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भारत सरकार  
उत्तर क्षेत्रीय विद्युत समिति

18-ए, शाहीद जीत सिंह मार्ग, कटवारिया सराय नई दिल्ली - 110016

Government of India  
**Northern Regional Power Committee**  
18-A, Shaheed Jeet Singh Marg, Katwaria Sarai, New Delhi-110016

No. NRPC/SE (P&S)/12-PSC/10/

Dated: 31.08.2010

**Sub:-Agenda for the 12<sup>th</sup> Protection sub Committee Meeting on 10.09.2010**

The 12<sup>th</sup> Protection sub Committee Meeting will be held at 10:30 Hrs on 10<sup>th</sup> September 2010 at Dadri Thermal Power Plant of NTPC. The Agenda can be down loaded from NRPC website at <http://www.nrpc.gov.in>.

Kindly make it convenient to attend the meeting.

K.K.Arya

Superintending Engineer (P&S)

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NORTHERN REGIONAL POWER COMMITTEE

AGENDA

FOR

12<sup>th</sup> MEETING OF PROTECTION SUB-COMMITTEE

Time of meeting : 10.30 Hrs.

Date of meeting : 10<sup>th</sup> September, 2010

Venue : Dadri Thermal Power Plant of NTPC

**A . C O N F I R M A T I O N O F M I N U T E S**

**A.1 CONFIRMATION OF MINUTES OF 11<sup>th</sup> MEETING OF PROTECTION SUB-COMMITTEE.**

Minutes of 11th meeting of Protection Sub-committee, held on 23<sup>rd</sup> April, 2010 circulated vide letter No. NRPC/SE (P&S)/Protection/10/2010 dated 22.06.2010. The Minutes are also available on NRPC's website at <http://www.nrpc.gov.in>. As no comments have been received from any of the constituents, the Committee may confirm the same.

**B. ITEMS FOR FOLLOW UP ACTIONS**

**B.1.CO-ORDINATION OF RELAY SETTINGS FOR PROTECTION OF TRANSMISSION LINES OF DIFFERENT UTILITIES / ORGANISATIONS**

**B.1.1** In 13<sup>th</sup> NRPC meeting held on 27<sup>th</sup> July, 2009 it was agreed that uniform philosophy for protection of lines to avoid indiscriminate tripping under fault condition, need to be implemented by all Constituents. Protection philosophy accepted by PSC is given in **Annexure-I**. In order to verify and monitor the co-ordination of relay settings for protection of transmission lines in the Northern Region, all utilities may submit details of relays provided in their system and protection setting adopted by them(Annexure-II). It was decided in 11<sup>th</sup> PSC meeting held on 23<sup>rd</sup> April 2010 at Chamera-1 that certain modifications are required in the Annexure-II including Line Parameter, Type and Configuration of the conductor. Now the revised Annexure with the above modifications is available on NRPC website.

Information from BBMB, PGCIL, has been received and from other are awaited.

Other GENCO and TRANSCO are requested to submit the details as per format given in Annexure-II through e-mail ([nrpcprotection@gmail.com](mailto:nrpcprotection@gmail.com)).

### **B.1.2 df/dt relay setting**

Analysis of grid incidents, based on 40 ms PMU measurement shows that an initial Oscillation of +/-1 to +/-2 Hz / sec is being observed in the system that settles down in about 8 cycles or about 160 ms. The df/dt relays in the system should not operate during such incidents of fault and it should only operate during the event of a big loss of generation. In view of this it is proposed that throughout the region the measurement time of df/dt relay shall be set at 8 cycles or 160 ms to avoid any spurious tripping and there should not be any additional delay in operation time. Constituents are requested to confirm the status.

### **B.1.3 Over-Voltage Stage-II relay Setting**

It was decided in 11<sup>th</sup> PSC meeting held on 23<sup>rd</sup> April 2010 at Chamera-1 that a delay of 100 m-sec is required for the lines having over-voltage relays which are numerical. PSC agreed that a time delay of 100 m-secs should be provided only for numerical relays for setting at 150% over-voltage. For electromechanical relays, no need to provide delay as it would be inherent in the relay. The utilities may confirm implementation of these settings.

### **B.1.4 Provision of directional earth fault (DEF) on all the 400 kV lines**

As per the protection philosophy agreed for implementation in the Northern Region, backup protection on all the 400 kV and 220 kV lines with two main protections should also have backup earth fault protection.

It has been observed during that grid disturbance on 2<sup>nd</sup> January 2010 at 21:54 hrs due to non-availability of directional earth fault protection on 400 KV Bawana-Bamnauli lines, the fault on 400kV Ballabgarh-Bamnauli remained unclear for about 2 minutes.

PSC agrees that Back up Earth Fault protection should be directional for all 400 kV and 220 kV lines.

All the constituents were requested to implement the same and confirm to NRPC secretariat.

## **B.2 PROTECTION AUDIT FOR UPGRDATION OF PROTECTION SYSTEM**

In the 16<sup>th</sup> NRPC Meeting held on 15<sup>th</sup> / 16<sup>th</sup> April, 2010, it was decided that the DTL and UPPTCL would carry out the Protection Audit for their system before Common Wealth Games. In the 11<sup>th</sup> Protection Sub-Committee Meeting held on 23<sup>rd</sup> April'10, other utilities were also requested to initiate the processing of protection audit. DTL has awarded the Protection Audit work to CPRI.

The respective utilities may update the status.

During the hearing on 25-5-2010 by CERC in the matter of grid disturbance which occurred on 2-1-2010, CERC directed Member Secretary, NRPC to submit a concrete proposal for third party protection audit within two weeks. Accordingly, the proposal has been formulated and forwarded to CERC. (A copy enclosed at Annexure-III).

In the 17<sup>th</sup> NRPC Board Meeting held on 17<sup>th</sup> July, 2010, it was decided that the CPRI may be entrusted with the task of protection audit. CEA was requested to co-ordinate with CPRI so as to obtain the detailed proposal from them. CEA has requested CPRI with a request to submit the proposal in this regard. It was also decided in NRPC meeting that the expert group constituted for supervising and monitoring the progress of third party protection audit would also co-ordinate with CPRI.

As decided by the expert group three consultants were shortlisted as follows:

1. Power Research & Development Consultants, Bangalore
2. Tata Consulting Engineers, Mumbai with IIT Mumbai
3. Central Power Research Institute, Bangalore

For the completion of complete project by CPRI it would take 2.5 years. It is proposed to divide the work among three proposed consultants so that project is expedited and completed in one year.

If any utility feels that its sub-station/generating station are critical and should be included in proposal submitted to CERC for protection audit, the same may be submitted to NRPC secretariat.

### **B.3 STATUS OF AVAILABILITY/COMMISSIONING OF BUS BAR PROTECTION AT EACH 400 KV & 220 KV SUBSTATIONS**

**B.3.1** As decided in 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup>, 7<sup>th</sup>, 8<sup>th</sup> 9<sup>th</sup> PSC all constituents are to implement Bus Bar protection at 400 kV and 220 kV substations to improve the reliability of the system. The detailed status of Bus bar protection schemes provided at 400kV and 220kV substations have been received only from all constituents except PSEB, HPSEB, J&K, RRVUNL, UPPTCL, SJVNL, and NPCIL. These constituents are requested to provide the information in following format:

Name of State					
		Bus bar protection			
Name of generating station/ Sub-Station	Sub-Station	Bus bar protection provided and in service	Bus bar protection provided but not in service (with reason)	Installation in progress/ under construction (with target date of completion)	Bus bar protection not provided / not required

(Signature of SLDC Head)

The status of bus bar protection in the State utilities as updated by the members is given as under.

