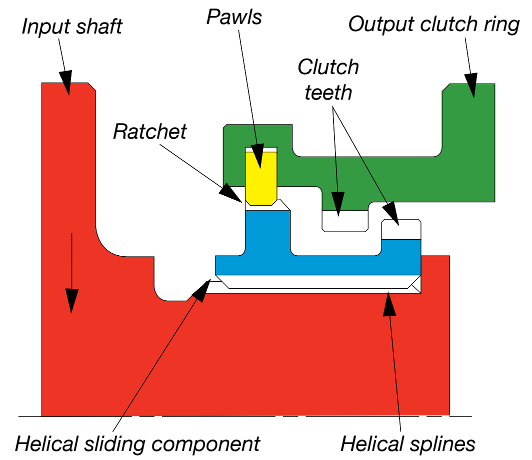


Figure 1: Clutch disengaged

When the input shaft rotates, the sliding component rotates with it until a ratchet tooth contacts the tip of a pawl on the output clutch ring to prevent rotation of the sliding component relative to the output clutch ring, and align the driving and driven clutch teeth (see Figure 1 and Figure 4).

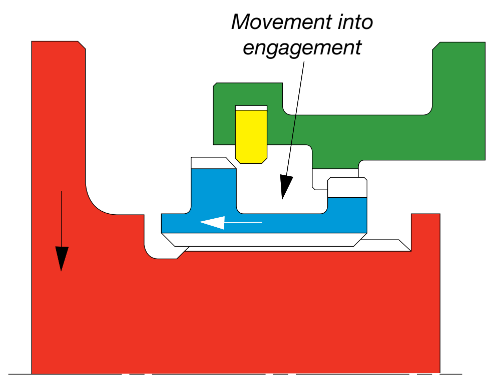


Figure 2: Engaging travel (pawls unloaded)

As the input shaft continues to rotate, the sliding component will move axially along the helical splines of the input shaft moving the clutch driving and driven teeth smoothly into engagement.

During this movement, the only load taken by the pawl is that required to shift the lightweight sliding component along the helical splines.

As the sliding component moves along the input shaft, the pawl passes out of contact with the ratchet tooth, allowing the driving teeth to come into flank contact with the driven teeth and continues the engaging travel (see Figure 2).

Driving torque from the input shaft will only be transmitted when the sliding component completes its travel by contacting an end stop on the input shaft, with the clutch teeth fully engaged and the pawls unloaded (see Figure 3).

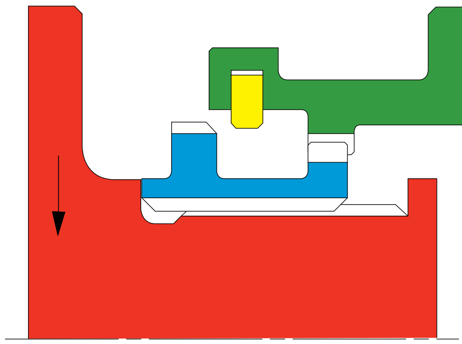


Figure 3: Clutch engaged

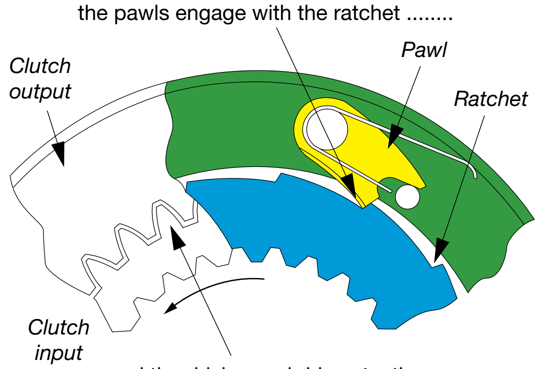


Figure 4: Clutch teeth alignment

When a nut is screwed against the head of a bolt, no external thrust is produced. Similarly when the sliding component of an SSS clutch reaches its end stop and the clutch is transmitting driving torque, no external thrust loads are produced by the helical splines.

If the speed of the input shaft is reduced relative to the output shaft, the torque on the helical splines will reverse. This causes the sliding component to return to the disengaged position and the clutch will overrun. At high overrunning speeds, pawl ratcheting is prevented by a combination of centrifugal and hydrodynamic effects acting on the pawls.

The basic SSS clutch can operate continuously engaged or overrunning at maximum speed without wear occurring.

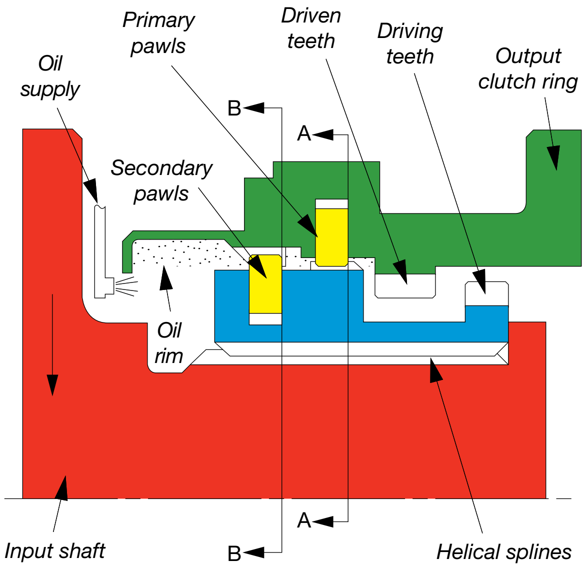
SSS Principle No.2a
Prisec pawls - Primary and Secondary

The purpose of Prisec pawls is to enable the clutch to engage both at low speed and at high speed but prevent sustained ratcheting action of the pawls with the clutch output at speed and the clutch input stopped.

Prisec Pawls
(Primary and Secondary)

The secondary pawls are activated by centrifugal force.

The primary pawls are spring loaded inwards and retracted by centrifugal force.

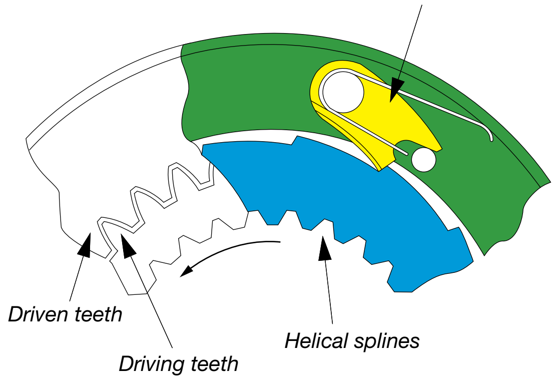


Primary Pawls
Engage the clutch in the low speed range and have the following features:

Mounted on the clutch output.

Spring loaded onto the ratchet teeth.

Unbalanced relative to pivot to centrifugally retract when the output exceeds a predetermined speed (usually about 500 rpm).



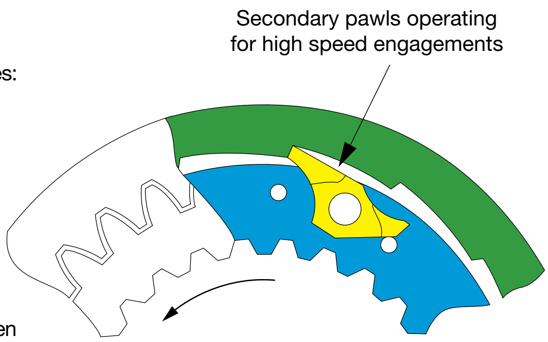
Section A-A

Secondary Pawls
Engage the clutch in the high speed range and have the following features:

Mounted on the sliding component driven by the clutch input.

Unbalanced relative to pivot to give a centrifugal movement towards the ratchet teeth when the input rotates.

Oil immersed ratchet teeth provides a skimming action for the pawls when there is a high relative speed between the pawls and the ratchet teeth keeping the pawls out of contact with the ratchet teeth until the input speed approaches the output.



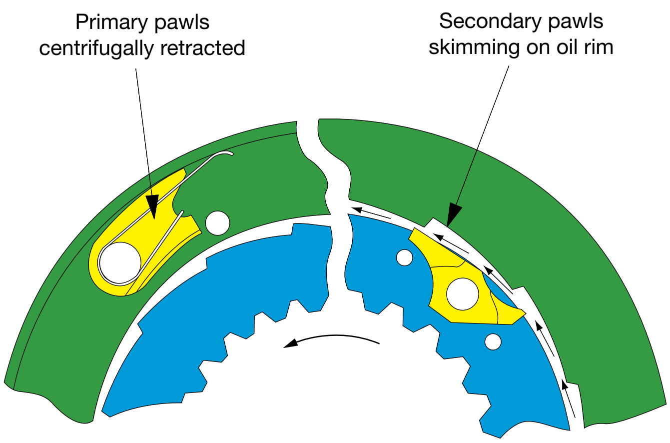
Section B-B

Prisec Pawls

Primary pawls are centrifugally retracted when the clutch output is at speed.

