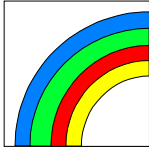


SPRS

Slip Power Recovery System





Control & Automation from L&T

L&T offers system solutions for control, regulation and monitoring. It plans and implements drive controls and automation projects from concept to commissioning.

The spectrum includes system analysis, project planning, hardware selection, application engineering, application software, manufacture, procurement, testing, integration, commissioning, training, spares and after-sales service.

Applications



Iron and Steel *

- .. Sponge iron plants
- .. Blast furnaces/arc furnaces
- .. Continuous casting plants
- .. Wire rod mills
- .. Annealing furnaces
- .. Cold rolling mills
- .. Process and finishing lines



Cement *

Plant-wide drives, control and instrumentation from crusher to packing.

SPRS for ID, FD fans, classifier fans



Paper *

- .. Sectional paper machines
- .. Super calenders
- .. Slitters
- .. Rewinders



Material Handling *

- .. Port-based long conveyor
- .. Stacker reclaimers
- .. Bagging plants

* Exhaustive reference lists are available.





Chemical *

- .. LPG/gas sweetening
- .. Distillation column control
- .. Naphtha cracker and aromatic plants
- .. Lactum and anone plants



Power *

- .. Boiler interlocks, burner management
- .. Water treatment
- .. Coal & ash handling

Range of Equipment

Drive Systems

based on



- .. Fully digital DC drives - ACEDRIVE
- .. High performance, *vector control* AC drives with powerpack from YASKAWA ELECTRIC, Japan
- .. Slip Power Recovery Systems (SPRS)
- .. Transformers, motors, control desks, sensors and other electrics

Automation Systems

based on



- .. High-end 'Quantum' process controllers and accessories from SCHNEIDER AUTOMATION, U.S.A.
- .. Mid-size 'GL' process controllers and accessories from YASKAWA ELECTRIC, Japan

Both with a full range of 1000/1600 I/O modules and panels.

- .. Windows® 95/NT based 'Panorama' supervisory colour graphic operator stations. Network hardware and integration
- .. Programming packages, sensors, instruments, consoles and other accessories

* Exhaustive reference lists are available.



Overview

L&T has acquired expertise in design, system engineering, manufacturing and commissioning of **Slip Power Recovery Systems** in the Indian industry with over 100 installations.

Continuous improvements achieved on working installations have helped us to offer you an efficient and reliable SPRS with several key features.

Advantages of SPRS

Slip Power Recovery System (SPRS) provides :

- **Lower operating costs** by slashing energy bills
- **Enhanced life** of mechanical equipment by reducing vibrations
- **Accurate process control** with excellent speed holding accuracy

What is SPRS?

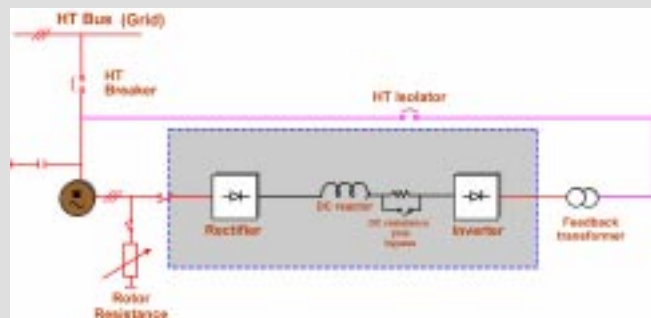
Slip Power Recovery System (SPRS) is a variable speed drive for slip ring induction motors. It recovers and delivers the slip* dependent rotor power from the motor to the grid.

At changeover speed, SPRS is connected to the rotor and the rotor resistance is disconnected.

The diode rectifier converts the rotor voltage to DC voltage. This rectified rotor voltage is counter-balanced by a line commutated inverter.

By controlling the ‘counter-balancing’ inverter voltage, the rotor current, hence rotor speed is regulated.

The slip power collected at the slip rings is fed back to the grid through the inverter.



* Difference between actual speed and synchronous speed.



Key features

Designed for tropical conditions

- Designed for 50°C ambient temperature.
- Special surface treatment*.
- ‘Process controller’ for referencing, interlocking and protection - thus avoiding several electrical moving contacts which are prone to malfunctioning in dusty environments.