States/ utility	Total generating stations/	substations Nos.	Bus Bar Protection		
			Existing & functioning	By March 2010	During 2010-11
Haryana		41	8	19	10
UP		77	20		
Rajasthan	4	62	4 and 19		
HP		6	3	3	
Punjab		45		5	40
J&K		NA			
Uttrakhand		11	7		
Delhi					
BBMB	7	10	7 and 8	2	

Summarised status for Bus Bar protection is enclosed in Annexure-IV. Constituents may give details through e-mail ([nrpcprotection@gmail.com](mailto:nrpcprotection@gmail.com)) in the format given in Annexure-V.

#### **B.4 SINGLE POLE AUTO-RECLOSING ON 220 KV LINES:.**

As decided in 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup>, 7<sup>th</sup>, 8<sup>th</sup> 9<sup>th</sup> PSC all constituents are to implement Single Pole Auto reclosure schemes on all lines of 220 kV and above. During the 13<sup>th</sup> NRPC meeting also it was decided that all lines of the region will have Single phase Pole Auto reclosing schemes and the same is to be implemented by March 2010 to improve the stability and reliability of the system. The details of Single Pole Auto reclosure schemes on all lines of 220 kV and above are received from all except HPSEB, J&K, UPPTCL, and SJVNL.

These constituents are requested to provide the information in following format:

**Name of State/Organization**

			Single Phase Auto Re closure Scheme				
	Name of Transmissi on Line		Name of generating station/ sub-station from where line is emanating	Auto Re closure protection provided and in service	Auto Re closure protection provided but not in service (with reason)	Installation in progress/ under construction(wit h target date of completion)	Auto Re closure protection not provided / not required(wit h reasons thereof)
	From	To					
400 kV							
220 kV							

(Signature of SLDC Head)

Constituents may give details through e-mail ([nrpcprotection@gmail.com](mailto:nrpcprotection@gmail.com)) in the above format.

Summarised status for Single Pole Auto reclosure scheme is enclosed in Annexure-VI)

**B.5 IMPLEMENTATION OF DECISION ON “BACK UP PROTECTION”**

As agreed in the 5th Meeting of protection sub committee held on 28th March 2008, the details of 400KV lines and 220KV lines, where the following backup protection features have either been disabled or retained, were required to be submitted to NRPC secretariat. The characteristics are:

- 1) Over current protection features shall have to be disabled and only the earth fault protection features to be retained in all 400kV lines.
- 2) Earth fault & Over current shall have to be retained, in all 220kV lines provided with only One Main protection.

As discussed in 11<sup>th</sup> PSC meeting held on 23<sup>rd</sup> April 2010 at Chamera-1 that some incidents still occurs which indicates that Back up Protection has not been implemented fully by all constituents. It was decided by PSC that for all existing and new lines, a certification is to be issued by respective SLDC head and submitted to NRPC secretariat and NRLDC confirming the implementation of protection schemes as per NRPC philosophy.

The utilities confirm implementation of these settings.

### **B.6 PLCC problem at NAPS**

Non-availability of PLCC links between Narora and UPPTCL system affects direct communication with remote end sub-stations and carrier aided line protection. PLCC links (voice and carrier inter trip features) between NAPS & UPPTCL sub-stations are defective and needs to be normalized soon. NAPS requested for the help of UPPTCL in making the PLCC functional at their end also.

NAPS/ UPPTCL intimate the latest status.

## **C . N E W I T E M S F O R D I S C U S S I O N**

### **C.1 Provision of time synchronisation through GPS in all the generating stations sub-stations of regional importance.**

As discussed in 11<sup>th</sup> PSC meeting held on 23<sup>rd</sup> April 2010 at Chamera-1 that while carrying out the detailed study of the grid disturbances and analysis of the faults during grid incidents on 2<sup>nd</sup> Jan 2010, it has been observed that in case of a number of constituents stations, the timing of the disturbances was not tallying due to mis-match in the timings being set at their respective stations. In order to carry out the post analysis it is extremely important that all the recording equipment at generating stations / sub-stations, which are important from regional consideration, must be time-synchronized using GPS.

Apart from time synchronization, the triggering of DRs or EL or Numerical Relays for different analog and digital inputs must be tested periodically so as to facilitate proper analysis at the time of any major tripping.

PSC emphasized the need to test Time-synchronization of GPS periodically. As decided by NRPC a format was designed which is to be filled and certified by constituents and submitted to NRPC/NRLDC. The same is enclosed in Annexure-VI.

**Members may like to deliberate**

### **C.2 Self Certification of Protection setting with respect to NRPC recommendation**

It was decided that a system of periodic self certification along with deviation if any with reason with respect to setting recommended by NRPC by all the constituents / utilities should be established for the lines above 400 kV and generation station 210 MW and above.

It was decided that first certification should be done within one month of issue of format at NRPC website. A sample format is enclosed at Annexure-VII for submission of information to NRPC secretariat.

**Members may like to deliberate**

**C.3 Status of action taken on Recommendation of various Enquiry Committee reports**

Utilities are requested to submit their status/action as per Annexure-VIII on the Recommendation of Enquiry Committee.

Members may update the status

**C.4 TRIPPINGS/GRID DISTURBANCES IN THE REGION FOR THE PERIOD (March 2010-May 2010)**

Some of the important incidents need to be discussed are as under:-

**1. Multiple tripping at 400/220 kV substation Bamnauli**

On 14th April 2010 00.455 hrs, 15th April 2010 23.50 hrs and on 18th May 2010 all the ICTs at 400 /220 kV Bamnauli tripped reportedly on bus bar protection misoperation. Such tripping results in about 600 MW to 800 MW loss of load in this area.

**Members may deliberate**

**2. Multiple tripping at 400/220 kV substation Bawana**

On 27th June 2010 at 15.56 hrs all the lines from 400 kV Bawana tripped. 400 kV Bawana is one of the major substation in the central to west corridor in the northern region and the tripping of lines from Bawana results in overloading of other parallel lines in this corridor and the event of multiple line tripping from Bawana result in major grid disturbance in north western part of NR on 2nd June 2010 at 21.54 hrs.

**Members may deliberate**

**3. Loss of 1200 MW generation at Suratgarh TPS**

All the running units of Suratgarh TPS tripped on 23 May 2010 at 01.32 hrs resulting in about 1200 MW loss of generation. Reportedly units –1, 3, 4 & 5 tripped on failure of auxiliary supply failure and unit-2 tripped due to operation of Bus Bar protection.

**Members may deliberate**

**4.Loss of 2000 MW generation at Rihand STPS:**

During maintenance of 400 kV tie bay circuit breaker of Rihand HVDC-2 and Rihand Singrauli-1 line, all the 4 running units of Rihand STPS tripped resulting in about 2000 MW loss of generation NRLDC

**Members may deliberate**

**5.Loss of 1000 MW generation at Unchahar TPS**

All the running units of Unchahar tripped on 21st Jun 2010 at 15.57 hrs due to tripping in the evacuation system reportedly due to a bus fault at the 220 kV Raibareilly station.

#### **6. Loss of generation at Panipat TPS**

All the running units Panipat TPS both the stages tripped on 12th July 2010 at 15.45 hrs due to problem in the evacuation system. On the 24th June 2010 at 15.30 hrs all the running units of Panipat TPS stage –II tripped.

