SYSTEM PROTECTION SCHEMES (SPS)

POWER SYSTEM OPERATION CORPORATION LIMITED

National Load Despatch Centre, New Delhi

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INDEX

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1. Introduction

The complexities in Indian electric power system operation are increasing day by day. The size of the grid has expanded manifold and is on a high growth phase. The need of System Protection Schemes (SPS) is spelt due to long haulage of power. Due to heavy flow of power through these corridors, any outage usually results in congestion in this part of the network.

This results into reduction in transfer capability across this corridor; subsequently disturbance in a large area of the grid resulting into loss of load and generation.

SPS- System Protection scheme is a system protection scheme in addition to the normal protection system to take care of some special contingencies like tripping of important corridor/flow gates etc. to avoid the voltage collapse, cascade tripping, load generation mismatch and finally blackouts in the system.

2. System Protection Schemes

System Protection Schemes are used during rare contingencies, when focus for the protection is on the power system supply capability rather than on specific equipment and when the consequences of an operating condition are outside the capability of conventional protection. SPS consists of three main parts i.e., the input which is the level of physical magnitudes and status of circuits breakers, decision making system which initiate some actions based on inputs and output which may be generator tripping/ back down or load tripping.

SPS are tailor made schemes & are required to operate infrequently. The Control actions taken are predetermined & can be armed or disarmed depending upon system conditions. It can comprise of a large number of coordinated actions, in a cascaded manner.

For large interconnected system the non-operation of unit (like differential protection etc) / non-unit (Like distance protection or over-current protection etc.) or backup protections may lead wide spread disturbances. Also there is heavy rush of power flow from on inter-regional or important intra-regional corridors. Tripping of these tie lines may overload other lines in the corridor which may result in cascading. This necessitates the implementation of SPS as safety net for the grid.

3. Need for SPS

As per Indian Electricity Grid Code(IEGC), interstate transmission system (ISTS) shall be capable of withstanding and be secured against the certain outages without necessitating load shedding or rescheduling of generation during steady state operation. These include outage of a 132 kV D/C line or Outage of a 220 kV D/C line or Outage of a 400 kV S/C line or Outage of a single ICT or Outage of one pole of HVDC bipole or Outage of 765 kV S/C line.

The aforesaid contingencies would be superimposed over a planned outage of another 220 kV D/C line or 400 kV S/C line in another corridor and not emanating from the same sub-station. ISTS shall be capable of withstanding the loss of most severe single system infeed without loss of stability. It has also been stated that any one of the aforesaid events shall not cause loss of supply, abnormal frequency on sustained basis, unacceptable high or low voltage, system instability, unacceptable overloading of ISTS elements.

As per the IEGC or transmission planning criteria, the system is not designed for 400 kV double circuit line or outage of HVDC bipole. In practice it has been observed that there are some contingencies happening in the system resulting in outage of multiple elements for which system is not designed.

Disturbances like loss of load, loss of generation or loss of transmission line in large grid may cause wide variations in frequency, voltage & load angles. Originating causes of grid failure may be due to equipment failure (including those of protective systems), human error and cascade tripping or large scale disturbances due to weather and/or natural calamities.

Disturbances cause discomfort to the people as well as results into huge economic loss. Therefore, in addition to conventional unit protection system few System Protection Schemes (SPS) are also desirable for safe and reliable operation of the power system.

The main objective of SPS is to preserve the integrity of the electric system by using automatic measures that are simple, reliable and safe for the system as a whole and to provide the most extensive coverage against all possible extreme credible contingencies.

3.1 IEGC Requirement

As per CL. 5.2 (O)

" All Users, STU/SLDC , CTU/RLDC and NLDC, shall also facilitate **identification, installation and commissioning of System Protection Schemes (SPS) (including inter-tripping and run-back)** in the power system to operate the transmission system closer to their limits and to protect against situations such as voltage collapse and cascade tripping, tripping of important corridors/flow-gates etc.. Such schemes would be finalized by the concerned RPC forum, and shall always be kept in service. If any SPS is to be taken out of service, permission of RLDC shall be obtained indicating reason and duration of anticipated outage from service"

3.2 CEA Manual on Transmission Planning Criteria

As per CL. 4.3 of Planning Criteria

After suffering single contingency (N-1), grid is still vulnerable to experience second contingency, though less probable ('N-1-1'), wherein some of the equipment's may be loaded up to their emergency limits.

To bring the system parameters back within their normal limits, load shedding/re-scheduling of generation may have to be applied either manually or through automatic system protection schemes (SPS).

Such measures shall generally be applied within one and a half hour (1½) after the disturbance.

4. Summary of System Protection Schemes (SPS)

Normally all the System protection schemes are proposed, discussed and getting approved in RPC meetings such as OCC, PCC, TCC and RPC Board meetings.

The Summary of System Protection Schemes (SPS) both inter/Intra regional which are in service, and no of schemes Approved, no of schemes under discussion stage are detailed below

Sl. No.	Region	No. of Schemes In service	No. of Schemes approved (yet to be operationalized)	No. of schemes under discussion	Remarks
1	Northern Region	14	11		Inclusive of ER-NR and WR-NR corridors
2	Eastern Region	5	1	1	Inclusive of ER-SR corridor
3	Western Region	18	1		Inclusive of WR-NR and WR-SR corridor
4	Southern Region	18	1	1	Inclusive ER-SR and WR-SR corridor
5	North Eastern Region	1			
	TOTAL	56	14	2	72

The System protection schemes for Inter / intra-regional corridor (Region wise) divided in to three categories as stated below.

i) SPS related to tripping of critical line / corridor

ii) SPS related to safe evacuation of Generation

iii) SPS related to overloading of Transformers

The summary of SPS both inter/intra regional which are in service, and number of schemes yet to be operationalized based on the categories above are detailed below:

Region	Tripping of critical line(s) / corridor			Safe evacuation of generation			Overloading of Transformers			TOTAL
	In Service	Approved	Under Discussion	In Service	Approved	Under Discussion	In Service	Approved	Under Discussion	
NR	6	3		3	3		5	5		25
ER	3			2	1				1	7
WR	10	1		7			1			19
SR	8	1	1	5			5			20
NER				1						1
Total	27	5	1	18	4		11	5	1	72

Also the system protection schemes for inter/intra-regional corridors (region-wise) can be categorized as stated below:

i) SPS related to Generation rejection

ii) SPS related to Load rejection

iii) SPS related to Generation/Load rejection

iv) SPS related to HVDC controls

v) SPS related to others

5. SPS in Northern Region

Sl. No	Name of the Scheme	Agency	Approved date & Status	Remarks	Category type
SPS related to tripping of critical line / Corridor					
1	**SPS for WR-NR corridor** 765kV Agra-Gwalior & 1 & 2	CTU	27-11-10 In service	Scheme has been implemented for load shedding. However, the SPS is not wired/ working properly for Jamsher, Mohali, Nara & Kota. Implementation for 500MW generation back down in Western region was completed (Korba, Vindhyachal, CGPL Mundra). The setting has been modified on 13.04.2014. Mock testing of this SPS was carried out on 03rd April, 2014 with the co-ordination of all concerned. Deficiencies observed during Mock testing are being attended to.	Load Rejection / Gen. Rejection
2	**SPS for WR-NR corridor** SPS for contingency due to tripping of Mundra-Mahendergarh HVDC Bipoles	Adani power	13-07-12 In service	Partially implemented further Load shedding at NR needs to be identified. Mock testing of this SPS was carried out on 08th June, 2014 with co-ordination of the concerned. Deficiencies observed during Mock testing are being attended to.	Load Rejection / Gen. Rejection
3	**SPS for ER-NR Corridor** SPS for high capacity 400kV Muzaffarpur-Gorakhpur D/C Inter-regional tie line related contingency	CTU	15-12-06 In service	Implemented	Load Rejection / Gen. Rejection
4	SPS for 1500 MW HVDC Rihand-Dadri Bipole related contingency	CTU	29-06-2005 In service	Implemented	Load Rejection / Gen. Rejection

Sl. No	Name of the Scheme	Agency	Approved date & Status	Remarks	Category type
5	SPS for HVDC Balia-Bhiwadi Bipole	CTU	15-04-2010 & 27-11-2010 In service	ERPC had forwarded its comments to NRPC proposing for backing down of generation are from Khalegaon STPS-II and Barh STPS of NTPC only, instead of their proposal from Farakka STPS & Khalegaon STPS-I. Automatic backing down of generation in the Singrauli – Rihand complex for Case 2 is yet to be implemented.	Load Rejection / Gen. Rejection
6	SPS for reliability of Uttarakhand power system (400 kV Moradabad-Kashipur)	PTCUL	27-11-2010 In service	Implemented. SPS is hard wired	Load/ Gen. Rejection
7	SPS for contingency due to tripping of multiple lines at Dadri	CTU	27-11-2010 Approved	Under Implementation by NTPC	Load/ Gen. Rejection
8	SPS for 220 kV Salal- Jammu circuit carrying more than 150 MW each	CTU	27-11-2010 Approved	No information from PDD, J&K. PDD, J&K to intimate in writing about the status of implementation of this SPS. Also status of underlying transmission network from Wanpoh and Sambha S/S to be intimated. OCC was of the opinion that once underlying transmission network from Sambha substation is commissioned, this SPS may not be required.	Load rejection
9	SPS Proposed for Kashmir Valley	CTU/ PDD	13-01-2013 Approved (But Yet to be discussed in RPC meeting)	A committee formed and approved.	Load rejection
SPS related to Safe evacuation of Generation					

Sl. No	Name of the Scheme	Agency	Approved date & Status	Remarks	Category type
10	SPS for reliable evacuation of power from NJPS and Baspa H.E.P and Karcham wangtoo	Karcham/ Jhakri	04-02-2011 In service	Implemented. Due to commissioning of Rampur HPS, in the 99th OCC meeting the existing logic of SPS at NJHPS for taking care of contingency of lines from NJHPS (for reduction in generation at NJHPS and KWHPS) was approved for reduction in Generation at Rampur HPS as well. Further, it was also decided that NRLDC will furnish the detailed modalities in writing. The setting of 800 MW at which two units are being tripped at KWHPS was raised to 850 MW as approved by OCC (100th). Also, Rampur HEP was also included in the SPS logic and same approved in the 100th OCC itself.	Gen. Rejection
11	SPS for Reliable Evacuation of Ropar Generation	Ropar TPS	27-11-2010 In service	SPS installed and commissioned on 29.05.2013.	Gen. Rejection
12	SPS for Reliable Evacuation of Panipat TPS stage I & II Generation	HVPNL/ HPGCL	27-11-2010 Approved	Panipat TPS vide his letter no. Ch-77/SMD-46 Vol.-II dated 01.03.2013 has informed SE(SLDC), HVPNL that SPS for Panipat-I units is not technically feasible as these units have not been provided with EHTC (Electro Hydraulic Turbine Control). **This SPS issue already stands referred to CEA.**	Gen. Rejection
13	SPS for Reliable Evacuation of Rosa Generation	UPPTCL	27-11-2010 Approved	SPS was envisaged for one unit with connectivity at 220 kV level but now the scheme has been revised for four units with connectivity at 400 kV level and 2 new upcoming outlets. SPS is likely to be commissioned by September, 2014	Gen. Rejection

Sl. No	Name of the Scheme	Agency	Approved date & Status	Remarks	Category type
14	SPS for contingency due to tripping of evacuating lines from Narora Atomic Power Station	UPPTCL	11-05-2012 Approved	**In 100th OCC, UPPTCL intimated that SPS scheme has been finalized and will be implemented by their Transmission South (Agra) wing. OCC advised representative of UPPTCL to intimate the time frame by the next meeting.**	Gen. Rejection
15	SPS for evacuation of Kawai TPS	RRVPNL	In Service	Implemented	Gen. Rejection
SPS related to overloading of Transformers					
16	SPS for Transformers at Ballabgarh (PG) substation	CTU	27-11-2010 In service	Implemented	Load rejection
17	SPS for Transformers at Maharanibagh (PG) substation	CTU	27-11-2010 In service	Implemented	Load rejection
18	SPS for Transformers at Mandola (PG)	CTU	27-11-2010 In service	Implemented	Load rejection
19	SPS for Transformers at Bamnauli (DTL) Substation	DTL	27-11-2010 In service	Implemented	Load rejection
20	SPS for Transformers at Meerut(PG) substation	CTU	20-08-2013 Approved	Approved in 90th OCC meeting to install the SPS at Meerut. To be installed by November, 2013. Loads identified by UPPTCL & POWERGRID has to now implement the SPS. Since Optic Fibre communication is not available at all the 07 outgoing, 220 kV feeders from Meerut, SPS has to be implemented using PLCC communication. POWERGRID is examining the reliability of SPS on PLCC communication.	Load rejection
21	SPS for Transformers at Bawana (DTL) Substation	DTL	27-11-2010 In service	Implemented	Load rejection
22	SPS for Transformers at Moradabad (UPPTCL) Substation	UPPTCL	27-11-2010 Approved	As no response has been received for the tender enquiry floated, for Muradabad and Muradnagar, re-tendering has to be done.	Load rejection

Sl. No	Name of the Scheme	Agency	Approved date & Status	Remarks	Category type
23	SPS for Transformers at Muradnagar (UPPTCL) Substation	UPPTCL	27-11-2010 Approved	As no response has been received for the tender enquiry floated, for Muradabad and Muradnagar, re-tendering has to be done.	Load rejection
24	SPS for Transformers at Agra (UPPTCL) Substation	UPPTCL	27-11-2010 Approved	Vendors were contacted by UPPTCL; Order for SPS has been placed.	Load rejection
25	SPS for Transformers at Bassi Substation	CTU	Approved	Under Implementation. In 97th OCC meeting, it was decided that RRVPNL would identify radial loads equivalent to the loading of one ICT i.e around 350 MW in and around Bassi area and intimate the same to POWERGRID for facilitating early commissioning of SPS. Accordingly RRVPNL has submitted the feeders list. With the expected addition of new ICT of 500 MVA capacity by August, 2014, OCC in its 100th meeting has decided to keep on hold the installation of SPS at Bassi for the time being.	Load rejection

6. SPS in Eastern Region

Sl. No.	Name of the Scheme	Agency	Approved date & Status	Remarks	Category Type
SPS related to tripping of critical line / Corridor					
1	**SPS for ER-SR corridor** SPS for Talcher – Kolar HVDC Bipole - at Talcher end	NTPC / Powergrid	In service	Implemented and there is a proposal for modification in the existing scheme to back down all the generating units instead of tripping the units. It was decided in ERPC PCC meeting that NTPC may take up the issue with CEA for any modification etc. of the existing scheme. Modification of this SPS was done after synchronization of NEW grid with SR to provide additional generation relief from other generators viz. Sterlite, GMR and JITPL	Gen. Rejection
2	SPS for Sterlite Energy Limited (SEL)	SEL	In service	Implemented	Gen. Rejection
3	SPS for power transfer to Bangladesh through Bheramara HVDC	Powergrid	In Service	Implemented	Load shedding
SPS related to Safe evacuation of Generation					
4.	Interim arrangement for evacuation of TEESTA –III generation	NHPC	In service		

5	SPS for Chuzachen Generation Unit	Gati-Infrastructure	Approved	Implemented	Gen. Rejection
6	SPS scheme of Chukha HPS, Bhutan.		In principle approved by 17th PCC meeting.	PCC agreed for the scheme and decided to send the SPS scheme to Chuka HEP for their study, comments and suggestion. Then the scheme will be placed before all concerned parties in a separate meeting before placing the same in TCC/ERPC meeting for final approval.	Gen. Rejection
SPS related to overloading of Transformers					
7	Heavy loading of 315MVA ICTs at Jeypore and 220KV Jaypore-Jaynagar D/C line	OPTCL	Under discussion	ERLDC designed the SPS and submitted in 90th OCC held on 25.10.13. It is decided to send the SPS scheme to OPTCL for further analysis and views/ comments. Further, OCC felt that if second Jaypore- Jaynagar D/C line, which is expected to be commissioned shortly, comes then SPS is not required.	Gen. Rejection

7. SPS in Western Region

Sl. No		Agency	Approved date & Status	Remarks	Category Type
SPS related to tripping of critical line / Corridor					
1	SPS at HVDC APL Bi-pole (2x1250MW)	APL	In service	Implemented	HVDC control
2	SPS for sudden large reduction in NR import at 765 kV Agra (from WR)	CTU	Approved	Implemented	Gen. Rejection
3	SPS at Sipat Power Station for tripping of 765kV Sipat-Bilaspur-Seoni line	NTPC	Approved	Approved but still under discussion	Gen. Rejection
4	SPS for 400 kV Tirora-Warora D/C	APML	Approved	Implemented	Gen. Rejection
5	SPS at 400 kV Tirora for Warora-Chandrapur-II D/C	APML	Approved	Implemented	Gen. Rejection
SPS related to NEW & SR grid Synchronisation in WR					
6	SPS for 765 kV Sholapur-Raichur 2 x S/C section Flow > 1500MW (SPS-1)		Approved	Implemented	Load rejection/ Gen. Backdown
7	SPS for 765 kV Sholapur-Raichur 2 x S/C section SPS for loss of 800MW import by SR(SPS-3)		Approved	Implemented	Load rejection/ Gen. Backdown
8	SPS for 400 kV Raipur-Wardha D/Cs (SPS-4)		Approved	Implemented	Load rejection/ Gen. Backdown

9	SPS for 400 kV Wardha-Parli D/C (SPS-5)		Approved	Implemented	Load rejection/ Gen. Backdown
10	SPS for 400 kV Parli-Sholapur D/C (SPS-6)		Approved	Implemented	Load rejection/ Gen. Backdown
11	SPS for Raichur-Sholapur line current exceeding 800 Amp(1000MW from Sholapur to Raichur direction)-SPS 7		Approved	Implemented	Load rejection/ Gen. Backdown
SPS related to Safe evacuation of generation					
12	SPS at LANCO (Pathadi)	LANCO	In service	Implemented	Gen. Rejection
13	SPS at JPL (TAMNAR)	JPL	In service	Implemented	Gen. Rejection
14	SPS at Adani Power Ltd, MUNDRA	APL	Aug 2011 In service	Implemented	Gen. Rejection
15	SPS for CGPL Mundra units	CGPL	Approved	Implemented. Revision proposed.	Gen. Rejection
16	SPS at BALCO	M/s BALCO	Approved	Implemented	Gen. Rejection
17	SPS at Essar Mahan Ltd	Essar	Approved	Implemented	Gen. Rejection
18	SPS at Jaypee Nigrie STPP	Jaypee	Approved	Implemented	Gen. Rejection
SPS related to overloading of Transformers					
19	SPS at Essar Steel India Ltd	ESIL	Approved	Implemented	Load Rejection

8. SPS in Southern Region

Sl. NO	Name of the Scheme	Agency	Status	Remarks	Category Type
SPS related to tripping of critical line / Corridor					
1	**SPS for ER-SR corridor** SPS for Talcher – Kolar HVDC Bipole - at Kolar	CTU	In service	Implemented. SPS Extension: HVDC Kolar Trip Signal 3 SPS was completed successfully on 05.06.2013 Additional trip logic (dp/dt) to the kolar SPS during contingencies similar to NEW grid disturbance on 31-07-12 is under implementation.	HVDC control & Load rejection
2	Modification in SPS of Hiriyur-Neelamangala line (For Synchronisation of SR grid with NEW grid)		Approved	Implemented	Load rejection
3	SPS for 400kV Gooty-Nelamangala SC / 400kV Gooty-Somanahalli SC (For Synchronisation of SR grid with NEW grid)		Approved	Implemented	Load rejection/ Gen. Backdown
4	SPS at 220kV Neelamangala	KPTCL	In service	Implemented	Load rejection
5	SPS at Salem	TNEB	In service	Implemented	Load rejection

Sl. NO	Name of the Scheme	Agency	Status	Remarks	Category Type
6	SPS for 400kV Vijayawada-Nellore line	CTU	09.07.10 Approved	Under implementation	Gen. Backdown
7	SPS for 220kV Chittur-Tiruvalam	APTRANSCO	18.07.2012 Approved	Implemented w.e.f 27/07/13	Load rejection
8	SPS for 220kV Sulurpet-Gummidipoondi	APTRANSCO	18.07.2012 Approved	Implemented w.e.f 29/07/13	Load rejection
9	SPS for 400kV Nellore-Almatti DC	CTU	18.07.2012 Approved	Implemented w.e.f 23/05/13	Generation Backdown
10	SPS for 400kV Kolar-Hosur Line		Agreed in principle. Funding to be decided.	-	HVDC Control & Load Rejection
SPS related to Safe evacuation of generation					
11	SPS at Muddanur	APTRANSCO	In service	Implemented	Generation rejection
12	SPS at Nagjheri Power House	KPTCL	In service	Implemented	Generation rejection
13	SPS at UPCL	LANCO	In service	Implemented	Generation rejection
14	SPS at Varahi	KPTCL	In service	Implemented	Generation rejection

Sl. NO	Name of the Scheme	Agency	Status	Remarks	Category Type
15	SPS at Kudankulam APS	CTU	In service	<u>Modification in Present SPS:-</u> SPS of Kudankulam Unit and SPS of Talcher-Kolar Pole trip at Kolar end are having the same group of loads for shedding and this needs to be segregated at the earliest by identifying separate loads for Kudankulam SPS. This has been implemented.	Load rejection
SPS related to overloading of Transformers					
16	SPS for Madakathara ICT	KSEB	In service	Implemented	Load rejection
17	SPS for Hosur ICT	CTU	In service	Implemented 30th PCSC recommended that in view of ICT loadings coming down after commissioning of 3rd ICT, SPS may be disabled and may be activated when one of the ICTs is taken under outage	Load rejection
18	SPS for Mamidipalli ICT / Ghanapur ICT	APTRANSCO	In service	Implemented	Load rejection
19	SPS for Thirunelveli ICT	TANTRANSCO	Approved	Implemented	Load rejection
20	SPS for Madurai ICT	TANTRANSCO	Approved	Implemented	Load rejection

9. SPS in North Eastern Region

Sl.. NO	Name of the Scheme	Implementing Agency	Approval date & Status	Remarks	Category Type
SPS related to Safe evacuation of generation					
1	4 (Four) number SPS associated with 1st module of OTPC Palatana generating station and NER Grid conditions thereof (363.3MW)	CTU, OTPC and AEGCL	SPS-1 and SPS-4 are already In Service (from 14.09.13). SPS-2 and SPS-3 could not be implemented yet due to difficulties in generation reduction expressed by OTPC. This is endangering grid security of NER. This issue is under discussion in several NERPC forum meetings (OCC) but not solution reached yet.	Implemented. The current SPS scheme is keeping in mind generation from 1 module of Palatana (363.3 MW) and the grid condition of NER prior to commissioning of 400/220 kV Azara substation. Following the commissioning of 400/220 kV Azara substation along with 400 kV Silchar – Azara S/C line, there might be revision in the existing scheme. The scheme may undergo a futher revision post commissioning of 2nd Module of Palatana CCGT.	Load rejection/ Gen reduction