Rotating oil rim depresses secondary pawls to prevent ratcheting when overrunning at high speeds.

Both sets of pawls are inert when the clutch output is rotating at high speed and the input is at rest or at low speed.



Condition with output at high speed and input stopped

SSS Principle No.4
Dashpot - double acting type

The purpose of the double acting dashpot is to cushion clutch engagement at high acceleration and slow down the rate of disengagement.

Figure 1:

Clutch Disengaged

The dashpot is continuously supplied with low pressure oil, usually from the main plant lubrication system.

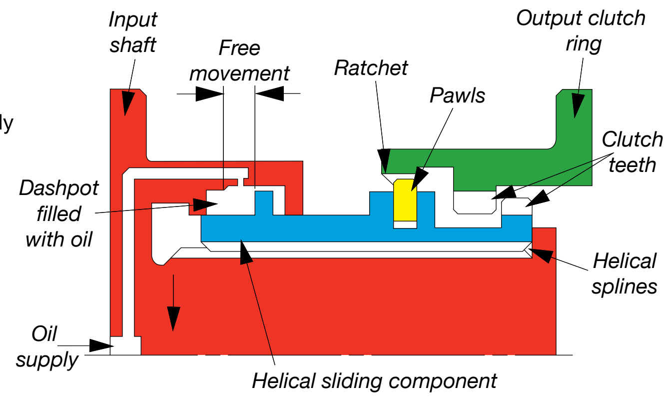


Figure 2:

Clutch Engaging

Strong dashpot action starts when the pawls are unloaded and then continues to the end of the clutch engaging travel.

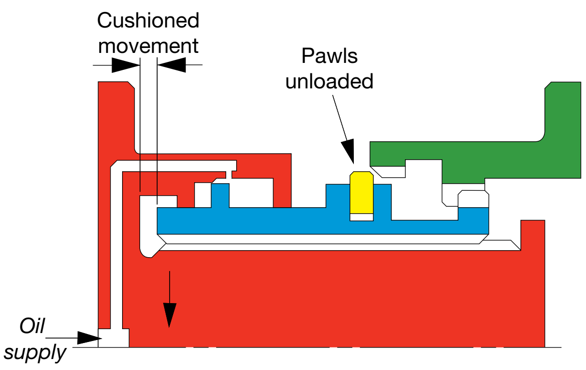
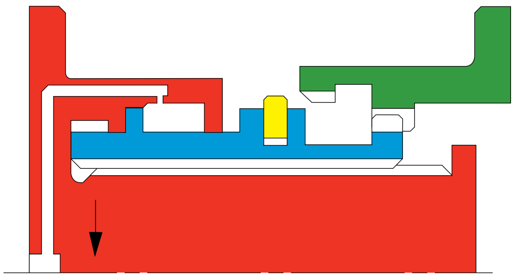


Figure 3:

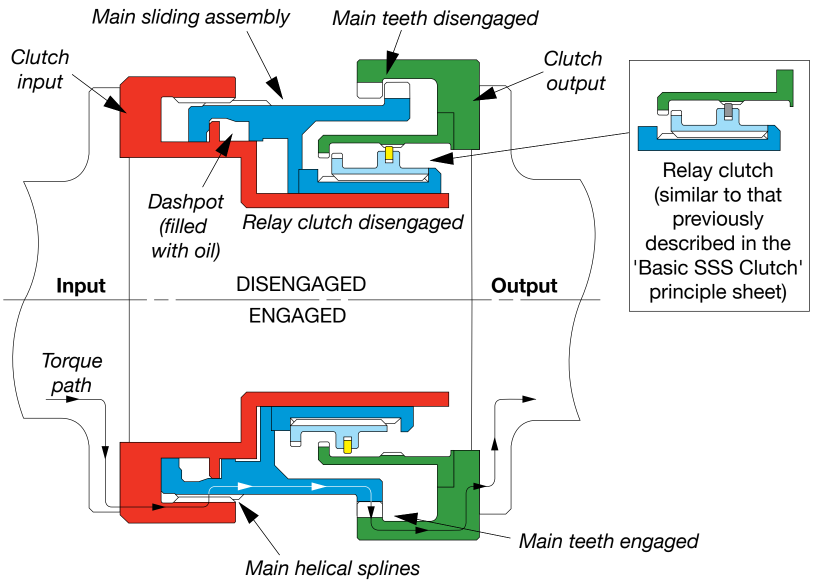
Clutch Engaged

Final clutch engaging travel is cushioned by the dashpot action. The dashpot also slows down the rate of clutch disengagement.



SSS Principle No.5
Relay Type Clutch

For high power applications a relay clutch is used to initiate engagement of the main clutch. Lightweight pawls are used to first engage the small relay clutch. The more powerful teeth of the relay clutch then engage the larger mass of the main clutch.



Sequence to engage/disengage

1: With the output side of the clutch overrunning and the input side at rest, the clutch is disengaged as shown in the upper half of the illustration. The pawls are inactive.

2: The input side of the clutch is accelerated and, at the instant the input side overtakes the output side , the relay clutch is engaged by the pawls as described in the 'Basic SSS Cutch Principle' sheet.

3: When the relay clutch has engaged, the main teeth are still disengaged but are now aligned for inter-engagement.

4: The relay clutch teeth now move the main sliding assembly along the main helical splines to shift the main teeth smoothly into engagement. During this movement the relay teeth become unloaded when the main teeth are partially engaged.

5: The oil filled dashpot becomes effective whilst the main teeth are shifting the clutch fully into engagement.

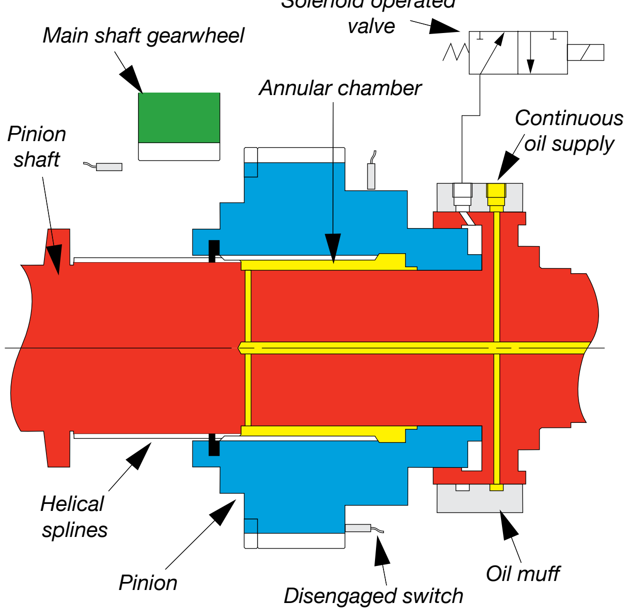
6: The clutch is fully engaged as shown in the lower half of the drawing.

7: When the input side slows down relative to the output side, the torque is reversed on the main helical splines and the main sliding assembly moves to disengage the main teeth. The relay clutch then disengages so the input side is disengaged from the output side.

SSS Principle No. 12c
Pinion clutch - Direct Engagement

The SSS Pinion Clutch engages and disengages a pinion, driven by the turning gear motor, with a gearwheel on the turbine/generator shaft system to enable the turbine/ generator to rotate at turning gear speed for cooling or inspection purposes.

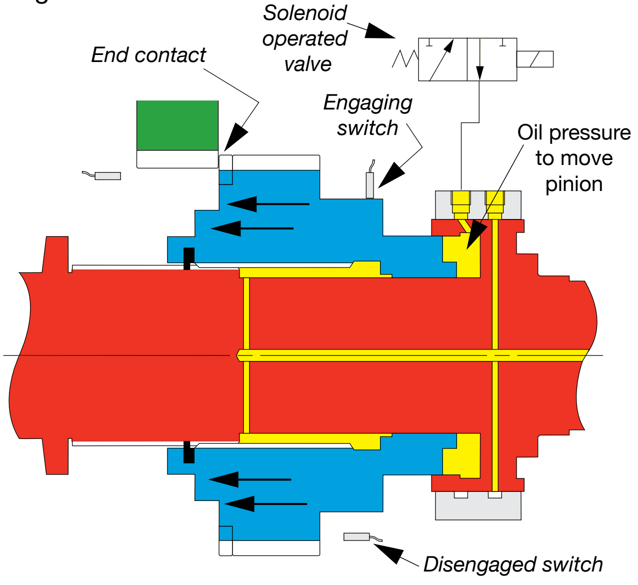
Figure 1:



Disengaged:

Continuous oil pressure enters the oil muff for lubrication purposes. Also this oil pressure acts in the annular chamber between the outside diameter of the pinion shaft and the bore of the pinion to hold the pinion in the disengaged position.
The disengaged switch is activated to show that the pinion is fully disengaged from the gearwheel.

