Chapter.7 Financial and Economic Analysis and Business Evaluation

7.1 Financial and Economic Analysis

The purpose of the project is to improve transmission capacity by replacement of the existing transmission line with a high quality and low loss transmission line and to increase the number of the transmission lines. The benefit of the improvement of the transmission network is to contribute to the increase of power supply to the capital city area and to the improvement of the reliability of electricity supply.

The objective for evaluation of the project is to analyse the possibility of implementation of improvement of the existing 220kV transmission line between Tarbela substation and Burhan substation (approximately 35 km). In addition to the improvement mentioned above, analysis of the possibility of implementation of the new construction of a branch transmission line (approximately 40 km) will also be conducted, which will be reviewed in the other report.

The output of the implementation of the project, e.g. goods and services, is the transmission infrastructure to be improved by the project. The fundamental framework of the project is to be as follows;

(1) Output: Increase of electricity supply by improvement of the transmission line
(2) Outcome: Improvement of reliability on electricity supply and countermeasures against future expected insufficient transmission line capacity
(3) Impact: Sustainable economic and social development

7.1.1 Financial Analysis

Financial analysis is to be carried out to evaluate the profitability of NTDCL as the implementation organization. The investment amount is to be estimated by the market price as the financial cost and at the same time the financial benefit given by the implementation of the project is also to be estimated by the market price.

(1) Financial Cost

The financial expenses are consisting of the following items[7];

1) Construction cost and materials price
2) Consultant costs

[7] Interest during construction (IDC) and price escalation are not included.

3) Fund of the construction and materials (physical contingency)
4) Administrative expenses
5) Taxes (VAT and Import Duties[8])
6) Front-End Fee

(2) Financial Benefit

The major benefit is to be recognised by the increase in income based on increased quantity of electric transmission of 87.75MW together with the benefit of 2.78MW gained by the reduction of transmission loss. The benefit is estimated as the increase of income by NTDCL using a wheeling charge of PKR130 /kW month[9]. Assessment of the benefit is based on① transmission quantity due to the strengthened transmission lines and ②reduction of transmission loss by the usage of high quality transmission lines. The following table shows the annual increase of the quantity measured between the "With-project" and "Without-project" cases.

Table 7.1.1 Benefits of implementation of the project

	Tarbela-Bruhan (circuit 3) (MW)			Tarbela-ISPR (MW)			Total (MW)	
	Send. End	Receiv. End	Loss	Send. End	Receiv. End	Loss	Performance	Loss
2020 (without)	233.52	230.71	2.81	241.26	238.58	2.68	469.29	5.49
2020 (with)	289.96	288.41	1.55	269.79	268.63	1.16	557.04	2.71
Difference		57.7	1.26		30.05	1.52	87.75	2.78

(Source: JICA Survey Team)

(3) Prerequisites for the IRR calculation

Followings are the assumptions for estimating IRR;

Table 7.1.2 Assumptions for estimating IRR[10]

O&M Cost	2% of linitial nvestment
Transmission Loss	3%
Annual Increase of Power	5%
Income by TL (UOSC)	130 Rs/kW/month

(Source: JICA Survey Team)

8 VAT in Pakistan are defined as 17% as General Sales Tax (GST), Customs Duty: 20% (Conductor), GST: 17%, Income Tax: 5.5% 。Comprehensive tax rate is (1+20%) x (1+17%) x (1+5.5%) = 1.481 (48%)

9 PKR 126.75/kW month is the official rate of the wheeling charge determined by NEPRA for NTDCL as of June 2016. The

10 PKR130/kW month is used by the JICA survey derived from the rate for the economic evaluation in PC-1 planned by NTDCL in January 2016.

Financial costs and financial benefits are compared as the present value over the expected useful life of the project, i.e. 40 years. The discount rate in the case of the present value of the total financial cost, being equal to the present value of the total financial benefit, is evaluated as the benchmark to evaluate the feasibility of this project, which is determined as the financial internal rate of return, FIRR. Being based on the conditions above, IRR is calculated as follows;

1) Financial internal rate of return (FIRR) is to be 3.35%.
2) B/C ratio is to be 0.72 (discount rate of 10%) and 0.65 (discount rate of 12%).
3) Annual benefit of 72.8 million yen gives a breakeven period of 42.7 years for the investment cost of 3,109.4 million yen.

Table 7.1.7 shows the result of estimation of the financial internal rate of return (FIRR).

Table 7.1.3 Financial internal rate of return (FIRR)

FINANCIAL ANALYSIS - CASHFLOWS
Tarbera - Bruhan (Existing)

JPY = 1.01 x PKR
(JPY. in Million)

	Financial year	Project Cost			Project Benefit					
		Investment Cost	O & M Cost 2%	Total Annual Cost	Power Gross (increase p.a.) 5%	Power Net 97%	Project Revenue @ USCF Rs./kW/month 130.00	Loss Reduction USCF (MW) 2.78 130.00	Total Revenue	Net Benefits
		(JPY.mln)	(JPY.mln)	(JPY.mln)	(MW)	(MW)	(JPY.mln)	(JPY.mln)	(JPY.mln)	(JPY.mln)
	1	2	3	4	5	6	7	8	9	10
	2016	0.0		0.0						0.0
	2017	66.8		66.8						-66.8
	2018	469.5		469.5						-469.5
	2019	2,421.4		2,421.4						-2,421.4
1	2020	151.7	62.2	213.9	87.8	85.1	134.1	4.4	138.5	-75.4
2	2021		62.2	62.2	92.1	89.4	140.8	4.6	145.4	83.2
3	2022		62.2	62.2	96.7	93.8	147.9	4.8	152.7	90.5
4	2023		62.2	62.2	101.6	98.5	155.3	5.1	160.3	98.1
5	2024		62.2	62.2	106.7	103.5	163.0	5.3	168.3	106.1
6	2025		62.2	62.2	112.0	108.6	171.2	5.6	176.8	114.6
7	2026		62.2	62.2	117.6	114.1	179.7	5.9	185.6	123.4
8	2027		62.2	62.2	123.5	119.8	188.7	6.2	194.9	132.7
9	2028		62.2	62.2	129.6	125.8	198.1	6.5	204.6	142.4
10	2029		62.2	62.2	136.1	132.0	208.1	6.8	214.8	152.7
11	2030		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
12	2031		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
13	2032		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
14	2033		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
15	2034		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
16	2035		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
17	2036		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
18	2037		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
19	2038		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
20	2039		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
21	2040		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
22	2041		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
23	2042		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
24	2043		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
25	2044		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
26	2045		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
27	2046		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
28	2047		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
29	2048		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
30	2049		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
31	2050		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
32	2051		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
33	2052		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
34	2053		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
35	2054		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
36	2055		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
37	2056		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
38	2057		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
39	2058		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
40	2059		62.2	62.2	142.9	138.6	218.5	7.1	225.6	163.4
	Total	3,109.4	2,487.5	5,596.9	5,391.8	5,230.0			8,509.6	2,912.6
										IRR
										3.35%
	Total Capital Cost			3,109.4			Costs	Benefits	B/C Ratio	
	Income p.a.			72.8	NPV @	10.00%	2,571.4	1,850.2	0.72	
	Simple Payback Yrs			42.7		12.00%	2,338.2	1,525.9	0.65	

Source: JICA Survey Team

7.1.2 Economic Analysis

Economic analysis is to be carried out from the viewpoint of the national economy rather than the implementation organization, NTDCL of the project. The economic cost is 2,282.1 million yen as described earlier.

(1) Economic Cost

The economic cost consists of the following items[11];

1) Construction and materials cost
2) Consultant services costs
3) Physical contingency for construction and materials
4) Administrative expenses
5) Front end fee

The price and cost of the goods and services generated in Pakistan are converted by the standard conversion factor[12].

(2) Economic Benefit

Assessment of the economic benefit is based on① increase of the transmission quantity of electricity by the strengthened transmission lines and ② the reduction of transmission loss by the usage of high quality transmission lines. Economic benefit is calcurated according to the values reviewed in Table 7.1.5 Benefits of implementation of the project

1) Conversion to the power supply amount of transmission

84MW, the increase of power transmission, are translated into electric energy of MWh, which can be regarded as the supplied generation power.

Power supply amount = Load flow (MW) × 8,760(hour) × Annual load factor[13] (20%) × Installation Factor of Diesel Generators[14] (73%)

= 87.75W × 97% (Transmission loss3%) × 8,760 × 20% × 73%

= 108,861.88 MWh/year

[11] Price escalation, tax and interest during construction are excluded.

[12] Price and cost of construction works and goods including local consultant services are converted by the standard conversion factor, i.e. 90%, to convert the price and cost as the international level.

[13] Annual load factor is reported as 20 - 100%. 20% is applied to estimation of generated power for the project analysis.

[14] Electrification ratio of Pakistan at the national level of 73% (2013) is published in “Electricity Access in Developing Asia-2013 of IEA World Energy Outlook 2015”.

2) Benefits as alternative cost reduction (avoided cost)

If this project were not carried out, it can be assumed that relying on the installation of diesel generators would be the alternative. The alternative diesel generators are no longer required by the implementation of the project. Thus the alternative cost (generation cost of diesel generators: PKR 5.78 / kWh[15]) should be regarded as the avoided cost, i.e. benefit.

Alternative cost reduction ＝ 108,861.88 MWh/year × PKR 5.78/kWh
＝ PKR 629.2 million
＝ JPY 635.5 million

Together with the avoided cost, i.e. alternative cost saving reviewed as above, the increase of income realised by the increase of transmission quantity 2.78 MW (see Table 7.1.8), from the reduction effect of transmission loss is to be considered as the benefit. PKR 130/kW month (Table 7.1.8) provides the amount of income with NTDCL from wheeling charges.

(3) Assumption for estimation of IRR and the estimation result

IRR estimated with the assumptions mentioned above are as follows;

Table 7.1.4 Assumptions for estimation of IRR

O&M Cost	2% of Initial Investment
Transmission Loss	3%
Income by TL	130 Rs/kW/month
Diesel Generation Cost Saving	Rs.5.78/kWh
Annual Increase of Power	5%

(Source: JICA Survey Team)

Economic costs and economic benefits are compared as the present value over the expected useful life of the project, i.e. 40 years. The discount rate in the case of the present value of the total financial cost, being equal to the present value of the total financial benefit, is evaluated as the benchmark to evaluate the feasibility of this project, which is determined as the financial internal rate of return, FIRR. The IRR estimated with the assumptions mentioned above are as follows;

[15] Diesel generation cost: PKR 13.9/kWh
Based on the generation cost in the report of power project in Pakistan, correction of the generation costs is made in terms of the diesel fuel price from official statistics as at June 2016.

1) Economic internal rate of return (EIRR) is to be 29.59%
2) B/C ratio is to be 4.53 (discount rate of 10%) and 4.11 (discount rate of 12%)
3) Annual benefit of 880.3 million yen gives a breakeven period of 2.59 years for the investment cost of 2,282.1 million yen

An EIRR 29.59% is more feasible than 12% or 15%[16], the Pakistan social development IRR.

[16] "Survey for the Economic Benefit by Implementation by the smooth Yen Loan", JICA & Mitsubishi Research Institute Inc., March 2013

Table 7.1.5 Economic internal rate of eturn (EIRR)

ECONIMIC ANALYSIS - CASHFLOWS

Benefit **Tarbera - Bruhan** JPY = 1.01 x PKR

(JPY. in Million)

	Financial year	PROJECT COST			PROJECT BENEFITS					
		Investment Cost	O & M Cost 2%	Total Annual Cost	Power Gross (increase p.a.) 5%	Power Net 97%	Alternative Cost (Saving) Rs./kWh 5.78	Loss Reduction USCF (MW) 2.78 130.00	Total Revenue	Net Benefits
		(JPY.mln)	(Rs.mln)	(Rs.mln)	(MW)	(MW)	(JPY.mln)	(JPY.mln)	(JPY.mln)	(JPY.mln)
	1	2	3	4	5		6	7	8	9
	2016			0.0						0.0
	2017	55.6		55.6						-55.6
	2018	335.9		335.9						-335.9
	2019	1,780.6		1,780.6						-1,780.6
1	2020	110.0	45.6	155.6	87.8	85.1	635.5	4.4	639.9	484.3
2	2021		45.6	45.6	92.1	89.4	667.3	4.6	671.9	626.2
3	2022		45.6	45.6	96.7	93.8	700.7	4.8	705.5	659.8
4	2023		45.6	45.6	101.6	98.5	735.7	5.1	740.8	695.1
5	2024		45.6	45.6	106.7	103.5	772.5	5.3	777.8	732.2
6	2025		45.6	45.6	112.0	108.6	811.1	5.6	816.7	771.0
7	2026		45.6	45.6	117.6	114.1	851.6	5.9	857.5	811.9
8	2027		45.6	45.6	123.5	119.8	894.2	6.2	900.4	854.8
9	2028		45.6	45.6	129.6	125.8	938.9	6.5	945.4	899.8
10	2029		45.6	45.6	136.1	132.0	985.9	6.8	992.7	947.0
11	2030		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
12	2031		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
13	2032		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
14	2033		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
15	2034		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
16	2035		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
17	2036		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
18	2037		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
19	2038		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
20	2039		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
21	2040		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
22	2041		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
23	2042		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
24	2043		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
25	2044		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
26	2045		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
27	2046		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
28	2047		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
29	2048		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
30	2049		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
31	2050		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
32	2051		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
33	2052		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
34	2053		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
35	2054		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
36	2055		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
37	2056		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
38	2057		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
39	2058		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
40	2059		45.6	45.6	142.9	138.6	1,035.2	7.1	1,042.3	996.7
	Total	2,282.1	1,825.7	4,107.8	5,391.8	5,230.0			39,318.1	35,210.3

							IRR
							29.59%
Total Capital Cost	2,282.1			Costs	Benefits	B/C Ratio	
Income p.a.	880.3	NPV @	10.00%	1,887.6	8,549.0	4.53	
Simple Payback Yrs	2.59		12.00%	1,716.6	7,050.4	4.11	

代替案:

ディーゼル発電機の設置

① Diesel Generation Cost: **Rs.13.88/kWh**

② Penetration Ratio of Diesel Generation: 73% (Electrification Rate in Pakistan 2013)

③ Qy[kWH]=P×f×8760 = P×**1,752** (f : Minimum Load Factor **20%**)

④ Economic Cost "With Project"(Minimum Value: Average Power Tariff in 2013=**Rs.8.1/kWh**

⑤ Avoided Cost of Diesel Generation : Rs.13.88/kWh － Rs.8.1/kWh ＝ **Rs.5.78/kWh**

(Source: JICA Survey Team)

7.2 Estimation of reduction of CO2

The reduction effect will result from the usage of high quality low loss transmission lines and so on. Estimation of CO2 emission is conducted assuming that transmission loss is to be considered as the reduction of power generation.

In order to estimate the reduction of CO2 emmission, i.e. the reduction of transmission loss, reference is made to Table 7.1.5.

It is to be noted that the estimation and calculation of CO2 emissions is based on the procedures of the "JICA Climate Finance Impact Tool for Mitigation and Adaptation, June 2011".

7.2.1 The calculation method of CO2 emission reduction based on the transmission power loss

(1) The reduction of losses due to implementation of the project is considered as the reduction of power generation, which should be estimated in terms of the CO2 emission reductions.

(a) The estimation of the power generation corresponds to the transmission loss without the project implementation

(b) The estimation of the power generation corresponds to the transmission loss with the project implementation

(c) Power generation reduction given by the difference between and (a) and (b) is to be estimated as the CO2 emissions reduction.

7.2.2 The calculation of CO2 emission reduction

The following formula (ref. NNEX-3.1.5-1) is used to provide the power loss.

Loss of power：$Q\ y\ \mathrm{kWh} = P \times (0.3f + 0.7f^2) \times 8760$

P：Load flow　f：Annual load factor (50%)

(1) Tarbela-Burhan circuit-3

1) Calculation of power generation amount corresponding to the power transmission loss without the project implementation

2.81 MW × (0.3×50% + 0.7×50% ×50%) × 8760 = 8,000.07 MWh

2) Calculation of power generation amount corresponding to the power transmission loss with the project implementation

1.55 MW × (0.3×50% + 0.7×50% ×50%) × 8760 = 4,412.85 MWh

3) Reduced amount of power generation (a) - (b)

= 8,000.07 MWh - 4,412.85 MWh = 3,587.22 MWh

4) Calculation of CO2 emission reductions due to the reduced amount of power generation

3,587.22 MWh × 0.5403 t CO2/MWh[17] = 1,938.17 t CO2/year

(2) Tarbela-ISPR

1) Calculation of power generation amount corresponding to the transmission loss without the project implementation

2.68 MW×(0.3×50% + 0.7×50% ×50%)×8760 = 7,629.96 MWh

2) Calculation of power generation amount corresponding to the power transmission loss with the project implementation

1.16 MW×(0.3×50% + 0.7×50% ×50%)×8760 = 3,302.52 MWh

3) Reduced amount of power generation (a) - (b)

= 7,629.96 MWh - 3,302.52 MWh = 4,276.29 MWh

4) Calculation of CO2 emission reductions due to the reduced amount of power generation 4,276.29 MWh

4,276.29 MWh × 0.5403 t CO2/MWh = 2,338.12 t CO2/year

(3) Overall project CO2 emission reductions

CO2 emission reduction is as follows throughout this project.

Tarbela-Burhan Circuit-3	: 1,938.17 t CO2/year
Tarbela ISPR	: 2,338.12 t CO2/year
Total	: 4,276.29 t CO2/year

7.3 Operation and effect Indicators

The Yen Loan project is carried out to conduct an ex-post evaluation after two years from the completion of the project in order to scrutinize the goal attainment level of operation and effect in terms of indicators. Operation and effect Indicators are to be fixed referring to the guidelines of the "Yen loan operation and effect indicators reference".

In order to understand the operational status of the infrastructure, the following are considered;

1) Indicators should be linked to the factors belonging to transmission business;
2) In order to mitigate the manpower burden, the data should be obtained through the day-to-day operations.

[17] IGES “Grid Emission Factor, as of October 31st, 2015”, Pakistan, Combined Margin (CM）/average

7.3.1 Operation and effect indicators (Part 1), plant factor of the transmission line

Part 1 of the operation and effect indicators is the plant factor.

Table 7.3.1 Operation and Effect Indicators (Part 1) , Plant Factor (%)

Name of Transmission Line	Baseline Value in 2015 (%)	Target Value in 2022 (%)
Tarbela – Burhan (circuit 3)	62.5	17.3
Tarbela – ISPR	68.8	12.3

(Source: JICA Survey Team)

(1) Calculation: Maximum load (MW) / {Transmission line capacity (MVA) x Power Factor}

(2) Base line value in 2015, Tarbela – Burhan (Circuits 1 and 2) and Tarbela – Burhan (Circuit 3), is calculated based on the data provided by GSO Burhan, i.e. "AVAILABILITY FACTOR OF TRANSFORMERS AND TRANSMISSION LINES FOR THE YEAR 2011-2015 IN RESPECT OF 220KV GRID STATION NTDC BURHAN ISLAMABAD p.5", using the maximum load (MW) and power factor of 0.95 of each capacity of the transmission line section.

(3) Base line value in 2015, Tarbela – ISPR, Burhan – ISPR, is calculated based on the data provided by GSO Burhan, i.e. "AVAILABILITY FACTOR OF TRANSFORMERS AND TRANSMISSION LINES FOR THE YEAR 2011-2015 IN RESPECT OF 220KV GRID STATION NTDC SANGJANI (ISPR) ISLAMABAD p.5", using the maximum load (MW) and power factor of 0.95 of each capacity of the transmission line section.

(4) Example: Case of Tarbela-Burhan (circuit 1 and 2)

Availability Factor = 200 (MW) ÷ (337 (MVA) × 0.95) ×100 = 62.5 (%)

The maximum load of each transmission network is to calculate the plant factor, i.e. the operation and effect indicators, shown in the table below. Data for 2020 are based on the value provided by the system analysis software PSS / E.

Table 7.3.2 Basic Data for Calculation of Operation and Effect Indicators for Maximum Load (MW)

Name of Transmission Line	Baseline Value in 2015 (%)	Target Value in 2022 (%)
Tarbela – Burhan (circuit 3)	200 (MW)	151.1 (MW)
Tarbela – ISPR	220 (MW)	107.1 (MW)

(Source: JICA Survey Team)

The rated capacity of transmission line (in MVA) at each section, which is used for analysis of the project, is as indicated in the table below.

Table 7.3.3 Basic Data for Calculation of Operation and Effect Indicators Rated Capacity of Transmission Line (MVA)

Name of Transmission Line	Baseline Value in 2015 (%)	Target Value in 2022 (%)
Tarbela – Burhan (circuit 3)	337MVA (Rail)	919.8MVA (LL-ACSR/AC610)
Tarbela – ISPR	337MVA (Rail)	919.8MVA (Tarbela-Burhan, partially LL-ACSR/AC610)

(Source: JICA Survey Team)

7.3.2 Operation and effect indicators that show the annual amount of transmitted power (MWh)

The second operation and effect indicator is the annual amount of transmitted power (MWh) as indicated in the table below.

Table 7.3.4 Operation and effect indicators (2) the amount of transmitted power (MWh)

Name of Transmission Line	Baseline Value in 2015 (MWh/year)	Target Value in 2020 (MWh/year)
Tarbela-Burhan (circuit 3)	1,086,100	761,091
Tarbela-ISPR	505,233	539,463

(Source: JICA Survey Team)

(1) The baseline value for 2015 refers to the data provided from NPCC.

(2) The target value for 2020 is estimated with 57.5% of the annual load factor.
The following formula (ref. ANNEX 3.1.5-1) is used to provide with the loss power of transmission line.
Loss of Power：Q x kWh=P × (0.3f+0.7f^2) × 8760 (hours)
P：Load Flow f：Annual load factor (50%)

7.3.3 Operation and effect Indicators i3) Transmission Loss Rate (%)

The third indicator is the transmission loss rate (%) as reviewed below;

Table 7.3.5 compares the loss power rate between the conventional conductors based on PC-1 and the low-loss conductors based on the project.

Table 7.3.5 Operation and Effect Indicators (Part 3) Loss Power Rate (%)

Name of Transmission Line	Baseline Value (%) Rail Single Conductor 2015	Target Value (%) LL ACSR / AC 610 2020
Tarbela-Bruhan circuit 3	1.02	0.26
Tarbela-ISPR	1.15	0.19

(Source: JICA Survey Team)

7.4 Project evaluation

The overall purpose of the project is to contribute to the improvement of the infrastructure in Pakistan, which is aimed to improve the reliability of the power supply and as a response to the insufficient capacity for a future transmission line in the Islamabad metropolitan area.

In order to evaluate the project effectiveness, as reviewed in the previous section, Table 7.4.1 shows the comprehensive output of the financial and economic evaluation;

Table 7.4.1 Internal Rate of Return, Investment Recovery Period and B / C ratio

Unit: JPY. In Million

	Financial Analysis		Economic Analysis	
Discounted Rate	10%	12%	10%	12%
Net Benefit	2,912.6		35,210.3	
Investment Cost	3,109.4		2,282.1	
Income p.a.	72.8		880.3	
Simple Payback Period	42.70		2.59	
IRR (%)	3.35		29.59	
NPV Cost	2,571.4	2,338.2	1,887.6	1,716.6
NPV Benefits	1,850.2	1,525.9	8,549.0	7,050.4
B/C Ratio	0.72	0.65	4.53	4.11

(Source: JICA Survey Team)

7.4.1 Financial Benefit

The increase of the transmission power including the reduction of transmission losses are considered as the benefit provided by the project implementation. For the analysis of internal rate of return (IRR), the discount rates of both 10% and 12% are applied. Payback time and B/C ratio are also presented to evaluate the project feasibility.

At a discount rate of 10%, the financial internal rate of return (FIRR) is calculated to be 3.35%, which is not feasible because it is lower than the discount rate of 10%.

To identify a more feasible situation in search of a higher feasibility for the project, the sensibility analysis, i.e. both benefits and costs assumed with + / - 5% and + / - 10% is conducted. Table 7.4.2 represents the results of the sensitivity analysis of Financial Analysis.

Table 7.4.2 Sensitivity Analysis of Financial Internal Rate of Return (FIRR)

FIRR		Benefit				
		90%	95%	100%	105%	110%
Cost	110%	1.73%	2.16%	2.57%	2.97%	3.35%
	105%	2.10%	2.54%	2.95%	3.35%	3.73%
	100%	2.49%	2.93%	**3.35%**	3.75%	4.13%
	95%	2.91%	3.35%	3.77%	4.17%	4.57%
	90%	3.35%	3.79%	4.22%	4.63%	5.03%

(Source: JICA Survey Team)

The maximum feasible case is seen with a benefit increase of 10% together with a cost reduction of 10% which nevertheless provides a FIRR of only 5.03%, which is still not to enable to clear the 10% criteria, i.e. the discount rate applied.

If the stabilization of the power supply in the metropolitan area is regarded as high priority target from the view point of national economic development, the project should be examined from a different perspective, i.e. a feasibility study using economic analysis.

7.4.2 Economic Benefits (alternative cost reduction benefits)

If the project, i.e. transmission improvement, were not implemented, diesel generators might be assumed to be promoted as one of the alternative projects. However, if the project is implemented, the diesel generators project promotion will be no longer required. Thus the avoided cost, the cost saved by the cancellation of the diesel generators project, is to be estimated by the generation cost of diesel generators, i.e. PKR 5.78/kWh[18].

As reviewed in section 7.1.2 Economic Analysis, the following 108,861.88 MWh/year is the basis of the benefit of alternative cost saving.

[18] See 7.1.2 Economic Analysis

Benefit of alternative cost saving = 108,861.88 MWh/year × PKR 5.78 / kWh
= PKR 629.2 million
= 635.5 million yen

As seen in the previous section in the economic analysis, the Economic internal rate of return (EIRR) of 29.59% is much better than the social discount rate of Pakistan, either 12% or 15%. Table 7.4.3 shows the results of the sensitivity analysis by economic analysis.

Table 7.4.3 Sensitivity Analysis of Economic Internal Rate of Return (EIRR)

EIRR (Discount Rate = 10.0%)		**Benefit**				
		90%	95%	100%	105%	110%
Cost	110%	24.72%	25.95%	27.17%	28.39%	29.59%
	105%	25.77%	27.06%	28.33%	29.59%	30.84%
	100%	26.93%	28.27%	**29.59%**	30.91%	32.21%
	95%	28.20%	29.59%	30.97%	32.35%	33.71%
	90%	29.59%	31.05%	32.57%	33.93%	35.36%

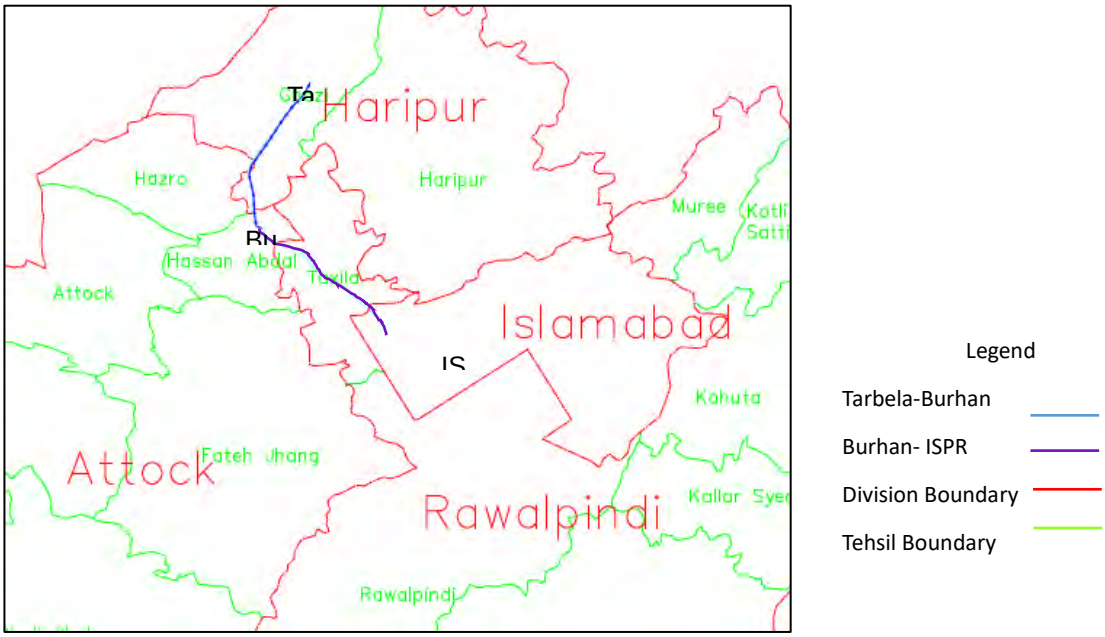
(Source: JICA Survey Team)

Chapter.8 Environmental Social Consideration

8.1 Basic Social and Natural Environment

8.1.1 Basic Social Condition

The Project target area is located in northern part of Punjab and a part of KP. Figure 8.1.1 shows the administrative boundaries. Tehsil is an administrative area, part of a Division. The target transmission lines are Tarbela-Burhan 1 circuit and Tarbela-Burhan-Islamabad 1 circuit. The blue line in the figure indicates Tarbela- Burhan section and the purple line indicates Burhan-ISPR section.



(Source: JICA Survey Team)

Figure 8.1.1 Administrative Boundaries

The population data is summarised in Table 8.1.1. The latest official census data was collected in 1998, and the population in 2016 is estimated by the growth rate. The latest official census was carried out in 1998. Therefore, some statistical data are estimates and there is variation among data sources. The survey team examined trustworthiness for the selection of sources, and the data used is indicated with its data source.

Table 8.1.1 Population of Project Area

Population								
District	District	District	District					
			Male	Female	Urban	Rural	Total	Growth Rate
Islamabad			434,239	370,996	529,180	276,055	805,235	5.20
Punjab	Rawalpindi		1,723,000	1,641,000	1,788,000	1,576,000	3,364,000	2.64
		Taxila	194,000	177,000	271,000	100,000	371,000	2.64
	Attock		-	-	118,000	144,000	262,000	2.64
		Hasan Abdal	70,000	66,000	38,000	98,000	136,000	2.64
		Hazro	-	-	42,000	197,000	239,000	2.64
KP	Haripur		345,561	346,667	82,735	609,493	692,228	2.82
	Haripur	Ghazi	56,366	56,683	-	113,049	13,049	2.82

District	Division	Tehsil	Estimation 2015				
			Male	Female	Urban	Rural	Total
Islamabad			1,080,869	924,554	1,303,525	701,898	2,005,423
Punjab	Rawalpindi		2,392,410	2,298,590	2,622,000	2,069,000	4,691,000
		Taxila	275,400	264,600	343,000	197,000	540,000
	Attock		-	-	155,000	199,000	354,000
		Hasan Abdal	91,290	87,710	50,000	129,000	179,000
		Hazro	-	-	55,000	268,000	323,000
KP	Haripur		421,000	422,000	101,280	742,720	844,000
		Ghazi	72,000	72,000	-	-	144,000

(Source: Census 1998, Survey team)

The major proportion of total population is self-employed; others are private employees and government employees. The difference in the proportions of employed population is significant between the genders and between urban and rural residents. The major occupation in the project area is agricultural farming, small businesses and employment in the public and private sectors.

The women in rural areas are mainly housewives and working for housekeeping that includes taking care of cattle, extracting butter and ghee from milk, weaving and sewing of family

clothes. In addition, they generally help in farm work with the lighter duties like transplanting of seedlings, threshing and winnowing of grains. Sometimes the women also help in harvesting. In the city, women are housewives or work as professionals, such as doctors, nurses, teachers, or in private jobs etc.

The table 8.1.2 shows the literacy rates in the project area. The data of 1998 is the result of a census. The Pakistan Bureau of Statistics carried out a survey named 'Pakistan Social and Living Standards Measurement Survey' from 2014 to 2015 and its result is also shown in the table. These are the literacy rates of the population of 10 years of age and older.

Table 8.1.2 Literacy Rates in the Project Area

District	Division	As per 1998 Census		
		Male	Female	Total
Islamabad		75.09	48.78	62.52
Punjab	Rawalpindi	81.19	59.18	70.40
	Attock	66.94	31.99	49.30
KP	Haripur	70.50	37.40	53.70
District	**Division**	**PSLM* Survey 2014-15**		
		Male	**Female**	**Total**
Islamabad		91.00	79.00	85.00
Punjub	Rawalpindi	90.00	76.00	83.00
	Attock	81.00	57.00	68.00
KP	Haripur	81.00	59.00	69.00

(Source: Pakistan Bureau of Statistics, Pakistan Social & Living Standards Measurement Survey 2014-15)

The literacy rate is highest in Islamabad. The literacy rate has improved, but still the women's literacy level is lower than that for men, and in the rural area it is lower than in urban areas. Tehsil level data is not available.

8.1.2 Basic Natural Condition

The basic natural condition is described in section 1. The detailed condition revealed by the survey is explained in section 8.4.

8.2 Comparison of Alternatives

The Study Team examined a number of scopes to improve the capacity of power transmission. During this study, NTDCL has decided to implement the part of two routes of Tarbela – Burhan with their own funds. Then, the study has been concentrated in the route of Tarbela – Burhan – ISPR on the basis that the reinforcement plan of NTDCL in Tarbela – Burhan would be completed in 2017 as planned. The following alternatives have been considered:

1) Zero option: No change
2) Replacing to increased capacity conductor
3) Change from single conductor to double conductors
4) Replacing to low loss conductors
5) Reinforcement of towers in case of double conductor use (reconstruction or increase of number of towers)

The result of comparison is summarised in Table 8.2.1. And the comparison of reinforcement of towers in case of double conductor use is shown in Table 8.2.2.

Table 8.2.1 Result of comparison of alternatives

	Options	Content	Positive impact	Negative impact	Evaluation
1	Zero option	No any change	No further positive impact occurs.	Supply capacity cannot meet the increasing demand caused by urbanization and population growth. Current network cannot cover N-1 contingency.	- -
2	Replacing to increased capacity conductor	To increase supply capacity by use of 'increased capacity conductor instead of existing conductor	Social infrastructure is improved by increased power supply. Present towers can be used because weight of conductor is almost same but capacity is double. Negative impact is limited because it is only replacement. The impact in construction stage is limited because it is short.	Increased capacity conductor has larger transmission loss to compare with conventional conductor, so the lower energy efficiency causes negative environmental effect for long-term vision. The same reason results in the financially negative impact on NTDCL.	++
3	Change from single conductor to double conductors	To increase capacity by use of conventional double conductors instead of single conductor	Social infrastructure is improved by increased power supply. NTDCL can manage implementation because of the conventional technology.	Towers should be reinforced or added to tolerate the doubled weight of conductors. It might create negative impact by construction, and potential land acquisition and resettlement.	+
4	Replacing to low loss conductors	To increase capacity by use of low loss double conductors instead of conventional single conductor	Social infrastructure is improved by increased power supply. Transmission loss could be improved by use of low loss conductor, and it will provide positive impact on environment due to better energy efficiency. For same reason, it is good for NTDCL finance.	Towers should be reinforced or added to tolerate the doubled weight of conductors. It might create negative impact by construction, and potential land acquisition and resettlement.	++

(Source: JICA Survey Team)

Item 2 and 4 are similar in the evaluation. Use of low loss conductors is recommended for long-term energy conservation.

Table 8.2.2 Comparison of reinforcement of towers

Options	Content	Positive impact	Negative impact	Evaluation
Reinforcement of towers	Number of towers is same but increase in strength	Occupied area by towers is almost same, and impact on land use is limited. For same reason, resettlement is minimum.	Feasible design and construction method in Pakistan should be considered. Removal of towers is required and it needs additional cost and longer construction period.	+-
Increase a number of towers	Present towers are used, and new towers are added between existing ones in order to cover the necessary strength.	Removal of present towers is not necessary. Conventional construction method and design of tower are applicable.	Number of towers will be almost double and the occupied area will be increased. It may create impact on land use. For same reason, the potential resettlement scale is increased. The mixture of new and old towers will create the difficulty of maintenance.	-

(Source: JICA Survey Team)

There are two procedures for tower reinforcement, and there is an option to mix these methods. The reinforcement method is recommended from the above evaluation.

8.3 Scoping Result and TOR of Survey

Basically, the T/L already exists and the further environmental impact created by the replacement is limited. However, if reinforcement of the towers is required, it may increase the environmental and social impact significantly. The extent of impact depends highly on the necessity for tower reinforcement, procedure of enforcement and its scale.

NTDCL said that replacement was considered as a kind of maintenance, so that such type of project did not require EIA/IEE and any permission. NTDCL has never requested the permission for similar project. ESIC explained that the permission would not be required in the

range of the same ROW. The director of Pak-EPA stated the same opinion. However, NTDCL has decided to replace all towers for the part of project with its own funds, and they have considered the necessity of EIA. This project will prepare the EIA report as well.

The survey team re-examined the scoping and revised the TOR. The result is shown in Table 8.3.1.

Table 8.3.1 Result of Scoping

Category	No	Item	Evaluation		Reason of evaluation
			Construction	Operation	
Mitigation Measures	1	Air pollution	B-	D	Construction : During the construction phase, air pollution such as exhaust fumes from earthmoving equipment as well as construction vehicles will occur. However, the impact is temporary and minor.
	2	Water pollution	B-	B-	Construction : During the construction phase, water pollution from construction vehicles, machinery and worker's camp will occur. However, the impact is temporary and minor.
	3	Waste	B-	D	Construction : Construction waste, soil, litter 建 of workers will be generated.
	4	Soil pollution	B-	D	Construction : During the construction phase, soil pollution by oil spill from construction vehicles or machinery may occur.
	5	Noise and vibration	B-	D	Construction : During the construction phase, noises and vibration associated with construction anticipated. However, the impact is temporary and minor.
	6	Ground subsidence	D	D	There is not any work to cause subsidence.
	7	Smell	D	D	There is not any work to generate bad smell.
	8	Sediment	D	D	There is not any work to effect sediment condition.
Natural Environment	9	Protected Areas	D	D	There is no protected area and national park inside and vicinity of the project site.

	10	Ecosystem and biota	B-	D	The existing T/L is there and further impact on ecosystem is limited. However, traffic of construction vehicle and noise at construction site will affect during construction stage.
	11	Hydrology	D	D	There is not any work to change water flow or riverbed.
	12	topography and geography	D	D	The existing T/L is there and further impact on topography and geography.
Social Environment	13	Resettlement	B-	B-	In case of use of double conductors, the number of towers might be increased. Consequently, the encroachment
	14	Poverty group	C	B+	Construction : Poverty group is possible to be a part of resettlement target.
	15	Ethnic Minorities and Indigenous	D	D	There is no ethnic minorities and indigenous peoples in the project site and surroundings
	16	Employment and Livelihood	B+	B+	Construction : Construction work will create new employment.
	17	Land use and resources	B-	D	The existing T/L is there and further impact on land use and resources is limited. However, the construction work could disturb the land use of the area under T/L, and compensation will be required.
	18	Water use	B-	B-	Construction : Effect of turbid water generated by construction work if the river or water body exist near the project site. Operation: Cover ratio of vegetation under the transmission line will be decreased and turbid water
	19	Disturbance to social	B-	B+	Construction : Traffic congestion will occur during construction stage.
	20	Social capital and social organization	D	D	It is not expected any effect on Social capital and social organization.
	21	Uneven existence of damage and profit	D	D	It is no significant the uneven existence of damage and profit caused by the project.
	22	Interruption to residential activities	D	D	It is not expected that the project create interruption of residential activities.

	23	Heritage	C	C	There is no information about heritage in and around the project site, so that the survey is required.
	24	Landscape	D	D	The existing T/L is there and further impact on landscape is limited.
	25	Gender	D	D	It is not significant the effect on gender issues by this project.
	26	Children's right	D	D	It is not expected the effect on children's right.
	27	Increase the risk of infectious diseases such as HIV/AIDS	B-	D	Construction: A temporary influx of migrant labor increases the risk of sexual transmitted diseases incidents in the project area.
	28	working conditions (including	B-	D	Risk of injure is increased with construction work, vehicle operation, etc.
Others	29	Accident	B-	B-	Construction : Risk of accident is increased with construction work, vehicle operation, etc.
	30	Impact of cross-border, climate change	D	B+	The impacts of cross-border and climate change are ignorable. Stabilized power supply decreases the individual use of generators, and it will enhance energy efficiency and impact positively on environment.

(Source: JICA Survey Team)

A+/-: Significant positive or negative impact is anticipated
B+/-: Positive or negative impact is anticipated
C+/-: Extent of impact is unknown (Examination is needed. Impacts may become clear as study progresses)
D: No impact is anticipated

The draft TOR for the environmental and social survey is shown in Table 8.3.2.

Table 8.3.2 Draft TOR for Environmental and Social Survey

Item	Target	Procedure
Alternatives	(1) Selection of appropriate technology (2) Examination of method of construction	(1) Minimizing land acquisition and resettlement, maximize the benefit
Air quality	(1) Environmental standards (Pakistan, Japan, WHO, etc.) (2) Current condition of Air pollution (3) Location of premise, school, hospital near	(1) Literature survey (2) Literature survey (3) Field survey and hearing (4) Study of construction type, procedure, period,
Water quality	(1) Water quality of river water	(1) Literature survey, hearing
Waste	(1) Management of construction waste	(1) Hearing of relevant organization, Case research
Soil contamination	(1) Preventive measures to oil spill during construction	(1) Method of construction, duration, kind of vehicles and machinery , procedure to store the oil and place to store
Noise and vibration	(1) Environmental standards (Pakistan, Japan, WHO, etc.) (2) Distance from source to the premises, school, and hospital. (3) Effect of construction	(1) Literature survey (2) Literature survey, hearing (3) Study of construction type, procedure, period, location, using equipment, transportation road, simulation
Ecosystem and biota	Laws and regulations for protection of ecosystem Present condition at the site Presence of important species	Literature survey Site survey Literature and site survey
Land acquisition and resettlement	(1)Laws and regulations in Pakistan and difference from JICA and WB standards (2) Magnitude of land acquisition, and resettlement Existence of poverty group. (3) In case of the land acquisition and resettlement is required, relocation plan is prepared.	(1) Investigation of the information of relevant laws and regulations (2) Survey by satellite image, site visit to check the presence of target person, crop and building. Interview at the site to check the land use and presence of poverty group. (3) Preparation of RAP or ARAP to satisfy the requirement of Pakistani Lands Act, JICA guideline, NTDCL LATF and Operational Policy
Poverty group	(1) Presence of poverty group in POP	(1) Site survey and hearing
Land use	Current condition of land use at project area Estimation of affected area	Survey by satellite image and site visit Survey by satellite image and site visit

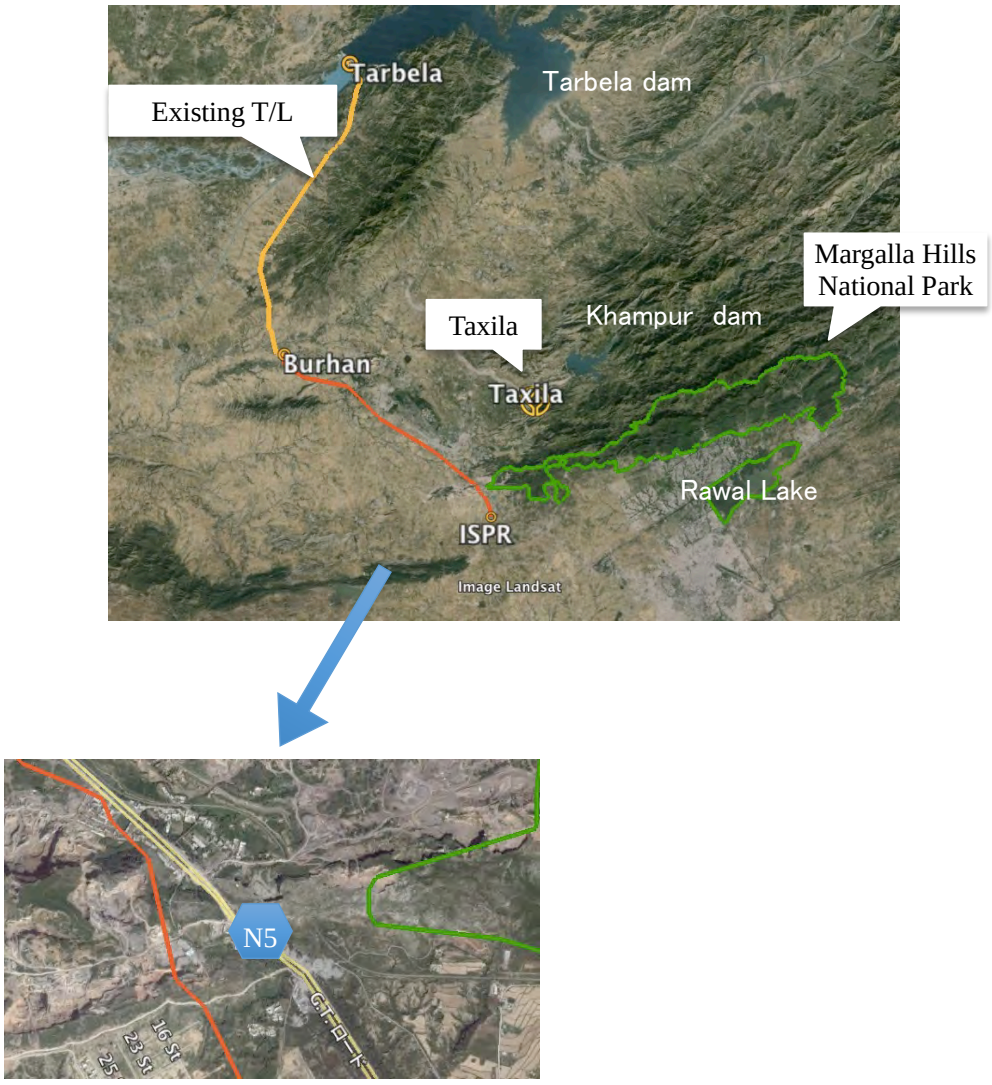
Water use	Location of water sources near project site Purpose of use	Survey by satellite image and site visit Site survey and interview
Disturbance to social infrastructures and services	(1) Residents, school, hospital, road condition of the Project site and vicinity	(1) Projection of the traffic jam during construction
Heritage	(1) Location of heritage near the project site	(1) Literature survey and hearing to archaeological
Increase the risk of infectious diseases	(1) Incident rate of HIV/AIDS at project site and surroundings	(1) Literature survey, hearing (2) Hearing to relevant organizations
working conditions (including	(1) Safety measures for labors	(1) Literature survey, hearing, case survey (2) Planning of countermeasures and training
Accident	(1) Preventive measures of accident	(1) Literature survey and site survey
Stakeholder meetings (SHM)	SHM will be held 2 times (1) At scoping stage	(1) Individual visit and group interview (2) Participation of stakeholders

(Source: JICA Survey Team)

8.4 Results of social and environmental survey (Including projection)

8.4.1 Protected Area and Heritage

The Figure 8.4.1 shows the natural reserves and protected areas near the project site



（Source：JICA Survey Team）

Figure 8.4.1 Natural reserves and protected areas near the project site

The nearest reserve is Margalla Hills National Park (MHNP), the boundary of which is indicated by the green line in Figure 9.4.1. The area containing Rawal Lake is a detached piece of MHNP. The nearest distance between the edge of MHNP and existing T/L is about 85m at the east part of MHNP. There is a six-lane national highway (N5) in between the T/L and MHNP, and the continuity of the natural environment has been divided. Therefore, the reinforcement of the T/L does not create further significant impact.

The main bird migration route is from Tarbela dam to Rawal Lake via Khampur dam. The location of T/L is far from the route and the impact on migratory bird is limited.
The nearest important archaeological place named Taxila is also shown in Figure 8.4.1. It is an ancient Buddhist ruin and registered as one of the world heritage by UNESCO. The distance from T/L is about 10km at nearest point. The effect is negligible.

8.4.2 Air Quality

The air quality in the project area is not so clean. In Pakistan, many of households use biomass for energy source such as fire trees. It is a major source of air pollution especially for particulate materials in whole country. It has been pointed out that use of fire trees causes the serious air pollution inside the house. The other major sources of air pollution are vehicular emissions on the road, dust arising from construction and other ground or soil disturbance, during dry weather, and from movement of vehicles on poorly surfaced or unpaved access roads. Table 8.4.1 shows the result of observation in Islamabad. In urban area, NOx and lead which are caused by vehicle exhaust are also over the NEQS as well as PM2.5.

Table 8.4.1 Ambient Air Quality of the Project Area

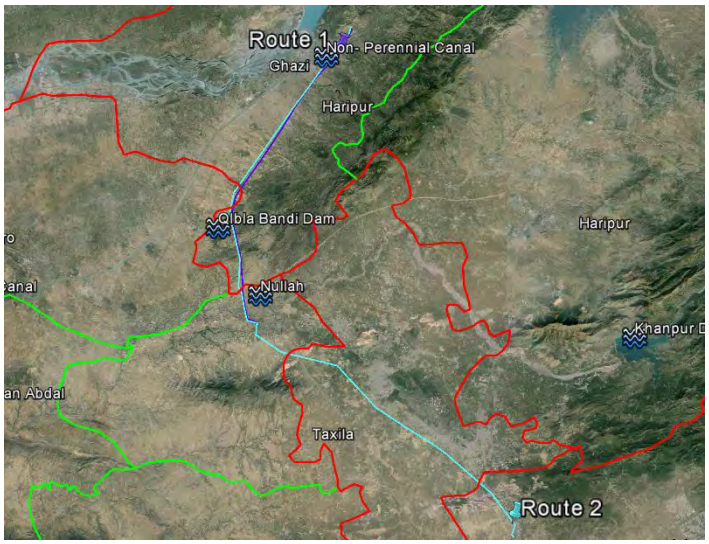
Source	PM2.5	NO	SO_2	O_3	CO	NO_2	Lead
Units	ug/m^3	ug/m^3	ug/m^3	ug/m^3	mg/ m^3	ppm	ug/m^3
Islamabad	65	80	6 ± 3	83	1	49 ± 28	2
NEQS	15	40	120	130	10	40	1.5

(Source: Research Article on Measurements and analysis of air quality in Islamabad, Pakistan by Anjum Rasheed, Viney P. Aneja, Anantha Aiyyer, and Uzaira Rafique, Policy Options to Address the Cost of Outdoor Air Pollution by World Bank and Air Pollution: causes and control by Dr. Muhammad Anwar)

The impact on air quality by the project is created by the operation of vehicles, machinery and generators at the time of construction. The extent is not large and the period is limited, so that it cannot create a significant impact on the current pollution condition. It is necessary to know the status of the current air quality as a background to be compared for assessing the impact of the project. However, it requires continuous monitoring for certain periods at the site and not practical. Therefore, the Project controls the air quality by the emission control but not by monitoring of air quality.

8.4.3 Water Resource and Quality

The potential water sources along the transmission line are Tarbela Dam, Ghazi Barotha Canal, Qibla Bandi Dam, tube wells and wells. According to the hearing survey, the water present there is used for both drinking and irrigation purposes. A map showing the locations of dams is shown in Figure 8.4.2.



(Source: JICA Survey Team)

Figure 8.4.2 Water Sources and sampling points

The water quality was tested at two places along the route; Qibla Bandi Dam and groundwater taken from well near the Burhan Grid station. The water samples were delivered to National Physical & Standard Laboratory, Islamabad (NPSL) for determining different parameters of water. The result is summarised in Table 8.4.2.

Table 8.4.2 Water Quality Standards and Sample Results

Properties/ Parameters	Standard Values for Pakistan	WHO Guidelines	1st Sample	2nd Sample
pH at 25^{0}C	6.5 – 8.5	6.5 – 8.5	7.45	7.55
Conductivity (µS/ cm) at 25^{0}C	-	-	524	1030
Total dissolved solids (mg/L)	< 1000	< 1000	259 ± 1	506 ± 1
Total suspended solids (mg/L)	-	-	< 2	< 2
Total Hardness (mg/L)	< 500	-	130 ± 5	323 ± 5
Calcium (mg/L)	-	-	30 ± 1	50 ± 1
Magnesium (mg/L)	-	-	17 ± 1	48 ± 1
Chloride (mg/L)	< 250	250	20 ± 1	21 ± 1
Fluoride (mg/L)	≤ 1.5	1.5	0.12 ± 0.01	0.15 ± 0.01
Nitrate (mg/L)	≤ 50	50	0.20 ± 0.01	0.55 ± 0.01
Sulfate (mg/L)	-	250	62 ± 1	85 ± 1
Arsenic (mg/l)	≤ 0.05	0.01	ND	ND
Cadmium (Cd)	0.01	0.003	0.06 ± 0.01	0.07 ± 0.01
Lead (Pb)	≤ 0.05	0.01	ND	ND
Nickel (Ni)	≤ 0.02	0.02	ND	ND
Iron (Fe)	-	0.3	ND	ND

(Source: JICA Survey Team)

The table has rows for national standards and WHO guideline values. Both samples exceed the standard value of cadmium. The reason for high cadmium is not clear. The survey team searched the literature, but could not find any document reported the pollution of cadmium in this area. It is difficult to conclude anything from only one testing because there is possibility of sample contamination or other technical problems. The sampled water has low suspended solid, and it seems to be clear water.

These three water sources have more than 1 km distance from the transmission line. Therefore, the water sources will not be contaminated directly from construction sites. In case of construction near seasonal rivers, the turbid water should be managed to prevent contamination.

There is no underground construction work, the ground water will not be affected.

8.4.4 Waste

In Pakistan, the waste management is still in the developing stage. No sufficient waste collection system is functioning even in the urban area. Legislation on waste treatment is also weak. The waste management guidelines (The Solid Waste Management Guidelines) were drafted with the cooperation of JICA, but they have not been approved. It is mentioned that the general solid waste management is implemented as a part of the public services of the municipality in the SBNP Local Government Ordinance 2001.

The waste is disposed within or outside municipal limits into low lying areas like ponds etc., without any treatment except recyclable separation by scavengers. The land is also hired/ leased on long-term basis for disposal. There are no garbage incineration facilities and open dumping is the most common practice throughout Pakistan, with dumpsites commonly being set alight to reduce the volumes of accumulating waste, hence adding to the air pollution caused by the uncovered dumped waste itself. The same practice is in use in the project area. The hygiene condition is not very good.

The practice of sanitary land filling is still in its infancy in Pakistan and the first site has yet to be developed. There is no particular guideline or legislation for construction waste.

It is pertinent to mention that proper waste management system along with sanitation and sewerage is available along the transmission line in the Islamabad area. Beyond the ISPR grid station, disposal/ treatment of waste system exists in the areas where housing societies are being developed. An adequate waste management system along with waste treatment is functioning in the area near Bahter Morr (Burhan, Taxila).

There is no guidelines and legislations that refer to waste management. The Project will treat the waste which is generated by the construction, workers daily activities, soil, etc. with regards guidance from the relevant authorities, such as EPA, local government. It is recommended that the metal waste generated by the tower reconstruction will be recycled as resources by the contract with waste collection company. No hazardous waste is generated by the Project.

8.4.5 Noise

Pakistan has a national standard for noise, but there is no monitoring system and monitoring result. EPA has carried out the project-base monitoring and response to complaint of resident. The very high noise level is reported in Islamabad, 47 dB (A) to 104.5 dB (A) (Pakistan

Environment Protection Agency, Position Paper for Environmental Quality Standards of Noise in Pakistan). The Tarbela-Burhan area is the countryside, and it is considered the relative low noise area.

Noise regulation is not present in Pakistan, only the emission noise regulation for cars in use is stated as 85dB (A) in Gazette SRO72 (KE), 2009.

The noise creating construction work is as follows. Attention to the residents near the site should be considered.

1) Removal of the towe
2) Rehabilitation of foundation of the tower
3) Construction of the new tower
4) Wiring of power lines

The work from 1), 2) and 3) is work that generates noise and vibrations. The work 4) creates noise and vibration only at the end of wire for winching work with generator. The main noise vibration sources in the work of 1) to 3) are vehicles, machinery, and generators. The effect is limited because the working period is several months per location, and the activity period is short. Only a few residents are recognised near the towers in the Tarbela-Burhan section. In case of the presence of residents near the construction site, noise reduction should be considered, e.g., use of sound insulation facility, if necessary.

8.4.6 Ecosystem and Biota

(1) Floral Attributes of the Project Area

During June 2016, a vegetation survey was carried out in six sampling locations selected in various habitats of the project area. Sampling locations in the project area were selected at random intervals in order to identify the maximum number of species. During fieldwork of the study, 110 plant species belonging to 49 families and 96 genera were identified. Annex 8.4.6-1provides the complete list of floral species with their available local names, family name and life form. Poaceae was found to be the dominant family with 11 species followed by Asteraceae 8, Mimosaceae 6, Solanaceae, Moraceae and Lamiaceae each having 5, Amaranthaceae, Verbenaceae and Myrtaceae each having 4 species in the study area. Table 8.4.3 shows the number of floral species within the dominant families. Table 8.4.4 shows the life forms of all the 135 species that were observed during the field survey.

