STUDY REPORT
ON THE
EVACUATION ARRANGEMENTS FROM
HYDRO GENERATION PROJECTS
IN UTTARANCHAL

NEW DELHI
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INTRODUCTION

1. CMD Utaranchal vide letter no. 1833/CMD/UPPCL had enclosed a list of hydro projects in the Uttaranchal which have been allocated to NTPC/NHPC/THDC and to the state sector for execution.

Sl. No.	Projects	Capacity (MW)	Executing Agency
1.	Vishnuprayag	400	Private Sector
2.	Srinagar	330	Private Sector
3.	Lohri Nagpal	520	NTPC
4.	Tapovan Vishnu Gad	360	NTPC
5.	Kotli Behl	1000	NHPC
6.	Lakhar Vyasi	300+120=420	NHPC
7.	Vishnugad Pipal Kothi	340	THDC
8.	Kihhu Dam	600 MW	THDC
9.	Arakot-Tuni	70	UJVUNL
10.	Tuni Palasu	42	UJVUNL
11.	Pala Maneri	416	UJVUNL
12.	Bawla Nand Pryag	132	UJVUNL

The projects are expected in the early 12th plan / by the end of 11th plans timeframe. Out of the above projects Vishnu Prayag HEP is under execution and is likely to yield benefit by the end of 10th plan period. Many of the projects are in the same valley and considering the severe right of the way constraint in the Uttaranchal hills it would require to evolve consolidated evacuation system. CMD Uttaranchal has requested CEA to carry out load flow studies and desired to develop an valley wise integrated evacuation system from the generating projects.

2. Scope of the Study

The scope of the study includes load flow studies for the end of 11th plan period. The studies have been carried out considering the transmission system-strengthening requirement in Uttaranchal and the adjoining area for evacuation of power from the power to the beneficiary states of the Northern Region.

3. Assumption made in the studies

3.1 The load data in the load flow studies have been taken from the data banks of CEA for 11th plan period. The load demand as projected in the 16th EPS has been considered in the studies. The disaggregated load data of Northern Regional grid for 11th plan period were by and large obtained from the State utilities. Where ever the data was not available, the 10th plan load data furnished by the utilities have been projected on pro-rata basis for 11th plan taking the % of load growth as mentioned for the state in the 16 EPS.

The state-wise load of Northern Region as per 16th EPS for 11th plan time frame are as under

	(MW)
Punjab	10001
Haryana	6659
Rajasthan	8725
Delhi	5240
UP	13672
Uttaranchal	1160
HP	1254
J&K	2373
Chandigarh	590
Total Aggregate Maximum Demand	**53648**
Total Simultaneous Maximum Demand	**49674**

3.2 From the above it is seen that the total aggregated load of Northern Region as projected for 16th plan period is about 53648 MW. Considering a load diversity of about 1.08 % for Northern Region. The Simultaneous demand for Northern Region works out to be 49647 MW only. The load flow studies have been carried out based on the simultaneous demand of 49647 MW of Northern Region. Accordingly the total load of each state has been modified. The transmission system losses corresponding to the state-wise load (modified) has been considered as 2.5%. The details of the load considered are given in Annex-I.

3.3. **Generations Capacity**

The generation capacity anticipated to be available by the end of 11th plan time frame is based on generation planning studies carried out by CEA for 11th plan conditions. The details of the generation capacity considered in the studies are given in Annex- II. Studies corresponding to peak load have been carried out considering peak demand in Northern Region during July /August when the hydro generations is maximum. For carrying the load flow studies, the generation capacity additions during 9th plan, 10th plan and 11th plan period, as given below for the Northern Region, have been considered.

	(MW)
At the end of 8th plan	24420
Addition during 9th plan	5653
At the end of 9th plan	30073
Addition during 10th plan	9707
At the end of 10th plan	39780
Addition during 11th plan	12400
At the end of 11th plan	53016

The above generation projection figure for 11th plan does not include the generation of 3258 MW proposed in Uttaranchal.