Conceived for process stability

- Speed holding accuracy of 0.5%.
- Bumpless transfer from SPRS to rotor resistance control in case of fault.
- Changeover to voltage feedback in case of tacho-generator failure.

Environment - friendly configuration

- Typically for ratings above 1000kW, SPRS is equipped with a 12-pulse configuration to eliminate 5th & 7th harmonics - thus ensuring good quality power, without polluting the grid.

Safety to induction motor

- DC reactor to reduce stress on motor winding.
- Software-based rotor current asymmetry detection.
- Fail-safe changeover from rotor resistance control to SPRS to avoid a rotor open circuit.

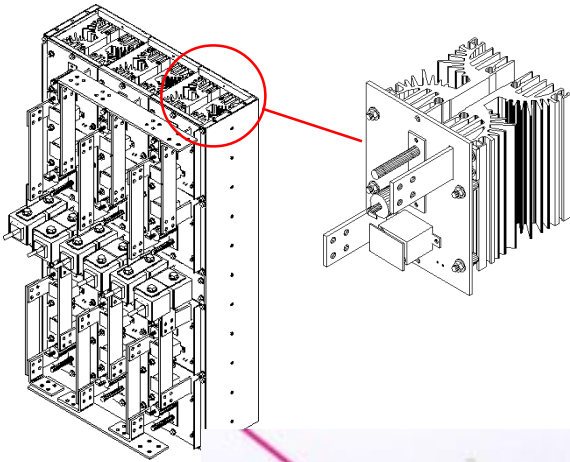
Safety to mechanical system

- Closed-loop speed control to reduce vibrations.
- Resonance speed skip facility to avoid excessive vibrations and damage.

Supply voltage fluctuations

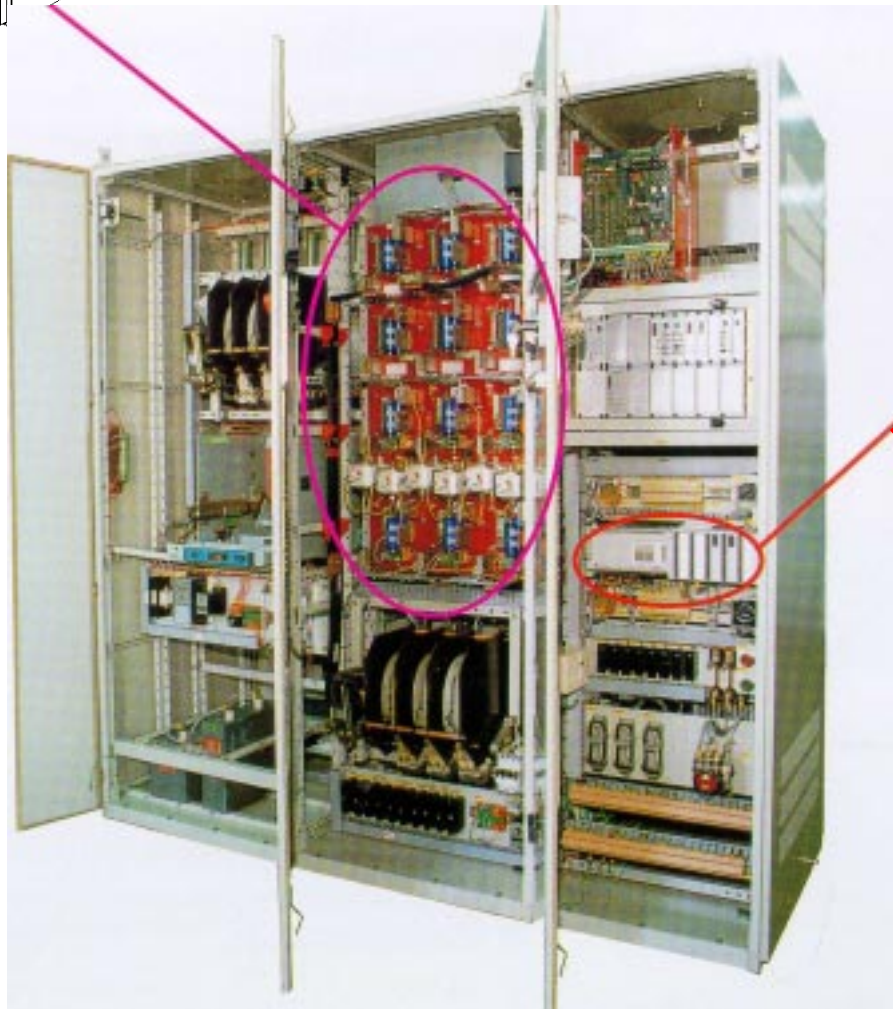
- Control system designed to withstand upto 20% voltage dip.
- Fast undervoltage detection circuit to take corrective action.
- DC resistance *plus* bypass system* to protect SPRS in case of severe undervoltage.