Table 8.4.3 Status of Species Belonging to Dominant Families

Sr. No.	Family Name	No. of Species
1	Poaceae	11
2	Asteraceae	8
3	Mimosaceae	6
4	Solanaceae	5
5	Moraceae	5
6	Lamiaceae	5
7	Amaranthaceae	4
8	Verbenaceae	4
9	Myrtaceae	4

(Source: JICA Survey Team)

Table8.4.4 Breakdown of Species by Life Form

Sr. No.	Life Form	Number of Species
1	Herbs	43
2	Shrubs	22
3	Grasses	11
4	Trees	28
6	Sedges	02
7	Creepers	02
8	Climbers	02
Total		**110**

(Source: JICA Survey Team)

A number of plant species having medicinal value were observed in the project area. Most of these are naturally grown and are used by local people for treatment of various ailments. Ficus benghalensis, Ficus religiosa, Ficus virgata, Withania somnifera, Adhatoda vesica, Withania somnifera and Riccinus communis are commonly used.

No endemic or rare species were recorded during the field visits. All species have a wide range of distribution in other ecological zones of the country, especially at other locations of Khyber Pakhtunkhwa and Punjab provinces and in the districts of Haripur and Attock in particular.

(2) Fauna

1) Birds:

Field visits of study of the Tarbela, Burhan & ISPR transmission line were conducted during June 2016. A total of 32 species of birds were recorded in the project area. Since the field visit was conducted during the hot summer season, the number and diversity of avifauna were both quite low, as the majority of winter migrants have already left for their

breeding grounds in north. Only summer migrants and a few others were reported during the field visits. Most of the species were recorded in the vicinity of seasonal stream habitat and agricultural fields/orchards. Other productive habitat was agriculture fields away from human settlements.

The majority of the bird species recorded during current field visit are common in Pakistan and their presence in the project area is also good in numbers. Among the recorded birds, blue rock pigeon, black partridge and grey partridge are species of interest. Other common birds of the project include house crows, house sparrows, red-vented bulbul and white cheeked bulbul. Among the raptors, the common kestrel, black winged kites and black kites were reported.

Out of total 32 recorded bird species, only 3 are migratory and remaining 29 are resident in the project area. Among these, 13 are common, 14 abundant, 3 are less common and 2 are rare species. 1 species is protected under the Punjab Wildlife Protection Act 1974, none are on the IUCN red list, no species are listed under CMS (Conservation of Migratory Species of Wild Animals) and 3 are listed under CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) appendices due to their potential value in international trade. A complete list of bird species observed/reported in the project area can be seen in Table 8.4.6.

Table 8.4.5 List of birds under protection

List for wildlife projection	Number of species	Common Name
IUCN Red list	0	—
Punjab Wildlife Protection Act 1974 Attachment	1	Cattle Egret
Convention on International Trade in Endangered Species of Wild Fauna and Flora	0	—

(Source: JICA Survey Team)

Table 8.4.6 shows the list of birds observed in the survey area

Table 8.4.6 List of birds observed in the survey area

No.	Common Name	Scientific Name	Status		Occurrence				Listing			
			Migratory	Resident	Common	Abundant	Less Common	Rare	WPO/Act	IUCN Red List	CMS Appendix	CITES Appendix
1.	Bank Myna	*Acridotheres ginginianus*		x		x						
2.	Bay backed Shrike	*Lanius vittatus*		x	x							
3.	Black Drongo	*Dicrurus macrocercus*		x		x						
4.	Black Partridge/Francolin	*Francolinus francolinus*		x			x					
5.	Blue cheeked Bee eater	*Merops superciliosus*	x		x							
6.	Blue Rock Pigeon	*Columba livia*		x			x					III
7.	Cattle Egret	*Bubulcus ibis*		x		x			x			III
8.	Common/Indian Myna	*Acridotheres tristis*		x		x						
9.	Common Quail	*Coturnix coturnix*	x				x					
10.	Collared Dove	*Streptopelia decaocto*		x		x						
11.	Common Babbler	*Turdoides caudatus*		x		x						
12.	Coppersmith/Crimson-breasted Barbet	*Megalaima haemacephala*		x	x							
13.	Crested lark	*Galerida cristata*		x		x						
14.	Greater Grey Shrike	*Lanius excubitor*		x	x							
15.	Grey Partridge	*Francolinus pondicerianus*		x	x							
16.	Hoopoe	*Upupa epops*		x	x							
17.	House Sparrow	*Passer domesticus*		x		x						
18.	House crow	*Corvus splendens*		x		x						
19.	House Swift	*Apus affinis*		x		x						

No.	Common Name	Scientific Name	Status		Occurrence				Listing			
			Migratory	Resident	Common	Abundant	Less Common	Rare	WPO/Act	IUCN Red List	CMS Appendix	CITES Appendix
20.	Hume's Wheatear	*Oenanthe alboniger*		x				x				
21.	Indian Robin	*Saxicoloides fulicata*		x	x							
22.	Indian Roller	*Coracias benghalensis*		x	x							
23.	Indian Tree-Pie	*Dendrocitta vagabunda*		x	x							
24.	Little Brown Dove	*Streptopelia senegalensis*		x		x						III
25.	Little Green Bee-eater	*Merops orientalis*		x		x						
26.	Purple Sunbird	*Nectarinia asiatica*		x	x							
27.	Red-vented Bulbul	*Pycnonotus cafer*		x	x							
28.	Red wattled Lapwing	*Hoplopterus indicus*		x		x						
29.	Small Yellow-naped Woodpecker	*Picus chlorolophus*	x					x				
30.	White breasted Kingfisher	*Halcyon smyrnensis*		x	x							
31.	White breasted Waterhen	*Amaurornis phoenicurus*		x	x							
32.	White cheeked Bulbul	*Pycnonotus leucogenys*		x		x						

(Source: JICA Survey Team)

2) Mammals:

A total of 11 mammalian species were observed /reported from the project area during the field visit conducted in June 2016. Out of these 11 reported /observed mammalian species, a majority of species (9) are commonly found in the area while two are less common. Carnivore species were also recorded from project area including the Asiatic jackal, the small Indian mongoose, and the common red fox. Other common mammals like wild boar and Indian crested porcupine are commonly observed in thick vegetation and in forests along seasonal streams. Small mammals/rodents were recorded in the project area through direct sightings and observation of their tracks and burrow systems. These include Indian bush rats, the house mouse, and house rat. No key species of mammals such as ungulates,

common leopards or striped hyenas could be recorded in the project area. Sighting or kills of common leopards are sometimes reported close to hilly terrain. It has concluded that the status and diversity of mammals in the project area are low. A complete list of the mammalian species observed/reported in the project area can be seen in Table 8.4.7.

Table 8.4.7 List of mammals observed/reported in the project area

No.	Common Name	Scientific Name	Occurrence				Listing		
			Abundant	Common	Less Common	Rare	WPO/Act	IUCN Red list	CITES Appendix
1.	Asiatic jackal	*Canis aureus*		x					III
2.	Common Red Fox	*Vulpes vulpes*			x				
3.	Five stripped Palm Squirrel	*Funambulus pennantii*		x					
4.	House Mouse	*Mus musculus*		x					
5.	Indian Bush Rat	*Golunda ellioti*			x				
6.	Indian crested Porcupine	*Hystrix indica*		x					
7.	Indian/Desert hare	*Lepus nigricollis*		x					
8.	Little Indian Field Mouse	*Mus booduga*		x					
9.	Roof/House Rat	*Rattus rattus*		x					
10.	Small Indian Mongoose	*Herpestes javanicus*		x					
11.	Wild Boar	*Sus scrofa*		x					

(Source: JICA Survey Team)

3) Reptiles:

A total of 6 reptiles were observed /reported from the project area during the field visit of the Tarbela, Burhan and ISPR transmission lines. Most of the species are commonly observed in such habitats and even in close proximity of human settlements. The common reptiles of project area include the garden lizard and house (yellow bellied and spotted) geckos. The snakes observed/reported in project area are the indian cobra, saw-scaled viper and the Dhaman/common rat snake. The last species is non-poisonous and protected under the Punjab Wildlife Protection Act (PWPA) 1974 as being a farmer friendly species

controlling rodent/vermin population. Three out of total 6 reptiles are protected under the PWPA and 4 are listed on CITES appendices due to the potential demand for them on the international market. The Indian monitor, a CITES Appendix-I species is distributed widely in the streams/irrigated agriculture habitat. The desert monitor having the same status is distributed in dry and desert conditions including rain-fed agriculture areas and around seasonal streams. A complete list of the reptilian species observed/reported in the project area can be seen in Table 8.4.8.

Table 8.4.8 List of reptiles reported from study area

No.	Common Name	Scientific Name	Listing		
			WPO/Act	IUCN	CITES Appendix
1.	Desert Monitor	*Varanus griseus koniecznyi*	**x**		**I**
2.	Dhaman/Rat snake	*Ptyas mucosus*	**x**		**II**
3.	Garden Lizard	*Calotes versicolor*			
4.	Indian Cobra	*Naja naja naja*			**II**
5.	Indian Monitor lizard	*Varanus bengalensis*	**x**		**I**
6.	Spotted Indian house Gecko	*Hemidactylus brookii brookii*			

(Source: JICA Survey Team)

4）Species of Concern/Species of Interest:

None of the wildlife species including birds, mammals and reptiles may be categorised as species of concern in the project area. The scope of the project is tower reconstruction and powerline replacement, so that the effect on habitat is also limited

However, the chances to encounter workers or vehicles will increase for wildlife during construction. Mitigation measures should be taken to reduce any problems.

8.4.7 Land Acquisition and Resettlement

This project area is not so environmentally sensitive, and the project scope is not considered to create big impact because the expected cause of environmental impact is the reconstruction of towers. Therefore, the largest impact is associated with the impact on land use. NTDCL cannot acquire the land under transmission and space for towers due to the regulations of the

Telegraph Act, and has no right on the ROW. In case of Japan, power supplying company makes contract with the landowner for limitation of land use under the line. There are no such measures in Pakistan, and the power supply company has no power to restrict the land use. NTDCL does not allow the construction of the buildings under the line but it cannot stop any construction activities. Such condition resulted in the development of housing within the ROW especially on the land near Islamabad. Table 9.4.9 is a summary of encroachments in the ROW. During this survey, NTDCL decided to implement the project in the Tarbela-Burhan (Circuit I & II) section with its own funds and the Burhan-ISPR section of Tarbela-Burhan-ISPR was placed out of scope due to low necessity. But there is possibility for NTDCL to implement such project and these data might be helpful.

Table 8.4.9 Number of encroachments

Route		House	Resident	School	Commercial	Others
Tarbela-Burhan (Circuit I & II)		18	136	0	0	1
Tarbela-Burha n- ISPR	Tarbela-Burhan	11	81	1	0	0
	Burhan−ISPR	130	686	2	106	12
	Total	151	767	3	106	12

(Source: JICA Survey Team)

The survey has been completed for almost all of the T/L route except for some restricted-access military areas. This report names Circuit I & II as Route 1, and Circuit III as Route 2 for convenience, and # means the tower number (NTDCL number).

[Tarbela-Burhan]

A forest area continues about 3km from the Tarbela dam. Except this area, almost all project area is covered by cultivated land and shrubs.

M-1 highway is located between #78 and #79 in Route 1, between # 79 and #80 of Route 2. A small river passes between #83 and #84 of Route 1, between # 84 and #85 of Route 2. The depth of river is about at the level of a man's knee in May. The distance from nearest tower is about 27 m. A NTDCL maintenance person told the survey team that the river has never had any impact on towers. There is one school which has 80 to 90 pupils between #66 and #67. The other buildings are one-story farmers' houses.

[Burhan – ISPR]

The 10 km distance on the Burhan side is an area of cultivated land and shrubs. However, residential areas become more frequent the closer it gets to Islamabad. NTDCL does not

allow the construction of buildings under the T/L but it has no power to stop it. This results in increased development pressure in urban areas because the land near the Islamabad is valuable. For example, in the area of #1 to #8 and area near #32, a housing company is developing houses on large scale without any consideration of the T/L. There is a shopping mall which consists of 50 shops near # 40 and one school with 400 pupils near # 42.

NTDCL regards the reinforcement of network as a kind of maintenance work, and it does not evict encroachments under the T/L. The construction will be done with appropriate protective measures. More of the encroachments are near Islamabad. The project implementation is difficult in the area of Burhan-ISPR. The number of towers which have households in the vicinity is 7 of a total of 91 towers in the Tarbela-Burhan section. The use of buildings is not clear because some houses seemed empty.

NTDCL should undertake following countermeasures in case the project is carried out in densely populated areas.

- Briefing meeting for local residents
- Preparation of a safety management plan and its implementation
- Monitoring of safety conditions

The tower type, construction procedure and exact location will be determined in the detailed design. Resettlement is preventable by the consideration of these conditions.

8.4.8 Risk of infectious disease

The number of hospitals is relative high in Islamabad and Rawalpindi, but it is lower in rural areas. There is no hospital in the area near the T/L. The number of hospitals is listed in Table 8.4.10.

Table 8.4.10 Number of Hospitals

District	Division	Tehsil	Hospital
Islamabad			7
Punjab	Rawalpindi		13
		Taxila	1
	Attock		8
		Hasan Abdal	1
KP	Haripur		5
		Ghazi	0

（Source: *Punjab Bureau of Statistics*）

The survey team conducted the hearing survey but could not obtain any information about infectious diseases in the project area. The Joint United Nations Programme on HIV/AIDS (UNAIDS) prepared a summary report of current condition of HIV/AIDS in Pakistan. It estimated the total number of HIV infected patients in 2015 to be 100,000, of which 2,500 patients were 14 years old and younger. UNAIDS estimated and forecasted the change of patients by use of model calculations. The patients were mainly sex workers (especially, homosexuals) and drug addicts, but the situation is changing and UNAIDS predicted that the infection would spread to the general population. This project causes the influx of construction workers into the site but the period and extent are limited. However, the training and education program for the workers is effective and should be prepared as a preventive action.

8.4.9 Accidents

The survey team conducted hearings with NTDCL personnel about the history of accidents, but there is no record and report of any accidents during construction and operation work. NTDCL personnel said that they have enough safety measures and management so that no accident has happened. However, the presence of standard operating procedure (SOP) and/or guidelines for work were not assured. Nevertheless, residents near the line said that they never encountered any problems with safety or danger regarding the T/L.

The possible accidents are as follows.

- Traffic accident at the access roads
- Occupational accidents during construction
- Accident such as falling objects from high positions
  (danger to the person under T/L)
- labour accident in service

The countermeasures envisioned for each incident are summarised in table 8.4.11.

Table 8.4.11 Assumed accidents and countermeasures

Period	Accident	Current condition and countermeasures
Construction	Traffic accident	Towers are located in the cultivated area in Tarbela-Burhan; the numbers of people living near the access road are very few. The accident is not encountered by human but animals and livestock. Therefore, the training and awareness-raising program for the drivers are effective.
	Occupational accident	High place work is necessary, so the training and awareness raising for the occupational safety is important. Electricity current is stopped during work and the risk of electric shock does not exist.
	Falling accident	The potential accident of falling materials on residents and people passing-by should be prevented by the use of protection scaffolding. The public relation activity is conducted if necessary.
Operation	Occupational accident	NTDCL should continue the usual practice of occupational safety

There are some buildings under the line, so that preventive action such as construction of protective scaffolding should be taken against potential accidents during wiring.

The review of scoping result is shown in Table 8.4.12.

Table 8.4.12 Scoping and Survey Result

		Items	Evaluation at Scoping		Evaluation after Survey		Reason
			Before and Under Construction	Operation	Before and Under Construction	Operation Operation	
Pollution	1	Air pollution	B-	D	D	D	Construction : Air pollution such as exhaust fumes from earthmoving equipment as well as construction vehicles are considered for construction phase, but additional pollution on current condition is not significant.
	2	Water pollution	B-	B-	B-	D	Construction : Construction work is possible to create turbid water but it occurs near the construction site of towers and the impact is not significant. Turbid water from earth and rock should be controlled.
	3	Waste	B-	D	B-	D	Construction：Construction waste, soil, litter of workers will be generated. There is no special rule applicable for construction waste. The project should create own rule with the guidance from local authorities.
	4	Soil pollution	B-	D	B-	D	Construction：During the construction phase, soil pollution by oil spill from construction vehicles or machinery may occur.
	5	Noise and vibration	B-	D	B-	D	Construction：During the construction phase, noises and vibration associated with construction anticipated.
Natural	6	Ecosystem	B-	D	B-	D	Construction: There is no habitat of important species in most of project area and its vicinity. The main land use is cultivated area or shrubs, and it is the rehabilitation of existing T/L so that the additional impact is not significant. But area of Tarbela Dam vicinity is in forest area, this 3 km distance should be taken care of deforestation and construction work.

Social	7	Resettlement	B-	B-	D	D	This project is to reconstruct the towers and replace conductors. It is not expected the construction of new towers. NTDCL has no power to remove the resident under the existing line, and the construction will be done with them as it is. Therefore, any resettlement does not occur.
	8	Poverty group	C	B+	B-	D	The compensation will be done fairly.
	9	Land use and resources	B-	D	B-	D	Construction : Land for construction work and access road is necessary. NTDCL should compensate the loss of crops for temporal use.
	10	Water use	B-	D	B-	D	Construction: Impact on drinking water is not expected. It will be compensated and measures will be taken in case.
	11	Disturbance to social infrastructures and	B-	B+	D	B+	Construction : Traffic congestion is possible to occur during construction stage but most project area is located in rural area and the impact is limited.
	12	Heritage	C	C	D	D	There is no heritage near the project site.
	13	Increase the risk of infectious diseases	B-	D	B-	D	Construction：Construction period is short and the impact is not significant.
	14	working conditions	B-	D	B-	D	Construction : Safety management will be undertaken as usual practice.
Others	15	Accident	B-	B-	B-	B-	Construction : Access road will be constructed and the chance of traffic accident will increase for human, livestock and wildlife. Some buildings exist under T/L and the safety measures should be prepared and implemented.

8.5 Mitigation Measures and Its Cost

Table 8.5.1 shows the mitigation measures considered on the basis of the survey results.

Table 8.5.1 Mitigation Measures

	Items	Environmental Management Plan	Implementation party	Responsible party	Cost
Construction					
1	Water Pollution	Earth generated by the construction work is applied cover to prevent the flow out. Temporally storage yard is placed at location of least impact on water. When construction site is close to the water source, a drainage pit is installed, to prevent the discharge flow into the stream directly. The turbid water is introduced to the drainage pit and let the turbid material settle. The supernatant water can discharge.	PIU	NTDCL/ESIC	0
2	Waste	Construction waste, soil, litter of workers will be generated should be managed to follow the instruction of local government, CDA and EPA. Temporal dumping yard is prepared and the waste is transferred to official dumping site. The recyclable material should be separated and reused.	PIU	NTDCL/ESIC	0
3	Soil Pollution	There is a possibility of oil leakage by the vehicles so that the storage is managed for leakage prevention.	PIU	NTDCL/ESIC	0
4	Noise and Vibration	Construction vehicles are registered and maintained. Construction time is limited at the residential area and noise will be monitored.	PIU	NTDCL/ESIC	0
5	Ecosystem	Tree cutting at the site will be least in the forest area near Tarbela dam. Unnecessary uprooting is prohibited and minimizes the deforestation area. The space required for storage or other purpose will be placed outside of the forest area. The use of cable way should be considered for forest area. Reforestation will be done near the site for compensation.	PIU	NTDCL/ESIC	0.1 million Rs
6	Poverty	Resettlement does not occur. Every POPs should receive a fair compensation on the basis of project policy.	PIU	NTDCL/ESIC	Included in8

7	Land use and resources	Land under T/L has owner. Any damage by the crops or property should be compensated with replacement price on the rule of entitle matrix.	PIU	NTDCL/ESIC	1.2 million Rs
8	Water use	Impact on drinking water is not expected. It will be compensated and measures will be taken in case.	PIU	NTDCL/ESIC	0
9	Disturbance to social infrastructures and services	Possibility of traffic conjunction is very little but detour is installed at the village area and the advance notice is necessary. Road, canal or any infrastructure should be protected during construction.	PIU	NTDCL/ESIC	0
10	Increase the risk of infectious diseases	Contractor will provides educational program of infectious disease prevention for construction workers	PIU	NTDCL/ESIC	0
11	working conditions	Occupational safety plan is prepared. Training for safety is implemented for management of safety. Safety equipment is supplied to construction worker. Restricted area will be created for the safety.	PIU	NTDCL	0
12	Accident	Awareness-raising program for preventing accident is given to workers. The safety management plan is prepared and implemented with the consideration of the livelihood and commercial activities under T/L.	PIU	NTDCL	0
Operation					
	Accident	Safety of working environment in the high-voltage power lines and aerial work will be secured.	NTDCL	NTDCL	0

(Source: JICA Survey Team)

8.6 Monitoring Plan

The monitoring plan is prepared on the basis of survey results as shown in Table 8.6.1. Monitoring in the construction period is conducted by contractor and supervised by PMU/ESIC as responsible authority. The extent of the project is limited and the monitoring items are not many, so that NTDCL is able to do the supervision.

Table 8.6.1 Monitoring Plan

Category	Monitoring Item	Monitoring point	Frequency	Method
Noise	Noise	Near construction site	Once a month	Noise meter
	Operation time	Construction site	Once a month	Working record
Water quality and water use	Turbidity	Discharge water and the point of inter to water body	Once a month Every day for the period of earth work	Turbidity meter
Soil contamination	Condition of oil storage	Oil storage location at the site	Once a month	Patrol by health and hygiene manager
Waste	Separation and collection of waste	Dumping site of construction	Once a month	Patrol by health and hygiene manager
Ecosystem	Forestation	Area of deforestation and afforestation	After cutting After planning	Number of cut trees and species Number of planted trees and species
Land use and resources	Location of access road and working space for construction	Location of access road and working space for construction	Design stage	Drawing
Disturbance to social infrastructures and services	Appropriate diversion road Explanation of construction to public	Resident under line and living near the construction site	Before construction, during construction	Patrol by safety manager Safety management plan
Working safety and measures for infectious disease	Educational activities	Construction office	Once a six-months	Report of educational activities
Accident	Condition of protection structure awareness-raising and public relations activities	Affected land owner, user local resident near and under T/L,	Before construction and under construction	Patrol by safety management officer Report of the implementation status of the safety management plan

(Source: JICA Survey Team)

8.7 Stakeholder meetings

The stakeholder meetings were conducted with NTDCL, relevant authorities and interviews of local residents as well. It is summarised in the following table. Minutes of stakeholder meetings and records of resident interviews are attached in Annex 8.7.1-1.

Table 8.7.1 Stakeholder meetings

Key group	Date and place	Participant	Procedure	Contents
Pak EPA	2016/3/10 Pak-EPA, Islamabad	DG-EIA	Hearing	The survey team confirmed the necessary permission for T/L project. The project for the existing T/L does not require EIA/IEE if it is in same ROW.
NTDCL,ESIC	2016/3/15 NTDCL, Lahore	Director, Assistant director	Meeting	New project of T/L more than 11kV needs the EIA but project for existing T/L is a kind of maintenance and any permission is not necessary. NTDCL has no right to acquire land for T/L and towers. NTDCL compensates for the damage except the construction of grid station.
Residents under T/L	2016/4/19 Project site village	Residents in the project site, NTDCL officers	Consultation meeting	Some of the residents stated that they didn't receive any compensation appropriately. They requested the pre-explanation prior to implementation in order to prevent any accident, and appropriate compensation based on the market price.
NTDCL	2016/6/26 NTDCL, Lahore	CE, Design ESIC	Meeting	NTDCL is not necessary to obtain EIA/IEE approval and no any NOCs for the project of existing line. The project for route 1（Circuit I &II）has started without any permission. The project area is not considerable for environmental and social issues.

(Source: JICA Survey Team)

8.8 Necessity of land acquisition, resettlement and its extent

Because the project is to reinforce the present T/L, the construction work including replacement of conductor is done at the original position of the T/L. Therefore, if there are

encroachments, they will not be a target of land acquisition and/or resettlement.
NTDCL has a guideline of necessary clearance from T/L for several type of structures. In case of 220kV, the necessary clearance is 7.01m (23feet) for the private property, buildings 6.10m （20feet） in vertical clearance and 7.62m （25feet） in horizontal clearance. Some encroachments were observed under the T/L but the clearance was kept for all buildings. Therefore, NTDCL is able to conduct construction work with the present building conditions. However, safety and protection measures should be taken such as construction of protective scaffolds to avoid a danger of hanging wires, falling material, etc.

The reconstruction of towers requires temporary use of land for an access road, stockyards, and workspace. The total number of towers is 91, and 52 towers are located in cultivated land. 34 towers are located in bare land and shrub area. 15 towers are in the sparse forest. The main product of crop is wheat and next is maize.

The distance from tower to the nearest road is read from satellite image, and the total length is estimated at about 5,000m. Assuming road of 6m width, the total area will be 3ha. The compensation amount is calculated by use of the market price of maize PKR 149,435/ha (2014 to 2015) which is higher than wheat per unit area. The affected period is considered two seasons.

The workspace including the stockyard is assumed to be 10m by 10m, totalling 100m^2. The compensation is estimated for 91 towers for two seasons. The compensation will be PKR 1,170, 000.

Table 8.8.1 Land for Compensation

Use	Area (ha)	Period	Cost (thousand Rs)	Condition
Access Road	3	2 seasons	900	Width 6m Length 5km
Workspace	0.9	2 seasons	270	100 m^2/ Tower
Total	3.9		1,170	

(Source: JICA Survey Team)

8.9 Practical Measures of Compensation and Assistance

The temporary use of land for construction is conducted with compensation and resettlement is not required. Some of residents near the site complained about the compensation, so that the entitlement matrix is prepared as follows, i.e. all PAPs will receive market price compensation. Table 8.9.1 shows the draft of entitlement matrix

Table 8.9.1 Entitlement Matrix

	Type of loss	Entitled Persons (Beneficiaries)	Entitlement (Compensation Package)	Implementation issues/Guidelines	Responsible Organization
1	Arable Land temporarily affected by the construction/Installation of Towers/ or T/L	Tenants /sharecropper/ Legal owner /grower / socially recognized owner / lessee/ unauthorized occupant of land	Compensation, in cash, for all damaged crops and trees	Full market price of expected crops	PMU/ESIC
5	Unidentified Losses	All affected people	Follow the project policy		PMU/ESIC/ NTDCL board

(Source: JICA Survey Team)

8.10 Community Consultation

The location of access roads and spaces required for construction work will be determined at the detailed design stage. NTDCL will host a community consultation before making the decision and declare a cut-off date.

Expected participants are as follows

- Land owners of project area
- Holders and users of building under T/L
- Community representatives
- Persons in charge of valuation in local government
- Persons in charge of social consideration in community and/or local government
- ESIC, person in charge of design and construction from NTDCL

8.11 Monitoring Form (Draft)

Table 8.11.1 shows a draft of the monitoring form.

Table 8.11.1 Monitoring form (Construction Stage)

Monitoring Item	Result	Measures to be taken	Reference standard	Frequency
Noise			NEQS (Residential area) 55 dB (6:00~22:00) 45 dB (22:00~6:00)	Monthly
Water Quality (Turbidity)			200NTU*	Monthly, Daily during earthwork
Oil Spill				Monthly
Waste (Construction)				Weekly
Waste (Domestic)				Weekly
Deforestation and Reforestation				After deforest After reforest
Accident				Before construction, Weekly during construction
Claim and comment				Monthly

(Source: JICA Survey Team)

* NEQS has TSS as the monitoring indicator for discharge. The project considers the ease of the monitoring and takes turbidity as the indicator of the discharge water quality because turbidity correlates with TSS. The reported correlation factor drops in the range of 0.3 - 1. The standard value of TSS for water discharged to inland waters is 200 mg/l. In order to be on the safe side, the project assumes the correlation factor to be 1 and set the monitoring management value of turbidity as 200NTU.

Table 8.11.2 Monitoring form (Compensation)

Monitoring Item	Report
Selection of route of access road and working area	
Valuation of Land for compensation	
Payment	

(Source: JICA Survey Team)

8.12 Environmental Checklist

The environmental checklist is attached as Table 8.12.1.

Table 8.12.1 Environmental Checklist

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a)Y (b)N (c)N (d)N	(a)EIA is required. IEE has been done and NTDCL will conduct the further study to meet the EIA requirement. (b)It will be approved by EPA. (c)NTDCL will take measures to obtain approval. (d)Other permission is not required.
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a)N (b)Y	(a)Consultation meeting was held. (b)The entitle matrix is reviewed by the comment of local residents.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a)Y	(a)Alternatives are examined, such as replacement, double conductors, construction method to minimize environmental, social impact and cost.
2 Pollution Control	(1) Water Quality	(a) Is there any possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? If the water quality degradation is anticipated, are adequate measures considered?	(a)Y	(a)Replacement of existing line is main part of the project and the effect on water quality is limited. The possible impact occurs only during reconstruction of towers. It is avoidable by covering and management of temporal storage yard.
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country’s laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a)N	(a) There is no protected area in the project site.

	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife and livestock? (e) Is there any possibility that the project will cause the negative impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystem due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered? (f) In cases where the project site is located in undeveloped areas, is there any possibility that the new development will result in extensive loss of natural environments?	(a)N (b)N (c)N (d)Y (e)N (f)N	(a)Project site is developed area and not include environmentally vulnerable area. (b)There is no habitat of endangered species. (c)It is not significant. (d)During construction, migration pass could be affected by access road, but not significant. EMP shall include a preventive procedure against accident. (e)(f) This project is improvement of present T/L and the length is short, so further impact is not significant.
	(3) Topography and Geology	(a) Is there any soft ground on the route of power transmission and distribution lines that may cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides, where needed? (b) Is there any possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? (c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	(a)Y (b)N (c)N	(a)Erosion of basement of tower is observed. Tower will be protected by the structure. (b),(c) Towers will be constructed at same place of existing ones. The negative impact on topography and geology is negligible.

	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a)N (b)NA (c)NA (d)NA (e)NA (f)NA (g)NA (h)NA (i)NA (j)NA	(a) Towers will be constructed at same site of existing ones and resettlement is not required. Some encroachments are observed under the line but the clearance is enough. (b) to (j) are not applicable.
4 Social Environment	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that diseases, including infectious diseases, such as HIV will be brought due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary? (c) Is there any possibility that installation of structures, such as power line towers will cause a radio interference? If any significant radio interference is anticipated, are adequate measures considered? (d) Are the compensations for transmission wires given in accordance with the domestic law?	(a)N (b)Y (c)N (d)Y	(a)It is enhancement of the existing T/L, and impact is limited. However, the encroachments under T/L should be taken care of the safety during construction stage. (b)Construction period is short and location is not populated area, so the impact is limited. EMP should have a part of hygiene education to workers. (c)Further interference will not be expected. (d)NTDCL follows LARF and project policy.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archaeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a)N	(a) Project will not damage the local archaeological, historical, cultural, and religious heritage
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a)N	(a)T/L has been present and further adverse effect is not significant.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a)NA (b)NA	(a)(b)There are no ethnic minorities and indigenous people.

	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a)Y (b)Y (c)Y (d)Y	(a) NTDCL obeys Pakistani labour law（Factories Act 1934,Hazardous Occupation Rules1978）. (b) It is managed by EMP. (c) It is managed by EMP. (d) It is managed by EMP.
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a)Y (b)Y (c)Y	(a)Current condition of water, air and noise in the project area does not meet the all requirement of NEQS. However, the discharge water, gas and noise from construction should be managed to prevent any further pollution. The management and mitigation measures of discharge water and gas, noise to meet the NEQS will be included in EMP. (b) There is T/L present and location of towers are mainly in cultivated land, so that further adverse impact on environment is not significant, but some activities of construction may cause impact, such as transportation of vehicle and noise. The mitigation measures will be prepared in EMP. (c)The access road for the project will increase the number of vehicles in the area. Mitigation measures such as information sharing to local community and setting of diversion can minimize the impact. The safety management to the building under T/L is very important. The information sharing activities will be conducted. The compensation for business loss of the shop under T/L will be paid by NTDCL.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a)Y (b)Y (c)Y (d)Y	(a)ESIC prepares EMP, contractor obeys the plan and ESIC supervises them. (b)After preparation of draft EMP, validity will be examined. (c)NTDCL establishes monitoring framework which is done by PMU, PIU and ESIC with the requirement of LARF. (d)These will be a part of EMP.

6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Road checklist should also be checked (e.g., projects including installation of electric transmission lines and/or electric distribution facilities).	(a)N/A	(a) None
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed, (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a)N/A	(a)None

ANNEX

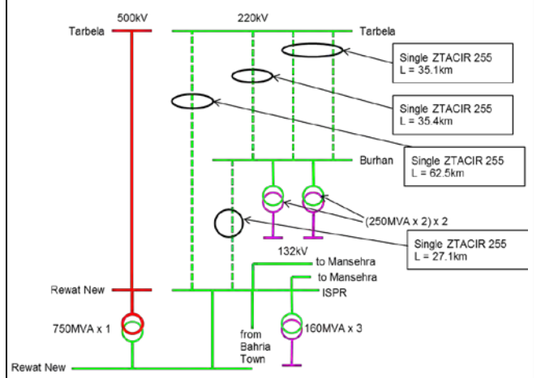
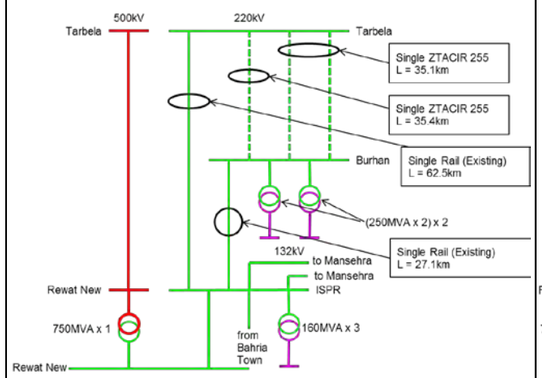
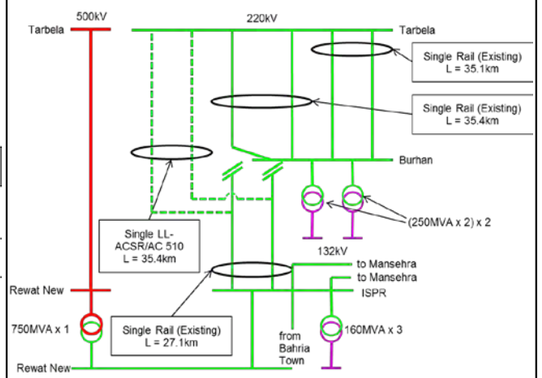
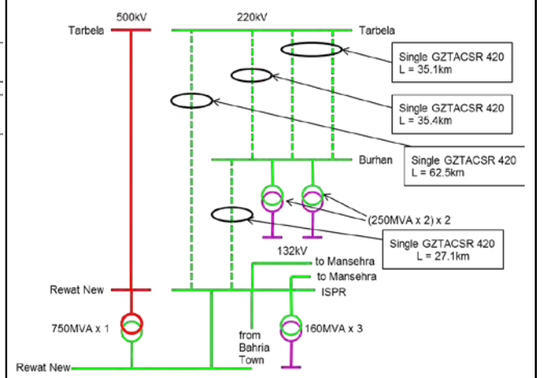
ANNEX 2.2.2-1 Power Flow Analysis on the Candidate Project Scopes considered in the Course of Discussion with NTDCL

Power flow analysis on the candidate project scopes considered in the course of discussion with NTDCL for 2018 summer peak condition were carried out. The candidate project scopes are shown in Table A1 and their system configuration are summarized in Figure A1.

Table A1 Candidate Transmission Line Reinforcement Project Scopes

Plan No.	Concept	Section	Circuit	Conductor Type	Length
1	Invar conductor is applied to all of the sections listed in the right column	Tarbela-Burhan	1, 2	ZTACIR 255 (Invar conductor, single)	35.1km
		Tarbela-Burhan	3		35.4km
		Tarbela-ISPR	1		62.5km
		Burhan-ISPR	1		27.1km
2	Limit the number of sections to which invar conductor is applied.	Tarbela-Burhan	1, 2	ZTACIR 255 (Invar conductor, single)	35.1km
		Tarbela-Burhan	3		35.4km
		Tarbela-ISPR	1	Single Rail (existing)	62.5km
		Burhan-ISPR	1	Single Rail (existing)	27.1km
3	Use existing conductor as much as possible and construct new line from Tarbela to Burhan applying to low loss conductor	Tarbela-Burhan	1, 2	Single Rail (existing)	35.1km
		Tarbela-Burhan	3	Single Rail (existing)	35.4km
		Tarbela-ISPR (Connecting to Burhan) Burhan-ISPR section is disconnected at Burhan	1	Single Rail (existing)	35.4km
		Burhan-ISPR (Disconnected at Burhan)	1	Single Rail (existing)	27.1km
		Tarbela-Burhan (new construction) Connecting to existing Burhan-ISPR at the tower located near Burhan substation	4	LL-ACSR/AC 510 (Low loss conductor, single)	35.4km
		Tarbela-Burhan (new construction) Connecting to existing Tarbela-ISPR line at the tower located near Burhan substation	5	LL-ACSR/AC 510 (Low loss conductor, single)	35.4km
4	Gap conductor is	Tarbela-Burhan	1, 2	GTACSR 420	35.1km

	applied to all of the sections listed in the right column	Tarbela-Burhan	3	(Gap conductor, single)	35.4km
		Tarbela-ISPR	1		62.5km
		Burhan-ISPR	1		27.1km
5	Limit application of Gap conductor as much as possible without changing system configuration	Tarbela-Burhan	1, 2	GTACSR 420	35.1km
		Tarbela-Burhan	3	(Gap conductor, single)	35.4km
		Tarbela-ISPR	1	Single Rail (existing)	62.5km
		Burhan-ISPR	1	Single Rail (existing)	27.1km
6	Limit application of Gap conductor as much as possible	Tarbela-Burhan	1, 2	GTACSR 420	35.1km
		Tarbela-Burhan	3		35.4km
		Replace conductor only Tarbela-Burhan section of Tarbela-ISPR line and connect to Burhan substation	1	(Gap conductor, single)	35.4km
		Disconnect Burhan-ISPR section of Tarbela-ISPR line at Burhan substation	1	Single Rail (existing)	27.1km
		Burhan-ISPR	1	Single Rail (existing)	27.1km
7	Application of low loss conductor to all the sections but that is constructed by NTDCL's own fund	Tarbela-Burhan	1, 2	Rail (twin-bundle, NTDCL own fund project)	35.1km
		Tarbela-Burhan	3	LL-ACSR/AC 610 (twin-bundle)	35.4km
		Tarbela-ISPR	1	LL-ACSR/AC 610 (twin-bundle)	62.5km
		Burhan-ISPR	1	LL-ACSR/AC 610 (twin-bundle)	27.1km

Plan No.	1	2	3	4
Concept	Invar conductor is applied to all of the sections listed in the right column	Limit the number of sections to which invar conductor is applied	Use existing conductor as much as possible and construct new line from Tarbela to Burhan applying to low loss conductor	Gap conductor is applied to all of the sections listed in the right column
System Configuration				
Plan No.	5	6	7	
Concept	Limit application of Gap conductor as much as possible without changing system configuration	Limit application of Gap conductor as much as possible	Application of low loss conductor to all the sections but that is constructed by NTDCL's own fund	
System Configuration				

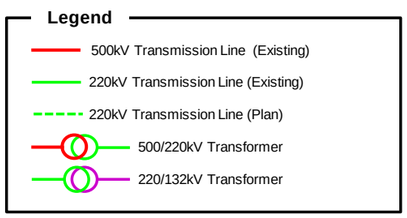


Figure A1 System Configuration of Candidate Project Scopes (Year 2018)

[Power Flow Analysis Results (2018 Summer Peak Load Condition)]

Power Flow Analysis Results for the candidate project scopes are summarized in Table A2.

For Plans 1 and 2 (Invar conductor application cases), no overload occurred to the 220kV transmission lines and 220/132kV transformers in the project target system under both normal operation condition and N-1 contingency condition.

For Plan 3 (new construction of double circuit transmission lines in the section between Tarbela-Burhan with low loss conductor application), power flow through 2 units of 220/132kV transformers at Burhan substation reach 104% (520.2MVA) of the rated capacity (2 x 250MVA) under N-1 contingency condition (fault section: Tarbela-ISPR). Since the power flow up to 120% of the rated capacity of the facilities is allowed under emergency condition, it is not considered problematic. However, this system configuration was not adopted due to following concerns:

- Although this plan requires extension of line bays for 2 circuits in Tarbela hydropower station site, there is no available space in the existing site.
- Longer construction period is necessary.
- Securing the Right-of-way for the new double circuit lines may take long time.

For Plan 4 to 6 (Gap conductor application cases), no overloading occurs to transmission lines or 220/132kV transformers for Plan 4 and 5. However, For Plan 6 (replacing single Rail conductor with Gap conductor for only Tarbela-Burhan section of Tarbela-ISPR line, connecting the Tarbela-Burhan section to Burhan substation), 2 units of 220/132kV transformers at Burhan substation becomes overloaded with 101% (505MVA) loading of the rated capacity of the transformers even under normal operation condition. Although Plan 4 and 5 have no problem from the viewpoint of power flow under both normal operation condition and N-1 contingency condition, these plans were eliminated as the result of life cycle cost comparison among the candidate plans due to large accumulated transmission losses.

As for Plan 7, the project scope reflected the discussion results of the joint meeting among NTDCL, JICA headquarter, and JICA Survey Team held on March 17th, 2016. Tarbela-Burhan circuit No.1 and No.2 will be replaced with twin-bundle Rail conductor by NTDCL's own fund before completion of Tarbela hydropower station 4th extension project, which is expected to be completed in June 2017. Conductor replacement with low loss conductor (twin-bundle LL-ACSR/AC 610) of Tarbela-Burhan circuit No.3, Tarbela-ISPR, and Burhan-ISPR by external loan was assumed.

In 2018, 3 units of 220/132kV transformers at ISPR substation became overloaded with 104% loading of the rated capacity of transformers under normal operation condition. Also, 2 units of 220/132kV transformers at Burhan substation became overloaded in the case of single circuit fault of

the sections Tarbela-ISPR and Burhan-ISPR with 100.5% and 103% loading of the rated capacity, respectively. In 2020, however, the power flow of the transformers at Burhan and ISPR substations is expected to be decreased along with development of 500/220kV Islamabad West substation. According to Planning Power, NTDCL, from the viewpoint of system operation, this overload situation is regarded permissible since the extent of overloading is slight and this situation would occur in just a couple of years in summer peak hours.

Table A2 Power Flow Analysis Results for each Candidate Project Scope (2018 Summer Peak)

Plan		Normal Operation	N-1 Contingency			
			Tarbela-Burhan (circuit 1 or circuit 2)	Tarbela-Burhan (circuit 3)	Tarbela-ISPR	Burhan-ISPR
1	Invar conductor is applied to all of the reinforcement sections	No overloading of transmission lines or transformers	Same as on the left	Same as on the left	Same as on the left	Same as on the left
2	Limit the number of sections to which invar conductor is applied	ditto	Same as on the left	Same as on the left	Same as on the left	Same as on the left
3	Use existing conductor as much as possible and construct new line from Tarbela to Burhan applying to low loss conductor	ditto	Same as on the left	Same as on the left	Loading of two (2) 220/132kV transformers at Burhan substation is 104% (520.2MVA)	Same as on the left
4	Gap conductor is applied to all of the reinforcement sections	ditto	Same as on the left	Same as on the left	Same as on the left	Same as on the left
5	Limit application of Gap conductor as much as possible without changing system configuration	ditto	Same as on the left	Same as on the left	Same as on the left	Same as on the left
6	Limit application of Gap conductor as much as possible	Loading of two (2) 220/132kV transformers at Burhan substation is 101% (505MVA)	No overloading of transmission lines or transformers	Same as on the left		･Loading of one (1) 500/220kV transformers at Rewat New substation is 100.3% (752.4MVA) ･Loading of two (2) 220/132kV transformers at Burhan substation is 111.8% (558.8MVA) ･Loading of other two (2) 220/132kV transformers at Burhan substation is 107.1% (535.3MVA)
7	Application of low loss conductor to all the sections but that is constructed by NTDCL's own fund	Loading of three (3) 220/132kV transformers at ISPR substation is 104% (502.5MVA)	Same as on the left	Same as on the left	Loading of two (2) 220/132kV transformers at Burhan substation is 100.5% (502.6MVA)	Loading of two (2) 220/132kV transformers at Burhan substation is 103% (514.8MVA)

ANNEX 2.2.2-2 Power Flow Analysis Result (Year 2018 Summer Peak)

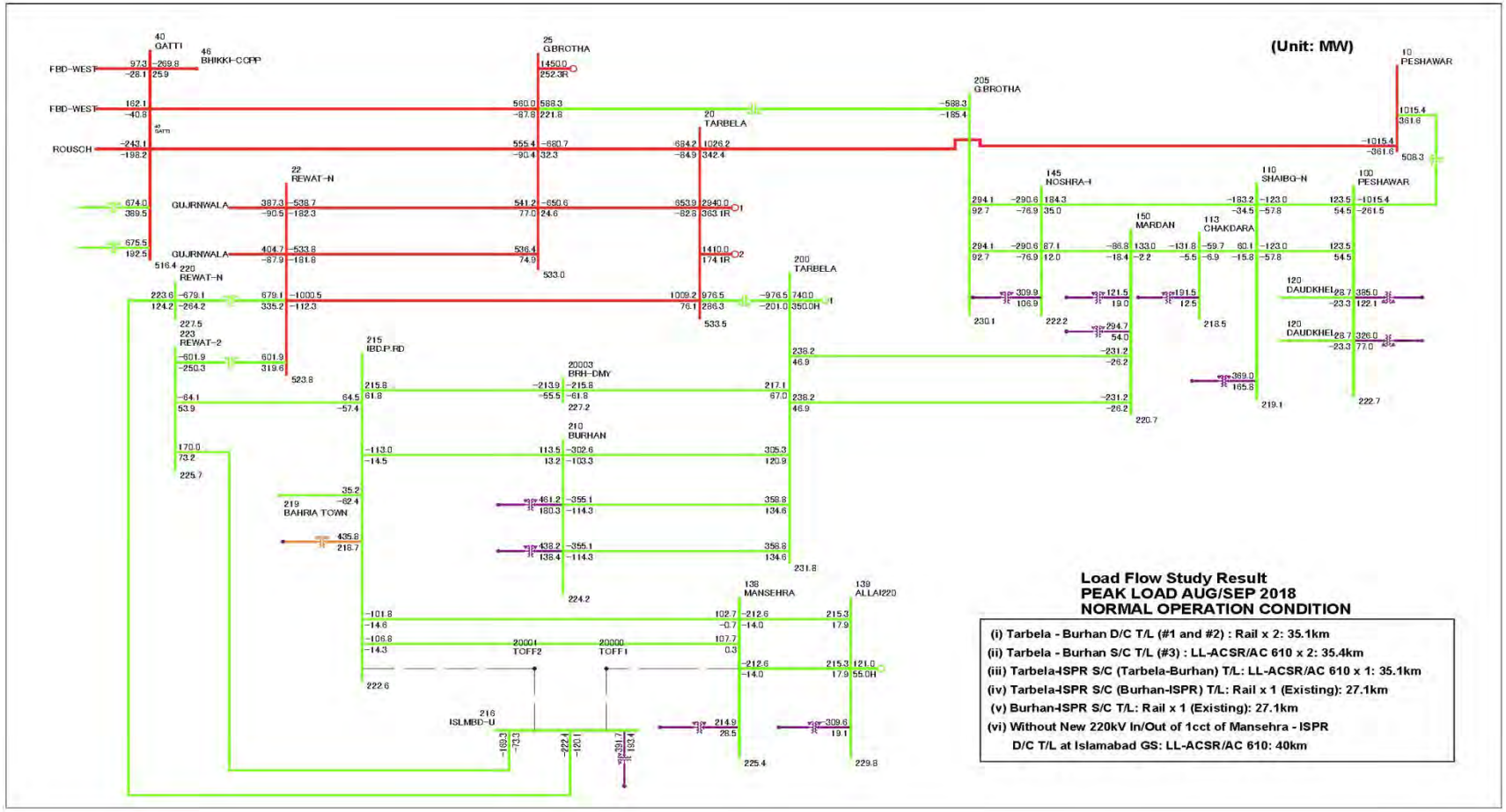


Figure 1. Power Flow Diagram (Normal Operation Condition)

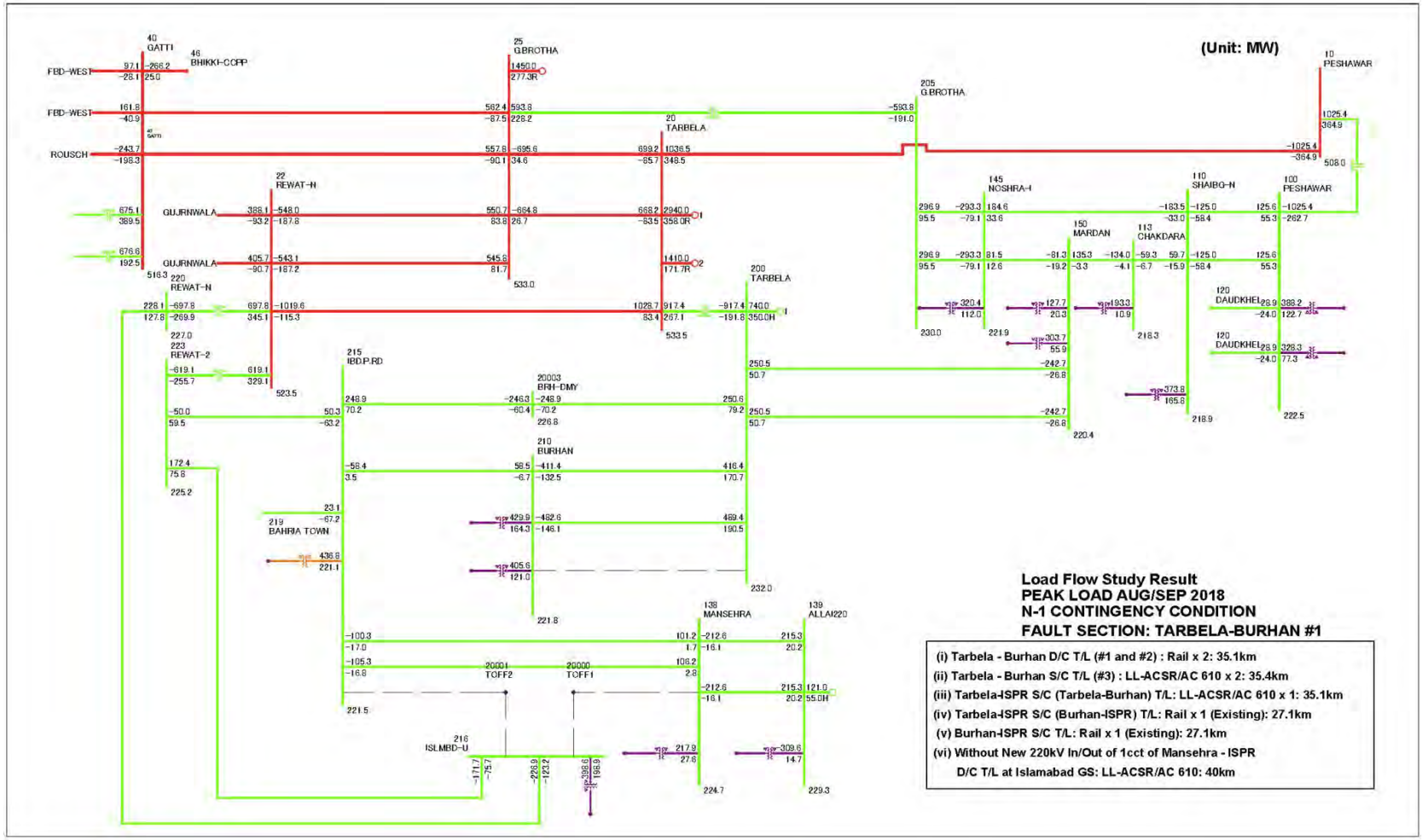


Figure 2. Power Flow Diagram (N-1Contingency Condition, Fault Section: Tarbela – Burhan Circuit #1)

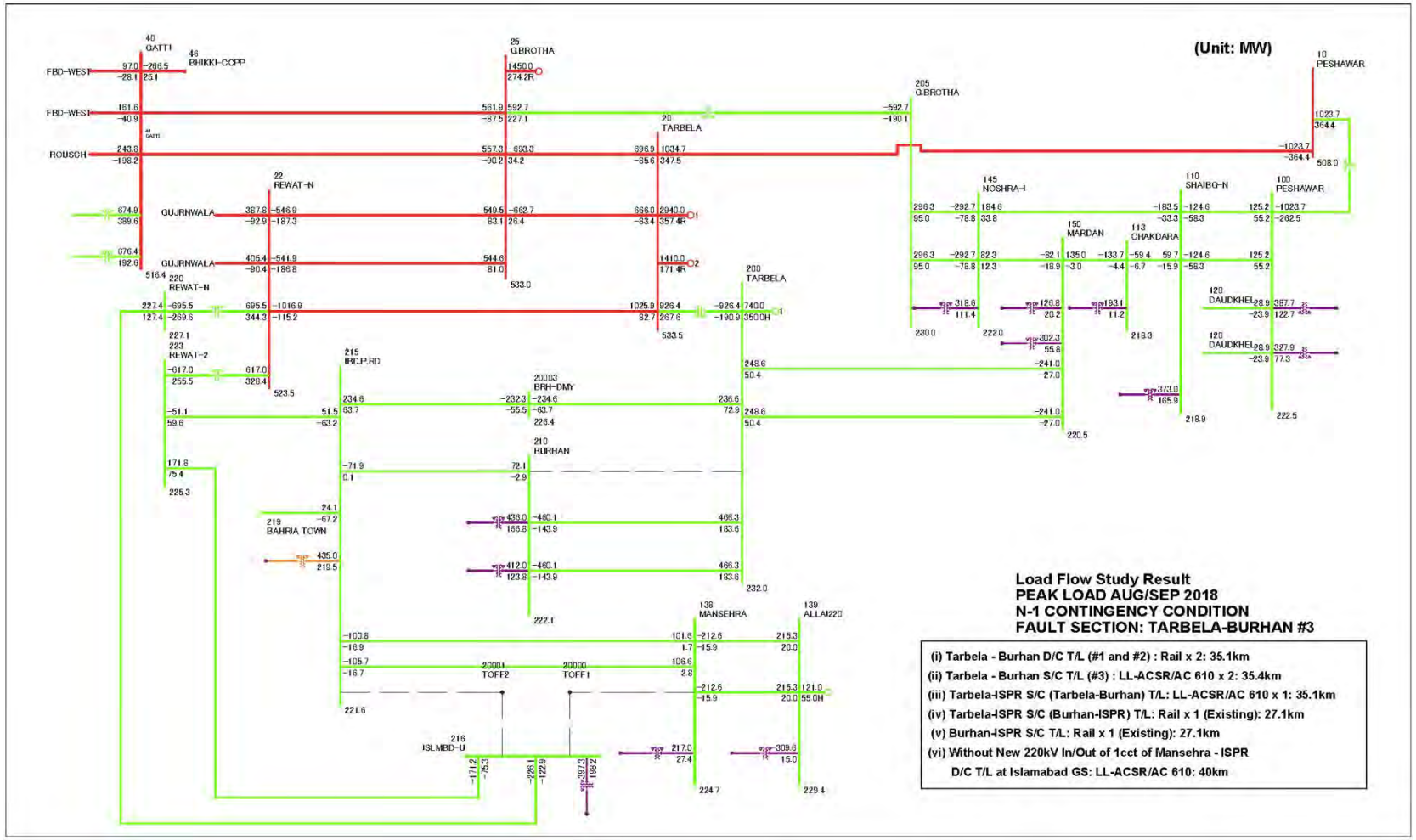


Figure 3. Power Flow Diagram (N-1Contingency Condition, Fault Section: Tarbela – Burhan Circuit #3)