3.4 Further for evolving the transmission system, it is assumed that the benefit of the above generations would be available during the same time frame. Also, considering the topography/terrain of these hydroelectric projects basin and difficulty in obtaining ROW for transmission system, it was decided to evolve a valley wise integrated evacuation arrangement for transmitting power to the beneficiaries. Power dispatch from the above projects in Uttaranchal is assumed to be fully absorbed by the constituents of

Northern Region viz. Punjab, Haryana, Rajasthan, UP, Delhi, J&K, Himachal Pradesh and UT Chandigarh. as per the norms laid down for absorption of power from Central Sector generation stations/ the MoU sighened between the generator and the beneficiaries. Beside this, all generations, which are expected in Northern Region during the 11th plan time frame, has been considered for carrying out the load flow studies.

3.5 Other assumptions that were made for the study are as under:

i Studies have been carried out considering the load /generations that is expected in the Northern region during 11th plan period.

ii Maximum dispatch was considered from the proposed hydro projects in Uttaranchal and the generating stations around it, so that, the transmission system so evolved is capable of evacuating power under most stringent dispatch conditions to the other part of Northern Region without any bottle-neck.

iii Import of surplus power from Eastern Region have been considered to meet the deficit of Northern Region

iv 765 kV as well as 400 kV inter-regional transmission lines have been considered for the purpose of import of Eastern Region Surplus power to Northern Region.

v. In the present study Tehri – Meerut line have been considered to be charged at 765 kV and off take of power at 765 kV have been considered from Moradabad and Meerut vi In the present study, transmission at 220 kV and above have only been considered.

vii Tuni plasu (42 MW) and Arakot Tuni have been considered to be evacuated at lower voltage, so the generations have not been considered in the study.

viii. Bawla Nand Pryag (132 MW) generation have been considered to be stepped up at 132 kV and the power from the project to be fed at Srinagar at 132 kV. So the generation has not been considered in the study.

4. <u>Planning Criterion</u>

4.1 Following assumptions, in the planning criteria and limitations regarding setting up of load flow cases for studies and evolving a transmission system have been made.

Assumptions

- ❖ As per the planning criteria, contingency of outage of a 400kV S/C has been considered for transmission planning.
- ❖ According to the criteria for planning transmission system, the generation dispatch of hydro and thermal/nuclear units would be determined judiciously on the basis of hydrology as well as schedule maintenance program of generating stations.
- ❖ Under steady state conditions, the following steady statevoltage limits were assumed.

4.2 Steady State Voltage Limits

The steady state voltage shall be maintained within the limits given below

VOLTAGE (kV rms)		
Nominal	**Maximum**	**Minimum**
765	800	728
400	420	380
220	245	198
132	145	122

4.3 Permissible Line Loading Limits

Permissible line loading limit depends on many factors such as voltage regulation, stability and current carrying capacity (thermal capacity) etc. While Surge Impedance Loading (SIL) gives a general idea of the loading capability of the line, it is usual to load the short lines above SIL and long lines lower than SIL (because of the stability limitations). SIL at different voltage levels are given as under.

VOLTAGE (kV)	NUMBER AND SIZE OF CONDUCTOR	SIL (MW)
765	4X686	2250
765 kV Op. at 400kV	4X686	614
400	2x520	515
400	4x420	614
400	3x420	560
400 kV Op. at	2x520	155

220 kV			
	220	420	132
	132	200	50

In case of shunt compensated lines, the SIL will get reduced by a factor k, where

K = (1-Degree of compansation)$^{\mathbf{1/2}}$

For lines whose permissible line loading as determined from the St. Clair's curve is higher than the thermal loading limit, permissible loading limit shall be restricted to thermal loading limit.

4.4 Thermal loading limits are generally decided by design practice on the basis of ambient temperature, maximum permissible conductor temperature, wind velocity, etc. In India, the ambient temperatures obtained in the various parts of the country are different and vary considerably during the various seasons of the year. Designs of transmission line with ACSR conductors in EHV systems will normally be based on a conductor temperature limit of 75 ^{o}C. However, for some of the existing lines which have been designed for a conductor temperature of 65 ^{o}C the loading shall be correspondingly reduced. In the case of AAAC conductors, maximum conductor temperature limit will be taken as 85 ^{o}C. The maximum permissible line loadings in respect of standard sizes of ACSR and AAAC conductors employed in EHV transmission lines for different ambient temperatures and different maximum conductor temperatures have been adopted as per the figers given in the transmission planning criteria, keeping in view the stability and voltage regulation aspects.

❖ Following thermal loading limits of lines line were considered.