**Members may deliberate**

#### **7. Multiple tripping at 400/220 kV substation Muradnagar**

All the feeders from 400/220 Muradnagar tripped on 23rd July 2010 at 18.16 hrs affecting load in this area. Similar incident of multiple element outage have also occurred on 1st Jan 2010 at 23.39 hrs and 19th May 2009 at 21.17 hrs.

**Members may deliberate**

#### **8. Multiple tripping at 400/220 kV substation Ballabgarh**

All the 400 kV lines and 400/220 kV ICTs at Ballabgarh tripped on 23rd August 2010 at 11.42 hrs. This resulted in loss of about 300 MW generations at Pragati Gas and about 800 MW load was affected in the Faridabad and Gurgaon area of Haryana.

**Members may deliberate**

#### **9. Multiple tripping at Singrauli complex at 1003 hrs on 7<sup>th</sup> August 2009**

The 400 kV Singrauli-Anpara and 400 kV Singrauli-Allahabad-I were under shut down since 1<sup>st</sup> August 2009 for re-alignment of line in connection with Anpara D power station. On 7<sup>th</sup> August 2009 at around 1003 hours in the run-up to synchronize 500 MW unit-7 at SSTPS, following four 400 kV lines also tripped:

- i. 400 kV Singrauli-Kanpur
- ii. 400 kV Singrauli-Rihand I
- iii. 400 kV Singrauli- Rihand-II
- iv. 400 kV Singrauli-Vindhyachal

From the details submitted to NRLDC and reply received from Singrauli STPS and Rihand STPS, the situation and sequence of events not explained properly. It was decided that NTPC would submit a copy of complete details to NRPC secretariat and NRLDC. Considering that this incident had potential to cause outage of the entire power station, this event needs thorough investigation.

The above tripping might be investigated in detail by NTPC and presented to protection sub-committee.

Annexure-I**Uniform Protection Philosophy as agreed by NRPC**

S.No	Protection Setting	Reach & Time
1.	Long lines Zone-1	80% of the Protected line, Instantaneous
	Zone-2	100% of the Protected line + 50% of the shortest line emanating from the far end bus bar or 120% of the Protected line which ever is higher. Time Setting: 350ms for short lines ( $\leq 100\text{km}$ ) and 500ms for long lines $> 100\text{km}$ .
	Zone-3	120% of the protected line + 100% of the longest line emanating from the far end bus bar or 100% of the Protected line + 100% of the longest line emanating from the far end bus bar + 25% of the longest line emanating from the far end of the second line considered, which ever is lower. The zone setting to be limited such that it will not reach into the next voltage level. Time Setting: 1000m sec.
	Zone- 3R	25% of the Zone-1 reach. Time Setting: 1000m sec
2.	Lines with Series and other compensations in the vicinity of Substation	80% of the Protected line. 100ms-time delay for allowing correct distance measurement after the series capacitor is bypassed.
3.	Power Swing Blocking	Block tripping in all zones, all lines. Out of Step tripping to be applied on all inter regional tie lines Deblock time delay = 2s
4.	Protection for broken conductor	Negative Sequence current to Positive Sequence current ratio more than 0.2( $I_2/I_1 \geq 0.2$ ) Only for alarm: Time delay = 3-5 sec
5.	Carrier Protection	To be applied on all 400kV and 220kV lines with the only exception of radial feeders.
6.	Back up Protection	On 400 & 220kV lines with 2 Main Protections, back up Earth Fault protections alone to be provided. No Over current protection to be applied. On 220kV and lower voltage lines with only one Main protection Back up protection by IDMT O/C and E/F to be applied.
7.	Auto Re-closing with dead time.	Single pole trip and re-closing Dead time = 1.0s. Reclaim time = 25.0s
8	LBB Protection and bus bar protection	To be applied on all 400kV and 220kV sub stations with the only exception of 220kV radial fed bus bars. LBB Current sensor $I > 20\% I_n$ LBB time delay = 200ms



## **Proposal for Protection System Study and Third Party Audit for Northern Region**

### **Introduction**

Protection Scheme is a very important component of Power System. It has to be reliable, efficient, and fast in operation, maintainable, flexible, compact and dependable with self-checking features to protect the system from all types of faults.

The complexity of grid is increasing with the addition of transmission elements viz. substations, transmission lines and distribution feeders to meet increasing demand and generation. It requires protection systems so that basic criteria of protection i.e. selectivity, sensitivity, discrimination and speed are maintained. In addition to this there are the problems associated with aging of equipment like conductor, insulator and other accessories. The combined effect of this is manifold increase in magnitude of fault current and frequency of faults. Protection mal-operations are quite common leading to multiple element outages or near miss situations which has the potential to cause a major grid disturbance. It will be the responsibility of each constituent of the combined grid to see that their protection system perform flawlessly to ensure that there is no reflection of major disturbances in one area to the entire network

### **Need of Protection Audit**

Protection system of all the utilities, that are part of grid should be coordinated to avoid indiscriminate tripping and safe and reliable grid. For that a Uniform Protection Philosophy which was evolved by Protection Sub-Committee in various meetings (Annexure-I) and approved by NRPC is to be implemented by all the constituents for better coordination of relays to avoid indiscriminate tripping under fault conditions.

As per the Grid connectivity Standard notified by CEA it is the responsibility of the utility to keep its protection system healthy. However, one of the reasons for the grid incidents on 2.01.2010 was due to unintended/unexpected operation of the protection system. At some of the locations in the grid even the desired protection did not operate. The inquiry Committee on grid disturbance has recommended that each utility should get the protection study and audit done through third parties. The third party protection audit will cover following scope:

- To carry out relay coordination studies for the different protection schemes.
- Review past record (say for 2 years) of Normal & Abnormal Tripping.
- To assess the conditions of existing relays.
- Recommend modern Protection relays with improved features.
- Up gradation of protection system.

## **NRPC Initiative**

NRPC in its 13<sup>th</sup> meeting held on 26<sup>th</sup> June, 2009 decided that an independent Consultant would be appointed to perform the protection system study and Protection Audit of Northern Region. Accordingly, in 9<sup>th</sup> Protection Sub-Committee meeting held on 24<sup>th</sup> July, 2009 an expert group comprising the representatives of NTPC, PGCIL, RRVPNL, DTL, NPCIL, UPPTCL and NRPC was constituted to frame the Terms of Reference for proposed consultant.

Recommendations of expert group are as under:

1. The expert group is of the opinion that the protection system studies and protection audit for the complete northern system would be voluminous work and unmanageable to identify the protection problem and focus on the protection issue.
2. In accordance with the decision of 15<sup>th</sup> NRPC, the expert group identified the pilot project for protection audit for Delhi system and Western UP sub-system. The pilot project for these areas would be more important if completed before the Common Wealth Games so as to ensure secure, reliable, safe system of power supply for Delhi.

The expert group formulated the scope of work for carrying out protection study and audit for Delhi system at first instance.

3. To identify the eligible consultant for protection study and audit for these pilot projects the expert group did an extensive survey to search the national level consultant and after interaction with the various entities short-listed the following:
  - i. Power Research & Development Consultants, Bangalore
  - ii. Tata Consulting Engineers, Mumbai
  - iii. Central Power Research Institute, Bangalore
  - iv. Indian Institute of Technology, Mumbai

Further, based on their evaluation, the expert group recommended CPRI, Bangalore, PRDC, Bangalore, and TCE, Mumbai in association with IIT, Mumbai.