Annexure 1

SPS IN NORTHERN REGION

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INDEX

Ref No.	Name of the Scheme	Implementing Agency	Status	Pg. No.
SPS related to Safe evacuation of Generation				
SPS/NR/GEN/01	SPS for reliable evacuation of power from NJPS and Baspa H.E.P and Karcham wangtoo	Karcham/ Jhakri	In service	40
SPS/NR/GEN/02	SPS for Reliable Evacuation of Ropar Generation	Ropar TPS	In service	42
SPS/NR/GEN/03	SPS for Reliable Evacuation of Panipat TPS stage I & II Generation	HVPNL/ HPGCL	Approved	-
SPS/NR/GEN/04	SPS for Reliable Evacuation of Rosa Generation	UPPTCL	Approved	-
SPS/NR/GEN/05	SPS for contingency due to tripping of evacuating lines from Narora Atomic Power Station	UPPTCL	Approved	43
SPS/NR/GEN/06	SPS for evacuation of Kawai TPS	RRVPNL	In Service	44
SPS related to overloading of Transformers				
SPS/NR/TRF/01	SPS for Transformers at Ballabgarh (PG) substation	CTU	In service	47
SPS/NR/TRF/02	SPS for Transformers at Maharanibagh (PG) substation	CTU	In service	47
SPS/NR/TRF/03	SPS for Transformers at Mandola (PG)	CTU	In service	47
SPS/NR/TRF/04	SPS for Transformers at Bamnauli (DTL) Substation	DTL	In service	48
SPS/NR/TRF/05	SPS for Transformers at Meerut(PG) substation	CTU	Approved	-
SPS/NR/TRF/06	SPS for Transformers at Bawana (DTL) Substation	DTL	In service	-
SPS/NR/TRF/07	SPS for Transformers at Moradabad (UPPTCL) Substation	UPPTCL	Approved	-
SPS/NR/TRF/08	SPS for Transformers at Muradnagar (UPPTCL) Substation	UPPTCL	Approved	-

Ref No.	Name of the Scheme	Implementing Agency	Status	Pg. No.
SPS/NR/TRF/09	SPS for Transformers at Agra (UPPTCL) Substation	UPPTCL	Approved	-
SPS/NR/TRF/10	SPS for Transformers at Bassi Substation	CTU	Approved	-

SPS related to tripping of critical line / Corridor

Ref No: SPS/NR/LINE/01: SPS for WR-NR Corridor

SPS for WR-NR corridor - 765kV Agra-Gwalior D/C

Case	Contingency	Action
Case-1	Reduction of import by NR on 765 kV Agra-Gwalior ckt-I & II by more than 1000 MW but less than 1500 MW	Shed loads in Groups C and D in the Northern Region
Case-2	Reduction of import by NR on 765 kV Agra-Gwalior ckt-I & II by more than or equal to 1500 MW	**Action-1** Shed Loads in Groups C, D, E and F **Action-2** Automatically back down 500 MW generation in Western Region in the shortest possible time. (Korba, Vindhyachal, CGPL Mundra stations)
Case-3	Total steady state flow on 765 kV Gwalior to Agra in case both ckt is in service more than 2500 MW for a period of 10(ten) seconds or b. flow on 765kV from Gwalior to Agra when only one ckt is in service more than 1800 MW for a period of 5 (five) seconds OR Steady State voltage at 400 kV Agra less than 380 kV kV respectively for a period of 10(ten) seconds (direction of power flow is West to North)	Shed load in Group C and D

Remark:

1. Load Shedding shall be achieved within 500ms, including all signal propagation/breaker opening time delay.

2. Load shedding in Western Uttar Pradesh, Rajasthan, Punjab and Haryana area

		Delhi		UP		Rajasthan		Haryana		Punjab		
Sl No.	Group	Load	Planned Load (MW)	Load	Planned Load (MW)	Load	Planned Load (MW)	Load	Planned Load (MW)	Load	Planned Load (MW)	Group Total
1	Group-A	**Mandaula (PG)**-220 kV Mandaula-Narela D/C	150	Feeders from **220/132 kV Muradnagar** old Sub-station.	100	**220/132 kV Bagru**-132 kV GSS Bagru	25			**220/66 kV Malerkotla** -66 kV Malerkotla ckt -66 kV Naudhrani ckt	35	310
2	Group-B	**Mandaula (PG)** -220 kV Mandaula-Gopalpur	200			**220/132 kV Ratangarh** - 132 kV GSS Momasar	26	**Panipat (BBMB)** -1x100 MVA, 220/33 kV ICT at Panipat	50			276
3	Group-C			Feeders from **220/132 kV Modipuram** Sub-station.	100	**220/132 kV KOTA**- 132KV Baroli; **220/132 kV Bhilwara**-132KV Gss Hamirgarh	60	**Samaypur (BBMB)** -220 kV Samaypur –Palwal D/C (MW)	50	**220/66 kV Gobindgarh-1** -66 kV Chourwala ckt. -66 kV Talwara ckt-1 '-66 kV Talwara ckt-2	71	281
4	Group-D					**220/132 kV Alwar**-132 kV GSS Bansoor, 132KV GSSRamgarh;	59	**Samaypur (BBMB)**-220kV Samaypur-Badsahpur D/C	90	**220/66 kV Laltokalan** -66 kV Gill Road ckt-1 -66 kV Gill Road ckt-2 -66 kV Feozpur Road ckt	90	239
5	Group-E			**220 kV Mainpuri** - 2 x 132/33 kV , 40 MVA T/F (20 MW - 60 MW)	50	**220/132kV Alwar** - 132 kVGSS Malakheda;**220/132kV Bhilwara** - 132 kVGSS Gangapur,132 kVGSS Danta,132 kVGSS Devgarh and 132 kVGSS Kareda ;**220/132 kV Merta** -132 kV GSS Kuchera	100	**132kV PTPS** 132kV PTPS-Chandauli 132kV PTPS-Munak	50	**220 kV Jamsher** - 66 kV Nakodar Road-1 -66 kV Nakodar Road-2	100	300
	Group-F			**220 kV Nara**- 132/33 kV , 40 MVA T/F and 132/33 kV , 63 MVA T/F(32 MW - 52 MW)	50	**220/132 kV Alwar** -132 kV GSS Alwar(local load);**220/132 kV Merta** - 132 kV GSS Lamba, -132 kV GSS Golan	100	**132kV Narwana** 132kV Narwana-Garhi 132kV Narwana-Tohana 132kV Narwana-Uklana 132kV Narwana-Dhamtansahib 132/33kV T/F 20MVA 132/11kV T/F 8 MVA	75	**220 kV Mohali** -66 kV Mohali ckt-I & II - 66 kV Mohali ckt-III & IV	100	325
6	Group-G					**400/220 kV Ratangarh** --220 kV GSS Sujangarh, and **220/132 kV Ratangarh** - 132 kV GSS Sardarsahar	100	**132kV Dadri** 132kV Dadri-Dadri city 132kV Dadri-Matenhail 132kV Dadri-Kalanaur 132kV Dadri-Bahu 132/33kV T/F 20/25MVA 132/133V T/F 16/20 MVA	75	**220 kV Ablowal** -66 kV Rakhra-I -66 kV Rakhra-II -66 kV Rakhra-III -66 kV Rakhra-IV	100	275
TOTAL			350		300		470		390		496	2006

Fig 1 Load Details

Ref No: SPS/NR/LINE/02: SPS for WR-NR Corridor

SPS for contingency due to tripping of HVDC Mundra-Mahendergarh

Case-1		
Contingency	**Action-1**	**Action-2**
Blocking of (one pole or Bipole) AND Reduction in power injection at Mahendergarh by more than 600 MW and upto 900 MW	Generation reduction of equivalent amount in Mundra Stage-III (WR) through the run back scheme	Shed 300 MW identified load in Northern Region within 500 ms (including all signal propagation / breaker opening time delay) Haryana: 150 MW, Punjab:50 MW, Rajasthan: 50 MW, UP: 50 MW
Case-2	**Action-1**	**Action-2**
Blocking of (one pole or Bipole) AND Reduction in power injection at Mahendergarh by more than 900 MW and upto 1250 MW	Generation reduction of equivalent amount in Mundra Stage-III (WR) through the run back scheme	Shed 600 MW load identified in Northern Region within 500 ms (including all signal propagation / breaker opening time delay) Haryana: 300 MW, Punjab:100 MW, Rajasthan: 100 MW, UP: 100 MW
Case-3	**Action-1**	**Action-2**
Blocking of Bipole AND Reduction in power injection at Mahendergarh by more than 1250 MW and upto 2000 MW	Generation reduction of equivalent amount in Mundra Stage-III (WR) through the run back scheme	Shed 1400 MW load identified in Northern Region within 500 ms (including all signal propagation / breaker opening time delay) Haryana: 600 MW, Punjab:200 MW, Rajasthan: 200 MW, UP: 200 MW, Delhi: 200 MW
Case-4	**Action-1**	**Action-2**
Blocking of Bipole AND Reduction in power injection at Mahendergarh by more than 2000MW	Generation reduction of equivalent amount in Mundra Stage-III (WR) through the run back scheme	Shed 1900 MW load identified in Northern Region within 500 ms (including all signal propagation / breaker opening time delay) Haryana: 700 MW, Punjab:300 MW, Rajasthan: 300 MW, UP: 300 MW, Delhi: 300 MW

Load Details for tripping of HVDC Mundra-Mahendergarh

Table 3: Details of Load Shedding

S No.	State / L.S. quantum	Name of feeding substation	Feeder/ line /equipment	Case-1 300 MW	Case-2 600 MW	Case-3 1400 MW	Case-4 2000MW
1	Rajasthan Case-1: 50 MW Case-2: 100MW Case-3: 200MW Case-4: 300MW	220/132 kV Alwar	132kV Mandaver	1	1	1	1
2			132kV Bansoor		1	1	1
3			132kV Ramgarh		1	1	1
4			132kV Malakheda			1	1
5			Alwar (local load)				1
6		220/132 kV Ratangarh	132kV Saradar Shahar	1	1	1	1
7		220/132 kV Bhilwara	132kV Gangapur			1	1
8			132kV Danta			1	1
9			132kV Devgarh			1	1
10			132kV Kareda			1	1
11		220/132 kV Merta	132kV Kuchera			1	1
12			132kV Lamaba				1
13			132kV Gotan				1
14	Haryana Case-1: 150MW Case-2: 300MW Case-3: 600MW Case-4: 700MW	400/220 kV Bhiwani_BB	220kV Bapora D/C			1	1
15		400/220 kV Hisar_PG	220kV Isharwal D/C			1	1
16		400/220 kV Dhanonda Thru 220 kV Lula Ahir	220kV Rewari (3x100 MVA)	1	1	1	1
17		400/220 kV Bahadurgarh	220 kV Nuna Majra (3x100 MVA)		1	1	1
18		132kV Ch Dadri	132 kV Kalanaur			1	1
19	Punjab Case-1: 50 MW Case-2: 100MW Case-3: 200 MW Case-4: 300 MW	220/66 Gobindgarh	66kV Talwara-1			1	1
20			66kV Talwara-2				1
21		220/66 kV Laltokalan	66kV Gill road-1		1	1	1
22			66kV Gill road-2	1	1	1	1
23			66kV Dugri			1	1
24		220/66kV Malerkotla	66kV Malerkotla				1
25			66kV Lasoi Amargarh				1
26	Uttar Pradesh Case-1: 50 MW Case-2: 100MW Case-3: 200MW Case-4: 400MW	Shamli	Thana Bhawan-1	1	1	1	
27			Thana Bhawan-2	1	1	1	
28			Jasala-1		1	1	
29			Jasala-2		1	1	
30			Kharad-1			1	
31			Kharad-2			1	
32			Baraut-1				1
33			Baraut-2				1
34	Delhi Case-1: Nil Case-2: Nil Case-3: 200MW Case-4: 300MW	400/220kV Bamnauli	Najafgarh-1			1	1
35			Najafgarh-2			1	1
36		400/220kV Mandola	Gopalpur-1			1	1
37			Gopalpur-2			1	1

Ref No: SPS/NR/LINE/03: SPS for ER-NR corridor

SPS for high capacity 400 kV Muzaffarpur-Gorakhpur D/C Inter-regional tie-line related contingency

The 400 kV Muzaffarpur-Gorakhpur D/C is an important tie line between ER and NR.

SPS Scheme logic:

Case-1

Contingency: Flow >1200 MW (ER to NR, measured at Gorakhpur) & D/C trips

Action-1: Immediately Shed Loads in Groups in Groups A and D (of Fig 1 Load Details).

Action 2: Ramp up the power flow from West to North by 100 MW (variable) to Northern Region through HVDC back-to-back stations at Vindhyachal at the maximum ramp rate possible (300 MW/Sec).

Case-2

Contingency: Flow >1800 MW (ER to NR, measured at Gorakhpur) & stays above this value for more than 5 seconds.

Action-1: Immediately Shed Loads in Groups in Groups C and D (of Fig 1 Load Details).

Action 2: Ramp up the power flow from West to North by 100 MW (variable) to Northern Region through HVDC back-to-back stations at Vindhyachal at the maximum ramp rate possible (300 MW/Sec).

Load Shedding shall be achieved within 500 ms, including all signal propagation/breaker opening time delay

Ref No: SPS/NR/LINE/04

SPS for 1500 MW HVDC Rihand-Dadri bipole related contingency

The 1500 MW HVDC Rihand-Dadri bipole is the major high capacity link between the pit head generating stations in south – east part of northern region (NR) and the load centres in the central and western part of NR. Outage of this high capacity link results in overloading of the parallel AC network. In order to take care of any contingency due to outage of this high capacity link, scheme has been developed to carry out the automatic backing down of generation at the sending end and load shedding at the receiving end. For the purpose of load shedding the loads have been distributed in different groups say group- A, B, C & D.

Details of the corrective action logic for different cases are as explained below.

SPS Scheme logic:

Case-1

Contingency: Tripping of any or both poles resulting in power order reduction by 750 MW and above.

Action 1: Immediately Shed Loads in Groups A, B, C & D. (Fig 1 Load Details)

And

Action 2: Reduce generation at Singrauli/Rihand by 500 MW in the fastest possible time

And

Action 3: Ramp down the power flow from West to North by 100 MW (variable) at Vindhyachal HVDC station at the maximum ramp rate possible (300MW/Sec)

Case-2

Contingency: Tripping of any or both poles resulting in power order reduction above 500MW but less than 750MW

Action 1: Immediately Shed Loads in Groups C & D. (Fig 1 Load Details)

And

Action 2: Ramp down the power flow from West to North by 100 MW (variable) to Northern Region through HVDC back-to-back stations at Vindhyachal at the maximum ramp rate possible (300 MW/Sec).

Load Shedding shall be achieved within 500ms, including all signal propagation/breaker opening time delay

Ref No: SPS/NR/LINE/05

System Protection Scheme (SPS) for HVDC Balia-Bhiwadi Bipole

Case	Contingency	Action
Case-1	Tripping of pole resulting in power order reduction by more than 500 MW and upto 750 MW. (Measured at Bhiwadi)	Shed Loads in Groups C & D (of Fig 1 Load Details).
Case-2	Tripping of pole resulting in power order reduction by more than 750 MW and up to 1500 MW. (Measured at Bhiwadi)	**Action-1:-** Shed Loads in Groups A, B, C & D as Described (of Fig 1 Load Details). **Action-2:-** Automatically back down generation by 250 MW at Singrauli-Rihand complex in Northern region and by 250 MW in the Eastern region at Kahalgaon in the shortest possible time
Case-3	Tripping of poles resulting in power order reduction above 1500 MW and up to 2000 MW.(Measured at Bhiwadi)	**Action-1:-** Shed loads in Groups A, B, C, D, E & F (of Fig 1 Load Details). **Action-2:-** Automatically back down generation by 750 MW at Singrauli-Rihand complex in northern region and by 750 MW in the eastern region at Kahalgaon/ Barh/ Farakka in the shortest possible time.
Case-4	Tripping of poles resulting in power order reduction above 2000 MW. (Measured at Bhiwadi)	**Action 1:-** Shed loads in Groups A, B, C, D, E, F & G(of Fig 1 Load Details). **Action 2:-** Automatically back down generation by 750 MW at Singrauli-Rihand complex in northern region and by 750 MW in the eastern region at Kahalgaon/ Barh/Farakka in the shortest possible time.

Remark:

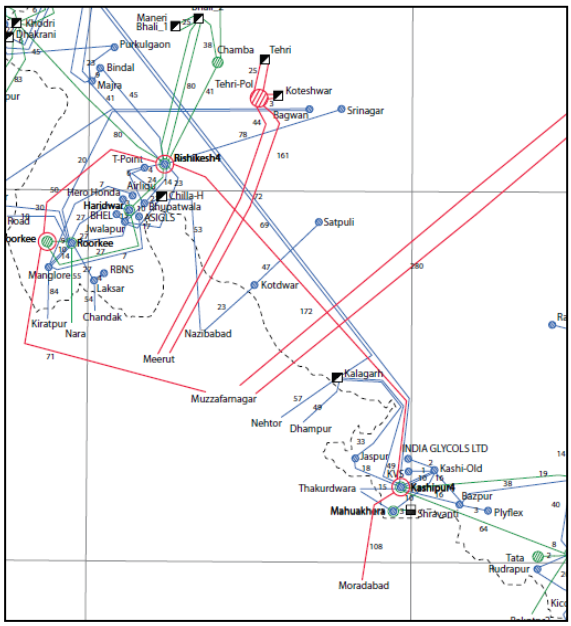
1. The envisaged automatic backing down of generation in the Singrauli-Rihand complex for Case-2 is yet to be implemented.

2. Load Shedding shall be achieved within 500ms, including all signal propagation / breaker opening time delay

Ref No: SPS/NR/LINE/06

SPS for reliability of Uttarakhand power system (400 kV Moradabad-Kashipur)

The Garhwal area of Uttarakhand power system is connected with rest of the grid mainly through 400 kV Moradabad-Kashipur-Rishikesh S/C, 400 kV Muzaffarnagar-Roorkee-Rishikesh S/C and 220 kV Nara-Roorkee S/C.



The entire Garhwal area of Uttarakhand had witnessed several incidences of blackouts due to weak network connectivity of Uttarakhand with rest of the grid. Since 400 kV Moradabad-Kashipur carries major part of the load to this area, tripping of 400 kV Moradabad-Kashipur results in rush of power through 400 kV & 220 kV Muzaffarnagar-Roorkee-Rishikesh route, resulting in heavy / critical loading of the remaining network and severe low voltage in this area and the reliability / security of balance of networks becomes very low.

On 30th March 2010 there was complete blackout in this area following the tripping of 400 kV Moradabad-Kashipur. Similar instances of complete blackout in this area have occurred on 23rd and 27th July 2009. A SPS at Kashipur for the contingency of 400 kV Moradabad-Kashipur outage would consist of shedding loads at Kashipur and near Rishikesh.

SPS Scheme logic:

Contingency: Tripping of 400 kV Moradabad-Kashipur carrying 400 MW and above.

Action 1: Shed loads at 400 kV Kashipur (150 MW) and near Rishikesh (150 MW).

(Load Shedding Shall be achieved within 500 ms, including all signal propagation/breaker opening time delay)

Ref No: SPS/NR/LINE/07

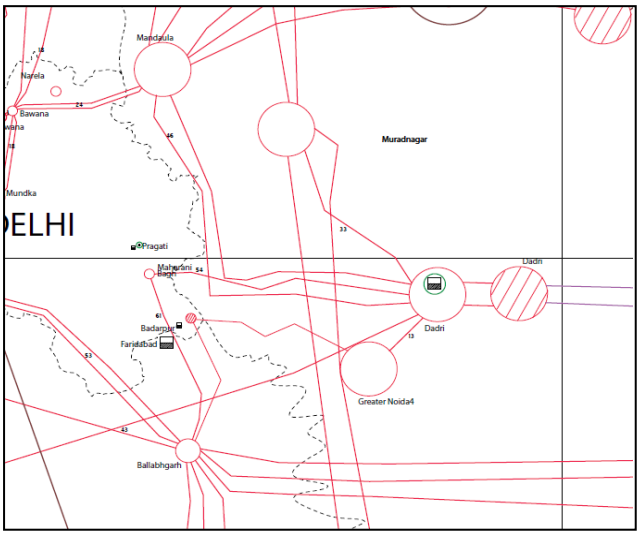
SPS for contingency due to tripping of multiple lines at Dadri

Subsequent to augmentation in generation capacity in NTPC Dadri complex the total generation available at Dadri is generally of the order of 3500 MW to 4000 MW including the injection from HVDC Rihand-Dadri bipole. Loading on each of the following lines emanating from Dadri generally is generally above 600 MW.

a. 400 kV Dadri Mandola D/C.

b. 400 kV Dadri-Maharanibagh

c. 400 kV Dadri-Greater Noida.



Tripping of either (400 kV Dadri-Mandola D/C), or (400 kV Dadri-Maharanibagh & 400 kV Dadri-Greater Noida) results in heavy rush of power on the remaining circuits, leading to low voltage & overloading of the remaining lines specially in Delhi ring. The tripping also open the 400 kV Delhi ring and reduces the reliability of transmission of power to North-west part of Northern Grid.

SPS Scheme logic:

Contingency: Tripping of either (400 kV Dadri-Mandola D/C), or (400 kV Dadri-Maharanibagh and 400 kV Dadri-Greater Noida), while each sets of circuits carrying more than 1500MW either towards Mandola or towards Ballabgarh.

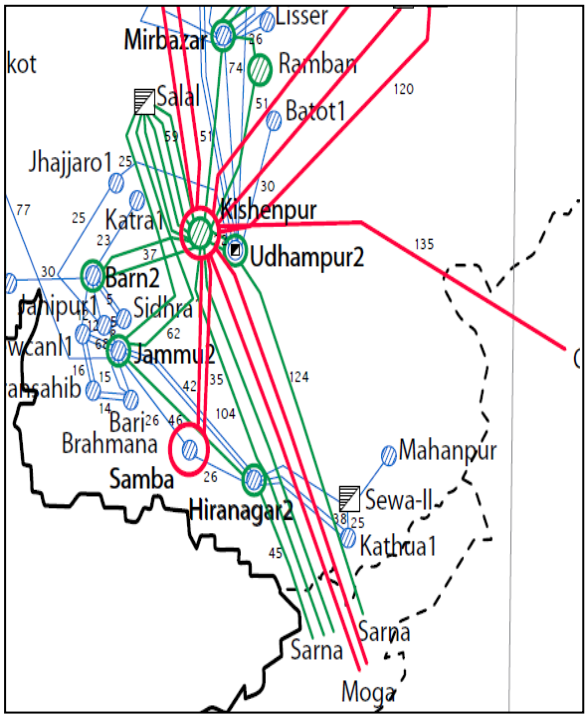
Action 1: Shed Loads at 400 kV Mandola (200 MW) and 400 kV Greater Noida (200 MW). (Load Shedding shall be achieved within 500ms, including all signal propagation/breaker opening time delay.)

And

Action 2: Automatically back down generation at Dadri by 400 MW in the shortest possible time.

Ref No: SPS/NR/LINE/08

SPS for 220 kV Salal- Jammu D/C outage contingency



During high hydro condition outage of one of the two 220 kV Salal- Jammu circuit results in overloading of other circuit and it has been observed that the remaining ckt also trips immediately on overloading. Subsequently, after this the 220 kV Sarna- Hiranagar also trips on overloading. Such cascaded tripping results in blackout in Jammu & Hiranagar area.

A SPS at Jammu consisting of shedding load at Jammu in case of outage of any one of the two 220 kV Salal-Jammu circuits carrying more than 150 MW each circuit.

SPS Scheme logic:

Contingency: Tripping of one of the two 220 kV Salal- Jammu circuit carrying more than 150 MW each.

Action 1: Shed Loads in Jammu (200 MW). (Load Shedding shall be achieved within 500 ms, including all signal propagation/breaker opening time delay.)