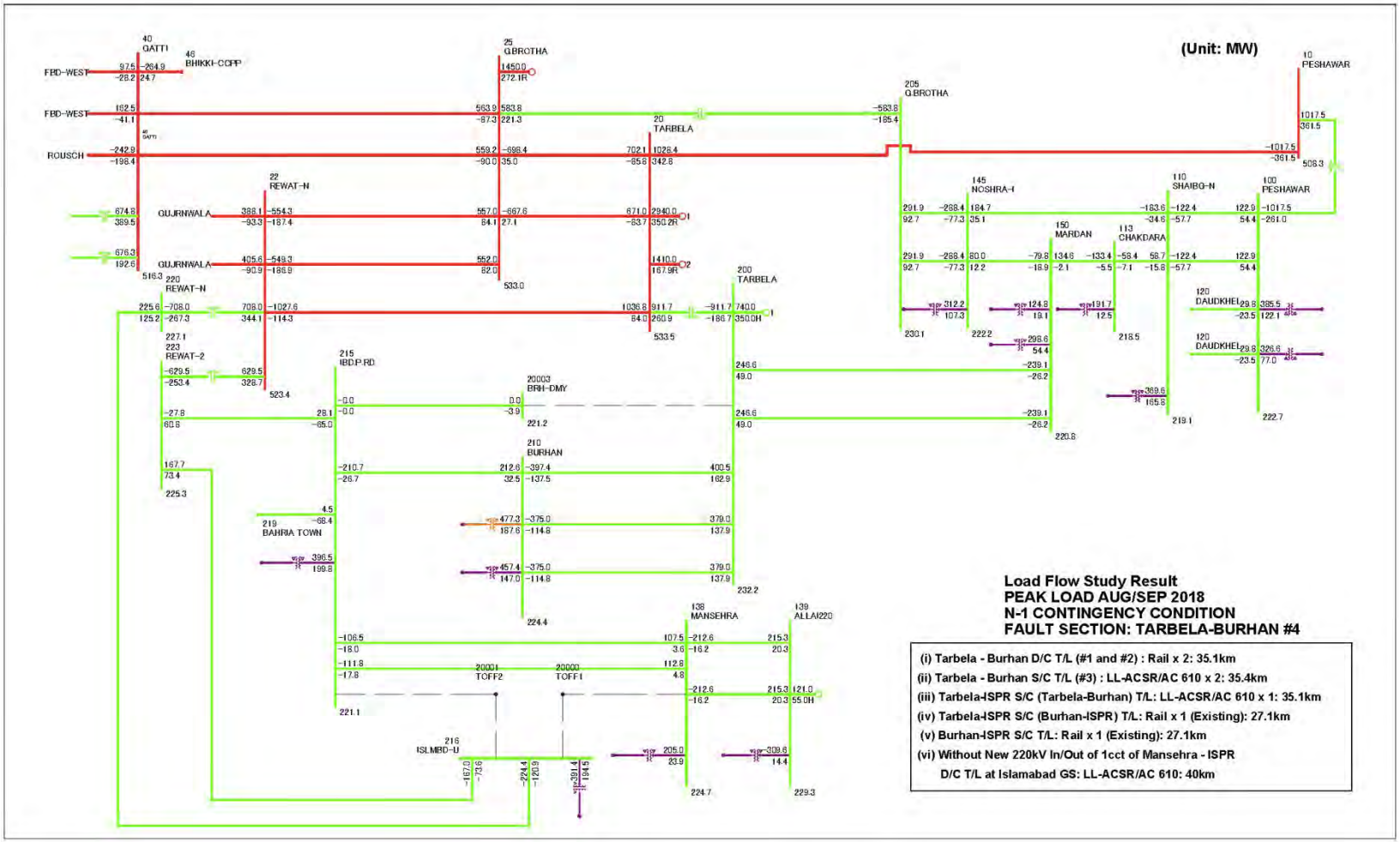


Figure 4. Power Flow Diagram (N-1Contingency Condition, Fault Section: Tarbela – ISPR Circuit #1)

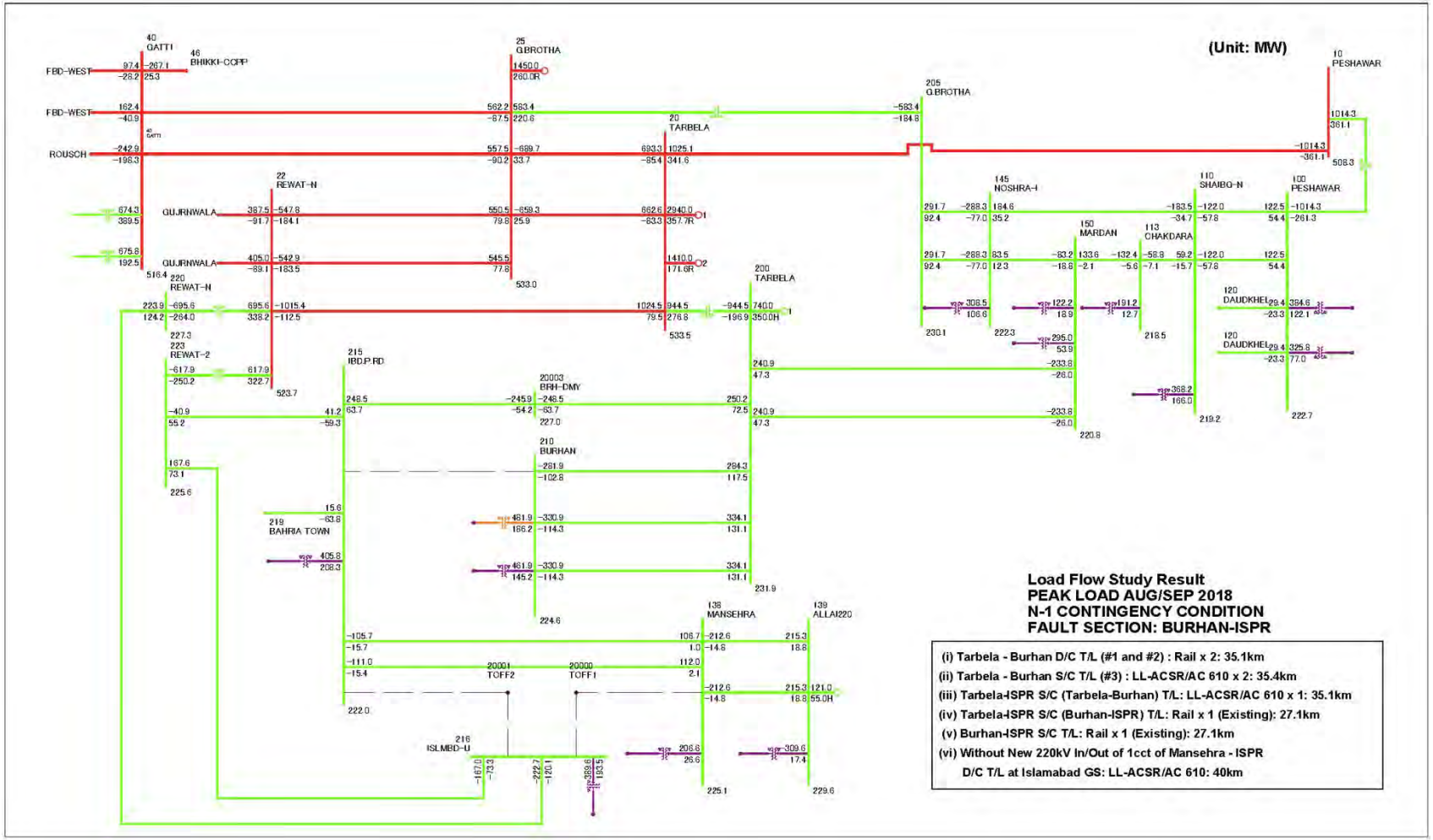
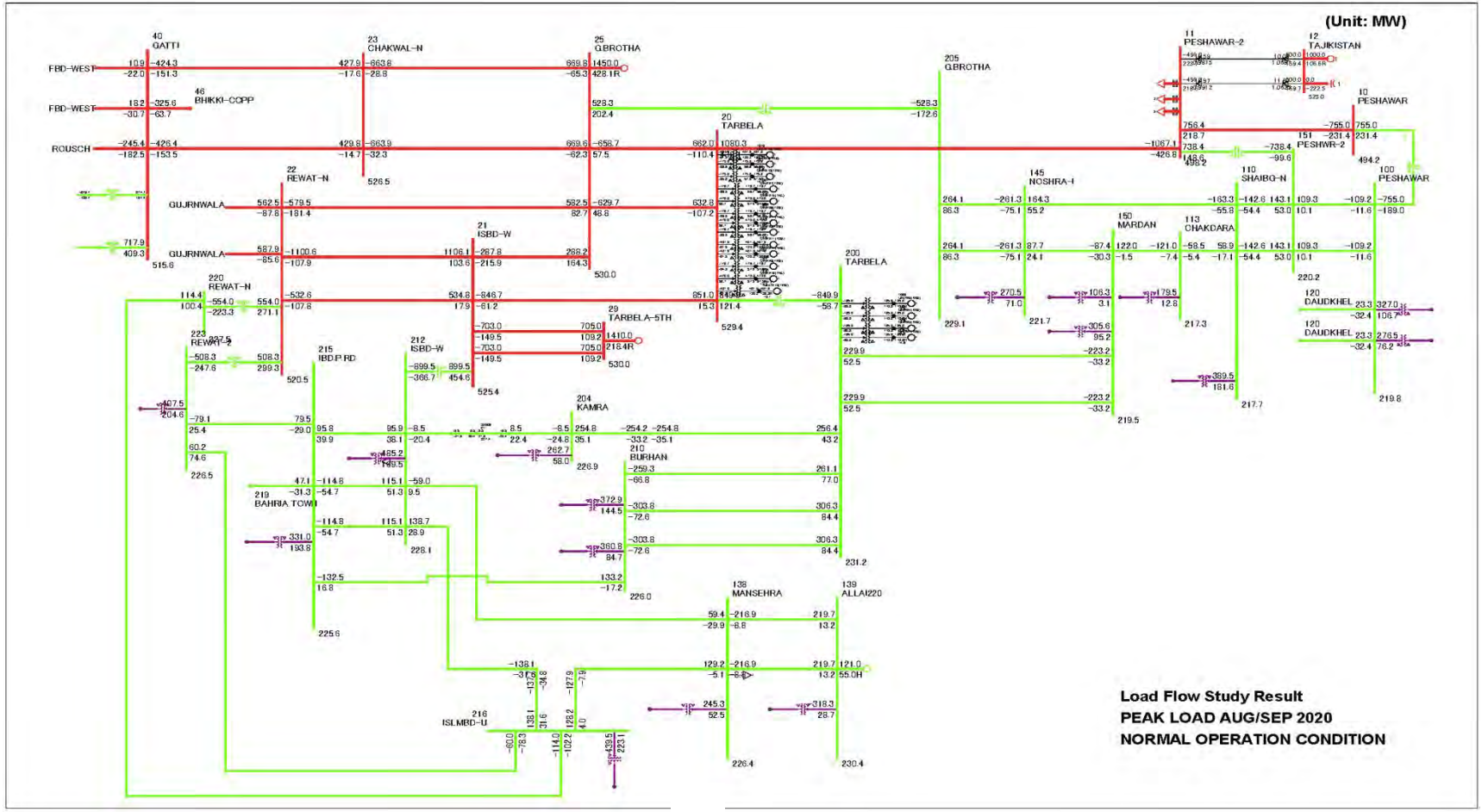


Figure 5. Power Flow Diagram (N-1Contingency Condition, Fault Section: Burhan – ISPR Circuit #1)

ANNEX 2.2.2-3 Power Flow Analysis Result (Year 2020)



1

Figure 1. Power Flow Diagram (2020 Summer Peak, Normal Operation Condition)

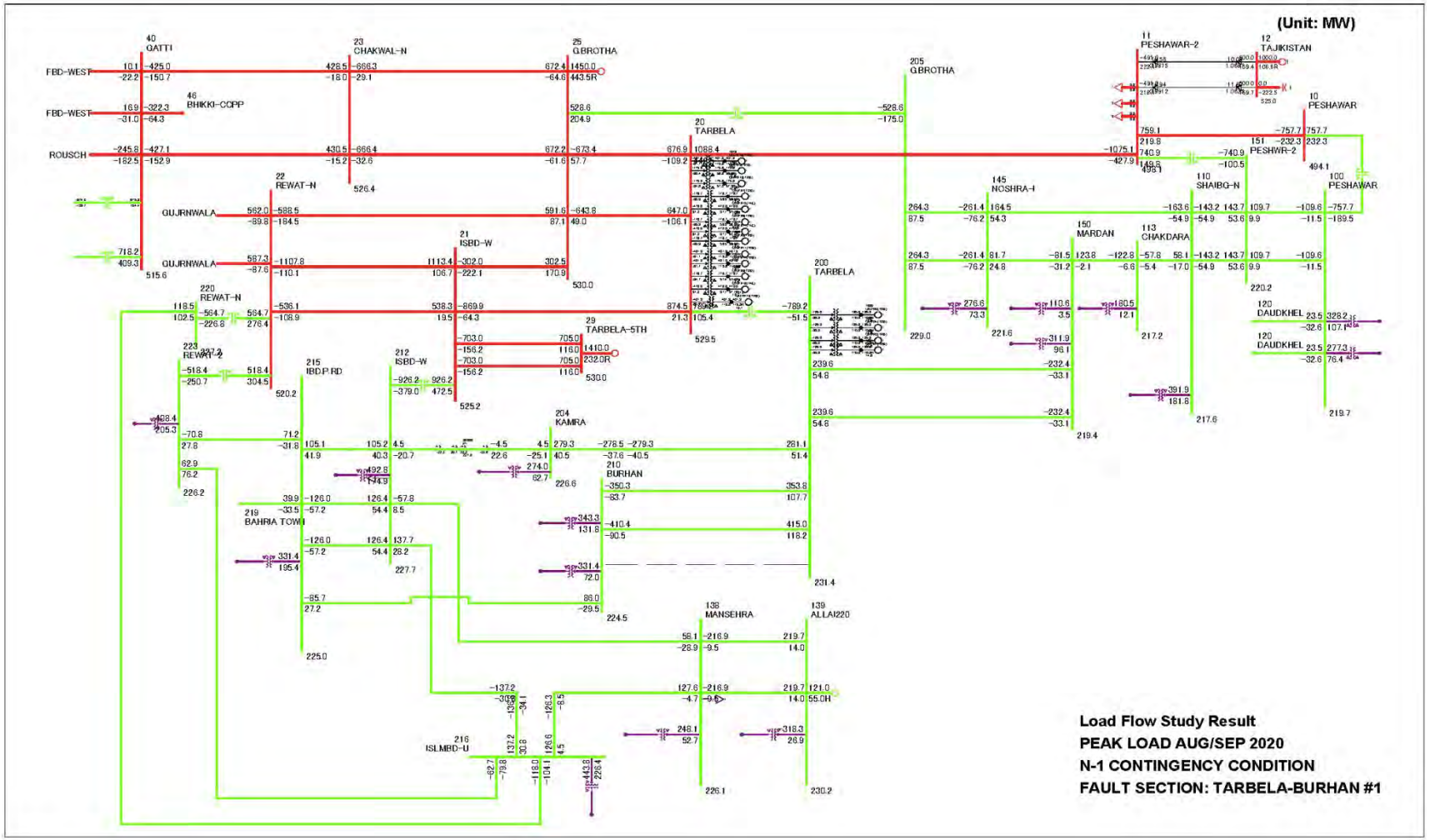


Figure 2. Power Flow Diagram (2020 Summer Peak, N-1Contingency Condition, Fault Section: Tarbela – Burhan Circuit #1)

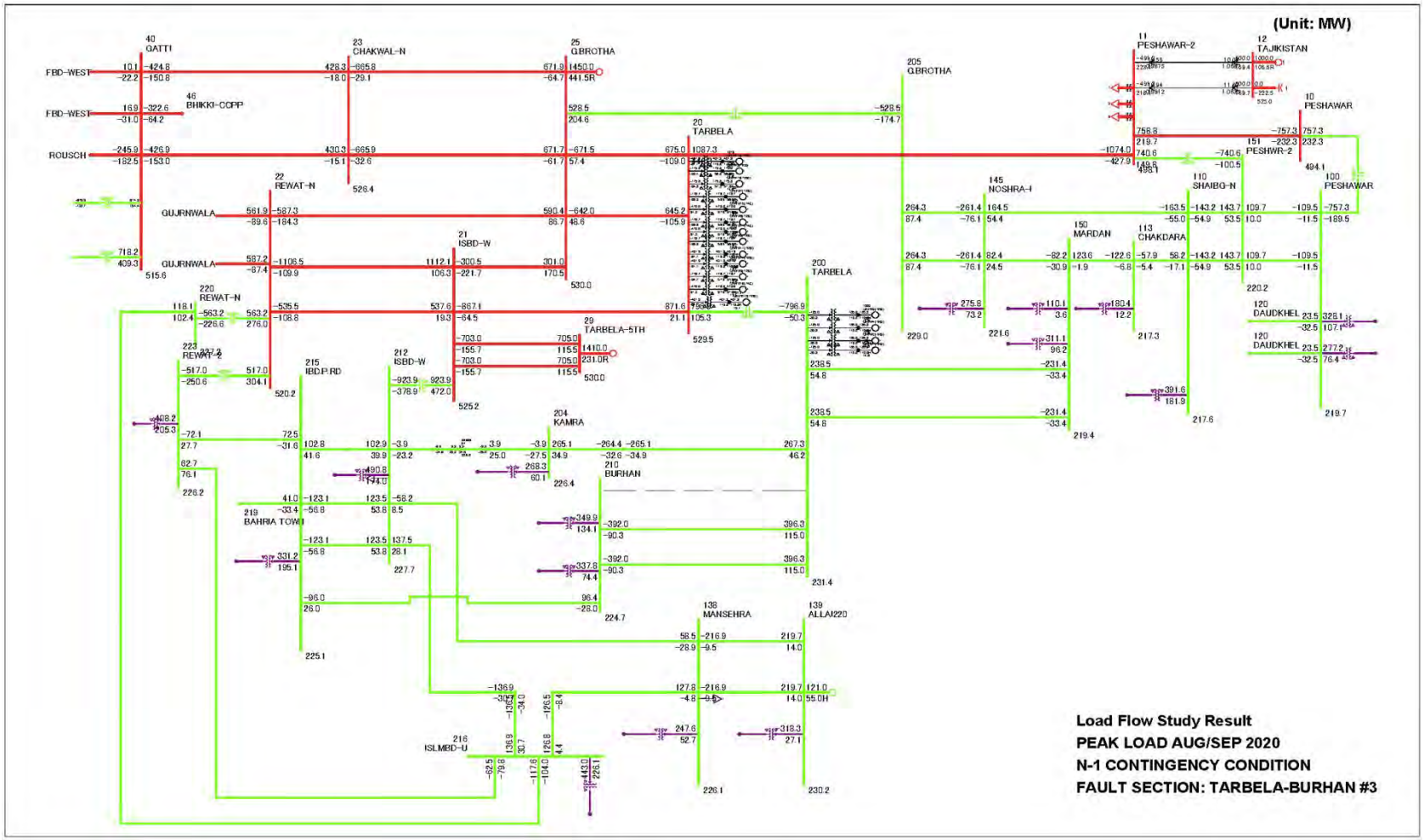


Figure 3. Power Flow Diagram (2020 Summer Peak, N-1Contingency Condition, Fault Section: Tarbela – Burhan Circuit #3)

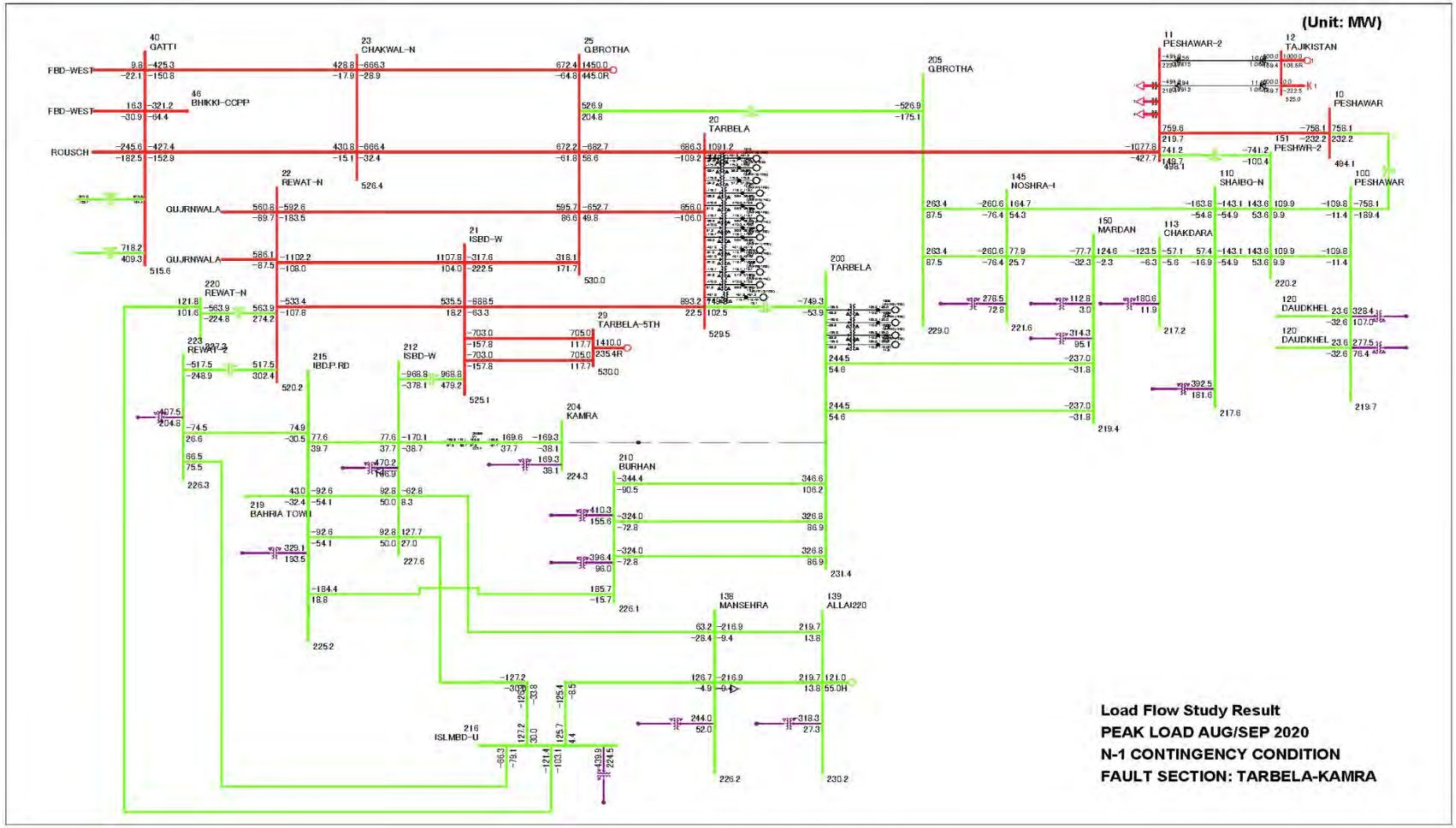


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Figure 4. Power Flow Diagram (2020 Summer Peak, N-1Contingency Condition, Fault Section: Tarbela – Kamra Circuit #1)

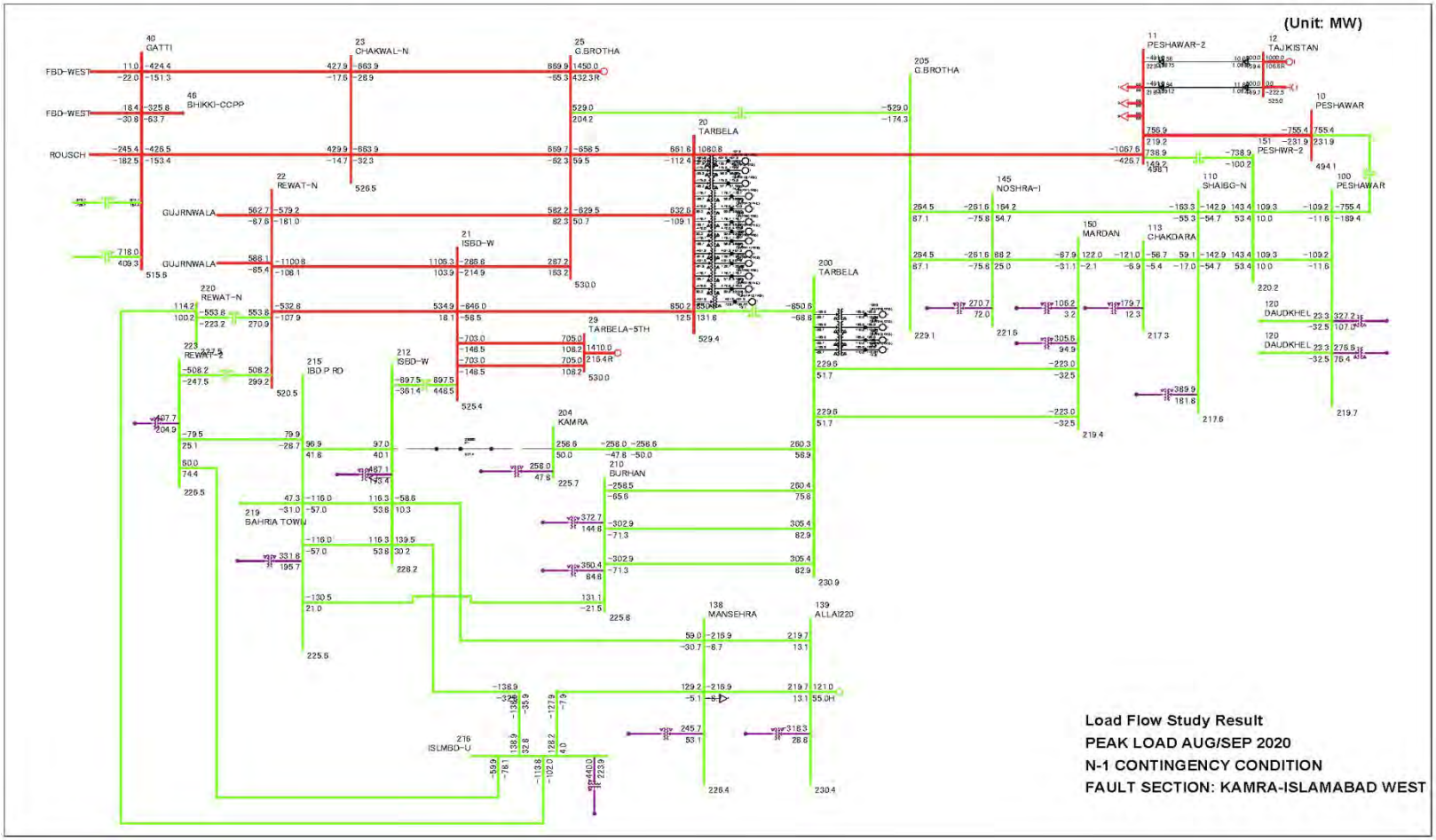


Figure 5. Power Flow Diagram (2020 Summer Peak, N-1Contingency Condition, Fault Section: Kamra – Islamabad West Circuit #1)

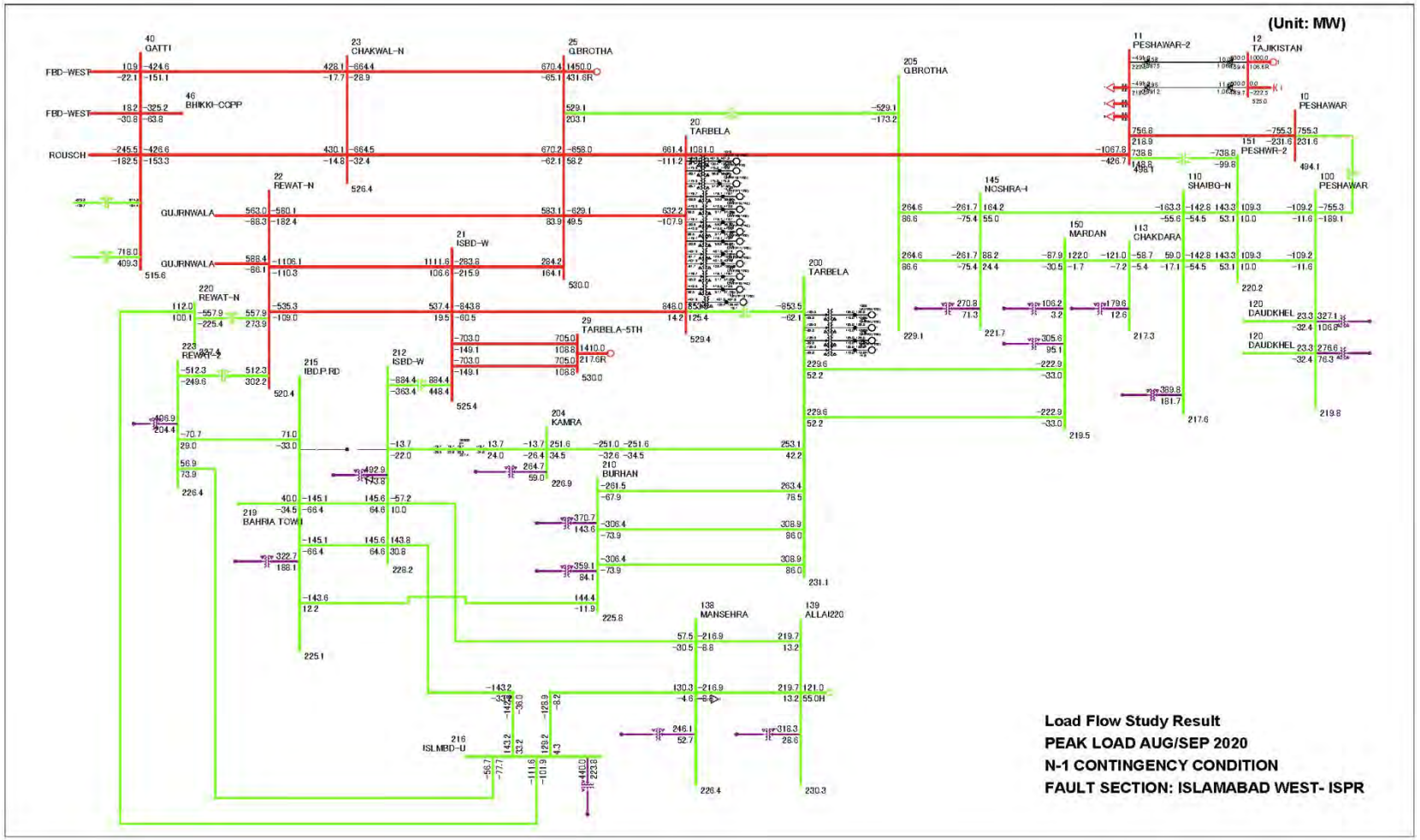


Figure 6. Power Flow Diagram (2020 Summer Peak, N-1Contingency Condition, Fault Section: Islamabad West – ISPR Circuit #1)

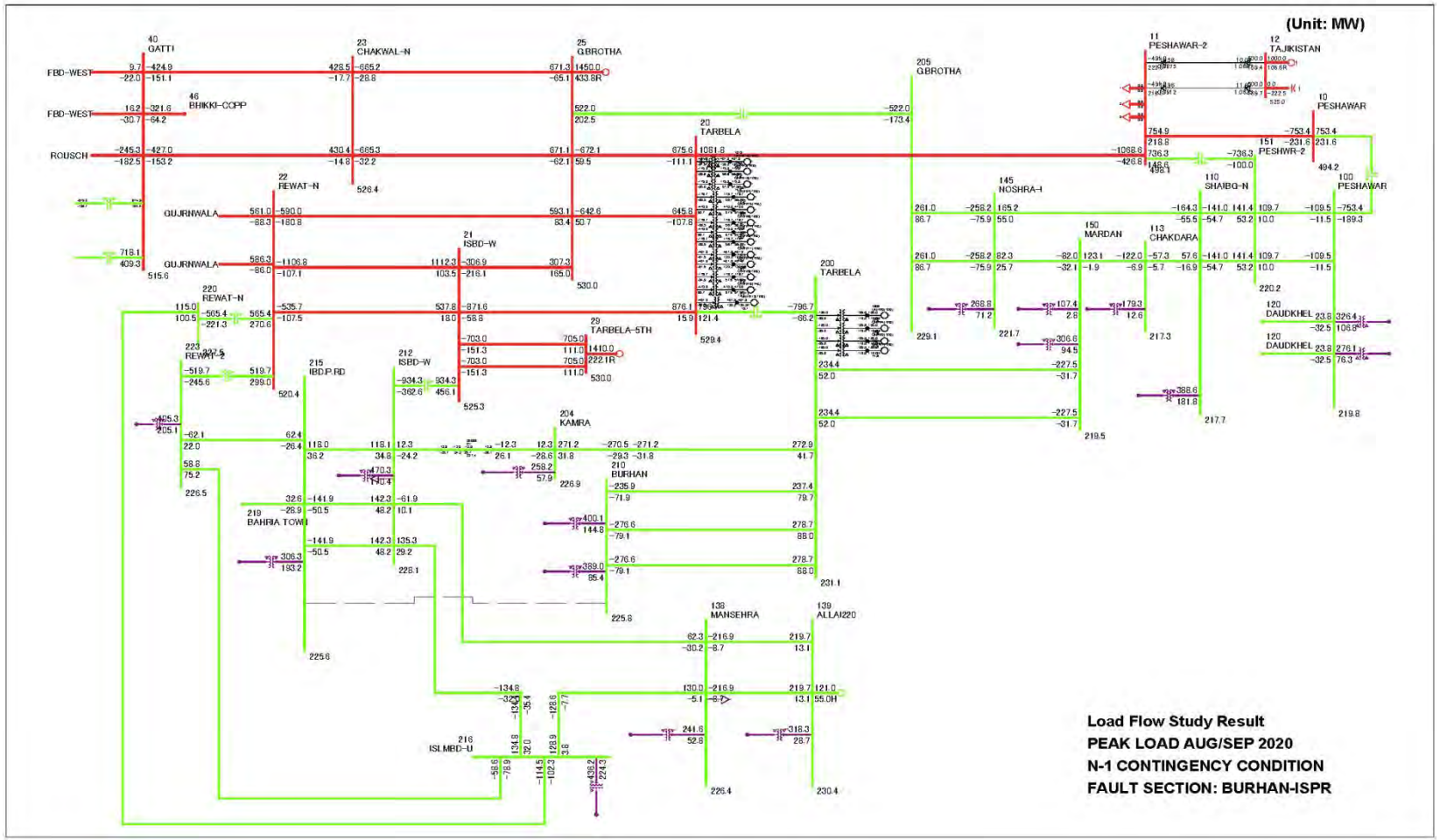


Figure 7. Power Flow Diagram (2020 Summer Peak, N-1Contingency Condition, Fault Section: Burhan – ISPR Circuit #1)

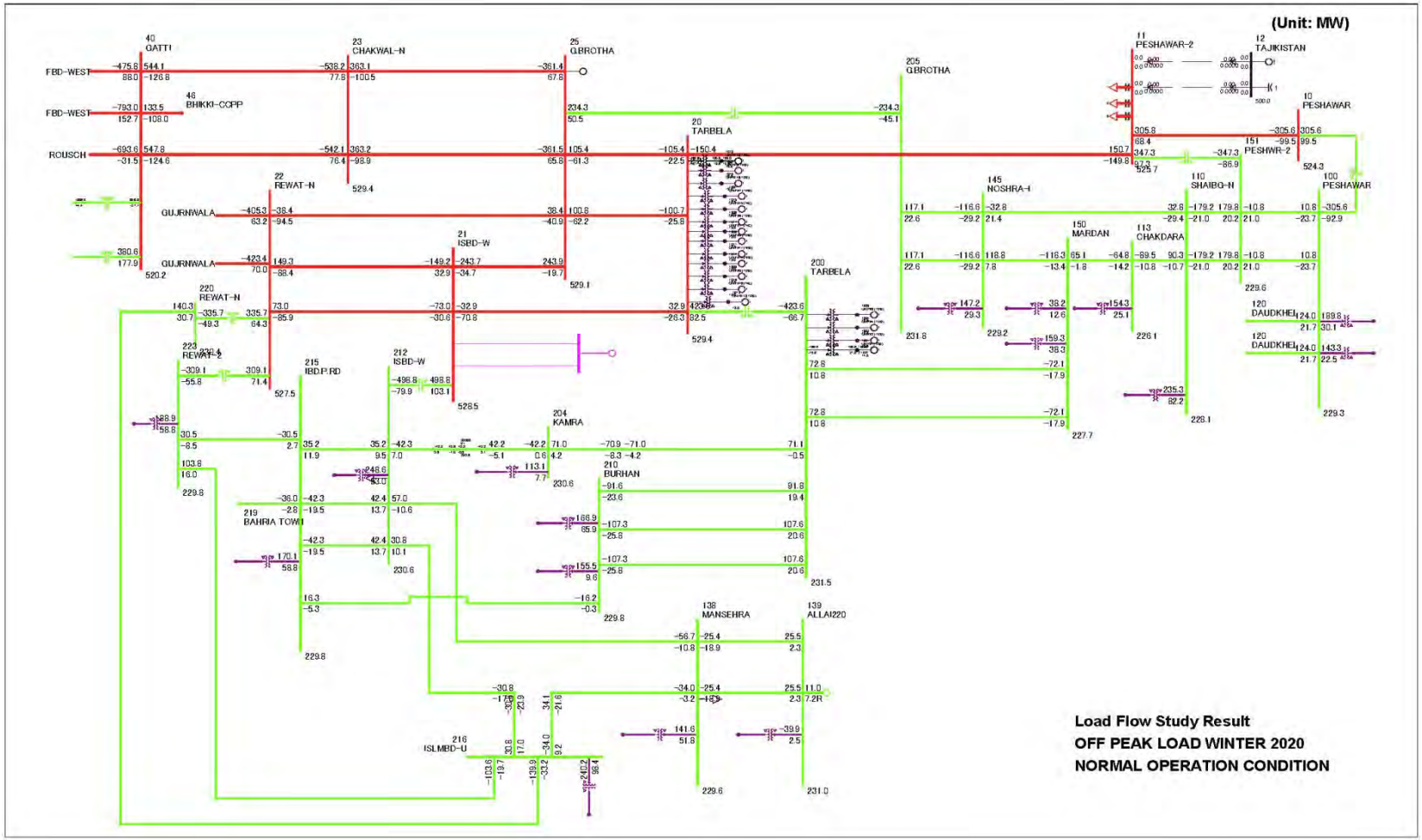


Figure 8. Power Flow Diagram (2020 Winter Off-peak, Normal Operation Condition)

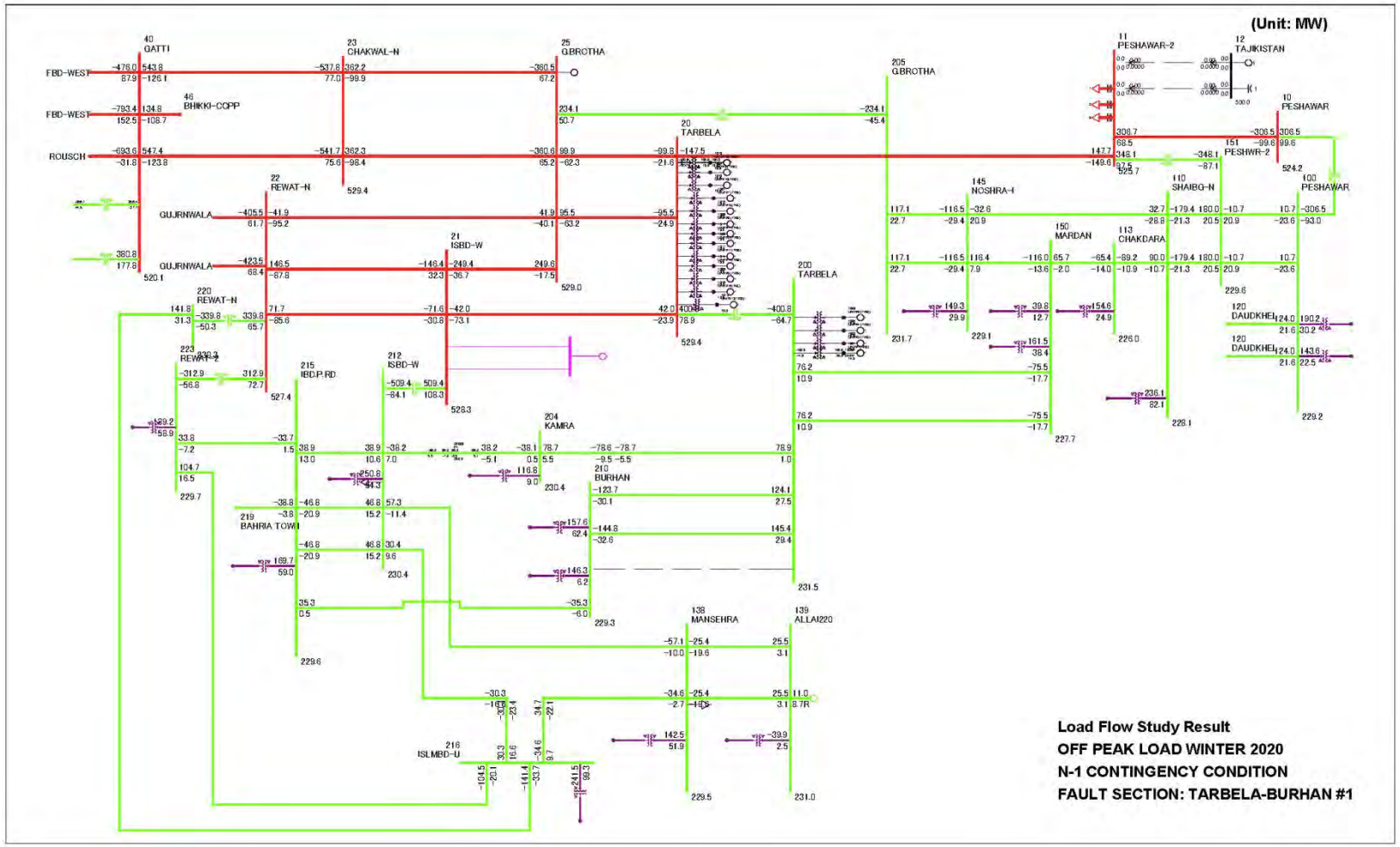


Figure 9. Power Flow Diagram (2020 Winter Off-peak, N-1Contingency Condition, Fault Section: Tarbela – Burhan Circuit #1)

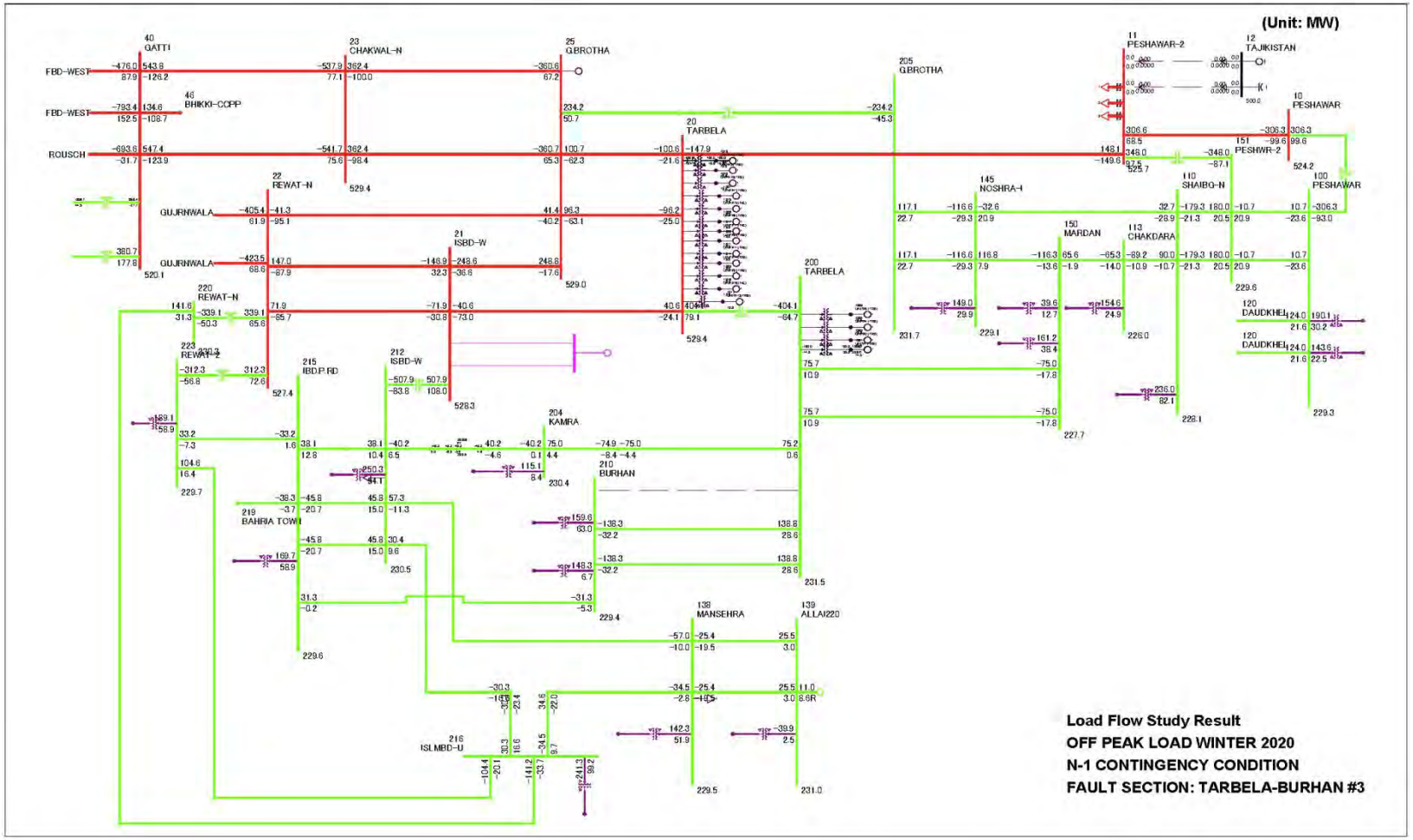


Figure 10. Power Flow Diagram (2020 Winter Off-peak, N-1Contingency Condition, Fault Section: Tarbela – Burhan Circuit #3)

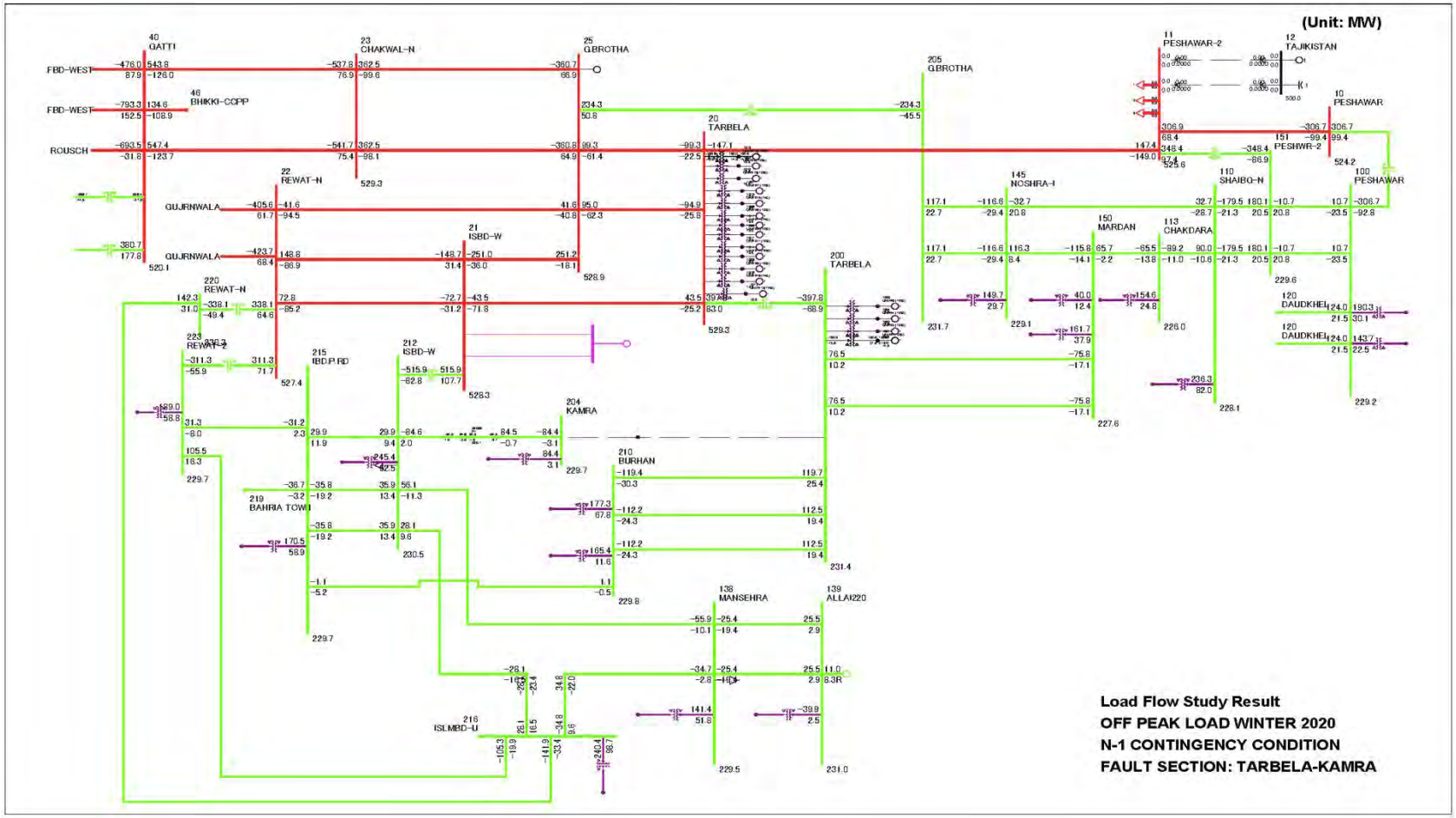


Figure 11. Power Flow Diagram (2020 Winter Off-peak, N-1Contingency Condition, Fault Section: Tarbela – Kamra Circuit #1)

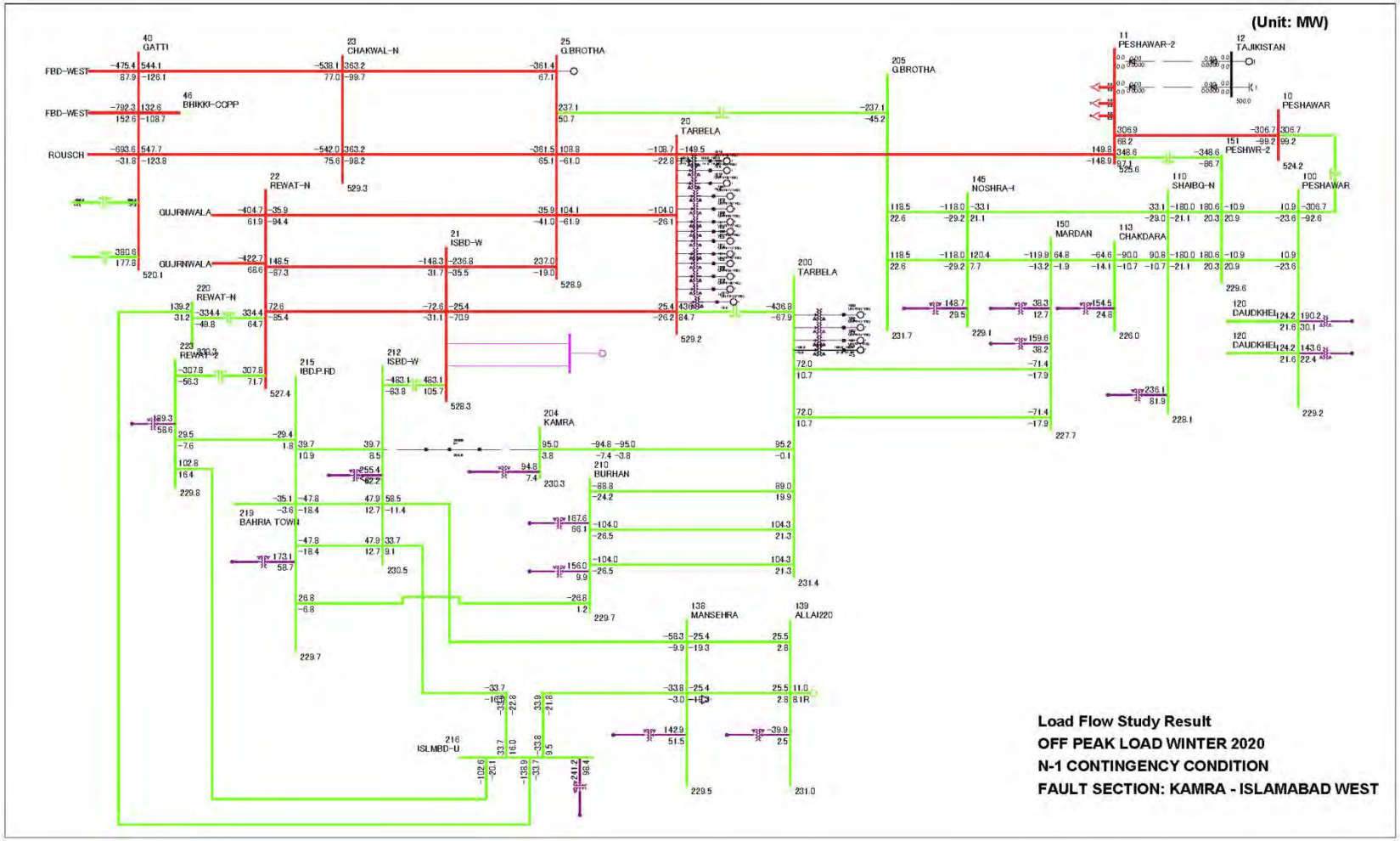


Figure 12. Power Flow Diagram (2020 Winter Off-peak, N-1Contingency Condition, Fault Section: Kamra – Islamabad West Circuit #1)

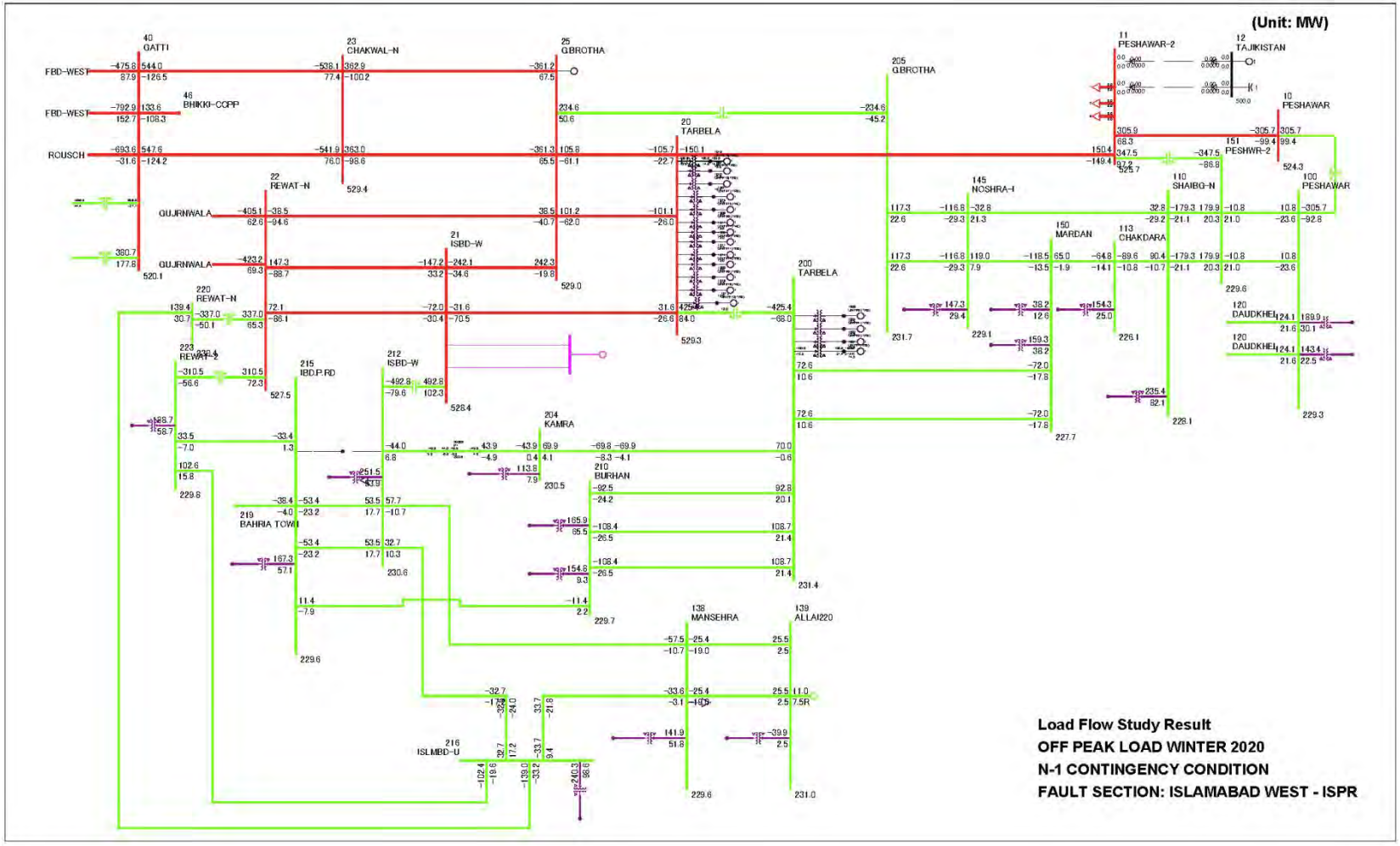


Figure 13. Power Flow Diagram (2020 Winter Off-peak, N-1Contingency Condition, Fault Section: Islamabad West – ISPR Circuit #1)