*Optional



ACESTACK 50

- ❑ ACESTACK 50 is a highly aesthetic and space saving modular thyristor stack using the latest technology semi-conductor modules.
- ❑ Front access for module and quick fuse removal.
- ❑ Pre-calibrated bar-clamp assembly helps easy maintenance.



Typical panel - 1200 kW



Outside panel

DC aircore reactor

- ❑ **Truncates the rate of rise of current (di/dt) in case of fault conditions to allow sufficient time for fault clearance.** Moreover, fault clearance takes place at a level much lower than the system fault level thus reducing stresses on the rotor and the system.
- ❑ Keeps motor losses low by absorbing ripple voltage.
- ❑ Does not saturate even under fault conditions.

High performance process controller

- ❑ Sequencing & interlocks
- ❑ Speed referencing
- ❑ Digital setting for - Speed, Voltage, Current
- ❑ Fault detection
 - Rotor asymmetry
 - Overvoltage
- ❑ Calculations
 - Feedback power and losses
- ❑ Resonance speed skip
- ❑ LRS tracking
- ❑ 3 level check for changeover (speed, voltage and time)
- ❑ Fault logging

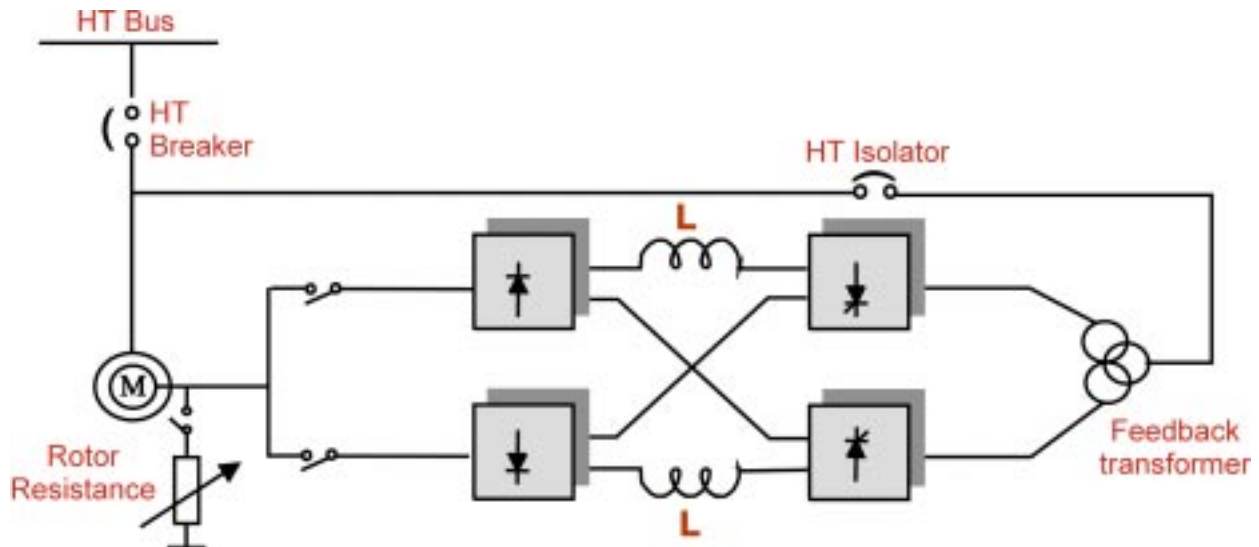


12-pulse configuration

Typically for ratings above 1000kW, SPRS comes with a 12-pulse series-parallel configuration.

