

Neutral Reactor Soft Starter

NRSS

Proven Technique of starting

Series NRSS - 101

HT

Squirrel Cage Induction Motors

INTRODUCTION

Squirrel Cage Induction Motor is the most preferred drive in industry. However, starting of this motor has always been an intricate affair. The starting techniques that are universally employed fall into two basic categories.

1) FULL VOLTAGE (DOL) STARTING

Direct On Line (DOL) starting is the simplest and the cheapest method for starting HT motors but suffers from the limitation of high starting current.

2) REDUCED VOLTAGE STARTING

Reduced Voltage starting is achieved by Star-Delta / Autotransformer / Series Impedance starting.

- a) Star Delta starting cannot be applied to HT Motors since their windings are generally connected in star.
- b) Autotransformer starting provides a better solution. However, the open transition from the tap to full voltage causes severe current surges during changeover. Closed transition from tap to full voltage overcomes this defect but the costs involved are abnormally high.
- c) The series impedance method consists of introducing either a resistance or reactance of appropriate value in series with the motor winding at starting & bypassing it when the motor reaches full speed. For minimum energy loss a series reactance type arrangement is used for large induction motors.

The reactance is introduced on the neutral side i.e. between the winding & the star point of HT motor so that it need not be designed for surges & fault levels prevailing on the lineside. Further this reactance can be designed to operate as air-core reactance to eliminate the iron losses & saturation effects caused by magnetic core.

NRSS SOFT STARTER

The JAYASHREE 'NRSS' falls in the category of series impedance type of starters & provides an optimum solution by reducing the starting current & ensuring gradual increase in the motor terminal voltage from the initial lower value to the line voltage in a smooth stepless manner.



The simple and elegant construction of NRSS makes it the most reliable, economical and convenient device for starting of HT induction motors, particularly for drives such as centrifugal pumps, compressors whose load characteristics are parabolic permitting low starting torque and involve moderate inertia. Several models of NRSS are in operation throughout the country for more than twenty years.

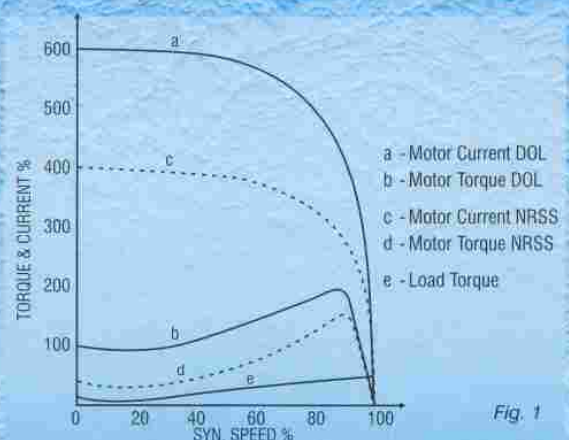


Fig. 1

PRINCIPLE OF OPERATION

The NRSS acts as an impedance in series with winding and allows only a part of the line voltage to be applied at the motor terminals at the time of starting as shown in the schematic diagram (Fig.2)

This results in reduced starting current coupled with reduced starting torque as compared with the DOL values. The reactor parameters are so chosen as to allow the motor to generate adequate starting torque to overcome the load torque and friction to ensure smooth acceleration. The starting current reduces well below DOL value, the actual permissible value, depending upon the starting torque and starting current parameters of the motor and torque speed characteristics of the driven load. Please refer to Fig.1.

As the motor accelerates in a soft and smooth manner, the current drawn by motor goes on reducing as a result of generation of counter EMF in the motor winding. This in turn causes less drop across the reactor and allows more voltage across the motor terminals thereby increasing the torque gradually. This entire process of reduction in current with gradual increase in motor torque takes place in a stepless manner from zero to full speed thus achieving very soft and smooth starting of the loads such as pumps & compressors.

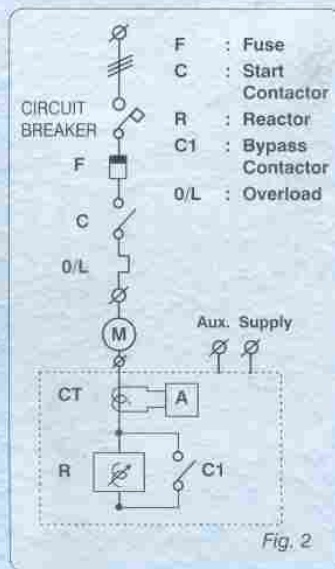
The currents and voltages fully retain their sinusoidal form and harmonic disturbance are totally absent. This starting sequence is achieved as a result of natural behaviour of squirrel cage induction motor and the reactor as a series combination. Hence no external control elements are required, thereby enhancing reliability.

NRSS does not incorporate any electronic controls which are likely to cause apprehension in the minds of the operating staff at remote locations. NRSS has found wide acceptance in countries like JAPAN & USA. IS 3914 also has taken cognisance of this method of starting.

CONSTRUCTION

The NRSS consists of:

- The reactance module in the form of a set of insulated air cored coil, held on a rigid steel frame, duly insulated for the rated voltage and with suitable taps. The coils are duly insulated to class "F" and vacuum impregnated to withstand the rated voltage and are built from heavy copper



section to circulate the current involved in starting duty without overheating.

- Shorting / Bypassing contactor suitable for the rated current and voltage of the motor.
- A strong sheet metal, floor standing, cubicle which houses, the reactor module, the shorting contactor, cable boxes, and control elements such as timer, auxiliary contactor, CT's, space heater etc. to meet all application requirements.
- The power interconnections and control wiring for automatic starting and stopping by push button provided on the front door. An ammeter with CT can be provided as an option. The reactor is provided with suitable taps for making finer adjustments at site to provide optimum starting solutions. The coils are natural air cooled and do not require any maintenance in services.

STANDARD MODELS OF NRSS FOR MOTORS UPTO 11 KV

Model No.	Rating Kw	Line Voltage kv
NRSS - 1011	186 / 300	3.3 / 6.6
NRSS - 1012	400 / 750	3.3 / 6.6
NRSS - 1013	800 / 1200	6.6 / 11
NRSS - 1014	1300 / 2000	6.6 / 11
NRSS - 1015	2200 / 3000	6.6 / 11

STANDARD SPECIFICATIONS

- Operating Voltage : 3.3 / 6.6 / 11kv $\pm 5\%$
- Control Voltage : 240 V, 50Hz from Auxiliary supply
- Insulation : Class F
- Duty Cycle : 2 starts from cold or 1 hot start or 4 equispaced start / hour.
- Method of Cooling : Natural air cooled.
- Operating Condition : 40° C ambient + altitude upto 1000mtr
- Space Heater : Provided on aux supply.
- Enclosure - 12/14-Swg sheet steel floor-mounting cubicle with bottom/side cable entry in IP31 grade of protection suitable for indoor installation.
- Finish : Epoxy paint / Powder coated / Spray painted.

ORDERING INFORMATION

- The motor output in Kw, rated voltage, current, speed, power factor and resistance per phase.
- Control supply voltage.
- The motor torque speed characteristic at rated voltage and starting current with DOL starting.
- The load torque speed characteristics.
- The inertia of motor rotor as well as machine rotating parts.
- Site conditions including max ambient temp., humidity etc.
- The number of consecutive starts from cold and hot equally spaced starts per hour.
- Any other relevant data.

Please refer to Works for any non-standard requirements.

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