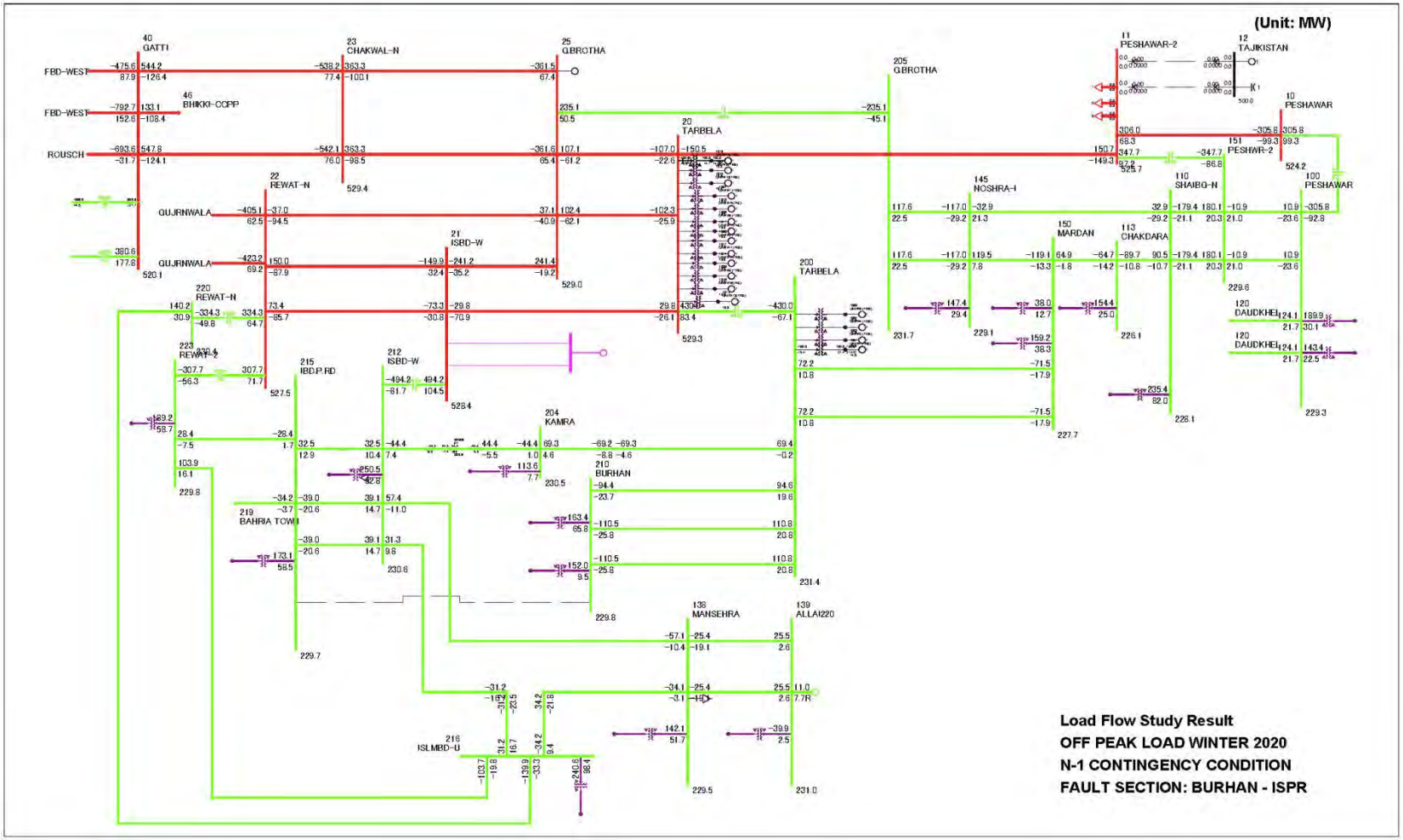
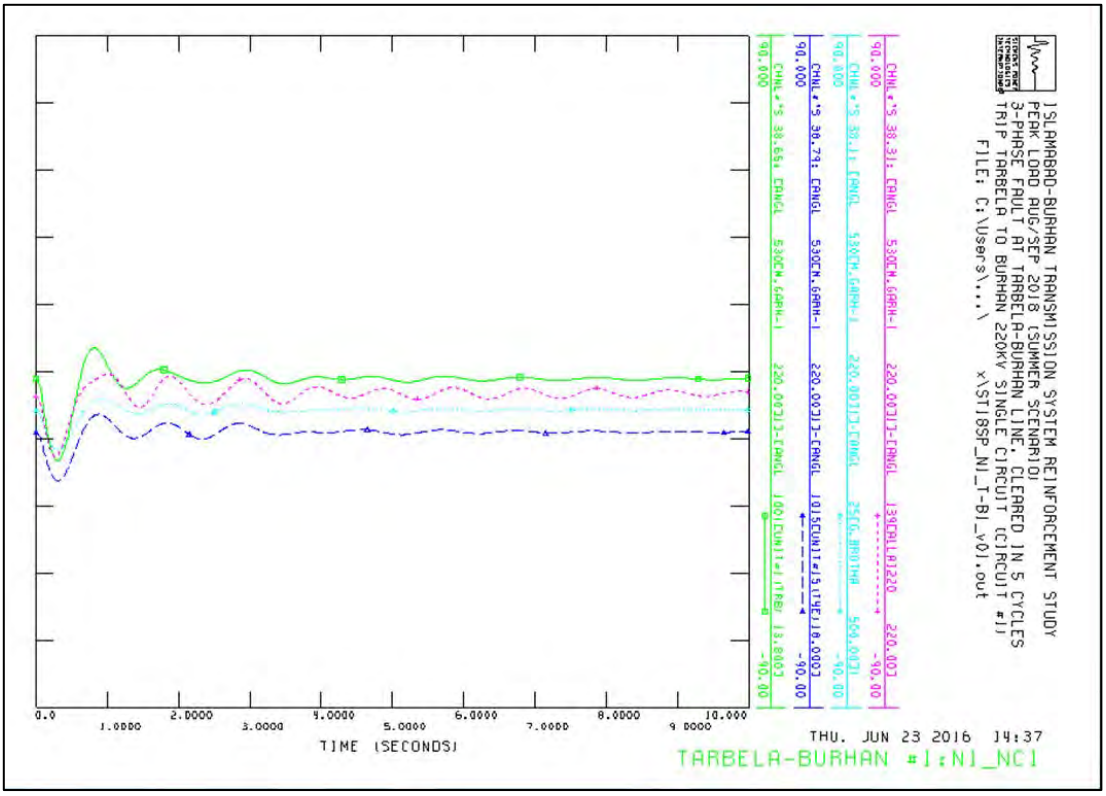


Figure 14. Power Flow Diagram (2020 Winter Off-peak, N-1Contingency Condition, Fault Section: Burhan – ISPR Circuit #1)

ANNEX2.2.4-1



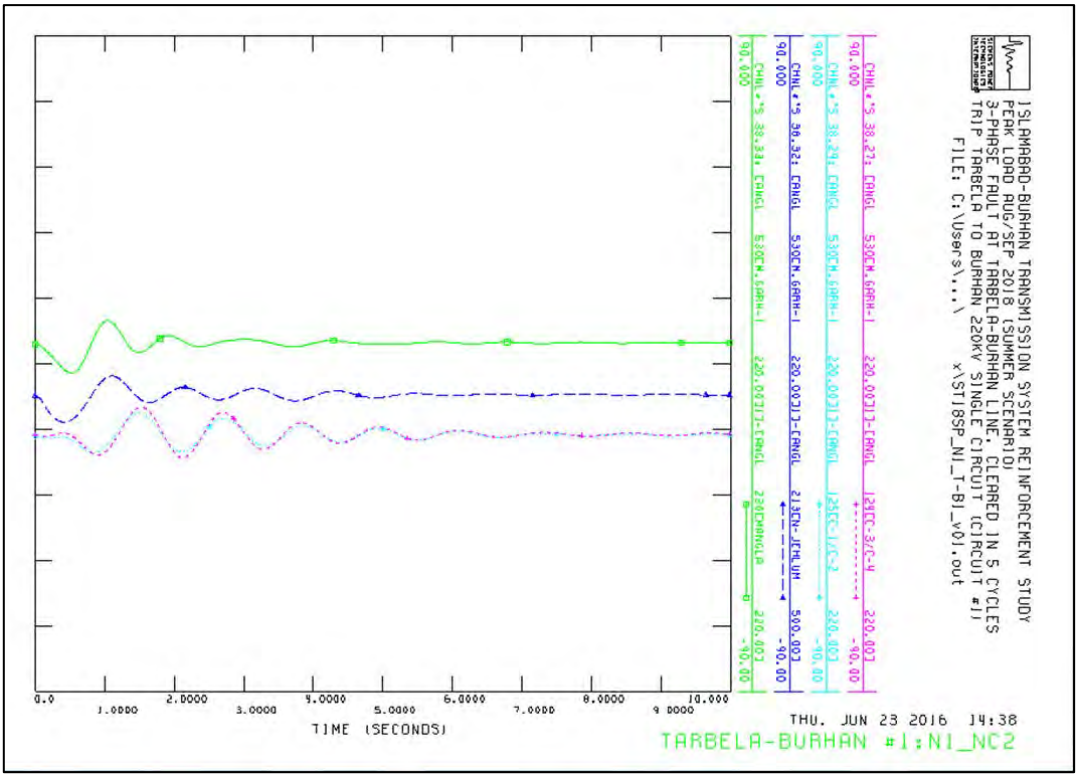
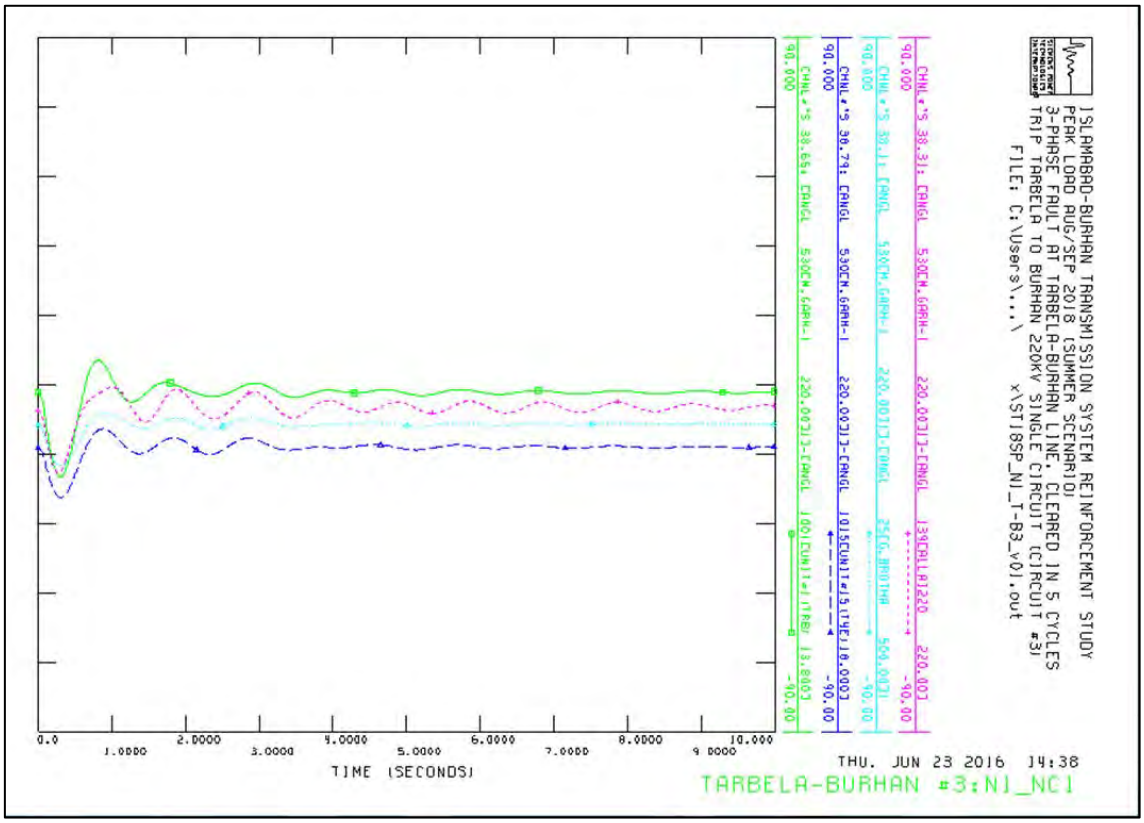


Figure A1 (Normal Clearing, Fault Section: Tarbela – Burhan Circuit No.1)



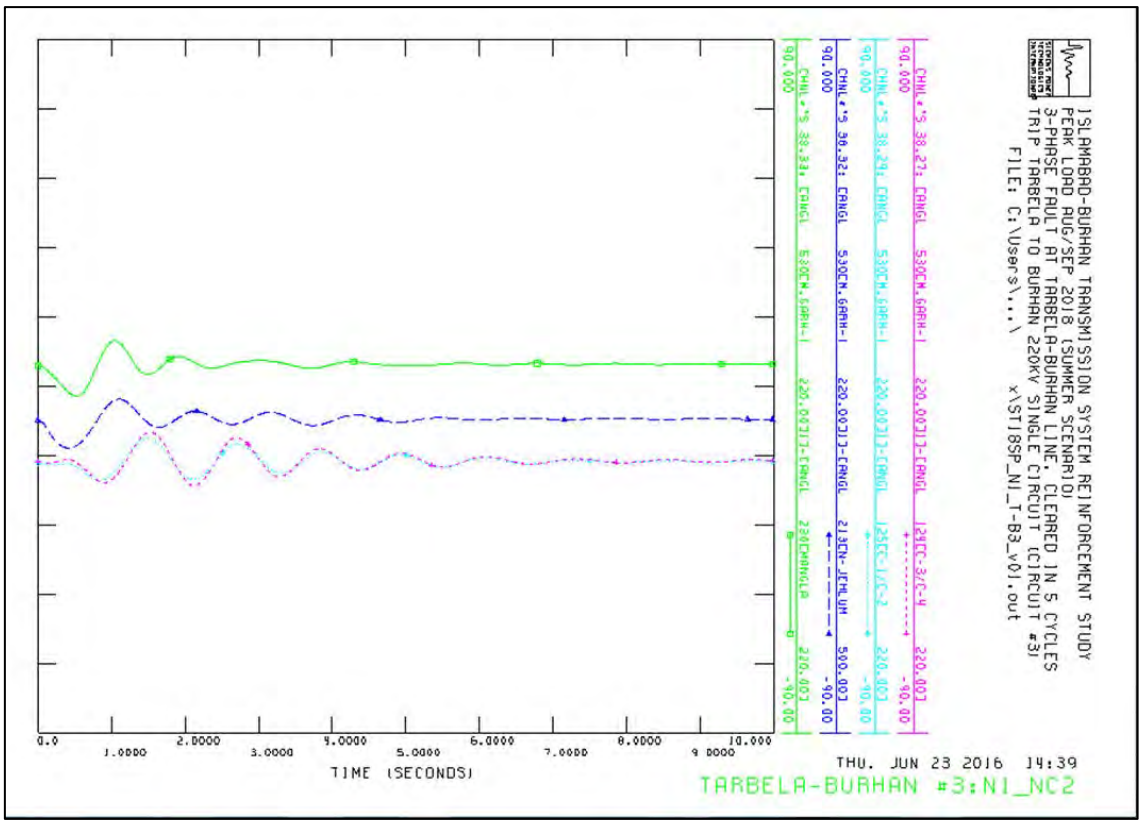


Figure A2 (Normal Clearing, Fault Section: Burhan – ISPR Circuit No.3)

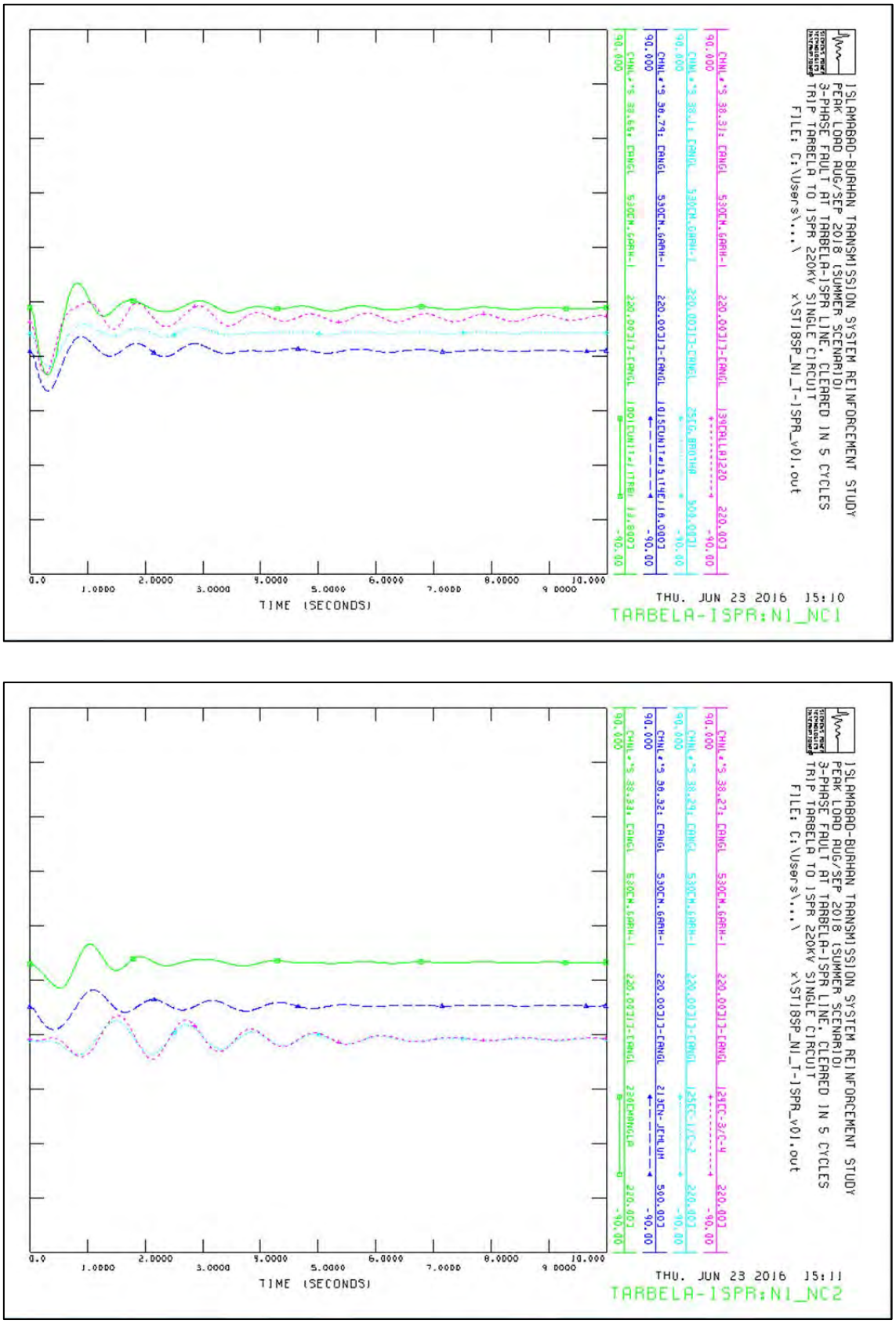
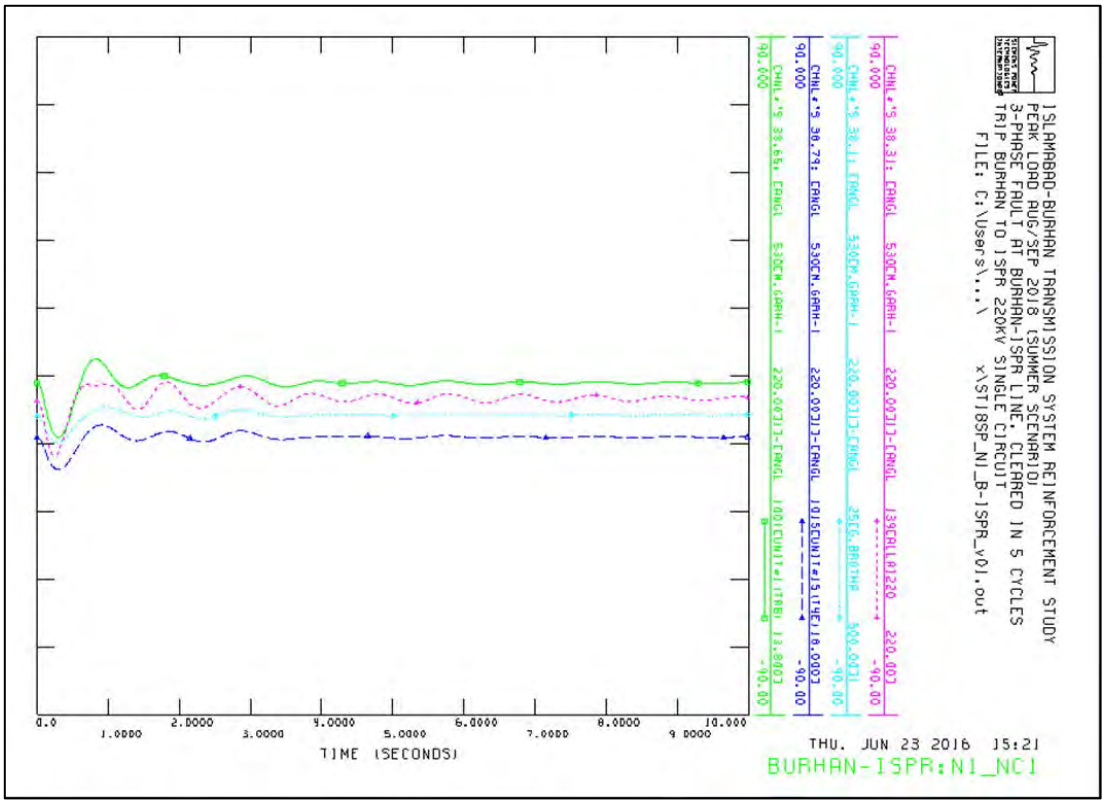


Figure A3 (Normal Clearing, Fault Section: Tarbela – ISPR)



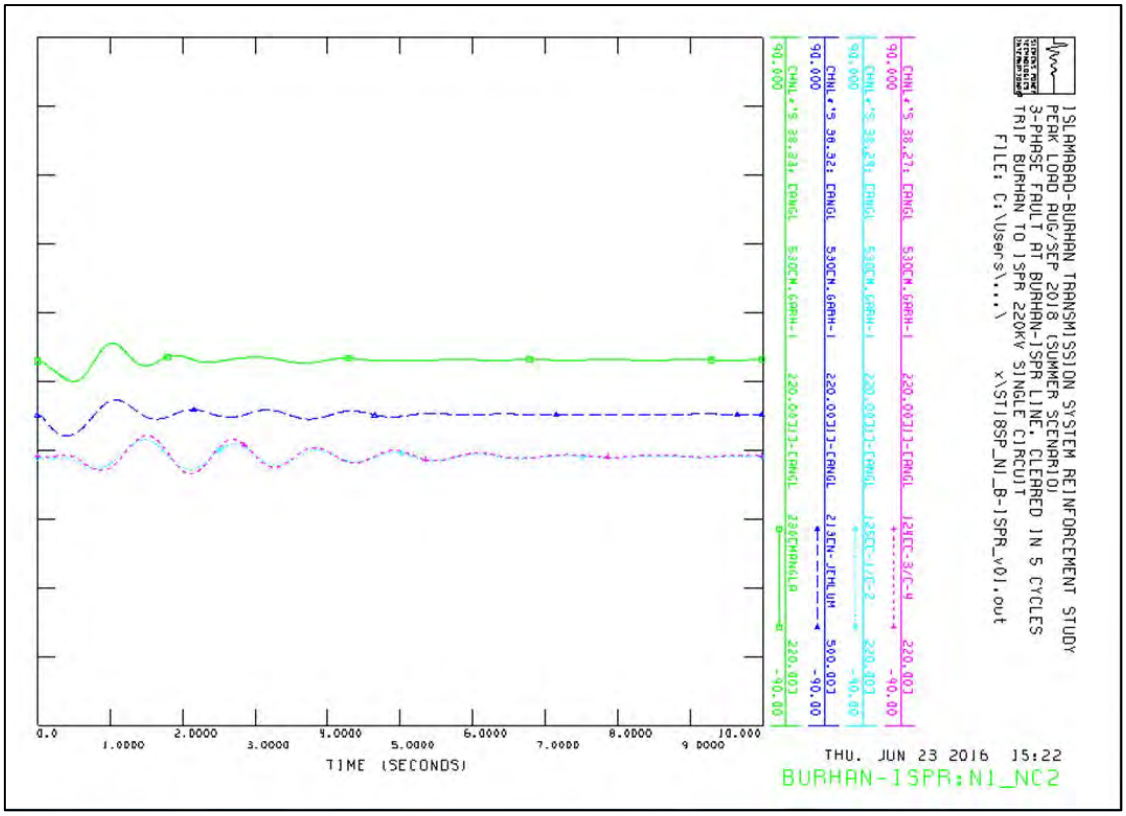


Figure A4 (Normal Clearing, Fault Section: Burhan – ISPR)

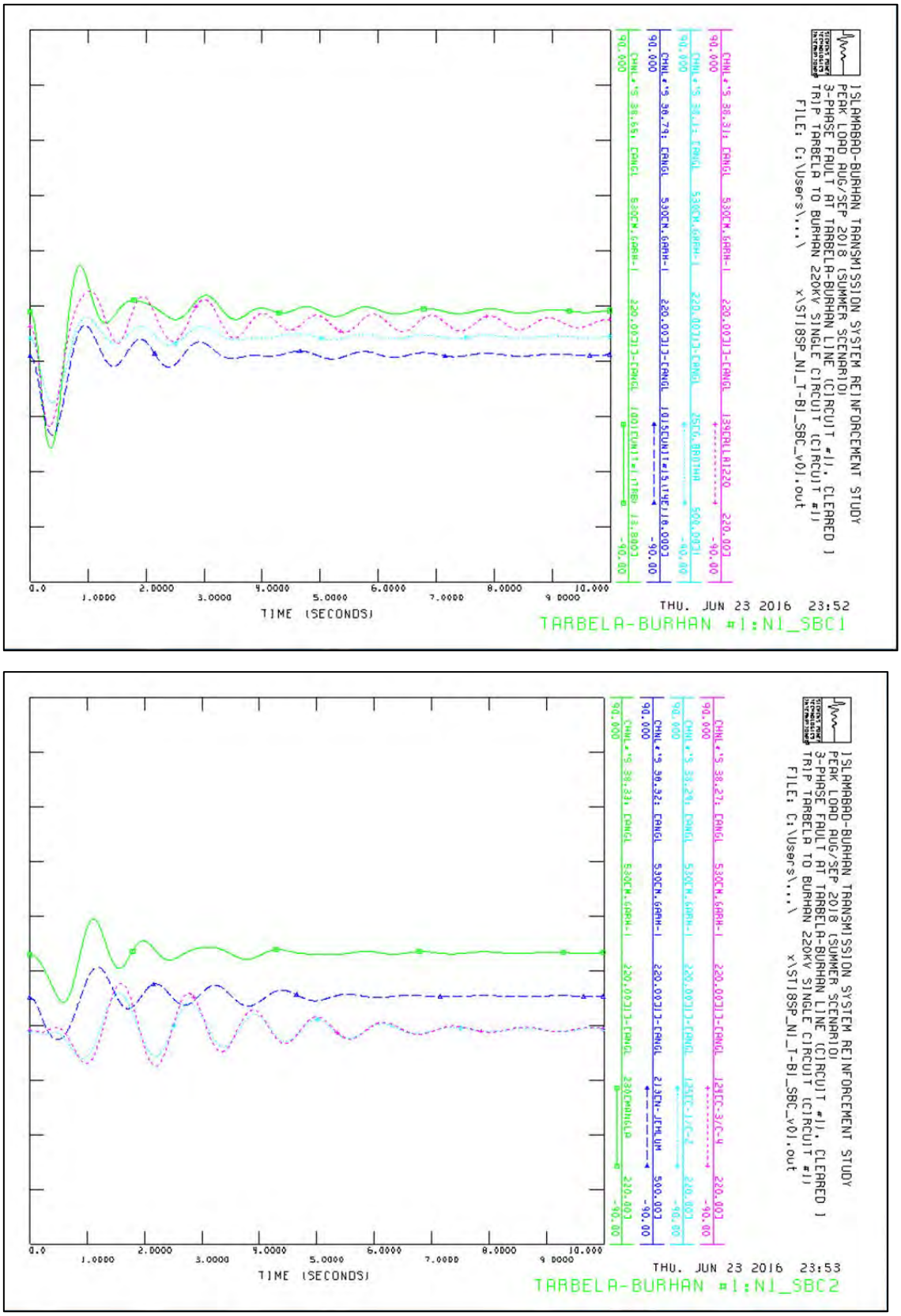
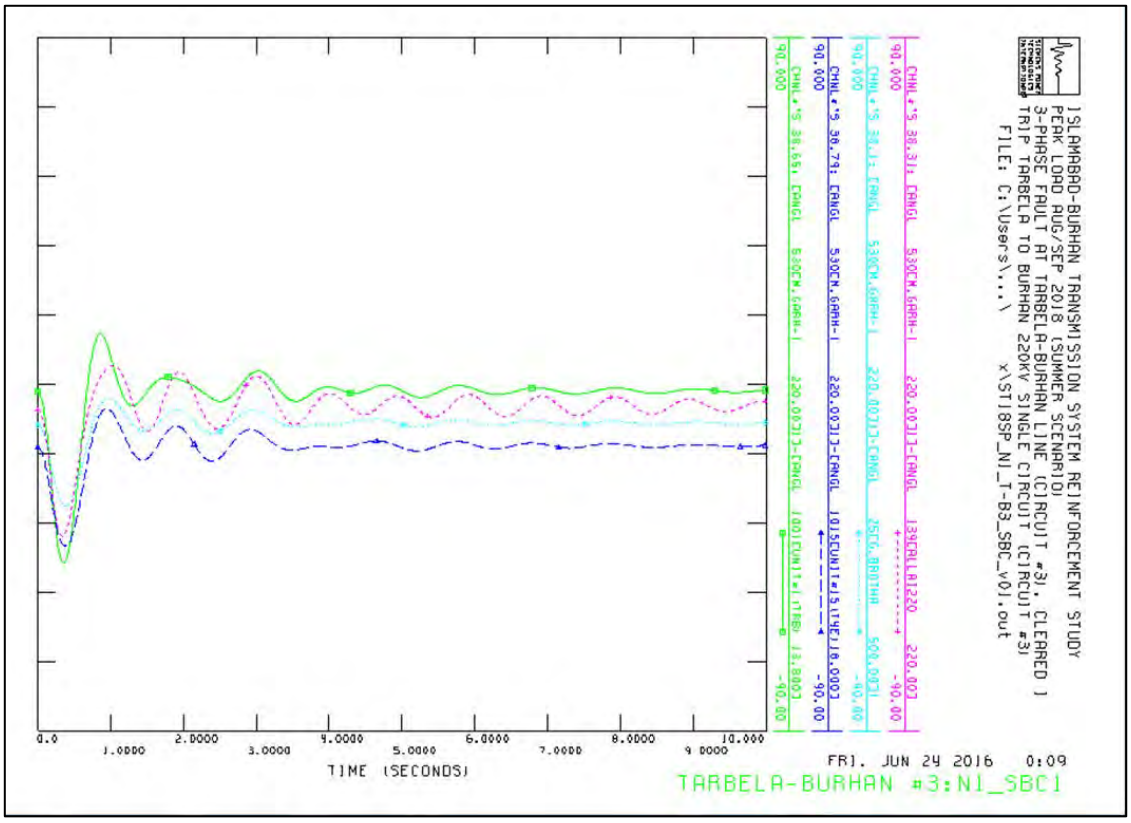


Figure A5 (Stuck Breaker Condition, Fault Section: Tarbela – Burhan Circuit No.1)



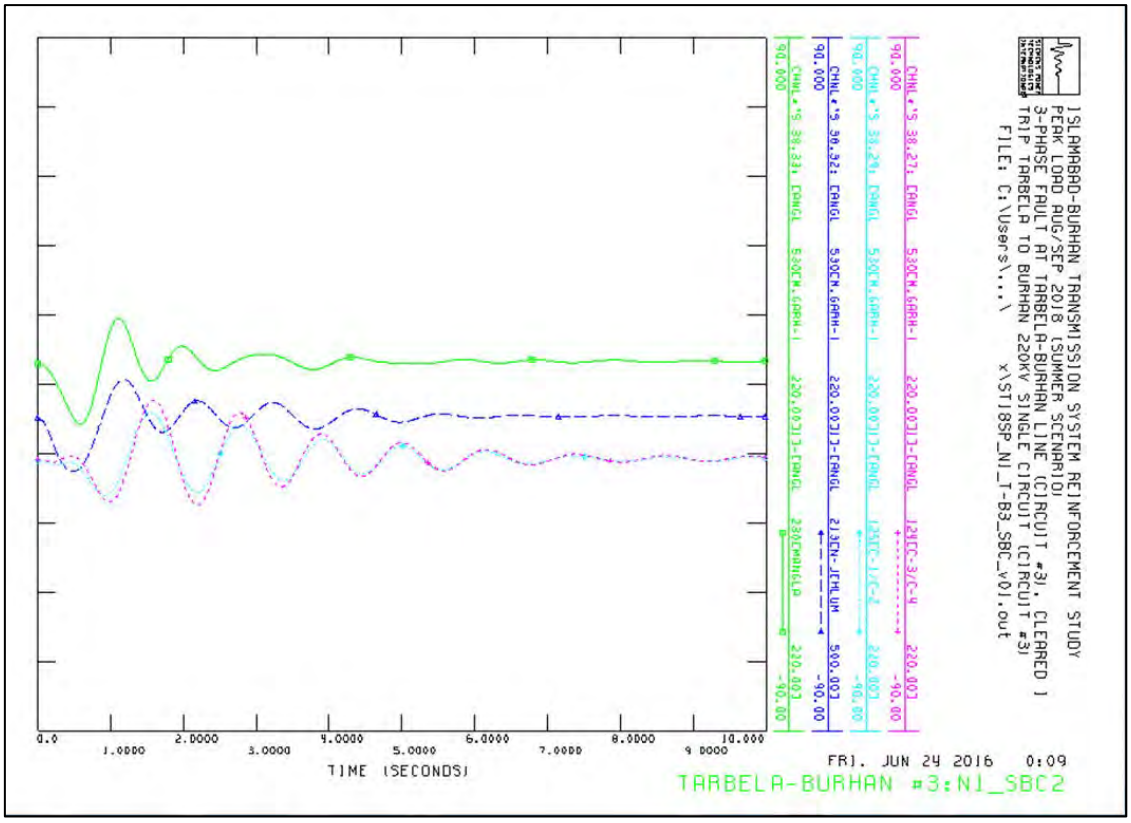
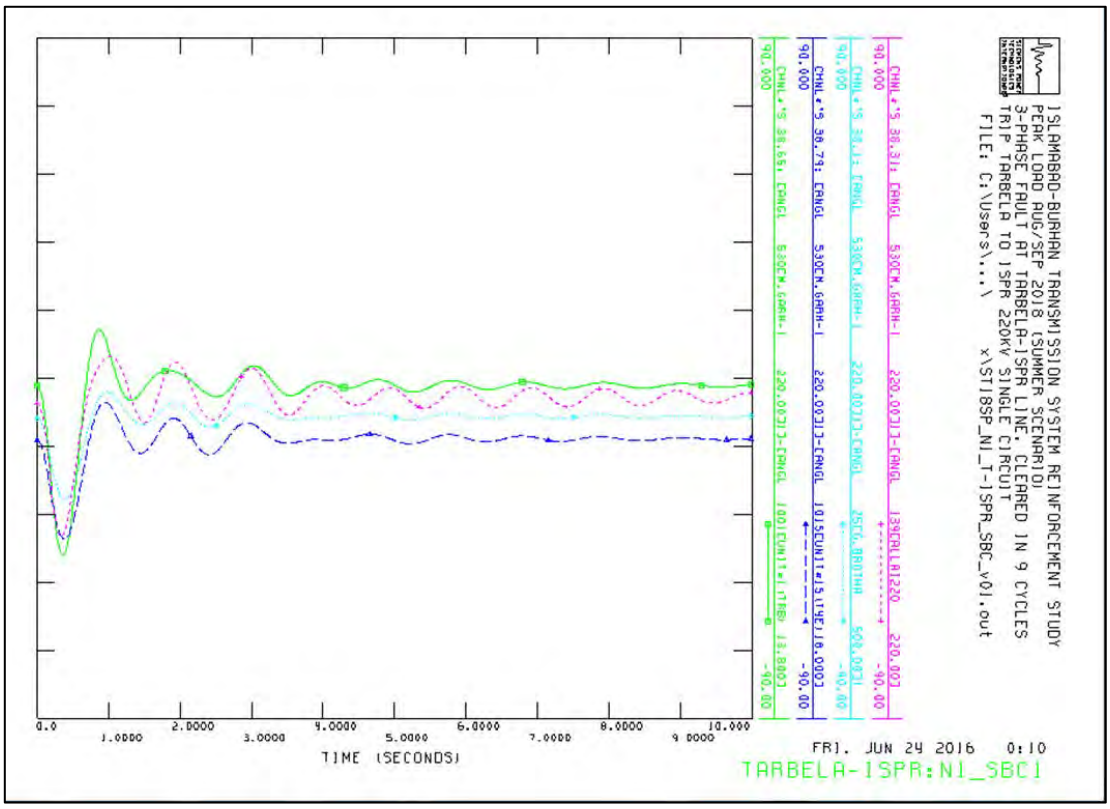


Figure A6 (Stuck Breaker Condition, Fault Section: Tarbela – Burhan Circuit No.3)



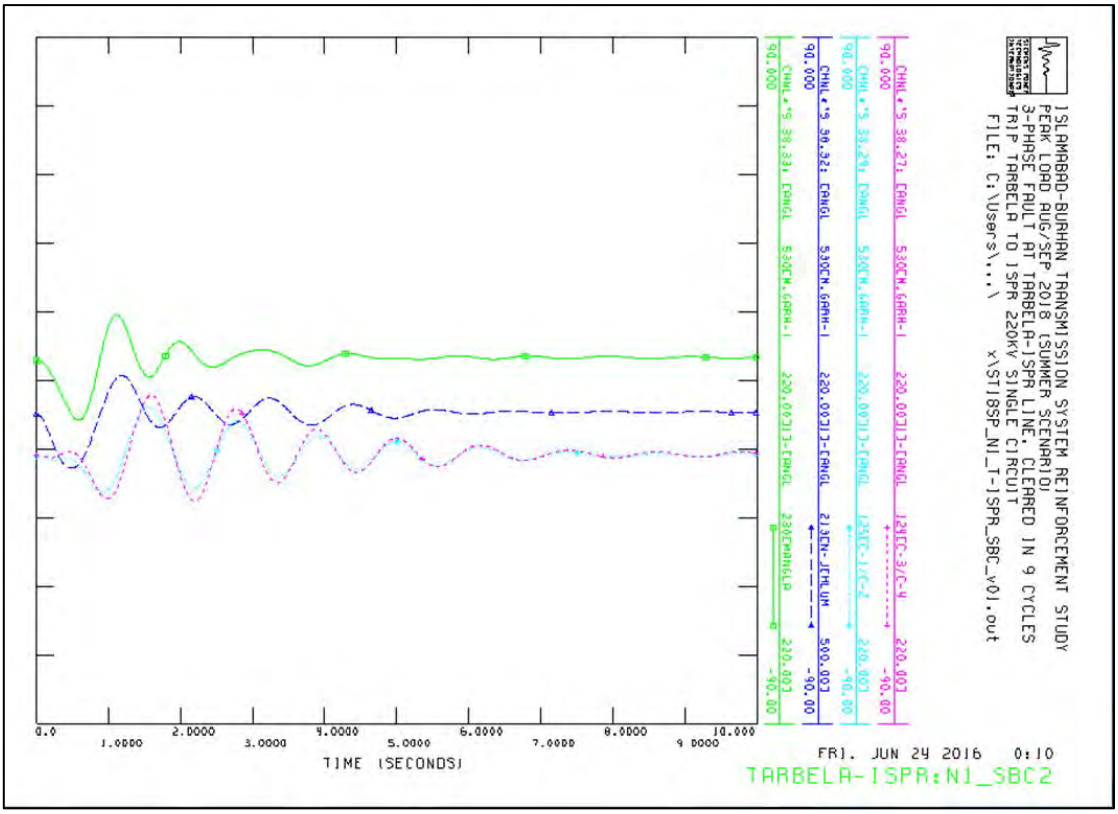
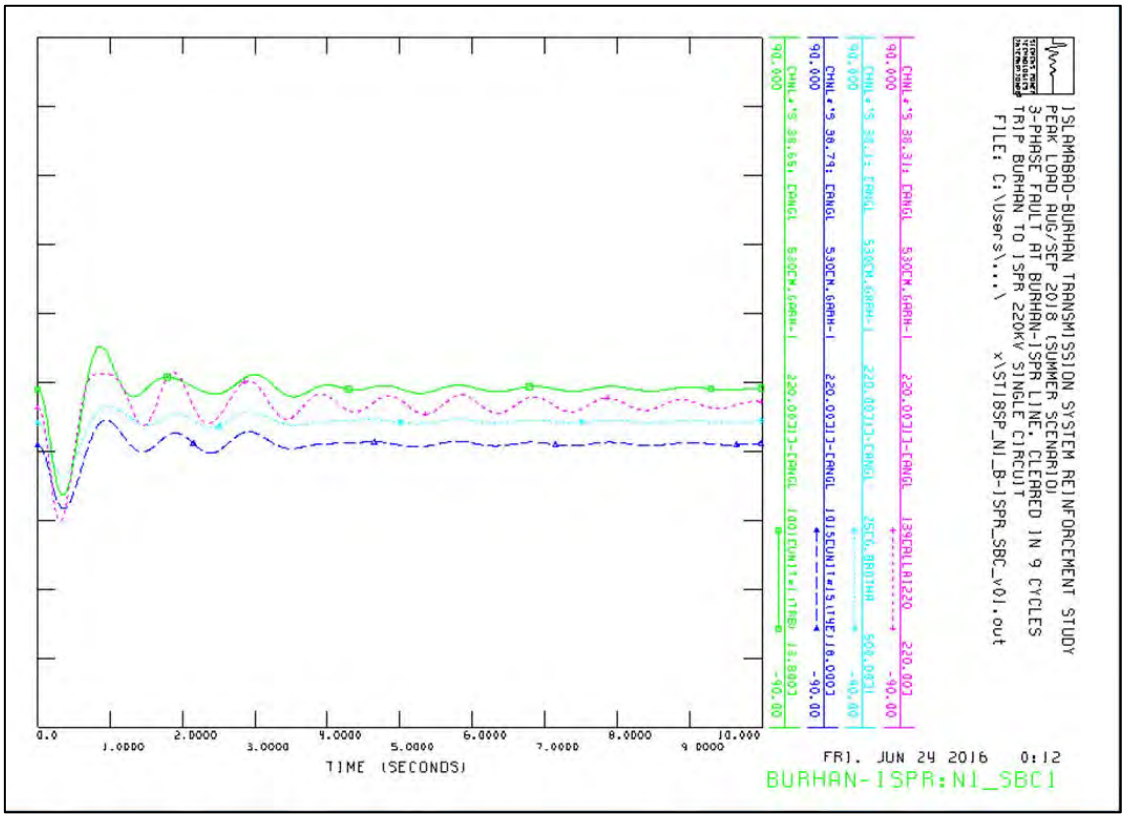


Figure A7 (Stuck Breaker Condition, Fault Section: Tarbela – ISPR)



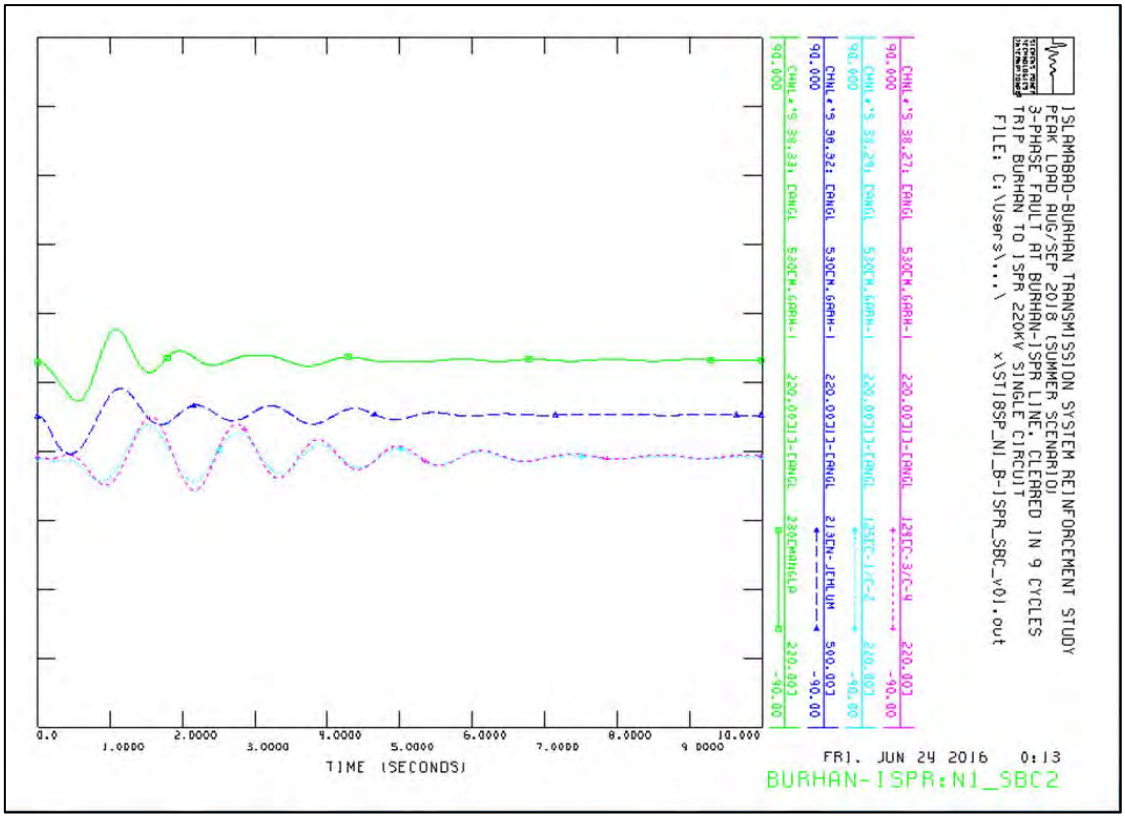


Figure A8 (Stuck Breaker Condition, Fault Section: Burhan – ISPR)

ANNEX 3.1.3-1　Result of Site Survey of Existing Steel Towers

Some part of target area, ground had eroded due to stream flow. Therefore, there are problem about stability of tower. Result of site survey for these towers are mentioned below.

Table. 1　Towers should be replace/protect

Section	Circuit	Tower No.
Tarbela-Burhan	Tarbela-Burhan　I&II	33,41,42
	Tarbela-Burhan III &Tarbela-ISPR	52
Burhan-ISPR	Burhan-ISPR &Tarbela-ISPR	34,34

Figure. 1　Tower Location (Tarbela-Burhan)

図 2　Tower Location (Burhan-ISPR)

Table.2　Result of Site Survey of Tower (No.33-1)

Route	Tarbela – Burhan Circuit I&II	Tower No.	No.33

Photograph

Tower has placed on above of cliff where height difference is approximately 6m. Stream flow go thoriugh under the cliff after raining, maimum depth of stream flow is 2.5m. The cliff had eroded by stream flow. Strem flow had washed bottom side of cliff, it collupsing edge of cliff. The edge of cliff transit 1m toward tower in recent few years. Bank protection was constructed in years past, however bank protection had destroyed by the flood due to heavy rain. The cliff consist sand with gravel, cohesive soil and sand in alternate layers.

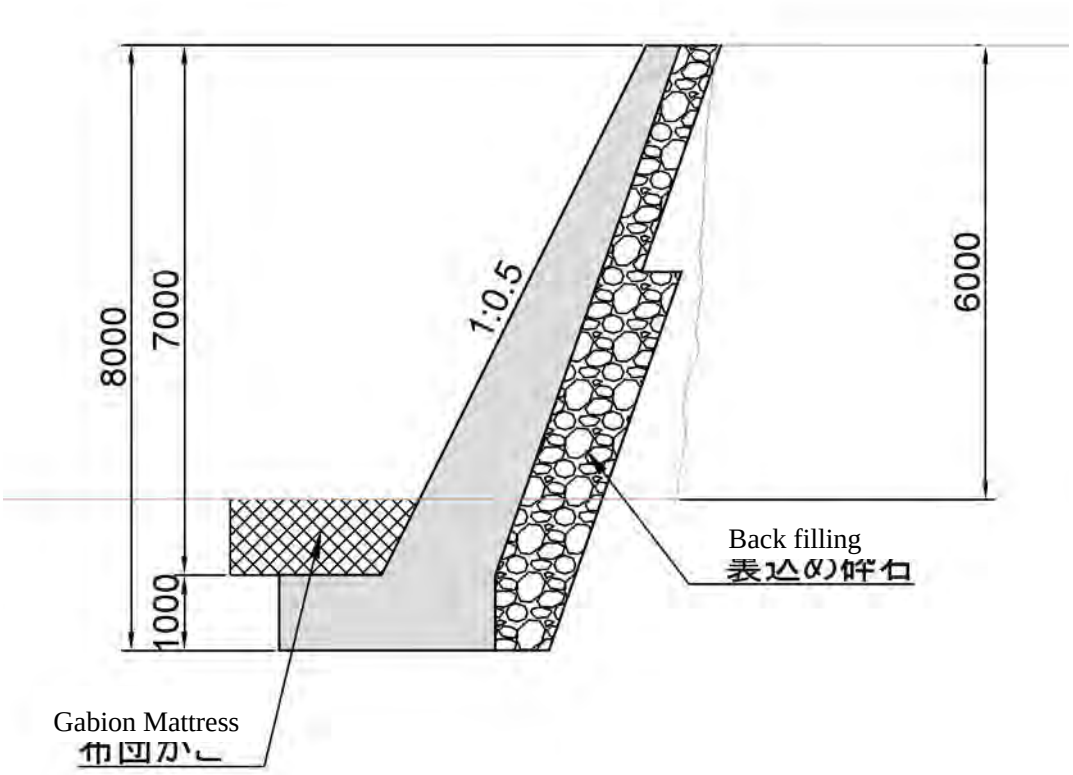
There is access road to settlement under the cliff. This road close to the edge of cliff. Therefore, road had be in danger of collupse due to stream flow. The cliff shall be protected at an early date.

Table.3　Result of Site Survey of Tower (No.33-2)

Route	Tarbela – Burhan Circuit I&II	Tower No.	No.41

Proposed measures

Outline Figure



As a countermeasure, it is conceivable method of preventing the collapse of the cliff part by the retaining wall. Since cliff section is water colliding front, the base of the retaining wall at the time of the water takes a large embedment of the retaining wall from undergoing scouring, and to carry out the installation of the gabion mattress is desirable as scour protection.

Table.4 Result of Site Survey of Tower (No.41-1)

Route	Tarbela – Burhan Circuit I&II	Tower No.	No.41

Photograph

The ground around tower had eroded due to rain fall. Height difference is approximately 30m. The ground consist sandy soil, erosion had advancing due to rain fall. Stability of tower will be losed to advancing of erosion.

Table.5　Result of Site Survey of Tower (No.42-1)

Route	Tarbela – Burhan Circuit I&II	Tower No.	No.42

Photograph

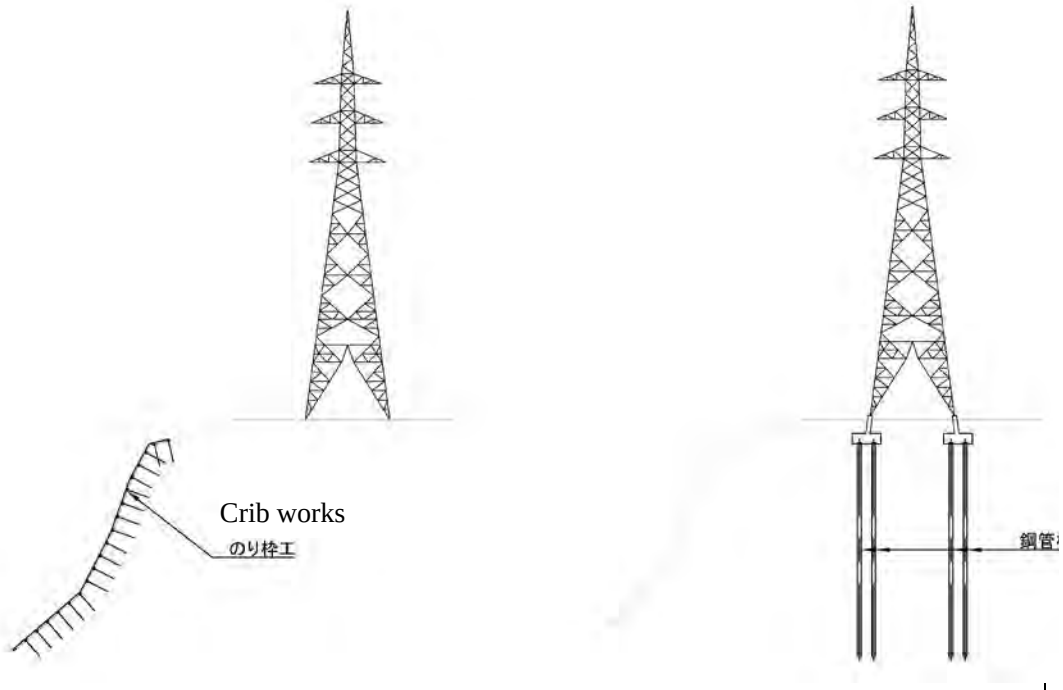
The ground around tower had eroded due to rain fall. Height difference is approximately 30m. The ground consist sandy soil, erosion had advancing due to rain fall. Stability of tower will be losed to advancing of erosion.

Table.6　Result of Site Survey of Tower (No41-2）

Route	Tarbela – Burhan Circuit I&II	Tower No.	No.41,42

Proposed measures

Outline figure



Slope should be protected by crib works or reconstruct as pile foundation to against erosion due to rain fall. In case of pile foundation, embedment length of pile shall be studied based on geological survey.

Table.7　Result of Site Survey of Tower (No.52-1）

Route	Tarbela-Burhan Circuit3 & Tarbela-ISPR	Tower No.	No.52

Photograph

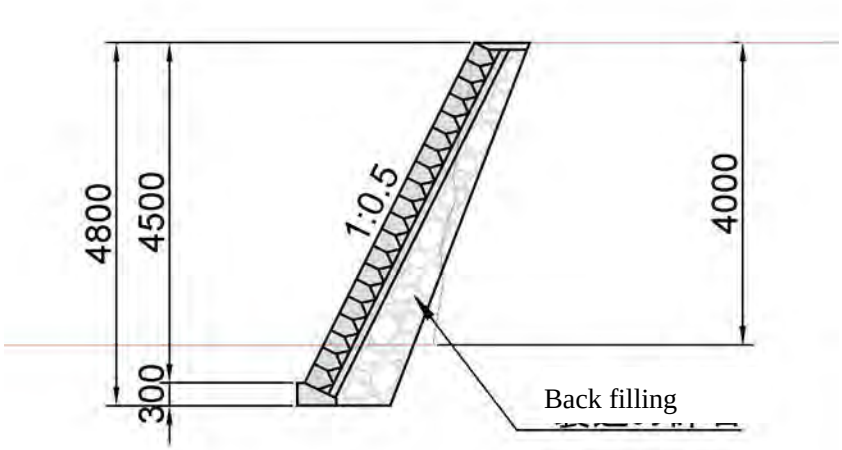
In the vicinity of the tower has a cliff-like steps, and has a height difference is approximately about 4m. Soil of the cliff section, and is a relatively good condition has been mainly composed of mudstone and cohesive soil, Doroiwaso weathering is likely to progress in the mind, there is a possibility that muddy reduction due to rainfall occurs, is allowed to stand in this state steel tower　which can result in the stable problems.

Table.8　Result of Site Survey of Tower (No52-2）

Route	Tarbela-Burhan Circuit3 & Tarbela-ISPR	Tower No.	No.52

Proposed measures

Outline Figure



By placing the retaining wall in order to prevent cliffs of weathering and erosion, the safety of the tower is considered to be ensured.

