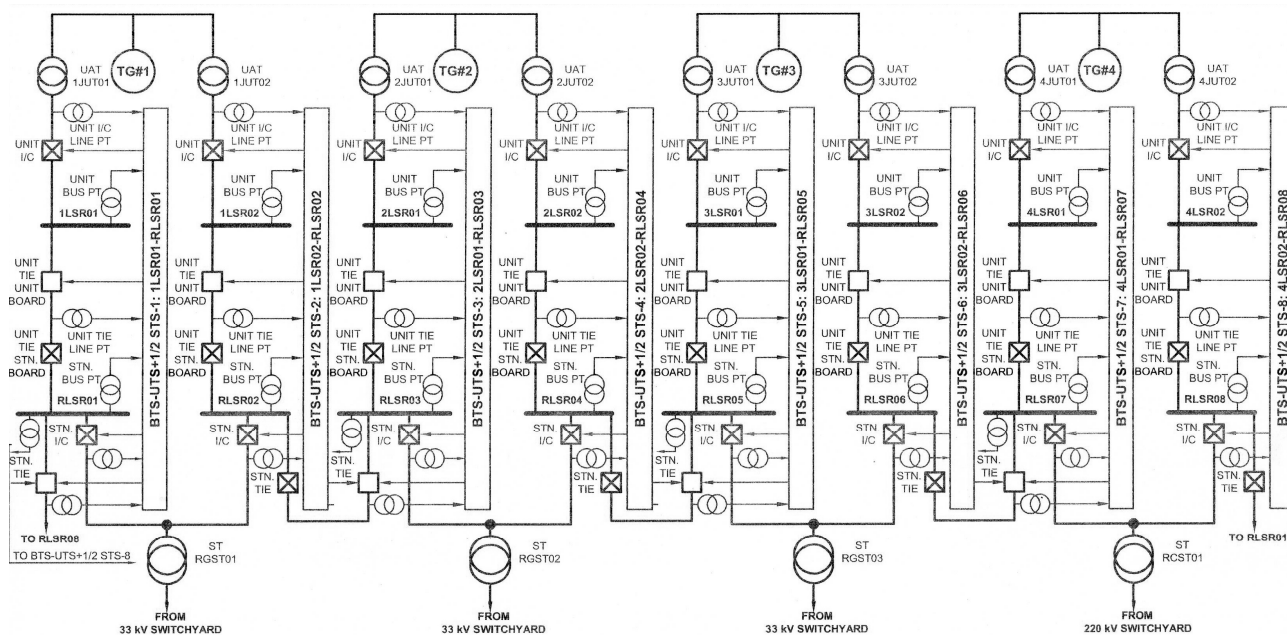


## I. INTEGRATED UNIT-TO-STATION + 1/2 STATION-TO-STATION SCHEMES

While a Unit-to-Station scheme typically takes care of bus transfer requirements for a unit board, and a Station-to-Station scheme typically takes care of a pair of two station boards; an integrated Unit-to-Station + 1/2 Station-to-Station scheme takes care of bus transfer requirements of a pair of 1 Unit Board and 1 Station Board with only marginal limitations compared to the original full fledged schemes such as availability of transfer direction between station incomers.



**Figure 1: Four Breaker BTS 2000 Unit-to-Station + 1/2 Station-to-Station Bus Transfer Scheme Configuration**

This scheme however offers significant advantages in terms of economy (per scheme) along with a superior automatic fast bus transfer facility for station boards which is usually not considered in system designs, yet may be critical incase of important auxiliaries being provided on the station boards and other considerations. These schemes have been implemented and successfully commissioned in O.P. Jindal TPS 4x250 MW Mega Power Plant in 2007.

## II. BUS TRANSFER DIRECTIONS

Bus transfers can take place in a four breaker bus configuration in several directions. Each bus transfer direction uniquely identifies the transfer bus, the old source feeding the bus prior to transfer, and the new source which will feed the bus after the transfer. The old source breaker (tripping breaker) and the new source breaker (closing breaker) are thus uniquely identified along with the identity of the transfer bus PT, the old source PT and the new source PT inputs. This information is used to determine the monitoring and supervision of various system dynamics during bus transfer.