4. The expert group is of the view that the respective utilities may consider other national and international entities for Third Party protection study and audit apart from the consultant as recommended above.

5. Expert group is of the view that financial requirement for protection audit of the system would be dependent upon the various factors including the size of the system for protection audit. The respective utility, Delhi and UP may take up the pilot project by identifying and inviting bids from the various consultants.

Expert group prepared the scope of work for carrying out the protection audit and study and the same is enclosed at Annexure-II.

The scope of work and recommendations of expert group were discussed and accepted in

15<sup>th</sup> NRPC meeting held on 24<sup>th</sup> December, 2009.

In 16<sup>th</sup> NRPC meeting held on 16<sup>th</sup> April 2010 it was decided that protection system studies and audit of Delhi Sub-system would be carried out by DTL before Commonwealth Games. Based on the approval of NRPC, DTL has gone ahead with the bidding process. UPPTCL is yet to take initiative for the protection audit.

### **Proposal**

CERC in its order dated 14.01.2010 in reference to petition no 2/2010(Suo motto) on Grid disturbance in Northern Region on 02.01.2010 had directed CTU and NRLDC to carry out the detailed study of the grid disturbance and submit a report containing the reasons for disturbance and suggest remedial measures. Accordingly, in its Record of Proceedings on said petition dated 25.05.2010, CERC directed Member Secretary, NRPC to submit a concrete proposal for third party protection audit.

Based on the initiative taken by NRPC, the Expert Group has submitted its recommendations in the matter of protection audit which has been accepted by NRPC.

The broad Scope of Work for carrying out protection audit is as given below:

- Collect & Compile Data such as Single Line Diagram of State grid as well as Sub-station/Generator switch yard, network configuration & parameters, relay settings etc.
- Comprehensive Protection review including protection philosophy, Relays and Inter-tripping schemes etc.
- Review past record (say 02 years) of Normal & Abnormal Tripping.
- To assess the conditions of existing relays.
- Recommend state of art Protection relays with improved features if any.
- Carryout relay coordination studies.
- Capacity building of field staff.
- Identification of works involved for up gradation of protection system and estimated cost for the same.

It is proposed to carry out protection audit for the selected network of Northern Region as indicated below:-

1. Generating stations of capacity 1000 MW and above and its associated network.
2. 400 kV sub-stations and its associated network.
3. Critical 220 kV sub-stations and its associated network.

It involves 20 nos. Generating Stations of capacity 1000 MW, 66 nos. 400 kV sub-stations, 21 nos. critical 220 kV sub-stations and its associated network. The state wise indicative list of the Generating Stations and Sub stations is given below (Details enclosed at Annexure-III):

Name of state	Generating Stations 1000 MW & above (Nos.)	Sub-stations (Nos.)	
		400 kV	Critical 220 kV
UP	10	25	05
Haryana	02	12	02
Punjab	01	06	05
J&K	-	05	02
Uttarakhand	01	05	03
Rajasthan	05	09	03
HP	01	04	01

It is proposed to carry out the Third Party Protection audit for the above mentioned system of the organization/utility in the respective State in a phased manner. To begin with, UP system can be taken, being critical having large no. substations and interconnected network in the central part of NEW grid.

#### **Suggested Implementation Strategy**

An expert group comprising of officers from CEA, CTU, NRPC, Concerned utility and NRLDC could be constituted to supervise/monitor the progress of third party audit. It is suggested that the tendering process for appointment of consultant to carry out protection audit may be taken up by the CTU.

The consultant will submit its detailed report indicating deficiency in the protection system and up gradation required / corrective measures/suggestion along with the cost estimates. Each utility will ensure implementation of the corrective measures/suggestions in order to ensure proper functioning of protection system.

#### **Expenditure/Cost Implication**

The indicative cost of the consultant for carrying out third party protection audit per location could be around Rs. 5 lakh.

In 13<sup>th</sup> meeting held on 27.06.2009, members of NRPC were of the view that expenditure in respect of protection studies could be financed from the funds available in UI Pool account. It is proposed that expenditure for protection studies and third party audit could be met from Power System Development Fund.

Based on consultant's detailed report/recommended corrective measures/up gradation of protection system, each utility will ensure its comprehensive implementation so as to have safe, secure and reliable operation of grid. It is suggested that the 50% of total expenditure

incurred in implementation of recommended corrective action/up gradation of protection system could be reimbursed to the respective owning utility from Power System Development Fund on successful timely implementation of the protection system.

**Annexure-I**

**Uniform Protection Philosophy as agreed by NRPC**

S.No	Protection Setting	Reach & Time
1.	Long lines Zone-1	80% of the Protected line, Instantaneous
	Zone-2	100% of the Protected line + 50% of the shortest line emanating from the far end bus bar or 120% of the Protected line which ever is higher. Time Setting: 350ms for short lines ( $\leq 100\text{km}$ ) and 500ms for long lines $> 100\text{km}$ .
	Zone-3	120% of the protected line + 100% of the longest line emanating from the far end bus bar or 100% of the Protected line + 100% of the longest line emanating from the far end bus bar + 25% of the longest line emanating from the far end of the second line considered, which ever is lower. The zone setting to be limited such that it will not reach into the next voltage level. Time Setting: 1000m sec.
	Zone- 3R	25% of the Zone-1 reach. Time Setting: 1000m sec
2.	Lines with Series and other compensations in the vicinity of Substation	80% of the Protected line. 100ms-time delay for allowing correct distance measurement after the series capacitor is bypassed.
3.	Power Swing Blocking	Block tripping in all zones, all lines. Out of Step tripping to be applied on all inter regional tie lines Deblock time delay = 2s
4.	Protection for broken conductor	Negative Sequence current to Positive Sequence current ratio more than 0.2 ( $I_2/I_1 \geq 0.2$ ) Only for alarm: Time delay = 3-5 sec
5.	Carrier Protection	To be applied on all 400kV and 220kV lines with the only exception of radial feeders.
6.	Back up Protection	On 400 & 220kV lines with 2 Main Protections, back up Earth Fault protections alone to be provided. No Over current protection to be applied. On 220kV and lower voltage lines with only one Main protection Back up protection by IDMT O/C and E/F to be applied.
7.	Auto Re-closing with dead time.	Single pole trip and re-closing Dead time = 1.0s. Reclaim time = 25.0s
8	LBB Protection and bus bar protection	To be applied on all 400kV and 220kV sub stations with the only exception of 220kV radial fed bus bars. LBB Current sensor $I > 20\% I_n$ LBB time delay = 200ms