Table.9　Result of Site Survey of Tower (No.34-1）

Route	Burhan-ISPR & Tarbela-ISPR	Tower No.	No.34

Photograph

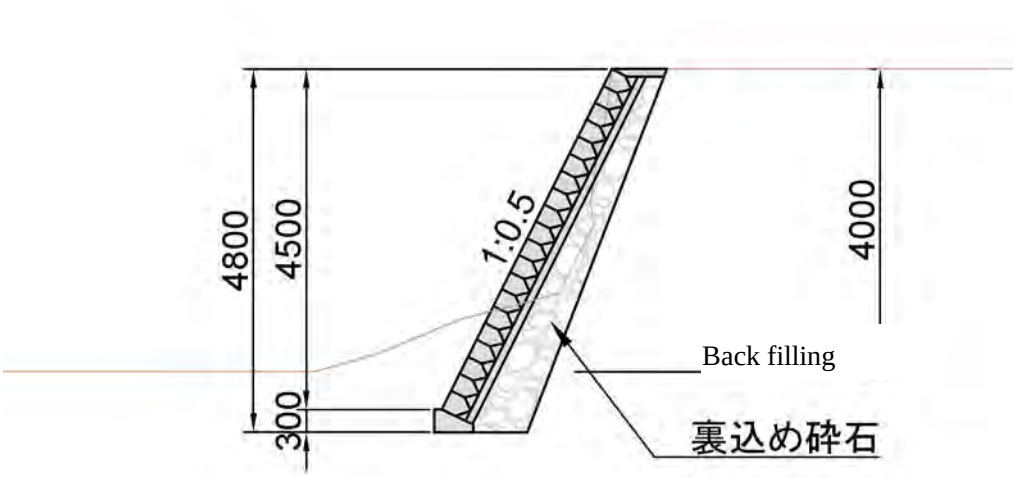
Around the tower have been conducted construction is, the ground surface after the construction there is a height difference of roughly about 3m ~ 8m than steel tower position. Although partly retaining wall is installed, for the portions that are not installed in the retaining wall, erosion due to rainfall is observed. Tower and the cliff part is very close, there is a possibility that the erosion is exposed is the basis by which to proceed.

Table.10　Result of Site Survey of Tower (No34-2）

Route	Burhan-ISPR & Tarbela-ISPR	Tower No.	No.34

Proposed measures

Outline Figure



For even places not protected by the retaining wall, it is necessary to take measures to prevent performs erosion installation of retaining wall. Since the construction base surface of the peripheral is not clear, to obtain the information, it is considered that it is necessary to protect Engineering design.

From the circumstances of the present situation, it is believed that masonry or block masonry retaining wall is suitable.

Table.11　Result of Site Survey of Tower (No.36-1)

Route	Tarbela-Burha Circuit3 & Tarbela-ISPR	Tower No.	No.36

Photograph

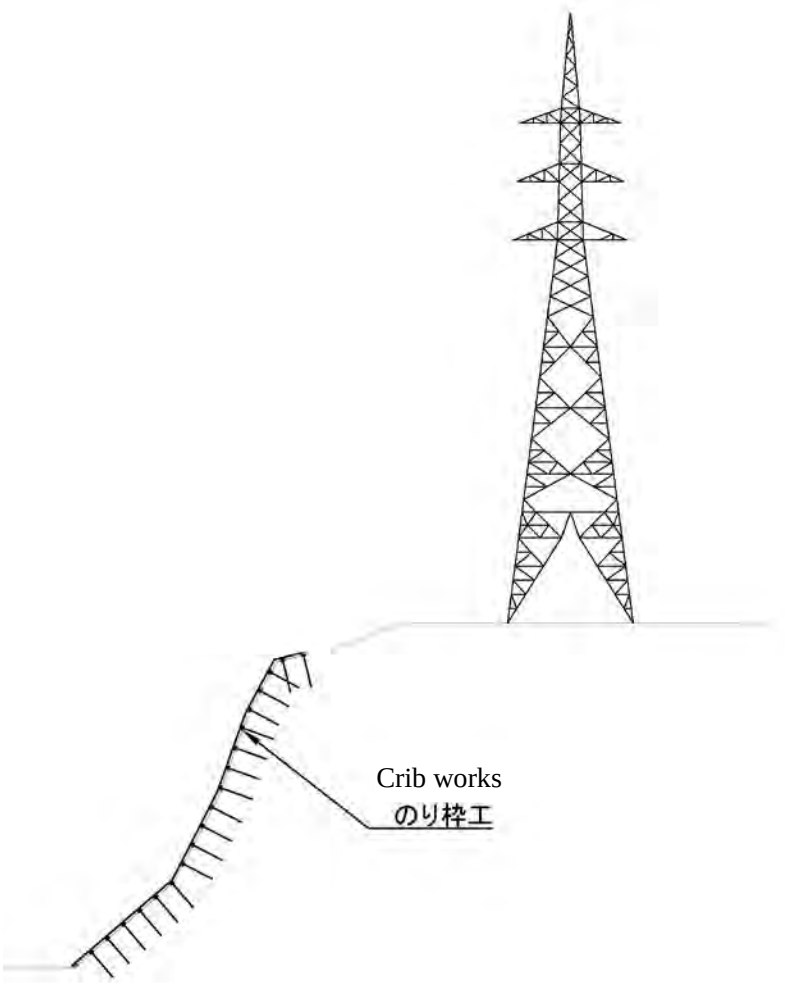
In the vicinity of the tower has a cliff-like steps, height difference is generally made about 10m ~ 20m. Soil of the cliff section, and is a relatively good condition has been mainly composed of mudstone and cohesive soil, Doroiwaso weathering is likely to progress in the mind, there is a possibility that muddy reduction due to rainfall occurs, is allowed to stand in this state steel tower which can result in the stable problems. In addition, it is considered under the cliff has been carried out construction of residential areas, and caused the earth and sand collapse after the development of the developed land, since it is expected also damage to the developed land side, it is necessary to collapse prevention measures of the cliff section .

Table.12　Result of Site Survey of Tower (No36-2）

Route	Tarbela-Burha Circuit3 & Tarbela-ISPR	Tower No.	No.36

Proposed measures

Outline Figure



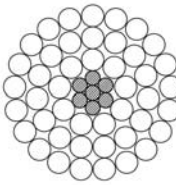
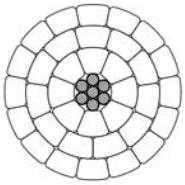
Cliff part is mainly composed of mudstone layer, vulnerable to weathering as a characteristic of the consolidated mud rock of what is the ground, and muddy by supply of moisture due to rain, because there is a fear that lead to weakening of the ground, of the cliff section collapse measures have to perform. There is also that the height difference is large, the measures in the retaining walls of Engineering, is difficult. Further, since it is highly self-supporting ground, thought can respond by performing weathering measures cliff portion surface, as the countermeasure method considered to glue frame factory are suitable.

ANNEX -3.1.5-1

1. Characteristics of Conductor

Example design of low loss conductor (LL-ACSR) has considered as secure current capacity and same diameter of conventional Rail conductor. Characteristics of conductor is shown in Table.1.

Table.1 Characteristics of Conductor

	Unit	ACSR ASTM:Rail	LL-ACSR LL-ACSR/AS610
Figure			
construction		45/3.7-Al 7/2.47-St	16/TW-AL 11/TW-AL 8/TWAl 7/2.1-14EAS
Nominal Diameter	mm	29.61	29.59
Min. Breaking Load	kN	116.1	126.5
Cross section area:Al	mm2	483.8	610.7
Core		33.54	24.25
Total		517.3	635.0
Nominal weight	kg/km	1600	1867
DC Resistance at 20deg-C	Ohm/km	0.0597	0.0471
Co-efficient of linear expansion	/deg-C	$20.9x10^{-6}$	$21.9x10^{-6}$
Current capacity	A	956 at 90 deg-C	1207 at 90 deg-c
Sag (at 350m)	m	14.4 at 90 deg-C	15.2 at 90 deg-C

2. Estimation of Cost-efficiency

Cost-efficiency is shown in Figure.1. The different cost of existing line related to this project between Rail480 and LL-ACSR610 will become zero after 5.5 years. 15 years later, 250 mill. PKRs of cost efficiency will be expected in the case of adopt the LL-ACSR610 instead of Rail conductor planned in PC-1.

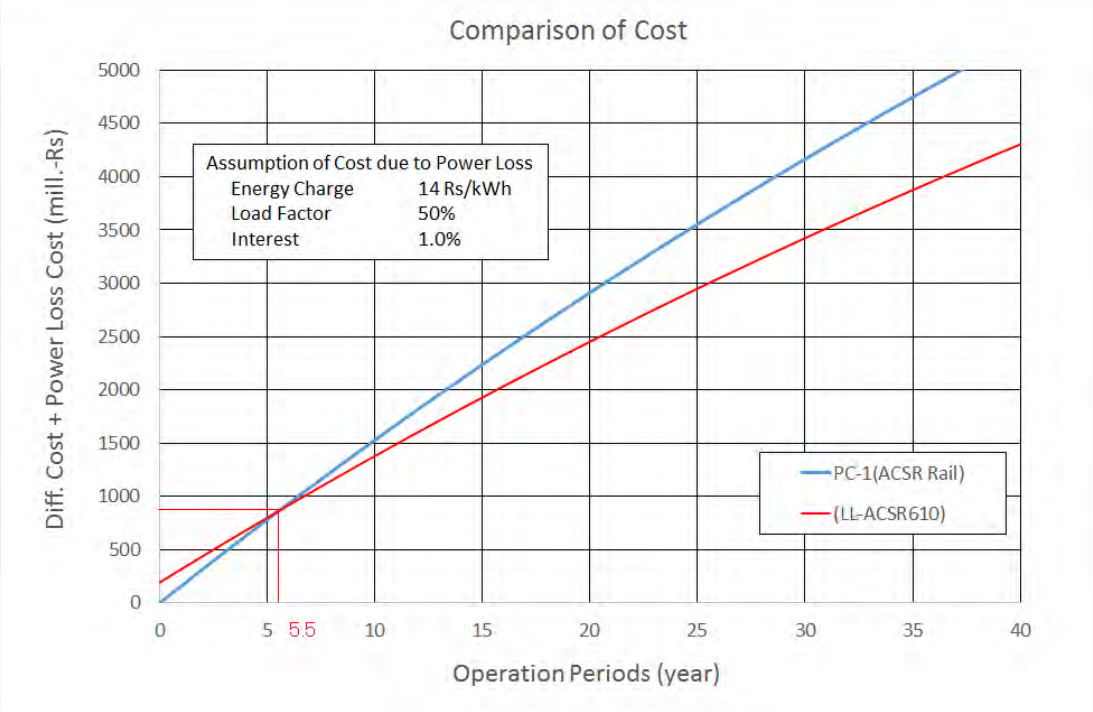


Figure.1 Cost-efficiency

2.1 Desctiption of Study

Cost-efficiency has evaluated inaccordance with following conditions.

(1) Pattern of Load

Transmission power capacity was obtained by power flow analysis. Transmission power capacity is shown in Table.2. For the reason of the existing line which will be completed in Mar. 2020, power flow analysis calculated in 2020 was adopted. Upper is in the case of PC-1 planning of Rail x 2, lower is in the case of this PJ of LL-610 x 2.

Table.2 Transmission Capacity of Target Line

Section (Rail x 2)		Transmission Capacity［MW］	
		In the year 2020	
Existing T/L	Tarbela-Burhan route 2 (1/2 cct)	294.22	
	Tarbela-Burhan-ISPR route 2 (2/2 cct)	268.36	
New T/L	In/out of Mansehra to ISBU	136.79	128.49

Section (LL-610 x 2)		Transmission Capacity［MW］	
		In the year 2020	
Existing T/L	Tarbela-Burhan route 2 (1/2 cct)	289.96	
	Tarbela-Burhan-ISPR route 2 (2/2 cct)	269.79	
New T/L	In/out of Mansehra to ISBU	139.55	129.56

Bases of these calculation, power flow pattern is assumed to continue as same as the 2020' value.

(1) Calculation of Transmission Loss

Transmission Loss has calculated from formula (1).

$$\text{Load Current(I)[A]} = Transmission\ Capacity[MW] \Big/ \left(\sqrt{3} \cdot 220kV \cdot \cos\theta\right) \quad (1)$$

$$\text{Transmission Powe Loss(P) [kW/km]} = 3 \times I^2 \times R_{AC} \times N \times 10^{-6} \quad (2)$$

Where:

R_{AC} : AC resistance of conductor [Ω]

N : Numbers of conductor

Calculation result is shown in Table3 and Table4.

Table.3　Transmission Loss (PC-1)

2018 year	Reinforcement existing line		New construction line
Calculation condition	2	3-1	4
Section of the line	T－B ルート2 1/2cct	T－B ルート2 2/2cct	ISPR/Mansehra－ISBU
nominal voltage(kV)	220	220	220
Number of circuit (cct)	1	1	2
Line length (km)	35.1	35.1	40
Carrying power flow (MW)	311.8	235.2	0
Circuit load current (A)	818.3	617.2	0
Kind of conductor	Rail－480	Rail－480	Rail－480
Number of conductor (bundled)	2	2	2
conductor current (A)	409.15	308.6	0
DC resistance (Ω／km: at20℃)	0.0597	0.0597	0.0597
Resistance temparature coeff. (／℃)	0.004	0.004	0.004
AC/DC resistance ratio (β)	1.05	1.05	1.05
Conductor temparature mentioned on the above (℃)	47	44	41
Ambient temparature (℃)	40	40	40
Acresistance (Ω／km)	0.06945498	0.06870276	0.06795054
Power loss (MW)	2.45	1.38	0

2020 year	Reinforcement existing line		New construction line
Calculation condition	2	3-1	4
Section of the line	T－B Route2 1/2cct	T－B Route2 2/2cct	ISPR/Mansehra－ISBU
nominal voltage(kV)	220	220	220
Number of circuit (cct)	1	1	2
Line length (km)	35.4	35.4	40
Carrying power flow (MW)	269.2	246.9	141.7
Circuit load current (A)	706.5	647.9	371.9
Kind of conductor	Rail－480	Rail－480	Rail－480
Number of conductor (bundled)	2	2	2
conductor current (A)	353.25	323.95	185.95
DC resistance (Ω／km:	0.0597	0.0597	0.0597
Resistance temparature coeff. (／℃)	0.004	0.004	0.004
AC/DC resistance ratio (β)	1.05	1.05	1.05
Conductor temparature mentioned on the above (℃)	45	44	46
Ambient temparature (℃)	40	40	40
Acresistance (Ω／km)	0.0689535	0.06870276	0.06920424
Power loss (MW)	1.83	1.53	0.57

Table.4　Transmission Loss (with Project)

2018 year	Reinforcement existing line		New construction line
Calculation condition	2	3-1	4
Section of the line	T－B Route2 1/2cct	T－B Route2 2/2cct	ISPR/Mansehra－ISBU
nominal voltage(kV)	220	220	220
Number of circuit (cct)	1	1	2
Line length (km)	35.4	35.4	40
Carrying power flow (MW)	311.8	235.2	0
Circuit load current (A)	818.3	617.2	0
Kind of conductor	LL-610	LL-610	LL-610
Number of conductor (bundled)	2	2	2
conductor current (A)	409.15	308.6	0
DC resistance (Ω／km: at20℃)	0.0471	0.0471	0.0471
Resistance temparature coeff. (／℃)	0.004	0.004	0.004
AC/DC resistance ratio (β)	1.05	1.05	1.05
Conductor temparature mentioned on the above (℃)	47	56	41
Ambient temparature (℃)	40	40	40
Acresistance (Ω／km)	0.05479614	0.05657652	0.05360922
Power loss (MW)	1.95	1.14	0

2020 year	Reinforcement existing line		New construction line
Calculation condition	2	3-1	4
Section of the line	T－B Route2 1/2cct	T－B Route2 2/2cct	ISPR/Mansehra－ISBU
nominal voltage(kV)	220	220	220
Number of circuit (cct)	1	1	2
Line length (km)	35.4	35.4	40
Carrying power flow (MW)	269.2	246.9	141.7
Circuit load current (A)	706.5	647.9	371.9
Kind of conductor	LL-610	LL-610	LL-610
Number of conductor (bundled)	2	2	2
conductor current (A)	353.25	323.95	185.95
DC resistance (Ω／km: at20℃)	0.0471	0.0471	0.0471
Resistance temparature coeff. (／℃)	0.004	0.004	0.004
AC/DC resistance ratio (β)	1.05	1.05	1.05
Conductor temparature mentioned on the above (℃)	45	44	46
Ambient temparature (℃)	40	40	40
Acresistance (Ω／km)	0.0544005	0.05420268	0.05459832
Power loss (MW)	1.44	1.21	0.45

(2)　Calculation of Cost-efficiency

Cost-efficiency is calculate from conditions mentioned as following and transmission loss resulting from (2).

・Initial cost has taken as material cost of conductor.

Existing Transmission Line　Rail：181.11、LL-ACSR：254.68　［mill. RP］

New Transmission Line　Rail : 234.76、LL-ACSR : 330.12　［mill. RP］(after year 2020)

・Cost of transmission loss is calculate from formula (3) and (4).

$$\text{Power Loss Qy}\left[{}^{\text{kWH}}/_{km}\right] = \text{P} \times (0.3\text{f} + 0.7\text{f}^2) \times 8760 \qquad (3)$$

Transmission Powe Loss Cost $= \sum_{y}^{n} \left[{C_1 \cdot Q_y} \Big/ {(1+i)^y} \right]$ (4)

・C1 is cost of generation, average cost of generation has taken as 14Rp/kWH.

f : Load factor (50%)

i: Interest rates (1%)

y : Numbers of year (50 years)

Power loss is calculate in accordance with formula advocated by Buller-Woodrow (Reference-1)

References-1 : F. H. Buller and C. A. Woodrow, “Load factor equivalent hours values compared -----”, Electrical World, Jul. 1928”

ANNEX-7.1.2-1 Financial Statement Analysis

1. Financial Statements Analysis for the Accounts of June 2014 and June 2013

The analysis has been made for the financial statements both of June 2014 and June 2013, which are the latest financial statements attached to the audit reports provided by the financial department of NTDCL.

Figure ANNEX-8.1.1 is prepared to compare the major indexes of financial analysis both of Balance Sheets and Income Statements for the year of 2014 and 2013. The financial statements are listed at the end of this report.

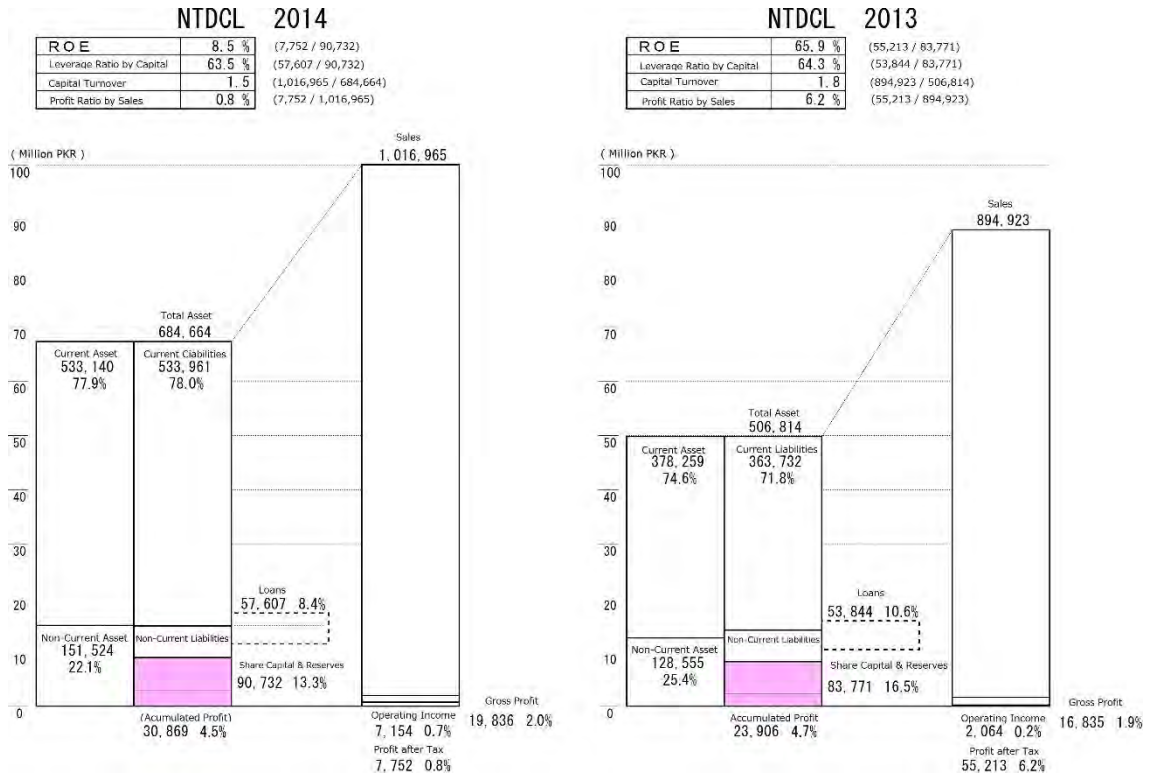


Figure ANNEX-8.1.1 Analysis of the Financial Statements for the year of 2014 & 2013

Source : Excerpted from the Audit Report

1.1 Special Notes

(1) The Accounts of June 2014

1) The sales of 2014 amounted to Rs.1,016,965 million increased by Rs.122,042million (13.6%) compared with 2013. The increase was based on the revenue increase by the wheeling charge paid by DISCOs.

2) Net income in 2014 was Rs.7,752 million reduced by Rs.47,461 million (86.0%) from 2013. By the way, operating income was Rs.7,154 million in 2014.

3) The allowable reference value of Transmission Loss was 3% determined by NEPRA. The excess of the reference value is calculated in terms of amount of money to record as Transmission Loss expense. Transmission Loss expense in 2014 was Rs.1,003 million.

(2) The Accounts of June 2013

1) Net income in 2013 was recorded as Rs.55,213 million. The net income in 2014 was Rs.7,752 million as described above. Net income of 2012 was Rs.202 million.

2) Special note in 2013 was to cancel Rs.95,484 million of allowance for doubtful accounts (increase of profit). 42,875 million (increase of expense) was recorded by the corporate tax adjustment. Except those special figures, 2,607 million was the net profit in 2013. Operating income in 2013 was Rs.2,604 million.

3) The allowable reference value of Transmission Loss in 2013 was determined as 2.5%. The excess cost of the reference value in 2013 was Rs.4,728 million.

1.2 Financial Analysis Indicators

(1) ROE (Return on Equity: Net income / Net assets): Profitability indicators

Shareholders have the funds invested, or earn a profit how efficiently, that is an indicator to show the efficiency of shareholders' equity.

The results in 2014 and 2013 were as follows;

1) 2014：8.5%

2) 2013：65.9%

If 5~10% of ROE is realized, it is fairly good. If it exceeds 10%, it is really good. Seeing the figure of 65.9%, unusual transaction might be recorded in 2013. In order to have the reasonable indicator of ROE, the operating income is taken as the index to output ROE of 2013 instead of net income, which included the unusual transaction recorded by the accounting and tax regulations. The corrected ROE are shown as below;

3) 2014：7.89%

4) 2013：2.46%

ROE in 2014, i.e. 7.89 in 2014, was fairly good. On the other hand, ROE, i.e. 2.46% in 2013,

was rather low.

(2) Total Capital Turnover (Sales / Total Capital): Profitability Indicators

This is the indicator to show the efficient operation of the capital, which is an index that indicates whether the business earns how big sales with less capital.

1) 2014：1.0 time

2) 2013：1.8 times

Total capital turnover rate is regarded as the higher the better, but the general target value is 'One', which is as the satisfactory level as an average. As a large amount of capital investment is required by NTDCL, 1.0 time in 2014 and 1.8 times in 2013 are satisfactory level as the capital efficiency.

(3) Net Profit Margin (net income / sales): Profitability Indicators

Net profit margin is an index to indicate how the capacity of the earning power is and how the profitability is. The index indicates the scale of profit compared with sales. Net profit margin of 2014 and 2013 were as follows;

1) 2014：0.8%

2) 2013：6.29%

Seeing the figure in 2013, the figure and transactions should be reconsidered to be adjusted in terms of special circumstances. Therefore, the index of net income should be replaced by the operating profit, which does not include special transactions based on the regulations of accounting and tax. Thus the adjusted Net Profit Margins are recalculated as follows;

3) 2014：0.70%

4) 2013：0.23%

Net profit margin in 2014 and 2013 were fairly low level. Considering the business of NTDCL as one of the typical public utility works, the level of wheeling charges can be assumed that has been kept to a certain degree to secure the necessary level of the profits to continue normal business operations. In other words, at the same time as the revenue is large and so is the cost, i.e. the profit level is not so large, what can be frequently seen in the industries requiring the large capital investment.

(4) Leverage Ratio (Interest-bearing Debt / Net Assets): Index of Safety

The three indexes, i.e. "ROE", "Total Capital Turnover" and "Net Profit Margin", referred in earlier, are all for examining the profitability. The leverage ratio is the only index to show the safety in this analysis. The index is to indicate the following;

The scale of loan

The capacity of self –owned capital to pay back loan

The scale of loan to increase return in addition to the use of own capital

1) 2014：63.5%

2) 2013：64.3%

Interest-bearing Debt in 2014 was 63.5% of the equity capital. In 2013, the one in 2013 was 64.3%. It is possible to payback the loans by the own capital both year of 2014 and 2013 within the range of own equity. Even if the remaining debt is cleared by the full lump-sum repayment, more than 30% of the equity still remain. Thus, the stability is very high. However, focusing on the less use of borrowed capital, it comes to leverage effect is rather low.

2. Financial Strength Rating

The loan conditions of the Asian Development Bank (ADB) for the NTDCL, the following two conditions are the key indexes:

(1) Debt Service Coverage Ratio（DSCR）

NTDC will maintain a Debt Service Coverage Ratio（DSCR）at least 1.2 from 2010 onward.

(2) A Self-Financing Ratio

NTDC will maintain a Self-Financing Ratio of at least 20% from 2008 onward

The survey conducted by the latest visit in June 2016,

(1) Debt Service Coverage Ratio (DSCR）: There is no data and information available.

(2) Self-Financing Ratio[19] : The following data was provided by the Finance Department

Confirming the fact that both years clear 20% of the minimum requirement proposed by ADB, for (2) above, i.e. Self-Financing Ratio, 65.71% in 2014 and 36.34% in 2013 were identified and detailed as follows;

1) 2014：65.71%

Own Source : Rs, 17,302,114,404

Total Expenditure : Rs, 26,332,163,333

A Self-Financing Ratio：Rs, 17,302,114,404 / Rs, 26,332,163,333 = 65.71%

2) 2013：36.34%

Own Source : Rs, 4,699,236,907

Total Expenditure : Rs, 12,929,843,140

A Self-Financing Ratio：Rs, 4,699,236,907 / Rs, 12,929,843,140 = 36.34%

[19] Obtained by the interview with the Finance Department of NTDCL provided by the Finance

Profit and Loss Statement

As at 30 June 2014	2014	2013 (restated)
ASSETS		
Current Assets		
Cash and bank balances	25,499,459,033	17,232,470,579
Trade debts	365,856,969,014	234,882,321,605
Stores,spare parts and losse tools	9,353,132,102	9,366,579,366
Receivable from Gorvernment of Pakistan	31,000,000,000	31,000,000,000
Current portion of long term loans and advances	50,752,012	47,497,265
advances	26,862,998,841	41,519,112,974
Accrued Mark up	23,958,166	19,525,414
Other receivables	74,493,087,038	44,191,909,025
Short term investments	-	-
	533,140,356,206	378,259,416,228
Non-current Assets		
Property,plant and equipment	150,262,851,292	127,321,282,099
Long term loans and advances	1,254,108,907	1,225,830,385
Long term deposits	7,466,823	7,466,823
	151,524,427,022	128,554,579,307
Total Assets	684,664,783,228	506,813,995,535
LIABILITIES AND EQUITY		
Current Liabilities		
Trade and other payables	499,585,805,448	341,748,749,931
Short term borrowings		
Accrued Mark up	7,558,222,392	4,414,657,115
Current portion of long term loans	26,817,388,172	17,513,477,645
Provision for taxation	0	55,500,187
	533,961,416,012	363,732,384,878
Non-Current Liabilities		
Long term loans	32,094,679,150	37,603,952,698
Deferred liabilities	16,557,461,681	15,609,095,000
deferred taxation	6,100,180,469	6,043,400,130
Deferred credit	5,218,817,975	54,696,874
	59,971,139,275	59,311,144,702
Share Capital and Reserves		
Share capital	52,700,381,000	52,700,381,000
Share deposit money	7,163,232,938	7,163,232,938
Accumulated profit/(loss)	30,868,614,003	23,906,852,017
	90,732,227,941	83,770,465,955
Total Liabilities and Equity	684,664,783,228	506,813,995,535

Profit and Loss Account
For the year ended 30 June

	2014	2013
Sales-Net	1,016,964,904,009	894,922,559,635
Cost of electricity	(997,128,569,006)	(878,088,008,357)
	19,836,335,003	16,834,551,278
	7,153,811,174	
Operating expences*1	12,682,523,829	14,770,870,780
Finance cost	1,364,623,545	748,674,385
	(14,047,147,374)	(15,519,545,165)
Other income*2	1,609,228,411	96,859,704,195
Profit for the year	7,398,416,040	98,174,710,308
		2,690,710,647
Taxation		
-Current	0	(83,911,250)
-Deferred	(56,780,339)	(38,666,814,204)
(Loss)/profit for the year	7,341,635,701	59,423,984,854
Other comprehensive income:		
Remeasurement of obligation of employees retirement benefits	410,632,000	(4,211,148,000)
Total comprehensive income for the year	7,752,267,701	55,212,836,854

ANNEX 8.4.6-1 Resuts of plant survey

No.	Botanical Name	Local Name	Family	Life Form						
				Herb	Shrub	Grass	Tree	Sedge	Climber	Creeper
25.	*Broussonwsia papyrifera*		Malvaceae				x			
26.	*Bulboschoenus glaucus*		Cyperaceae					x		
27.	*Callistemon lanceolatus*		Myrtaceae				x			
28.	*Calotropis procera*	Ak	Asclepiadaceae		x					
29.	*Canna indica*		Cannaceae	x						
30.	*Cannabis sativus*		Cannabaceae	x						
31.	*Carthamus oxycantha*	Pohli	Asteraceae	x						
32.	*Cenchrus ciliaris*	Dhamni	Poaceae			x				
33.	*Chenopodium album*	Bathu	Chenopodiaceae	x						
34.	*Chenopodium murale*		Chenopodiaceae	x						
35.	*Cleome viscosa*		Tiliaceae	x						
36.	*Convolvulus arvensis*		Convolvulaceae							x
37.	*Conyza canadensis*		Asteraceae	x						
38.	*Corriandrum sativum*		Umbelliferae	x						
39.	*Cynodon dactylon*	Ghass	Poaceae			x				
40.	*Cupressus sp.*	Sarroo	Cuppressaceae				x			
41.	*Cuscuta reflexa*	Akashbel	Cuscutaceae						x	
42.	*Dalbergia sissoo*	Taali	Papilionaceae				x			
43.	*Datura innoxia*	Dhatura	Solanaceae	x						
44.	*Desmostachya bipinnata*		Poacaee			x				
45.	*Dicanthium annulatum*	-	Poaceae			x				
46.	*Dodonaea viscosa*		Sapindaceae		x					
47.	*Enneapogon schimperanus*		Poaceae			x				
48.	*Eucalyptus globulus*		Myrtaceae				x			

No.	Botanical Name	Local Name	Family	Life Form						
				Herb	Shrub	Grass	Tree	Sedge	Climber	Creeper
49.	*Eugenia jambolana*		Myrtaceae				x			
50.	*Chrozophora tinctoria*		Euphorbiaceae	x						
51.	*Ficus benghalensis*		Moraceae				x			
52.	*Ficus religiosa*	Peepal	Moraceae				x			
53.	*Ficus virgata*	Phagwara	Moraceae				x			
54.	*Fumaria indica*		Fumariaceae	x						
55.	*Ipomoea carnea*		Convolvulaceae		x					
56.	*Jasminum humile*		Oleaceae		x					
57.	*Lantana camara*		Verbenaceae		x					
58.	*Leucaena leucocephala*		Mimosaceae		x					
59.	*Malvastrum coromendelianu*	-	Malvaceae	x						
60.	*Maytenus royleanus*	Pattakh	Celastraceae		x					
61.	*Melia azadirach*	Dhrek	Meliaceae				x			
62.	*Melilotus parviflora*		Papilionaceae	x						
63.	*Mentha longifolia*	Podina	Lamiaceae	x						
64.	*Mentha sylvestris*	Podina	Lamiaceae	x						
65.	*Moringa oleifera*	Sohanjna	Moringaceae				x			
66.	*Morus alba*	Toot siah	Moraceae				x			
67.	*Morus nigra*	Shahtoot	Moraceae				x			
68.	*Salix alba*		Salicaceae		x					
69.	*Nerium oleander*		Apocynaceae		x					
70.	*Nicotiana tobbacum*	Tambakoo	Solanaceae	x						
71.	*Olea ferruginea*		Oleaceae				x			
72.	*Opuntia ficus-indica*		Cactaceae	x						

No.	Botanical Name	Local Name	Family	Life Form						
				Herb	Shrub	Grass	Tree	Sedge	Climber	Creeper
73.	*Peristrophe paniculata*		Acanthaceae	x						
74.	*Pinus roxburghii*	Chir	Pinaceae				x			
75.	*Pongamia pinnata*	Sukhchain	Papilionaceae				x			
76.	*Prosopis glandulosa*	Devi	Mimosaceae		x					
77.	*Prosopis juliflora*	Devi	Mimosaceae		x					
78.	*Psidium guava*	Amrud	Myrtaceae				x			
79.	*Rhazya stricta*		Apocynaceae		x					
80.	*Tamarix aphylla*		Tamaricaceae				x			
81.	*Taraxacum officinale*		Asteraceae	x						
82.	*Thevetia peruviana*	Peeli kaner	Apocynaceae		x					
83.	*Thuja orientalis*		Cupressaceae		x					
84.	*Otostegia limbata*	Bui	Lamiaceae		x					
85.	*Oxalis corniculata*		Oxalidaceae	x						
86.	*Parthenium hysterophorus*	Chitti Booti	Asteraceae	x						
87.	*Phragmites karka*	Naro	Poaceae			x				
88.	*Phoenix sylvestris*	Khajoor	Palmae				x			
89.	*Populus alba*		Salicaceae				x			
90.	*Punica granatum*		Punicaceae		x					
91.	*Riccinus communis*		Euphorbiaceae		x					
92.	*Rosa alba*		Rosaceae		x					
93.	*Musa indica*	Kela	Musaceae				x			
94.	*Saccharum benghalense*		Poaceae			x				
95.	*Saccharum spontanaeum*		Poaceae			x				
96.	*Salvia moorcroftiana*		Lamiaceae	x						

No.	Botanical Name	Local Name	Family	Life Form						
				Herb	Shrub	Grass	Tree	Sedge	Climber	Creeper
97.	*Schoenoplectus littoralis*		Cyperaceae					x		
98.	*Solanum nigrum*	Mako	Solanaceae	x						
99.	*Solanum surattense*	Katari	Solanaceae	x						
100	*Sonchus asper*	Dodhal	Asteraceae	x						
101	*Sonchus oleraceous*	Dodhak	Asteraceae	x						
102	*Typha latifolia*	Pan	Typhaceae	x						
103	*Withania somnifera*	Asgand Nagori	Solanaceae	x						
104	*Verbascum thapsus*		Scrophulariaceae	x						
105	*Verbena tenuisecta*		Verbenaceae	x						
106	*Verbena americanum*		Verbenaceae	x						
107	*Vitex negundo*		Verbenaceae		x					
108	*Xanthium strumarium*		Asteraceae	x						
109	*Ziziphus mauritiana*		Rhamnaceae				x			
110	*Ziziphus nummularia*	Jangli Ber	Rhamnaceae		x					

Pictorial view of the study area

	
A view of general habitat of study area	Agricultural fields & Seasonal streams
	
Ficus benghalensis	*Aerva javanica*
	
Calotropis procera	*Ipomoea carnea*

Adhatoda vesica

Ziziphus nummularia

Chrozophora tinctoria

Carthamus oxycantha

Ficus virgata with *Tamarix aphylla*

Nerium oleander

	
Livestock rearing along seasonal streams	Nesting of Common Myna
	
Pycnonotus leucogenys (White Cheeked Bulbul)	*Pycnonotus cafer* (Red Vented Bulbul)
	
Acridotheres ginginianus	*Passer domesticus*

Volume 3.

The Plan for Installation of New Transmission Line

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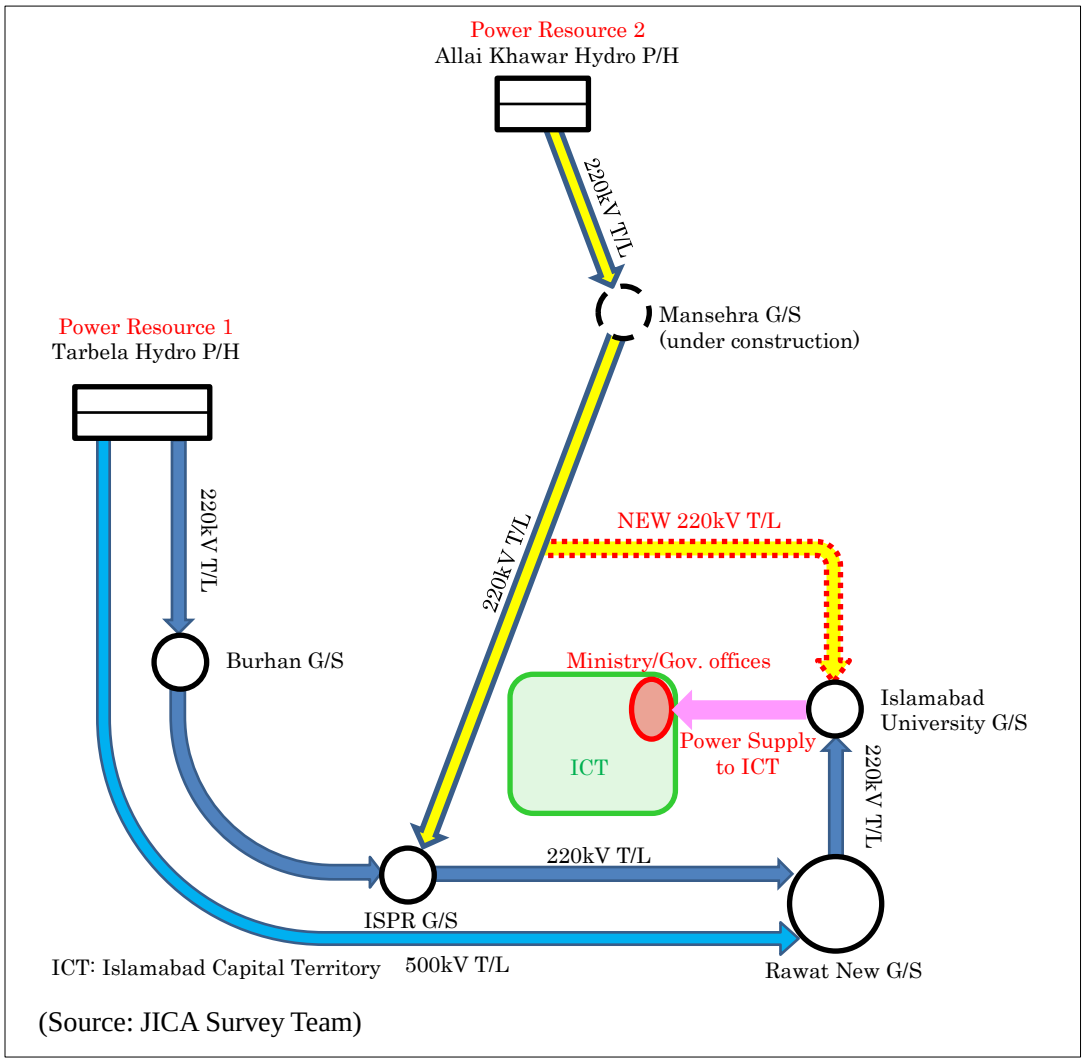
Volume.3 The Plan for Installation of the New Transmission Line

Chapter1 Objective of the Project and the Current Power Flow on the Target Grid System

1.1 Objective of the Project

The Islamabad University substation provides power to the facilities of parliament, the office of the prime minister, and government offices in Islamabad. The Islamabad University substation is presently being fed from a single source from Tarbela Hydro Power House through the 500kV Rawat substation. In the case of fault at the 500kV Rawat substation, the supply to Islamabad University is interrupted. Therefore, an additional source of supply to Islamabad University has been proposed to improve the reliability of the power supply to the Islamabad Capital Territory.



(Source: JICA Survey Team)

Figure 1.1.1 Outline of Grid System on Project Target Area

Chapter2　Current Situation of Power Flow and Voltage of the Target System of the Project

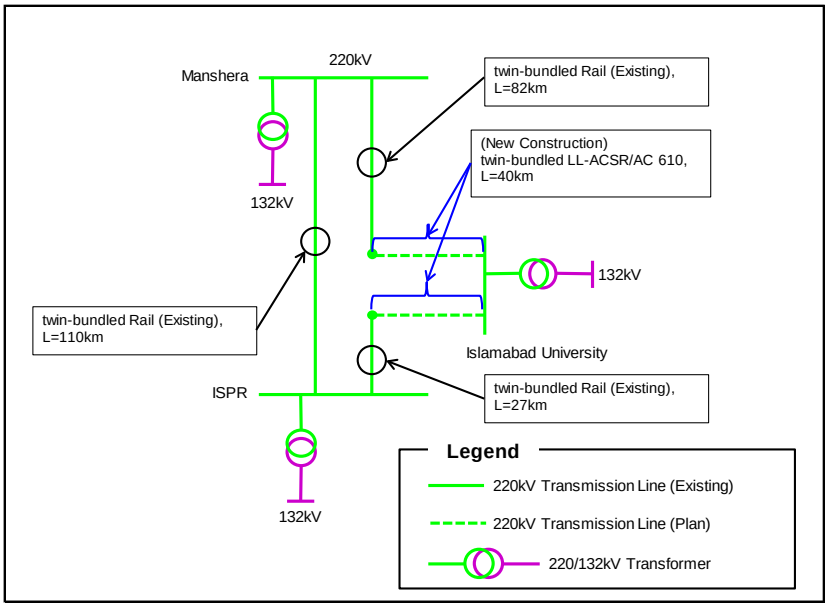
2.1　Power System Analysis

2.1.1　Study Phase

As the power flow and voltage analysis study years, 2018 (immediately after completion of the Tarbela hydropower station 4th extension project[1] (1,410MW)) and 2020 (expected completion year of the Tarbela hydropower station 5th extension project (1,410MW)) were selected. For 2018, the summer peak load condition was analyzed, and for 2020, both summer peak load and winter off-peak load conditions were analyzed.

2.1.2　Target System for the Analysis

Power flow analysis for the new construction section (from the branch point to the Islamabad University substation at 220kV Mansehra-ISPR line to the Islamabad University substation) was carried out. The system configuration of the target system is shown in Figure 2.1.1.[2]



(Source: JICA Survey Team)

Figure 2.1.1　System configuration of the New Construction Section and Target of Power Flow Analysis

[1] According to the information in the PC-1 prepared by NTDCL Planning Power in July 2014, the expected Tarbela 4th extension project completion year was 2017; however, based on the information obtained by the interview with the World Bank in December 2015, the expected commissioning year was 2018. Therefore, the updated information was taken into consideration.

[2] LL-ACSR/AC (Low Electrical Power Loss Aluminum Conductor, Aluminum-Clad Steel) is a type of low loss conductor

2.1.3 Power System Analysis Model

The power system analysis model which covered the overall NTDCL network for the year 2018 and 2020 was provided by NTDCL. The model was modified taking into account both with and without the project, namely, the replacement of conductors and construction of the new transmission line. As for the system configuration of the Tarbela-Burhan section, the following conductors were assumed:

1) Tarbela-Burhan circuit No.1 and 2: Twin-bundled Rail

2) Tarbela-Burhan circuit No.3: Twin-bundled LL-ACSR/AC 610

Tarbela-Burhan section of Tarbela-ISPR express line: Twin-bundled LL-ACSR/AC 610

The conductor types assumed for the "With Project" case are shown in Table 2.1.1, while the conductor types assumed for the "Without Project" case are shown in Table 2.1.2.

Table 2.1.1 Conductor Types assumed for the Power System Analysis Model ("With Project" Case)

Transmission Line	Circuit No.	Conductor Type	Length
220kV branch point (Mansehra side) – Islamabad University	1	LL-ACSR/AC 610 (twin-bundle)	40km
220kV Islamabad University – branch point (ISPR side)	1	LL-ACSR/AC 610 (twin-bundle)	40km

(Source: JICA Survey Team)

Table 2.1.2 Conductor Types assumed for the Power System Analysis Model ("Without Project" Case)

Transmission Line	Circuit No.	Conductor Type	Length
220kV Mansehra - ISPR	1, 2	Twin-bundle Rail	123km

(Source: JICA Survey Team)

The line constants used for power system analysis models are shown in Table 2.1.3.

Table 2.1.3 Line Constants used for the Power System Analysis Model

Conductor Type	Circuit No.	Number of bundles	Positive sequence impedance (p.u./km)			Transmission Capacity (MVA)
			R	X	B	
Rail	1	2	0.00007778	0.00058889	0.00192222	674
LL-ACSR/AC610	1	2	0.00005197	0.00054685	0.00193751	919.8

(Source: JICA Survey Team)

All networks are modeled and simulated with the Siemens PTI Power System Simulator for Engineering (PSS/E) ver.33, which NTDCL uses.

2.2 Power Flow Analysis

Power flow analysis for both “With Project” and “Without Project” cases for the year 2018 (summer peak load condition) was carried out. As the N-1 contingency condition, single circuit fault of the following sections are assumed.

Table 2.2.1 Fault Sections Assumed for N-1 Contingency Condition

No.	Fault Section
1	Mansehra – ISPR (“Without Project” case only)
2	Mansehra - Islamabad University
3	Islamabad University - ISPR

(Source: JICA Survey Team)

a) With Project Case

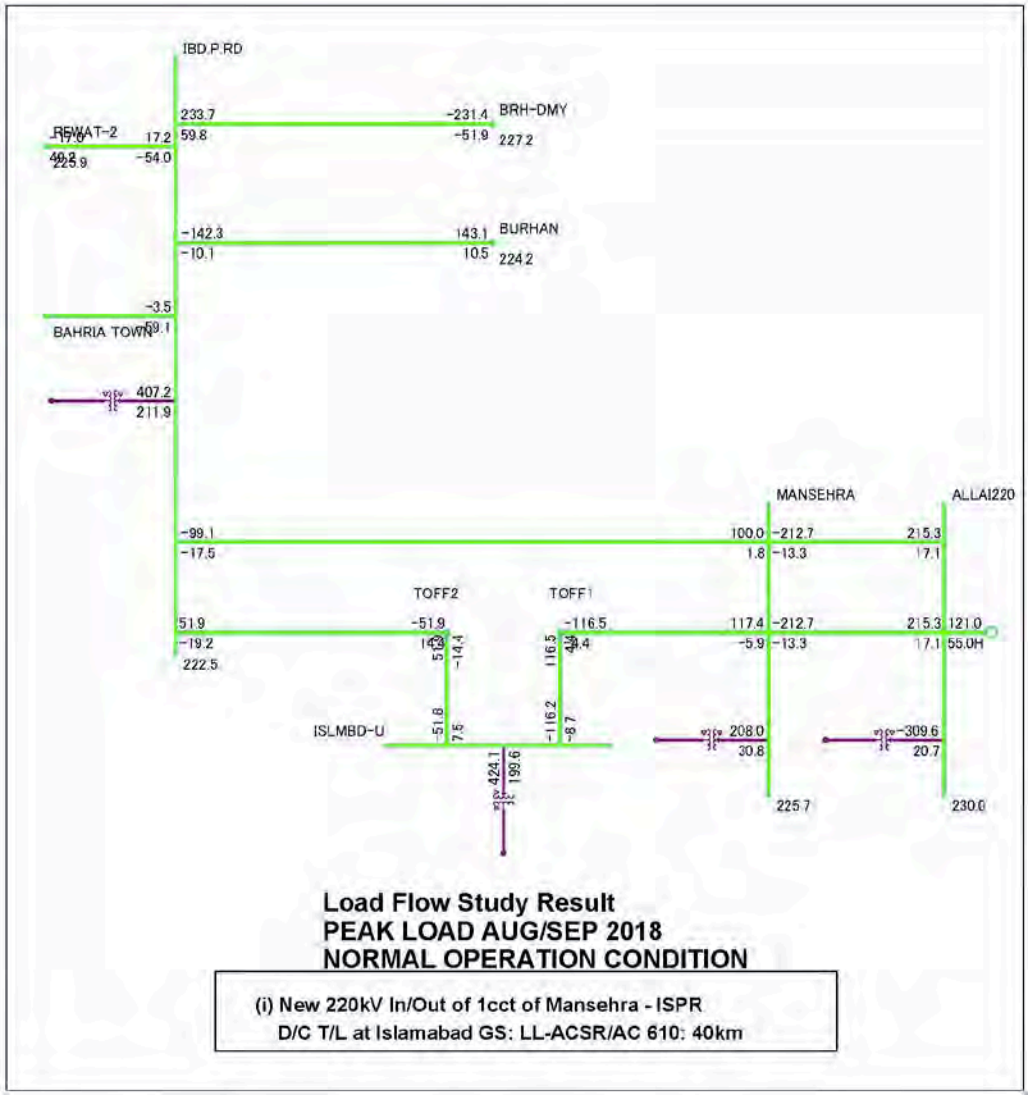
[Power Flow Analysis Results (2018 Summer Peak Load Condition)]

The analysis result and power flow diagram is shown in Table 2.2.2 and Figure 2.2.1, respectively. As shown in the Table, no overload occurred to the relevant 220kV transmission lines and transformers of the 220kV system around the Islamabad University substation.

Table 2.2.2 Power Flow Analysis Results (2018 Summer Peak)

Normal Operation	N-1 Contingency		
	Mansehra - ISPR	Mansehra - Islamabad University	Islamabad University - ISPR
No overloading of transmission lines or transformers	Same as on the left	Same as on the left	Same as on the left

(Source: JICA Survey Team)

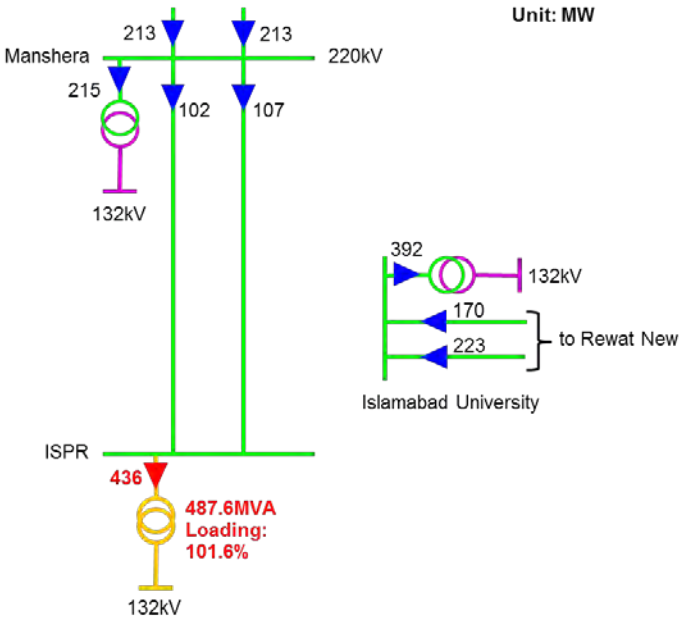


(Source: JICA Survey Team)

Figure 2.2.1 Power Flow Diagram (With Project: 2018 Summer Peak, Normal Operation)

b) Without Project Case

The loading of three (3) units of 220/132kV transformers at ISPR substation is 101.6% (487.6MVA) of the rated capacity of the transformers (160MVA x 3) even under normal operation conditions. No overload occurred to the 220kV transmission lines in the surrounding 220kV system under both normal operation conditions and the N-1 contingency condition (Mansehra-ISPR single circuit fault). The power flow diagram is shown in Figure 311-2. The transformer colored orange indicates that the transformer is loaded over 100% of its rated capacity.



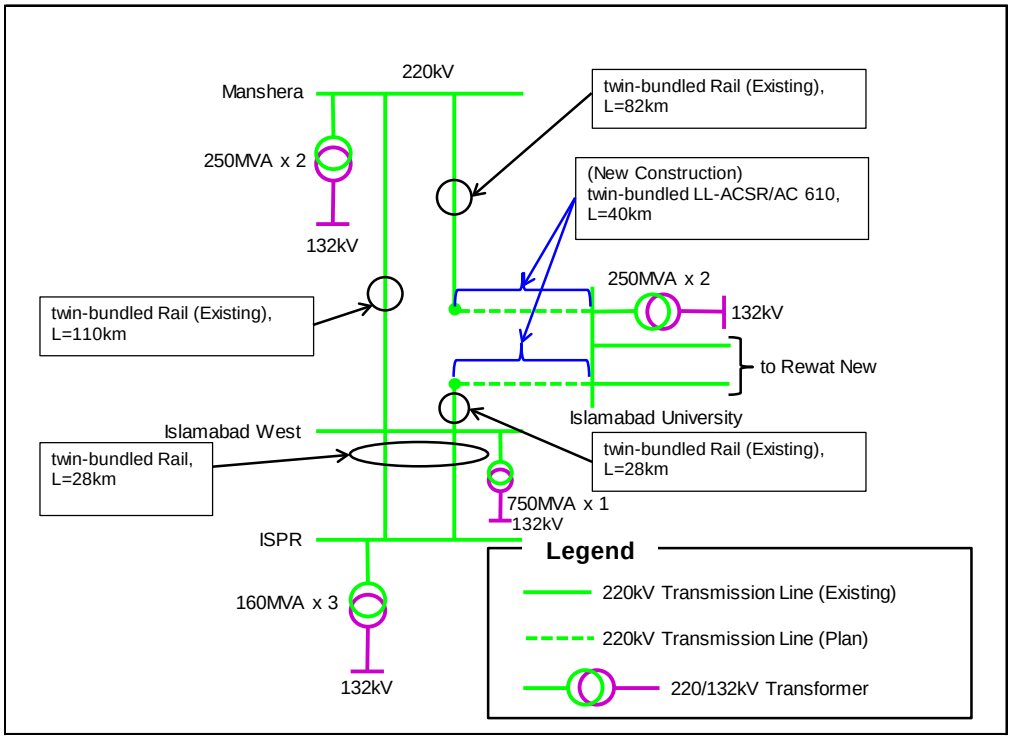
(Source: JICA Survey Team)

Figure 2.2.2 Power Flow Diagram (Without Project: Normal Operation Conditions)

[Power Flow Analysis Results in 2020]

Power flow analysis was carried out for both summer peak and winter off-peak conditions in 2020.

Figure 2.2.3, and the power flow analysis result for the system in 2020 for both summer peak and winter off-peak load conditions are summarized in Table 2.2.3.



(Source: JICA Survey Team)

Figure 2.2.3 System Configuration of the Project Target Area in 2020

Table 2.2.3 Power Flow Analysis Results (2020 Summer Peak and Winter Off-peak Load Conditions)

Load Condition	Normal Operation	N-1 Contingency		
		Mansehra-Islamabad West	Mansehra-Islamabad University	Islamabad University-Islamabad West
Summer Peak	No overloading of transmission lines or transformers	Same as on the left	Same as on the left	Same as on the left
Winter Off-peak	No overloading of transmission lines or transformers	Same as on the left	Same as on the left	Same as on the left

(Source: JICA Survey Team)

As shown in Table 2.2.3, no overload occurred to the relevant transmission lines and transformers under normal operation and N-1 contingency conditions for both summer peak load and winter off-peak load conditions in 2020.

2.3 Short-circuit Fault Current Analysis

The three-phase short-circuit fault current was calculated for the substation buses of the Islamabad-Burhan region and its peripheral system for the year 2018 and 2020.[3] For 2018, calculation was carried out for all of the eight (8) candidate plans in which different conductor replacement sections and types of conductors were taken into account (See Volume 2 Annex 2.2.2-1 Table 1). Plan 8 is the final proposal of the survey team. For 2020, calculation was carried out only for the Plan 8.

The three-phase short-circuit fault current for each of the substation buses in 2018 and 2020 is summarized in Table 2.3.1 and Table 2.3.2, respectively.

The three-phase short-circuit current value at the 220kV bus of the Islamabad University substations and ISPR substation, relevant to this project, were below the breaking capacity of the existing circuit breaker (40kA) in all cases. Therefore, it is not considered necessary to upgrade the breaking capacity of the circuit breakers of the substation in question.

Table 2.3.1 Three-phase Short-circuit Fault Current in 2018

Bus Name	Bus Voltage (kV)	Three-phase Short-circuit Current (kA)							
		Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7	Plan 8
ISPR	220	25.9	26.4	24.9	26.6	26.5	24.6	28.1	26.8
Islamabad University	220	25.4	25.5	25.3	25.5	25.5	25.2	25.7	25.5

(Source: JICA Survey Team)

Table 2.3.2 Three-phase Short-circuit Fault Current in 2020

Bus Name	Bus Voltage (kV)	Three-phase Short-circuit Current (kA)
		Plan 8
ISPR	220	35.0
Islamabad University	220	29.4

(Source: JICA Survey Team)

[3] The rated breaking capacity of the circuit breakers to be installed in a substation is selected in order to break the maximum three phase short circuit current, which is the severest fault current of the short circuit fault.