Conductor used	Voltage Limit	Thermal limit at 75^0C conductor temp. and 45^0C ambient temp. (Amps)	Thermal limit at 85^0C conductor temp. and 45^0C ambient temp. (Amps)
765 kV	Quad Bersimis	697x4	
400 kV	ACSR Twin-Moose	2x595	
400kV	AAAC Moose eq.		773
400kV	AAAC Zabra eq.		701
220 kV	ACSR Zebra	546	

4.5 Security Standards:

The security standards are dictated by the operational requirements. The operational standards normally define the expected level of power system performance under different conditions of system operations and thus provide the guiding objectives for the planning and design of transmission systems. As per the transmission planning Criteria of CEA following objectives are considered for setting the security standard in a system.

(i) The system parameters (voltage and frequency) shall be as close to the nominal values as possible and there shall be no overloading of any system element under normal conditions and different feasible load-generation conditions.

(ii) The system parameters and loading of system elements shall remain within prescribed limits and not necessitate load shedding or generation re-scheduling in the event of outage of any single system element over and above a pre-contingency system depletion of another element in another corridor. In the case of 220kV and 132kV systems this shall hold good for outage of Double Circuit lines. In case of power evacuation from major generating station/complex (when the terrain indicates possibilities of tower failure) the system shall withstand the outage of two 400kV circuits if these are on the same tower. Also in the case of large load complexes with demand exceeding 1000 MW, the impact of outage of two incoming 400kV circuits (if these are on the same towers) shall be minimum.

(iii) The system shall remain in synchronism without necessitating load shedding of islanding in the event of Single-phase-to-ground fault (three-phase fault in the case of 220kV and 132kV systems) assuming successful clearing of fault by isolating/opening of the faulted system element.

(iv) The system shall have adequate margins in terms of voltage and steady state oscillatory stability.

(v) No more than four 220kV feeders/two 400kV feeders/one 765kV feeder shall be disrupted in the event of a 'stuck breaker' situation.

4.6 **Steady State Operation**

i) As a general rule, the EHV grid system shall be capable of withstanding without necessitating load shedding or rescheduling of generation, the following contingencies:

- Outage of a 132 kV D/C line or,
- Outage of a 220 kV D/C line or,
- Outage of 400 kV single circuit line or,
- Outage of 765 kV single circuit line or,
- Outage of one pole of HVDC Bipolar line or
- Outage of an Interconnecting Transformer

The above contingencies shall be considered assuming a pre-contingency system depletion (planned outage) of another 220kV double circuit line or 400 kV single circuit line in another corridor and not emanating from the same substation. All the generating plants shall operate within their reactive capability curves and the network voltage profile shall also be maintained within voltage limits specified in para 4.3 above.

ii) The power evacuation system from major generating station/complex shall be adequate to withstand outage of a 400 kV D/C line if the terrain indicates such a possibility.

iii) In case of large load complexes with demand exceeding 1000 MW the need for load shedding in the event of outage of a 400 kV D/C line shall be assessed and kept minimum. System strengthening required, if any, on account of this shall be planned on an individual case-to-case basis.

iv) The maximum angular separation between any two adjacent buses shall not normally exceed 30 degrees.

4.7 **Fault levels**

The maximum fault level of an existing 400 kV substation bus would not normally exceed 80% of the rated rupturing capacity of the circuit breakers, which would be 40 kA.

In the event that the fault level at a 400 kV bus would be close to the value listed above, either a 765 kV option on an HVDC option would be considered for expansion.

For new substation buses at 400 kV, the option to provide for circuit breakers with 63 kA rupturing capacity would be used wherever necessary.

4.8 **Limitations**

For evolving a transmission system, the whole set of studies comprising of Load Flow, short circuit, stability and dynamic over-voltage studies are required to be carried out. However as per the requirement the present studies cover only load flow studies.

5. <u>Power Dispatches</u>

5.1 The generation addition by 11th plan period has been obtained from the generation planning studies carried out in CEA. On the basis of the projected generation additions up to 11th plan period the total installed capacity in the Northern Region by the end of XI plan period i.e (end of 2011-12) would be around 53016 MW and corresponding generation capacity addition of about 5653 MW during IX plan, about 9707 MW during

X plan and 12400 MW during XI plan. However the net power availability in the Northern Region works out to be around 38346 MW. The above generation projection figure for 11th plan does not include the generation of 3258 MW proposed in Uttaranchal. Considering the load projection of 49674 MW as per the 16th EPS, it is seen that by 2011-12 the Northern Region would be deficit in power by around 11300 MW. The details of the generation capacity addition is given in para 3.3 above.