### Scope of Work for Proposed Consultant

1. Review of the implemented protection schemes/philosophy & settings in the 400kV & 220kV feeders of Delhi ring which includes protection of Generator, Transmission line, Transformer, Reactor, Circuit Breaker, Bus Bar, Series Compensation Device. CBIP Publication no. 274 (revised) viz. 'Manual on Protection of Generators, Generator Transformers and 220 kV and 400 kV networks' may be used as a standard for the above purpose along with NRPC recommended settings. Review of settings for relay loadability (load encroachment) as per NERC criteria PRC-023-1. The Protection review should be done keeping in view the following :
  - 1.1. Availability of all recommended protection philosophy as per CBIP Manual 274.
  - 1.2. Relay settings as per NRPC recommendations.
  - 1.3. Local deviations in implementation of schemes, relay settings, coordination as per above standards & reasons thereof.
  - 1.4. Consultants recommendations based on studies/ international experience.
2. To carry out relay coordination studies for the different protection schemes.
3. To check for the adequacy/healthiness of the Primary & Backup protection scheme & settings. Recommend corrective action for any additional protection and disabling any unwanted setting/ protection.
4. Checking healthiness/ adequacy of 220/110/50V DC System available at Substations for protection/PLCC and suggest corrective measures in case of any problem.
5. Review of availability/ healthiness of communication links like PLCC, optical fiber used for protection.
6. Review of availability/ Healthiness of recording instruments - Disturbance Recorder, Event Logger.
7. Review of availability/ Healthiness of Time synchronization unit.
8. Review of test reports for assessing the healthiness of Circuit Breaker - Trip and close coil healthiness, Breaker close & open timings, SF6 & operating media pressure settings for alarm, Auto reclose lock out and Breaker operational lockout & Pole discrepancy operation.
9. Review the protection testing procedures benchmarked against best practices in the knowledge of the consultant being adopted around the world.
10. Review of Field testing on all protection relays (including end to end testing), PLCC along with simulation of Disturbance Recorder & Event Logger signals individually for 02 No. 400kV & 02 No. 220kV feeders. The testing will be carried out in the presence of Testing & Commissioning personnel of respective Substation.

11. Field inspection of existing protection devices for obsolescence of technology, suitability, healthiness (based on test reports).
12. The test reports available at site may be compared against POWERGRID norms or other best norms in the knowledge of the consultant.
13. Prepare a directory of the protection system.
14. Presenting the finding of the study and conducting 2 day tutorial/ workshop to the concerned engineers.
15. Prepare a report on the protection review which shall include the details of recommended protection philosophy, setting calculation procedures for different protections, suitable solutions for rectification of identified problems. A report on the progress of work is to be submitted every month to expert group.



Total	4	8	10	26	8	17	30	38	1	2	4								
PUNJAB					AMRITSAR	2	1	4											
					JALLANDHAR(PG)	2	6	7											
					LUDHIANA (PG)	3	2	2											
					MALERKOTLA(PG)	2	3	6											
					MOGA(PG)	4	8	8											
				PATIALA (PG)	2	3	3												
Total	0				6	15	23	30											
RAJASTHAN	HEERPURA	4	4	11	BASSI	2	7	4	SURATGARH	6	2	3	4	RAPP C	2		3		
	MERTA	1	5	3	BHIWADI	2	8	4											
	JODHPUR	2	3	5	KOTA(PG)		3												
	RATANGARH	3	3	10	KANKROLI	3	6	4											
					BHINMAL	1	2	1											
Total	4	10	15	29	5	8	26	13	1	6	2	3	4	1	2		3		
HIMACHAL PRADESH					NALLAGARH(PG)	2	6	4						JHAKRI	6		6		
					BASPA		2												
					CHAMERA-1		3												
					CHAMERA-2		2												
Total	0				4	2	13	4						1	6		6		
UTTARAKHAND	RISHIKESH	2	2	4	ROORKEE(PG)	1	2							TEHRI	4		2		
	KASHIPUR	3	2	2	KOTESHWAR(PG)		2												
	VISHNUPRAYAG		2																
Total	3	5	6	6	2	1	4							1	4		2		
JUMMU & KASHMIR					KISHENPUR	2	8	12											
					WAGOORA(PG)	4	4	4											
					DULHASTI		1												
					BAGLIHAR		2												
					URI		2												
Total	0				5	6	17	16											
GRAND TOTAL	26	58	101	129	43	68	189	136	4	18	9	12	9	5	24	2	30	4	

**Note :**

- For Delhi system the protection audit is being taken up under pilot project for Protection audit and the same is at the bidding stage
- For audit of a 400/220 kV S/s the 220kV outlet are also to be considered along with the terminating 220kV Substation.

Table 2: 220kV Substations & Generating Stations and its associated network

Area	SUBSTATION						GENERATING STATION							
	State			Central			State				Central			
	Station	Trafo	220 kV	Station	Trafo	220 kV	Station	Units	Trafo	220 kV	Station	Units	Trafo	No. Of Lines
	Station	Trafo	220 kV	Station	Trafo	220 kV	Station	Units	Trafo	220 kV	Station	Units	Trafo	220 kV
U.P	HARDUAGANJ	2	6								NAPPS	2		5
	NARA	2	3								DADRI	10		
	CBGANJ	2	6								OBRA	3		
	FATEHPUR	2	8								UNCHAHAR	5		9
	CHINHAT	1	4											
Total	5	9	27								4	20		14
HARYANA	CHARHI													
	DADRI	2	12				PANIPAT	8						
	SAMAYPUR		12											
Total	2	2	24				1	8						
PUNJAB	GANGUWAL	2	15				ROPAR	6	2	10				
	JAMALPUR	6	10											
	SARNA	1	14											
	GOBIDGARH I	3	10											
	MOHALI	3	8											
Total	5	15	57				1	6	2	10				
RAJASTAN	KOTA													
	SAKATPURA	2	10				RAPP A	2		4				
	BHILWARA	2	9				RAPP B	2		7				
Total	KHETRI	1	8				KOTA	7		10				
	3	5	27				3	11	0	21				
HIMACHAL PRADESH	KUNIHAR	4	4											
Total	1	4	4											
UTTARAKHAND	KHODRI	1	7	SITARGANJ	1	2								
				PITHORAGARH		2								
Total	1	1	7	2	1	4								
JUMMU & KASHMIR	PAMPORE	3	4											
	GLADNI(JAMMU)	1	3											
Total	2	4	7											
GRAND TOTAL	19	40	153	2	1	4	5	25	2	31	4	20	0	14

## Annexure-IV

**Status of availability of bus bar protection at 400kV, 220kV substations,**

	<b>States</b>	<b>Constituent</b>	<b>BUS bar-400KV</b>	<b>Bus bar-220KV</b>
1	Delhi	DTL	Available.	Available.
2	Delhi	IPGCL	<b>No 400 kV substation owned by IPGCL</b>	220 kV IP S/s and its 220 kV yard (High Impedance Percentage Differential Scheme) main and check zones on Bus-I & II.
4	Haryana	HVPNL	<b>Not Available</b>	Yes
4	Haryana	HPGCL	<b>No 400kV substation owned by HGPCL</b>	awaited, xcept Panipat Tps
5	HP	HPSEB	<b>No 400 kV substation owned by HPSEB</b>	Information awaited
6	J&K	PDD	<b>No 400 kV substation owned by J&amp;K</b>	Information awaited
7	PUNJAB	PSEB	<b>No 400 kV substation owned by PSEB.</b>	Not available
8	RAJASTHAN	RRVNL	Available	Available at <b>selected</b> substations.
9	UTTARAKHAND	UPPCL	Information awaited	Information awaited
9	UTTARAKHAND	UJVNL	Information awaited	Information awaited
10	UP	UPTCL	Available at selected substations.	Available at selected substations.
11	PowerGrid-I		Available	Available
12	PowerGrid-II		Available	Available
13	NTPC (NCR)		Available	Available
14	NTPC-NR		Available	Available,
15	BBMB		Available	Available at <b>selected</b> substations.
16	NPC		Available-but details needed	Available-but details needed
17	THDC		Available-but details needed	Available-but details needed
18	NHPC		<b>Available</b>	<b>Available</b>
19	SJVN		Information awaited	Information awaited