2.4 Transient Stability Analysis

Transient stability analysis was carried out for the year 2018 for the candidate plan 8, which is the final proposal of the survey team.[4]

2.4.1 Evaluation Criteria

The system was considered stable if the amplitude of the oscillation waveform of the phase angle difference of the generator rotors of two primary power stations in the northern Pakistan area which is closed to the Islamabad and Burhan area is likely to converge under the N-1 contingency condition of the project target transmission lines for both of the following two cases stated in NEPRA Grid Code:

i. Normal Clearing: Main Protection (5 cycles, 100msec)
ii. Stuck Breaker Condition: Back-up Protection (9 cycles, 180msec)

2.4.2 Study Cases

A “Single line three-phase short-circuit fault without reclosing” of the sections shown in Table 2.4.1was assumed for the analysis. The fault sequence is shown in Table 2.4.2.

Table 2.4.1 Fault Section

Case No.	Fault Section
1	Mansehra – Islamabad University
2	ISPR – Islamabad University

(Source: JICA Survey Team)

Table 2.4.2 Fault Sequence

Normal Clearing Condition		Stuck Breaker Condition	
Time	Sequence	Time	Sequence
0 msec	Single circuit three-phase short-circuit fault occurs.	0 msec	Single circuit three-phase short-circuit fault occurs.
100 msec	Fault Cleared (Trip the faulted Line)	180 msec	Fault Cleared (Trip the faulted Line)
10 sec	End of Calculation	10 sec	End of Calculation

(Source: JICA Survey Team)

[4] The transient stability analysis for 2020 summer peak and winter off-peak conditions was not carried out due to incomplete dynamic data (several tens of generator models were missing). Therefore, it is necessary to confirm the stability in detailed design stage.

The reference of the phase angle difference is set to the Muzaffargarh power station, which is also assumed by NTDCL Planning Power for their analysis practice. The following power stations located near the Islamabad and Burhan area in the northern system are considered for phase angle comparison:

- Tarbela (Hydro)
- Ghazi Barotha (Hydro)
- Mangla (Hydro)
- Allai Khwar (Hydro)
- Neelum Jehlum (Hydro)
- Chasnupp-1/ Chasnupp -2 (Nuclear)
- Chasnupp -3/ Chasnupp -4 (Nuclear)

2.4.3 Analysis Results

The analysis results are summarized in Table 2.4.3. The results shows that the NTDCL power system in the Islamabad and Burhan area and the surrounding northern system remains stable in the case of single line fault of the project target transmission lines for both normal clearing and stuck breaker conditions.

Table 2.4.3 Transient Stability Analysis Results

Study Phase	Fault Section / Case	Mansehra - Islamabad University	ISPR - Islamabad University
2018 Summer Peak	Normal Clearing Condition	Stable	Stable
	Stuck Breaker Condition	Stable	Stable

(Source: JICA Survey Team)

Chapter3 The Outline of Installation of New Transmission Line Facilities

3.1 Transmission Line Facilities

3.1.1 Specification of New Transmission Line Facilities

Specification of new transmission line facilities corresponds to the existing Mansehra-ISPR transmission line mentioned in PC-I. Specification of existing Mansehra-ISPR transmission line facilities is shown as follows.

Table 3.1.1 Existing T/L facilities on Mansehra – ISPR

Section			Mansehra - ISPR（Sangjani）
Name of Line			220kV Mansehra - ISPR(Sangjani） T/Line Circuit-I & II
Completion			09.08.2011
Length of T/L			100.48 km
Nos of Tower			356 (3.54 Nos/km)
Number of Circuit			2
Conductor			
	Bundle		twin bundle
	ASTM Code		Rail
	Overall Diameter		29.1 mm
	Strand	Steel	7 x 2.45 (33.54 mm^2)
		Alminium	45 x 3.70 (483.8 mm^2)
		Total	(517.3 mm^2)
Stringing condition			19.58 kN
Kind of Ground Wire			Gulbanaized Steel Wire(Optical fiber installed/OPGW)
Kind of Insulator		Type	Porcelain, made by EMKO, 120kN
		Nos	14
Arcing Horn Gap length			6 feet

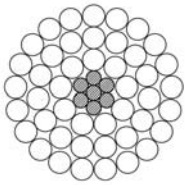
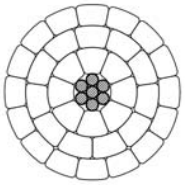
(Source: JICA Survey Team)

3.1.2 Selection of Conductor

(1) Selection of Conductor to be Compared

The selection of a conductor to be applied for a new transmission line is based on comparative study between conventional Rail conductors and low loss conductors (LL-ACSR), which provide current capacity either equaling or surpassing Rail conductors and equivalent diameter to Rail conductors. Comparison of conductors is shown in following table.

Table 3.1.2 Specification of Conductors

		ACSR	LL-ACSR
		ASTM:Rail	LL-ACSR610
Figure			
construction		45/3.7-Al 7/2.47-St	16/TW-AL 11/TW-AL 8/TWAl 7/2.1-14EAS
Nominal Diameter	mm	29.61	29.59
Min. Breaking Load	kN	116.1	126.5
Cross section area:Al	mm2	483.8	610.7
Core		33.54	24.25
Total		517.3	635.0
Nominal weight	kg/km	1600	1867
DC Resistance at 20deg-C	Ohm/km	0.0597	0.0471
Co-efficient of linear expansion	/deg-C	20.9×10^{-6}	21.9×10^{-6}
Current capacity	A	1075 at 90 deg-C	1207 at 90 deg-c
Sag (at 350m)	m	14.4 at 90 deg-C	15.2 at 90 deg-C

(Source: JICA Survey Team)

(2) Comparison of Conductors

Low loss conductors (LL-ACSR) apply to a new transmission line, which provide advantages for life-cycle cost through reduction of transmission loss. According to this comparison, LL-ACSR will be profitable in terms of life-cycle cost in 34 years after the beginning of operation when compared with conventional Rail. Life-cycle cost is reduced 20 mill. Rs in the 20 years after the beginning of operation through installation of LL-ACSR.

3.1.3 Outline Study of Transmission Line Facilities

(1) Design Condition

Applicable standards for design of transmission line facilities are shown as follows:

1) Applicable Standard

・IEC60826 Design criteria of overhead transmission lines Third edition (2003-10)
・Building code of Pakistan (2007)
・WAPDA/NTDCL Specifications

2) Allowable Continuous Current Calculation Condition

・Based on IEEE738
・Wind velocity 3feet/s (Line Temperature 90℃)
・Ambient Temperature (40℃)

Note: Line temperature under emergency shall be taken as 100℃. Ambient temperature shall be taken corresponding to the target area.

・Amount of Solar Radiation (0.5 W/m)

3) Insulating Distance

・Conductor-Tower (Normal condition 2.1m, High wind condition 40m/secs 1.6m)
・Conductor-Ground (8m, Line temperature 100℃)

4) Sag Calculation Condition

・Sag equivalent to Normal Tensile Force of ACSR Rail (17%UTS, Calm/No accretion of snow and ice, Ambient Temperature 25℃)
・Maximum Sag equivalent to Rail (Calm/No accretion of snow and ice, Line temperature 65℃)
・Space of conductor (457mm)
・Wind pressure (970Pa, No accretion of snow and ice, Temperature 25℃)
・Insulator String

:Single Rail (Porcelain 120kNx14nos, Length 2922mm, Gap length of arcing hone 6feet）

:Twin Bundle Rail (porcelain 120kNx14nos x2, Length 2922mm, Anti-fog, Gap length of arcing hone 6feet)

5) Earthquake

Seismic zone and seismic zone of target area are as described in Volume 1. Chapter 4. 4.3.

(2) Tower Shape

Towers shall be adopted as standard EA-Type suspension towers, EG-Type angle towers and JKD-Type tension towers for using the existing Mansehra-ISPR transmission line. The existing Mansehra-ISPR transmission line had been designed as a twin-bundle Rail. These standard towers are applicable to reinforcement of the existing transmission line for this project.

In the case of applying the LL-ACSR610, which is equivalent to the outer diameter of the Rail conductor, the horizontal load (wind load) is equal. Because the vertical load will be increased by the difference of unit weight (1.867-1.600=0.267kg/m), the foundation compression load also will be increased and uplift load will be decreased. These loads are estimated to be about 320kg/foot for a 400m loading span. Due to the approximately 1 % difference of foundation load, LL-ACSR610 shall be able to be applied to the new construction line.

On the other hand, the sag of LL-ACSR610 will be increased under the same tension stringing condition as the Rail conductor because of the increased unit weight. So, it is necessary to add to the tower height to keep the distance from the ground. The additional height of the tower will be about 2m average in the case of a 400m span. The different sag of each conductor is shown in Figure 3.1.2.

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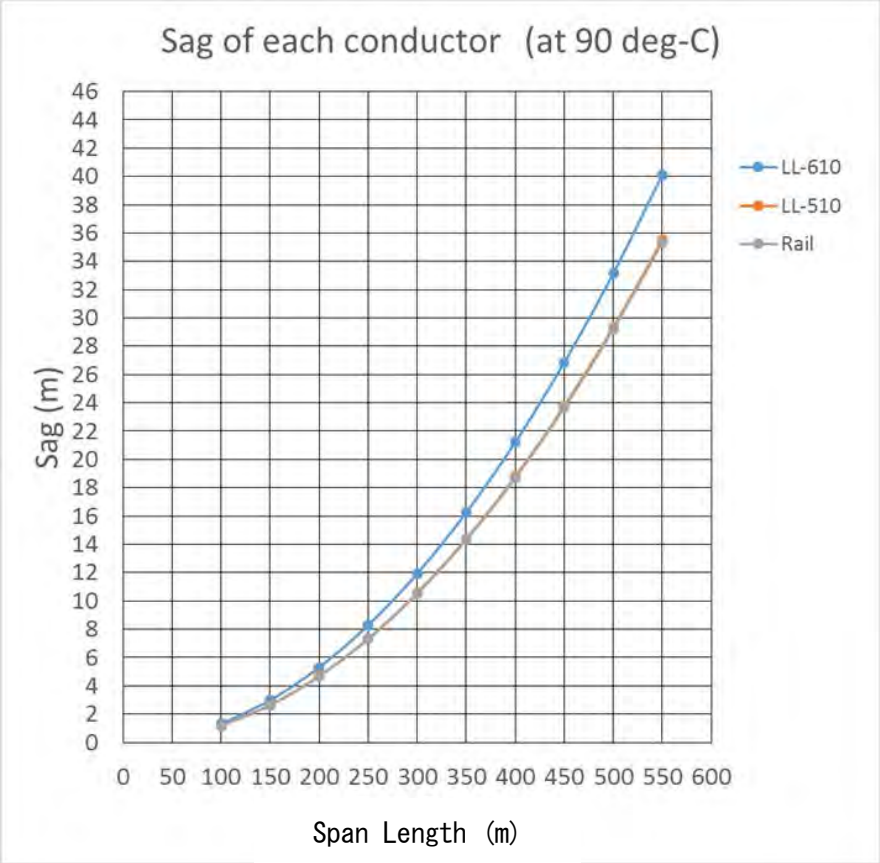


(Source: JICA Survey Team)

Figure 3.1.1 Comparison of each conductor sag (No wind and snow, 90 deg.C, T=1,970kg/wire)

Table 3.1.1 Suspension Tower Design Condition

DESIGN DATA

– DEFLECTION ANGLE

SINGLE CONDUCTOR	0-2 DEGREE
TWIN CONDUCTOR	0 DEGREE

– WIND SPAN (MAX.)

SINGLE CONDUCTOR	400 m
TWIN CONDUCTOR	370 m

– WEIGHT SPAN (MAX.)

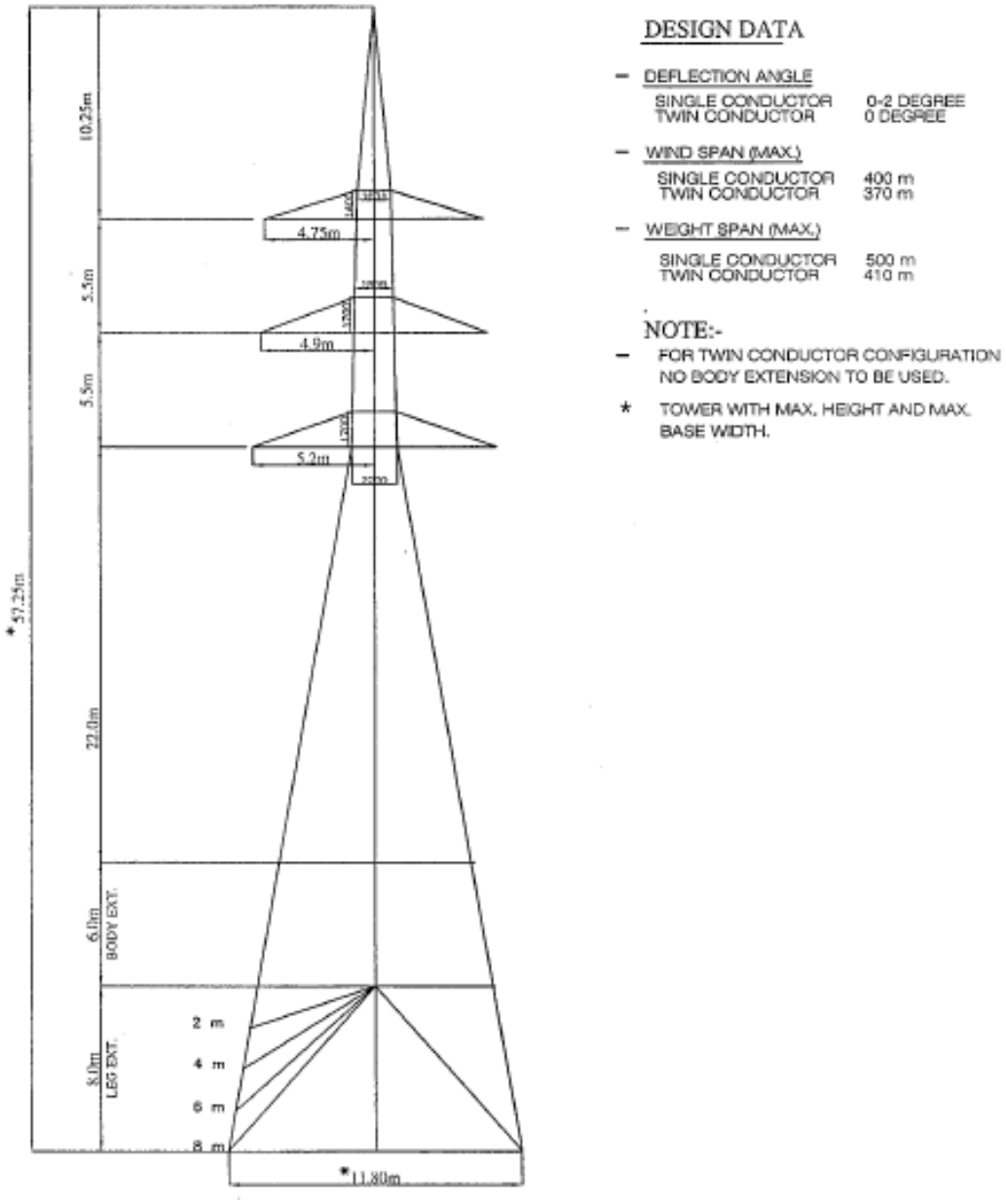
SINGLE CONDUCTOR	500 m
TWIN CONDUCTOR	410 m

NOTE:-

– FOR TWIN CONDUCTOR CONFIGURATION NO BODY EXTENSION TO BE USED.

* TOWER WITH MAX. HEIGHT AND MAX. BASE WIDTH.

(Source: JICA Survey Team)

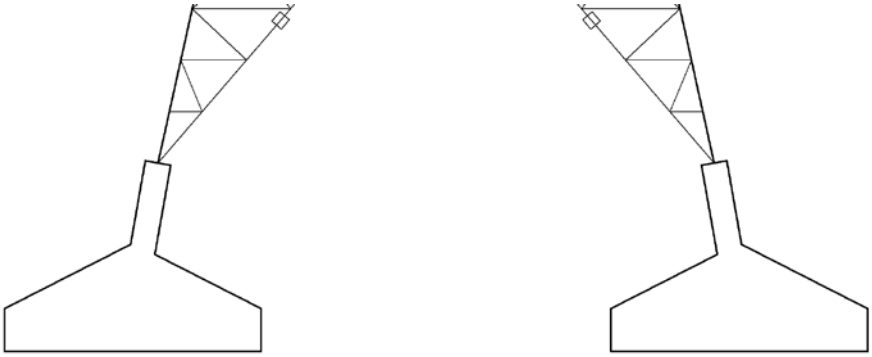


(Source: JICA Survey Team)

Figure 3.1.2 Standard Double Circuit Tower

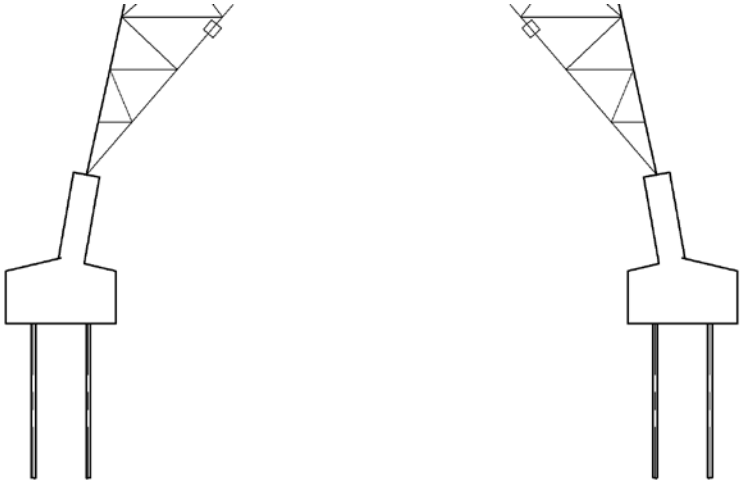
(3) Foundation

The ground of the target area consists mainly of a rock formation within the Paleocene to the Eocene. This rock formation consists of shale, sandstone, marl, and limestone, which has enough bearing capacity except for the weathered rock on the surface. Therefore, the foundation type may be adopted as the standard inverted-T shaped foundation. However, the size of foundations may not be sufficient for counter weight because it is difficult to excavate if bedrock is fresh, and in that case a rock anchor shall be applied against the uplift force.



(Source: JICA Survey Team)

Figure 3.1.3 Outline Drawings of Spread Foundation



(Source: JICA Survey Team)

Figure 3.1.4 Outline Drawings of Pile Foundation

(4) Insulator

The specifications of the insulators shall be the same as that of the existing Mansehra-ISPR twin-bundled transmission line. Arcing hone shall be adopted to avoid corruption of insulator due to lightning strikes.

Table 3.1.2 Specifications of Insulator

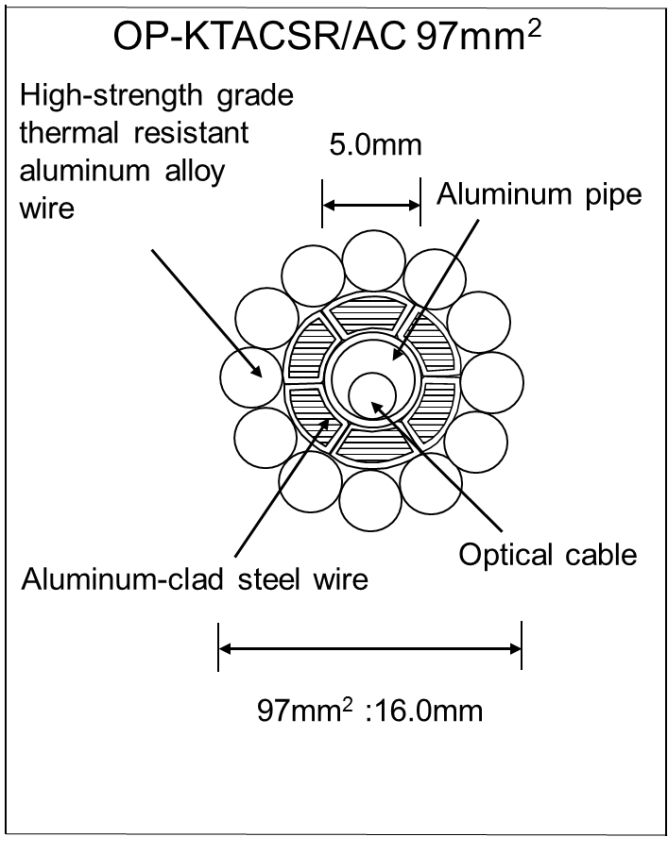
	Type/Shape	Strength	Nos (nos)	Length (mm)	Remarks
Single Strings for Suspension	Porcelein, Anti-fog	120	14	2,922	Twin-bundle
Double Strings for Tension	Ditto	120x2kN	Ditto	Ditto	Ditto

(Source: JICA Survey Team)

(5) Ground wire

OPGW had been introduced to recent transmission lines. For the scope of work of this project, ground wire is planned to be adopted as OPGW. Therefore, OPGW has been adopted in all sections of this project. The size of the ground wire shall be adopted as OP-AC97sq corresponding to Rail 480sq. The cross-section of OP-AC97sq is shown in Figure 3.1.6.

The number of optical fibers is assumed to be the same number of 24nos as planned in PC-1. However, the number of optical fibers shall be decided by the detailed design.



(Source: JICA Survey Team)

Figure 3.1.5 Outline diagram of OP-AC97sq

3.2 Substation

3.2.1 Basic Concept of the Design

The Substation which requires modifications and/or additions along with the installation of a new transmission line under this Reinforcement Project is the ISD. Univ substation only. The existing 220kV GIS and connecting busduct from the transmission line bay will need to be modified due to the addition of the power receiving transmission line from In/out Mansehra-ISPR line. Although the modification/addition of metering and protection relaying circuits and operation/control panels are required, the cost was estimated as the ancillary facility cost after the main equipment cost was calculated. Table 3.2.1 shows the scope of the substation equipment and the associated works in this reinforcement project.

Table 3.2.1 Scope of the substation equipment and the associated works in this reinforcement project

	Item of device, equipment, installation, and wiring work
1	Equipment for 220kV transmission line receiving bay:measuring/protection devices, line arrestors, and connecting busbar with 220kV switchgear
2	220kV switchgear equipment (circuit breaker, isolator, busbar, measurement, indicating circuits, insulation gas, and related devices) (those which are required for expansion of transmission lines and modified equipment)
3	Measurement, protection, indicating, and control circuits for 220kV switchgear (including for modified existing circuits)
4	Supply of drawings of foundation works for the above mentioned equipment
5	Execution of the above foundation works
6	Check of strength of steel structure for modification of AIS type substation
7	Reinforcement work of the steel structure as result of the above check

3.2.2 The Selection of Optimum Plan and Outline Design (Results of study of specifications)

1) As the 220kV In/out Mansehra-ISPR transmission line accesses from the eastside of the ISD. Univ substation, the transmission line from 220kV Rawat-NEW will be shifted westward and connected to a new line bay to avoid crossing with the transmission line from Mansehra-ISPR. The power receiving line bay from the 220kV In/Out Mansehra-ISPR transmission line shall be placed at the position of the existing line bay from Rawat-New. (Refer to Figure 3.2.1)

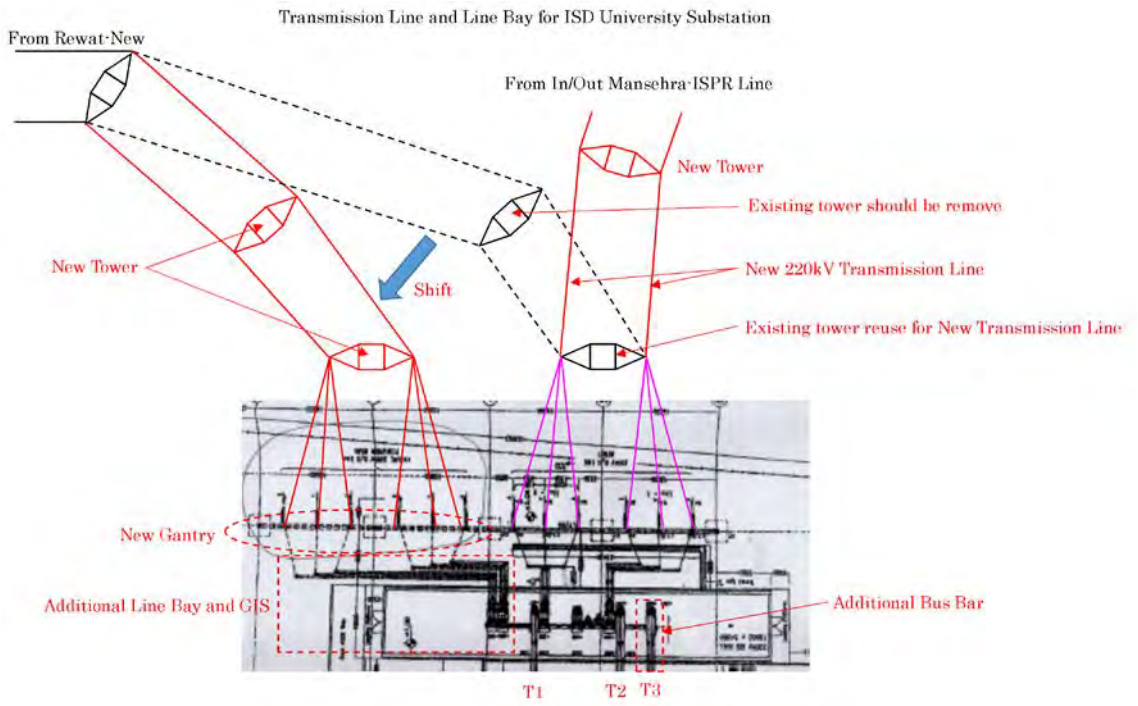
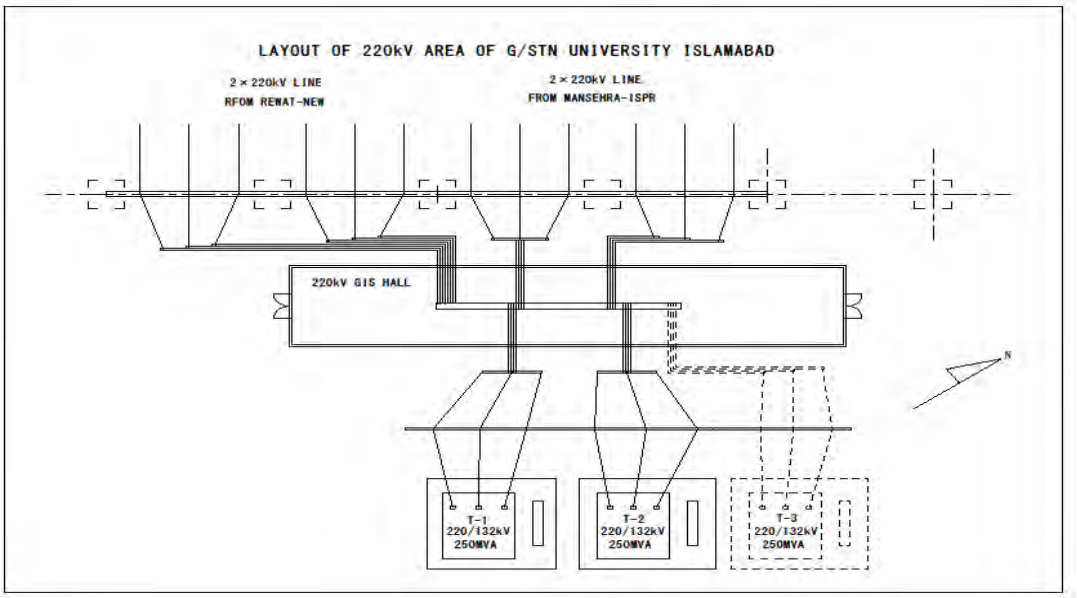


Figure 3.2.1 Transmission Line and Line Bay for ISD.Univ Substation

2) Line bay for in/Out Mansehra－ISPR will be located at the position of the existing Rawat-New line bay and necessary equipment will be installed.

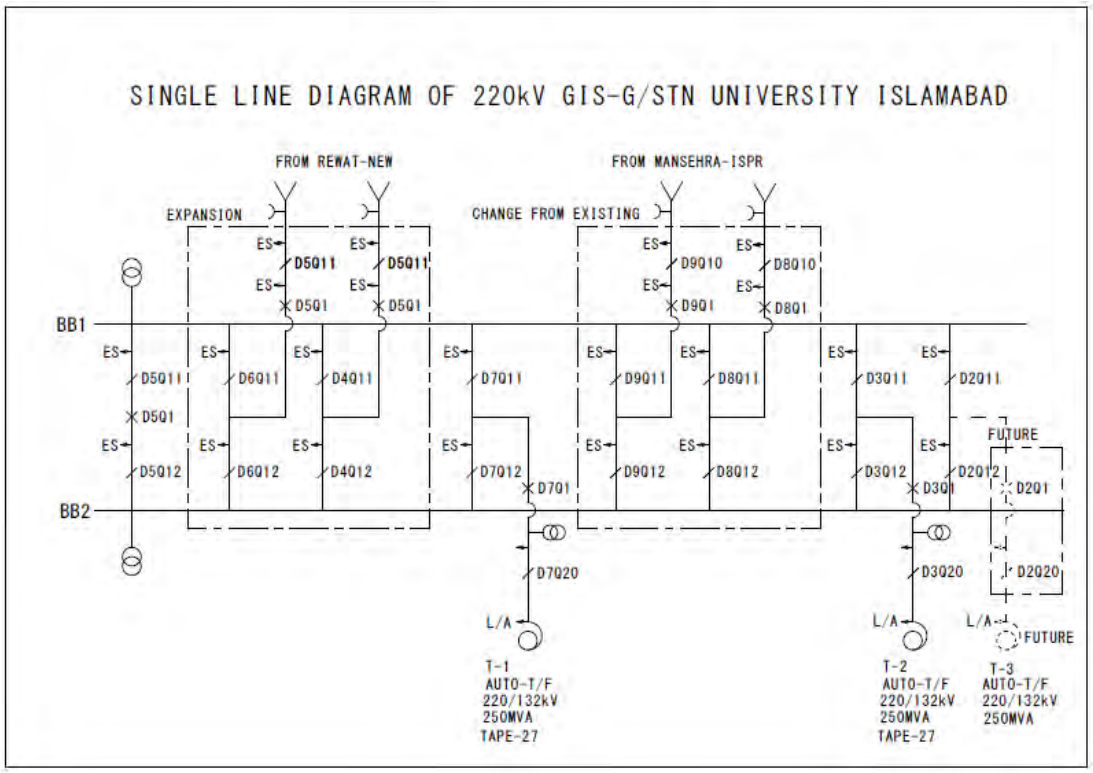
3) To meet the new arrangement of the transmission line and line bays, the 220kVGIS will be expanded westward to connect to the transmission line from the Rawat-New line. The 220kV GIS feeder circuit for the 220/132 kV transformer (T-3) will also be added. Refer to Figure 3.2.2 for the circuit after modification. However, in the detailed design by the manufacturer, some changes may be expected.

3.2.3 Layout of ISD. Univ substation



(Source: JICA Survey Team)

Figure 3.2.2 Layout of Expansion Area of ISD. Univ Substation



(Source: JICA Survey Team)

Figure 3.2.3 Single Line Diagram of Expansion Area of ISD. Univ Substation

Table 3.2.2 ISD. Univ Substation：Expansion Specification

No.	Item name and specification	Q'ty	Application
Part-1	Circuit breaker, 3 phase, Rated voltage 245kV Rated current 4,000A, Rated short circuit current 50kA	3	2 for Expansion line 1 for Expansion Transformer feeder
Part-2	Disconnecting switch(LS), 3 phase: Rated voltage 245kV, Rated current 4,000A, Rated short time withstand current 50kA	6	4 for Expansion line 2 for Expansion Transformer feeder
Part-3	Outdoor type disconnecting switch(LS), 3 phase: Rated voltage 245kV, Rated current 4,000A, Rated short time withstand current(3s) 50kA	2	
Part-4	Lightning arrester(LA), single phase type Impulse test voltage 750kV	6	For Transformer
Part-5	Protection relay panel	1	Distance protection relays, over current relays
Part-6	Control and operation panel	1	

(Source: JICA Survey Team)

Chapter4 Construction Method

4.1 Construction Method of Transmission Line Facilities

(1) Problems for the Grid System

In the summer peak period, it is necessary to make all of the existing lines usable in order to secure both freedom and transmission capacity of the power system as a whole. Threfore, connection works at the junction point of in/out of Mansehra-ISPR shall be avoided during this period, in which the impact of the power supply interruption accompanied by an electrical accident caused by construction work is enormous. However, foundation, tower erection, and line installation work can be done in a timely fashion except for the junction point

(2) Construction Method to be considered above

The normal method can be applied for all works. However, the status of load flow shall be taken into account for the work period.

(3) Special Instructions for Specific Construction Methods

At the π junction, the horizontal force will be unbalanced during the installation work of the conductor at the existing tower. Moreover, the acting direction of horizontal forces will be changed after completion of the π junction construction work. Therefore, the strength of the existing tower must be validated as safe when considering the construction sequence. Moreover, safety should be secured during the connection work through the arrangement of temporary protection works, because connection work will be executed with the live line of one circuit of Mansehra-ISPR.

It is required to minimize the area of deforestation to protect the natural environment for the section through the national park. There should be consideration of excavated soil treatment for foundation work and of preclusion of damage to the forest during the tower erection and conductor installation work. Particularly an installation method will be required which is able to secure distance between the conductor and the trees.

(4) Measures for safety on execution management

During the erection of the connection tower for in/out of Mansehra-ISPR to the ISD. Univ substation, the existing Mansehra-ISPR line will be a live line, so the erection work will be executed close to the live line. The work shall be executed under due attention, and it will be required for there to be a full time observer to ensure safety for the duration of the erection

work.

4.2 Construction of Substation

(1) Issues/advice cautioned in construction of the Substation

1) The modification of the above 220kV GIS is difficult for anyone other than Siemens, which is the manufacturer of existing GIS, because the extension of GIS is difficult to interface with the existing part due to its structure, and high-accuracy mechanical matching is necessary to compose the integrated gas insulated space. (In this case, modification of GIS may be exclusively ordered to the Siemens company.)

2) The modification work of the 220kV GIS will be supervised through the expertise of the manufacturer of GIS, the Siemens company. However, it is usual for NTDCL to prepare workmen to execute the modification work to save costs paid to the manufacturer. NTDCL is supposed to be capable of dispatching workmen/technicians to execute the work. NTDCL shall recognize that this modification work is an opportunity for NTDCL to study the technology for the maintenance of the facility from the manufacturer.

(2) Study of the Construction Method

Since this substation has the duty of supplying power to sensitive governmental facilities, the total shutdown of the 220kV circuit will not be allowed. Therefore, the elaborate plan of the place change work of the line bay and the modification work of the 220kV GIS shall be made utilizing the advantage of the two line power receiving and double busbar system of switchgear to avoid total shutdown of 220kV.

Chapter5 Implementation Schedule of this Project

5.1 Implementation Schedule for the New Transmission Line (Confidential)

5.2 Implementation Schedule for the Substation (Confidential)

Chapter6 Estimated Construction Cost

6.1 Estimated Construction Cost for the New Transmission Line (Confidential)

6.2 Budgetary Cost of the Substation (Confidential)

6.3 Schedule and Cost Estimation of the Consulting Service (Confidential)

6.4 Finance of Implementation Cost of the New Transmission Line Construction (Confidential)

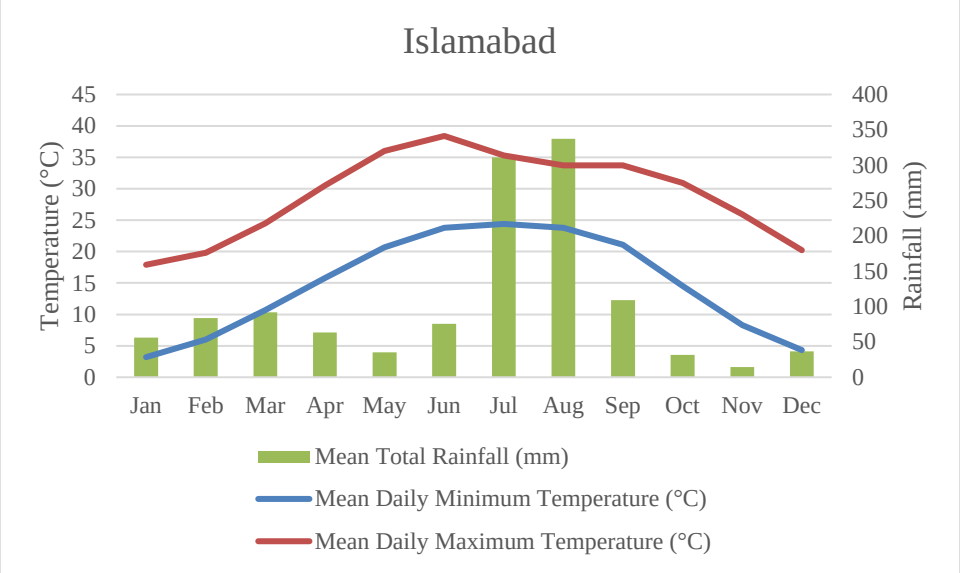
Chapter7 Environmental and Social Considerations

7.1 Environmental and Social Baseline

The following section describes the natural and social baseline of the project area. Although more than nine alternatives are examined, only the original route is shown in the maps in this report.

7.1.1 Climate

The project location falls in a temperate climate and is categorized as Subtropical-Dry Winter (Cwa) by the Köppen climate classification. Four seasons are clearly observed and the precipitation amount is 1,247 mm per year. The temperature in June is the highest. On some days, the temperature reaches more than 40 °C. On the other hand, the minimum temperature in winter is less than 10 °C. At that time, the electricity demand for air conditioning is high.



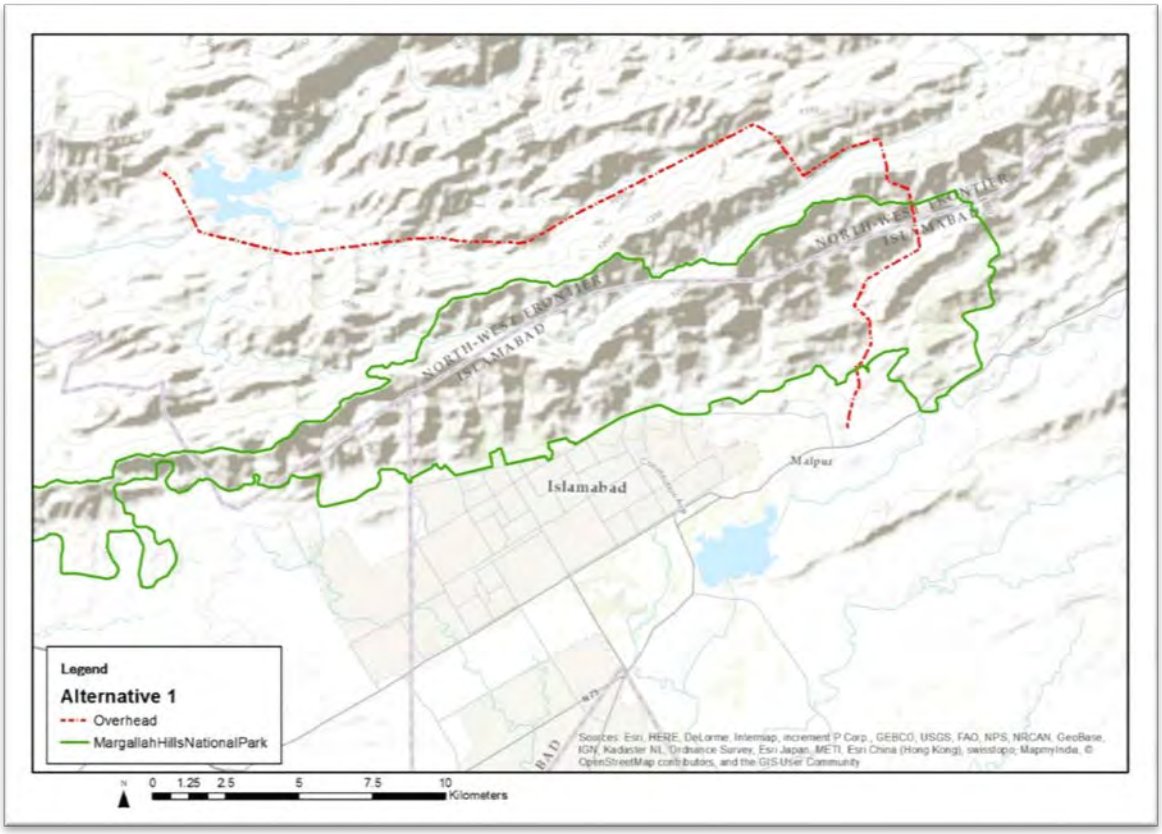
(Source: Pakistan Meteorological Department (1981-2010))

Figure 7.1.1 Temperature and rainfall of Islamabad

7.1.2 Geography and geology

The elevation of the west end of the route is around 600m. The planned line goes to the east up to 1,000m in height. After turning right to the south, the line crosses mountains of 1,400m to 1,600m in height and down to the southern end at 600m.

Figure 7.1.2 shows a shaded-relief map of the target area. The red line indicates the original plan of the route and the green line indicates the boundary of the Margalla Hills National Park (MHNP). There are steep slopes more than 70% in MHNP.



(Source: JICA Survey Team)

Figure 7.1.2 Geography around the project site

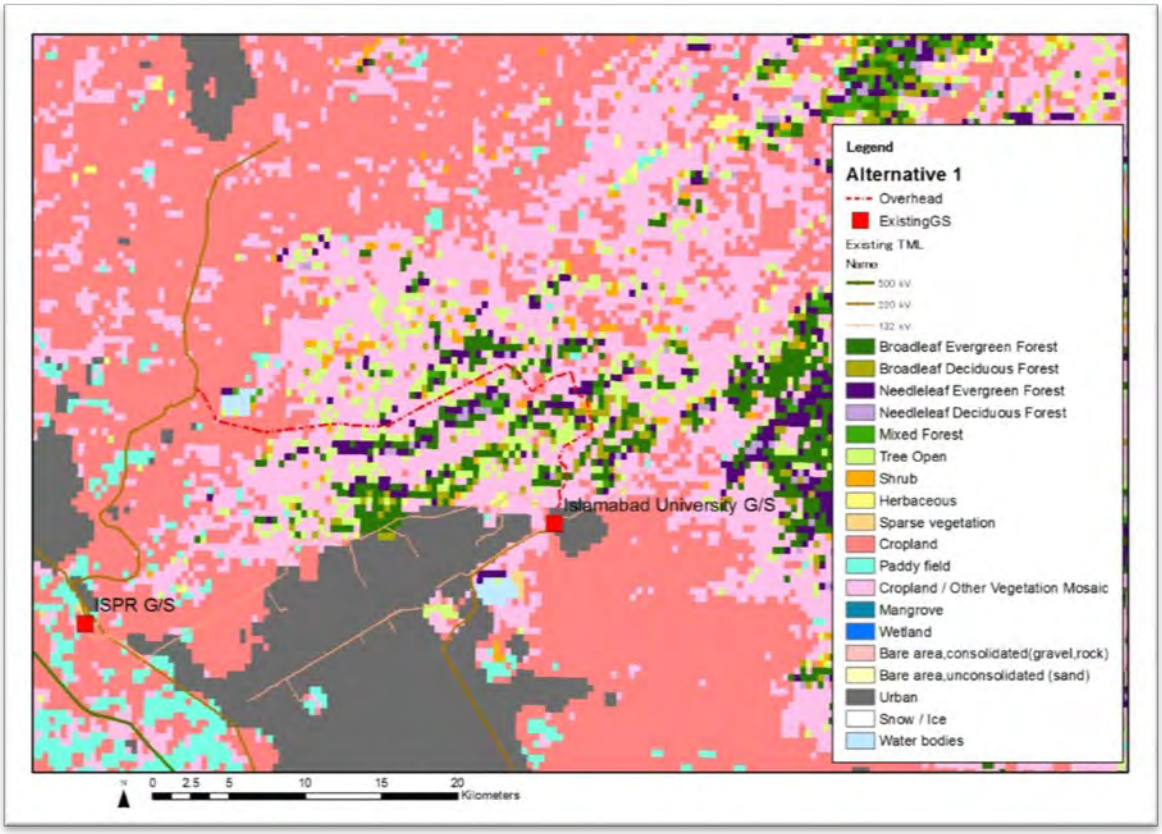
The geologic system of Islamabad Capital Territory (ICT) area is mainly tertiary terrain with smaller areas of formations belonging to quartzite, calcareous shale, and limestone. The rocks are thinly developed, but outcrops are observed in the Margalla Hills slopes (Ahmed et al., 1979). The rocks are 40 million years old and contain fossils of sea animals, indicating that this was developed in the sea (Anwar 2001). The Main Boundary Thrust (MBT) can be seen north of Islamabad. Earthquakes of more than magnitude 6 have happened on four occasions since 2000.

The Margalla ridge is predominantly made up of limestone and shale with a very thin layer of top soil. In common with other highland areas, the Margalla Hills area is being affected by deforestation, with the effect that in periods of heavy rain the top soil flows into the stream on the low-lying areas and is slowly replaced by river-made deposits of red sandstone and

wind-borne deposits of fine sandy dust. These latter deposits are often heavily eroded leaving a sort of lunar landscape (Holmes 1990).

7.1.3 Land use

Land use around the project site is mainly for cropland. The part crossing the national park is Broadleaf Deciduous Forest, Broadleaf Evergreen Forest, Coniferous Forest, and sparse vegetation (See Figure 7.1.3).



（Source: GLCNMO 2013）

Figure 7.1.3 Land use around the project site

According to Higher Education Commission of Islamabad (2007)[5], in the British regime, ownership in the National Park was allowed and adjacent land was given as collective property to the local people known as Shamlat. After the establishment of Islamabad, the government has started to buy land from the local people living inside the proposed park. The revenue department is responsible for keeping land ownership records.

[5] Higher Education Commission (2007) Medicinal Plants of Margalla Hills National Park Islamabad

Four categories of the land can be found in the area:

- Malkiat: the land in personal ownership.
- Shamlat: Collective property of the village people; it is also called Guzara
- Qabza: the land illegally occupied or temporarily given to anybody who claimed ownership afterwards.
- CDA land: the land acquired by CDA.

The Park map provided by CDA (Figure 7.1.5) shows four areas, including the Army area, the Protected Forest, CDA land, and the City Park area. However, it does not show the above Malkiat, Shamlat, and Qabza.

7.1.4 Vegetation

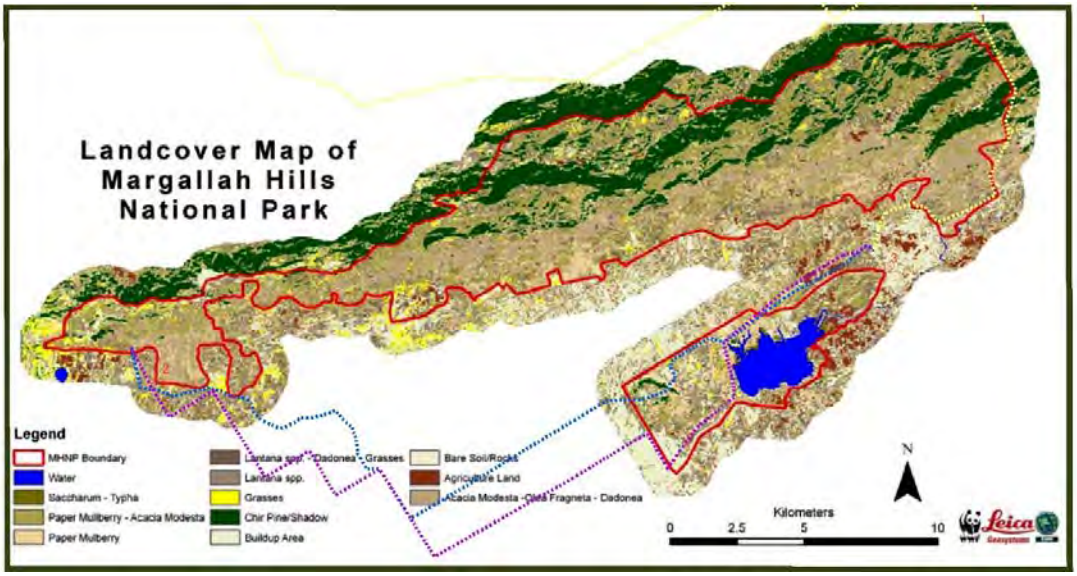
The vegetation map by WWF (2009)[6] shows that 69.9% of the forest area consists of Chir pine/Shadow, Paper Mulberry, and Kao - Dodoneae spp.; 17.9% of the shrub area consists of Lantana spp. and Dodonea spp.; and 8.7% is the agriculture and residential area (see Table 7.1.1). Many invasive species such as Paper Mulberry and Lantana have already encroached.

Table 7.1.1 Vegetation of MHNP

Name	Description	Area (ha)	Rate (%)
Chir pine/Shadow	Chir pine are the needle like trees which mostly exist above 900 m.	2,641	15.5
Paper Mulberry	It is a fast growing and highly invasive species which distresses the natural ecosystem.	1,990	11.7
Paper Mulberry - Acacia Modesta	Paper Mullberry and Acacia Modest are one of the dominating classes of the area.	4,676	27.5
Acacia Modesta - Kao - Dodoneae spp.	The community is present on the slopes.	2,584	15.2
Lantana spp.	Invasive species of shrub that generally grows best in open and unshaded situations.	1,675	9.9
Lantana spp./Dodonea spp./Grasses	Dodoneae spp., being the dry subtropical species of shrubs, is mostly present at low altitudes.	925	5.4
Grasses	Classification of grasses is dependent upon the acquisition window (season/time) of the satellite imagery. Grass cover was about 443 ha (2.6%) at the time of acquisition of image.	443	2.6
Saccharum spp. - Typha spp.	Saccharum spp and Typha spp are present in the peripheries of the Rawal Lake.	31	0.2
Buildup Area/Bare Rocks	Buildup area includes buildings, houses, roads and some barren patches of the rocks.	1,259	7.4
Water body	Rawal Lake and other feeding water channels	552	3.2
Agriculture land	Paddy and vegetables	219	1.3

(Source: JICA Survey Team)

[6] WWF (2009) Boundary Delineation of Margallah Hills National Park



(Source: WWF)

Figure 7.1.4 Landcover Map of MHNP

According to the list available in the IUCN office (Islamabad), 616 species (belonging to 465 genera and 104 families) of trees shrubs and vines are found in the park (IUCN 1991)[7]. In another study, 268 herbs (196 dicots and 72 monocots) belonging to 56 families and 199 genera have been collected and identified from MHNP (Akram 2005)[8]. IBAT (2017)[9] shows 1 Vulnerable (VU), 4 Least concern (LC), and 2 Data deficient (DD) from the total of seven species of the IUCN red list.

Table 7.1.2 IUCN red list plants recorded around the project site

Species	Common name	IUCN Red List Category
Anacyclus pyrethrum	Atlas Daisy	VU
Medicago sativa	Alfalfa	LC
Pistacia eurycarpa	Unknown	LC
Pistacia khinjuk	Unknown	LC
Prunus bifrons	Unknown	DD
Prunus jaquemontii	Flowering Almond	DD
Prunus mahaleb	Mahaleb Cherry	LC

(Source: IBAT)

[7] IUCN (1991) Management Plan: Margalla Hills National Park
[8] Akram H. (2005) Herbal Diversity of Margalla Hills National Park. M. Sc. Thesis, University of Arid Agriculture, Rawalpindi, Pakistan.
[9] IBAT for research and planning

7.1.5 Fauna

The park forests host 37 species of fish, at least 13 taxa of reptiles, 250 species of birds, 38 species of mammals, 55 species of butterflies, and numerous taxa of insects (Anwar 1986, 1989a, 1989b, 1991[10]). According to Masud (1979)[11] , the park was setup to provide refuge to the Gray Goral, Barking deer, and the Leopard. Rhesus monkeys, jackals (often heard cackling at night near the hills), wild boars, porcupines, mongoose, and the pangolin or scaly anteater exists in the area. IBAT (2017) shows 4 critically endangered (CR), 4 Endangered (EN), 12 Vulnerable (VU), and 20 Near threatened (NT) in and around the project area (See ANNEX 7.1.5-1).

Table 7.1.3 Number of IUCN red list species around MHNP

Type	Critically endangered (CR)	Endangered (EN)	Vulnerable (VU)	Near threatened (NT)	Least concern (LC)	Data deficient (DD)	Total
Mammals			2	1	55		**58**
Birds	3	4	10	16	321		**354**
Reptiles	1				6	2	**9**
Amphibians					10		**10**
Fishes				3	20		**23**
Invertebrates					35		**35**
Total	**4**	**4**	**12**	**20**	**447**	**2**	**489**

(Source: IBAT)

7.1.6 Protected area

There are 14 National parks of 12,000 ha, 54 Wildlife Sanctuaries of 19,000 ha, and 64 Game Reserves of 30,000 ha in Pakistan. Six of them are designated as Ramsar sites (See ANNEX 7.1.6-1).

[10] Anwar, M. (1991) Mammals of Margalla Hills National Park: An Annotated List of Mammals
[11] Masud, R.M. (1979). Master plan for Margallah Hills National Park, Islamabad, Pakistan. National Council for Conservation of Wildlife, Islamabad. 48 pp

Table 7.1.4 Number and areas of the Protected areas

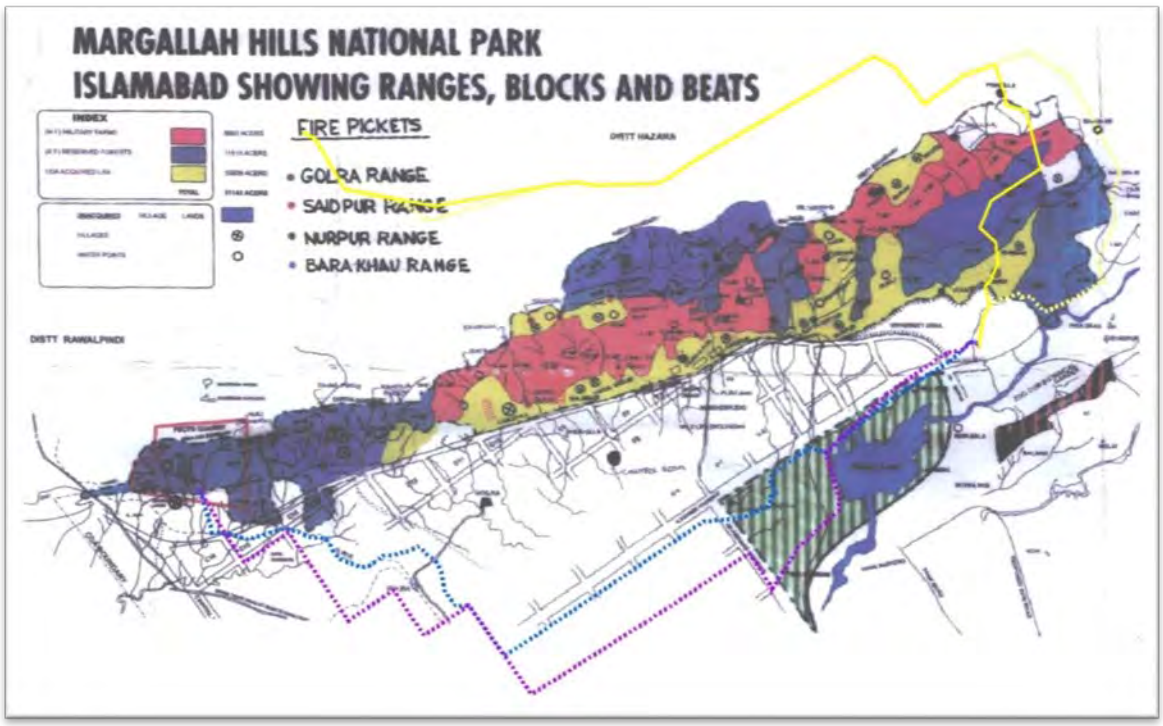
Type	Number	Area (ha)
National Park	14	11,692
Wildlife Sanctuary	54	19,175
Game Reserve	64	29,936
Nature Reserve	1	15,000
Other Area	1	9
Private Reserve	1	16
Protected Area	1	0
Sanctuary	1	7,506
Grand Total	137	83,334

MHNP, with an area of 173 km^2, was established formally in 1980. MHNP was managed by Capital Development Authority (CDA) on the basis of the Islamabad Wildlife (Protection, Preservation, Conservation and Management) Ordinance, 1979. However, the boundary had not been cleared until June 2009 by Notification of CDA. The Ordinance (1979) stipulates the purpose and prohibitions as follows.