In order to mitigate the heavy shortfall of power in Northern Region, as indicated above, Northern Region would require to import power from Eastern Region as well as from Western/Southern Region.

In the proposed study, only high hydro dispatch scenario has been considered. The same is due to predominance of hydro generations in Uttaranchal Region.

5.2 Maximum Hydro dispatch

The study for maximum hydro dispatch have been carried out to simulate a condition arising in the Northern Region during the months of July/ August when the load in the region remains maximum and the hydro potential is also at its peak. During this period maximum dispatch has been taken from the hydro generation available in the northern part of Northern Region and the dispatch from thermal generation have been adjusted as per the availability of thermal machines.

6. <u>Evolution of transmission System and result of the study</u>

The load flow studies have been carried out for peak conditions. As per the load data available with CEA, it has been observed that the peak load in the Northern Region comes during the month of June-July and during that period the availability of hydro generation is also high. Accordingly, all the hydro generation in the vicinity of the proposed generations in Uttaranchal have been considered generating full so as to test the adequacy of transmission system for evacuation of power and accordingly, the generation from other projects have been adjusted to arrive at a load generation balance. The studies have been carried out with the assumption that beneficiaries of the above projects would be the constituents of Northern Region. Based on these assumption, the transmission system has been evolved to transmit the power to the beneficiaries directly or through displacement. The following transmission system has been assumed from the above-proposed hydro projects in Uttaranchal.

*6.1 **Vishnupryag HEP (400 MW)***

i) Vishnupryag HEP generation stepped at 400 kV.

ii) 400 kV Vishnupryag - Muzaffarnagar D/C line

iii) LILO of 400 kV Rishikesh – Muradabad S/C line at Kishipur

iv) 400/220 kV Kashipur S/S

Vishnupryag HEP is under construction in private sector. The project has been examined in CEA from techno-economically. The private operator executing the project has

indicated that the project would be completed by 10^{th} plan period. The evacuation system from the project has been finalized and is under execution with POWERGRID as a deposit work of UPPCL. The load flow study carried out with the proposed system indicates loading on the lines for evacuation of power from the project are with in limit under normal as well under contingency operating condition. The result of the study is given in exhibit -I

6.2 ***Srinagar HEP (330 MW)***

i) Generation Stepped up to 400 kV

ii) 400 kV Srinagar - Kashipur S/C line

iii) LILO of 400 kV Vishnupryag - Muzaffarnagar D/C line at Srinagar HEP

iv) Creation of 400/132 kV Srinagar S/S

Srinagar HEP is being constructed under private sector. The project site is located in the downstream of Vishnupryag HEP, so the above evacuation system has been evolved by UPPCL and UPCL as a part of the integrated transmission system for evacuation of power from the

Vishnupryag and Srinagar HEP. The load flow study carried out with the proposed system indicates loading on the lines for evacuation of power from the project are with in limit under normal as well under contingency operating condition. The result of the study is given in exhibit -I

*6.3 **Topovan HEP (360 MW)***

i) Generation stepped at 400 kV

ii) LILO of one ckt. of 400 kV Vishnupryag - Srinagar D/C line at Topovan HEP

iii) Topovan – Srinagar 400 kV S/C line

The Topovan HEP(360 MW) is to be executed by NTPC. The project is expected by 11th plan end/early 12th plan period. The project is located in the Dhauli ganga basin below Vishnupryag HEP. Considering the geographic location of the project it was envisaged that the surplus capacity that would be available in the Vishnupryag/Srinagar transmission system could be utilised for evacuation of power from this project. According, the above system has been evolved. The load flow study with the above system indicates normal loading on the lines emanating from Topovan HEP. Result of the study is given in exhibit-I.