Ref No: SPS/NR/LINE/09

SPS for Kashmir Valley

Taking care of tripping of Kishenpur-Wagoora (in winter), 220 kV Kishenpur-Mirabazar/Ramban (in winter) and load through off in Kashmir (in summer)

Tripping of 400kV Kishenpur-Wagoora circuits (monitoring at 400 kV Wagoora substation)		
Case-1		
Contingency	Action-1	Action-2
Tripping of 400kV Kishenpur-Wagoora Ckt-1 & 2 carrying more than 300 MW but less than 400 MW	Shed load of the order of 200 MW in valley	Signal to Pampore GTs to start
Case-2		
Contingency	Action-1	Action-2
Tripping of 400kV Kishenpur-Wagoora Ckt-1 & 2 carrying more than 400 MW but less than 500 MW	Shed load of the order of 350 MW in valley	Signal to Pampore GTs to start
Case-3		
Contingency	Action-1	Action-2
Tripping of 400kV Kishenpur-Wagoora Ckt-1 & 2 carrying 500 MW or more	Shed load of the order of 550 MW in valley	Signal to Pampore GTs to start

SPS for Tripping of 220 kV Pampore-Mirbazar-Ramban/Kishenpur (monitoring at Mirbazar substation)		
Case-1		
Contingency	Action-1	Action-2
Loading of any 220kV Pampore-Mirbazar-ckt 1 or ckt 2 above 200 MW	Shed load of the order of 100 MW in valley	----

Case-2		
Contingency	Action-1	Action-2
Tripping of only one 220kV Pampore-Mirbazar-ckt 1 or ckt 2 carrying more than150 MW each	Shed load of the order of 150 MW in valley	----
Case-3		
Contingency	Action-1	Action-2
Tripping of both 220kV Pampore-Mirbazar-1 and 2 (both were in operation before tripping) carrying more than 300 MW	Shed load of the order of 300 MW in valley	----

SPS for Load throw off, power export from Kashmir valley (Summer scenario)		
Case-1		
Contingency	**Action-1**	**Action-2**
Tripping of 400kV Kishenpur-Wagoora ckt-1 & 2 carrying more than 300 MW from Wagoora to Kishenpur	Trip 02 no. running units at Uri HPS	----

SPS related to Safe evacuation of generation

Ref No: SPS/NR/GEN/01

SPS for reliable evacuation of power from NJPS and Baspa H.E.P and Karcham wangtoo

In order to evacuate the generation of Baspa & Jhakri HEP, four outgoing circuits from Jhakri has been planned, which is adequate to take care of 'N-1' contingency of outgoing lines from Jhakri. However, if one out of these four lines is out for a prolonged period due to any reasons, then ensuring reliable operation under full generation at Jhakri & Baspa would be difficult, as in the event of tripping of any further circuit, the balance circuits may not be able to evacuate the full generation, which may result into complete outage of the generating stations. Therefore, a SPS has been implemented at Jhakri H.E.P as a contingency arrangement for reliable evacuation of power from NJPS and Baspa HEP during summer/ monsoon months with only 3/2 circuits in operation. The scheme is designed for backing down of generation at Jhakri HPS complex subsequent to the tripping of downstream circuits emanating from Jhakri complex. The logic has been designed such that whenever one or more than one out of available outgoing feeders from Jhakri trips, the generation at Jhakri or Baspa is backed by tripping the units.

In the below mentioned cases of contingency the units would be immediately tripped following any contingency of line outage. Subsequent to SPS action, Jhakri shall immediately maintain the generation at such a level that can be reliably evacuated with the remaining available circuits without waiting for any operational instruction from NRLDC.

Scheme logic

Case	Contingency	Action
Case-1	Load on any of the lines at Jhakri or Rampur towards Nalagarh exceeds 850 MW	Trip 1 unit of Wangtoo HPS & 1 unit of Jhakri HEP
Case-2	400 kV bus voltage at Wangtoo drops below 395 kV	Trip 2 units of Wangtoo HPS

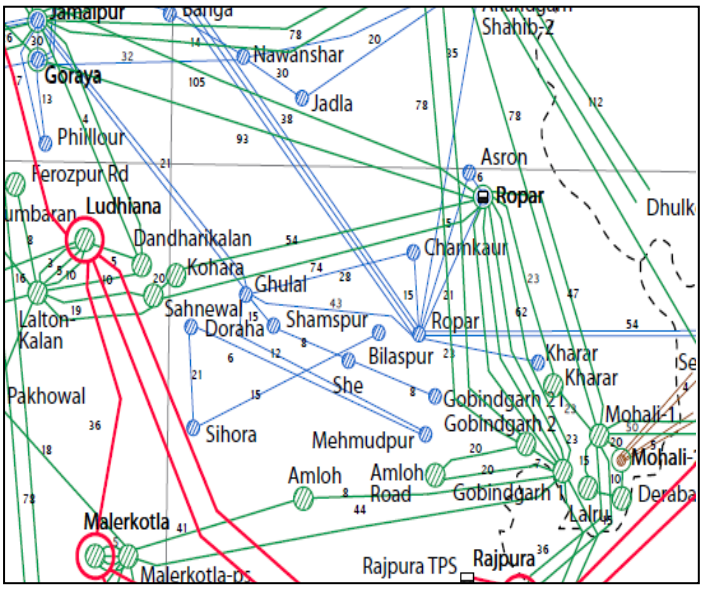
Case-3	Any two lines of Jhakri or Rampur HPS trip	Trip 2 units of Jhakri, 2 units of Rampur HPS and 2 units of Wangtoo HPS
Case-4	Both 400 kV Wangtoo-Abdullapur lines at Wangtoo trip	Trip 2 units of Wangtoo HPS

SPS action to be achieved within 100ms of the contingency.

* Due to commissioning of Rampur HPS, it is approved in the in the 99th OCC meeting that the existing logic of SPS at NJHPS for taking care of contingency of lines from NJHPS (For reduction in generation at NJHPS and KWHPS) should include Rampur HPS also for Generation reduction.

Ref No: SPS/NR/GEN/02

SPS for Reliable Evacuation of Ropar Generation



There are 10 number of 220 kV lines for evacuation of generation at Ropar (1260 MW). Ropar TPS has lost its complete generation due to problem in the evacuation network around it and recently on 2nd Jan 2010, the loss of complete generation at Ropar had aggravated problem in already depleted network in this area.

A SPS at Ropar TPS dropping some generation at Ropar in case of problem in the evacuation system would help in preventing complete loss of generation at Ropar.

220 kV lines from Ropar are as listed below:

1. 220 kV Ropar-Gobindgarh ckt-1
2. 220 kV Ropar-Gobindgarh ckt-2
3. 220 kV Ropar-Gobindgarh ckt-3
4. 220 kV Ropar-Gobindgarh ckt-4
5. 220 kV Ropar-Mohali ckt-1
6. 220 kV Ropar-Kharar ckt-1
7. 220 kV Ropar Jamsher-ckt-I
8. 220 kV Ropar Goraya-ckt-1
9. 220 kV Ropar Sanewal –1
10. 220 kV Ropar Kohara –1

SPS Scheme logic:

Contingency: Outage of multiple lines from Ropar TPS resulting in export of more than 220 MW on any of the remaining lines from Ropar.

Action 1: Calculate the no of lines (N) carrying more than 220 MW. Back down by (N * 50) MW and shed load by 250 MW in the areas being fed by Ropar.

Ref No: SPS/NR/GEN/05

SPS for contingency due to tripping of evacuating lines from Narora Atomic Power Station

SPS 1

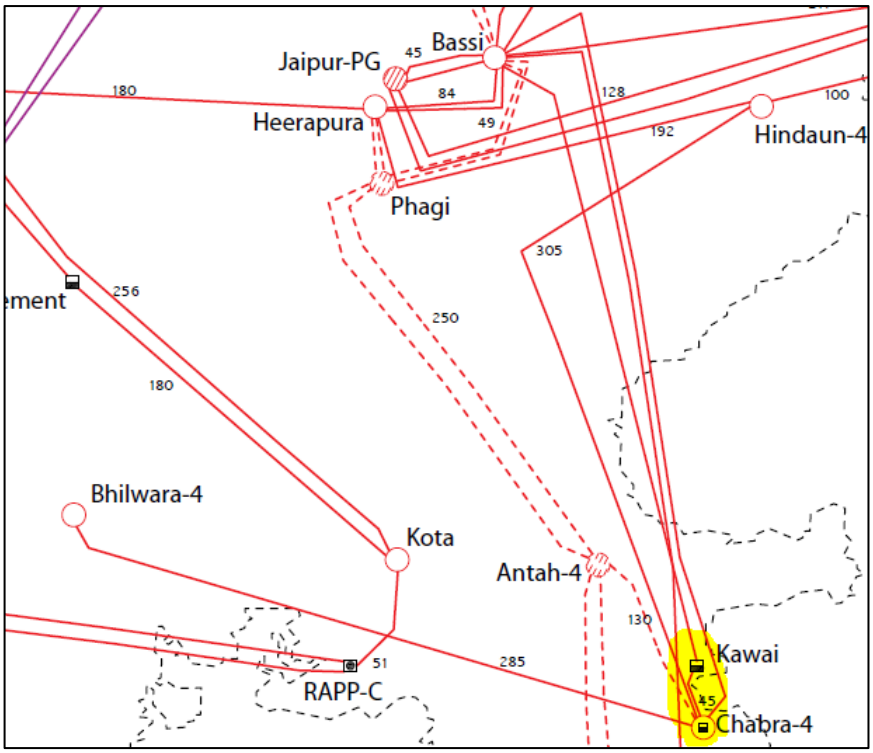
Case-1		
Contingency	**Action - 1**	**Action-2**
Tripping of 220kV Mainpuri(PG)-Etah line. **A)** Post tripping power flow on 220kV Harduaganj-Etah > 80MW & 220kV Mainpuri(U.P)-Harduaganj > 200MW **B)**After time delay of 5 Sec, post trip power flow on 220kV Mainpuri(U.P)-Harduaganj > 220 MW	**1)** Tripping of 2 x 100MVA transformers at 220/132kV Etah **2)**Tripping of 132kV Sarsaul ckt-1&2 from Harduaganj TPS	40-50MW load shedding at Khurja
Case-2		
Contingency	**Action - 1**	**Action-2**
A)Tripping of 220kV Mainpuri(U.P)-Harduaganj line. **B)**After time delay of 5 Sec, post trip power flow on 220kV Mainpuri(P.G)-Etah line > 220 MW	**1)** Tripping of 2 x 100MVA transformers at 220/132kV Etah **2)**Tripping of 132kV Sarsaul ckt-1&2 from Harduaganj TPS	40-50MW load shedding at Khurja

SPS 2

Contingency	**Action**
Tripping of either of 220kV Moradabad-Sambal or 220kV Sambal-NAPS line.	**1)** 50 MW load shedding at Sambhal **2)** 50MW load shedding at 220kV Khurja/Simbholi/Harduaganj/Jahangirabad

Ref No: SPS/NR/GEN/06

SPS for evacuation of Kawai TPS



SPS (Inter trip) arrangement has been implemented for taking care of any N-1 contingency in the Chhabra/Kawai complex. Design of SPS is as under:

Contingency	**Action**
MW flow in 400 kV Kawai-Bassi < 10 MW OR MW flow in in 400 kV Kawai-Bassi > 950 MW	Trip Kawai unit 2

SPS related to overloading of Transformers

SPS would be provided at those locations where loading on ICT does not fulfil the “N-1” criteria, during full loading conditions.

Sample Calculation of Designing SPS for ICTs

		Single Transformer	Single Transformer	
ICT Rating	**MVA**	**315**	**240**	
Overload Capacity	**%**	**10**	**10**	
Over load Rating	**MVA**	**347**	**264**	
No. of ICTs in Parallel	**Total Transformation Capacity (MVA)**	**Permissible loading per ICT satisfying the (N-1) criteria**	**Total loading on the remaining ICT under (N-1) contingency**	
2	**630**	**174**	**347**	**55.08%**
3	**945**	**231**	**694**	**73.44%**
4	**1260**	**260**	**1041**	**82.62%**
3	**795**	**176**	**528**	**55.87%**
	(2*240+1*315)	**264*2/3**		

SPS Scheme logic:

The SPS would shed load in groups depending on no. of ICTs in operation. In order to achieve it, loads for shedding by SPS would be divided into number of groups. The no. of groups would be one less than the no. of transformers operating in parallel. Count the no. of ICTs operating in parallel.

Case-1

Contingency: Loading on the ICT is more than 85 % and no. of ICTs operating in parallel is 4 and 1 out of these 4 ICT trips.

Action: Shed load in one of the identified groups.

Case-2

Contingency: Loading on the ICT is more than 75 % and no. of ICTs operating in parallel is 3 and 1 out of these 3 ICT trips.

Action: Shed load in one of the identified groups

Case-3

Contingency: Loading on the ICT is more than 55 % and no. of ICTs operating in parallel is 2 and 1 out of these 2 ICT trips.

Action: Shed load in one of the identified groups

Ref No: SPS/NR/TRF/01

SPS for Transformers at Ballabgarh (PG) substation

Transformer Details:- 4 x 315 MVA = 1260 MVA

Feeder details for tripping during SPS operation

a) 220kV Samaypur-Palwal ckt-1
b) 220kV Samaypur-Palwal ckt-2

Ref No: SPS/NR/TRF/02

SPS for Transformers at Maharanibagh (PG) substation

Transformer Details:- 2 x 315 MVA = 630 MVA

Feeder details for tripping during SPS operation

a) 220kV Maharanibagh - Masjid Moth ckt-1
b) 220kV Maharanibagh - Sarita vihar
c) 220kV Maharanibagh - AIIMS Trauma center ckt-1
d) 220kV Maharanibagh - Electric lane

Ref No: SPS/NR/TRF/03

SPS for Transformers at Mandola (PG) substation

Transformer Details:- 4 x 315 MVA = 1260 MVA

Feeder details for tripping during SPS operation

a) 220kV Mandola-Gopalpur
b) 220kV Mandola-Narela ckt-1&2

Ref No: SPS/NR/TRF/04

SPS for Transformers at Bamnauli (DTL) Substation

Transformer Details:- 4 x 315 MVA = 1260 MVA

Feeder details for tripping during SPS operation

a) 220kV Bamnauli-Papankalan ckt-1
b) 220kV Bamnauli-Papankalan ckt-2

Annexure 2

SPS IN EASTERN REGION

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INDEX

SPS related to tripping of critical line / Corridor

Ref No: SPS/ER/LINE/01: SPS for ER-SR Corridor

SPS for Talcher – Kolar HVDC Bipole - SPS at Talcher (SPS 450 & SPS 1000)

Talcher Super thermal power station having a capacity of 3000MW(6x500 MW) is located in Orissa of Eastern Region. The station was commissioned with 2x500MW capacity and subsequently its second stage was commissioned and station capacity was augmented to 3000MW with commissioning of its further 4x 500MW machines.

The station is the largest capacity station in the region. However, the capacity of the entire stage II (4x500 MW) was allocated to the beneficiaries of southern region.

Subsequently, 10% of the capacity was allocated to the Orissa, in Eastern region. For evacuation of Talcher STPS –II generation to Southern Region, +/- 500kV HVDC bipole transmission system was commissioned right upto the load centre of Southern Region at Kolar. The HVDC substation at Talcher has two pole blocks 1000MW capacity each(subsequently augmented to 1250MW).

The very basic design of the evacuation system of Talcher stage II to SR poses a major threat to Eastern Region and subsequently to the New Grid as any sudden forced outage of one or both the poles would mean that Eastern Grid has to initially absorb a jerk of load throw off to the tune of 1800-2000MW . The surplus power would get wheeled through Talcher-Rourkella 400kV D/C and Rengali –Baripada-Kolaghat S/C. During monsoon as such these corridors remain heavily loaded and such contingency of pole block at Talcher would lead to a definite cascade tripping leading to isolation /possible collapse of Orissa system including TSTPP station.

In order to avoid such contingency two automatic special protection schemes were envisaged and have been implemented at Talcher Super Thermal power station. The 1st scheme as commonly known as SPS 450 was first implemented and subsequently a further improvised 2nd scheme was devised as known as SPS 1000 scheme. Both the schemes and their modalities of arming and disarming is described below:

SPS 450: This scheme was originally implemented with a view that Eastern and Western Region would absorb a jerk of 450 MW therefore rest of the generation as available at Talcher stage II generation must be shed in order avoid a cascade tripping of the network.

However, during monsoon, from Eastern Regional point of view at times absorbing even 450MW under N-1 contingency criteria of Talcher-Rourkella 400kV D/C Line becomes critical when major generation at Talcher stage II must be shed in order to avoid further criticality of the Grid. Further under any critical outage condition in the rest of the New Grid outage of HVDC bipole might pose a serious threat when it might necessitate arming of SPS -450 scheme with due coordination with NLDC. Under this mode of SPS the power injection to N-E-W grid is limited to 450 MW. The actual generation by the generators is considered for building the logic.

Logic for single pole tripping:

This logic is based on the assumption that during the tripping of one pole of HVDC the other available pole will automatically ramp up to 1250 MW. The logic is built using power relays and the logic adopted is detailed below.

One pole trips

AND

Total Power injected by generators is more than 1700 MW

THEN

Tripp one of the selected unit (Presently unit six selected) instantly

Logic for Bipole tripping

Presently this logic is built using power relays and the logic adopted is detailed below.

If Both Poles trip

AND

Power injected by Generators is more than 1100 MW

THEN

Trip two nos of selected units(presently unit six and three are selected)

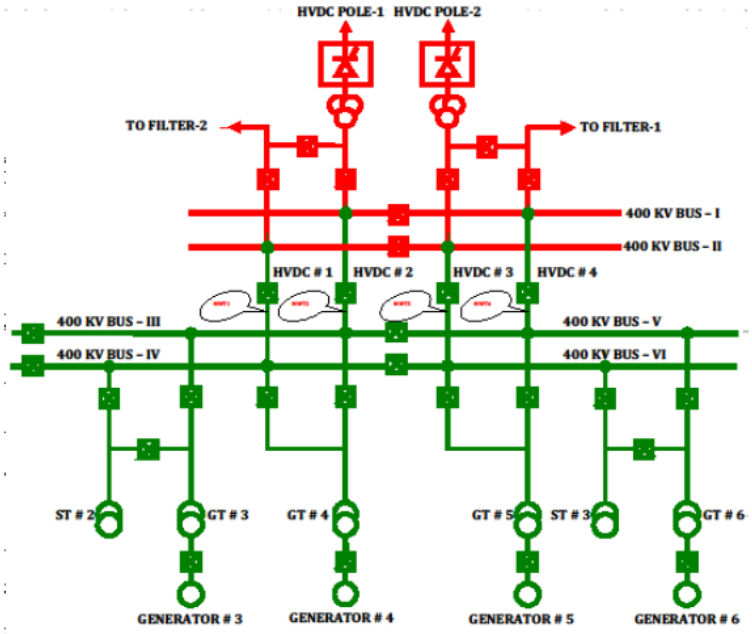
IF

The total power injected by the generators is still more than 550 MW for more than 250 milliseconds

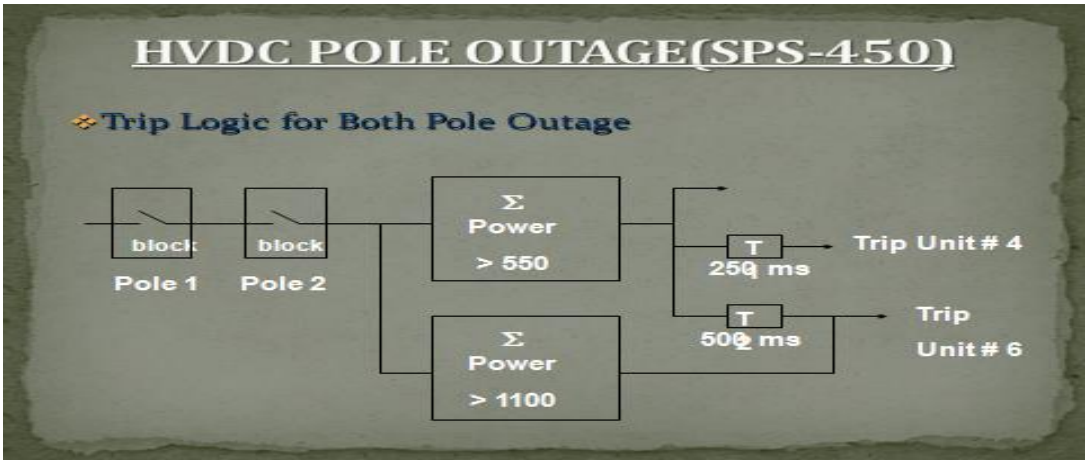
THEN

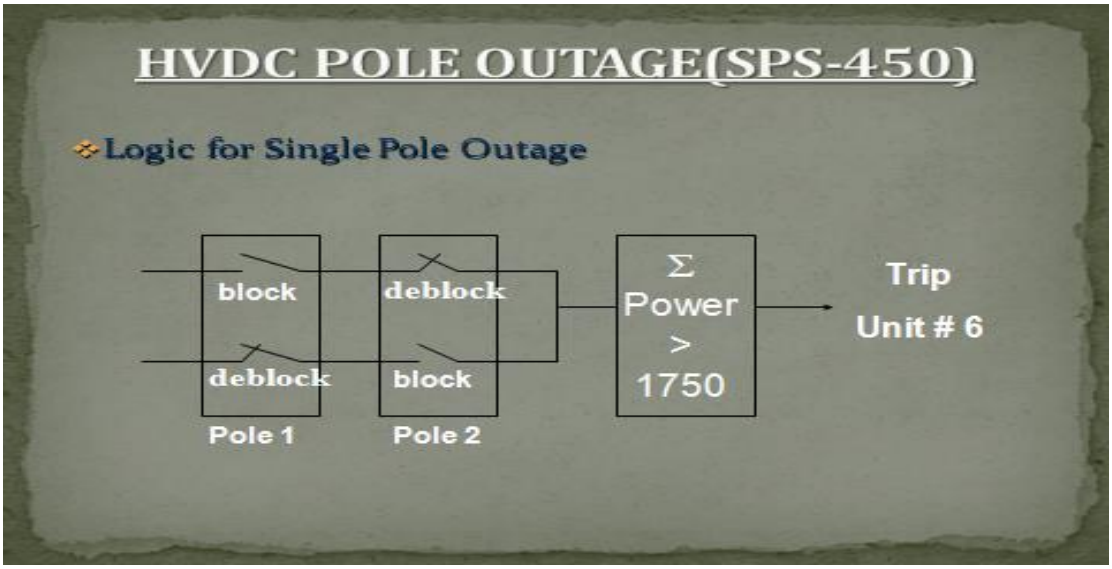
Trip Unit 4

SPS 1000: Post formation of the NEW Grid this scheme was subsequently envisaged in order to minimise shedding of generation at Talcher STPP. The basic philosophy of this scheme is to absorb 1000MW in place of 450 MW as the Grid size increased. However, as one of the prerequisites for arming this scheme Eastern Regional operator has to ensure that sufficient evacuation margin(approx 1000 MW) is available at the AC evacuation system of TSTPP. Under this mode of SPS the power injection to N-E-W grid is limited to 1000 MW. The actual injection to the HVDC system (by measuring the flow on four a/c lines between TSTPS and Talcher HVDC station) is considered for building the logic. Under SPS 1000 scheme no generation shedding is required for a single pole tripping. For contingencies of both pole tripping and for single pole tripping with the HVDC system going to ground return mode, generation shedding will be done. Extent of generation shedding depends on the actual power flow through the HVDC link and to limit the actual injection to N-E-W grid to 1000 MW.