Figure 2:

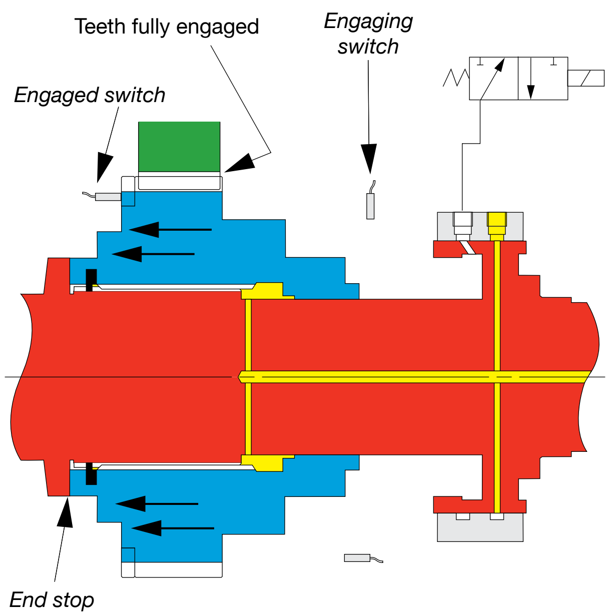


Engaging:

The turbine must be confirmed to be at rest for a period of, say, 10 seconds. Then when pinion engagement is required the solenoid control valve is energised. Oil pressure moves the pinion axially and the disengaged switch is
de-activated. The pinion continues to be moved axially towards engagement along helical splines until the pinion teeth make end contact with the teeth on the main shaft gear or partial engagement may take place.

SSS Principle No. 12c

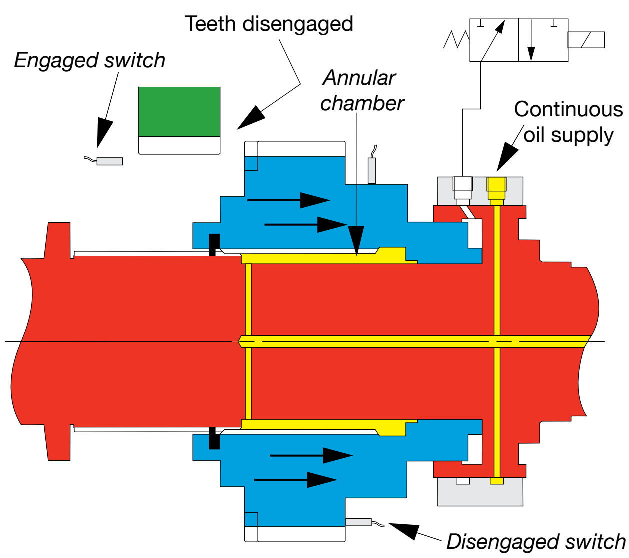
Figure 3:



Engaged:

After a short delay (10 seconds) the turning gear motor starts under low torque. Initial rotation causes the pinion teeth to align with the gearwheel teeth. Further rotation moves the pinion along the helical spline so the engaging switch is deactivated and the solenoid valve is de-energised to remove the oil pressure.
Further rotation of the turning gear motor causes the pinion to move along the helical splines into full engagement. This movement is due only to torque on the helical splines. Full engagement occurs when the pinion contacts an end stop and the engaged switch is activated.

Figure 4:



Disengaging:

Disengagement is fully automatic when the turbine speed overtakes that of the turning gear. At this time the reverse torque on the helical splines causes the pinion to move automatically away from engagement and the engaged switch is de-activated.
When the teeth are fully disengaged oil pressure in the annular chamber within the bore of the pinion moves the pinion fully clear of the gearwheel and the disengaged switch is activated.

Balancing Procedure

An SSS Clutch has a sliding component which connects the input and output elements together before positive torque is applied through the clutch. This sliding element must have sliding clearances, therefore it is not possible to dynamically balance the complete clutch as a single assembly.

In general the input, sliding and output elements are each dynamically balanced as sub-assemblies. Where spare parts may be required, these parts are balanced as separate items.

For each design of SSS Clutch a balancing procedure is prepared detailing which components are to be dynamically balanced either as separate items or as sub-assemblies.

The majority of components/sub-assemblies have to be balanced using a central mandrel as it is not practicable to support the component/sub assembly on the balancing machine without such a mandrel due to the component size/shape. The mandrel itself is previously balanced.

Components are checked for concentricity when assembled to the mandrel and any fixings required are retained in match-weighed sets.

All balancing correction is carried out by removing metal - usually drilling holes. The SSS balancing procedure drawing will indicate where to drill and state the maximum size of holes that may be drilled to correct unbalance. When preparing the balancing procedure drawing, care is taken to ensure that any balancing holes are kept clear of stressed areas.

In general, SSS adopts the following balancing standard.

Maximum unbalance in each correction plane must not exceed the value given by the formulae:

$$u = \frac{4W}{N} \text{ Imperial} \qquad \left(\frac{6350W}{N} \text{ Metric}\right)$$

u = unbalance/plane in oz.-in (grams-mm)
w = weight of component/sub-assembly (not including mandrel weight if used) in lbs (Kg)
n = maximum operational speed

The above is based on a particular British Standard and is better than ISO 1940 Grade 2.5 and approaching Grade 1.

Dependant on the design and operating requirements other standards may be adopted to meet special operating requirements.

Balancing certificates for each component/sub-assembly are retained by SSS Gears Limited.

1. All forgings are supplied to SSS in a rough-machined condition.

2. Chemical analysis is provided for casts from which the forgings are produced.

3. All forgings have Brinell hardness tests to confirm satisfactory heat treatment/strength.

4. Where specified by SSS, forgings for components carrying full turbine torque are covered by mechanical testing. A separate test piece is provided from the same cast which is then heat treated with the forgings and used for mechanical testing purposes. SSS usually arranges for such mechanical testing of forgings for high-power and/or high-speed SSS Clutches such as naval main propulsion drives, and high-power, turbine-driven generator applications. Mechanical tests are not usually performed on torque-transmitting forgings of SSS Clutches for auxiliary drive applications; (turning gears, starting drives etc.).

5. All forgings are ultrasonically tested after rough-machining.

6. All forgings supplied to SSS must be to the steel specification requirements as each specific forging is not identified during subsequent machining operations to an individual finished component.

7. Certificates covering the tests in paragraphs 2, 3 and 5, and 4 where applicable, are retained by SSS and may be inspected by the customer if necessary. However, copies of these certificates are not supplied to the customer.

8. All surface hardened components made from steel forgings are finally crack tested by the magnetic particle or dye-penetrant method.

SSS Gears Limited
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England: TW16 5BL

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Fax:+44(0)1932 780018

SSS CLUTCH TEST CERTIFICATE

Customer:	SSS Clutch Company Inc
Customer Order Number:	8683
Clutch Size:	272T Encased Clutch and Pinion Clutch
Clutch Serial Number:	R24209
Pinion Clutch Drawing Number:	SL19802/1
Clutch Drawing Number:	SL19797/4
SSS Gears' Contract:	C12927
Test Date:	13th September 2011

1. QUALITY SYSTEM

The quality procedures used throughout this contract conform with the SSS Quality Manual (current issue). These procedures are generally comparable to the requirements of BS5750, Part 1 (ISO 9001).

SIGNED **PURCHASING MANAGER**

2. MATERIAL TESTS (Rotating Parts)

It is SSS policy to reject all material which does not conform with the relevant specification requirements regarding chemical composition, strength, etc. No concessions are permitted in this respect.

It is certified that Material Test Certificates held by SSS Gears Limited specified requirements. These test certificates are available for inspection, if necessary.

It is certified that all forgings have been tested for hardness and ultrasonic soundness. Chemical analysis has been carried out on casts from which the forgings were produced.

It is certified that, where components transmit full torque, mechanical test pieces taken from the forgings (or from the same cast) have undergone heat treatment with the forgings and have been tested for tensile strength.

SIGNED **PURCHASING MANAGER**

3. MAGNETIC CRACK DETECTION (Rotating Parts)

It is confirmed that all surface hardened components have been magnetically crack tested by a suitably qualified operator and no detectable flaws were apparent.

SIGNED **PURCHASING MANAGER**

4. INTERFACE DIMENSIONS

All interface dimensions have been measured, and are correct to SSS Gears Limited drawing number SL.19797

SIGNED WORKS MANAGER

5. DYNAMIC BALANCING

The SSS clutch has been dynamically balanced as a number of sub-assemblies and separate components in accordance with SSS standard procedure 0585/4, but to the accuracy required by ISO 1940, Class G2.5.

SIGNED PURCHASING MANAGER

6. LUBRICATING OIL

Oil used for all testing was ISO VG 32 turbine oil, which has a viscosity of 32 cSt at 40°C.