6.4 ***Pipal Kothi HEP (340 MW)***

i) Generation stepped at 400 kV

ii) LILO of 400 kV Topovan – Srinagar 400 kV S/C line at Pipal Kothi HEP

The Pipal Kothi HEP (340 MW) is to be executed by THDC. The project is expected by 11th plan end/early 12th plan period. The project is located in the Alaknanda basin downstream of Vishnupryag HEP and Topovan HEP. Considering the geographic location of the project it was envisaged that the surplus margin that would be available in the Vishnupryag/Srinagar/Topovan transmission system could be utilised for evacuation of power from this project. Accordingly, the above system has been evolved. The load flow study with the above system indicates normal loading on the lines emanating from Topovan HEP. Result of the study is given in exhibit-I.

6.5 ***Lohari Nagpala HEP (520 MW)***

i) Generation stepped at 400 kV

ii) Lohari Nagpala HEP – Tehri (P.P) 400 kV D/C line with triple AAAC conductor

Pala Manari HEP (416 MW)

i) Generation stepped at 400 kV

ii) LILO of one ckt. of Lohari Nagpala HEP – Tehri (P.P) 400 kV D/C line at Pala Maneri HEP

The Lohari Nagpala HEP (520 MW) and Pala Maneri HEP(416 MW) is to be executed by NTPC and UJVNL respectively. The projects are expected by 11th plan end/early 12th plan period. Both these projects are located in the Bhagirathi basin upstream of Tehri HEP. Considering the geographic location of the projects and the severe ROW constraint in the Bhagirathi valley, it was found prudent to evolve a consolidated evacuation system for Lohari Nagpala HEP (340 MW) and Pala Maneri HEP (416 MW) and then integrate it with the Tehri system so that the capacity/margin available in the 765 kV Tehri – Meerut line could be utilised for evacuation of power from Lohari Nagpala HEP (520 MW), Pala Maneri HEP(416 MW), Tehri Stage I & II(2000 MW) and Koteshwar HEP(400 MW). Accordingly, the above system has been evolved. The load flow study with the above system indicates normal loading on the lines emanating from

Lohari Nagpala HEP and Pala Maneri HEPHEP. The result of the study is given in exhibit-I.

6.6 An alternative study was also carried out for Lohari Nagpala HEP (520 MW), Pala Maneri HEP (416 MW) considering the condition that the adequate land required for creation of 765/400 kV pooling point in the hills of Uttaranchal is not available, under that condition the power from Tehri St I&II and generation from Koteshwar HEP continues to be evacuated at 400 kV. Under this circumstances it would not be possible to evacuate the power from Lohari Nagpala HEP (520 MW), Pala Maneri HEP(416 MW) through the Tehri System and as such would require a separate evacuation system. Considering this following alternate system has been envisaged.

Lohari Nagpala HEP (520 MW)

i) Generation stepped at 400 kV

ii) Lohari Nagpala HEP – Muzaffarnagar 400 kV D/C line
With AAAC conductor

Pala Maneri HEP (416 MW)

i) Generation stepped at 400 kV

ii) LILO of one circuit of Lohari Nagpala HEP – Muzaffarnagar 400 kV D/C line at Palamenari HEP

Load flow studies were carried out with the above system indicates normal loading on both the lines from Lohari Nagpala HEP and Palamaneri HEP. Result of the study given in exhibit IA

6.7 ***Kishau Dam HEP (600 MW)***

i) Generation stepped at 400 kV

ii) Kishu Dam – Rishikesh 400 kV D/C line

The Kishu Dam HEP (600 MW) to be executed by THDC. The project is expected by 11th plan end/early 12th plan period. the project is located in the Ton Valley (Ton a tributary of river Yamuna) upstream of Tehri HEP. Considering the geographic location of the projects, a 400 kV D/C line from Kishau Dam - Rishikesh was envisaged for evacuation of power from Kishau Dam HEP. Load flow studies have been carried out with the above system indicates normal loading on the lines emanating from Kishau Dam HEP and also on lines further from Rishikesh S/S. Result of the study is given in exhibit-I.

*6.8 **Kotli Behl HEP (1000 MW)***

i) Generation stepped at 400 kV

ii) Kotli Behl – Rishikesh 400 kV D/C line

The Kotli Behal HEP (1000 MW) to be executed by NHPC. The project is expected by 11th plan end/early 12th plan period. The project is located in the Bhagirathi valley basin in the downstream of Tehri HEP. Considering the geographic location of the projects, a 400 kV D/C line from Kotlibhel - Rishikesh was envisaged for evacuation of power from Kotlibhel HEP. Load flow studies have been carried out with the above system indicates normal loading on the lines emanating from Kotlibhel HEP and also on lines further from Rishikesh S/S. Result of the study is given in exhibit-I.