**Annexure-V**

<b><u>Bus Bar Protection for 400 kV Level</u></b>					
Name of State	Type of Station	Name of generating station/Sub-station	Bus bar protection provided and in service	Bus bar protection provided but not in service (with reason)	Installation in progress/ under construction(with target date of completion)
Uttar Pradesh	Generating Station	DADRI			
		ANPARA			
		OBRA			
		AURIAAYA			
		RIHAND			
		SINGRAULI			
	Sub-Station	AGRA(UP)			
		MURADNAGAR			
		PANKI			
		MUZAFFARNAGAR			
		MORADABAD			
		BAREILY (UP)			
		LUCKNOW(UP)			
		UNNAO			
		SULTANPUR			
		GORAKHPUR(UP)			
		AZAMGARH			
		SARNATH			
		MAU			
		AGRA(PG)			
KANPUR(PG)					
MAINPURI(PG)					

		MEERUT(PG)			
		MANDOLA			
		ALLHABAD			
		BALIA			
		BAREILY (PG)			
		GORAKHPUR(PG)			
		LUCKNOW(PG)			
		VINDHYACHAL			
		Greater Noida			
Delhi	Sub-Station	BAWANA			
		BAMNAULI			
		MAHARANIBAGH			
<b>HARYANA</b>	Generating Station	KHEDAR			
	Sub-Station	KIRORI			
		BHIWANI			
		DEHAR			
		PANIPAT			
		ABDULLAPUR(PG)			
		BAHADURGARH			
		BALLABGARH(PG)			
		FATEHABAD (PG)			
		HISAR (PG)			
		KAITHAL(PG)			
		GURGAON			
		SONIPAT			
<b>Punjab</b>	Sub-station	AMRITSAR			

		JALLANDHAR(PG)			
		LUDHIANA (PG)			
		MALERKOTLA(PG)			
		MOGA(PG)			
		PATIALA (PG)			
<b>RAJASTAN</b>	Generating Station	SURATGARH			
		RAPP C			
	Sub-Station	HEERPURA			
		MERTA			
		JODHPUR			
		RATANGARH			
		BASSI			
		BHIWADI			
		KOTA(PG)			
		KANKROLI			
BHINMAL					
<b>HIMACHAL PRADESH</b>	Generating Station	JHAKARI			
	Sub-station	NALLAGARH(PG)			
		BASPA			
		CHAMERA-1			
		CHAMERA-2			
<b>UTTARAKHAND</b>	Generating Station	TEHRI			
	Sub-Station	RISHIKESH			
		KASHIPUR			
		VISHNUPRAYAG			
		ROORKEE(PG)			

		KOTESHWAR(PG)			
<b>JUMMU &amp; KASHMIR</b>	Sub-Station	KISHENPUR			
		WAGOORA(PG)			
		DULHASTI			
		BAGLIHAR			
		URI			

<b>Bus Bar Protection for 220 kV Level</b>					
Name of State	Type of Station	Name of generating station/Sub-station	Bus bar protection provided and in service	Bus bar protection provided but not in service (with reason)	Installation in progress/ under construction(with target date of completion)
Uttar Pradesh	Generating Station	NAPPS			
		DADRI			
		OBRA			
		UNCHAHAR			
	Sub-Station	HARDUAGANJ			
		NARA			
		CBGANJ			
		FATEHPUR			
HARYANA	Generating Station	PANIPAT			
	Sub-Station	CHARHI DADRI			
		SAMAYPUR			
Punjab	Generating Station	ROPAR			
	Sub-Station	GANGUWAL			

		JAMALPUR			
		SARNA			
<b>RAJASTAN</b>	Generating Station	RAPP A			
		RAPP B			
		KOTA			
	Sub-Station	KOTA SAKATPURA			
		BHILWARA			
		KHETRI			
<b>HIMACHAL PRADESH</b>	Sub-Station	KUNIHAR			
<b>UTTARAKHAND</b>	Sub-Station	KHODRI			
		SITARGANJ			
		PITHORAGARH			
<b>JUMMU &amp; KASHMIR</b>	Sub-Station	PAMPORE			
		GLADNI(JAMMU)			

### Annexure-V

Status of availability of Single Phase Auto Reclosure scheme on 400kV, 220kV Lines & BACK up protections

	States	Constituent	A/R-400KV	A/R-220KV	400KV	220KV
1	Delhi	DTL	Available	Out of Service as PLCC not available	AWAITED	AWAITED
2	Delhi	IPGCL			not applicable	
4	Haryana	HVPNL	No 400kV LINES owned by HVPNL	Available.	AWAITED	AWAITED
4	Haryana	HPGCL	Information awaited	Information awaited	not applicable	
5	HP	HPSEB	No 400 kV LINES owned by HPSEB	Information awaited	AWAITED	AWAITED
6	J&K	PDD	No 400 kV LINES owned by J&K	Information awaited	AWAITED	AWAITED
7	PUNJAB	PSEB	No 400 kV LINES owned by PSEB.	Information awaited details received-provided at selected S/s, Nowhere activated	AWAITED	AWAITED
8	RAJASTHAN	RRVPNL	Available	Available at selected* substations.	AWAITED	AWAITED
8	RAJASTHAN	RRVUNL	awaited-xcept Suratgrah	awaited-xcept Suratgrah	not applicable	
9	UTTARAKHAND	UPCL	Information awaited	Information awaited	AWAITED	AWAITED
9	UTTARAKHAND	UJVNL	Information awaited	Information awaited	not applicable	
10	UP	UPTCL	Information awaited	Information awaited	AWAITED	AWAITED
11	PowerGrid-I		Available	Available	yes	yes
12	PowerGrid-II		Available	Available	yes	yes
13	NTPC (NCR)		not applicable	not applicable	not applicable	
14	NTPC-NR		not applicable	not applicable	not applicable	
15	BBMB		Information awaited	Information awaited	AWAITED	AWAITED
16	NPC		Information awaited	Information awaited	AWAITED	AWAITED
17	THDC		Information awaited	Information awaited	AWAITED	AWAITED
18	NHPC		Available	Available	Available	Available
19	SJVN		Information awaited	Information awaited	AWAITED	AWAITED

**Annexure-VI**

**Self Certification by utilities w.r.t. time synchronized through GPS(Frequency six monthly)**

**Name of Organization**

**Date:** \_\_\_\_\_

Name of Sub-station	Whether GPS clock available at Sub-station(Yes/No)	If No give reason and target date for installation of GPS clock	DRs/ELs wired with GPS clock(Yes/No)	If No give reason thereof and target date for wiring up with GPC clock	Last Testing date of GPS clock	Actual output of DRs/ELs during an event and whether event time was same as other station/RLDC DRs/SOE.