7. CLUTCH ENGAGEMENT TESTS

With clutch output rotating at the following speeds, input was accelerated from 0 rpm and checked for satisfactory engagements at synchronism. A minimum of 10 engagements were made at 3600 rpm, and at least 2 engagements at the other speeds.

Engaging/Disengaging speed	No. of Engagements
0 rpm	2
500 rpm	2
1000 rpm	2
2000 rpm	2
2500 rpm	2
3000 rpm	2
3600 rpm	10

Clutch was engaged and rotated at 3600 rpm for 60 minutes.

8. CLUTCH OVERSPEED TEST

Clutch was engaged and rotated at 3960 rpm for 5 minutes.

9. OVERRUNNING TEST

With clutch disengaged and the input stationary, the output was rotated at 3600 rpm for 60 minutes.

10. CLUTCH OIL FLOW TESTS

The oil flows to the clutch package (including the turning gear)were measured under the following operating conditions:

Supply oil temperature approximately 140 °F, supply pressure 30 psi.

	Oil Flow (USGPM)
Clutch Engaged, 3600 rpm	134
Clutch Overrunning, 3600 rpm	134

11. CLUTCH OVERRUNNING DRAG TEST

With the output rotated at 3600 rpm, the input was rotated at the following speeds and the drag torque tending to accelerate the input was measured.

Oil temperature 140 °F.	Oil pressure 30 psi.
Speed of Input	Drag Torque
0 rpm	292 lbft

The brake torque at 500 rpm was measured with a air supply pressure of 58 psi - 543 lbft

12. PINION CLUTCH ENGAGEMENT TESTS

Main shaft at rest:

With the main shaft stationary, the turning gear servo valve was operated and then the test rig turning gear motor started.

Satisfactory engagement of the pinion with the gearwheel and acceleration of the main shaft to turning speed was confirmed.

The main shaft was then accelerated, and satisfactory disengagement of the pinion from the gearwheel confirmed.

The above engagement sequence was carried out a minimum of 3 times at normal oil pressure and 2 times at minimum (alarm) pressure.

13. TURNING TEST

The pinion was engaged with the gearwheel and rotated to drive the main shaft at turning speed for 30 minutes.

14. POST-TEST INSPECTION

The clutch output end was dismantled, and the pawl and ratchet mechanism and internal bearing were inspected. The shaft bearing pads and pinion clutch were also inspected.

All were found to be in good order.

15. CERTIFICATION

SSS Gears Limited certifies that clutch serial Number R.24209 has been subjected to the tests detailed above, and proved to be satisfactory.

For and on behalf of
SSS GEARS LIMITED

P.S.Bizzill
Director

Part of Notes Reference
NR2199 - Quality System
Pages 1, 3, 4, 5, 6 & 13

GEARS LTD

EXTRACT FROM QUALITY ASSURANCE SYSTEM

NOTE: Only these parts of SSS Quality System may be released outside of SSS Gears Ltd. For full details of this policy please see page 6 of 15 of NR2199 (attached).

SSS Gears Ltd. Park Road, Sunbury-on-Thames,
Middlesex, TW16 5BL. England.
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Quality Management System

Part 1 – Quality Manual

Abstract

The SSS Gears Ltd. Quality Management System is divided into four parts. This Quality Manual is Part 1 and describes the policies adopted by SSS Gears Limited (SSS). It defines:

- the overall Quality Management System adopted by SSS;
- the organisation that has been developed to implement that Quality Management System;
- the associated documentation (e.g. Quality Procedures, Quality Forms etc.) that have been designed to enable SSS to carry out the Quality Management System.

Contents

1.0 Company Background

Since its formation more than 60 years ago the overriding policy of SSS Gears Ltd has been to specialise in one product, the SSS Clutch, and to provide it to the highest quality, at a competitive price, supported by very efficient service.

SSS Clutches are used for the most arduous rotating equipment applications and are selected by most of the premier turbine and large gearbox manufacturers of the world.

The principle uses for SSS Clutches are, Power Generation, Auxiliary Drives, Marine Propulsion and Process applications. Powers transmitted by the SSS Clutches range from a few kW to 320MW and speeds from a few rpm to 16,000 rpm.

To achieve high quality, good internal communications are critical and it is a deliberate policy of SSS Gears Ltd to keep the number of employees to a minimum (preferably below 40). This is possible by sub-contracting all component manufacturing work to companies qualified to SSS Gears Ltd exacting quality standard but still assembling and testing all products ‘in-house’.

The small size of SSS means that liaison between staff is simplified, it also means that management can give great "attention to detail" and be involved in all aspects of the product.

The company controls costs by keeping administration to a minimum, and by ensuring it operates efficiently. SSS always quotes firm prices and does not discount/negotiate so that customers have the opportunity to seek comparisons before placing their orders. As component manufacture is almost entirely sub-contracted to other organisations, SSS staff form a comprehensive quality assurance organisation, with the Managing Director as head of Quality Assurance.

By sub-contracting all manufacturing work, SSS Gears Ltd is able to select sub-contractors on the basis of their efficiency, capability and cost effectiveness consistent with their ability to meet the company's high quality standards.

SSS takes total responsibility for work done by the sub-contractors on its behalf and continuously monitors them, therefore it will not divulge to customers any sub-contractors names or issue copies of sub-contracted orders, or grant access to sub-contractors premises for any purpose.

SSS does not permit auditing of accounts by any customer as this would add extra administrative loads, which again would increase costs and detract from the concentration on engineering excellence.

The final measure of success for a Quality System is the reliability of the product itself and the Quality of SSS Clutches has been proved to be very high by the negligible requirements for service, spare parts or repairs after supplying more than 25,000 clutches over 60 years.

2.0 Statement

SSS Gears Ltd is committed to consistently supplying a high quality product and services in accordance with the needs and expectations of our customers. The purpose of this manual is to define the general organisation and procedures for the operation and administration of the Quality Management System within SSS Gears Ltd.

The Managing Director with the assistance of the management team takes executive responsibility for the successful operation of the Quality Management System.

The company actively encourages the involvement and co-operation of all employees in using the Quality Management System to continue to improve its products and services and to increase efficiency in all areas. SSS staff also gain a higher level of job satisfaction from their broader roles.

This quality policy and procedures are a mandatory requirement on all SSS Gears Ltd personnel and must therefore be adhered to.

It is the policy of SSS Gears Ltd to provide a high quality product supported by quick and effective Customer Service. SSS keeps costs to a minimum, and always quotes firm prices without negotiations or discount, so that customers have the opportunity to seek comparisons before placing their orders.

The quality procedures adopted by SSS have been developed over 60 years to suit proven operating practices within a small company. The procedures have always generally met or exceeded the intent of the published standards of the time, from AQAP1 and BS5750 through to the current edition of ISO 9001. The Quality Manual and associated procedures are continually reviewed by senior management and updated when the need arises. On this basis SSS has never sought to be assessed/audited to ISO 9001 or its predecessors.

When explanation of quality system is required, SSS will generally provide the Abstract, Contents list, Company Background and Quality Policy statement from this document, which together explain the basis of the SSS Quality procedures. SSS refrain from completing complex customer quality questionnaires as these can absorb much senior management time, detracting from important engineering liaison and actual quality checking time.

SSS is committed to the Health and Safety of employees and the public from risks caused by our activities. SSS will monitor and comply with our Health and Safety Policy to minimise such risks and ensure we exceed the requirements of relevant legislation.

SSS is committed to reducing the harmful effects our operations have on the environment. SSS will comply with all environmental legislation and where applicable exceed it. SSS will raise awareness of environmental issues amongst staff and enlist their support in reducing SSS' impact.

SSS GEARS LIMITED ORGANISATION CHART

Company Structure and Department Responsibilities

Managing Director

Manages all aspects of company's business. Implements and maintains Company policy, including Quality Control.

Technical Sales Dept
Liaises with customer to determine technical, commercial and quality assurance requirements at enquiry and contract stages. Initiates action by other SSS Gears' departments to fulfil order. Communicates changes in customer requirements, or in SSS proposals. Monitors contract progress.

Directors

Purchasing Manager

Purchasing Dept
Place and progress orders for materials, components and sub-contract work. Schedules phases of design and production programme.

Design Manager

Design Dept
Produces outline design proposals at enquiry stage. Produces detailed design to meet customer's requirements at contract stage. Produces all manufacturing specifications.

Works Manager

Works Dept
Assembles SSS clutches. Controls stores and packing section.

Inspection Dept
Inspect sub-contracted work and purchased components.

Test Management

Test Dept
Specifies and conducts post-assembly functional tests. Issues final test certification

Publicity

Publicity Dept
Produces technical sales literature. Produces instruction books for clutch operation and maintenance. Arranges exhibitions

Despatch

Despatch Dept
Controls aspects of company shipping. Produces despatch documentation.