POWER FLOW DIAGRAM OF NTPC/KANIHA STAGE-II




HVDC POLE OUTAGE(SPS-450)
Logic for Single Pole Outage
block
deblock
deblock
block
Pole 1
Pole 2
Σ
Power
>
1750
Trip
Unit # 6

HVDC INTER TRIP SCHEME (SPS 1000)			
Sl number	Condition	Action	
1	IF THE HVDC POWER FLOW IS MORE THAN 1600 MW & BOTH POLE BLOCKED	Unit 6	Trip
		Unit 5	Unload by 150 MW
		Unit 4	Unload by 150 MW
2	IF THE HVDC POWER FLOW IS BETWEEN 1450 MW TO 1600 MW & BOTH POLE BLOCKED	Unit 6	Trip
		Unit 5	Unload by 150 MW
		Unit 4	No effect
3	IF THE HVDC POWER FLOW IS MORE THAN 1600 MW & ONE POLE BLOCKED WITH REMAINING POLE ON GROUND RETURN MODE	Unit 6	Trip
		Unit 5	Unload by 150 MW
		Unit 4	No effect
4	IF THE HVDC POWER FLOW IS BETWEEN 1300 MW TO 1450 MW & BOTH POLE BLOCKED	Unit 6	Unload by 150 MW
		Unit 5	Unload by 150 MW
		Unit 4	Unload by 150 MW
5	IF THE HVDC POWER FLOW IS MORE BETWEEN 1450 MW TO 1600 MW & ONE POLE BLOCKED WITH REMAINING POLE ON GROUND RETURN MODE	Unit 6	Unload by 150 MW
		Unit 5	Unload by 150 MW
		Unit 4	Unload by 150 MW
6	IF THE HVDC POWER FLOW IS BETWEEN 1150 MW TO 1300 MW & BOTH POLE BLOCKED	Unit 6	Unload by 150 MW
		Unit 5	No effect
		Unit 4	Unload by 150 MW
7	IF THE HVDC POWER FLOW IS MORE BETWEEN 1300 MW TO 1450 MW & ONE POLE BLOCKED WITH REMAINING POLE ON GROUND RETURN MODE	Unit 6	Unload by 150 MW
		Unit 5	No effect
		Unit 4	Unload by 150 MW
8	IF THE HVDC POWER FLOW IS BETWEEN 1000 MW TO 1150 MW & BOTH POLE BLOCKED	Unit 6	Unload by 150 MW
		Unit 5	No effect
		Unit 4	No effect
9	IF THE HVDC POWER FLOW IS MORE BETWEEN 1000 MW TO 1150 MW & ONE POLE BLOCKED WITH REMAINING POLE ON	Unit 6	Unload by 150 MW
		Unit 5	No effect
		Unit 4	No effect

Modification in Talcher-Kolar SPS in ER Region due to Synchronisation of SR grid with NEW grid:

Background

In Southern Region, there is a provision for load shedding in three groups depending on the power loss on HVDC (Trip Signal 1 for 800 MW load shedding, Trip Signal 2 for 700 MW additional load shedding, Trip signal 3 for 500 MW additional load shedding considering extended operation of HVDC in the 2000-2500 MW range). So a total of 2000 MW shedding is envisaged in Southern Region.

In the NEW grid side of Talcher-Kolar HVDC bipole, there is automatic reduction/tripping of generation at Talcher Stage-II of NTPC. Two schemes are available at Talcher Stage-II; SPS 450 and SPS 1000 where the number indicates the quantum of power injected into the NEW grid after tripping of Talcher-Kolar HVDC pole or bipole. In SPS 450, three units are tripped at Talcher Stage-II while in SPS 1000, a maximum of one unit is tripped and the balance reduction in generation achieved through fast automatic reduction of generation.

In normal operation, SPS 1000 is armed and in some exceptional cases such as an outage of elements in the NEW grid, SPS 450 is activated. There are instances when a single pole trips on line fault and the other pole goes to ground return. In such cases, the healthy pole retries thrice for going to metallic return and in case it fails, it goes in ground return mode where there is a restriction of 150 MW.

There have been instances when the Talcher-Kolar SPS fails to operate leading to high frequency in the NEW grid and low frequency in the Southern Grid. Post 765 kV Sholapur-Raichur in operation, the impact of any failure of Talcher-Kolar SPS would lead to wheeling of additional power to Southern Region through the NEW grid creating insecure conditions. In fact, even injection of 1000 MW into NEW grid and inadequate load shedding in Southern Region can lead to insecure conditions as the entire power would be wheeled through 765 kV Sholapur-Raichur. So, additional safeguards are required.

Triggering the SPS and SPS action

In case of single pole or bipole outage or blocking of Talcher-Kolar HVDC sensed at Talcher HVDC terminal, it is proposed that a trip signal be extended to nearby generators such as Sterlite, GMR, JITPL and Talcher Stage-I ensuring minimum communication hops so that the objective of restricting injection to NEW grid to 450 MW is achieved. The reduction in generation to be achieved through these stations is 600 MW so that the injection into NEW

grid is restricted to 450 MW. This would be in addition to SPS 1000 already in operation at Talcher-II.

SPS 1000 will be functional as it is with additional relief of 600 MW in the event of Talcher-Kolar pole tripping to ensure grid security.

Till synchronization/stabilization of JITPL, the additional relief of 600 MW will be shared by Sterlite 350 MW and GMR 250 MW respectively by either backing down and/or tripping of their generating units. On synchronization/stabilization of JITPL, sharing of this additional relief of 600 MW between Sterlite, GMR and JITPL will be reviewed.

Ref No: SPS/ER/LINE/02

SPS for Sterlite Energy Limited(SEL)

Principle and working

Actuates in event of tripping of any 400 kV outgoing line from SEL.

Backing down of generation or tripping of unit is done to reduce injection in grid for controlling line loading.

Assumptions:-

Unit 1, 3 & 4 are connected to PGCIL bus (400 kV).

Unit 2 is connected to OPTCL bus (400 kV).

Both the buses are decoupled

Principle of operation

CASE 1 (400 kV Buses are Decoupled) a) Contingency: Tripping of 400 kV SEL-ROURKELA LILO-1	
Effect: Overloading of 400 kV SEL-Rourkela(beyond 650 MW)-LILO-1	
CILMS Action depending on flow of 400 kV SEL-Rourkela	
i)	If Loading is greater than 650 MW but Grid Export Violation value less than 30 % of Priority one generator MW (say Gen1) CILMS Action: Tripping of Priority one generator HPLP (among unit 1,3,4)
ii)	If Grid Export Violation Value is greater than 30% of Priority one generator MW (say Gen1) but less than sum of 30% of Priority one Gen MW and 30% of Priority two Gen MW (If Prio2 Gen not available in the network then Prio3 Gen will be considered) CILMS Action: Tripping of Priority one Generator HPLP and Priority two generator HPLP (If Prio2 Gen not available in the network then Prio3 Gen will be considered among Unit 1,3 and 4)
iii)	If Grid Export Violation Value is greater than 30% of sum of all available generators MW in the network but less than Priority one Gen MW (say Gen1) CILMS Action: Tripping of Priority one generator (among unit 1,3,4)

iv)	If Grid Export Violation Value is greater than Priority one Gen MW (say Gen1) but less than sum of Priority one Gen MW and 30% of Priority two Gen MW (If Prio2 Gen not available in the network then Prio3 Gen will be considered) CILMS Action: Tripping of Priority one Generator and Priority two generator HPLP (If Prio2 Gen not available in the network then Prio3 Gen will be considered among Unit 1,3 and 4)

CASE 1 (400 kV Buses are Decoupled) b) Contingency: Tripping of 400 kV SEL-RAIGARH LILO-1	
Effect: Overloading of 400 kV SEL-Raigarh(beyond 650 MW)-LILO-1	
CILMS Action depending on flow of 400 kV SEL-Raigarh	
i)	If Loading is greater than 650 MW but Grid Export Violation value less than 30 % of Priority one generator MW (say Gen1) CILMS Action: Tripping of Priority one generator HPLP (among unit 1,3,4)
ii)	If Grid Export Violation Value is greater than 30% of Priority one generator MW (say Gen1) but less than sum of 30% of Priority one Gen MW and 30% of Priority two Gen MW (If Prio2 Gen not available in the network then Prio3 Gen will be considered) CILMS Action: Tripping of Priority one Generator HPLP and Priority two generator HPLP (If Prio2 Gen not available in the network then Prio3 Gen will be considered among Unit 1,3 and 4)
iii)	If Grid Export Violation Value is greater than 30% of sum of all available generators MW in the network but less than Priority one Gen MW (say Gen1) CILMS Action: Tripping of Priority one generator (among unit 1,3,4)
iv)	If Grid Export Violation Value is greater than Priority one Gen MW (say Gen1) but less than sum of Priority one Gen MW and 30% of Priority two Gen MW (If Prio2 Gen not available in the network then Prio3 Gen will be considered) CILMS Action: Tripping of Priority one Generator and Priority two generator HPLP (If Prio2 Gen not available in the network then Prio3 Gen will be considered among Unit 1,3 and 4)

Ref No: SPS/ER/LINE/03

SPS for power transfer to Bangladesh

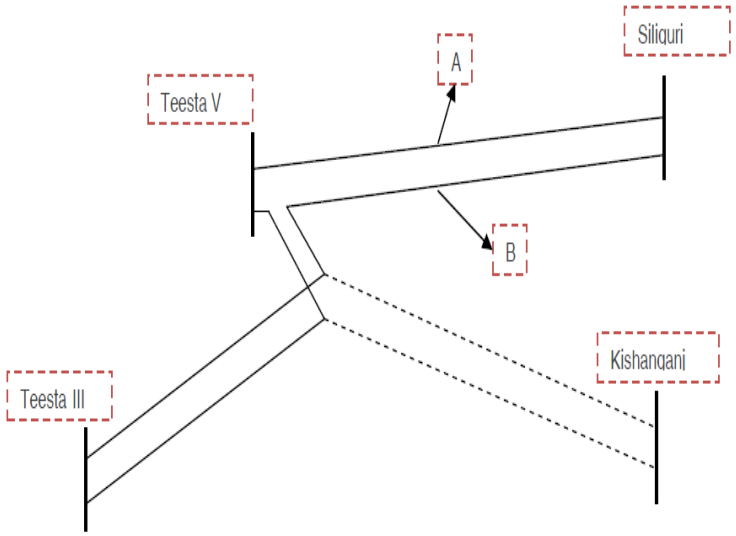
Bheramara back-to-back HVDC station with a capacity of 500 MW was commissioned in October 2013 in Bangladesh. Bheramara is connected to Behrampur in West Bengal, India through a 400 kV D/C line. 400 kV Farakka-Jeerat was LILOed at Behrampur to facilitate power transfer to Bangladesh. Keeping in mind low voltage problems at Jeerat and system security, the following SPS was devised and put into operation:

S. No.	Triggering Criteria for SPS	SPS actions (signal shall be generated to do following)	Signal to be sent Bheramara (Yes/No)
1	Tripping of 400kV Farakka-Behrampur, the SPS shall generate a signal	To trip 80 MVAR Bus reactor at 400kV Behrampur.	No, Local action at Behrampur.
		To ramp down HVDC set-point to 350 MW (with Appropriate Filter switching to maintain Bheramara Voltage)	Yes
	Voltage at 400kV Behrampur going below 390kV	To trip 80 MVAR Bus reactor at 400kV Behrampur.	No, Local action at Behrampur.
2	Voltage at 400kV Behrampur going below 380kV, the SPS shall generate a signal.	To ramp down HVDC set-point to 350 MW (with Appropriate Filter switching to maintain Bheramara Voltage)	Yes
3	If the frequency goes below 49.5 Hz.	To ramp down HVDC set-point to 350 MW (with Appropriate Filter switching to maintain Bheramara Voltage)	Yes
4	If the 400kV Farakka-Behrampur line flow goes above 780 MW (Flow may touch 800 MVA).	To ramp down HVDC set-point to 350 MW (with Appropriate Filter switching to maintain Bheramara Voltage)	yes

SPS related to safe evacuation of generation

Ref No: SPS/ER/GEN/01

SPS for interim arrangement for evacuation of TEESTA –III generation



Working principle

Once any circuit either Binaguri-Teesta-V or Binaguri-Teesta III trips the SPS gets activated.

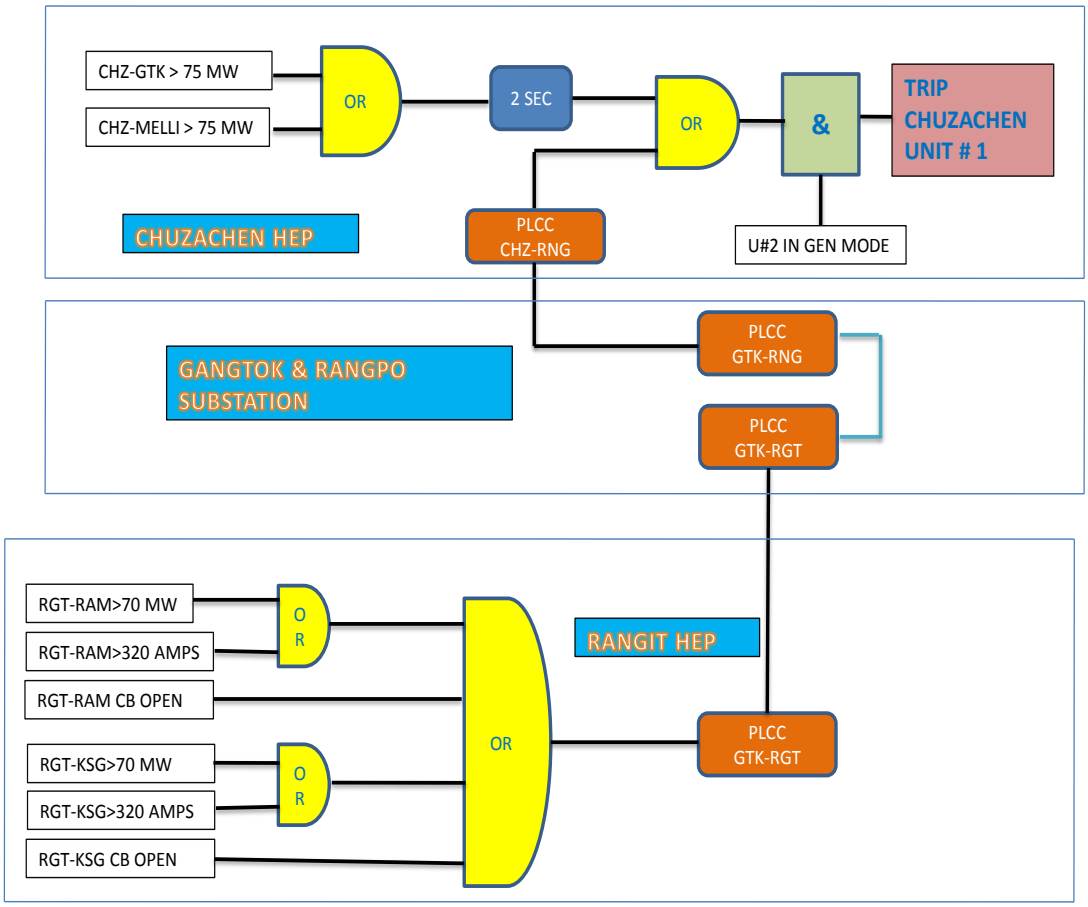
Suppose Binaguri-Teesta V trips and power flow in Binaguri-Teesta III is “A” MW, and allowable flow is X MW, thus the line is being overloaded by A – X = “B” MW. So it is required to reduce the generation at Teesta III by “B” MW to bring back the flow in line within allowable limits

Ref No: SPS/ER/GEN/02

SPS for Chuzachen HPS

Chuzachen has a total installed capacity of 110 MW (2 x 55 MW) and is located in Sikkim. It is connected with Rangpo through 132 kV Zebra S/C line and with Melli through 132 kV Panther S/C line. SPS is installed at Chuzachen to reduce generation at hydro power station in event of contingency to avoid cascading tripping of lines on account of high loading.

Sl No.	Event	Sensing at	Action
1	Tripping of 132 kV Rangit-Rammam	132 kV Rangit	Trip One unit at CHEP
2	Tripping of 132 kV Rangit-Kerseong	132 kV Rangit	Trip One unit at CHEP
3	Flow of Rangit-Rammam crosses 70 MW or 320 Amps	132 kV Rangit	Trip One unit at CHEP
4	Flow of Rangit-Kerseong crosses 70 MW or 320 Amps	132 kV Rangit	Trip One unit at CHEP
5	Flow of Chuzachen-Melli crosses 75 MW	132 kV Chuzachen	Trip One unit at CHEP
6	Flow of Chuzachen-Rangpo crosses 75 MW	132 kV Chuzachen	Trip One unit at CHEP


CHZ-GTK > 75 MW
CHZ-MELLI > 75 MW
OR
2 SEC
OR
&
TRIP CHUZACHEN UNIT # 1
CHUZACHEN HEP
PLCC CHZ-RNG
U#2 IN GEN MODE
GANGTOK & RANGPO SUBSTATION
PLCC GTK-RNG
PLCC GTK-RGT
RGT-RAM>70 MW
RGT-RAM>320 AMPS
RGT-RAM CB OPEN
RGT-KSG>70 MW
RGT-KSG>320 AMPS
RGT-KSG CB OPEN
O R
O R
OR
RANGIT HEP
PLCC GTK-RGT

Annexure 3

SPS IN WESTERN REGION

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INDEX

Ref No.	Name of the Scheme	Implementing Agency	Status	Pg. No.
SPS related to Safe evacuation of Generation				
SPS/WR/GEN/01	SPS at LANCO (Pathadi)	LANCO	In service	81
SPS/WR/GEN/02	SPS at JPL (TAMNAR)	JPL	In service	83
SPS/WR/GEN/03	SPS at Adani Power Ltd, MUNDRA	APL	In service	87
SPS/WR/GEN/04	SPS for CGPL Mundra units	CGPL	In service	90
SPS/WR/GEN/05	SPS at BALCO	M/s BALCO	In service	92
SPS/WR/GEN/06	SPS at Essar Mahan Ltd	Essar	In service	94
SPS/WR/GEN/07	SPS at Jaypee Nigrie STPP	Jaypee	In service	96
SPS related to overloading of Transformers				
SPS/WR/TRF/01	SPS at Essar Steel India Ltd	ESIL	In service	98

SPS related to tripping of critical line / Corridor

Ref No: SPS/WR/LINE/01

SPS at HVDC APL Bi-pole (2x1250MW)

Presently power flow of 2300MW is allowed in the APL-Mahendragarh HVDC towards NR

The following SPS is in operation for tripping of HVDC poles along with Stage-III units 7,8&9 of 660MW each**:**

- Loss of single pole: - Transfer power to other pole and there is no need to trip units in both GRM and metallic return mode.
- Loss of both poles:-
    - In case all units are running, trip two units of Stage-III.
    - Back up:- If dp/dt exceeds 150MW in 100 milliseconds and incremental flow on sectionaliser between stage-II&III has exceeded 150MW after two seconds, trip one unit from 7-9
    - Next back up: - If steady state power on sectionalizer is greater than 1000MW in 3.5 seconds, trip another unit from 7-9.
- Reverse Power Protection (Power flow from stage II to Stage-III).
    - In case of reverse flow from stage I&II to stage-III, due to tripping of units from 7-9 of stage-III, reduce the power order on HVDC to match generation of stage-III.
    - In case of tripping of all the units of Stage-III, pick up setting for the reverse power protection is 700MW. The HVDC power order would be reduced to 700MW in 1minute.
    - Steady state limit for reverse power would be 500MW. This flow shall not exceed 500MW under steady state and regulatory directives in this matter shall be adhered to by M/s APL.

Ref No: SPS/WR/LINE/02

SPS for sudden large reduction in NR import at 765 kV Agra (from WR)

During the scenario of heavy import by NR from Western Region, simultaneous tripping of 765 kV Agra-Gwalior circuit-I & II or tripping of 765 kV Bina-Gwalior ckt-I & II results in rush of power on parallel interconnections of NR with WR and ER. The contingency results in heavy overloading of network in Western region (especially in Gujarat) as well as in Eastern region with critically low voltage in the large part of 'NEW' grid.

Therefore, an SPS for shedding loads in western UP, Rajasthan, Punjab & Haryana area subsequent to sudden large reduction of import at 765 kV Agra (from WR) would help in minimizing the impact of contingency. If the actual import on the 765 kV Agra Gwalior D/C is more than a certain level, automatic backing down of generation in the WR would also be desirable.

SPS on 765KV Gwalior-Agra D/C when power flow crosses prescribed limit is as follows:

Load shedding of identified group C and D in NR when:-

1. Flow on 765KV Gwalior-Agra D/C crosses 2500MW OR.
2. Flow on 765KV Gwalior-Agra S/C crosses 1800MW OR
3. Voltage at 765/400KV Agra drops below 730/380KV.

The threshold values should be crossed for 5 sec before SPS initiates.

SPS for loss of import by NR on Agra-Gwalior-Bina lines

S.No.	Contingency	Action
1	Sudden reduction of import by NR on Agra-Gwalior I& II by more than 1000MW but less than 1500MW	Shed load in identified group C and group D in Northern region. (Load Shedding Shall be achieved within 500 ms, including all signal propagation/breaker opening time delay)
2	Sudden reduction of import by NR on Agra-Gwalior I& II by more than or equal to 1500MW	Shed load in identified group C, D, E and F in Northern region and Automatic back down of 500MW* generation in Western region. (Load Shedding Shall be achieved within 500 ms, including all signal

		propagation/breaker opening time delay)

-Trip 220KV Gwalior-Malanpur D/C in case of tripping of 765KV Gwalior-Agra 1 & 2.

*-The generating station and desired backing down to get total 500MW backing down in Western region is as follows:

S.No.	Generating Station	Desired back down
1	CGPL	180
2	Korba-NTPC	120
3	Vindhyachal-NTPC	200

The SPS for backing down generation in WR is implemented from 21.03.14.

Ref No: SPS/WR/LINE/03

SPS at Sipat Power Station for Tripping of 765kV Sipat-Bilaspur-Seoni line (Proposed)

- SIPAT NTPC(3X660 +2X500MW) has its evacuation as follows:

  -765KV Sipat-Bilaspur-Seoni D/C

  -765/400KV 2X1000MVA ICT

  -400KV Sipat-Raipur T/C

  -400KV Sipat-Ranchi D/C

  -400KV Pathadi-Sipat SC

- With the tripping of 765KV Sipat-Bilaspur D/C or Bilaspur-Seoni D/C the evacuation path is only 765/400KV 2X 1000MVA ICTs. Hence SPS is required at Sipat NTPC.The proposed SPS is as follows:

  (A) If the Ex-Bus generation at Sipat is more than 2200MW(which is 110% of the rated capacity of both the ICTs) and both the 765KV Sipat-Bilaspur D/C or Bilaspur-Seoni D/C trips, NTPC shall back down generation quantum equal to (Ex-bus Generation 2200MWs) automatically. Appropriate unit selection at NTPC Sipat may be decided by NTPC.

  (B) Even after backing down the above quantum at 'A' the loading on ICTs is above 100%, NTPC shall manually back down/trip the generation, so that loading on both the ICTs is acceptable.

Ref No: SPS/WR/LINE/04

SPS for 400 kV Tirora-Warora D/C

Tirora,is a generating station in Maharashtra with capacity of 3300MW(5X660MW).