(Signature of Sub-Station In-charge)

(Signature of SLDC Head)

## Annexure-VII

## Self Certification of Protection setting with respect to NRPC recommendation (Frequency Six Monthly)

Name of the utilities \_\_\_\_\_

Date \_\_\_\_\_

Name of Sub-station/transmission lines	Protection Setting	Reach & Time	Setting by Utility as per the Philosophy(Yes/No)	If No state the reason with target date of implementation
	Long lines Zone-1	<b>80% of the Protected line, Instantaneous</b>		
	Zone-2	<b>100% of the Protected line + 50% of the shortest line emanating from the far end bus bar or 120% of the Protected line which ever is higher. Time Setting: 350ms for short lines (<math>\leq 100\text{km}</math>) and 500ms for long lines <math>&gt; 100\text{km}</math>.</b>		
	Zone-3	<b>120% of the protected line + 100% of the longest line emanating from the far end bus bar or 100% of the Protected line + 100% of the longest line emanating from the far end bus bar + 25% of the longest line emanating from the far end of the second line considered, which ever is lower. The zone setting to be limited such that it will not reach into the next voltage level. Time Setting: 1000m sec.</b>		
	Zone- 3R	<b>25% of the Zone-1 reach. Time Setting: 1000m sec</b>		
	Lines with Series and other compensations in the vicinity of Substation	<b>80% of the Protected line. 100ms-time delay for allowing correct distance measurement after the series capacitor is bypassed.</b>		
	Power Swing Blocking	<b>Block tripping in all zones, all lines. Out of Step tripping to be applied on all inter regional tie lines Deblock time delay = 2s</b>		
	Protection for broken conductor	<b>Negative Sequence current to Positive Sequence current ratio more than 0.2(<math>I_2/I_1 \geq 0.2</math>) Only for alarm: Time delay = 3-5 sec</b>		
	Carrier Protection	<b>To be applied on all 400kV and 220kV lines with the only exception of radial feeders.</b>		
	Back up Protection	<b>1) On 400 &amp; 220kV lines with 2 Main Protections, back up Earth Fault protections alone to be provided. No Over current protection to be applied. 2) On 220kV and lower voltage lines with only one Main protection Back up protection by IDMT O/C and E/F to be applied.</b>		
	Auto Re-closing with dead time.	<b>Single pole trip and re-closing Dead time = 1.0s. Reclaim time = 25.0s</b>		
	LBB Protection and bus bar protection	<b>To be applied on all 400kV and 220kV sub stations with the only exception of 220kV radial fed bus bars. LBB Current sensor <math>I &gt; 20\%</math> In LBB time delay = 200ms</b>		

(Signature of Sub-Station In-charge)

(Signature of SLDC Head)

## Annexure-VIII

**Status of compliance on Report on Frequent tripping  
of Pragti GT of PPCL**

<b>Sl. No.</b>	<b>Recommendation</b>	<b>Time Frame</b>	<b>Action to be taken by</b>	<b>Status</b>
1	Reviewing of Bus split at Pragati GT	one month	SLDC, Delhi and NRLDC	<u>Bus split is already in force at Pragati S/s</u>
2	Reviewing of setting of excitation system of Pragati Units	three month	PPCL	<u>Completed</u>
3	Provision of Disturbance recorder on Pragati GTs	three month	PPCL	<u>Expected date of completion – Dec 2010</u>
4	Improving maintenance practice of DTL system	one month	DTL	<u>Provided by the concerned dept</u>

5	Provision of inter trip on the lines and auto re closure	Six month	DTL	<u>Expected date of completion – Aug 2010</u>
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**Tripping of evacuation lines leading to loss of generation of about 1700 MW at Nathpa Jhakri and Baspa Hydro power stations on 19th May, 2009 in HP**

<b>Sl. No.</b>	<b>Recommendation</b>	<b>Time Frame</b>	<b>Action to be taken by</b>	<b>Status</b>
1	<p>The relays and switchgear operation should be tested on regular basis and reported to Protection sub-committee of NRPC. The Committee observed that while relays are tested periodically for reach, zone timings etc. they are not tested for non-operation under different loadability conditions. In the US power system the North American Electric Reliability Corporation (NERC) has a reliability standard Standard PRC-023-1 — Transmission Relay Loadability which requires each generator and transmission line owner to test the relays for non-operation during different conditions. A copy of the Reliability Standard as downloaded from website <a href="http://www.nerc.com">www.nerc.com</a> is enclosed at Annexure -I. Protection subcommittee of NRPC may consider these requirements for adopting in the testing philosophy by constituents</p>		NR constituents	

	of NR at least for the trunk 400 kV system.			
2	reported to Protection sub-committee of NRPC		protection Sub committee of NRPC	
3	Disturbance recorder (DR) and event logger (EL) should be in healthy condition and time synchronized with GPS for recording any Grid incident to enable the analysis of such incident. Time synchronization of Relays, Disturbance Recorders (DRs) and Event Loggers (ERs) should be accomplished and certificate to be submitted every quarter to NRPC/NRLDC.		All stakeholders	
4	Patrolling of the power evacuation lines to be carried out frequently on the stretches where faults due to growth of vegetation have been reported in past or where clearances have reduced due to urbanization / overgrown trees in the near vicinity of lines 'right-of-the way		All stakeholders	

5	<p>Unauthorised constructions/activities in the vicinity of line route should be monitored and in case of any such development, the matter should be reported to the concerned organizations for appropriate action.</p>		<p>All stakeholders</p>	
6	<p>System Protection Scheme (SPS) for automatic reduction of generation in case of depletion in the transmission evacuation system be explored for Jhakri and other large power stations of 1000 MW and above. The details in this regard might be worked out separately at the RPC forum in line with section 5.2 (n) of IEGC.</p>		<p>All constituents of NRPC</p>	

**Fault in R-phase of GIS on line circuit breaker of Jhakri-Abdullapur line-I at Jhakri end on 19th November, 2009 in HP**

1	<p>Line Opening Rotation and sequence in NJHPS area during lean season in off peak hours when generation is nil/low would be monitored and optimized based on the following:</p> <ul style="list-style-type: none"> <li>· line lengths</li> <li>· voltage at Jhakri and neighbouring nodes</li> <li>· tapering of hydro generation.</li> <li>· overvoltage setting of parallel lines</li> </ul>		NRLDC/SJVNL/BA SPA/POWERGRID	
2	<p>50 MVAR non-switchable line reactor of Jhakri-Abdullapur Circuit -1 at Abdullapur substation which is out due to CB fault at Jhakri end can be utilised as bus reactor (As a temporary measure) by using the line breaker and ensuring the protection aspects</p>	immediate	POWERGRID	

3	One of the machines at Jhakri HEP and/or at Baspa HEP could be kept in operation for controlling voltages when the grid frequency is continuously below nominal value of 50 Hz during the night hours. During such period the generator shall absorb the maximum possible VARS as per its capability curve.	immediate	SJVNL/BASPA/NR LDC	
4	The transposition of the lines emanating from Jhakri Hydro Power Station may be checked up by POWERGRID.	immediate	POWERGRID	
5	Baspa Hydro Power Plant (3X100 MW) which is designed for running in synchronous condenser mode may be utilized for controlling over voltages in the Baspa & Jhakri Systems.	immediate	BASPA HPS/HPSEB	
6	The bus bar protection at Jhakri HPS needs to be checked for satisfactory operation.	immediate	SJVNL	

7	The additional reactive compensation of 125 MVAR each planned at Abdullapur and Nalagarh (under proposal stage) by POWERGRID may be commissioned on priority.	Long Term measures	POWERGRID	
8	Comprehensive study may be carried out by CTU to identify the reactive power compensation at NJHPS to contain voltages and also the switching surges. The study should also consider the proposed LILO of existing Jhakri-Nalagarh line at Rampur HPS. The options of providing line vis-a-vis Bus reactor at Jhakri HPS and Rampur HPS may also be examined.	Long Term measures	CTU/SJVNL	SJVN has also appointed a consultant to study the same in addition to CTU study. The LOA has been issued to M/s PRDC Bangalore on 20/04/10. Findings were scheduled to be submitted at the end of July 2010 however same is still awaited.
9	The capability of GIS equipments at Jhakri HPS to withstand design parameters particularly switching and normal over voltages needs to be examined and a comprehensive analysis may be got donethrough a third party	Long Term measures	SJVNL	SJVN has also appointed a consultant to study the same in addition to CTU study. The LOA has been issued to M/s PRDC Bangalore on 20/04/10. Findings were scheduled to be submitted at the end of July 2010 however same is still awaited.