Operation	Specification/ Acceptance Criteria	Verification Document	Inspection Code	
			SSS	Customer
Contract review				
Customer Order / Specification review	-	SSS Contract Sheet	-	-
SSS Arrangement Drawing	-	Approval by customer	H	A
SSS Specification (Where applicable)	-	Approval by customer	H	A
Component Production (Torque transmitting)				
Material drawing production	SSS Quality Manual (P)	Signed drawing (P)	H	-
Forging production	BS970 Part 2:1970, SSS procedures 0880/2 & PS100 (P)	-	-	-
Chemical analysis	SSS procedure PS100 (P)	Material Test Cert	C,H	V*
		SSS Q drg (P)	H	-
		SSS final test certificate	-	V
Mechanical test	SSS procedure PS100 (P)	Material Test Cert	C,H	V*
		SSS Q drg (P)	H	-
		SSS final test certificate	-	V
Brinell hardness test	SSS Procedure PS100 (P)	Material Test Cert	C,H	V*
		SSS Q drg (P)	H	-
		SSS final test certificate	-	V
Ultrasonic test	EN10228: 1998, SEP1923, SSS procedures PS101 – 104 (P)	Material Test Cert	C,H	V*
		SSS Q drg (P)	H	-
		SSS final test certificate	-	V
Machining drawing production	SSS Quality Manual (P)	Drawing signed	H	-
Component/ sub-assembly dimension check	SSS Quality Manual (P)	CMM report, SSS X & Y drgs (P)	C,H	-
Magnetic particle crack detection	SSS procedure PS105 (P) EN 9934-1: 2001	NDT cert, SSS Q drg (P)	C,H	V*
Balancing	SSS procedure PS106 (P) BS3853: 1996, ISO1940	Balance certificate, SSS Q drg (P)	C,H	-
		SSS final test certificate	-	V*

INSPECTION CODES A = Customer approval required. C = Certificate required. H = Hold point. V = Review document.
V* = Review document during witness of final tests, Copies not provided. W = Customer witness first unit (if required).
(P) = Document proprietary to SSS Gears.

Operation	Specification/ Acceptance Criteria	Verification Document	Inspection Code	
			SSS	Customer
Component Production (not torque transmitting)				
Material drawing production	SSS Quality Manual (P)	Drawing signed (P)	H	-
Forging production	BS970 Part 2: 1970, SSS procedures 0880/2 & PS100 (P)	-	-	-
Chemical analysis	SSS procedures PS100 (P)	Material Test Cert	C, H	-
		SSS Q drg (P)	**H**	**-**
Brinell hardness test	SSS procedures PS100 (P)	Material Test Cert	C, H	-
		SSS Q drg (P)	H	-
Ultrasonic testing	BS4124: 1991, EN10228: 1998, SEP1923, SSS procedures PS101-104 (P)	Material Test Cert	C, H	-
		SSS Q drg (P)	H	-
Machining drawing production	SSS Quality Manual (P)	Drawing signed (P)	H	-
Component / sub-assembly dimensional check	SSS Quality Manual (P)	CMM report, SSS X & Y drgs (P)	C, H	-
Magnetic particle crack detection	SSS procedure PS105 (P) EN 9934-1:2001	NDT cert, SSS Q drg (P)	C, H	-
Balancing	SSS procedure PS106 (P) BS3853: 1996, ISO1940	Balancing certificate, SSS Q drg (P)	C, H	-
		SSS final test certificate	-	V
Casing Production				
Welding	SSS procedure 0293/1		V	-
Casting (Size 30 only)	BS2789: 1985 350/22L40 + SSS detail drg.		V	-
Dimensional check	SSS Quality Manual (P)	SSS X & Y drgs (P)	C, H	-
Paint	Project dependent	-	V	W
Bearing production				
Whitemetal bond ultrasonic test	SSS procedure PS107 (P)	SSS Q drg (P)	C, H	-

INSPECTION CODES A = Customer approval required. C = Certificate required. H = Hold point. V = Review document.
V* = Review document during witness of final tests, Copies not provided. W = Customer witness first unit (if required).
(P) = Document proprietary to SSS Gears.

Operation	Specification/ Acceptance Criteria	Verification Document	Inspection Code	
			SSS	Customer
Clutch / Casing Assembly				
Subassembly dimensional check	SSS Quality Manual (P)	SSS Z drg (P)	C, H	
Interface dimensional check	SSS Quality Manual (P)	SSS Quality Manual (P)	H	C
Dynamic running test	SSS Test Procedure (P)	SSS final test certificate	H	C, W
Leak test	SSS Test Procedure (P)	SSS final test certificate	H	W
Post test inspection	SSS Quality Manual (P)	SSS final test certificate	H	C, W

INSPECTION CODES A = Customer approval required. C = Certificate required. H = Hold point. V = Review document.
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NR2056 - SSS Clutches for Synchronous Condensing
Large (65MW +) Industrial Type Gas Turbines

Gears Limited

SSS 0391/1 Ref. No.	SSS 'C' No.	Customer	Gas Turbine	SSS Clutch Size	Power (MW)	Speed	No. Clutches	Site Name	Date
29	C374	KWU (Siemens)	V93	280T Integral	65	3000	1	Malmoe, Sweden	1970
29	C421	KWU (Siemens)	V93	280T Integral	65	3000	1	Malmoe, Sweden	1970
39	C511	KWU (Siemens)	V93	280T Integral	65	3000	1	Kellosaari, Finland	1971
107	C1216	KWU (Siemens)	V93.1	300T Semi Rigid	70	3000	2	Farahbad, Iran	1976
128	C1564	KWU (Siemens)	V93.1	300T Semi Rigid	70	3000	1	Shiraz, Iran	1979
234	C6255	Siemens USA	V84.3A	280T Encased	170	3600	1	Kansas City, USA	1996
N/A	C10273	Siemens	SGT5-2000E (V94.2)	280T Encased	176	3000	7	South Africa	2006
71	C879	GEC Gas Turbines	EM510	310T Fluid	65	3000	1	Leicester, UK	1973
74	C943	Stal Laval	GT120	280T	80	3000	2	Stallbaca, Sweden	1974
169	C4020	Ruston Gas Turbines	EM610	320FT Fluid	70	3000	2	Hok Un, Hong Kong	1989
169	C4020	Ruston Gas Turbines	EM610	320FT Fluid	70	3000	2	Castle Peak, Hong Kong	1989
124	C1514	Fiat (Westinghouse)	TG50C	340T	110	3000	2	Pietrafitta, Italy	1978
129	C1566	Fiat (Westinghouse)	TG50C	340T	110	3000	2	Italy	1979
133	C1735	Fiat (Westinghouse)	TG50C	340T	110	3000	3	Capri, Italy	1979 / 1980
134	C1761	Fiat (Westinghouse)	TG50C	340T	110	3000	2	Italy	1980
147	C2463	Fiat (Westinghouse)	TG50C	340T	110	3000	2+1 spare	Abu Dhabi	1983
165	C3465	Fiat (Westinghouse)	TG50C	340T	110	3000	2	Giugliano, Italy	1987
259	C6855	Fiat (Westinghouse)	TG50	280T	110	3000	2	Giugliano, Italy	1997
145	C2344	Westinghouse	W501	300T	86	3600	3+2 spare	Hail, Saudia Arabia	1982
95	C1067	BBC (Alstom)	GT13D	260T	110	3000	3	Najaf, Iraq	1975
111	C1278	Turbodyne (Alstom)	GT11D	300T	80	3600	2	São Luíz, Brazil	1976
111	C1278	Turbodyne (Alstom)	GT11D	300T	80	3600	3	Salvador 1, Brazil	1977
111	C1278	Turbodyne (Alstom)	GT11D	300T	80	3600	2	Salvador 2, Brazil	1977
157	C3036	BBC (Alstom)	GT13D	260T	115	3000	4	Trakya, Turkey	1985
160	C3268	BBC (Alstom)	GT13D	260T	115	3000	2	Trakya, Turkey	1986
166	C3508	BBC (Alstom)	GT13D	260T	115	3000	2	Trakya, Turkey	1987
136	C2032	Nuovo Pignone, (GE)	FR9B	340T	110	3000	2	Trapani, Italy	1981
155	C2889	GE	FR9E	375FT	116	3000	4	Guddu, Pakistan	1985
185	C4444	GE	FR9E	360FT	140	3000	2	Montevideo, Uruguay	1990
228	C6040	GE	FR9E	360FT	170	3000	1	Brennilis, France	1996
227	C6215	GE	FR9E	360FT	160	3000	1	Indian Queens, England	1996
228	C6040	GE	FR9E	360FT	170	3000	1	Vitry, France	1997