Advantages

- ◆ **Eliminates 5th, 7th, 17th, 19th harmonics** (which form about 95% of total harmonics) **permanently** - thus ensuring good quality power without polluting the grid.
- ◆ Better power factor due to optimisation of the power circuit.
- ◆ Reduction in SPRS losses.



Energy saving

Role of SPRS in *energy saving* can be appreciated vis-a-vis conventional methods of controlling air/gas flow applications.

In process plants, a majority of fans (ID, FD, preheater, ESP, baghouse, etc.) are driven by slip ring induction motors, typical ratings being 400kW to 6000kW.

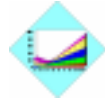
Conventional methods of flow control are:

- *Damper control*, where around **20%** of the power is lost.
- Speed variation by *rotor resistance control*, where around **10% to 15%** of the power is lost as heat, in the rotor resistance.

For a 1000 kW fan, with SPRS the energy saving could be around 200 kW or 4800 kWh per day, equivalent to a saving of Rs. 20,000 @ Rs. 4.20 per unit (one kWh) of energy.

That is the saving potential!!

An investment analysis will reinforce this proposition.



Investment analysis

(Data given is typical, and may vary from case to case)

1	Motor rating	:	1650kW
2	Application	:	Smoke gas fan
3	Energy saving	:	240 units per hour (one unit equal to one kWh)
4	Maintenance cost	:	Rs. 1.5 lakhs per annum (assumed to escalate @10% per year)
5	Net investment	:	Rs. 45 lakhs
6	Number of hours of operation per year	:	4800 hours/year (assumed 20 hrs. per day for 240 days in a year)
7	Cost of energy escalation	:	Assumed to be constant over the next 10 years
8	Tax rate	:	35%
9	Rate of depreciation	:	50% for 2 years
10	Considered life of equipment	:	10 years
11	Cost of energy per unit	:	Rs. 4.20
12	Rate of discount for NPV	:	18%

Sl. Parameters No.	Years											
	0	1	2	3	4	5	6	7	8	9	10	
a	Energy saving in Rs. lakhs	40.32	40.32	40.32	40.32	40.32	40.32	40.32	40.32	40.32	40.32	
b	Maintenance cost in Rs. lakhs	1.50	1.65	1.82	2.00	2.20	2.42	2.66	2.92	3.22	3.54	
c	Net income Rs. lakhs (a - b)	38.82	38.67	38.51	38.32	38.12	37.90	37.66	37.40	37.10	36.78	
d	Tax on net income @ 35% (Rs. lakhs)	13.59	13.53	13.48	13.41	13.34	13.27	13.18	13.09	12.99	12.87	
e	Net cost saving in Rs. lakhs (c - d)	25.23	25.14	25.03	24.91	24.78	24.64	24.48	24.31	24.12	23.91	
f	Depreciation Rs. lakhs	22.5	22.5									
g	Tax saving due to depreciation @ 35% (Rs. lakhs)	7.88	7.88									
h	Cash inflow in Rs. lakhs (e + g)	33.11	33.01	25.03	24.91	24.78	24.64	24.48	24.31	24.12	23.91	
i	Cash outflow Rs. lakhs	45										
j	Net cash flow in Rs. lakhs (h - i)	-45.00	33.11	33.01	25.03	24.91	24.78	24.64	24.48	24.31	24.12	23.91
k	Net present value (NPV)	-45.00	28.06	23.71	15.23	12.85	10.83	9.13	7.69	6.47	5.44	4.57
l	Internal rate of return (IRR)		41%									
m	Payback period		1.9 years									

* PRODUCT IMPROVEMENT IS A CONTINUOUS PROCESS IN L&T. INFORMATION GIVEN HEREIN IS THEREFORE SUBJECT TO REVISION WITHOUT NOTICE.

C & A D : SPRS : REV# : 0198
CAD 1012 1:5797



Notes :



Notes :