1) With a view to protecting and preserving scenery, flora, and fauna in a natural state, the Federal Government may, by notification in the official Gazette, declare any area to be a national park.
2) The national park shall be accessible to the public for recreation, education, and research, subject to such restrictions as the Federal Government may impose.
3) Provision for access roads to the national park, and construction of rest houses, hotels, and other buildings in the national park, along with amenities for the public, may be so made, the forest therein shall be so managed and forest produce so obtained as to not impair the object for which it is declared a national park.
4) Except as otherwise provided by this Ordinance and the rules, the following acts shall be prohibited in a national park, namely:
    a. hunting, shooting, trapping, killing, or capturing of any wild animal within a radius of two kilometers of its boundaries;
    b. firing any fire-arm or doing of any other act which may disturb any wild animal or interfere with its breeding place;
    c. felling, tapping, burning, damaging, or destroying of, or taking, collecting, or removing therefrom, any plant or tree;
    d. clearing or breaking up of any land for cultivation, mining, or for any other purposes; and
    e. polluting water flowing in or through it.

Provided that the authorized officer may, for specific purposes, authorize the doing of any of any of the aforementioned acts.

According to the map provided by CDA, the park was classified as four area including Military Farms (red), Reserved forests (blue), CDA acquired land (yellow), and City park (green) (see Figure 7.1.5).

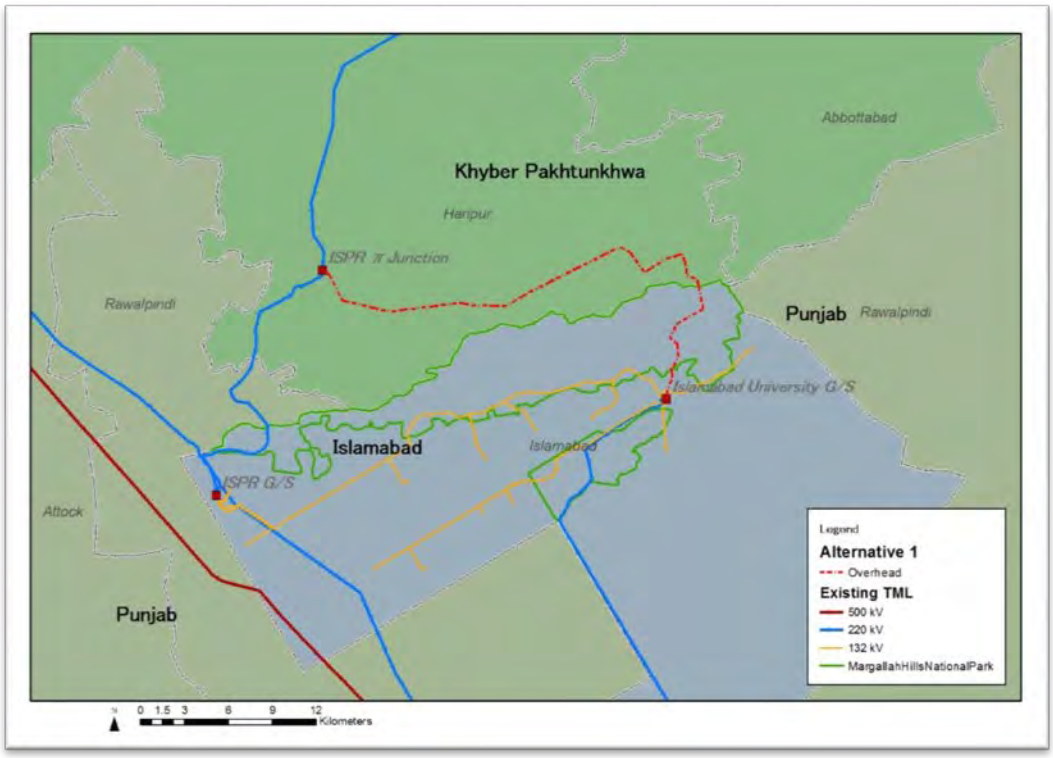


（Source: CDA）

Figure 7.1.5 Margalla Hills National Park area map

7.1.7 Administrative boundary

The proposed project is in the Haripur Division of Khyber Pakhtunkhwa Province and the Islamabad Capital Territory (See Figure 7.1.6).



（Source: JICA Survey Team）

Figure 7.1.6　Administrative boundaries around the project site

7.1.8　Population

Pakistan’s estimated population in July 2009 is around 175 million. During 1950–2008, Pakistan's urban population expanded over sevenfold, while the total population increased by over fourfold. By the end of this decade, the population is expected to be nearly 180 million. In the past, the country's population had a relatively high growth rate that has, however, been moderated by declining fertility and birth rates (Ministry of Environment, 2009)[12].

According to MDG status 2012-2013, the population in ICT is 1.15 million and in the Haripur Division of Khyber Pakhtunkhwa Province is 0.944 million. The project site is located in a relatively high-density area; the population growth rate of ICT from 2005 to 2015 is 73% and the estimated population in 2015 is 1.36 million (World Bank)

The human population in the park has been estimated as 5,749 (23 settlements) in 1991 (IUCN,

[12] Ministry of Environment (2009) LAND USE ATLAS OF PAKISTAN

1991) [13] and 92,342 (34 villages) in 2001 (HWNCS[14]). The ancestors of the present population have occupied the land of the park since the pre-British regime.

7.1.9 Zoning plan of ICT

Five zones are declared by the Islamabad Capital Territory (Zoning) Regulation, 1992. The following table and figure show the five zones.

Table 7.1.5 Five zones of ICT

Zone	Area (km^2)	Description	Legend in the map
I	222.4	City area (developed)	Pink
II	39.7	City area (future plan)	Cream
III	203.9	Margalla Hills National Park, Rawal lake and forest area	Dark green
IV	282.5	Islamabad Park and rural periphery wedged	Light green
V	157.9	South of Islamabad Park and extending	Orange

（Source: CDA）

（Source: CDA）

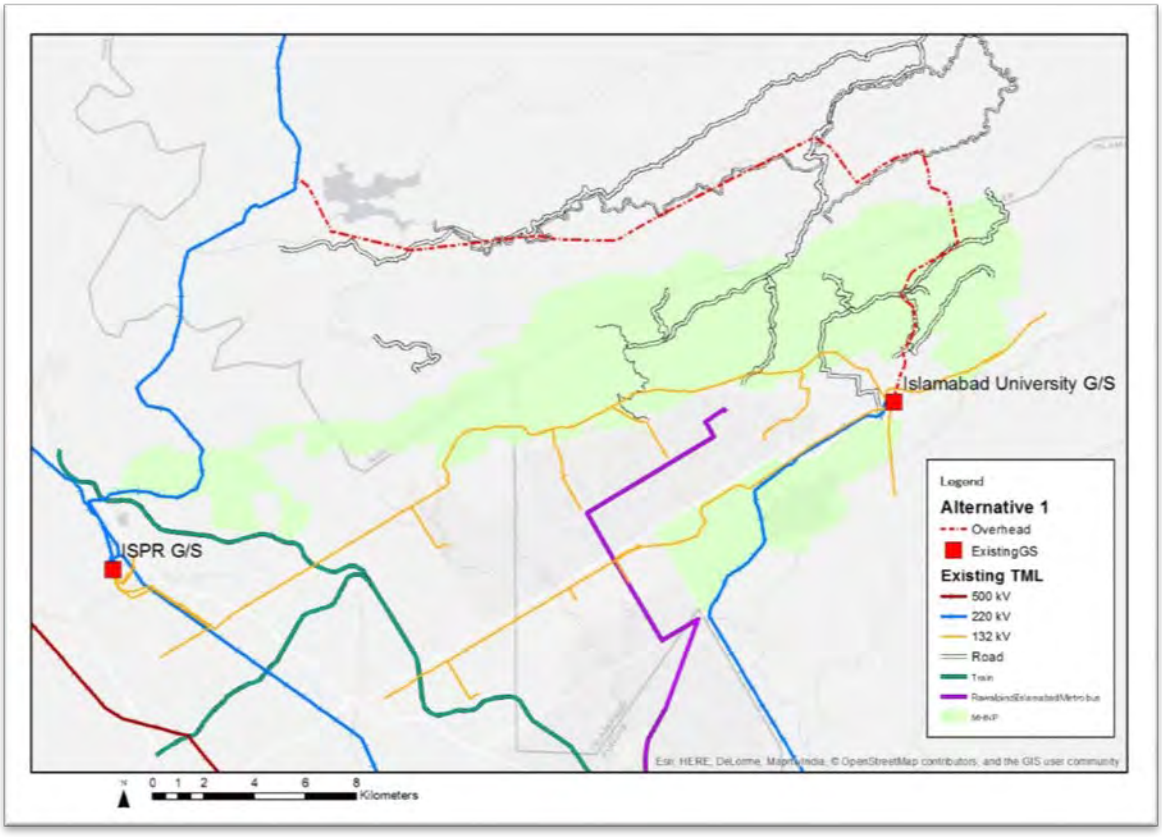
Figure 7.1.7 Zoning plan of ICT

[13] IUCN (1991) Management Plan: Margalla Hills National Park
[14] Human Welfare and Nature Conservation Society (2001) A Socio-Economic Survey of Margalla Hills National Park

7.1.10 Infrastructure

Some general roads are opened in the park and people can move by vehicles freely (See black double lines in Figure 7.1.8). National road No. 75 also passes through the MHNP at two parts. The non-electrified railways are located near the west side of the MHNP to Rawalpindi city (Green line in the map). The Rawalpindi-Islamabad Metrobus connects the two cities (Purple line in the map).

There are three Grid Stations, ISPR G/S, Islamabad University G/S, and Rawat New G/S. A 500kV transmission line is connected to Rawat New G/S. 132kV transmission lines exist in the ICT. Two parts of 220 kV T/L and four parts of 132 kV T/L pass through the MHNP. One of the 132kV T/L extends more than 1km in the southern part of the MHNP.



(Source: JICA Survey Team)

Figure 7.1.8 Infrastructure near the MHNP

7.1.11 Socio-economic conditions

The people are economically poor, but are now changing their professions for better earnings. Among the most important factors, fuel sources (fuelwood extraction and trade), dairy

products, and trade in medicinal plants are notable. Agriculture in the park pertains to the growing of a few crops such as wheat, maize, and some vegetables (turnip, tomato, onion, potato, cucumber) utilizing a blend of traditional and modern techniques, pesticides, and natural and artificial fertilizers. The livestock of the park area includes goats, cows, buffaloes, donkeys, and camels. Milk production is around more than 1000 kg per day. The cattle freely graze in the surroundings of the villages. The fodder is obtained from the forests and from cultivated areas. Rural trade includes carpentering, lumbering, and miscellaneous goods retailers. Of the villagers, 10% are employed in public or private sectors, 25% are unemployed, and 57% are self-employed (Ahmad et al. 2005) [15]. Sheesham (Dalbergia sissoo) and Chir (Pinus roxburghii) are cultivated for timber wood in the park area. The cultivated fruits of the area are Almond, Apple, Apricot, Walnut, Banana, Papeeta, Lemon, Loquat, Mulberry, Peach, Sweet Lime, and Sweet Orange.

7.1.12 Landscape

MHNP is utilized as a landscape resource. The main viewpoints to MHNP are tourism facilities in ICT, three Restaurants in MHNP, and nature trails in the MHNP.

Photo 7.1.1 Mountain view from the Zero Point in ICT

Photo 7.1.2 City view and Faisal Mosque from the view point in MHNP

[15] Ahmad, S.U., A. Akhter and I. Khan. 2005. A community based appraisal of the Anthropogenic pressures on Margalla Hills National Park. Sc. Tech. Dev. 24(1): 19-24. Pakistan Council for Science and Technology Pakistan

7.1.13 Cultural assets

There are six World Heritage sites registered to UNESCO as follows. The nearest one is Taxila west of the πconnection of the proposed project.

- Archaeological Ruins at Mohenjo-daro (1980)
- Buddhist Ruins of Takht-i-Bahi and Neighboring City Remains at Sahr-i-Bahlol (1980)
- Fort and Shalamar Gardens in Lahore (1981)
- Historical Monuments at Makli, Thatta (1981)
- Rohtas Fort (1997)
- Taxila (1980)

According to Archeology department of Pakistan, there are 17 possible historic sites in ICT. Construction is prohibited on historic sites. However, the exact locations of these sites have not been determined yet.

7.1.14 Ethnicity, religion, and language

There are main six ethnic groups in Pakistan. The Punjab and Pashutun account more than half of the total population. The major and native cast of the area is Raja, having the sub-cast Abbasi. However, Gujar from Punjab and Chaudhri from Kashmir have also migrated to the MHNP. The main language spoken in MHNP is Potohari, which is a branch of Punjabi.[16]

[16] Higher Education Commission (2007) Medicinal Plants of Margalla Hills National Park Islamabad

Chapter8 Alternative studies

8.1 Project Plan in the PC-1

The in/out of existing Mansehra-ISPR to the Islamabad University Substation has been planned in the PC-1. However, there is not an objectified route plan in the PC-1, and the length of the route is estimated to be approximately 40km in the request for a budget for this project.

As an argument for the budget request, a paper location study has been demonstrated by the PD EHV-1 Islamabad and Design Department. An overview of the transmission line route is shown below. In the route plan, the transmission line across the Margara Hill National Park is 33.5km in length.

(Source: Overview of Transmission Line Route, NTDCL)

Figure 8.1.1 Overview of Transmission Line Route

During discussions with the Design Department of NTDCL, consideration is given to the feasibility of a detour route which goes around the National Park as follows:

- Islamabad is highly populated, so it will be difficult to acquire the ROW for a detour route to the southside of the National Park; therefore, it is not realistic.
- The project objective is to enhance the reliability of the power supply to government agencies;

it may not be a problem to have the transmission line across the National Park.

Land acquisition for the route plan which goes through Islamabad will be very problematic. Therefore, preservation of the environment of the National Park and reduction of the environmental impact due to construction work shall be taken into account in the transmission line route study, which is based on the overview of the transmission line route shown in Figure 8.1.1.

8.2 Study of the Route Plan

8.2.1 Objective of the route study

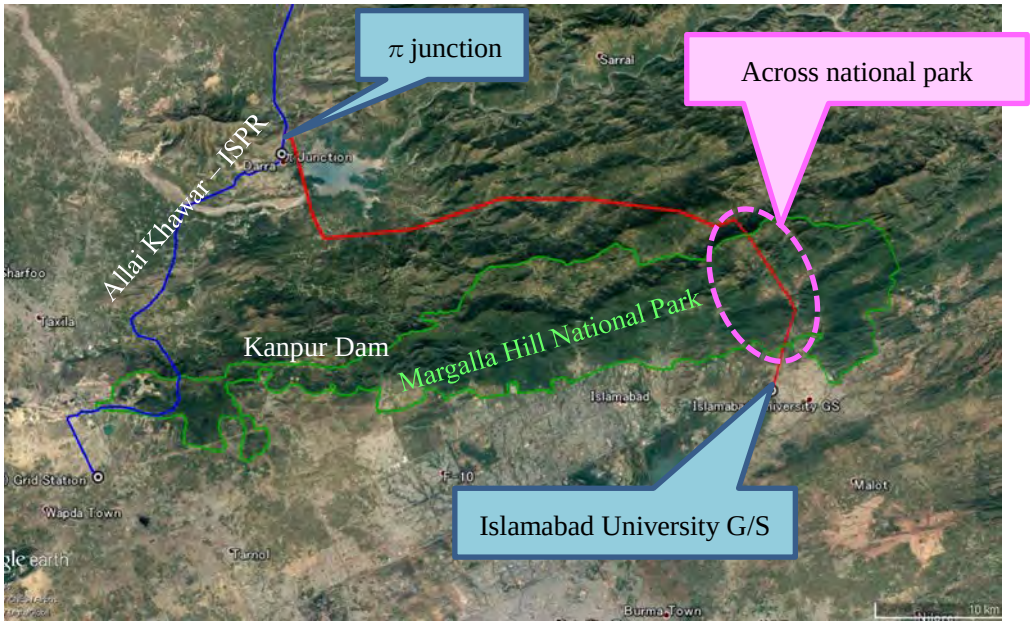
The new transmission line is planned as an in/out of Mansehra-ISPR to the Islamabad University substation. The Islamabad University substation has a key role in supplying power to government agencies along with the Islamabad Capital Territory. Currently, the Rawat substation is feeding a single source to the Islamabad University substation. Therefore, the new transmission line is subject to enhance the reliability of the Islamabad University substation through an additional source from Allai Khwar to ICT.

There are restrictions on construction because the target area occupies mainly mountainous terrain. Materials shall be transported by a land route, and helicopters are not applicable to transportation in NTDCL projects. The line route plan shall be considered accessible to transport vehicles. Moreover, part of the line route crosses the reserved forest in Margala Hills National Park, so minimization of the environmental impact due to construction work will be required. Therefore, the route of the new transmission line shall be located along the existing road in the National Park.

8.2.2 Issues of NTDCL's route plan

In the route plan by NTDCL, the new transmission line is connected in/out of Mansehra-ISPR to the Islamabad University substation used by the π-junction. The ISD Univ. substation exists east of Islamabad city and next to Quaid-Azam University, so the π-junction is planned in the vicinity of Kanpur Dam.

One of the issues of NTDCL's plan is the route across the intact forest inside of the national park, so the deforestation area is quite large and there will be a heavy environmental impact.
NTDCL's route plan is shown as follows:



（Source: JICA Survey Team）

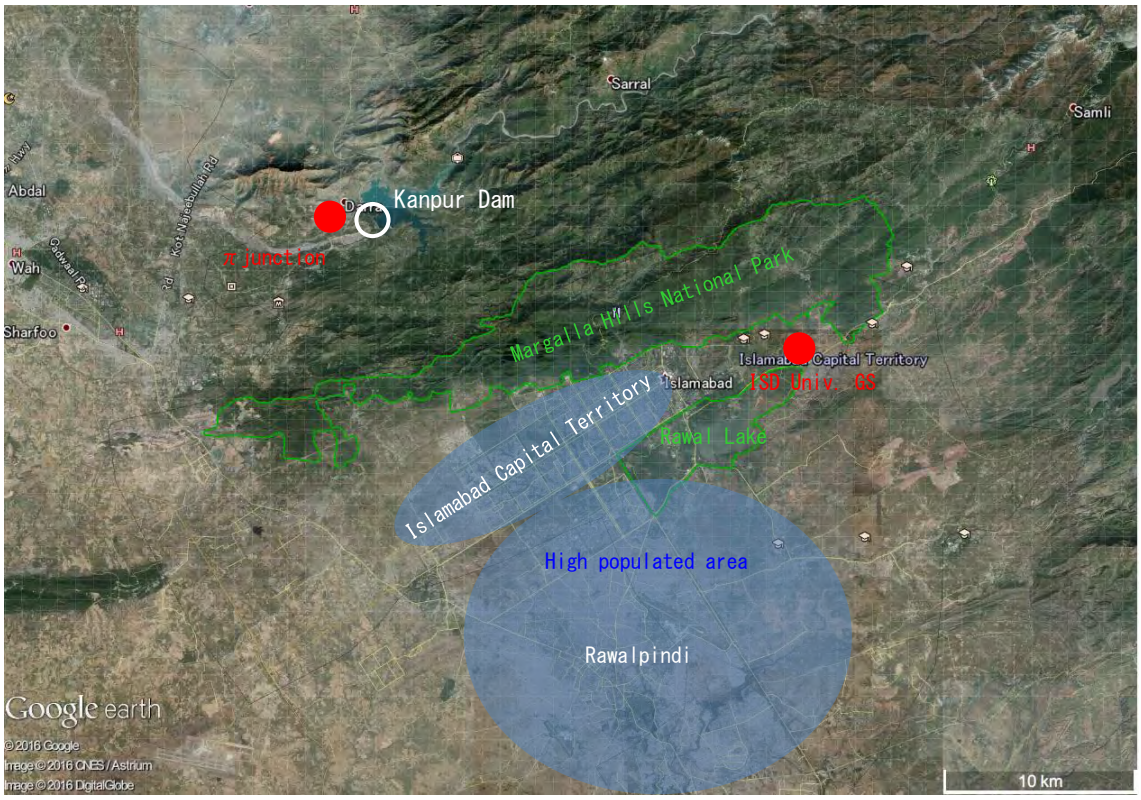
Figure 8.2.1 NTDCL's Plan

8.2.3 Issues of the alternative plan

This study proposed an alternative plan to NTDCL's plan. Issues to study in the alternative line route are as follows.

(1) Control point for study of route

- Islamabad City is a highly-populated area from the southern border of the national park to Rawalpindi, where it neighbors Islamabad. Therefore, it is difficult to acquire the Right of Way for the new transmission line.
- The National park is placed on the north side of Islamabad and mountainous terrain in the range of about 40km to the east and west, and about 10km north to south. Military reservations and reserved forests lie in the national park. Restrictions for development and reduction of environmental impact shall be taken into account for the route study.

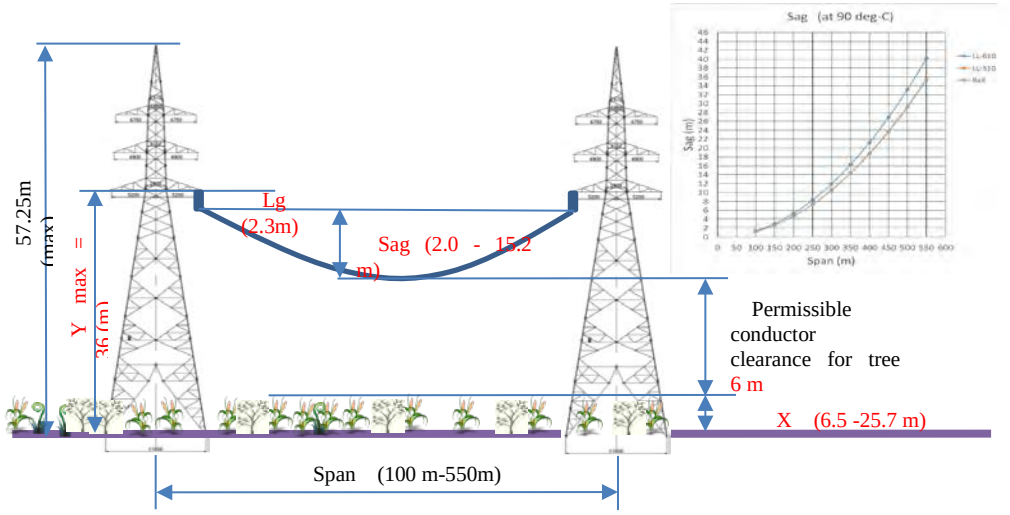


（Source: JICA Survey Team）

Figure 8.2.2 Location of origin-destination of new transmission line and control point for route study

(2) Constrained condition for land use and natural environment

The proposed design of the T/L is the overhead style, and the right of way (ROW) should be kept 15m from the center line for one side, which means a width of 30m. Buildings, houses, and high trees are not allowed in the ROW, but land ownership, cultivation, and low trees are allowed. The allowed vegetation heights are different, from 6.5m to 25.7m, depending on the tower height and tower distance.



（Source: JICA Survey Team）

Figure 8.2.3 Acceptable vegetation height and tower height

8.2.4 Comparison of the alternative plans for the new transmission line

In addition to the plan proposed in PC-1 and the route plan which was considered by the NTDCL Design Department, two alternatives were extracted and compared and examined. Outline of the route plan and outline drawings are shown in following:

NTDCL Plan : It is a new transmission line connecting to the Islamabad University Substation by the π-Junction from the existing Mansehra substation - ISPR substation line to the Islamabad University Substation

Alternative 1 : It is a plan to go around the National Park; the length of the route is the longest compared with other plans. The South area of the National Park faces a populated area, therefore a buried transmission line is proposed under the existing road, partially because it is difficult to construct an overhead transmission line.

Alternative 2 : It is a plan for a transmission line that goes along the existing road to reduce environmental impact with due respect for the NTDC Plan. It is almost the same line length compared with the NTDCL Plan. It is proposed to be an overhead transmission line.

PC-1 : It is not an objectified route plan and NTDCL is still working on it; the route is not decided.

Details of the comparison table and proposals are shown as follows.

（Source: JICA Survey Team）

Figure 8.2.4 Route Comparison

Table 8.2.1 Comparison of alternative route

		NTDCL Plan	Alternative-1	Alternative-2	PC-1
Length of route		34.37km (-5.63km)	49.35km (9.35km)	35.21km (-4.79km)	40.00km (0.00km)
Nos of Tower	Suspension	87	113	86	95
	Angle	21	49	29	26
	Total	108	162	115	121
Deforestation Area(ha)		123.7	133.1	126.2	---
Construction cost million Rs.		854.2 (0.90)	1554.1 (1.64)	1003.8 (1.06)	945.5 (1.00)

（Source: JICA Survey Team）

Alternative-2 is chosen as a proposal for the alternative although it is inferior economically to the NTDCL Plan. The transmission line passes through the vicinity of the existing road to secure accessibility during construction and to avoid disjunction of the natural forest. The deforestation area is larger than the NTDCL Plan; however, part of it crosses the National Park where rocks are outcrops and there are few trees. Therefore, actual deforestation will be less than the other alternatives and the impact on wildlife will be minimized.

NTDCL PLAN

Length		34.4 km
Nos of Tower	Suspension	87
	Angle	21
Altitude	Min	580 m
	Average	889 m
	Max	1528 m
Slope	Max	49.2 %
	Average	10.5 %

Deforestation Area

Right of Way	103.1 ha (17.1 ha)
Approach Road	3.5 ha (1.2 ha)
Total	123.7 ha (17.1 ha)

Note:
( ):inside of National Park

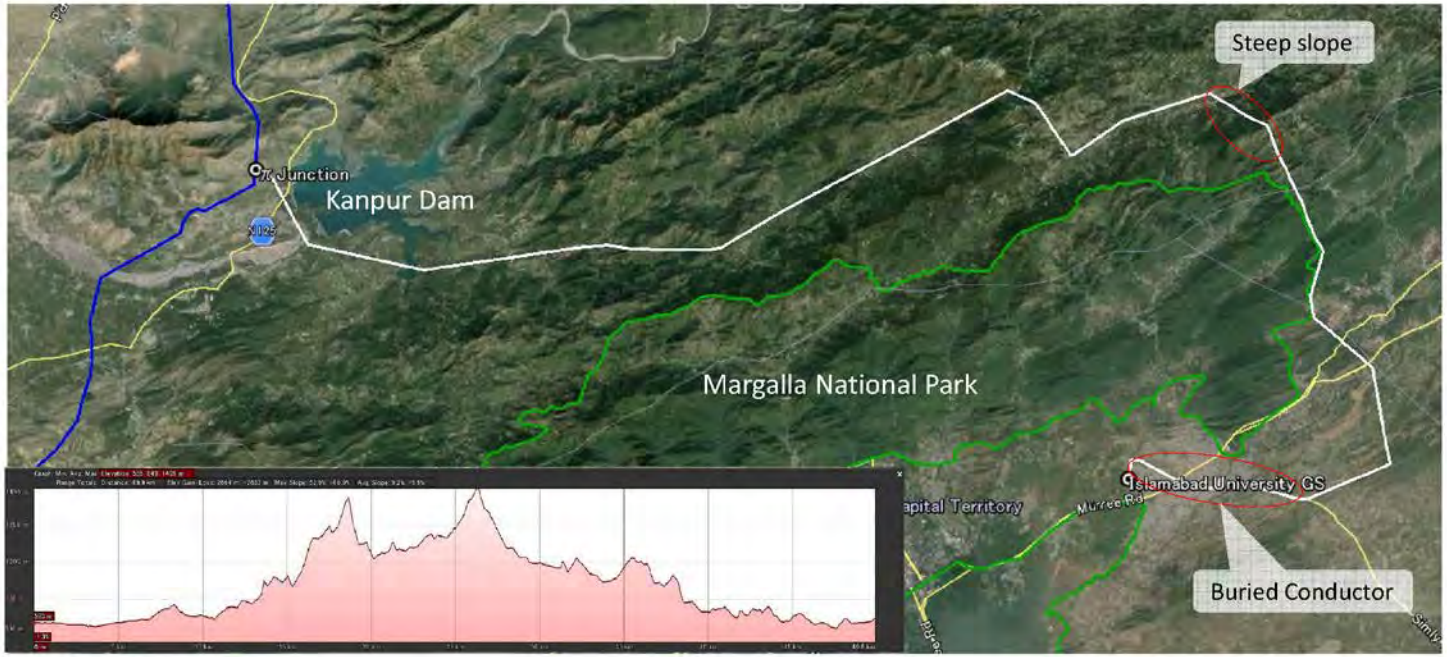
Advantage:
- Shortest distance compare with other plan
-

Disadvantage:
- Across natural forest
- Route is not along to existing road

(Source: JICA Survey Team)

Figure 8.2.5 NTDCL's Plan

Alternative-1



Alternative-1

Length		49.3 km
Nos of Tower	Suspension	113
	Angle	49
Altitude	Min	550 m
	Average	849 m
	Max	1499 m
Slope	Max	60.9 %
	Average	9.9 %

Deforestation Area

Right of Way	133.1 ha (0.0 ha)
Approach Road	4.1 ha (0.0 ha)
Total	137.2 ha (0 ha)

Note;
( ):inside of National Park

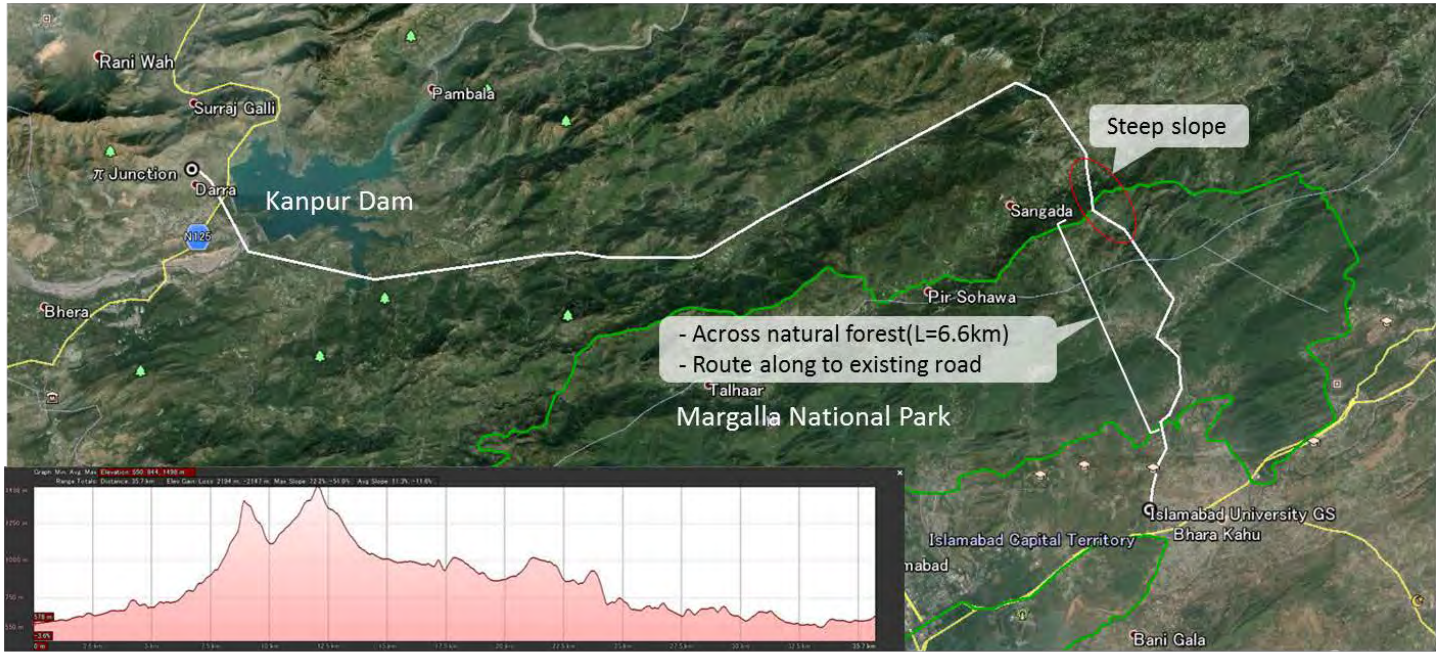
Advantage:
- Environmental impact would be minimize, cause of route go around national park

Disadvantage:
- Most long distance
- Steep slope

(Source: JICA Survey Team)

Figure 8.2.6 Alternative-1

Alternative-2



Alternative-2

Length		35.2 km
Nos of Tower	Suspension	86
	Angle	29
Altitude	Min	550 m
	Average	844 m
	Max	1498 m
Slope	Max	72.2 %
	Average	11.6 %

Deforestation Area

Right of Way	105.6 ha (17.7 ha)
Approach Road	2.9 ha (0.5 ha)
Total	126.2 ha (17.73 ha)

Note;
( ):inside of National Par

Advantage:
- Environmental impact due to construction work would be minimized cause of route along to existing road
- Ease to construct

Disadvantage:
- Across national park
- Steep slope
- Deforestation area is large

(Source: JICA Survey Team)

Figure 8.2.7 Alternative-2

8.3 Stakeholders meetings

Two stakeholder meetings were held to institute the route for the new transmission line. Alternative proposals are discussed in each round as follows.

8.3.1 First stakeholder meeting

(1) Alternatives discussed at the first stakeholder meeting

Three alternatives were examined at the 1st stakeholder meeting. Alternative 1 is the original proposed route which passes through the national park. Alternative 2 bypasses the National Park in the east and passes through the crowded housing area via underground cable. Alternative 3 bypasses the National Park to the south. The starting point is moved to the south and it passes through the ICT to the Islamabad highway by overhead lines. The lines go underground along the Islamabad highway to the Islamabad University G/S. Table 8.3.1 shows the three Alternatives.

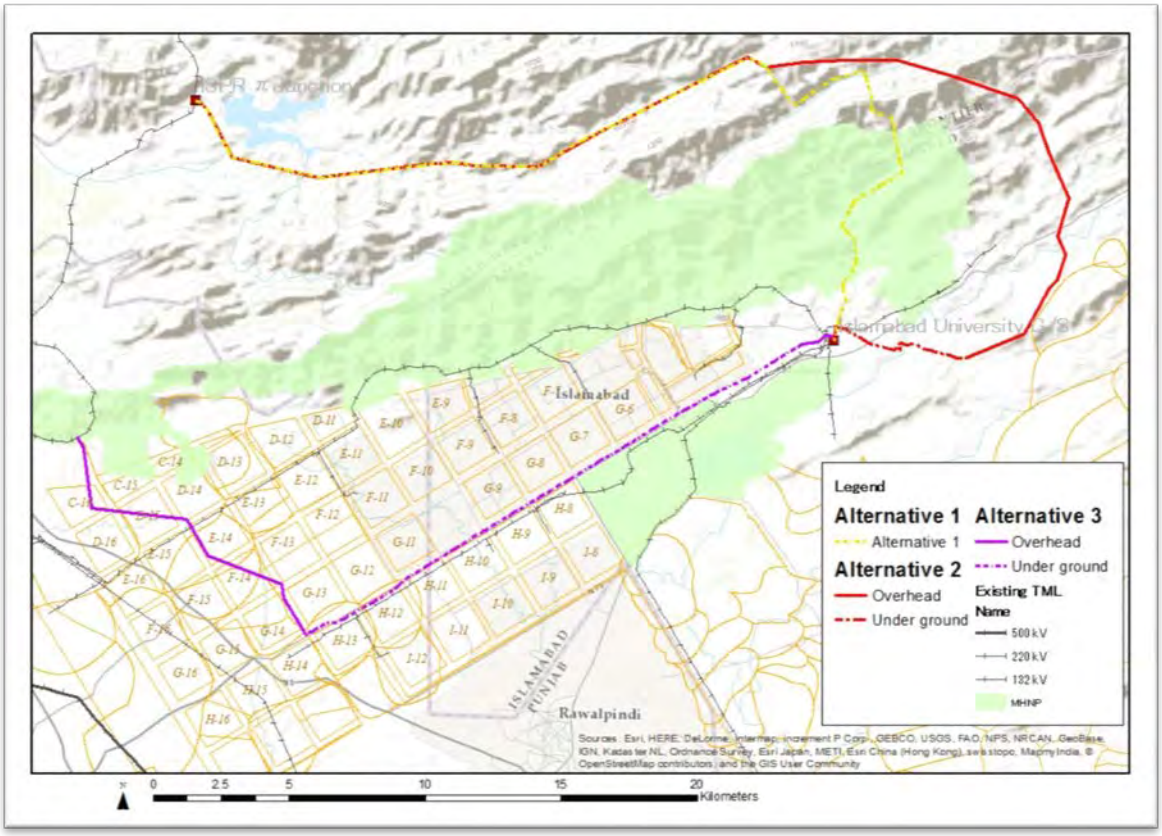
(2) Result of the 1st alternative study

The study team prepared two alternatives, the east bypass route and the south bypass route, other than NTDCL's original plan, and conducted a simple desk study based on literature and satellite images and prepared the study report (ANNEX8.3.1-1). The first SHM was held on 4th August 2016 at Islamabad based on the study report. Most of the participants supported Alternative 3 (the south bypass route), but NTDCL did not agree with Alternative 3. The record of the meeting was attached in ANNEX8.3.1-2 and ANNEX8.3.1-3

Table 8.3.1 Results of the first alternative study

Item	Alternative 1	Alternative 2	Alternative 3
Length	41 km	51 km	35 km
Forest area in ROW	84.71 ha	103.03 ha	10.59 ha
Length in the National Park	7.2 km	-	-
Houses/Buildings	133	32 (Underground 349)	24 (Underground 0)
Farm land	20.04 ha	17.21 ha	19.20 ha
Cost	1,637 mill. Rs	4,575 mill. Rs	11,413 mill. Rs
NTDCL's experience	Yes	No	No
Pros	Cheapest Technically easy	No impact on MHNP	No impact on MHNP No impact on the forest of KPK
Cons	Passing through MHNP	Expensive Technically unacceptable	Expensive Technically unacceptable

（Source: JICA Survey Team）



（Source: JICA Survey Team）

Figure 8.3.1 Three alternatives discussed at the first Stakeholder Meeting

8.3.2 Second stakeholder meeting

(1) Alternatives discussed at the second SHM

At the second SHM, the original route (Alternative 1a) and six other alternatives, including joint spanning with the existing 132 kV, were examined (See Table 8.3.2).

(2) Result of the second alternative study

After the first SHM, the study team and NTDCL prepared six new alternatives and studied the original design. Based on the study results of the seven alternatives, the second SHM was held on 17th October 2016. All the participants supported Alternative 3e and agreed to select it. Alternative 3e is based on Alternative 3, which was selected as the proposal in the first SHM. In this proposal, the transmission line is changed from a buried line to an overhead line which joins with the existing 132kV transmission line. Table 8.3.3 shows the study results and Table 8.3.4 shows the preferences of the participants for each alternative.

Table 8.3.2 Results of the second alternative study

Item		**Alt. 1**	**Alt. 1a**	**Alt.3b**	**Alt. 3c**	**Alt.3d**	**New**	**Alt.3e**
Length		41 km	46 km	37 km	42 km	41 km	31 km	24 km
High tower		38 km	43.6 km	6.6 km	7.4 km	6.6 km	0 km	0 km
Joint Spanning		0 km	0 km	22 km	0 km	6.6 km	0 km	11 km
Affected forest and bush*		3.5 ha	5.0 ha	0.0 ha	1.3 ha	0.0 ha	0.5 ha	0.0 ha
Length in the National Park		7.2 km	4.3 km	6.6 km	7.4 km	6.6 km	0.0km	0.0km
Potential impact on flora and fauna*		Δ	x	○	○	○	○	○
Houses/Buildings		133	38	58	80	96	0	58
Agriculture fields*		Δ	○	Δ	Δ	Δ	Δ	Δ
Construction cost (mil Rs.)	Monopole 10%	2,351	2,642	5,165	3,498	4,205	1,270	1,926◊
	Monopole 20%	2,351	2,642	7,611	5,155	6,196	1,270	3,615◊
	Monopole 30%	2,351	2,642	10,057	6,812	8,188	1,270	4,459◊
Main issues		NP	Forest	IESCO	NP	Cost IESCO	Mosque, Army	IESCO

* 576 m2 for one tower **Preferences: ○ (Better) Δ (Good) x (Fair) ◊Not included G/S cost

（Source: JICA Survey Team）

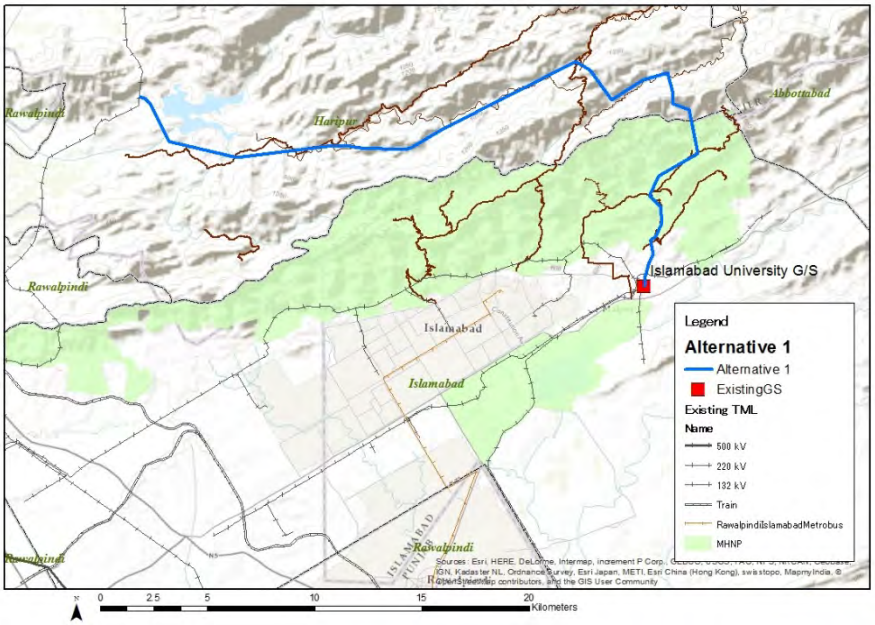
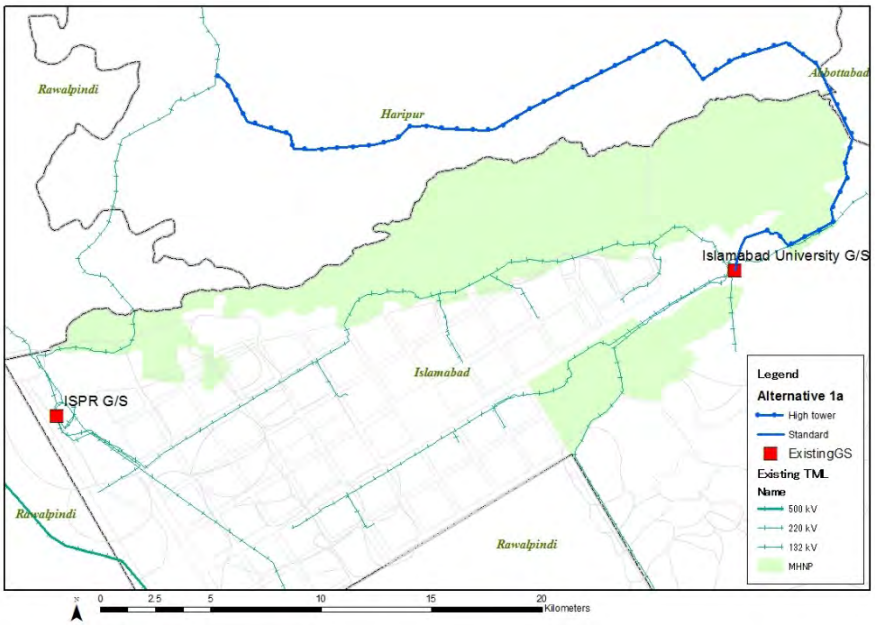
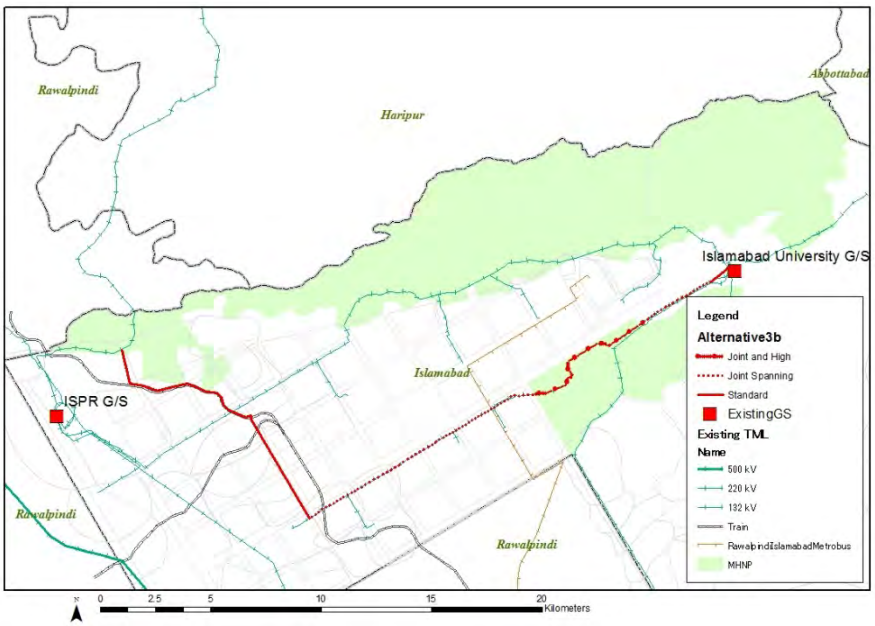
Table 8.3.3 Opinions of the participants of the second SHM

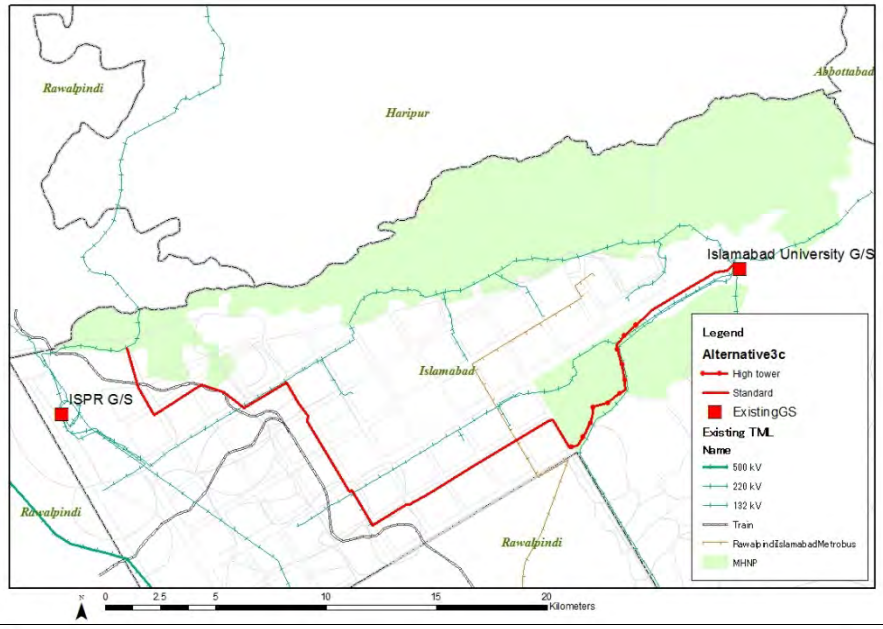
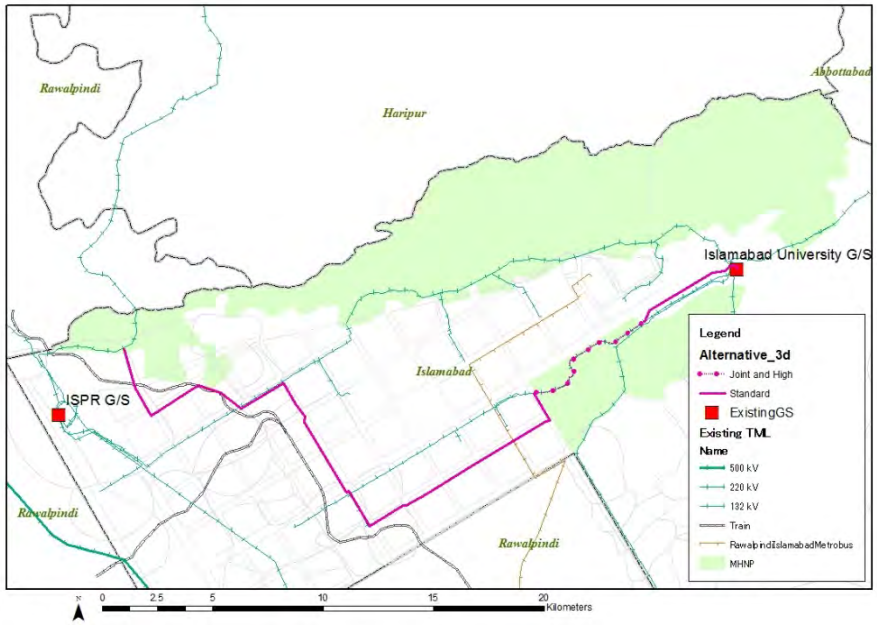
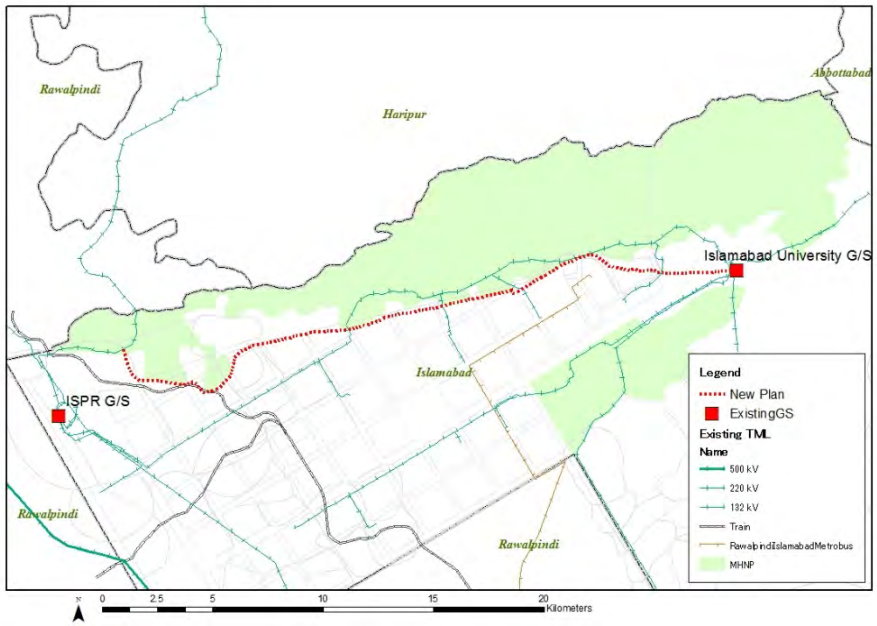
	1	1a	3b	3c	3d	new	3e
NTDCL	****	**	**	**	**	**	*****
IESCO	-	-	-	-	-	-	*****
CDA	*	*	***	*	***	*	***
Pak-EPA	*	*	*	*	*	****	*****
Punjab-EPA	*	*	***	*	***	*	*****
Punjab Forest Department	*	*	***	*	***	**	***
KPK Wildlife	*	*	-	**	-	-	*****
Quaid-e-Azam University	*	*	*	*	*	*	*****

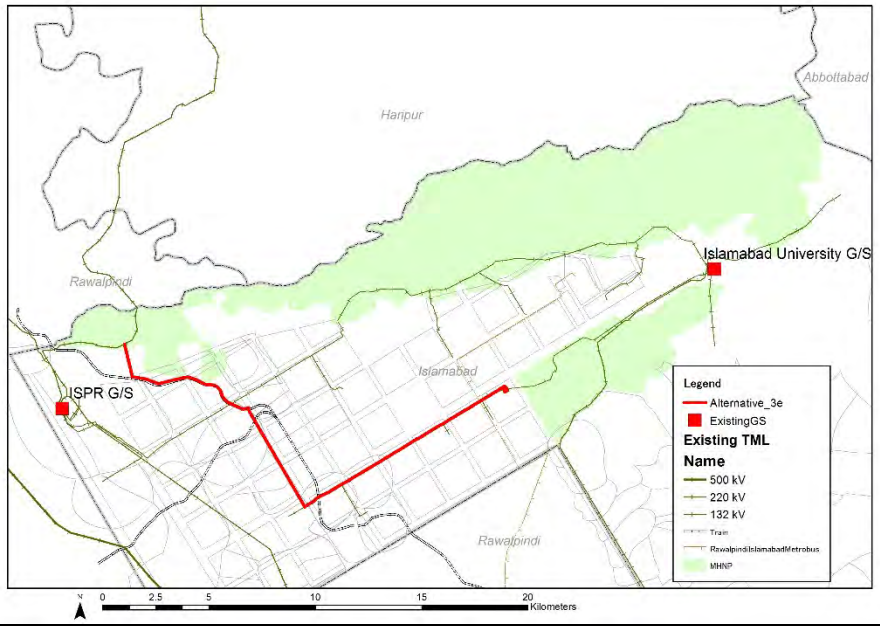
*****	Most prefer
****	Prefer
***	Acceptable
**	Not recommended
*	Unacceptable
-	No opinion

（Source: JICA Survey Team）

Table 8.3.4 Seven alternatives discussed at the second Stakeholder Meeting

	Alternative 1 (North route, along road) **Route**: Starting point is T-off from the existing Mansehra- ISPR 220 kV line, passing through planned MHNP area in KPK, passing through the MHNP along the road, and connected to the Islamabad University G/S
	Alternative 1a (North route, near boundary) **Route**: Starting point is T-off from the existing Mansehra- ISPR 220 kV line, passing through planned MHNP area in KPK, passing along the boundary of the MHNP, and connected to the Islamabad University G/S
	Alternative 3b (Long joint spanning along Kashmir Highway) **Route**: Starting point is T-off from the existing Mansehra- ISPR 220 kV line, going along the railway, following planned road area of CDA's master plan, joint spanning with existing 132 kV to the Islamabad University G/S. High tower is used in the MHNP to avoid vegetation clearance.

	Alternative 3c (South route, No joint spanning) **Route**: Starting point is T-off from the existing Mansehra- ISPR 220 kV line. It goes along planned road area of CDA's master plan, passing through the MHNP along with existing 220 kV to the Islamabad University G/S. High tower is used in the MHNP to avoid vegetation clearance.
	Alternative 3d (South route, Joint spanning only in the park) **Route**: Starting point is T-off from the existing Mansehra- ISPR 220 kV line. It goes along planned road area of CDA's master plan, passing through the MHNP joint spanning with existing 132 kV to the Islamabad University G/S. High tower is used in the MHNP to avoid vegetation clearance.
	Alternative new (Along the Margala road and Park boundary) **Route**: Starting point is T-off from the existing Mansehra- ISPR 220 kV line. It follows the road area of the CDA's master plan avoiding the Park area and connects to the Islamabad University G/S.



Alternative 3e (Joint spanning along Kashmir Highway and terminate at Zero-Point G/S)

Route: Starting point is T-off from the existing Mansehra- ISPR 220 kV line. It follows the road area of the CDA's master plan and joint spanning with existing 132 kV along the Kashmir Highway. It will be terminated at the existing Zero-point grid station. GIS transformer will be installed in the Zero-point grid station.

Chapter9 Outline, Agenda, and Recommendation for the New Selected Plan

9.1 Outline of the Favorite Proposal

9.1.1 Project Objective and Anticipated Efficacy

In the stakeholder meeting, Alternative-3e was selected as the best compared with other alternative plans. NTDCL has studied Alternative-3e to commercialize and prepare the Proforma PC-I (New PC-I[17]). The outline of the selected plan mentioned in the new PC-I, agenda, and recommendation for execution are summarized in this chapter.