Gears Limited

SSS Gears Notes ref. NR2083
SSS Clutches for Synchronous Condensing
Small and Medium Sized (up to 65MW) Industrial Gas Turbines and all Aero Derivative Gas Turbines

0391/1 REF. NO.	NO. OF CLUTCHES	NO. OF SETS	CLUTCH SIZE	CLUTCH TYPE	kW TRANSMITTED PER CLUTCH	CLUTCH SPEED (rpm)	DELIVERY DATE	PLANT NAME	DIAGRAM	SSS GEARS 'C' NO.	GT TYPE
1	1	1	66	T	3,000	1,500	1964	Patchway - England	1	C113	RR Proteus
2	8	4	220	FT	30,000	3,000	1964	Early, Lister Drive - England	2	C106	RR Avon
3	4	4	280	FT	70,000	3,000	1964	Croydon B, Rye House - England	3	C105	RR Olympus
4	4	4	280	FT	55,000	3,000	1965	Norwich, Hastings - England	4	C107	RR Avon
5	1	1	170	FT	10,000	3,000	1965	France	5	C156	Creusot
6	2	2	220	FT	30,000	3,000	1966	Johannesburg - South Africa	7	C187	RR Avon
7	1	1	208	FT	16,000	3,600	1966	Success - Canada	1	C202	Stal FT4
8	4	4	208	FT	20,000	3,000	1967	WAPDA Kotri - Pakistan	9	C229	CEM Type 7
9	2	2	160	FT	15,000	4,900	1967	Thunder Bay - Canada	11	C250	RR Avon
10	1	1	275	FT	50,000	3,000	1966-7	Otahuhu - New Zealand	5	C203	Stal GT120
N/A	3	3	275	FT	50,000	3,000	1967	Otahuhu - New Zealand	5	C219	Stal GT120
11	1	1	275	FT	50,000	3,000	1967	Peking - China	5	C211	Stal GT120
12	2	2	220	FT	30,000	3,000	1969	Zambia	7	C292	RR Avon
13	1	1	208	FT	20,000	3,000	1968	Shiraz - Iran	9	C285	Fiat TH18
14	1	1	208	FT	20,000	3,000	1968	Sudan	9	C304	Fiat TG16
15	1	1	208	FT	20,000	3,000	1968	Pakistan	9	C289	CEM Type 7
16	2	1	270	FT	30,000	3,000	1969	Middleridge - Australia	10	C293	RR Avon
17	2	2	170	T	20,000	3,000	1968	Yanhee - Thailand	9	C296	JBE Fr.5
18	1	1	208	FT	20,000	3,000	1968	Yanhee - Thailand	9	C333	Fiat TG16
19	3	3	160	FT	15,000	4,900	1968	BosEd - USA	11	C310	RR Avon
20	1	1	275	FT	50,000	3,000	1969	Vartan - Sweden	5	C349	Stal GT120
21	2	1	208	FT	20,000	3,000	1969	Stockholm - Sweden	10	C302	Stal PP3 / 4
22	1	1	275	FT	54,000	3,000	1969	Vanaja - Finland	5	C294	Stal GT120
23	2	2	170	T	20,000	3,000	1969	Yanhee, Bangkok - Thailand	9	C355	Stal GT120
24	1	1	160	FT	15,000	4,900	1969	Kenya	11	C383	RR Avon
25	1	1	160	FT	15,000	4,900	1969	Mount Isa - Australia	11	C383	RR Avon
26	6	3	220	FT	30,000	3,600	1970	BosEd - USA	2	C364	RR Avon
27	4	4	170	T	25,000	3,600	1970	PREPA, Puerto Rico	9	C401	JBE Fr.5
28	1	1	208	FT	20,000	3,000	1970	Sweden	1	C368	Stal PP3
30	3	3	208	FT	26,000	3,600	1970	Port Mann - Canada	9	C407	BBC
31	4	4	170	T	24,000	3,600	1970	Venezuela	9	C445	JBE Fr.5
32	3	3	220	FT	25,000	3,000	1970	Immatra, Voima - Finland	7	C450	RR Avon
33	3	3	280	FT	70,000	3,000	1971 - 2	Kimstad - Sweden	5	C463	Stal GT120
34	6	3	220	FT	30,000	3,000	1971	Lahal, Gothenburg - Sweden	2	C477	RR Avon
35	2	1	220	FT	30,000	3,000	1971	Hallstavick - Sweden	2	C414	RR Avon
36	2	1	220	FT	30,000	3,000	1971	Hallstavick - Sweden	2	C414	RR Avon
37	1	1	170	T	29,000	3,600	1971	Moncton - Canada	1	C492	Curtis Wright UACL FT4
38	2	2	170	T	25,000	-	1971	PREPA, Puerto Rico	9	C519	JBE Fr.5
40	4	2	208	FT	20,000	3,000	1971	Oskarh - Sweden	10	C536	Stal PP3 / 4
41	4	4	170	T	20,000	3,000	1971	-	9	C539	JBE Fr.5
42	1	1	170	T	20,000	3,600	1971	New Brunswick - Canada	1	C551	Curtis Wright UACL FT4
43	1	1	194	T	35,000	3,000	1971-2	Mashad Krec, Iran	9	C552	Alcatel Fr.5
43	1	1	194	T	35,000	3,000	1971-2	Portugal	9	C552	Alcatel Fr.5
43	1	1	194	T	35,000	3,000	1971-2	French Guyana	9	C552	Alcatel Fr.5
44	1	1	208	FT	20,000	3,000	1972	Bregado - Argentina	1	C370	Stal PP3 / 4
45	2	1	220	FT	30,000	3,000	1971	Coolkeeragh - N.Ireland	2	C592	RR Avon
46	1	1	170	T	25,000	3,000	1972	USA	9	C614	GE Fr. 5
47	2	1	208	FT	20,000	3,000	1972	Stockholm - Sweden	10	C624	STAL PP3
48	1	1	208	FT	9,000	3,000	1972	Czechoslovakia	5	C625	Skoda