It is connected to Western grid via 400KV Tirora-Warora-Wardha D/C and 765KV Tirora-Akola-S/C bypassing 765KV Koradi. The SPS implemented is as follows:

Stage No.	Action	Single line loading	Setting in MW	Settings in Amps	Time delay	Remark
1	Alarm	Full load (A)	926	1380	2 Sec	Alarm shall be generated when line loading crosses full load rating
2	Units run back at Tirora	10% of above (A)	1020	1520	3 Sec	Run back of units shall start at 10% over load on line
3	Tripping selected unit	60% of above (A)	1480	2200	600 mili Sec	Tripping of selected unit at 60% overload needs to be achieved prior to zone 3 time setting

The scheme shall aim to reduce the generation at Tirora in case of over loading of both sections of line between Tirora-Warora and Warora-Wardha.

The output derived from operation of over current protection of Warora-Wardha line at Warora end shall be carried forward to Tirora by using spare channels from PLCC link between Warora and Tirora.

Ref No: SPS/WR/LINE/05

SPS at 400 kV Tirora for Warora-Chandrapur-II D/C

WRLDC has declared Wardha flowgate (2480MW) comprising of the following lines:

- 400KV Wardha-Akola D/C

- 400KV Wardha-Parli D/C

APML,Tirora is connected to 400KV Wardha via 400KV Tirora-Warora-Wardha D/C. With the commissioning of 400KV Warora- Chandrapur-II D/C, major portion of the tirora generation flows over these ckts. Tripping of 400KV Warora- Chandrapur-II D/C will critically load the Wardha flowgate and therefore SPS was suggested in case of tripping of 400KV Warora- Chandrapur-II D/C.

Case A: If one 400 kV Warora-Chandrapur line trips, automatic backing down of generation to bring the generation level at APML to 1500 MW.

Case B: If both 400 kV Warora-Chandrapur lines trip, if one unit at Tirora will be tripped if three units are running. If two units are running, then there is no tripping.

In Case A and Case B, further backing down required, if any, will be advised by SLDC, Kalwa on real time basis.

Further SLDC, MSETCL to take action regarding increasing Koyna generation/Load shedding for Wardha flowgate violation more than 2480MW.

SPS related to NEW & SR Grid synchronization in WR

Ref No: SPS/WR/LINE/06

SPS for 765 kV Sholapur-Raichur 2 x S/C flow (SPS-1)

Triggering criteria for the SPS

i. **With both circuits of 765 kV Sholapur-Raichur in operation**: the total flow on the two circuits crosses 1500 MW and remains above 1500 MW for 2.5 seconds in Sholapur to Raichur direction sensed both at Sholapur and Raichur. These would be used for sending separate commands to Kolar.
   It should also act instantaneously when the total power flow crosses 2000 MW.

ii. **With only one circuit in operation**: the power flow on the line crosses 1000 MW and remains above 1000 MW for 2.5 seconds in Sholapur to Raichur direction sensed both at Sholapur and Raichur. These would be used for sending separate commands to Kolar.
   It should also act instantaneously when the power flow crosses 1500 MW

SPS actions

Signal sent from Sholapur and Raichur to trip 500 MW loads separately identified in Southern Region (loads should be different from Talcher-Kolar HVDC and Kudankulam SPS). Initially these signals could be used to trip loads as per Trip Signal 3 of Talcher-Kolar.

500MW Gen Back down in WR

JPL – 350MW

KSK-150MW

DB power – 0MW

(Additional backing down of 300 MW through additional generators yet to be implemented)

500MW Load shedding in SR

Tamilnadu – 146MW

Kerala - 125MW

Karnataka – 104MW

Andhra Pradesh – 125MW

Ref No: SPS/WR/LINE/07

SPS for loss of 765 kV Sholapur-Raichur lines carrying 800 MW towards SR (SPS-3)

Triggering criteria for the SPS

Loss of import by SR on 765 kV Sholapur-Raichur section by more than 800 MW due to tripping of these lines. Total power flow of both the circuits of 765 kV Sholapur-Raichur should be measured and in case there is tripping of both these circuits and loss of more than 800 MW import by SR, the SPS should act.

SPS actions

Signal sent from Sholapur and Raichur to trip 500 MW loads separately identified in Southern Region (loads should be different from Talcher-Kolar HVDC and Kudankulam SPS). Initially these signals could be used to trip loads as per Trip Signal 3 of Talcher-Kolar.

500MW Load shedding in SR

Tamilnadu – 146MW

Kerala - 125MW

Karnataka – 104MW

Andhra Pradesh – 125MW

Generation backing down in NEW grid is not required. Load Generation balance in NEW grid to be achieved by governor action.

Ref No: SPS/WR/LINE/08

SPS 400 kV Raipur-Wardha D/C (SPS-4)

Triggering criteria for SPS

i) Flow on either circuit of 400 kV Raipur-Wardha D/C (sensed at Raipur) crossing 850 MW and remaining above this value for 2.5 seconds.
OR

ii) Tripping of any one circuit of 400 kV Raipur-Wardha D/C carrying 700 MW or above, sensed at Raipur (instantaneous)

SPS actions

Western Region – 800 MW Gen Back down

JPL – 600 MW

KSK – 200 MW

DB Power – 0 MW

Southern Region – 800 MW Load Shedding (Kudankulam group)

Tamilnadu- 290 MW

Kerala - 135 MW

Karnataka- 195 MW

Andhra Pradesh- 230 MW

Ref No: SPS/WR/LINE/09

SPS for 400 kV Wardha-Parli D/C(SPS-5)

Triggering criteria for SPS

i) Flow on either circuit of 400 kV Wardha-Parli D/C (sensed at Wardha) crossing 850 MW and remaining above this value for 2.5 seconds
OR

ii) Tripping of any one circuit of 400 kV Wardha-Parli D/C carrying 750 MW or above, sensed at Wardha (instantaneous)

SPS actions

Western Region – 800 MW Gen Back down

APL Tiroda – 600 MW

NTPC Mauda - 200 MW

IEPL – 0 MW

Southern Region -800 MW Load Shedding (Kudankulam group)

Tamilnadu- 290 MW

Kerala - 135 MW

Karnataka- 195 MW

Andhra Pradesh- 230 MW

Ref No: SPS/WR/LINE/10

SPS for 400 kV Parli-Sholapur D/C (SPS-6)

Triggering criteria for SPS

i) Flow on either circuit of 400 kV Parli-Sholapur D/C (sensed at Sholapur) crossing 800 MW and remaining above this value for 2.5 seconds
OR

ii) Tripping of any one circuit of 400 kV Parli-Sholapur D/C carrying 600 MW or above, sensed at Sholapur (instantaneous)

SPS actions

300MW Load shedding by Maharashtra to be implemented. And 300MW generation pick up at Koyna.

Western Region – 800 MW Gen Back down

JPL – 600 MW

KSK - 200 MW

DB Power – 0 MW

Southern Region - 800MW Load Shedding (Kudankulam group)

Tamilnadu- 290 MW

Kerala - 135 MW

Karnataka- 195 MW

Andhra Pradesh 230 MW

Ref No: SPS/WR/LINE/11

SPS for 765 Raichur-Sholapur line current exceeding 800 Amp (1000MW in Sholapur to Raichur direction)(SPS-7)

Triggering criteria for SPS

i) **Both circuits of 765 kV Sholapur-Raichur in service**: SPS action to be blocked

ii) **Only one circuit of 765 kV Sholapur-Raichur in service**: SPS to act when 765 Raichur-Sholapur line current exceeds 800 Amp (1000 MW) from Sholapur to Raichur direction. SPS action in reverse direction, i.e**. SR to NEW grid shall be blocked**.

SPS Actions

Tripping of 765kV Raichur Sholapur line with 10 seconds delay.

SPS related to Safe evacuation of generation

Ref No: SPS/WR/GEN/01

SPS at LANCO (Pathadi)

Introduction

The SPS in LANCO PATHADI (2x300 MW) comprising of a Power Relay which is having CT input from CT-62 (Core-4, CT Ratio 1000/1 A) and PT input from Line CVT-62 (400kV/110 V) extended from LINE-1 (Pathadi-Sipat-Raipur) for Power measurement & Breaker contact of CB61 of Pathadi-Sipat-Raipur line at Lanco Pathadi end . Scheme is facilitated with Arming and Disarming selector for UNIT # 1 & UNIT # 2 .Trip signal of SPS will operate Master Trip relay of Generator Protection Panel which in turn will trip GCB and Turbine of selected unit. Facia indicators indicating SPS OFF, SPS ON FOR UNIT#1, SPS ON FOR UNIT#2 are also provided in the scheme.

Triggering signal for SPS action

SPS scheme will be triggered through Power Relay as the Power Flow in Pathadi-Sipat-Raipur Line is < 50 MW OR 400KV Pathadi-Sipat-Raipur Line Breaker (CB-61) at Pathadi end is opened.

SPS action on receipt of trigger signal

As the trigger signal is received tripping command will be issued to the Unit which is selected for tripping through SPS Selector Switch.

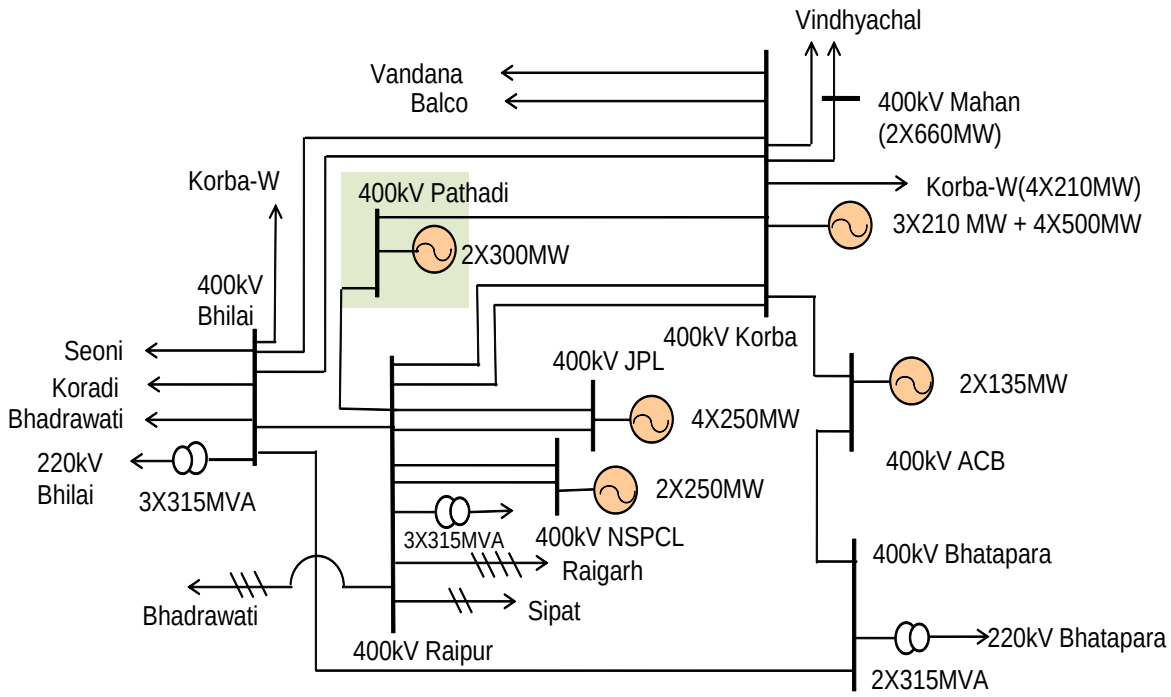
Arming and disarming of SPS

The SPS will be armed viz. kept in service through SPS selector switch whenever both the units at Lanco Pathadi are in operation. viz. normal operating conditions.

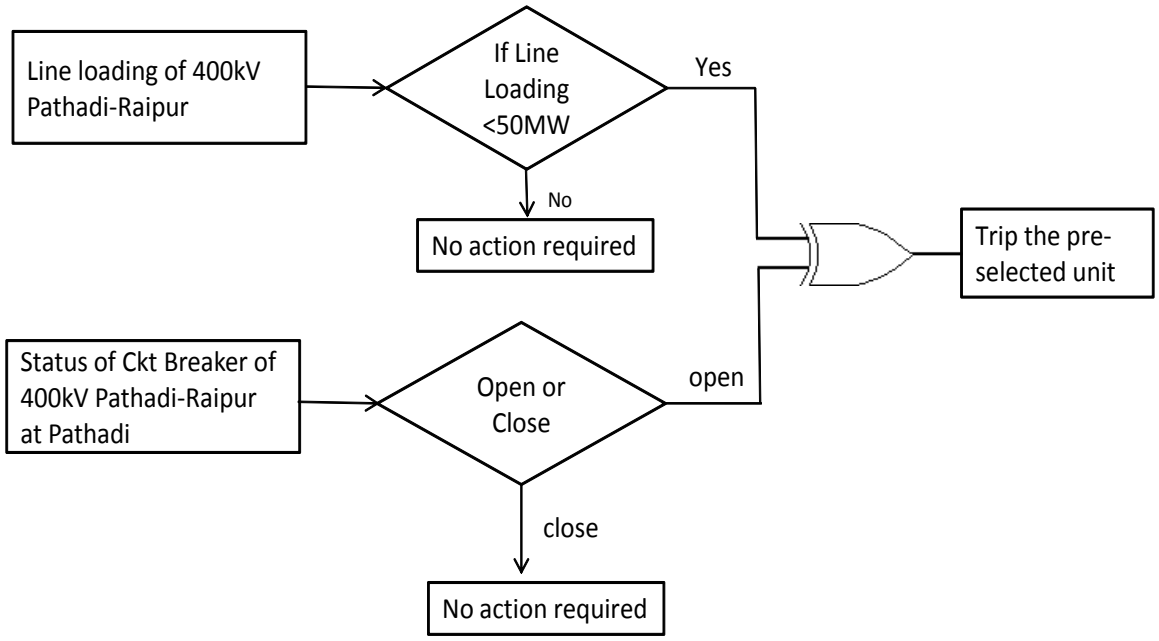
In case of planned shutdown of 400 kV Lanco Pathadi-Raipur line with both units operating at Lanco Pathadi, the generation will be backed down to technical minimum after which the SPS will be disarmed first before opening the line manually. SPS will be armed immediately after the 400 kV Pathadi-Sipat-Raipur line is restored. The generation at Lanco Pathadi will be ramped up only after the SPS is armed.

Facia indications for the plant operator and other operating instructions

Indicating lamps are provided in Control room panel to indicate the SPS status to operator. Indicating lamps are designated as SPS OFF (if SPS is disarmed), SPS ON U#1 (if SPS is armed for UNIT#1), SPS ON U#2 (if SPS is armed for UNIT#2).Provision of alarm in case of SPS operated is also made in Control room panel for selected unit.



Single Line Diagram of Lanco, Pathadi



SPS LOGIC at Lanco, Pathadi

Ref No: SPS/WR/GEN/02

SPS at JPL (Tamnar)

Introduction

Jindal Power Ltd,Tamnar (4x250MW) is connected to the grid via 400KV JPL(Tamnar)-Raipur D/C lines. Power evacuation of all the 4 units is through 400kV JPL-Raipur D/C lines except for industrial park load through 220kV system (around 830MW). Additional 2x135MW DCPP units are also connected to JPL through 220kV DCPP-Tamnar lines. So the power flow through each 400kV JPL-Raipur line shall be approx. 530MW. In view of the system security aspects considering (n-1) criteria and additional injection from DCPP, Special Protection Scheme(SPS) is implemented by JPL as recommended by WRLDC

Triggering signal for SPS action

SPS scheme will be triggered through tripping signal of any one 400KV JPL-Raipur circuit i.e.breaker of one 400KV JPL-Raipur in open condition.

SPS action on receipt of trigger signal

- When all the 4 units (4X250MW) are on bar and any one circuit of 400KV JPL-Raipur line trips, the SPR-1 (special protection relay) shall operate and trip one preselected unit. This will reduce line flow on the remaining line to approximately 590MW. Further 60MW load shall be reduced by auto tripping one coal mill of remaining unit within 3-4 minutes.
- When only three units (3X250MW) are on bar, tripping of any one circuit of 400KV JPL-Raipur D/C will trigger auto reduction of all 250 MW generation 230 MW through load controller resulting in total reduction of 60MW. This will bring down the flow on other line to 530MW.
- When 2x135 MW units of DCPP are in service along with 4x250MW Units, tripping of any one circuit of 400KV JPL-Raipur D/C will trip one preselected Unit of JPL along with auto-reduction of 60 MW on other units and tripping of 220KV JPL-DCPP line through SPR and thus tripping of 2x135MW units.

Arming and disarming of SPS

The SPS will be armed viz. kept in service through SPS selector switch whenever both the 400KV lines along with at least 3 units at JPL are in service.

In case of planned shutdown of 400 kV JPL-Raipur line with all units operating at JPL, the generation will be backed down to technical minimum after which the SPS will be disarmed first before opening the line manually. SPS will be armed immediately after the 400 kV JPL-

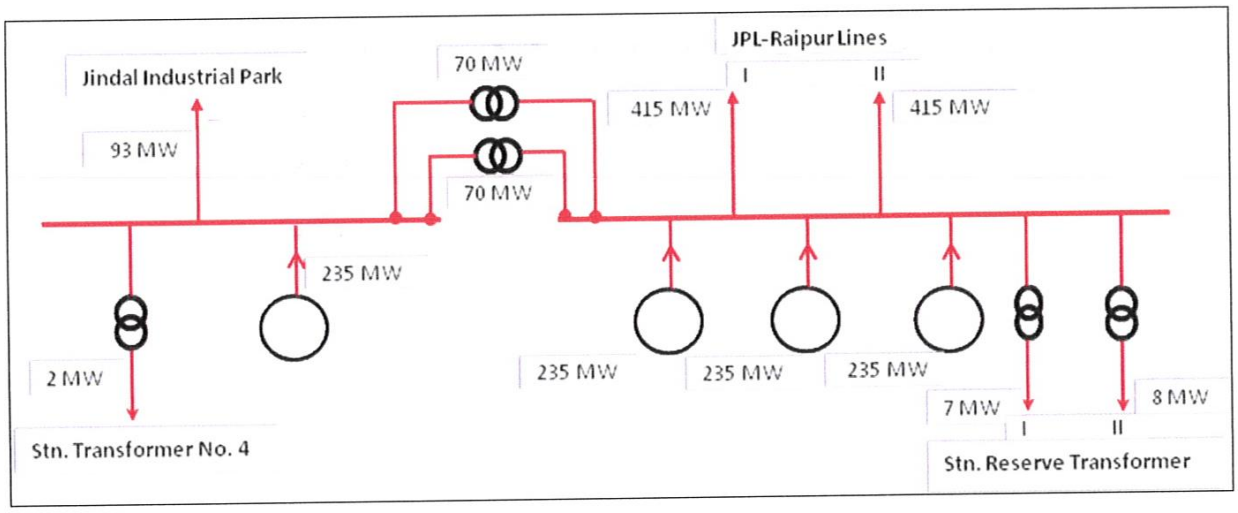
Raipur line is restored. The generation at JPL, Tamnar will be ramped up only after the SPS is armed.

Facia indications for the plant operator and other operating instructions

Indicating lamps are provided in Control room panel to indicate the SPS status to operator. Indicating lamps are designated as SPS OFF (if SPS is disarmed), SPS ON (if SPS is armed) and which unit is armed, Provision of alarm in case of SPS operated is also made in Control room panel for selected unit.

Checking healthiness of SPS

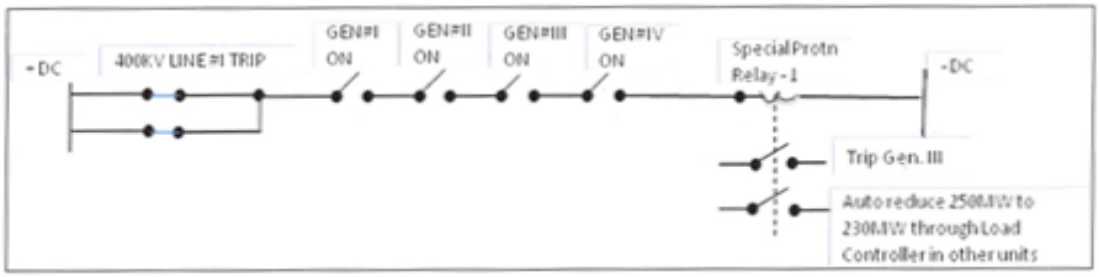
Healthiness of the scheme might be checked on a regular basis. Mock exercise for healthiness of the scheme might be carried out once in six months.



Single Line Diagram of 400kV JPL,Tamnar

SPS at JPL,Tamnar

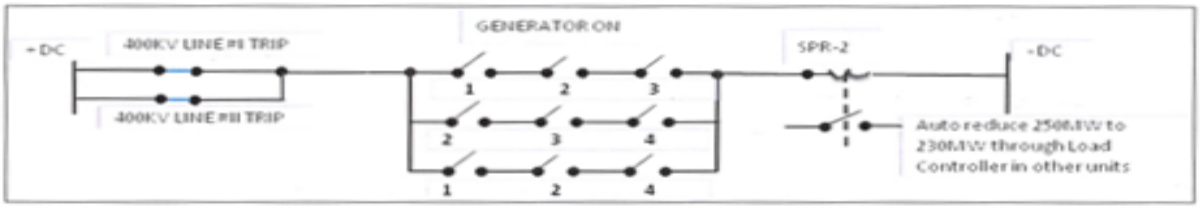
- In case of tripping of 400kV JPL-Raipur one circuit with 4X250MW generators on load, the SPS is as follows:



- Tripping of pre-selected unit (presently unit No.3)
- The flow on remaining circuit reduces to 590MW.
- Reduction of further 60MW in other units within next 3-4 min. with auto-tripping of one coal mill of generator unit 2.

SPS at JPL,Tamnar....Contd.

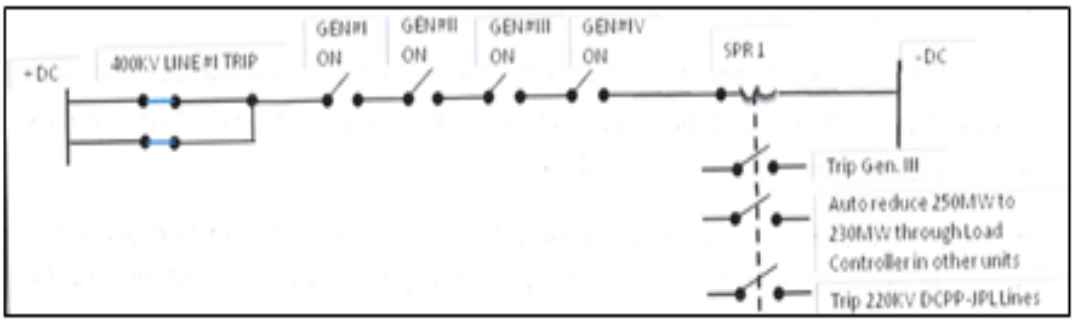
- In case of one 400kV JPL-Raipur circuit tripping with 3 generators on load the SPS is as follows:



➢Auto reduction of 60MW on other units through load controller

SPS at JPL,Tamnar....Contd.

- When 2X135 MW units are also connected along with 4 X250MW generator units, the scheme is as follows:



Ref No: SPS/WR/GEN/03

SPS at APL Mundra

Adani Power Ltd, Mundra (4x330MW+5x660MW) has its generation and transmission scheme in 3 stages.

The generation at APL, Mundra is as follows:

Stage 1: 4X330MW=1320MW

Stage 2: 2X660MW=1320MW

Stage 3: 3X660MW=1980MW

The associated transmission scheme is as follows:

Stage 1: 220kV Mundra-Nanikhakhar D/C

220kV Mundra-Tappar D/C

400kV Mundra-Hadala S/C

400kV APL-Versana-Hadala S/C

400kV Mundra-Sami-Dehgam D/C

Stage 2: 400kV Mundra -Zerda 2X D/C

Stage 3: 2X1250MW +/- 500kV APL,Mundra-Mohindergarh HVDC bipole.