TRANSFER DIRECTION		TRANSFER BUS	OLD (TRIPPING) SOURCE		NEW (CLOSING SOURCE)		TRANSFER INITIATION (MANUAL/ PROTECTIVE/ AUTO)
BREAKER STATUS			BKR	PT	BKR	PT	
UNIT/ STN I/C	UNIT/ STN TIE						
<b>UTS:</b> <b>UNIT: I/C =&gt; TIE</b> ON      OFF		UNIT BUS	UNIT I/C	UNIT I/C LINE PT	UNIT TIE	UNIT TIE LINE PT	MANUAL / PROTECTIVE / AUTO
<b>UTS:</b> <b>UNIT: TIE =&gt; I/C</b> OFF      ON		UNIT BUS	UNIT TIE	UNIT TIE LINE PT	UNIT I/C	UNIT I/C LINE PT	MANUAL
<b>STS:</b> <b>STN: I/C =&gt; TIE</b> ON      OFF		STN. BUS	STN. I/C	STN. I/C LINE PT	STN. TIE	STN. TIE LINE PT	MANUAL / PROTECTIVE / AUTO
<b>STS:</b> <b>STN: TIE =&gt; I/C</b> OFF      ON		STN. BUS	STN. TIE	STN. TIE LINE PT	STN. I/C	STN. I/C LINE PT	MANUAL

**Table 1: Bus Transfer Directions.**

The bus transfer direction for a given bus transfer is determined by several factors. For manual transfers, the bus transfer direction is selected by the operator based on the current bus configuration. For protective / auto transfers the bus transfer direction is selected automatically based on pre-fed software settings. Different transfer directions are selectively enabled for different transfer initiation criteria using pre-fed software settings.

## III. BUS TRANSFER INITIATION

The need of a bus transfer can be motivated by a variety of reasons. Depending on these, the means of initiating a bus transfer can be further classified as manual, protective and auto transfer. Manual transfers are planned transfers, while protective transfers are

actuated by protective relaying elements. **BTS 2000** can also be configured for intelligent auto transfers based on continuous system monitoring algorithms.

#### *A. Manual Transfer*

Manual transfer is used for a planned transfer during normal operation of the power station. This is useful during a startup, shutdown or certain kinds of maintenance work of the system. The choice of transfer direction among the available transfer directions needs to be pre-selected before initiating the transfer. The transfer can be manually actuated using the HMI on the front panel of **BTS 2000** or through a dedicated local computer or a remote central computer with SCADA, using the ModBus protocol to communicate with **BTS 2000** on the RS-485/ RS-232 port. Manual transfers are possible in various transfer directions as shown in Table 1. The Fast-In Phase-Slow mode is recommended for a manual transfer, although other choices including the momentary paralleling mode have also been provided.

#### *B. Protective Transfer*

Protective transfer initiation is done for unit source failure / station source failure conditions. For unit source failure, the initiating signals are typically derived from Class A / Class B unit/turbine lockout and turbine lockout UAT & GT winding temperature high trip / oil temp high trip and differential trip. For station source failure, the initiating signals are typically derived from station transformer winding temperature high trip / oil temp high trip and differential trip.

Each transfer direction can be individually enabled in the pre-fed software settings, following which it is automatically selected based on the current bus configuration as given below

<b>PROTECTIVE TRANSFER</b>	<b>UNIT / STN I/C BREAKER</b>	<b>UNIT / STN TIE BREAKER</b>	<b>TRANSFER DIRECTION</b>
<b>UNIT SOURCE FAILURE</b>	ON	OFF	UTS UNIT: I/C => TIE
<b>STATION SOURCE FAILURE</b>	ON	OFF	STS STN: I/C => TIE

**Table 2: Protective Transfer Directions**

The choice of transfer mode for unit source failure as well as station source failure are grouped together within the protective transfer settings, wherein the Fast-In Phase-Slow mode is recommended.

*C. Auto Transfer*

**BTS 2000** has the ability to do intelligent auto transfers based on continuous system monitoring algorithms. These algorithms can initiate a transfer on sustained conditions of bus under-voltage, bus under-frequency or a high bus |df/dt| with respect to their individual settings. This can be used to ensure a healthy source to the motor bus at all times without the need of additional protection elements for transfer initiation.

Each transfer direction can be individually enabled in the pre-fed software settings following which it is automatically selected based on the current bus configuration as given below:

AUTO TRANSFER	UNIT / STN I/C BREAKER	UNIT / STN TIE BREAKER	TRANSFER DIRECTION
UNIT BUS UNHEALTHY	ON	OFF	UTS UNIT: I/C => TIE
STATION BUS UNHEALTHY	ON	OFF	STS STN: I/C => TIE

**Table 3: Auto Transfer Directions**

The Fast-In Phase-Slow mode is recommended for auto transfers.