10	The condition of GIS equipments may be examined and accordingly appropriate corrective action may be taken by SJVNL	Long Term measures	SJVNL	The appraisal of faulty 01 on line CB Pole Type FB-16D has been carried out by AREVA on dated 01.04.2010 & appraisal/investigation report has already been submitted by the firm. The appraisal of remaining two nos. faulty line CB Poles has been also carried out on the dated 27/28.05.2010 & Appraisal/Investigation report has been also submitted by OEM
11	The insulation coordination studies for GIS substation including Very Fast Transient (VFT) studies or any other phenomenon related to GIS may be carried out under different operating conditions of the grid and future development.	Long Term measures	SJVNL	SJVNL has also appointed a consultant to study the same in addition to CTU study. The LOA has been issued to M/s PRDC Bangalore on 20/04/10. Findings were scheduled to be submitted at the end of July 2010 however same is still awaited.
12	220 kV Nalagarh-Mohali D/C line must be commissioned expeditiously by PSEB. This line would provide strong anchoring support at Nalagarh considering the proximity of Mohali to 6x210 MW Ropar TPS	Long Term measures	PSEB	

13	A comprehensive study may be carried out to examine the effect of Surge Arrestor at Nathpa Jhakri end on switching phenomena with special emphasis on GIS station. For this following is suggested	Long Term measures	SJVNL	SJVN has also appointed a consultant to study the same in addition to CTU study. The LOA has been issued to M/s PRDC Bangalore on 20/04/10. Findings were scheduled to be submitted at the end of July 2010 however same is still awaited.
14	The Protection sub-committee of NRPC could examine annual/seasonal reversal of the overvoltage settings on parallel lines for uniform distribution of switching impact on equipment		NRPC	
15	Necessary measures to control overvoltage by using other line reactors as bus reactors after the line is opened, may also be taken in due course of time after carrying out the necessary modifications in the protective system.		CTU	
16	Considering the growing number of GIS installations expected in the country, the following measures to enhance reliability of these installations are suggested. · Sharing of best practices through user groups of all the utilities owning such installations. · Measures to reduce the Mean Time to Repair (MTTR) of such installations which otherwise are designed to have a high Mean Time Between Failures (MTBF). · Breaker and a half switching scheme may be considered for future GIS installations.		All utilities having GIS installations	

17	All future remote hydro projects such as Karcham Wangtoo, Parbati, Koldam, wherever feasible, may have the capability to operate in synchronous mode.		All utilities setting up remote hydro power stations having unit size 50 MW and above	
18	SJVNL may also explore the possibility to take up a pilot R & D project towards retrofitting of one unit at Jhakri for synchronous condenser mode operation		SJVNL	Suitable action on this issue is yet to be initiated, how-ever same is being expedited.

**Action Plan as recommended by committee for grid incident of 02.01.2010**

S.No	Recommendation	Action By	Time frame
			(months )
1	The recommendations of the earlier inquiry committee to investigate the earlier Grid Incident of 27th January, 2007 and 7&9 March, 2008 which need to be complied immediately are:-		
	Classification of pollution levels of lines / line stretches by measurement of ESDD on insulator.	CTU, STUs	6
	Notifications by the respective State Government that no brick kiln or any industrial unit or biomass or diesel based power plant having chimney height up to 30 meters be set up within 0.5 km of the 220 kV or higher voltage transmission lines.	State Utilities, State Govts.	6
	Review of pollution standard in respect of smoke emission from Chimneys of brick kiln or any industrial unit or biomass power with height upto 30 meters so as to reduce level of emission of suspended particulate matter	State Utilities, State Govts.	6
	Pollution control of diesel vehicle entering NCR area.	State Govts.	6
	Pollution Mapping of the Country	POWERGRID	12
	Railway supply reliability	Railways	3
	<b>Replacement of existing insulators by Polymer/ Antifog Insulators</b>	CTU/STUs	6

	In addition to the replacement of porcelain insulators with polymer/anti-fog insulators on already identified line, utilities should also identify additional lines which are getting frequently affected due to fog in winter season. The work of replacement of porcelain insulators with polymer/anti-fog insulators should be carried out on the complete stretches of the lines especially in case of the critical 400kV and 200kV lines and evacuation lines from the generating station		
3	<b>Cleaning of Insulators and maintenance system Elements</b>	All utilities	Regularly, particularly by 15th Nov
4	<b>Maintenance of System Elements around NAPS</b>	UPPTCL	6
5	<b>Monitoring Mechanism</b>	SLDC, NRLDC, NRPC	Monthly basis
	SLDCs and NRLDC may closely monitor the criticality of lines vis-à-vis shutdown availed for cleaning/replacement of insulators of lines.		
6	<b>Alertness during foggy condition</b>	CTU, STUs, SLDCs, NRLDC,	Regularly, during winter period
	Data of Relative Humidity (RH) and temperature should be captured. All constituents should closely monitor these forecasts and ensure availability of suitable O&M staff in place and senior officers at all strategic locations		

	When the grid is critical, SLDCs may ensure the loading of major trunk line is controlled with adequate safety margin. NRLDC may reduce loading of lines in North- West part of NR system during foggy weather period. The operators at SLDCs may follow the instructions of NRLDC to reduce the drawal from the grid, maintain the system parameters particularly the voltages at the grid sub-stations. All the utility must be prepared to meet even more N-2 contingency under such operating condition of the grid.		
7	<b>Railway Supply Reliability</b>	Railways	3
	To make arrangement for additional supply point(s) for the traction system, replace porcelain insulators with polymer and enhance maintenance of the system elements		
8	<b>Protection Coordination</b>	All utilities	12
	Each utility should get the protection study and audit done through third party.		
9	Requirement to change the CT ratio to higher range	CTU/STUs	1
10	Functioning of RTU and data telemetry facilities-		
	All RTUs and data telemetry facility should be functioning in the generation stations/grid sub-stations. The non-reporting RTUs should be integrated with the system immediately.	CTU/STUs /Gencom/ IPPs	6
11	<b>Adequate back-up power supply at wide band communication and its regular upkeep</b>	CTU/STUs	6
12	<b>Effectiveness of defense mechanism and adequacy of safety net</b>	State Utilities,SLDCs, NRLDC and NRPC	3

	Defense mechanism should be further strengthened in NR		
13	<b>Healthiness of DR/EL and time synchronization</b>	All Utilities	6
	To ensure healthiness of all recording equipment at the generating station and sub-station which are important for analysis of grid incidents and must be time synchronized using GPS.		
14	<b>Planning/Commissioning of additional 400 kV links to take care of fog related Tripping</b>	CTU/STUs/CEA	12
15	<b>Reactive Power Management</b>	CTU/STUs/ Discom/GENCOS	6
16	<b>Pollution control</b>	State Govts/CTU/ STUs	9
	State Governments should strictly enforce the pollution check and ensure pollution causing establishments are not in the vicinity of the existing transmission lines		
17	<b>Chemical analysis of deposit on Insulators Strings</b>	CTU/ STUs	12
	STUs and CTU may get this analysis of deposits on insulators of lines preferably done every year.		
18	<b>Pollution mapping of the whole country</b>	POWERGRID	12
19	<b>Other issues</b>		
	-Ensuring PLCC equipments healthiness	CTU/STUs	6
	-All incidents must be analyzed and reported	CTU/STUs	Immediately