LILO of 400kV Bahadurgarh(PG)-Bhiwani (BBMB)

400kV Mohindergarh-Danauda D/C

400kV Mohindergarh Bhiwani D/C

- All the generating units are synchronized and the transmission lines of stage-1 and stage-3 are commissioned.
- Special Protection Scheme was commissioned by APL for mitigating any contingency arising out of any ckt tripping or overloading of lines.
- Triggering the trip is initiated by activation of respective stages of Over current relay used for line protection.
- **SPS settings at APL,Mundra are as follows:**

Settings for 400KV Mundra-Versana/ Hadala lines

SPS settings	Setting (Current/MW)	time delay	Action
Stage 1	715A	10 sec	Alarm
Stage 2	>600MW + Non availability of both APL-Sami or Sami-Dehgam lines	4 sec	Tripping of unit#3 or Unit#4

Stage 3	>600MW + Availability of any one or both APL-Sami or Sami-dehgam lines	4 sec	Generation backing down @200MW from unit 3, 4, 5, or 6.

Settings for 400KV Mundra-Sami 1& 2 and Sami-Dehgam 1 & 2 lines

SPS settings	Group 1: Both lines in service without FSC. Group 2: Single line in service without FSC		Group 3: Both line in service with FSC. Group 4: Single line in service with FSC.		Action
	Setting (Current/MW)	time delay	Setting (Current/MW)	time delay	
Stage 1	715	10 sec	715	10 sec	Alarm
Stage 2	850MW	1.5 Sec	Greater than 1000MW	1.5 Sec	Tripping of any one unit from 5 or 6
Stage 3	Greater than 700MW and less than 800MW	1.5 Sec	Greater than 850MW and less than 1000MW	1.5 Sec	Tripping of any one unit from 3 or 4
Stage 4	Greater than 650MW	within 15sec	Greater than 750MW	within 15sec after Stage-2 or Stage-3 operation	200 to 300MW generation reduction

Settings for 220KV Mundra-Nanikhakar D/C and Mundra-Tappar D/C

	Current(A)	Time Delay(Sec)	Relay setting	Action
Stage 1	500	5	0.63	Alarm

stage 2	550	2	0.69	Tripping of ICT-1 or ICT-2
stage 3	605	5	0.76	Generation backdown*
stage 4	670	2	0.84	Tripping of Unit-1 or Unit-2 to reduce generation by 330MW

*The quantum of back down shall be decided by APL and inform to APL C/R.

- In both SPS scheme, selector switch should not have OFF position.

Ref No: SPS/WR/GEN/04

SPS at CGPL Mundra

Coastal Gujarat power Limited, Mundra (5x800MW) has its transmission as follows:

- 400KV CGPL-Bachhau-Ranchodpura D/C
- 400KV CGPL-Chorania D/C
- 400KV CGPL-Jetpur D/C

All the generating units are synchronized and the transmission lines are of triple snowbird conductor.

SPS settings at CGPL,Mundra are as follows:

S. No.	SPS triggering condition	Actions required
1	If export is more than 3100MW and 400KV Mundra-Bachhau D/C trips	Trip one preselected unit
2	If export is more than 3100MW and two of six ckts (combination of one Bachhau,one Chorania and one Jetpur) trips.	Backing down of 800MW to bring the line loading to safe limit.
3	400KV CGPL-Jetpur D/C more than 750MW	Backing down of unit to bring the line loading to safe limit below 750MW

Proposed Revision in SPS at CGPL, Mundra

- 400KV Bachhau is connected to the grid with following transmission lines

  -400KV CGPL-Bachhau D/C

  -400KV Bachhau-Ranchodpura D/C

  -2X315MVA ICTs

- With the tripping of any one ckt of 400KV Bachhau-Ranchodpura D/C,the grid is not N-1 safe and causes critical loading on ckts emanating from CGPL,Mundra. Hence 400KV Bachhau-Ranchodpura D/C is to be included in SPS at CGPL.

Sl.No.	SPS triggering condition	Actions required
i)	If export is more than 3100MW and any one line out of eight lines trip (including Bachhau-Ranchodpura D/C) or line loading on any line exceeds 900MW	Reduce generation in two units to the tune of 800MW.
ii)	If export is more than 3100MW and if CGPL-Bachhau D/C trips	Trip one unit immediately.
iii)	In case of D/C tripping of CGPL-Chorania, CGPL-Jetpur or combination of one ckt of each of Bachhau or Chorania or Jetpur	Reduce generation 800MW and further reduce such that the line loadings of remaining lines are below 900MW.

Ref No: SPS/WR/GEN/05

SPS at BALCO Ltd

The interim evacuation of BALCO generating plant (2x67.5+4x300MW) is approved through LILO of 400kV Korba-Birsinghpur one ckt at BALCO, Chhattisgarh till commissioning of Dharamjaygarh pooling station. The margin for scheduling through STOA/PX from the BALCO units would be limited by the W3 injection TTC declared by NLDC and is available in NLDC/WRLDC website. The proposed system protection scheme is as under:-

Triggering signal for SPS action:

Case A: When 400 kV BALCO – Birsinghpur line trips OR the breaker position at BALCO is OPEN for Birsighpur line

Case B: When flow on BALCO-Birsighpur line exceeds 550MW

SPS action on receipt of triggering signal

Case A: Trip 300MW unit at BALCO immediately so that the flow towards Korba is limited to 100MW.

Case B: Automatic reduction of 100MW at BALCO immediatel

Arming of SPS:

The SPS would be armed viz. kept in service whenever the 300MW unit at BALCO is in operation. viz. normal operating conditions. In case there is a need to disarm the SPS under certain conditions as indicated in Sl. No 4 below, then the SPS would be armed immediately after the 400 kV BALCO-Birsinghpur line is restored. The generation at BALCO would be ramped up only after the SPS is armed.

Disarming of SPS:

The scheme would be manually disarmed or blocked in case of planned shutdown of 400 kV BALCO-Birsinghpur line. The SPS would be disarmed first before opening the line manually.

Visual /facia indications for plant operators

The operators at the power station should be able to arm/disarm the SPS based on the above guidelines and the following status must be clearly visible on the control panel.

- □□SPS armed
- □□SPS disarmed
- □□SPS operated

The above operating instructions must be available readily on the control panel.

Checking healthiness of SPS:

Healthiness of the scheme might be checked on a regular basis. Mock exercise for healthiness of the scheme might be carried out once in six months.

Time line for commissioning the SPS:

The scheme is implemented on 30.04.2014. The scheme will be reviewed while commissioning of 2nd unit of 300MW scheduled for future or under any other system requirement.

Ref No: SPS/WR/GEN/06

SPS at Essar Mahan Ltd

The interim evacuation of Essar-Mahan generating plant (2x600MW) is approved through LILO of 400kV Korba-Vindhyachal one ckt at Mahan, M.P till commissioning of Mahan-Bilaspur D/C lines. Till commissioning of Bilaspur lines, the margin for scheduling through STOA/PX from Essar-Mahan unit would be limited by margin declared by WRLDC after system studies(given in Annex-I). It is proposed to implement a SYSTEM protection scheme before commissioning of first 600MW unit. The proposed SYSTEM Protection scheme is as under:-

Triggering signal for SPS action:

Case A:- When the breaker position at Mahan is OPEN for Vindhyachal line OR Power flow towards Vindhyachal less than 12MW for atleast 1 sec.

SPS action on receipt of triggering signal

Trip 600MW unit at Mahan immediately for case A so that there is no injection towards Korba.

Arming of SPS:

The SPS would be armed viz. kept in service whenever the 600MW unit at Mahan is in operation. viz. normal operating conditions. In case there is a need to disarm the SPS under certain conditions as indicated in Sl. No 4 below, then the SPS would be armed immediately after the 400 kV Mahan-V'chal line is restored. The generation at Mahan would be ramped up only after the SPS is armed.

Disarming of SPS:

The scheme would be manually disarmed or blocked in case of planned shutdown of 400 kV Mahan-V'chal line. The SPS would be disarmed first before opening the line manually.

Visual /facia indications for plant operators

The operators at the power station should be able to arm/disarm the SPS based on the above guidelines and the following status must be clearly visible on the control panel.

- □□SPS armed
- □□SPS disarmed
- □□SPS operated

The above operating instructions must be available readily on the control panel.

Checking healthiness of SPS:

Healthiness of the scheme might be checked on a regular basis. Mock exercise for healthiness of the scheme might be carried out once in six months.

Time line for commissioning the SPS:

The SPS proposed is implemented. The scheme will be reviewed while commissioning of 2nd unit of 600MW scheduled for future or under any other system requirement.

Ref No: SPS/WR/GEN/07

SPS at Jaypee Nigrie STPP

The interim evacuation of Jaypee Nigrie STPP (2x660MW) is approved through LILO of 400kV Vindhyachal – Satna one ckt at Nigrie switchyard till commissioning of 400kV Jaypee Nigrie-Satna D/C lines. Till commissioning of these lines, the margin for scheduling through STOA/PX from JNSTPP unit would be limited by margin declared by WRLDC after system studies. Before commissioning of the units, detailed plan for testing to be intimated to WRLDC. As per minutes of the 16th meeting of WR constituents regarding connectivity/open access applications dt 23.5.12 issued by PGCIL, it is proposed to implement a system protection scheme before commissioning of first 660MW unit.. The proposed system protection scheme is as under:-

Triggering signal for SPS action:

Case A:- When the flow on 400kV Nigrie-Satna increases 550MW, Automatic backing down of 100MW to be done at Jaypee Nigrie.

Case B:- When 400 kV Nigrie-Satna line trips ie, the breaker position at Nigrie is OPEN for Satna line OR line flow becomes 10MW, the unit to be tripped.

SPS action on receipt of triggering signal

Case A:- Automatic backing down of 100MW at JNSTPP.

Case B:-Trip 660MW unit at Nigriee immediately for case B so that there is no injection towards Vindhyachal.

Arming of SPS:

The SPS would be armed viz. kept in service whenever the 600MW unit at JPNSPP is in operation. viz. normal operating conditions.

In case there is a need to disarm the SPS under certain conditions as indicated in Sl. No 4 below, then the SPS would be armed immediately after the 400 kV Nigrie-Satna line is restored. The generation at JNSTPP would be ramped up only after the SPS is armed.

Disarming of SPS:

The scheme would be manually disarmed or blocked in case of planned shutdown of 400 kV Nigrie-Satna line. The SPS would be disarmed first before opening the line manually.

Visual /facia indications for plant operators

The operators at the power station should be able to arm/disarm the SPS based on the above guidelines and the following status must be clearly visible on the control panel.

- □□SPS armed
- □□SPS disarmed
- □□SPS operated

The above operating instructions must be available readily on the control panel.

Checking healthiness of SPS:

Healthiness of the scheme might be checked on a regular basis. Mock exercise for healthiness of the scheme might be carried out once in six months.

Time line for commissioning the SPS:

The SPS proposed is implemented.

SPS related to overloading of Transformers

Ref No: SPS/WR/TRF/01

SPS at Essar Steel India Ltd.

Essar Steel India Ltd is connected at Hazira via Jhanor-Hazira D/C . The SPS implemented at ESIL is as follows:

Criteria for SPS triggering / Triggering signal for SPS action

'OFF' position of 400 KV side breaker of ICTs OR ICTs 220 KV side current more than 1100 ampere.

Arming of SPS

SPS to be armed i.e. kept 'ON' whenever both the ICTs are in service.

Disarming of SPS

To be disarmed before taking one ICT in planned shutdown (Load shall be brought down to 350 MW before taking shut down), MCB is provided in respective 400 KV breaker contact 21-22 to disarm the SPS for planned shut down of any of the ICT.

Checking healthiness of SPS

SPS DC failure alarm wired up in monitoring system for plant operator.

Action on receiving SPS signal

Tripping of running Furnaces at ESIL Plant-1 and 2.

Visual indication for plant operators on control panel for SPS operated

Alarm, indicating load shedding scheme operated.

Annexure 4

SPS IN SOUTHERN REGION

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INDEX

Ref No.	Name of the Scheme	Implementing Agency	Status	Pg. No.
SPS/SR/GEN/03	SPS at UPCL	LANCO	In service	120
SPS/SR/GEN/04	SPS at Varahi	KPTCL	In service	121
SPS/SR/GEN/05	SPS at Kudankulam APS	CTU	In service	122
SPS related to overloading of Transformers				
SPS/SR/TRF/01	SPS for Madakathara ICT	KSEB	In service	123
SPS/SR/TRF/02	SPS for Hosur ICT	CTU	In service	124
SPS/SR/TRF/03	SPS for Mamidipalli ICT / Ghanapur ICT	APTRANSCO	In service	125
SPS/SR/TRF/04	SPS for Thirunelveli ICT	TANTRANSCO	Approved	126
SPS/SR/TRF/05	SPS for Madurai ICT	TANTRANSCO	Approved	127

SPS related to tripping of critical line / Corridor

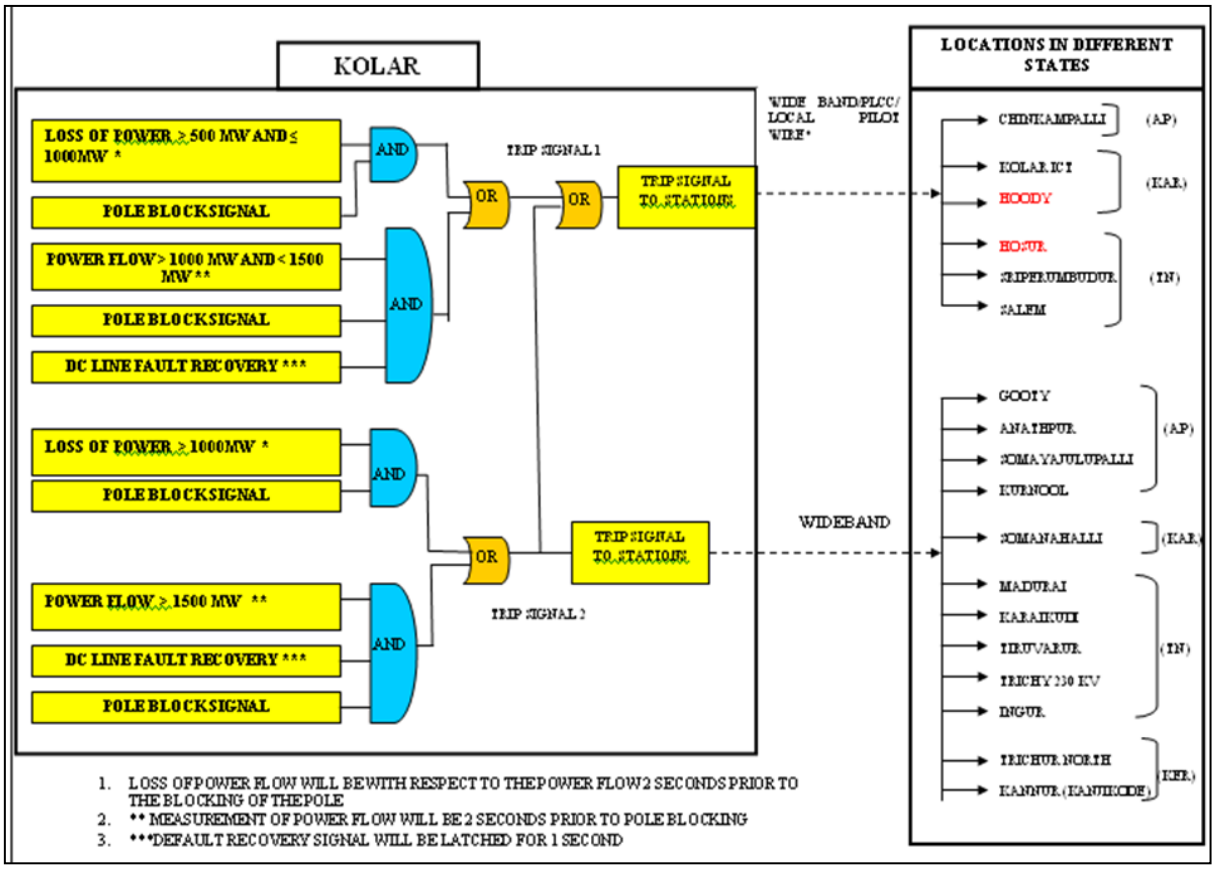
Ref No: SPS/SR/LINE/01: SPS for ER-SR Corridor

SPS for Talcher – Kolar HVDC Bipole - SPS at Kolar

Talcher-Kolar HVDC bipole link was envisaged to carry 2000 MW from Eastern to the Southern grid and the size of the southern grid was around 23000 MW. Due to less system inertia, absence of primary control for generators and with no spinning reserve the southern grid was susceptible to frequency deviations in the event of any sudden load-generation imbalance occurring due to contingency of the high capacity Talcher-Kolar HVDC bipole link. The frequency instability would have resulted in a sudden frequency dip which in turn would have resulted in cascade tripping of generators in the event inadequate load relief through under frequency load shedding scheme. In order to enhance the operational security of southern grid and to avoid grid instability due to frequency collapse, a system protection scheme has been implemented for fast load relief during contingency of tripping of Single pole/ Bi pole of the HVDC link.

The SPS for HVDC Talcher-Kolar has been designed to simultaneously shed load in Southern Region and reduce generation in Eastern region subsequent to the tripping of HVDC Talcher-Kolar Bipole an asynchronous link between Eastern Region and Southern Region. SPS was designed with 2000 MW capacity and considering a single largest allowable contingency of 500MW unit tripping, the loads to be interrupted in the SPS was decided as 1500MW. With the pole capacity enhanced to 2500MW the SPS has to trip a load of 2000MW (i.e. 500MW additional) the pole is carrying greater than 2000MW. It is therefore proposed to generate trip signal-3 for accommodating the conditions where the flows are greater than 2000MW.

SPS Scheme logic at Kolar



Trip Signal 1

Trip Signal 1 would be initiated to obtain a relief of around 800 MW under any one of the following conditions:

2. If loss of power flow on the HVDC link at any instant compared with the power flow 2 seconds prior to current instant is more than 500 MW but less than or equal to 1000 MW.
3. If one of the HVDC pole block on a line fault and the power flow on the HVDC link just prior to that instant was more than 1000 MW but less than or equal to 1500 MW.
4. When Trip signal 2 is generated
5. When trip signal 3 is generated

Sl No.	Karnataka		Andhra pradesh		Tamilnadu		
	Load	Planned Load (MW)	Load	Planned Load (MW)	Load	Planned Load (MW)	Group Total
1	**400kV Kolar** **Kolar ICT-1,2** **(2x500MVA)**	250	**220kV Yerraguntla** 132kV Vempally 132kV Pulivendula 132kV Proddutur-1&2	80	**230kV Vinnamangalam** 110 kV Vadakathipatti 110 kV Ambur 110kV Thirupathur	129	
2	**220kV Hoody** 66kV ITI 66kV Pottery road 66V Shantiniketan		**220kV Pulivendula** 132kV Pulivendula-1&2 132kV Lingala 132kV Balapanur	80	**230kV Hosur** 110kV Kempatty 110kV Bagalur 110kV Hosur GC II 110kV Zuzuwadi	128	
3			**220kV Kalikiri** 132kV Madanapalli-1&2 132kV Rompicherla	70	**230kV Unjanai** 110kV Elanagar 110kV Paruthipalli	23	
4					**230kV Puthansandai** 110kV Link 110kV KN Patty 110kV Valayapatty	70	
5					**230kV Deviakuruchi** 110kV Thammampatti 110kV Thalaivasal	45	
TOTAL		250		230		395	875

Trip Signal 2

Trip Signal 2 would be initiated to obtain an additional relief of around 800 MW (in addition to 700 MW as stated above) under any one of the following conditions:

i. If loss of power flow on the HVDC link at any instant compared with the power flow 2 seconds prior to current instant is more than 1000 MW.

ii. If one of the HVDC pole block on a line fault and the power flow on the HVDC link just prior to that instant was more than 1500 MW.

iii. When trip signal 3 is generated

Sl No	Karnataka		Andhra pradesh		Kerala		Tamilnadu		
	Load	Planned Load (MW)	Load	Planned Load (MW)	Load	Planned Load (MW)	Load	Planned Load (MW)	Group Total
1	**220kV Somanahalli** 66kV Kumbalgod 66kV Jigani 66kV Kanakpura	200	**400kV Narnoor** 220kV Brahmankottur	50	**220kV Kanhirode** 110kV Kanhirode-Mundayad I 110kV Kanhirode-Mundayad II	70	**230kV Madurai** 110kVThirmangalam	25	
2			**220kV Somayajulapally** 220kV Nandyala 1&2	60	**400kV Madakkathara** 110kV Madakkathara-Shornur 110kV Madakkathara-Wadakkancherry 110kV Madakkathara-Valappad 110kV Madakkathara-Cherp	100	**230kV Perambalur** 110kV Thuraiyur	35	
3			**220kV Anantapur** 220kV Kalyandurg	80			**230kV Thiruvarur** 110kV Thrivarur link 110kV Thiruturaipoondy	60	
4			**220kV Gooty** 220kV Boyareddypally	50			**230kV Ingur** 110kV Arasur	50	
TOTAL		200		240		170		170	780

Later with the pole capacity enhanced to 2500MW, an additional load shedding of 500MW through a third trip signal was incorporated in the SPS logic.

Trip signal-3 :

Trip Signal 3 would be initiated to obtain an additional relief of around 500 MW under any one of the following conditions:

i. If loss of power flow on the HVDC link at any instant compared with the power flow 2 seconds prior to current instant is more than 2000 MW.

ii. If one of the HVDC pole block on a line fault and the power flow on the HVDC link just prior to that instant was more than 2000 MW.

Sl No.	Karnataka		Andhra pradesh		Kerala		Tamilnadu		
	Load	Planned Load (MW)	Load	Planned Load (MW)	Load	Planned Load (MW)	Load	Planned Load (MW)	Group Total
1	**220kV Anchenepalaya** 66kV Anchenapalaya -2 66kV Huliyur durga	104	**220kV Chinakampalli** 132kV Rayichoti feeder	35	**220kV Edappon** 110kV Edappon-Kayamkulam 110kV Edappon-Mavelikkara 110kV Edappon-Adoor-I&II	77	**400kV Sriperambadur** 110kV Korattur fdr-2	70	
2	**220kV Nittur** 110kV KG Temple 110kV Gubbi		**220kV Kadappa** 132kV Vonimitta 132kV RTSS	90	**220kV Pallom** 66kV Pallom-Chumatra 110kV Pallom-Mallappally 66 kV Palloom - Pambady 66 kV Pallom - Ettumanoor 66 kV Pallom - Kuttanad 66kV Pallom - Mavelikkara	48	**400kV Salem** 110kV Thumbipani fdr	46	
3	**220kV KB Cross** 110kV Turuvekere 110kV Mayasandra						**230kV Gobi** 110kV Gobi S/s loads 110kV Barrage fdr-3	30	
TOTAL		104		125		125		146	500

SPS at Talcher end

The intent of the SPS at Talcher end is to limit the sudden injection of power from Talcher Stage II generators into N-E-W grid during the contingency of tripping of one pole/Bipole of Talcher-Kolar HVDC link. SPS at Talcher has two modes of operation namely SPS 450(Limit the sudden injection to 450 MW in to N-E-W Grid) and SPS 1000(Limit the sudden injection to 1000 MW in to N-E-W Grid). Depending on the grid condition of N-E-W grid and its ability to withstand additional injection of power, the scheme is toggled between the two schemes. Instruction for toggling between the mode of SPS is given to Talcher Stage II by SRLDC based on the advice given by NPSD to SRLDC.