0391/1 REF. NO.	NO. OF CLUTCHES	NO. OF SETS	CLUTCH SIZE	CLUTCH TYPE	kW TRANSMITTED PER CLUTCH	CLUTCH SPEED (rpm)	DELIVERY DATE	PLANT NAME	DIAGRAM	SSS GEARS 'C' NO.	GT TYPE
49	1	1	170	T	25,000	3,600	1972	Peru	9	C669	GE Fr. 5
50	5	5	170	T	25,000	3,000	1972	China	9	C689	JBE Fr.5
51	5	5	194	T	35,000	3,000	1972	Iraq	9	C698	ALS Fr.5
52	1	1	170	T	25,000	3,000	1972	Angola	9	C713	JBE Fr.5
53	2	1	208	FT	34,000	3,600	1972-3	Port Mann - Canada	10	C742	Curtis Wright UACL FT4
54	1	1	194	T	35,000	3,000	1972	Iraq	9	C729	Alstom Fr.5
55	2	2	170	T	25,000	3,600	1972	Argentina	9	C278	JBE Fr.5
56	1	1	170	T	25,000	3,600	1972	Canada	9	C730	JBE Fr.5
57	1	1	170	T	25,000	3,600	1972	Syria	9	C730	JBE Fr.5
58	4	4	170	T	25,000	3,000	1972	-	9	C730	JBE Fr.5
59	2	2	170	T	29,000	3,600	1973	Canada	1	C714	Curtis Wright UACL FT4
60	1	1	194	T	35,000	3,000	1973	Saarbrucken - Germany	12	C756	AEG Fr.5
60	1	1	194	T	20,600	3,000	1973	Saarbrucken - Germany	12	C757	AEG Fr.5
61	2	2	170	T	30,000	3,000	1973	Portugal	9	C765	GE Fr. 5
62	2	2	194	T	35,000	3,000	1973	Sarchesme, Iran	9	C793	Alstom Fr.5
63	2	2	194	T	35,000	3,000	1973	Jebel Jelloudi, Tunisia	9	C793	Alstom Fr.5
64	4	2	208	FT	20,000	3,000	1973	Malmo - Sweden	10	C801	Stal PP3
65	1	1	170	T	30,000	3,000	1973	Argentina	9	C818	GE Fr.5
66	4	2	220	FT	30,000	3,000	1974	Hallstavick 3 + 4 - Sweden	2	C823	RR Avon
67	4	4	220	FT	30,000	3,000	1973	Huntokoski - Finland	7	C824	RR Avon
68	3	3	170	T	25,000	3,000	1973	Rey Power, Iran	9	C833	JBE Fr.5
69	2	2	208	FT	20,000	3,000	1973	Finland	1	C855	STAL PP3
70	1	1	170	T	30,000	3,000	1973	-	9	C861	GE Fr.5
72	1	1	170	T	25,000	3,000	1973	-	9	C895	GE Fr.5
73	4	2	220	FT	35,000	3,000	1974	Lahall - Sweden	2	C908	RR Avon
75	2	2	194	T	35,000	3,000	1974	Stuttgart, Germany	9	C944	Alcatel Fr.5
75	1	1	194	T	35,000	3,000	1974	Santa Cruz, Bolivia	9	C944	Alcatel Fr.5
75	1	1	194	T	35,000	3,000	1974	-	9	C944	Alcatel Fr.5
76	4	2	208	FT	20,000	3,000	1974	-	10	C946	STAL PP3
77	2	2	170	T	30,000	3,000	1974	-	9	C950	GE Fr.5
78	2	1	220	FT	35,000	3,000	1974	Ballylumford - N.Ireland	2	C960	RR Avons
79	8	8	194	T	35,000	3,000	1974	Lyallpur - Pakistan	9	C967	AEG Fr.5
80	4	2	170	T	26,500	3,000	1974	Otahuhu - New Zealand	10	C975	Parsons Peebles
81	4	4	194	T	40,000	3,000	1974	Turkey	9	C986	Fiat TG20B2
82	1	1	194	T	16,000	1,500	1974	Nairobi - Kenya	9	C1011	Fiat TG16
83	2	2	170	T	30,000	3,000	1974	Nova Scotia - Canada	1	C1012	Brush UACL
84	2	1	220	FT	35,000	3,000	1975	Ballylumford - N.Ireland	2	C1013	RR Avons
85	2	2	208	FT	20,000	3,000	1975	-	1	C1017	STAL PP3
86	2	2	170	T	30,000	3,000	1975	-	9	C1027	GE Fr.5
87	1	1	170	T	30,000	3,600	1975	New Foundland - Canada	1	C1028	Curtis Wright UACL FT4
88	3	3	194	FT	35,000	3,000	1975	Argentina	9	C1030	Fiat TG20B2
89	3	3	194	T	35,000	3,000	1974-5	-	9	C1037	Alcatel Fr.5
90	8	4	170	T	32,000	3,000	1975	Whirinaki - New Zealand	10	C1040	Parson Peebles FT4
91	1	1	194	T	35,000	3,000	1975	-	9	C1041	Alcatel Fr.5
91	1	1	194	T	35,000	3,000	1975	Tunisia	9	C1041	Alcatel Fr.5
91	1	1	194	T	35,000	3,000	1975	Netherlands	9	C1041	Alcatel Fr.5
92	2	1	170	T	30,000	3,600	1975	Labrador - Canada	10	C1042	Curtis Wright UACL FT4
93	3	3	170	FT	19,000	3,600	1975	Venezuela/Argentina	9	C1048	Fiat TG16
94	2	1	170	T	30,000	3,600	1975	BC Hydro Keogh - Canada	10	C1050	Curtis Wright UACL FT4
96	1	1	170	T	25,000	3,000	1975	Western Mining - Australia	1	C1072	RR Avon
97	3	3	194	T	35,000	3,000	1975	Pakistan	9	C1075	Alcatel Fr.5
98	1	1	216	T	50,000	3,000	1974	Otahuhu - New Zealand	5	C1082	STAL GT120
100	20	10	220	T	43,000	3,000	1976-7	Bulls Bridge - England	2	C1102	RR Olympus
101	4	4	170	T	30,000	3,600	1975	Burnside - Canada	1	C1103	TPM FT4

0391/1 REF. NO.	NO. OF CLUTCHES	NO. OF SETS	CLUTCH SIZE	CLUTCH TYPE	kW TRANSMITTED PER CLUTCH	CLUTCH SPEED (rpm)	DELIVERY DATE	PLANT NAME	DIAGRAM	SSS GEARS 'C' NO.	GT TYPE
102	10	5	170	T	30,000	3,000	1975	Cape Town - South Africa	10	C1107	TPM FT4
103	6	6	194	T	35,000	3,000	1975	-	9	C1143	Alcatel Fr.5
104	6	3	208	FT	25,000	3,600	1976-91	Canada	10	C1151	Curtis Wright UACL FT4
105	2	1	208	FT	25,000	3,600	1976	N&L Hydro, Labrador - Canada	10	C1151	Curtis Wright UACL FT4
106	4	4	194	T	35,000	3,000	1976	Boufarik, Sonel - Algeria	9	C1155	Alcatel Fr.5
108	2	2	194	T	30,000	3,000	1977	Rey Power - Iran	9	C1270	Alcatel Fr.5
108	2	2	194	T	30,000	3,000	1977	Djeddah - Saudi Arabia	9	C1270	Alcatel Fr.5
108	1	1	194	T	30,000	3,000	1977	Agadira - Morocco	9	C1270	Alcatel Fr.5
108	1	1	194	T	30,000	3,000	1977	Amperwerke - Germany	9	C1270	Alcatel Fr.5
109	2	2	194	T	31,000	3,000	1976	-	9	C1272	BHS Fr.5
110	1	1	170	T	25,000	3,000	1977	-	9	C1284	JBE Fr.5
112	8	4	194	T	50,000	3,000	1978	Bulls Bridge - England	14	C1389	RR Olympus
113	3	3	194	T	30,000	3,000	1977	Reunion Island	9	C1357	Alcatel Fr.5
114	1	1	170	T	25,000	3,000	1977	Portugal	9	C1375	EDP Fr.5
115	3	3	170	T	30,000	3,000	1977	ETSA - Australia	1	C1407	Curtis Wright UACL FT4
116	2	2	170	FT	19,500	3,600	1978	-	9	C1416	Fiat TG16
117	3	3	194	T	31,000	3,000	1977-8	Santa Rosa, Quinto - Ecuador	9	C1417	AEG Fr.5
117	7	7	194	T	31,000	3,000	1977-8	-	9	C1417	AEG Fr.5
118	6	6	194	T	31,000	3,000	1977-8	Iran	9	C1418	BHS Fr.5
119	2	2	170	T	25,000	3,000	1977	Pakistan	9	C1422	JBE Fr.5
120	6	3	170	T	30,000	3,000	1977-8	Johannesburg - South Africa	10	C1443	Curtis Wright UACL FT4
121	2	2	194	T	31,000	3,000	1978	Shirvan Power - Iran	9	C1471	Alcatel Fr.5
122	7	7	260	FT	40,000	3,000	1977-8	Iran	9	C1485	Fiat TG20 B2
123	3	3	194	T	31,000	3,000	1978	Rey Power - Iran	9	C1507	Alcatel Fr.5
125	2	2	170	FT	20,000	3,000	1978	WAPDA Kotri - Pakistan	9	C1518	CEM Type 7
126	1	1	194	T	31,000	3,000	1978	Jarry Sud Power - Guadalupe	9	C1533	Alcatel Fr.5
126	1	1	194	T	31,000	3,000	1978	Shirvan Power - Iran	9	C1533	Alcatel Fr.5
127	2	2	194	T	31,000	3,000	1978	-	9	C1551	Alcatel Fr.5
127	1	1	194	T	31,000	3,000	1978	Fr. Pointers des Carries	9	C1551	Alcatel Fr.5
130	2	1	194	T	50,000	3,000	1979-80	Cowes IOW - England	14	C1675	RR Olympus
131	2	1	194	T	50,000	3,000	1979-80	Cowes IOW - England	14	C1676	RR Olympus
132	1	1	170	T	30,000	3,000	1979	Pretoria - South Africa	1	C1723	RR Olympus
135	3	3	170	T	30,000	3,000	1980-1	Sri Lanka	9	C1988	JBE Fr.5
137	2	1	170	T	30,000	3,000	1981	S.Africa	10	C2152	Curtis Wright UACL FT4
138	9	9	170	T	25,000	3,000	1981	Iraq	9	C2154	JBE Fr.5
139	4	4	260	FT	45,000	3,000	1981	Iraq	9	C2202	Fiat TG20 B2
140	1	1	170	T	25,000	3,000	1981	-	9	C2222	JBE Fr.5
141	1	1	170	T	25,000	3,000	1981	-	9	C2225	JBE Fr.5
142	1	1	194	T	31,000	3,000	1981	Iraq	9	C2227	Mosul - Iraq
143	5	5	260	FT	45,000	3,000	1982	Iraq	9	C2254	Fiat TG20 B2
144	3	3	194	T	31,000	3,000	1981-2	-	9	C2274	Alcatel Fr.5
146	2	1	170	T	30,000	3,000	1982	S.Africa	10	C2427	TPM FT4
148	3	3	194	T	31,000	3,000	1983	-	9	C2532	BHS Fr.5
149	1	1	170	T	30,000	3,000	1982	Kipevu - Kenya	9	C2539	JBE Fr.5
150	1	1	194	T	40,000	3,000	1983	Norway	9	C2670	RENK Fr.5
151	1	1	260	FT	32,000	3,000	1984	Pakistan	9	C2719	Mitsubishi MW251
152	2	2	194	T	35,000	3,000	1984	-	9	C2755	Alcatel Fr.5
153	4	4	194	T	52,000	3,000	1984	India	9	C2825	GE Fr.6
154	1	1	194	T	51,000	3,600	1984	Sask Power, Meadow Lake, SA - Canada	9	C2861	GE Fr.6
158	1	1	170	FT	15,000	3,000	1985	Broken Hill - Australia	1	C3084	Stal PP3
159	6	6	194	T	52,000	3,000	1985	India	9	C3152	GE Fr.6
161	1	1	194	T	35,000	3,000	1986	-	9	C3286	GE Fr.5
162	1	1	194	T	51,000	3,000	1986	Kenya	9	C3357	GE Fr.6
163	3	3	194	T	51,000	3,000	1986	India	9	C3377	GE Fr.6