*6.9 **Lakhwar HEP (300 MW)***

i) Generation stepped at 220 kV

ii) Lakhwar HEP – Rishikesh 220 kV D/C line

iii) Lakhwar HEP – Muzaffarnagar 220 kV D/C line

Vyasi HEP (120 MW)

i) Generation stepped at 220 kV

ii) LILO of 220 kV Lakhwar HEP – Muzaffarnagar D/C line at Vyasi HEP

The Lakhwar HEP (300 MW) and Vyasi HEP (120 MW) are to be executed by NHPC. The project are expected by 11th plan end/early 12th plan period. Both the projects are located in the Yamuna basin. Considering the geographic location of the projects and the severe ROW constraint in the Yamuna valley, it was found prudent to evolve a consolidated evacuation system for Lakhwar HEP and Vyasi HEP at 220 kV level. Accordingly, the above system has been evolved. The load flow study with the above system indicates normal loading on the lines emanating from Lakhwar HEP (300 MW) and Vyasi HEP(120 MW). The result of the study is given in exhibit-I.

7. Contingency Analysis

7.1 Basic Assumption

The above evacuation system proposed for evacuation of power from Parbati St-II have been studied for N-1 Contingency condition as per the Transmission Planning criteria of CEA. Further cases with N-2 contingency condition for trunk lines have also been carried out.

7.2 Contingency Cases

The Transmission system associated with Vishnupryag HEP and Srinagar HEP have already been studied in details and based on the result, the system from these projects have been agreed by UPPCL and UPCl. The Vishnupryag system is also under construction, so the system associated with these project have not been studied for contingency outage condition.

7.2.1 *Outage of 400 kV Srinagar(UP) – Pipalkothi S/C line*

With the outage of 400 kV Srinagar(UP) – Pipalkothi S/C line, the loading on the other circuit to Srinagar i.e. Topovan – Srinagar S/C line gets loaded to 686 MW and Vishnupryag – Srinagar S/C line gets loaded to 353 MW. Since the circuit This circuit are to be constructed with twine Moose conductor so the loading on the circuit are within limit. Exhibit II

7.2.2 *Outage of 400 kV Srinagar(UP) – Topovan S/C line*

With the outage of 400 kV Topovan - Srinagar(UP) S/C line, the loading on the other circuit to Srinagar i.e. Pipalkothi – Srinagar S/C line gets loaded to 727 MW and Vishnupryag – Srinagar S/C line gets loaded to 311 MW. Since the length of the Pipalkothi – Srinagar line is small and the circuit is to be constructed with twine Moose conductor so the loading on the circuit is within limit. Exhibit III

7.2.3 Outage of 400 kV Srinagar(UP) – Kashipur S/C line

This outage condition has been considered to test the adequacy of the system beyond Srinagar S/S. With the outage of 400 kV Srinagar(UP) – Kashipur one circuit, the other line gets loaded to 569 MW and the loading on Srinagar(UP) – Muzaffarnagar D/C line is 790 MW, which are with in limit. Exhibit IV

*7.2.4 **Outage of 400 kV Srinagar(UP) – Kashipur D/C line(n-2 contingency condition)***

With the outage of 400 kV Srinagar(UP) – Kashipur D/C circuit, the loading on Srinagar(UP) – Muzaffarnagar D/C line is 1358 MW, which are with in thermal loading limit of the line. Exhibit V

*7.2.5 **Outage of 400 kV Srinagar(UP) – Muzaffarnagar D/C line(n-2 contingency condition)***

With the outage of 400 kV Srinagar(UP) – Muzaffarnagar D/C line, the loading on Srinagar (UP) – Kashipur D/C line is 1348 MW, which are with in thermal loading limit of the line. Exhibit VI.

*7.2.6 **Outage of one ckt. of 765 kV Tehri-Meerut 2xS/C line***

With the outage of one circuit of 765 kV Tehri – Meerut 2xS/C line, the other circuit gets loaded to 3126 MW. Considering this circuit to be constructed with Quad Bersimis conductor, the above loading is normal and within thermal loading limit of the conductor. Exhibit VII.