SPS 450

Contingency	Action
CASE-1 : One pole blocking	
If one pole trips & if total power injected by generators is more than 1750MW	Trip one of the pre-selected unit
CASE-2 : Both pole blocking	
If one pole trips & if total power injected by generators is more than 1100MW	Trip two of the pre-selected unit
If total power injected by generators is still more than 550MW for 250ms	Trip Unit-4
If total power injected by generators is still more than 550MW for 500ms	Trip Unit-5

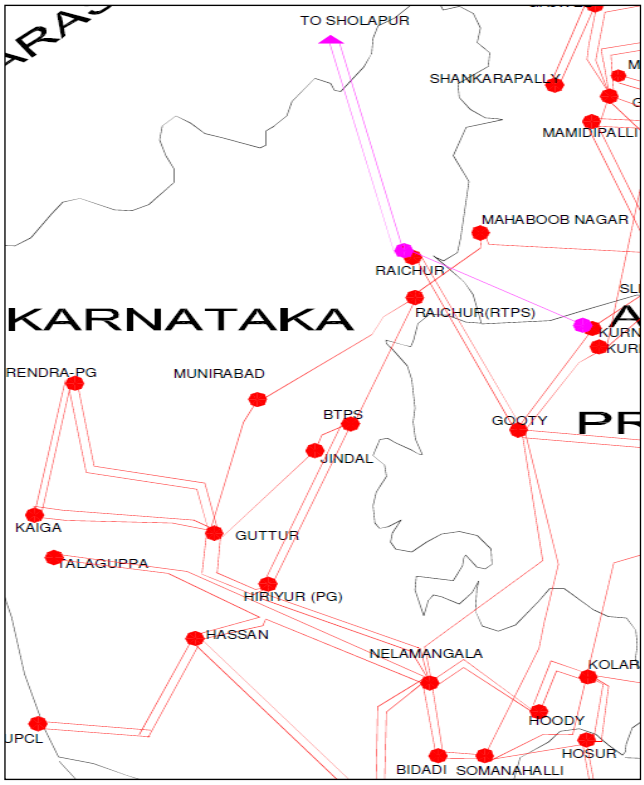
SPS 1000

Contingency	Action
CASE-1 : One pole blocking	
If one pole trips & if sum of antecedent power flow on four outgoing 400kV AC feeders > 1600 MW & if sum of post tripping power flow on four outgoing 400kV AC feeders is >100 & <180MW	Trip unit#6 and ramp down Unit#5 by 150MW
If one pole trips & if sum of antecedent power flow on four outgoing 400kV AC feeders < 1600 MW and >1450MW & if sum of post tripping power flow on four outgoing 400kV AC feeders is >100 & <180MW	Ramp down Unit#4, #5 and #6 by 150MW
If one pole trips & if sum of antecedent power flow on four outgoing 400kV AC feeders > 1300 MW and <1450 & if sum of post tripping power flow on four outgoing 400kV AC feeders is >100 & <180MW	Ramp down Unit#4 and #5 by 150MW
If one pole trips & if sum of antecedent power flow on four outgoing 400kV AC feeders > 1150 MW and <1300MW & if sum of post tripping power flow on four outgoing 400kV AC feeders is >100 & <180MW	Ramp down Unit#5 by 150MW

Contingency	Action
CASE- 2 : Two pole blocking	
If both pole trip & if sum of antecedent power flow on four outgoing 400kV AC feeders > 1600 MW	Trip unit#6 and ramp down Unit#4 and #5 by 150MW
If both pole trip & if sum of antecedent power flow on four outgoing 400kV AC feeders < 1600 MW and >1450MW	Trip unit#6 and ramp down #5 by 150MW
If both pole trip & if sum of antecedent power flow on four outgoing 400kV AC feeders > 1300 MW and <1450	Ramp down Unit#4, #5 and #6 by 150MW
If both pole trip & if sum of antecedent power flow on four outgoing 400kV AC feeders > 1150 MW and <1300MW	Ramp down Unit#4, #5 by 150MW
If both pole trip & if sum of antecedent power flow on four outgoing 400kV AC feeders > 1000 MW and <1150MW	Ramp down Unit #5 by 150MW

Ref No: SPS/SR/LINE/02

SPS for one of the 400kV Hiriyur- Neelamangala DC line (For synchronisation of SR grid with NEW grid)

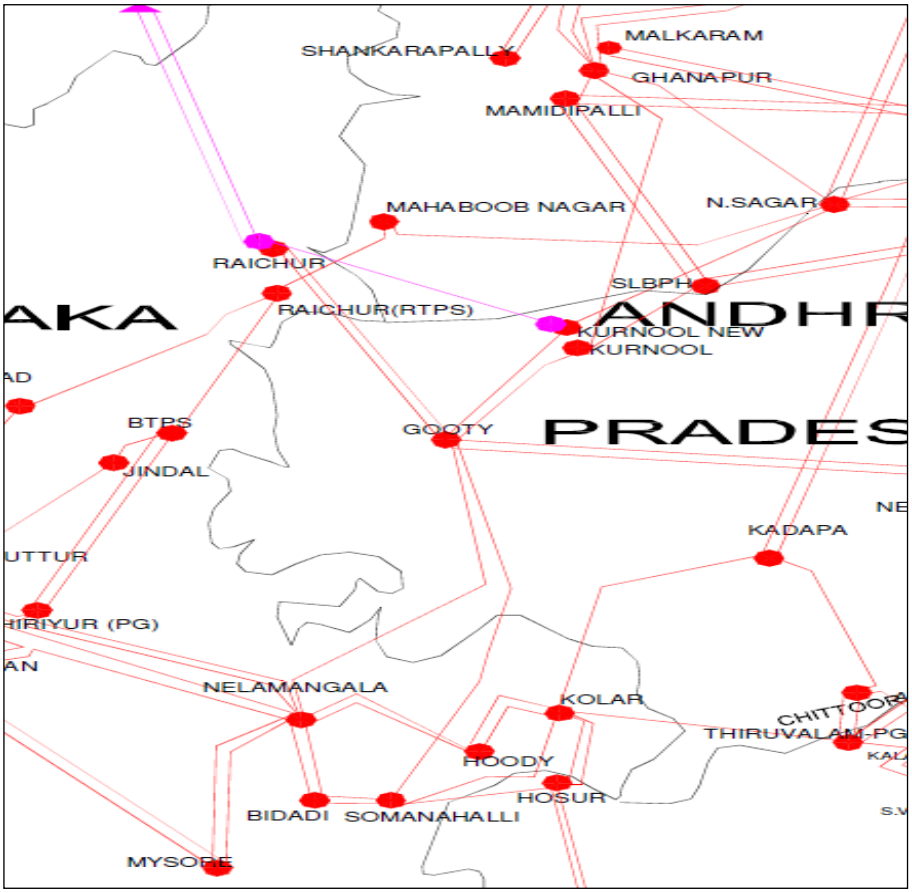


The loads at Neelamangala and part load of Mysore are fed through 400kV Hiryur-Neelamangala line-1&2. It was observed that in the event of contingency of one of the line of 400kV Hiryur-Neelamangala lines, the line in service was getting overloaded i.e., flow was observed to be beyond 850MW. Hence SPS was proposed for contingency of one of 400kV Hiryur-Neelamangala lines.

Contingency	Action
Tripping of one of the 400kV Hiriyur- Neelamangala DC line and Flow on other line > 850 MW	**Generation back down in Western Region - 800MW** JPL - 350MW, KSK - 150MW, DB Power – 0 MW **Load Shedding in Southern Region -500MW** Tamilnadu-146MW, Kerala - 125MW, Karnataka-104MW Andhra Pradesh-125MW

Ref No: SPS/SR/LINE/03

SPS for tripping of 400kV Gooty-Nelamangala SC line or 400kV Gooty- Somanahalli SC line (For synchronisation of SR grid with NEW grid)

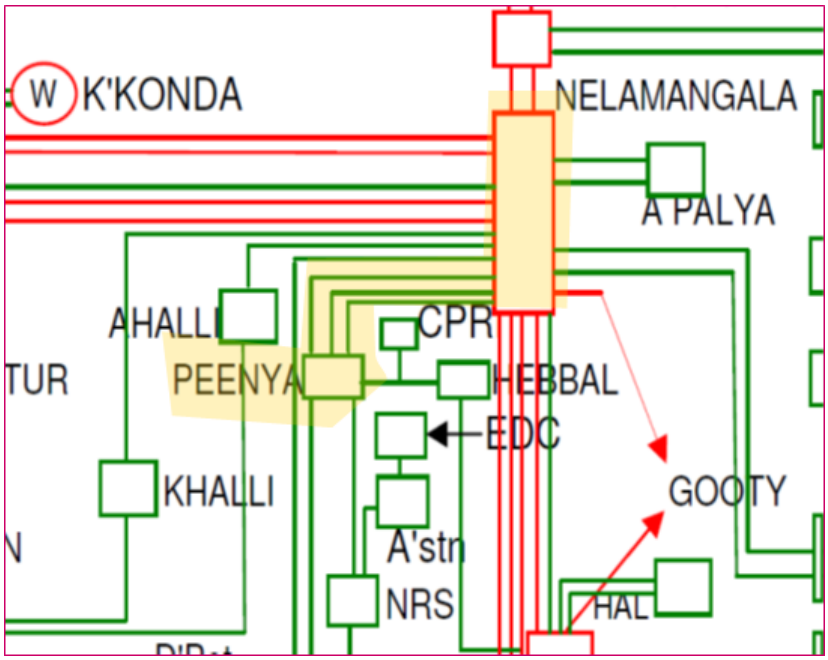


It was observed that in the event of contingency of either 400kV Gooty-Neelamangala or 400kV Gooty Somanahalli lines, the line in service was getting overloaded i.e., flow was observed to be beyond 850MW.

Contingency	Action
Tripping of one of the 400kV Gooty-Neelamangala or 400kV Gooty-Somanahalli line and Flow on other line > 850 MW	Generation back down in Western Region - 800MW JPL - 350MW, KSK - 150MW, DB Power – 0 MW Load Shedding in Southern Region -500MW (Trip signal-3) Tamilnadu-146MW, Kerala - 125MW, Karnataka-104MW Andhra Pradesh-125MW

Ref No: SPS/SR/LINE/04

SPS at 220kV Neelamangala

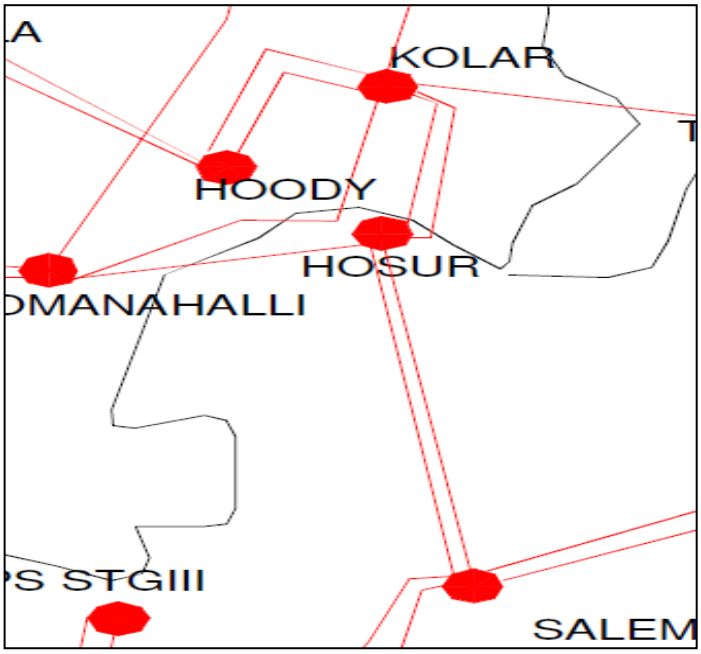


SPS put to decongest the loading on lines in the event of tripping of one circuit of the 220kV Neelamangala-Peenya

Contingency	Action
Tripping of one of When One of the 220kV Nelmangala-Peenya line Trips	Load shedding : 50MW

Ref No: SPS/SR/LINE/05

SPS for contingency of 400 kV Hosur-Salem lines

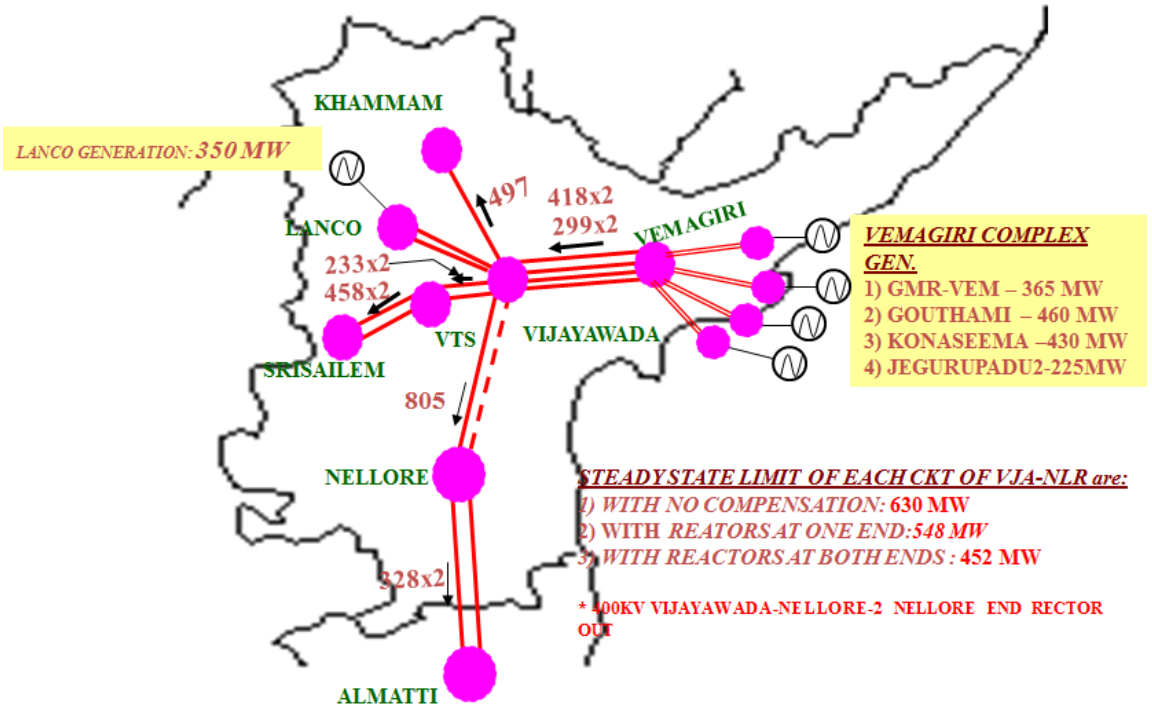


During months from January to May the power flow on 400kV Hosur-Salem and 400kV Somanahalli-Salem line is very high with no N-1 contingency .SPS was installed to relieve post contingency (N-1) stress on 400kV Hosur-Salem lines.

Contingency	Action
Tripping of one of 400kV Hosur-Salem lines and flow on remaining line is > 1260 A (870 MVA)	Load shedding at Salem - 300MW

Ref No: SPS/SR/LINE/06

SPS for contingency of one of 400kV Vijayawada-Nellore lines



SPS was installed to relieve post contingency (N-1) stress on 400kV Vijayawada-Nellore line

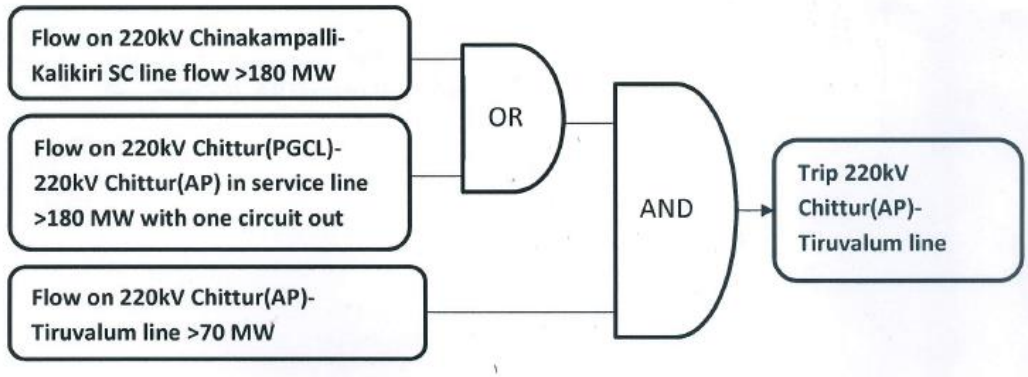
Contingency	Action
Tripping of one of the 400kV Vijayawada-Nellore DC line and before tripping flow each circuit is >550 MW	Generation back down - 430MW Generation backdown or trip one generating unit each at GMR Vemagiri, Gouthami, Konaseema, Jegurupadu-II and Lanco.

Ref No: SPS/SR/LINE/07

SPS for over loading of upstream 220kV lines connected to 220kV Chitoor-Thiruvalem lines in Andhra Pradesh Network

220 KV Chittoor-Tiruvalum line O/C setting at Chittoor end is 420 A (160 MW) and 220 KV Sullurpet-Gummidipoondi line O/C setting at Sullurpet end is 260 A (100 MW). Constraint was due to the loading concerns on the upstream lines in AP. Considering this fact, it was felt prudent to design an SPS to trip 220 KV Chittoor- Tiruvalum and 220 KV Sullurpet-Gummidipoondi lines based on the loading of critical upstream lines instead of over current protection. The Over current settings of 220 KV Chittoor –Tiruvalum Line at Chittoor end had been set to 600 A.

SPS Logic:



Ref No: SPS/SR/LINE/08

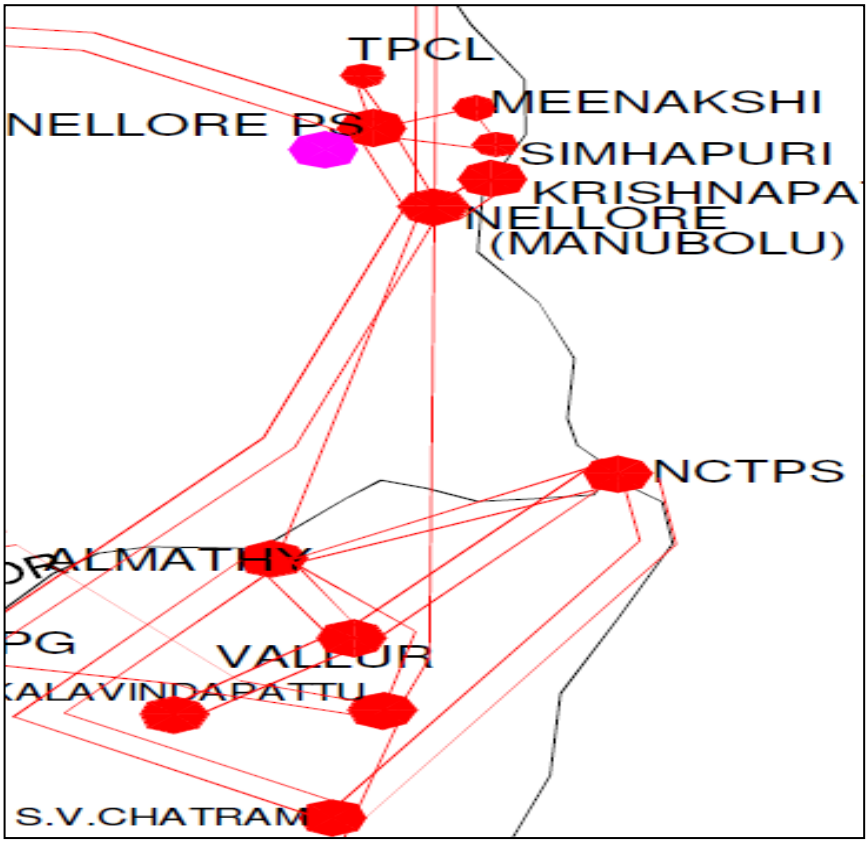
SPS for 220kV Sulurpet-Gummidipoondi

Tripping of 220kV Sulurpet-Gummidipoondi S/C lines in case over loading of upstream transmission line of Andhra Pradesh Network

Contingency	Action
Flow on 220kV Nellore-Sullurupet > 180MW	Trip 220kV Gummidipoondi-Sulurupet Line

Ref No: SPS/SR/LINE/09

SPS for contingency of one of 400kV Nellore-Alamatti DC



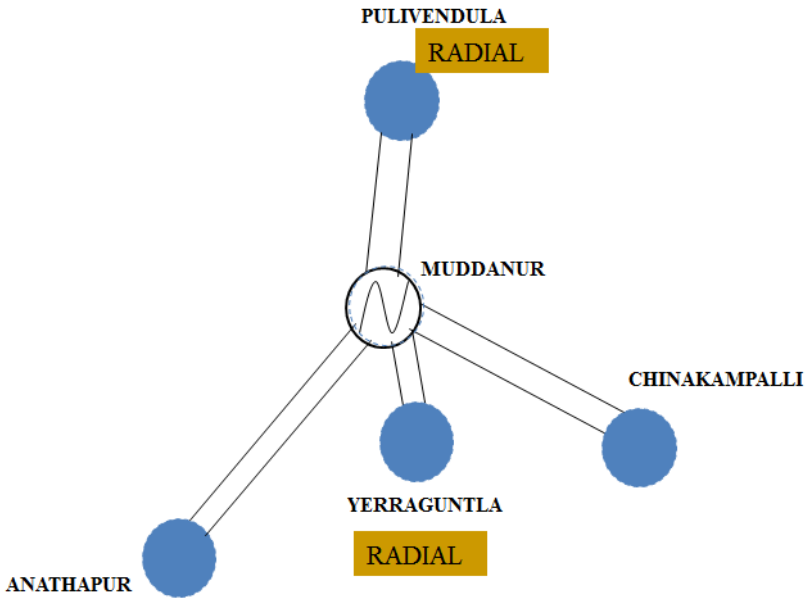
With the commissioning of Simhapuri (300 MW) and Meenakshi (300 MW) units, 400 KV Nellore-Almatti DC line was severely loaded. To avoid overloading the SPS was proposed to back down generation at Simhapuri & Meenakshi to alleviate post contingency flows during N-1 condition of this line.

Contingency	Action
Tripping of one of 400kV Nellore-Alamatti DC line and before tripping flow each circuit is >520 MW	Generation back down - 300MW trip one generating unit each at Simhapuri power station and at Meenakshi Power station.