0391/1 REF. NO.	NO. OF CLUTCHES	NO. OF SETS	CLUTCH SIZE	CLUTCH TYPE	kW TRANSMITTED PER CLUTCH	CLUTCH SPEED (rpm)	DELIVERY DATE	PLANT NAME	DIAGRAM	SSS GEARS 'C' NO.	GT TYPE
164	3	3	194	T	42,000	3,000	1987	Bangladesh	9	C3429	GE Fr.6
167	3	3	194	T	35,000	3,000	1987	-	9	C3563	GE Fr.5
168	4	4	194	T	46,000	3,000	1988-9	Australia	9	C3974	GE Fr.6
171	2	2	194	T	45,000	3,000	1989	Australia	9	C4137	GE Fr.6
183	4	4	194	T	35,000	3,000	1989	BHEL - India	9	C4296	BHEL Fr.5
	1	1	170	T	34,000	3,600	1990	Peru	9	C4626	GE Fr.5
184	3	3	194	T	45,000	3,000	1990	Australia	9	C4412	GE Fr.6
188	2	2	170	T	34,000	3,600	1991	Canada	9	C4661	GE Fr.5
198	1	1	170	T	35,000	3,000	1992	Egypt	9	C5198	GE Fr.5
	2	2	214	T Encased	34,000	3,600	1993	Buk Jeju Island, South Korea	1	C5209	FT4
208	3	3	194	T	51,000	3,000	1993	Israel	9	C5395	GE Fr.6
209	2	2	194	T	45,000	3,000	1994	BHEL - India	9	C5673	GE Fr.6
211	1	1	194	T	51,000	3,000	1994	Jordan	9	C5635	GE Fr.6
218	2	2	194	T	51,000	3,000	1994	India	9	C5525	GE Fr.6
222	1	1	194	T	51,000	3,000	1994	Jordan	9	C5821	GE Fr.6
224	2	2	194	T	51,000	3,000	1994	Malta	9	C5878	GE Fr.6
229	1	1	194	T	51,000	3,000	1995	Morocco	9	C6070	GE Fr.6
233	4	2	170	T	27,000	3,000	1996	Germany	10	C6230	GHH FT8
235	2	2	194	T	51,000	3,000	1995	Jordan	9	C6264	GE Fr.6
262	1	1	214	T	34,000	3,600	1997	Pacific Gas and Electric - USA	36	C6938	FT4 Twinpack
	1	1	194	T	51,000	3,000	1986	Kenya	9	C6770	GE Fr.6
271	1	1	194	T	54,000	3,000	1997	Panama	9	C6965	GE Fr.6
272	2	2	170	T Encased	25,000	3,600	1998	Key West - USA	9	C7119	GE Fr.5
279	1	1	260	T Encased	52,000	3,600	1999	ATCO Grand Prairie - Canada	1	C7600	GE LM6000
	4	4	260	T	52,000	3,600	1999 / 2000	PSE&G Burlington - USA	1	C7816	GE LM6000
	1	1	194	T	51,000	3,600	1999	Israel	9	C7846	GE Fr. 6
	2	2	260	T Encased	52,000	3,600	2000 / 2001	GWF Lemore, CA - USA	1	C8063	GE LM6000
	4	4	260	T Encased	52,000	3,600	2000 / 2001	PSE&G Kearny, NJ - USA	1	C8063	GE LM6000
	4	4	260	T Encased	52,000	3,600	2001	Chesapeake - USA	1	C8153	GE LM6000
	1	1	194	T	30,000	3,000	2001	Power Development Board - Bangladesh	9	C8440	GE Fr. 5
	1	1	170	T	34,000	3,000	2002	Ogden, Utah - USA	9	C8678	GE Fr. 5
	1	1	260	T Encased	52,000	3,600	2002	Atco Valley View - Canada	1	C8700	GE LM6000
	1	1	194	T	30,000	3,000	2002	Bangladesh	9	C8880	GE Fr. 5
	1	1	220	T	35,000	3,000	2003	Coolkeeragh - N. Ireland	10	C8939	RR Twin Avons
	1	1	194	T	30,000	3,000	2002	Barisal - Bangladesh	9	C9123	GE Fr. 5
	2	1	214	T	34,000	3,600	2004	Great River Energy - USA	10	C9459	FT4 Twinpack
	2	1	194	T	50,000	3,000	2004	Cowes IOW - England	14	C9482	RR Twin Olympus
	1	1	194	T	30,000	3,000	2004	Iraq	9	C9693	GE Fr. 5
	2	2	194	T	30,000	3,000	2004	Bangladesh	9	C9719	GE Fr. 5
	1	1	194	T	51,000	3,600	2005	Mexico	9	C9733	GE Fr. 6
	1	1	194	T	51,000	3,000	2005	Morocco	9	C9997	GE Fr. 6
	1	1	260	T Encased	52,000	3,600	2002	Lafayette - USA	1	C10042	GE LM6000
	3	3	194	T	51,000	3,000	2006	Pinjarra - Australia	9	C10400	GE Fr. 6
	1	1	194	T	51,000	3,000	2006	MRP Southdown, Otahuhu - N. Zealand	9	C10518	GE LM6000
	1	1	194	T	51,000	3,000	2007	Morocco	9	C11352	GE Fr. 6
	2	1	194	T	52,000	3,000	2007	Den Haag, Netherlands	37	C10654	GE LM6000 (twin)
	1	1	272	T Encased	132,000	3,600	2008	Calpine, Vineland, New Jersey, USA	1	C11277	GE LMS100
	1	1	260	T Encased	52,000	3,600	2009	SaskPower Ermine 1, Canada	1	C10489	GE LM6000
	1	1	260	T Encased	52,000	3,600	2009	SaskPower Ermine 2, Canada	1	C10771	GE LM6000
	1	1	260	T Encased	52,000	3,600	2010	SaskPower Yellowhead 1, USA	1	C10771	GE LM6000
	1	1	260	T Encased	52,000	3,600	2010	SaskPower Yellowhead 2, USA	1	C10771	GE LM6000
	1	1	260	T Encased	52,000	3,600	2010	SaskPower Yellowhead 3, USA	1	C10771	GE LM6000
	1	1	194	T	51,000	3,000	2010	Nairobi - Kenya	9	C6770A	JBE Fr. 6
	1	1	260	T Encased	52,000	3,600	2011	Northland Power Spy Hill 1, Canada	1	C12500	GE LM6000

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	1	1	260	T Encased	52,000	3,600	2011	Northland Power Spy Hill 2, Canada	1	C12500	GE LM6000
	1	1	260	T Encased	52,000	3,600	2011	Kearny 13-A, NJ, USA	1	C12500	GE LM6000
	1	1	260	T Encased	52,000	3,600	2011	Kearny 13-B, NJ, USA	1	C12500	GE LM6000
	1	1	260	T Encased	52,000	3,600	2011	Kearny 13-C, NJ, USA	1	C12500	GE LM6000
	1	1	260	T Encased	52,000	3,600	2011	Kearny 13-D, NJ, USA	1	C12500	GE LM6000
	2	2	220	T	72,000	3,600	2011	Dow Chemical, USA	5	C12925	Turbodyne GT11D
	1	1	170	T	34,000	3,000	2011	Kelanitissa - Sri Lanka	9	C10718A	GE Fr. 5
	2	2	272	T Encased	132,000	3,600	2012	LADWP Long Beach, CA USA	1	C12927	GE LMS100
	2	2	260	T Encased	52,000	3,600	2012	DEMEC Smyrna, Delaware, USA	1	C13040	GE LM6000
	1	1	260	T Encased	52,000	3,600	2012	Williston, North Dakota	1	C13040	GE LM6000
	1	1	260	T Encased	52,000	3,600	2012	Williston, North Dakota	1	C13040	GE LM6000
	1	1	260	T Encased	52,000	3,600	TBA	Tioga, North Dakota	1	C13040	GE LM6000
	1	1	260	T Encased	52,000	3,600	TBA	New Town North Dakota	1	C13040	GE LM6000