*7.2.7 **Outage of 220 kV Vyasi - Muzaffarnagar D/C line***

With the outage of 220 kV Vyasi – Muzaffarnagar D/C line, the loading on the other circuit i.e. Lakhwar – Rishikesh 220 D/C line gets loaded to 400 MW. Considering the length of the line to be small the loading is with in thermal loading limit of the line. Exhibit VIII.

7.2.8 *Outage of 400 kV Muzaffarnagar-Kaithal 2xS/C line*

With the outage of one circuit of 400 kV Muzaffarnagar-Kaithal D/C line, the other circuit gets loaded to 518 MW and Muzaffarnagar – Muradnagar S/C line gets loaded to 515 MW The loading are within limit. Exhibit IX.

8. Conclusion and Recommendation

8.1 Based on the studies carried out for evolving the Transmission system from the hydro projects proposed to be set up in Uttaranchal, the following conclusions are drawn up.

i) The power from all the projects except for Lakhwar(300 MW) and Vyasi(120 MW) would be stepped up to 400 kV (The evacuation of power from Tuni Plasu, Arakot-Tuni and Bal Nand Pryag which have not been taken in the study would be at 132 kV).

ii) The study for the proposed generation projects have been carried out considering the transmission lines that would be available with the existing generations in that zone as well as the transmission system that would be developed along with the generations that are expected in Uttatanchal during the same time frame. Any change in the generation schedule of the above projects may effect the result of the study. So the result of the above study would be valid only with the generation scenario considered in the study.

iii) It has been considered that the 765/400 kV Tehri pooling point would be available along with the system of Tehri St I&II and Koteshwar HEP for dispersal of power from these project. However in case the adequate land for construction of the 765/400 kV pooling station is not available then 400 kV Loharinagpala – Muzaffarnagar D/C line with one circuit LILO at Palameri HEP may be constructed.

Based on the result of the Techno-economic study, the following transmission system is recommended with the above proposed generations in Uttaranchal.

8.2 Recommendations

Topovan HEP (360 MW)

i) Generation stepped at 400 kV

ii) LILO of one ckt. of 400 kV Vishnupryag - Srinagar D/C line at Topovan HEP

iii) Topovan – Srinagar 400 kV S/C line

Pipal Kothi HEP (340 MW)

i) Generation stepped at 400 kV

ii) LILO of 400 kV Topovan – Srinagar 400 kV S/C line at Pipal Kothi HEP

Lohari Nagpala HEP (520 MW)

i) Generation stepped at 400 kV

ii Lohari Nagpala HEP – Tehri (P.P) 400 kV D/C line with triple AAAC conductor

Pala Manari HEP (416 MW)

i) Generation stepped at 400 kV

ii) LILO of one circuit of Lohari Nagpala HEP – Tehri (P.P) 400 kV D/C line at Pala Maneri HEP

Alternatively in the event of non commissioning of 765/400 kV Tehri pooling point not being feasible, the transmission system for Lohari Nagpala HEP and Palamaneri HEP may be constructed as under.

Lohari Nagpala HEP (520 MW)

i) Generation stepped at 400 kV

ii) Lohari Nagpala HEP – Muzaffarnagar 400 kV D/C line with triple AAAC conductor

Pala Manari HEP (416 MW)

i) Generation stepped at 400 kV

ii) LILO of one circuit of Lohari Nagpala HEP – Muzaffarnagar 400 kV D/C line at Pala Maneri HEP

Kishau Dam HEP (600 MW)

i) Generation stepped at 400 kV

ii) Kishu Dam – Rishikesh 400 kV D/C line

Kotli Behl HEP (1000 MW)

i) Generation stepped at 400 kV

ii) LILO of Lohari Nagpala HEP – Tehri (P.P) 400 kV D/C line at Pala Maneri HEP

Lakhwar HEP (300 MW)

i) Generation stepped at 220 kV

ii) Lakhwar HEP – Rishikesh 220 kV D/C line

iii) Lakhwar HEP – Muzaffarnagar 220 kV D/C line

Vyasi HEP (120 MW)

i) Generation stepped at 220 kV

ii) LILO of 220 kV Lakhwar HEP – Muzaffarnagar D/C line at Vyasi HEP

Exhibit II

Master Plan for Uttaranchal projects