SPS related to Safe evacuation of generation

Ref No: SPS/SR/GEN/01

SPS at Muddanur

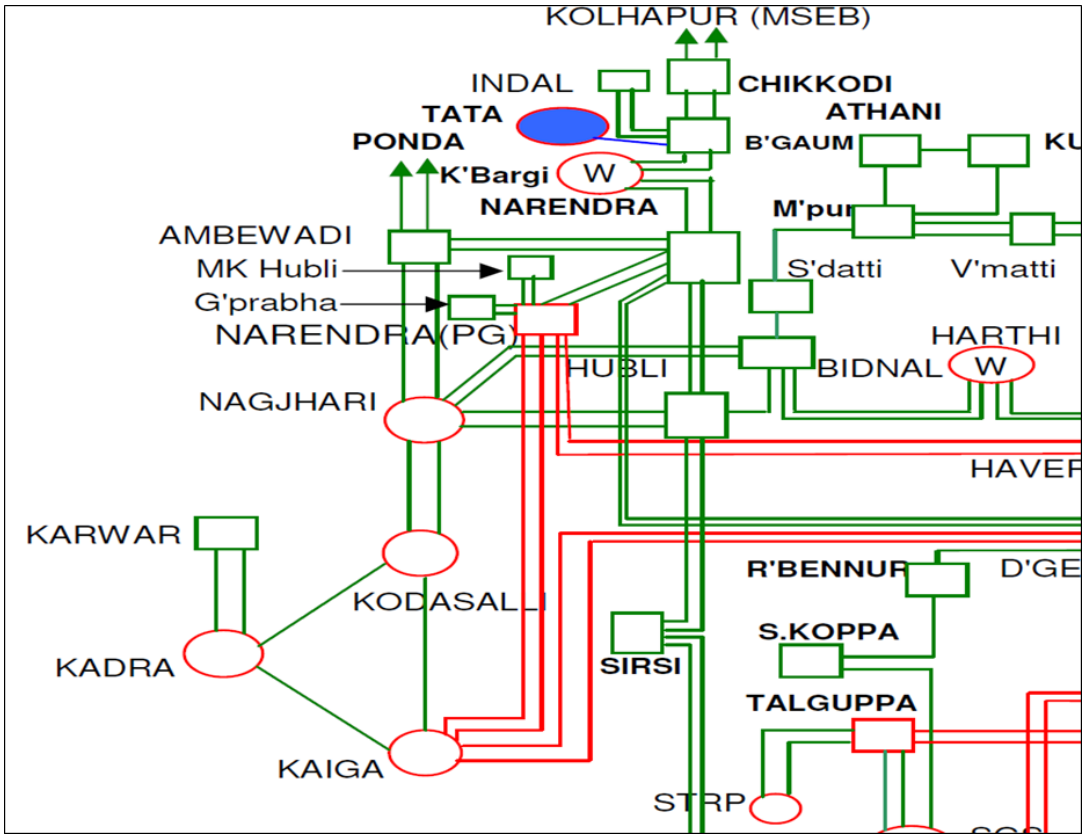


Muddanur generation (about 800 MW) has to be evacuated through four 220 kV lines, 220 kV D/C Chinnakampally and 220 kV D/C Ananthapur and radial loadings of 200 kV Pulivendala (120 MW) and 220 kV Yerraguntla (80 MW). In case of tripping of one of the lines of 220 kV Chinnakampally other line get over loaded and may lead to cascade tripping. Hence SPS was installed for contingency of outgoing lines from Muddanur Hydro station.

Contingency	Action
Case-1	
With 960MW generation at Mudannur and If one of 220kV Muddanur-Chnnakampally DC line trips	Reduction of 300MW generation at Mudannur
Case-2	
With 960MW generation at Mudannur and If both 220kV Muddanur-Chnnakampally line trips	Reduction of 400MW generation at Mudannur

Ref No: SPS/SR/GEN/02

SPS at Nagjheri Power House



Contingency	Action
Any line breaker at Naghjari connected lines trips OR Any Line current is less than 30 A (considered for remote breaker tripping) OR Any Line current is greater than 590 A AND Total Generation including Kodasalli line inflows is greater than 900MW	Either Unit 3 or Unit 5 trips (whichever is maximum)

Ref No: SPS/SR/GEN/03

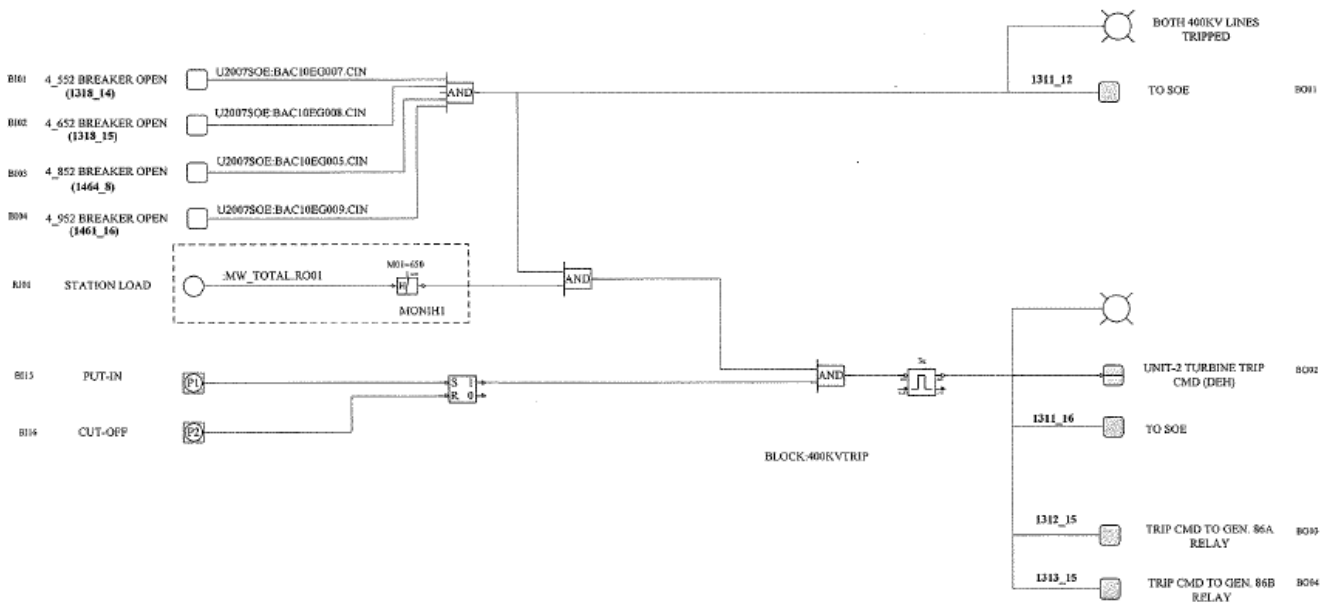
SPS for contingency of 400kV evacuating lines at Udupi Power Corporation Limited

Udupi thermal power station has 2x600MW units connected at 400kV level. The power is evacuated through two 400kV lines to Hassan, 220kV line double circuit to Kemar and two 315MVA 400/220kV ICT's. It was observed that in the event of tripping of both the 400kV lines from UPCL, the ICT's and 200kV evacuating lines were getting severely over-loaded hence SPS was installed to relieve the congestion in 220kV evacuating line from UPCL.

SPS logic and Action:

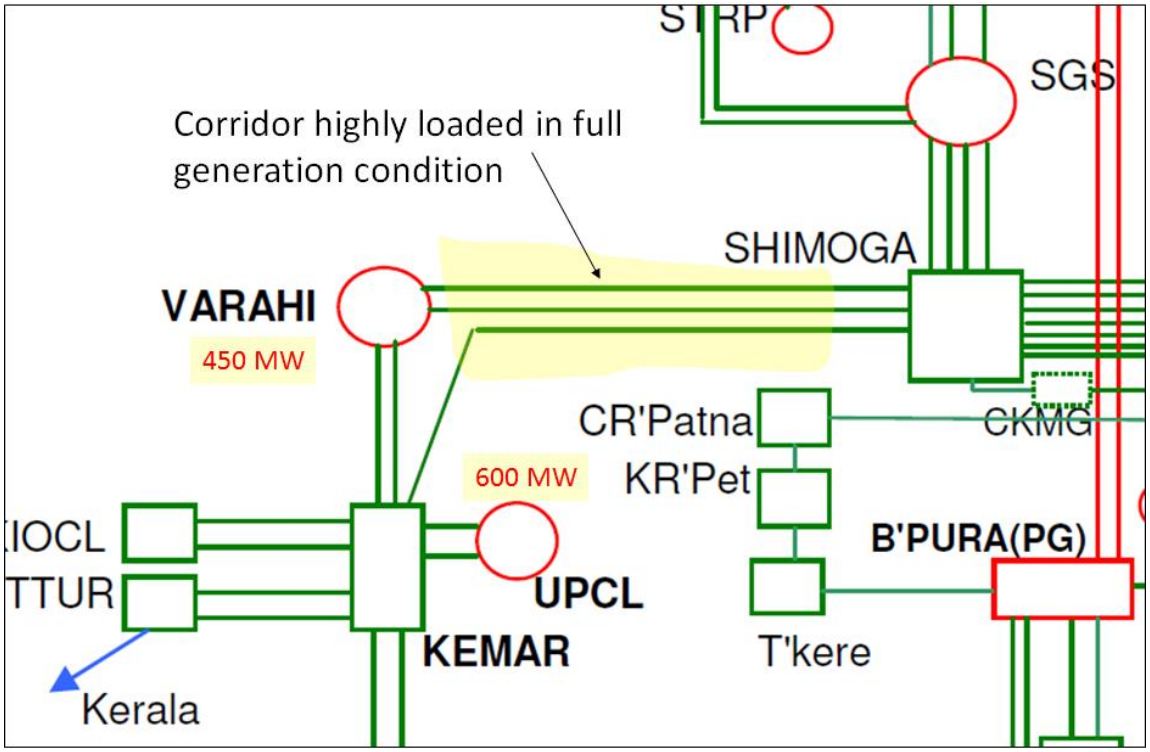
SPS for Contingency of overloading of 220kV evacuating lines at Udupi Power corporation limited	
Contingency	Action
Case-1	
If one circuit of 400kV UPCL-Hassan DC line trips and flow on other circuit more than 700 MW	Trip one of the unit at UPCL
Case-2	
If 400kV line trips & any 1 or both 220KV Lines not available (i.e breakers 2-452 & 2-352 opened) & Load >300MW	Trip both the units at UPCL

Schematic Diagram:



Ref No: SPS/SR/GEN/04

SPS at Varahi



Approximately 1050 MW (more than 450 MW at Varahi and 600 MW of UPCL) had to be evacuated through 220 kV Varahi – Shimoga D/C line and 220 kV Kemar – Shimoga S/C. It was informed that 220 kV Varahi –Shimoga D/C line severely loaded with no N-1 reliability. Hence SPS was envisaged for contingency of evacuating lines from Varahi power station

Contingency	Action
Case-1	
If one of the 220kV Varahi-Shimoga DC line trips and Flow on other circuit is >620 Amps	trip one unit of 115 MW at Varahi

Ref No: SPS/SR/GEN/05

SPS at Kudankulam Nuclear power plant

Kudankulam Nuclear power station is located in Tamilnadu and presently one 1000MW unit is operational. SPS was put for contingency of Unit at Kudankulam power station.

SPS for Contingency of Tripping of Units at Kudankulam	
Contingency	Action
Case-1	
Unit tripping and if power loss >500 and Frequency < 50 Hz	Trip signal sent via Kolar to shed loads in Tamil Nadu, Karnataka and A.P, Kerala

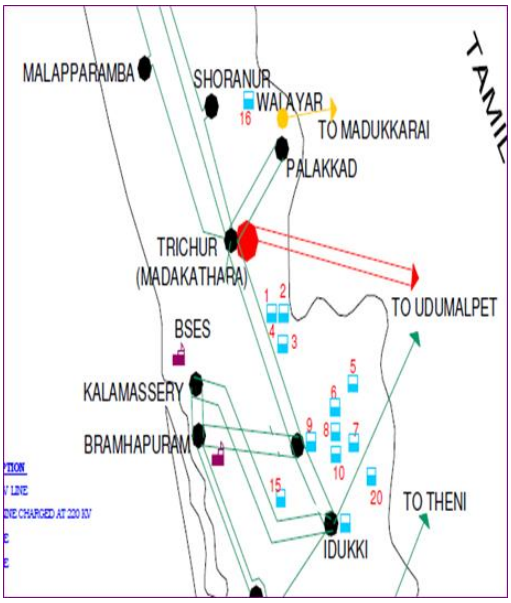
Sl No.	Karnataka		Andhra pradesh		Kerala		Tamilnadu		
	Load	Planned Load (MW)	Load	Planned Load (MW)	Load	Planned Load (MW)	Load	Planned Load (MW)	Group Total
1	**400kV Neelmangala** Anchenapalaya line-1&2	70	**220kV Yerraguntla** 132/33kV Transformers (2x31.5MVA)	20	**220kV Pothencode** 110kV Pothencode Attingal I &II	30	**230kV Kavanoor** 110kV Paramakudi	25	
2	**220kV DB Pura** 100MVA Transformer-2	55	**220kV Kalikiri** 132/33kV Transformers (2x31.5MVA)	40	**220kV Kundara** 110kV Kundara-Parippally		**230kV Karaikudi** 110kV Pudukottai 110kV Town	20	
3	**220kV Anthrasanahalli** 66kV Chelur line	30	**220kV Gooty receiving station** 132kV Pattikonda	25	**220kV Edamon** 110kV Edamon Punalure I &II	25	**230kV Kodikurichi** 110kV Veerasigamani#2	20	
4	**220kV Kibbanahalli** 110kV Turuvekere	40	**220kV Anantapur** 132/33kV Transformers (2x50 MVA & 2x16 MVA)	100	**110kV Kundara** 110kV Kundara-Punalure& 110kV Kundara-kottarakkara		**230kV Thiruvarur** 110kV Koilvenni	30	
5			**220kV Kadappa** 132/33kV Transformers (2x50)	45	**220kV Malaparamba** 110kV Malaparamba-Malappuram I&II 110kV Areakkode- Kizhissery I&II	80	**230kV Karambayam** 110kV Karambakudi	25	
					220kV Areakkode 110kV Areakkode- Kizhissery I&II		**230kV KR Thoppur** 110kV Thmbipadi	30	
6							**230kV Gobi** 110kV Barrage PH & 110kV Gobi link	80	
							230kV Ingur 110kV Arasur	60	
TOTAL		195		230		135		290	850

SPS related to overloading of Transformers

Ref No: SPS/SR/TRF/01

SPS for Madakathara ICT

400/220kV Madakathara ICTs are fully loaded most of the time. 220kV L.Periar-Madakathara DC line is heavily loaded when there is generation at Lower Periar and Idukki.



Contingency	Action
Stage-1	
Tripping of one ICT and when ICT secondary current is 800A and persists for 1.5 sec.	Tripping of 150MW radial loads 1. 110 kV Madakkathara-Shornur 2. 110 kV Madakkathara -Wadakkancheri 3. 110 kV Madakkathara –Valappad 4. 110 kV Madakkathara-Cherp
Stage-2	
Even after acting of stage 1 trip, if the ICT secondary current = 800A and persists for 1.75 sec, then second stage of SPS acts	Tripping of 120MW radial loads 1) 110kV Madakkathara-Viyyur I & II 2). 110kV Kanhirode-Mundayad I & II
Stage-3	
Even after acting of the above two stages and if ICT current = 800 A and persists for 2 Sec, then third stage of SPS will act	Tripping of 60MW radial loads 1) 110 kV Shornur – Koottanad. 2) 110 kV Shornur – Edappal .

Ref No: SPS/SR/TRF/02

SPS for Hosur ICT

Two 400/220kV ICTs are available at 400kV Hosur substation. The ICT's were getting over loaded at times and their flow was in excess of 250 MW most of the time. Under such conditions, tripping of one ICT due to any reason will immediately lead to sustained overloading of the 2nd ICT and it may trip on Overcurrent/Transformer trouble trip. In order to avoid such a situation, a Special Protection Scheme was implemented at Hosur S/S to facilitate accelerated load shedding /tripping of TANTRANSCO 230 KV lines i.e, 230kV Vinnamangalam, 230kV Karimangalam and 230kV Singarapet in case of tripping of one ICT.

Contingency	Action
Case-1	
Tripping of one ICT and loading on the ICT in service is 130%	Tripping of one identified 230kV feeder to get 200A relief
Case-2	
Tripping of one ICT and loading on the ICT in service is 150%	Tripping of two identified 230kV feeder to get 400A relief
Case-3	
Tripping of one ICT and loading on the ICT in service is 180%	Tripping of three identified 230kV feeder to get 600A relief

Ref No: SPS/SR/TRF/03

SPS for Mamidipalli ICT & Ghanapur ICT

Contingency	Action
Logic for Mamidapalli ICTs	
If one of the ICT trips at Mamidipalli	150-200 MW radial loads shedding at 220kV Mamidipalli
Logic for Ghanapur ICTs	
if one of the 400/220kV ICT trips at Ghanapur	200 MW radial loads shedding at 220kV Mamidipalli

Ref No: SPS/SR/TRF/04

SPS for Tirunelveli ICT

During June to September the wind generation is high in Tamilnadu. There is backflow of power in ICT's i.e., from 230kV to 400kV at 400kV Tirunelveli substation. It was observed that in the event of tripping of one ICT at Tirunelveli the remaining ICT was getting overloaded. Hence it SPS was put up for controlling the overloading on ICT.

Contingency	Action
Case-1	
Tripping of one ICT and loading on the ICT in service is 130% with time delay of 16 seconds	**Tripping of feeders : (Load: 360 MW)** 230/33kV Power transformer LV1 at 230kV Veeranam 230/33kV Power transformer LV2 at 230kV Sankaneri 110kV Sankaneri-Koodankulam 230/33kV Power transformer LV1 & LV3 at 230kV Udayathar 110kV Kayathar-Kodikuruchi feeder at 230kV Kayathar 110kV Kodikuruchi-Veerasingamani feeder-1 at 230kV Kodikuruchi
Case-2	
Tripping of one ICT and loading on the ICT in service is 150% with time delay of 600ms	**Tripping of feeders : (Load: 360 MW)** 230/33kV Power transformer LV1 at 230kV Veeranam 230/33kV Power transformer LV2 at 230kV Sankaneri 110kV Sankaneri-Koodankulam 230/33kV Power transformer LV1 & LV3 at 230kV Udayathar 110kV Kayathar-Kodikuruchi feeder at 230kV Kayathar 110kV Kodikuruchi-Veerasingamani feeder-1 at 230kV Kodikuruchi

Ref No: SPS/SR/TRF/05

SPS for Madurai ICT

SPS was put to avoid overloading of Madurai ICTs.

Contingency	Action
Case-1	
Tripping of one ICT and loading on the ICT in service is 130% with time delay of 16 seconds	Tripping of feeders 110kV Rasingapuram at Theni 110kV Keelaviranam at 230kV Kayathar 110kV Kodikuruchi at 230kV Kodikuruchi power transformer LV3 at Veeranam Power transformer LV3 & LV4 at 230kV Aamudapuram
Case-2	
Tripping of one ICT and loading on the ICT in service is 150% with time delay of 600ms	Tripping of feeders 110kV Rasingapuram at Theni 110kV Keelaviranam at 230kV Kayathar 110kV Kodikuruchi at 230kV Kodikuruchi 230/33kV Power transformer LV3 at Veeranam 230/33kV Power transformer LV3 & LV4 at 230kV Aamudapuram

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Annexure 5

SPS IN NORTH-EASTERN REGION

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INDEX

SPS related to Safe evacuation of Generation

Ref No: SPS/NER/GEN/01

SPS for NER Grid Security with 1 Module (GT+ST) of OTPC Palatana generating station (363.3MW)

There are 4 SPS schemes namely:

SPS 1 : When Palatana generating unit trips

SPS 2 : When 400 kV Palatana-Silcher (D/C) lines trip (with generation at Palatana)

SPS 3 : When 400 kV Silchar – Byrnihat S/C line trip (with generation at Pallatana)

SPS 4 : When 400 kV Silchar – Byrnihat S/C line trip (without generation at Palatana)

Pre-condition:

Following lines should be kept in open condition

- 132 kV Khliehriat – Lumshnong S/C
- 132 kV Pailapool – Jiribam line at Jiribam end
- 132 kV Khleihriat (PG) – Khliehriat (Me) D/C (Depending on Leshka Generation and existing system conditions, so as to enable complete evacuation of power from Leshka HPP)

SPS 1 - When Palatana unit trips

Scheme:

i. When generator at Palatana trips a signal will be generated from trip relay of the unit.

ii. This signal should trip the CB of 132 kV Silchar – Srikona D/C & 132 kV Silchar – Panchgram lines at Silchar.

iii. Subsequent to tripping of 132 kV Silchar – Panchgram line, a signal will be generated from trip relay of 132 kV Silchar –Panchgram line. This signal should trip the CB of 132 kV Badarpur – Panchgram line at Badarpur.

iv. After these trippings an instant load relief of 60 MW in off-peak & 105 MW in peak which will avert the system from cascade tripping

v. Then manual demand management / disconnection should be imposed, if necessary.

Load Relief		
	Off-Peak	Peak
Srikona :	15 MW	25 MW
Pailapool :	10 MW	20 MW
Panchgram:	20 MW	35 MW
Lumsnong :	15 MW	25 MW
Total	**60 MW**	**105 MW**

SPS 2 - When 400 kV Palatana-Silchar (D/C) lines trip

Scheme:

i. When both the ckts of 400 kV Palatana – Silchar lines trip, a signal will be generated from trip relays at Silchar

ii. This signal should trip the CB of 132 kV Silchar – Srikona D/C & 132 kV Silchar – Panchgram lines at Silchar.

iii. Subsequent to tripping of 132 kV Silchar – Panchgram line, a signal will be generated from trip relay of 132 kV Silchar –Panchgram line. This signal should trip the CB of 132 kV Badarpur – Panchgram line at Badarpur.

iv. After these trippings a instant load relief of 60 MW at off-peak & 105 MW in peak which will avert the system from cascade tripping

v. Then manual demand management / disconnection should be imposed, if necessary.

Load Relief		
	Off-Peak	Peak
Srikona :	15 MW	25 MW
Pailapool :	10 MW	20 MW
Panchgram:	20 MW	35 MW
Lumsnong :	15 MW	25 MW
Total	**60 MW**	**105 MW**

SPS 3 - When 400 kV Silchar – Byrnihat S/C line trips (with generation at Palatana)

Scheme:

i. When 400 kV Byrnihat – Silchar lines trip, signal will be generated from trip relays at Silchar

ii. This signal should trip CB of GTG / STG at Palatana (as may be required). But the tripped unit of Palatana will be running in FSNL (Full Speed No Load)

iii. A instant relief in line loading of 230 / 130 MW which will avert the system from cascade tripping.

iv. Then manual demand management / disconnection should be imposed, if necessary.

	Load Relief	
	Off-Peak	Peak
Srikona :	15 MW	25 MW
Pailapool :	10 MW	20 MW
Panchgram:	20 MW	35 MW
Lumsnong :	15 MW	25 MW
Total	**60 MW**	**105 MW**

SPS 4 - When 400 kV Silchar – Byrnihat S/C line trips (without generation at Palatana)

Scheme:

i. When 400 kV Byrnihat - Silchar line trips, a signal will be generated from trip relays at Silchar

ii. This signal should trip the CB of 132 kV Silchar – Srikona D/C & 132 kV Silchar – Panchgram S/C line at Silchar.

iii. Subsequent to tripping of 132 kV Silchar – Panchgram line, a signal will be generated from trip relay of 132 kV Silchar –Panchgram line. This signal should trip the CB of 132 kV Badarpur – Panchgram line at Badarpur.

iv. After these trippings an instant load relief of around 95 MW in Peak Hours which will avert the system from cascade tripping

v. Then manual demand management / disconnection should be imposed, if necessary.

Identified Radial Loads at Substations

	Peak
Srikona :	25 MW
Pailapool :	20 MW
Panchgram:	35 MW
Lumsnong :	15 MW
Total	**95 MW**

Note :

The SPS schemes as stated above are subject to changes with changing grid conditions. The loads being disconnected with the configuration as per current SPS include only loads in South Assam area.