9.1.2 Project Objective and Anticipated Efficacy

The objectives of this project are to relieve the load on IESCO's grid and reduce the load of the existing 220kV/132kV grid system in the vicinity of Islamabad through the Zero Point substation upgrade of 132kV to 220kVand the new 220kV transmission line to the Zero Point substation. Efficacy of this project is shown as follows:

- Enhancement of power supply to the Zero Point Substation and its surroundings
- Improvement of the voltage profile of the 132kV substation in the vicinity of the Zero Point substation
- Enhancement of the power supply corresponding to load increments on IESCO's grid system in the future
- Reduction of power transmission loss
- Provide relief of electrical substation equipment at the Islamabad University Substation, ISPR Substation, and Burhan Substation

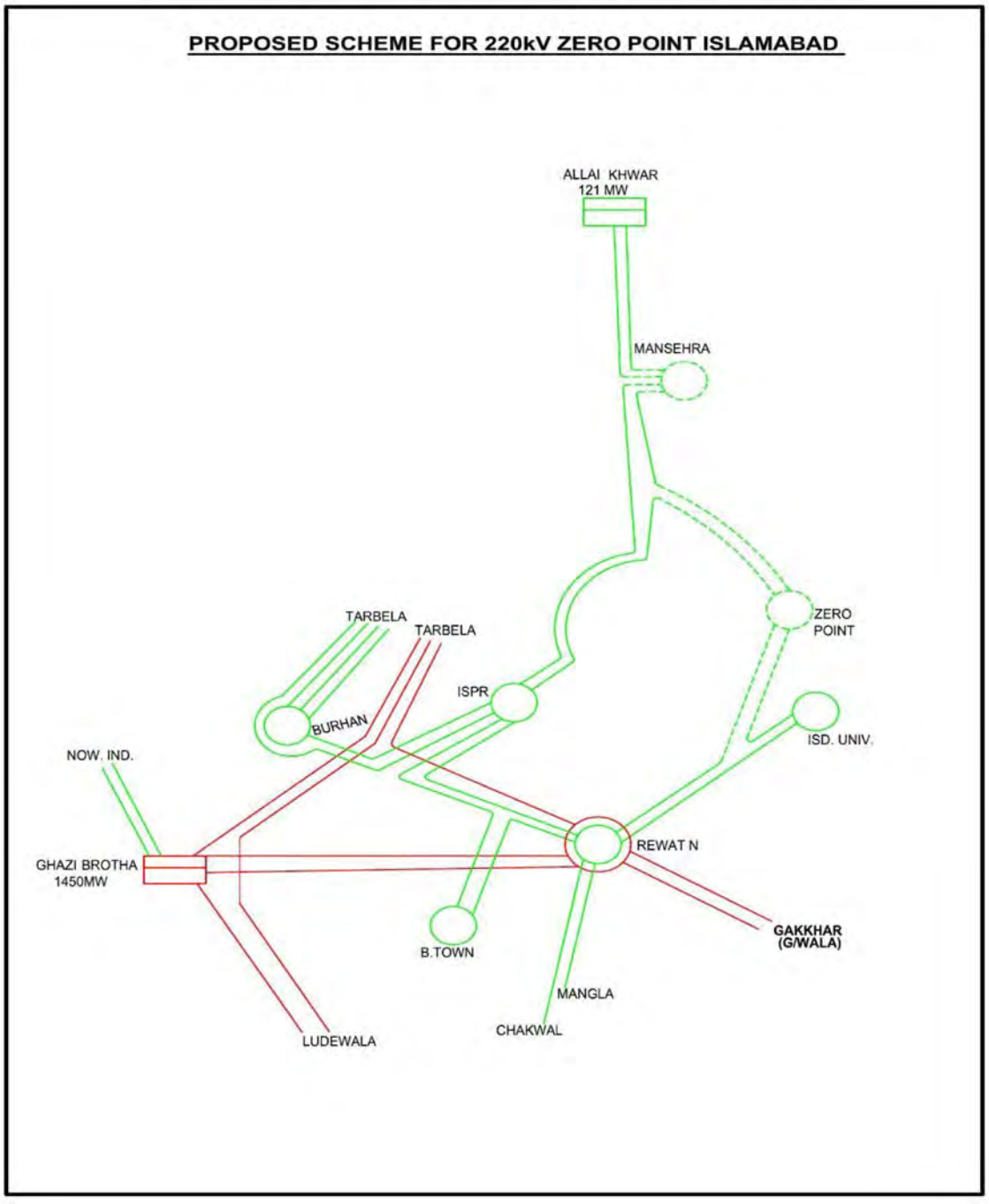
9.1.3 Project Scope

The project scope is mentioned in the new PC-1 as follows.
The outline diagram of the project is shown in Figure 9.1.1.

- The 220kV electrical substation equipment expands at the existing 132kV Zero Point substation
- The In/Out of the existing Mansehra-ISPR to Zero Point Substation (double circuit of twin-bundled Rail, 40km long)

[17] Proforma PC-I 220kV Zero Point Grid Station at Islamabad, January 2017, Planning Power NTDC (ANNEX4.1.2-1)

- The In/Out of the existing 220kV Rawat-Islamabad University to Zero Point (double circuit of twin-bundled Rail, 20km long)



（Source：Proforma PC-I 220kV Zero Point Grid Station at Islamabad, January 2017, Planning Power NTDC）

Figure 9.1.1 Outline Diagram of Zero Point Substation Enhancement

9.1.4 Estimated Project Cost (Confidential)

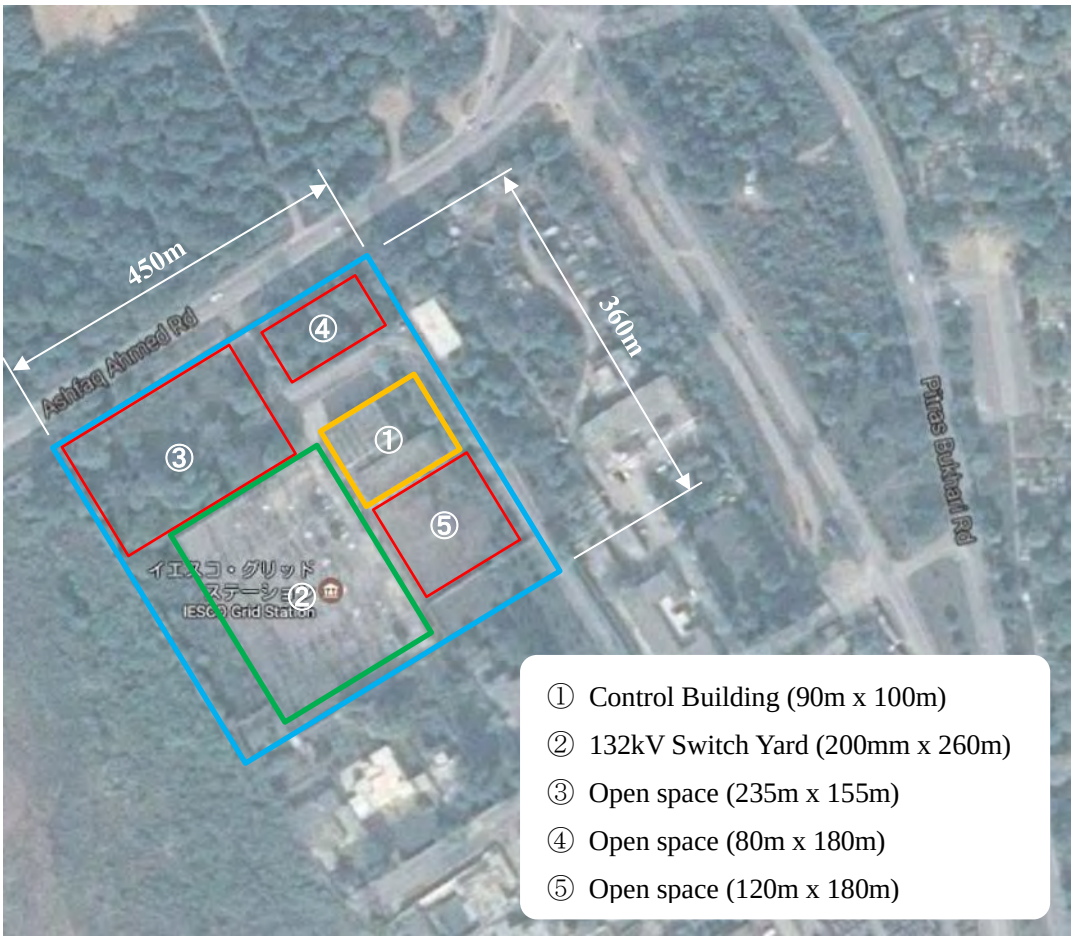
9.1.5 Report of on-site inspection

An on-site inspection was performed for the plan selected during the stakeholder meeting discussions.

(1) Zero Point Substation

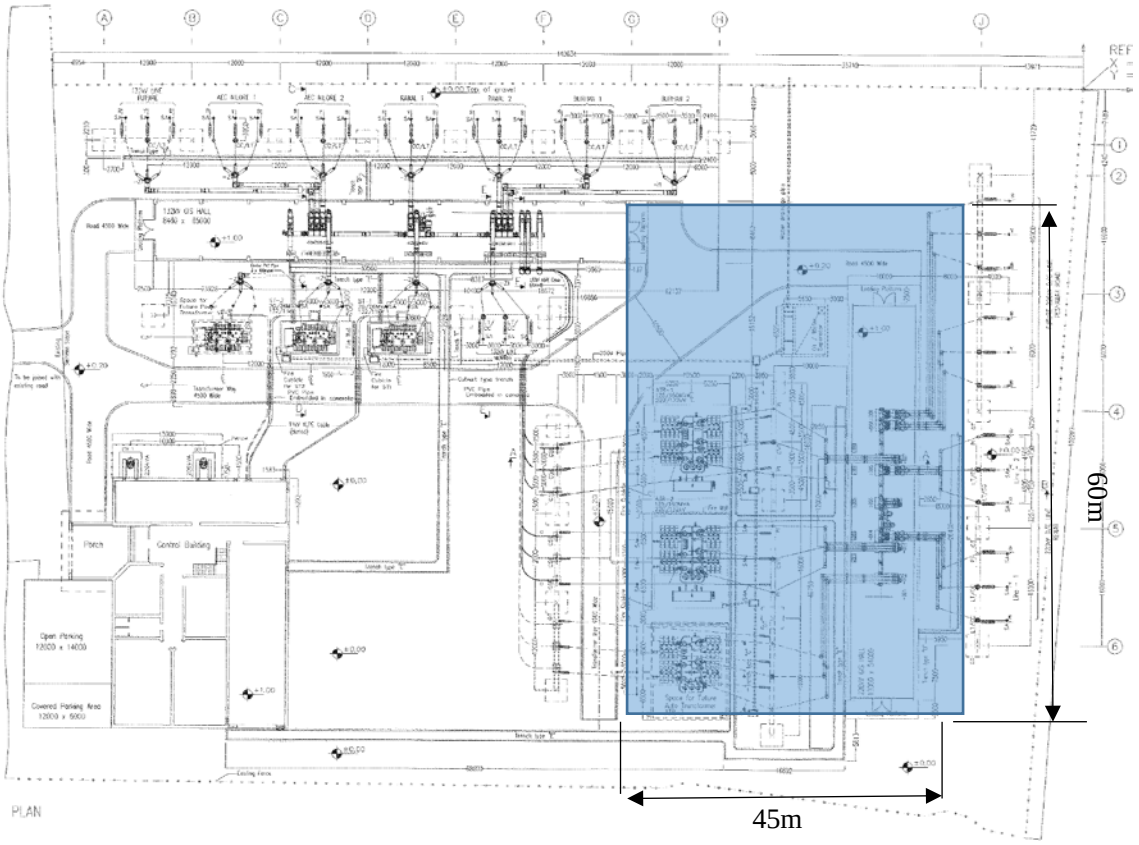
The existing Zero Point Substation is under IESCO control. Substation equipment is 132kV AIS (Air Insulated Switchgear). The report of the on-site inspection is shown as follows.

The overall substation yard is 16.2ha (360m x 450m) as shown in following figure. There is utilizable space numbered ③ to ⑤. However, in the case of the AIS apply to the 220kV substation equipment, the required area is quadruple of the 132kV switch yard. Therefore, in the case of no extension of premises, GIS shall be applied for the 220kV switch yard. For the arrangement of equipment, the existing 220kV Islamabad University substation has the same scale of equipment as the extension of the Zero Point substation, and the dimension of the building for GIS and the transformer fit into an area of 60m x 45m at the Islamabad University substation. Therefore, substation equipment is fit into the space numbered as ③.



（Source: JICA Survey Team）

Table 9.1.1 Plan View of Zero Point Substation



（Source: JICA Survey Team）

Figure 9.1.1 220kV GIS Equipment (Islamabad University Substation)

① Control building

② Existing 132kV switch yard

② Service corridor on side of 132kV switch yard

③ Open Space

④ Open Space

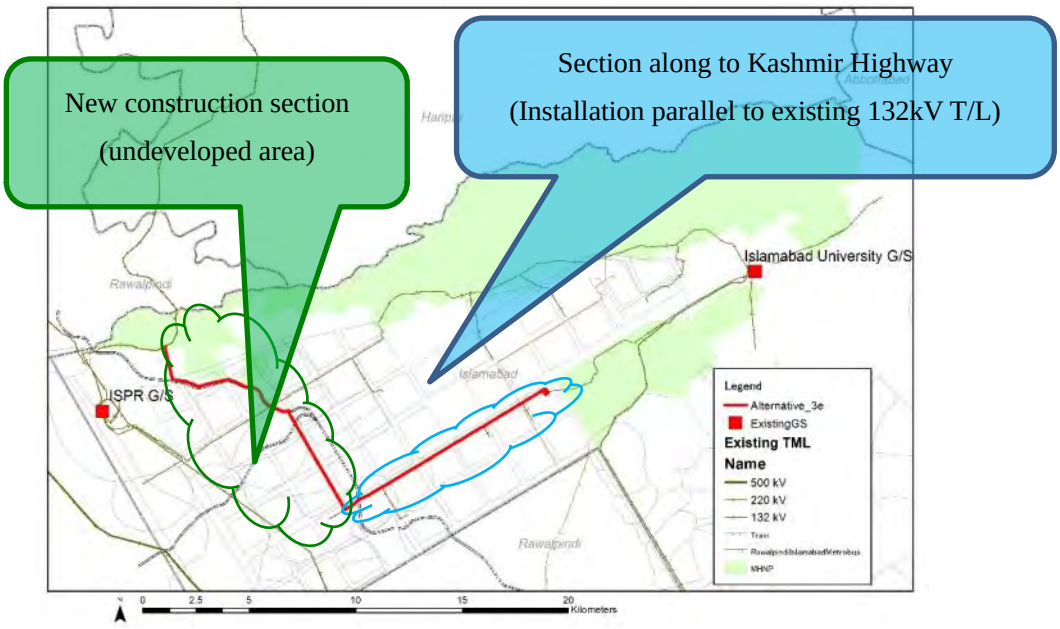
⑤ Open Space

Picture 9.1.1 Site Photograph (Zero Point Substation)

(2) In/Out of the Existing Mansehra-ISPR to Zero Point Substation

In NTDCL's plan, the transmission line has been placed on the green belt along the existing road, and part of the 132kV transmission line will be reconstructed as a 4-circuit tower which consists of 132kV and 220kV. The transmission line route through has been planned along with urban planning; however, part of the line route is not under the process of urban development, where the πjunction of the existing Mansehra-ISPR transmission line to the existing 132kV transmission line is parallel to the Kashmir Highway. Therefore, the situation of the planned line route was not checked during the on-site inspection.

For the section along the Kashmir Highway, in principle, the transmission line exists inside of the green belt of the road. However, in part of this section, towers were placed on the service road of Kashmir Highway. Therefore, in this section, there will be a shift from the existing 132kV transmission line to outside of the road. Moreover, the intersections of Kashmir Highway and the principal road which extends north and south are mostly in the path and interchange. Therefore, there are possibly restrictions on places where towers can be installed, so a detailed site survey will be required prior to implementation of this project. Moreover, discussion with Capital Development Authority shall be required at route selection. The transmission line route also crosses a military facility, so it will be necessary to negotiate with the army.



（Source: JICA Survey Team）

Figure 9.1.2 Transmission Line Route of Alternative-3e

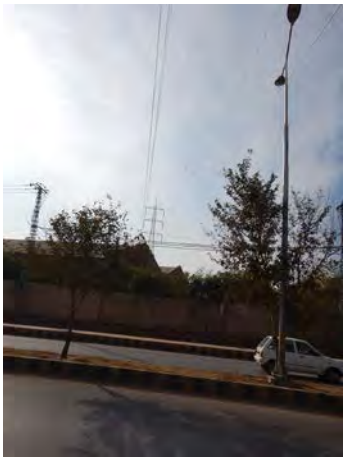
	
Existing transmission tower on the service road of Kashmir Highway	Existing transmission tower (mono pole) on the service road in front of Sunday market
	
View from Kashmir Highway existing 132kV transmission line	End tower view from switch yard of Zero Point substation
	
Existing transmission tower at educational facilities in vicinity of Zero Point Substation	Transmission line crossing military facilities

Photo 9.1.1 Arterial location on transmission line route

9.2 Conclusion

9.2.1 Issues and Recommendations

The initial objective is to target improved reliability of the power supply to the Islamabad Capital Territory through an additional power supply link to the 220kV Islamabad University Substation, which is currently being fed from a single source from the 500kV Rawat Substation. The new scope suggested at the stakeholder meetings is not suitable for the initial objective.

Moreover, the thinking of ways for a grid system expansion plan is different between the current plan and the existing plan of NTDCL and IESCO. The applicability of the new scope shall be validated as the view point of the grid system plan. NTDCL shall review the grid system plan prior to implementation of the project depending on the new scope. The availability of project implementation shall be evaluated after completing a review of the grid system plan. Moreover, the review of the grid system plan will take a long time depending on load flow analysis and consideration. Therefore in this project, this report points out problems of the new scope.

9.2.2 Issues and Recommendations on Power System Analysis

The future load flow situation of the transmission lines in the project target area will change according to changes in the proposed project scope, namely, upgrading of the existing 132kV Zero Point substation to a 220kV one and development of new 220 kV transmission lines to be connected to the substation. Therefore, it is necessary to review the existing 5-year expansion plan and the grid development plan of the system for supplying power to the Islamabad area considering the changes; in other words:

(1) No load flow analysis results are shown in the new PC-1, and it is unknown what kind of concrete examinations were done to show the validity of the project. It is necessary to confirm the effects (overloading of transmission lines and transformers, voltage anomaly, etc.) on the 220 kV and 132 kV systems under N-1 contingency condition and how the system reliability will be improved after the project.

(2) There is no information on the location of the junction point of the 220kV new transmission line branching off from the 220kV 2cct Rawat-Islamabad University transmission line (20km) to be connected to the Zero Point substation or the route of the branch transmission line. It is necessary to specify the length of each transmission section for the power system analysis.

(3) There is no information on the location of the junction point of the 220kV new transmission line branching off from the existing 220kV 2cct Mansehra-ISPR

transmission line (40km) to be connected to the Zero Point substation or the route of the branch transmission line. It is necessary to specify the length of each transmission section for the power system analysis.

(4) As upgrading and utilization of the Zero Point substation has become the new project scope, the related power system plan has also been drastically modified. From the viewpoint of power system planning, it is necessary to carry out a power system analysis in order to confirm the validity of the project scope.

9.2.3 Issues of the Transmission Line

(1) Since the route of Mansehra-ISPR to Zero Point Substation was proposed just before the day of the SHM, this route has not been examined in any detail. The conditions of new proposal are not mentioned in the PC-1, i.e. the constraint on construction in respect to level crossing with railways and roads, places where it is expected be difficult for land acquisition, etc. Therefore, it is required to study the feasibility thorough the survey along the proposed route in detail.

(2) The existing 132kV transmission line crosses the interchange of Islamabad Highway and Kashmir Highway. It will be required that construction work happens during the night when there is less traffic. It is also required to study the detour and traffic regulations during construction work. In addition to the existing tower which is placed on the ROW of the road, traffic regulations during dismantling and reconstruction work are required, and countermeasures for workers' safety and third-party damage are also required. It is recommended that the towers which are placed on the road be reconstructed outside of the road.

(3) On the proposed route, there are some important government agency facilities, so it is necessary to reach a consensus with concerned agencies. In case of accident incidents, i.e. a breakdown due to breakage of a conductor and insulator damage, etc., it will be difficult to respond to an emergency from the viewpoint of maintenance. Therefore, it is recommended to study detour routes for such areas.

(4) Part of the section of the transmission line from Islamabad University Substation to the Rawat Substation goes through the National Park. It will be required to conduct mutual consultations with CDA, EPA, and other concerned agencies.

9.2.4 Issues of the Substation

The scope of the substation construction was changed from extension of transmission line bay at Islamabad university substation to modification of the Zero point substation including voltage grade up. Therefore, securing of land for the substation and the design of the substation are to be

considered sufficiently, as concretely shown below.

(1) The layout of equipment and the connection diagram (single line diagram) of the main circuit of the substation are not provided in new PC-1. Therefore, it is necessary to study them at time of the detail design of this substation.

(2) Based on the system analysis, the specification of the equipment (rated capacity, short-circuit capacity etc.,) and the connection of the main circuit of the substation, etc., are to be reviewed.

(3) The space at the Zero point substation for 4 transmission line bays and 3 transformers is secured. However, for the new PC-1 220 kV Zero point substation, the construction cost is estimated not only for 220 kV GIS but also for 132 kV GIS, although existing 132 kV facilities are AIS (Air Insulated Switch Gear) and existing 132 kV facilities are not necessary to be changed to GIS. The space of the expansion of 132 kV facilities for AIS is secured at the Zero point substation.

9.2.5 Issues of Environmental and Social Considerations

(1) Power transmission route

Alternative 3e was selected after the two SHMs. But the detail design and route was not decided in 2016. NTDCL has to conduct detail design after topographical survey, geological survey, land use survey and housing survey under the discussion with CDA and IESCO. Some of the anxious issues are shown as follows.

- There are many houses and not acquired land at roads and utility areas planned by CDA. It should be decided whether the route will follow the CDA's city plan or just avoid the houses. If the route follow the city plan, it should be decided who will be responsible for the compensation to the resettlement, CDA or NTDCL.
- The part which is planned as joint spanning with 132 kV might have some issues such as towers in the middle of the road or houses under the ROW. These issues should be cleared by moving locations of the towers, using monopole towers, or resettlement, under the discussion with CDA and IESCO.
- There is possibility that the areas for new GIS grid station has not enough space. If it is not enough, moving the existing buildings must be considered.
- The T/L has to cross the railway and Islamabad highway. The locations and methods should be carefully selected.
- The location of military area is not clear. It might control the route of the T/L, so that it should be clarified.

(2) Project Category

Regarding the impact of the environment, this plan is based on the policy that does not go through Margalla Hills National Park. On the other hand, resettlement is considered to be inevitable. There is the possibility of that it is evaluated as category A in JICA guideline. (Over 200 resettlements)

(3) Environmental Impact

Though “Environmental Effect of the Project” is written in the section of 11.3 in the new PC-1, the contents are mentioned only typical topics. The contents is almost same as the former PC-1 written in the section of “220kV Transmission System Network Reinforcement in Islamabad and Burhan Area”. There is no described contents regarding the inpact of this project. It cannot be read from the new PC-1.

ANNEX

ANNEX3.1.2-1 Characteristics of Conductor (Confidential)

ANNEX 7.1.5-1 IUCN red list species recorded around the project site

ANNEX 7.1.6-1 Protected area and IUCN category

ANNEX 8.3.1-1 Alternative study report (Confidential)

ANNEX 8.3.1-2 Record of the first SHM (Confidential)

ANNEX 8.3.1-3 Record of the second SHM (Confidential)

ANNEX 9.1.2-1 Proforma PC-I 220kV Zero Point Grid Station at Islamabad, January 2017, Planning Power NTDC (Confidential)

ANNEX 7.1.5-1 IUCN red list species recorded around the project site

Taxonomic group	Species	Common name	IUCN Red List Category
Mammals	*Apodemus rusiges*	Kashmir Field Mouse	LC
Mammals	*Bandicota bengalensis*	Lesser Bandicoot Rat	LC
Mammals	*Barbastella leucomelas*	Eastern Barbastelle	LC
Mammals	*Canis aureus*	Golden Jackal	LC
Mammals	*Caracal caracal*	Caracal	LC
Mammals	*Eoglaucomys fimbriatus*	Small Kashmir Flying Squirrel	LC
Mammals	*Eptesicus bottae*	Botta's Serotine	LC
Mammals	*Eptesicus gobiensis*	Gobi Big Brown Bat	LC
Mammals	*Eptesicus serotinus*	Serotine	LC
Mammals	*Felis chaus*	Jungle Cat	LC
Mammals	*Funambulus pennantii*	Five-striped Palm Squirrel	LC
Mammals	*Golunda ellioti*	Indian Bush-rat	LC
Mammals	*Herpestes auropunctatus*	Small Indian Mongoose	LC
Mammals	*Herpestes edwardsii*	Indian Grey Mongoose	LC
Mammals	*Hipposideros fulvus*	Fulvus Leaf-nosed Bat	LC
Mammals	*Hyaena hyaena*	Striped Hyaena	NT
Mammals	*Hyperacrius wynnei*	Murree Vole	LC
Mammals	*Hypsugo savii*	Savi's Pipistrelle	LC
Mammals	*Hystrix indica*	Indian Crested Porcupine	LC
Mammals	*Lepus capensis*	Cape Hare	LC
Mammals	*Lepus nigricollis*	Indian Hare	LC
Mammals	*Macaca mulatta*	Rhesus Monkey	LC
Mammals	*Martes flavigula*	Yellow-throated Marten	LC
Mammals	*Megaderma lyra*	Greater False Vampire	LC
Mammals	*Murina huttoni*	White-bellied Tube-nosed Bat	LC
Mammals	*Murina tubinaris*	Scully's Tube-nosed Bat	LC
Mammals	*Mus musculus*	House Mouse	LC
Mammals	*Mustela erminea*	Stoat	LC
Mammals	*Myotis blythii*	Lesser Mouse-eared Myotis	LC
Mammals	*Myotis muricola*	Nepalese Whiskered Myotis	LC
Mammals	*Myotis nipalensis*	Nepal Myotis	LC
Mammals	*Niviventer fulvescens*	Chestnut White-bellied Rat	LC
Mammals	*Nyctalus leisleri*	Lesser Noctule	LC
Mammals	*Ovis orientalis*	Mouflon	VU
Mammals	*Panthera pardus*	Leopard	VU
Mammals	*Petaurista petaurista*	Red Giant Flying Squirrel	LC
Mammals	*Pipistrellus coromandra*	Coromandel Pipistrelle	LC
Mammals	*Pipistrellus javanicus*	Javan Pipistrelle	LC
Mammals	*Pipistrellus pipistrellus*	Common Pipistrelle	LC
Mammals	*Pipistrellus tenuis*	Least Pipistrelle	LC
Mammals	*Prionailurus bengalensis*	Leopard Cat	LC
Mammals	*Pteropus giganteus*	Indian Flying Fox	LC
Mammals	*Rattus pyctoris*	Himalayan Rat	LC
Mammals	*Rattus rattus*	House Rat	LC
Mammals	*Rattus tanezumi*	Oriental House Rat	LC
Mammals	*Rhinolophus ferrumequinum*	Greater Horseshoe Bat	LC
Mammals	*Rhinolophus lepidus*	Blyth's Horseshoe Bat	LC
Mammals	*Rhinolophus macrotis*	Big-eared Horseshoe Bat	LC
Mammals	*Rhinopoma microphyllum*	Greater Mouse-tailed Bat	LC
Mammals	*Rousettus leschenaultii*	Leschenault’s Rousette	LC
Mammals	*Scotophilus heathii*	Greater Asiatic Yellow House Bat	LC
Mammals	*Scotophilus kuhlii*	Lesser Asiatic Yellow House Bat	LC

Taxonomic group	Species	Common name	IUCN Red List Category
Mammals	*Semnopithecus schistaceus*	Nepal Gray Langur	LC
Mammals	*Suncus etruscus*	Pygmy White-toothed Shrew	LC
Mammals	*Suncus murinus*	House Shrew	LC
Mammals	*Sus scrofa*	Wild Boar	LC
Mammals	*Tatera indica*	Indian Gerbil	LC
Mammals	*Vulpes vulpes*	Red Fox	LC
Birds	*Accipiter badius*	Shikra	LC
Birds	*Accipiter nisus*	Eurasian Sparrowhawk	LC
Birds	*Acridotheres fuscus*	Jungle Myna	LC
Birds	*Acridotheres ginginianus*	Bank Myna	LC
Birds	*Acridotheres tristis*	Common Myna	LC
Birds	*Acrocephalus agricola*	Paddyfield Warbler	LC
Birds	*Acrocephalus concinens*	Blunt-winged Warbler	LC
Birds	*Acrocephalus dumetorum*	Blyth's Reed-warbler	LC
Birds	*Acrocephalus melanopogon*	Moustached Warbler	LC
Birds	*Acrocephalus stentoreus*	Clamorous Reed-warbler	LC
Birds	*Aegithalos iredalei*	Red-headed Bushtit	LC
Birds	*Aegypius monachus*	Cinereous Vulture	NT
Birds	*Alauda arvensis*	Eurasian Skylark	LC
Birds	*Alauda gulgula*	Oriental Skylark	LC
Birds	*Alaudala rufescens*	Lesser Short-toed Lark	LC
Birds	*Alcedo atthis*	Common Kingfisher	LC
Birds	*Alectoris chukar*	Chukar	LC
Birds	*Amandava amandava*	Red Avadavat	LC
Birds	*Amaurornis phoenicurus*	White-breasted Waterhen	LC
Birds	*Ammomanes deserti*	Desert Lark	LC
Birds	*Ammoperdix griseogularis*	See-see Partridge	LC
Birds	*Anas acuta*	Northern Pintail	LC
Birds	*Anas crecca*	Common Teal	LC
Birds	*Anas platyrhynchos*	Mallard	LC
Birds	*Anhinga melanogaster*	Oriental Darter	NT
Birds	*Anser albifrons*	Greater White-fronted Goose	LC
Birds	*Anser anser*	Greylag Goose	LC
Birds	*Anser indicus*	Bar-headed Goose	LC
Birds	*Anthus richardi*	Richard's Pipit	LC
Birds	*Anthus roseatus*	Rosy Pipit	LC
Birds	*Anthus rufulus*	Paddyfield Pipit	LC
Birds	*Anthus similis*	Long-billed Pipit	LC
Birds	*Anthus spinoletta*	Water Pipit	LC
Birds	*Anthus trivialis*	Tree Pipit	LC
Birds	*Apus affinis*	Little Swift	LC
Birds	*Apus apus*	Common Swift	LC
Birds	*Aquila chrysaetos*	Golden Eagle	LC
Birds	*Aquila fasciata*	Bonelli's Eagle	LC
Birds	*Aquila heliaca*	Eastern Imperial Eagle	VU
Birds	*Aquila nipalensis*	Steppe Eagle	EN
Birds	*Aquila rapax*	Tawny Eagle	LC
Birds	*Ardea alba*	Great White Egret	LC
Birds	*Ardea intermedia*	Intermediate Egret	LC
Birds	*Ardea purpurea*	Purple Heron	LC
Birds	*Ardeola grayii*	Indian Pond-heron	LC
Birds	*Argya caudata*	Common Babbler	LC
Birds	*Asio otus*	Northern Long-eared Owl	LC
Birds	*Aythya ferina*	Common Pochard	VU
Birds	*Aythya fuligula*	Tufted Duck	LC
Birds	*Aythya nyroca*	Ferruginous Duck	NT
Birds	*Botaurus stellaris*	Eurasian Bittern	LC

Taxonomic group	Species	Common name	IUCN Red List Category
Birds	*Bubo bengalensis*	Rock Eagle-owl	LC
Birds	*Bubulcus ibis*	Cattle Egret	LC
Birds	*Butastur teesa*	White-eyed Buzzard	LC
Birds	*Buteo japonicus*	Japanese Buzzard	LC
Birds	*Buteo refectus*	Himalayan Buzzard	LC
Birds	*Buteo rufinus*	Long-legged Buzzard	LC
Birds	*Butorides striata*	Green-backed Heron	LC
Birds	*Cacomantis passerinus*	Grey-bellied Cuckoo	LC
Birds	*Calandrella acutirostris*	Hume's Lark	LC
Birds	*Calidris alpina*	Dunlin	LC
Birds	*Calidris temminckii*	Temminck's Stint	LC
Birds	*Callacanthis burtoni*	Spectacled Finch	LC
Birds	*Calliope pectoralis*	Himalayan Rubythroat	LC
Birds	*Caprimulgus affinis*	Savanna Nightjar	LC
Birds	*Caprimulgus jotaka*	Grey Nightjar	LC
Birds	*Caprimulgus macrurus*	Large-tailed Nightjar	LC
Birds	*Carduelis caniceps*	Eastern Goldfinch	LC
Birds	*Carpodacus erythrinus*	Common Rosefinch	LC
Birds	*Carpodacus rhodochlamys*	Red-mantled Rosefinch	LC
Birds	*Catreus wallichii*	Cheer Pheasant	VU
Birds	*Cephalopyrus flammiceps*	Fire-capped Tit	LC
Birds	*Certhia himalayana*	Bar-tailed Treecreeper	LC
Birds	*Ceryle rudis*	Pied Kingfisher	LC
Birds	*Cettia brunnifrons*	Grey-sided Bush-warbler	LC
Birds	*Cettia cetti*	Cetti's Warbler	LC
Birds	*Charadrius alexandrinus*	Kentish Plover	LC
Birds	*Charadrius dubius*	Little Ringed Plover	LC
Birds	*Chlidonias hybrida*	Whiskered Tern	LC
Birds	*Chloris spinoides*	Yellow-breasted Greenfinch	LC
Birds	*Chrysomma sinense*	Yellow-eyed Babbler	LC
Birds	*Ciconia ciconia*	White Stork	LC
Birds	*Ciconia episcopus*	Asian Woollyneck	VU
Birds	*Ciconia nigra*	Black Stork	LC
Birds	*Cinclus cinclus*	White-throated Dipper	LC
Birds	*Cinclus pallasii*	Brown Dipper	LC
Birds	*Cinnyris asiaticus*	Purple Sunbird	LC
Birds	*Circaetus gallicus*	Short-toed Snake-eagle	LC
Birds	*Circus cyaneus*	Hen Harrier	LC
Birds	*Circus macrourus*	Pallid Harrier	NT
Birds	*Cisticola juncidis*	Zitting Cisticola	LC
Birds	*Clamator jacobinus*	Jacobin Cuckoo	LC
Birds	*Clanga clanga*	Greater Spotted Eagle	VU
Birds	*Columba livia*	Rock Dove	LC
Birds	*Columba palumbus*	Common Woodpigeon	LC
Birds	*Coracias benghalensis*	Indian Roller	LC
Birds	*Coracias garrulus*	European Roller	LC
Birds	*Corvus corax*	Common Raven	LC
Birds	*Corvus frugilegus*	Rook	LC
Birds	*Corvus monedula*	Eurasian Jackdaw	LC
Birds	*Corvus splendens*	House Crow	LC
Birds	*Coturnix coturnix*	Common Quail	LC
Birds	*Cuculus canorus*	Common Cuckoo	LC
Birds	*Cuculus poliocephalus*	Lesser Cuckoo	LC
Birds	*Culicicapa ceylonensis*	Grey-headed Canary-flycatcher	LC
Birds	*Cursorius coromandelicus*	Indian Courser	LC
Birds	*Cursorius cursor*	Cream-coloured Courser	LC
Birds	*Delichon dasypus*	Asian House Martin	LC
Birds	*Dendrocopos assimilis*	Sind Woodpecker	LC

Taxonomic group	Species	Common name	IUCN Red List Category
Birds	*Dicrurus macrocercus*	Black Drongo	LC
Birds	*Dinopium benghalense*	Black-rumped Flameback	LC
Birds	*Egretta garzetta*	Little Egret	LC
Birds	*Elanus caeruleus*	Black-winged Kite	LC
Birds	*Emberiza cia*	Rock Bunting	LC
Birds	*Emberiza lathami*	Crested Bunting	LC
Birds	*Emberiza leucocephalos*	Pine Bunting	LC
Birds	*Emberiza schoeniclus*	Reed Bunting	LC
Birds	*Emberiza stewarti*	White-capped Bunting	LC
Birds	*Emberiza striolata*	Striolated Bunting	LC
Birds	*Enicurus scouleri*	Little Forktail	LC
Birds	*Eremophila alpestris*	Horned Lark	LC
Birds	*Eremopterix griseus*	Ashy-crowned Sparrow-lark	LC
Birds	*Erythrogenys erythrogenys*	Rusty-cheeked Scimitar-babbler	LC
Birds	*Esacus recurvirostris*	Great Thick-knee	NT
Birds	*Eudynamys scolopaceus*	Western Koel	LC
Birds	*Eumyias thalassinus*	Verditer Flycatcher	LC
Birds	*Euodice malabarica*	Indian Silverbill	LC
Birds	*Falco cherrug*	Saker Falcon	EN
Birds	*Falco chicquera*	Red-headed Falcon	NT
Birds	*Falco columbarius*	Merlin	LC
Birds	*Falco jugger*	Laggar Falcon	NT
Birds	*Falco naumanni*	Lesser Kestrel	LC
Birds	*Falco peregrinus*	Peregrine Falcon	LC
Birds	*Falco subbuteo*	Eurasian Hobby	LC
Birds	*Falco tinnunculus*	Common Kestrel	LC
Birds	*Ficedula parva*	Red-breasted Flycatcher	LC
Birds	*Ficedula ruficauda*	Rusty-tailed Flycatcher	LC
Birds	*Ficedula superciliaris*	Ultramarine Flycatcher	LC
Birds	*Ficedula tricolor*	Slaty-blue Flycatcher	LC
Birds	*Francolinus francolinus*	Black Francolin	LC
Birds	*Francolinus pondicerianus*	Grey Francolin	LC
Birds	*Fringilla coelebs*	Common Chaffinch	LC
Birds	*Fringilla montifringilla*	Brambling	LC
Birds	*Fulica atra*	Common Coot	LC
Birds	*Galerida cristata*	Crested Lark	LC
Birds	*Gallicrex cinerea*	Watercock	LC
Birds	*Gallinago gallinago*	Common Snipe	LC
Birds	*Gallinula chloropus*	Common Moorhen	LC
Birds	*Garrulax albogularis*	White-throated Laughingthrush	LC
Birds	*Garrulax rufogularis*	Rufous-chinned Laughingthrush	LC
Birds	*Garrulus lanceolatus*	Black-headed Jay	LC
Birds	*Geokichla citrina*	Orange-headed Thrush	LC
Birds	*Glareola lactea*	Little Pratincole	LC
Birds	*Glaucidium cuculoides*	Asian Barred Owlet	LC
Birds	*Gymnoris xanthocollis*	Chestnut-shouldered Bush-sparrow	LC
Birds	*Gyps bengalensis*	White-rumped Vulture	CR
Birds	*Gyps fulvus*	Griffon Vulture	LC
Birds	*Halcyon smyrnensis*	White-breasted Kingfisher	LC
Birds	*Haliaeetus leucoryphus*	Pallas's Fish-eagle	VU
Birds	*Heterophasia capistrata*	Rufous Sibia	LC
Birds	*Hieraaetus pennatus*	Booted Eagle	LC
Birds	*Hierococcyx varius*	Common Hawk-cuckoo	LC
Birds	*Himantopus himantopus*	Black-winged Stilt	LC
Birds	*Hirundapus caudacutus*	White-throated Needletail	LC

Taxonomic group	Species	Common name	IUCN Red List Category
Birds	*Hirundo rustica*	Barn Swallow	LC
Birds	*Hirundo smithii*	Wire-tailed Swallow	LC
Birds	*Hodgsonius phaenicuroides*	White-bellied Redstart	LC
Birds	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana	LC
Birds	*Hypsipetes leucocephalus*	Black Bulbul	LC
Birds	*Ibidorhyncha struthersii*	Ibisbill	LC
Birds	*Iduna caligata*	Booted Warbler	LC
Birds	*Indicator xanthonotus*	Yellow-rumped Honeyguide	NT
Birds	*Ixobrychus cinnamomeus*	Cinnamon Bittern	LC
Birds	*Ixobrychus sinensis*	Yellow Bittern	LC
Birds	*Jynx torquilla*	Eurasian Wryneck	LC
Birds	*Ketupa zeylonensis*	Brown Fish-owl	LC
Birds	*Lanius excubitor*	Great Grey Shrike	LC
Birds	*Lanius isabellinus*	Isabelline Shrike	LC
Birds	*Lanius schach*	Long-tailed Shrike	LC
Birds	*Lanius vittatus*	Bay-backed Shrike	LC
Birds	*Larus fuscus*	Lesser Black-backed Gull	LC
Birds	*Leiopicus mahrattensis*	Yellow-crowned Woodpecker	LC
Birds	*Leucosticte nemoricola*	Plain Mountain-finch	LC
Birds	*Limosa limosa*	Black-tailed Godwit	NT
Birds	*Locustella lanceolata*	Lanceolated Warbler	LC
Birds	*Lonchura punctulata*	Scaly-breasted Munia	LC
Birds	*Lophura leucomelanos*	Kalij Pheasant	LC
Birds	*Mareca penelope*	Eurasian Wigeon	LC
Birds	*Mareca strepera*	Gadwall	LC
Birds	*Marmaronetta angustirostris*	Marbled Teal	VU
Birds	*Megaceryle lugubris*	Crested Kingfisher	LC
Birds	*Mergus merganser*	Goosander	LC
Birds	*Merops orientalis*	Asian Green Bee-eater	LC
Birds	*Merops persicus*	Blue-cheeked Bee-eater	LC
Birds	*Merops philippinus*	Blue-tailed Bee-eater	LC
Birds	*Milvus migrans*	Black Kite	LC
Birds	*Mirafra erythroptera*	Indian Bushlark	LC
Birds	*Monticola cinclorhyncha*	Blue-capped Rock-thrush	LC
Birds	*Monticola solitarius*	Blue Rock-thrush	LC
Birds	*Montifringilla nivalis*	White-winged Snowfinch	LC
Birds	*Motacilla alba*	White Wagtail	LC
Birds	*Motacilla cinerea*	Grey Wagtail	LC
Birds	*Motacilla citreola*	Citrine Wagtail	LC
Birds	*Motacilla maderaspatensis*	White-browed Wagtail	LC
Birds	*Muscicapa dauurica*	Asian Brown Flycatcher	LC
Birds	*Muscicapa sibirica*	Dark-sided Flycatcher	LC
Birds	*Mycerobas icterioides*	Black-and-yellow Grosbeak	LC
Birds	*Mycerobas melanozanthos*	Spot-winged Grosbeak	LC
Birds	*Myophonus caeruleus*	Blue Whistling-thrush	LC
Birds	*Neophron percnopterus*	Egyptian Vulture	EN
Birds	*Nettapus coromandelianus*	Cotton Pygmy-goose	LC
Birds	*Niltava sundara*	Rufous-bellied Niltava	LC
Birds	*Nisaetus nipalensis*	Mountain Hawk-eagle	LC
Birds	*Numenius arquata*	Eurasian Curlew	NT
Birds	*Nycticorax nycticorax*	Black-Crowned Night Heron	LC
Birds	*Oenanthe chrysopygia*	Red-tailed Wheatear	LC
Birds	*Oenanthe deserti*	Desert Wheatear	LC
Birds	*Oenanthe isabellina*	Isabelline Wheatear	LC
Birds	*Oenanthe picata*	Variable Wheatear	LC
Birds	*Oenanthe pleschanka*	Pied Wheatear	LC

Taxonomic group	Species	Common name	IUCN Red List Category
Birds	*Oriolus kundoo*	Indian Golden Oriole	LC
Birds	*Orthotomus sutorius*	Common Tailorbird	LC
Birds	*Otus bakkamoena*	Indian Scops-owl	LC
Birds	*Otus brucei*	Pallid Scops-owl	LC
Birds	*Otus lettia*	Collared Scops-owl	LC
Birds	*Otus sunia*	Oriental Scops-owl	LC
Birds	*Oxyura leucocephala*	White-headed Duck	EN
Birds	*Pandion haliaetus*	Osprey	LC
Birds	*Parus major*	Great Tit	LC
Birds	*Parus monticolus*	Green-backed Tit	LC
Birds	*Passer domesticus*	House Sparrow	LC
Birds	*Passer montanus*	Eurasian Tree Sparrow	LC
Birds	*Pelecanus crispus*	Dalmatian Pelican	VU
Birds	*Pericrocotus cinnamomeus*	Small Minivet	LC
Birds	*Pericrocotus ethologus*	Long-tailed Minivet	LC
Birds	*Pericrocotus roseus*	Rosy Minivet	LC
Birds	*Periparus ater*	Coal Tit	LC
Birds	*Pernis ptilorhynchus*	Oriental Honey-buzzard	LC
Birds	*Petrochelidon fluvicola*	Streak-throated Swallow	LC
Birds	*Phoenicopterus roseus*	Greater Flamingo	LC
Birds	*Phoenicurus coeruleocephala*	Blue-capped Redstart	LC
Birds	*Phoenicurus erythronotus*	Eversmann's Redstart	LC
Birds	*Phoenicurus fuliginosus*	Plumbeous Water-redstart	LC
Birds	*Phoenicurus ochruros*	Black Redstart	LC
Birds	*Phylloscopus affinis*	Tickell's Leaf-warbler	LC
Birds	*Phylloscopus chloronotus*	Lemon-rumped Leaf-warbler	LC
Birds	*Phylloscopus griseolus*	Sulphur-bellied Warbler	LC
Birds	*Phylloscopus humei*	Hume's Leaf-warbler	LC
Birds	*Phylloscopus neglectus*	Plain Leaf-warbler	LC
Birds	*Phylloscopus occipitalis*	Western Crowned Leaf-warbler	LC
Birds	*Phylloscopus subviridis*	Brooks's Leaf-warbler	LC
Birds	*Phylloscopus tristis*	Siberian Chiffchaff	LC
Birds	*Phylloscopus trochiloides*	Greenish Warbler	LC
Birds	*Phylloscopus tytleri*	Tytler's Leaf-warbler	NT
Birds	*Phylloscopus whistleri*	Whistler's Warbler	LC
Birds	*Pica pica*	Eurasian Magpie	LC
Birds	*Picumnus innominatus*	Speckled Piculet	LC
Birds	*Picus guerini*	Black-naped Woodpecker	LC
Birds	*Picus squamatus*	Scaly-bellied Woodpecker	LC
Birds	*Pitta brachyura*	Indian Pitta	LC
Birds	*Platalea leucorodia*	Eurasian Spoonbill	LC
Birds	*Plegadis falcinellus*	Glossy Ibis	LC
Birds	*Ploceus manyar*	Streaked Weaver	LC
Birds	*Ploceus philippinus*	Baya Weaver	LC
Birds	*Podiceps cristatus*	Great Crested Grebe	LC
Birds	*Podiceps nigricollis*	Black-necked Grebe	LC
Birds	*Porphyrio porphyrio*	Purple Swamphen	LC
Birds	*Prinia buchanani*	Rufous-fronted Prinia	LC
Birds	*Prinia crinigera*	Striated Prinia	LC
Birds	*Prinia flaviventris*	Yellow-bellied Prinia	LC
Birds	*Prinia gracilis*	Graceful Prinia	LC
Birds	*Prinia hodgsonii*	Grey-breasted Prinia	LC
Birds	*Prinia inornata*	Plain Prinia	LC
Birds	*Prinia socialis*	Ashy Prinia	LC
Birds	*Prunella atrogularis*	Black-throated Accentor	LC
Birds	*Psilopogon asiaticus*	Blue-throated Barbet	LC
Birds	*Psilopogon*	Coppersmith Barbet	LC

Taxonomic group	Species	Common name	IUCN Red List Category
	haemacephalus		
Birds	*Psilopogon virens*	Great Barbet	LC
Birds	*Psittacula cyanocephala*	Plum-headed Parakeet	LC
Birds	*Psittacula eupatria*	Alexandrine Parakeet	NT
Birds	*Psittacula krameri*	Rose-ringed Parakeet	LC
Birds	*Pterocles exustus*	Chestnut-bellied Sandgrouse	LC
Birds	*Pterocles orientalis*	Black-bellied Sandgrouse	LC
Birds	*Pteruthius aeralatus*	White-browed Shrike-babbler	LC
Birds	*Ptyonoprogne obsoleta*	Pale Rock Martin	LC
Birds	*Ptyonoprogne rupestris*	Eurasian Crag Martin	LC
Birds	*Pycnonotus cafer*	Red-vented Bulbul	LC
Birds	*Pycnonotus leucotis*	White-eared Bulbul	LC
Birds	*Pyrrhula aurantiaca*	Orange Bullfinch	LC
Birds	*Remiz coronatus*	White-crowned Penduline-tit	LC
Birds	*Rhipidura albicollis*	White-throated Fantail	LC
Birds	*Rhipidura aureola*	White-browed Fantail	LC
Birds	*Riparia chinensis*	Asian Plain Martin	LC
Birds	*Riparia diluta*	Pale Sand Martin	LC
Birds	*Rostratula benghalensis*	Greater Painted-snipe	LC
Birds	*Rynchops albicollis*	Indian Skimmer	VU
Birds	*Sarcogyps calvus*	Red-headed Vulture	CR
Birds	*Saxicola caprata*	Pied Bushchat	LC
Birds	*Saxicola ferreus*	Grey Bushchat	LC
Birds	*Saxicola macrorhynchus*	White-browed Bushchat	VU
Birds	*Saxicola torquatus*	Common Stonechat	LC
Birds	*Saxicoloides fulicatus*	Indian Robin	LC
Birds	*Scotocerca inquieta*	Streaked Scrub-warbler	LC
Birds	*Spatula clypeata*	Northern Shoveler	LC
Birds	*Spilopelia senegalensis*	Laughing Dove	LC
Birds	*Spilopelia suratensis*	Western Spotted Dove	LC
Birds	*Spilornis cheela*	Crested Serpent-eagle	LC
Birds	*Sterna aurantia*	River Tern	NT
Birds	*Sternula albifrons*	Little Tern	LC
Birds	*Streptopelia decaocto*	Eurasian Collared-dove	LC
Birds	*Streptopelia orientalis*	Oriental Turtle-dove	LC
Birds	*Streptopelia tranquebarica*	Red Turtle-dove	LC
Birds	*Strix aluco*	Tawny Owl	LC
Birds	*Sturnia pagodarum*	Brahminy Starling	LC
Birds	*Sturnus vulgaris*	Common Starling	LC
Birds	*Sylvia curruca*	Lesser Whitethroat	LC
Birds	*Sylvia nana*	Asian Desert Warbler	LC
Birds	*Tachybaptus ruficollis*	Little Grebe	LC
Birds	*Tadorna ferruginea*	Ruddy Shelduck	LC
Birds	*Tarsiger chrysaeus*	Golden Bush-robin	LC
Birds	*Tarsiger cyanurus*	Orange-flanked Bush-robin	LC
Birds	*Tarsiger rufilatus*	Himalayan Bush-robin	LC
Birds	*Tephrodornis pondicerianus*	Common Wood-shrike	LC
Birds	*Terpsiphone paradisi*	Indian Paradise-flycatcher	LC
Birds	*Tetrax tetrax*	Little Bustard	NT
Birds	*Tichodroma muraria*	Wallcreeper	LC
Birds	*Tringa erythropus*	Spotted Redshank	LC
Birds	*Tringa glareola*	Wood Sandpiper	LC
Birds	*Tringa nebularia*	Common Greenshank	LC
Birds	*Tringa totanus*	Common Redshank	LC
Birds	*Trochalopteron lineatum*	Streaked Laughingthrush	LC
Birds	*Trochalopteron variegatum*	Variegated Laughingthrush	LC

Taxonomic group	Species	Common name	IUCN Red List Category
Birds	*Troglodytes troglodytes*	Northern Wren	LC
Birds	*Turdoides striata*	Jungle Babbler	LC
Birds	*Turdus atrogularis*	Black-throated Thrush	LC
Birds	*Turdus boulboul*	Grey-winged Blackbird	LC
Birds	*Turdus maximus*	Tibetan Blackbird	LC
Birds	*Turdus rubrocanus*	Chestnut Thrush	LC
Birds	*Turdus ruficollis*	Rufous-throated Thrush	LC
Birds	*Turdus unicolor*	Tickell's Thrush	LC
Birds	*Turdus viscivorus*	Mistle Thrush	LC
Birds	*Turnix sylvaticus*	Common Buttonquail	LC
Birds	*Turnix tanki*	Yellow-legged Buttonquail	LC
Birds	*Tyto alba*	Common Barn-owl	LC
Birds	*Upupa epops*	Common Hoopoe	LC
Birds	*Vanellus gregarius*	Sociable Lapwing	CR
Birds	*Vanellus indicus*	Red-wattled Lapwing	LC
Birds	*Vanellus leucurus*	White-tailed Lapwing	LC
Birds	*Vanellus vanellus*	Northern Lapwing	NT
Birds	*Zapornia fusca*	Ruddy-breasted Crake	LC
Birds	*Zapornia parva*	Little Crake	LC
Birds	*Zoothera major*	Amami Thrush	NT
Birds	*Zoothera mollissima*	Alpine Thrush	LC
Birds	*Zosterops palpebrosus*	Oriental White-eye	LC
Reptiles	*Boiga trigonata*	Indian Gamma Snake	LC
Reptiles	*Calotes minor*	Hardwicke's Bloodsucker	DD
Reptiles	*Cyrtopodion potoharense*	Potwar Gecko	LC
Reptiles	*Cyrtopodion scabrum*	Rough Bent-toed Gecko	LC
Reptiles	*Gavialis gangeticus*	Gharial	CR
Reptiles	*Herpetoreas sieboldii*	Sikkim Keelback	DD
Reptiles	*Lissemys punctata*	Indian Flapshell Turtle	LR/lc
Reptiles	*Oligodon taeniolatus*	Streaked Kukri Snake	LC
Reptiles	*Sitana ponticeriana*	Fan Throated Lizard	LC
Reptiles	*Varanus bengalensis*	Common Indian Monitor	LC
Amphibians	*Allopaa hazarensis*	Kashmir Paa Frog	LC
Amphibians	*Duttaphrynus himalayanus*	Himalayan Toad	LC
Amphibians	*Duttaphrynus melanostictus*	Black-spectacled Toad	LC
Amphibians	*Duttaphrynus stomaticus*		LC
Amphibians	*Euphlyctis cyanophlyctis*		LC
Amphibians	*Fejervarya limnocharis*	Asian Grass Frog	LC
Amphibians	*Hoplobatrachus tigerinus*	Indian Bullfrog	LC
Amphibians	*Nanorana vicina*		LC
Amphibians	*Sphaerotheca breviceps*		LC
Amphibians	*Uperodon systoma*	Marbled Balloon Frog	LC
Invertebrates	*Acisoma panorpoides*	Grizzled Pintail	LC
Invertebrates	*Agriocnemis pygmaea*	Wandering Midget	LC
Invertebrates	*Anax ephippiger*	Vagrant Emperor	LC
Invertebrates	*Anax imperator*	Blue Emperor	LC
Invertebrates	*Anax indicus*		LC
Invertebrates	*Bellamya bengalensis*		LC
Invertebrates	*Bithynia cerameopoma*		LC
Invertebrates	*Ceriagrion cerinorubellum*		LC
Invertebrates	*Ceriagrion coromandelianum*		LC
Invertebrates	*Clenchiella microscopica*		LC
Invertebrates	*Clithon reticularis*		LC
Invertebrates	*Corbicula regularis*		LC
Invertebrates	*Corbicula striatella*		LC
Invertebrates	*Crocothemis erythraea*	Broad Scarlet	LC

Taxonomic group	Species	Common name	IUCN Red List Category
Invertebrates	*Diplacodes lefebvrii*	Black Percher	LC
Invertebrates	*Dreissena polymorpha*	Zebra Mussel	LC
Invertebrates	*Gabbia orcula*		LC
Invertebrates	*Gyraulus euphraticus*		LC
Invertebrates	*Himalayapotamon koolooense*		LC
Invertebrates	*Indoplanorbis exustus*		LC
Invertebrates	*Ischnura forcipata*		LC
Invertebrates	*Ischnura senegalensis*	Tropical Bluetail	LC
Invertebrates	*Lestes thoracicus*		LC
Invertebrates	*Lymnaea acuminata*		LC
Invertebrates	*Lymnaea luteola*		LC
Invertebrates	*Melanoides pyramis*		LC
Invertebrates	*Orthetrum japonicum*		LC
Invertebrates	*Pantala flavescens*	Wandering Glider	LC
Invertebrates	*Parreysia caerulea*		LC
Invertebrates	*Potamon gedrosianum*		LC
Invertebrates	*Radix auricularia*		LC
Invertebrates	*Sartoriana spinigera*		LC
Invertebrates	*Tramea basilaris*	Keyhole Glider	LC
Invertebrates	*Trithemis aurora*		LC
Invertebrates	*Zygonyx torridus*	Ringed Cascader	LC
Fishes	*Acanthocobitis botia*	Striped Loach	LC
Fishes	*Anguilla bengalensis*	Indian Mottled Eel	NT
Fishes	*Badis badis*		LC
Fishes	*Bangana ariza*	Ariza Labeo	LC
Fishes	*Bangana diplostoma*		LC
Fishes	*Channa gachua*	Dwarf Snakehead	LC
Fishes	*Channa marulius*		LC
Fishes	*Cirrhinus reba*	Reba Carp	LC
Fishes	*Esomus danrica*	Flying barb	LC
Fishes	*Gibelion catla*	Catla	LC
Fishes	*Glossogobius giuris*	Bareye Goby	LC
Fishes	*Heteropneustes fossilis*	Stinging catfish	LC
Fishes	*Labeo angra*	Angra Labeo	LC
Fishes	*Labeo bata*	Minor Carp	LC
Fishes	*Labeo microphthalmus*	Murree labeo	LC
Fishes	*Nangra nangra*	Kosi Nangra	LC
Fishes	*Notopterus notopterus*		LC
Fishes	*Ompok bimaculatus*		NT
Fishes	*Rasbora daniconius*	Slender Barb	LC
Fishes	*Silonia silondia*	Silong Catfish	LC
Fishes	*Sperata aor*	Long-whiskered Catfish	LC
Fishes	*Trichogaster lalius*		LC
Fishes	*Wallago attu*		NT

ANNEX 7.1.6-1 Protected area and IUCN category

Type	Name	Area	Year	IUCN Category	Ramsal
National Park	Lal Suhanra	874	1972	V	
National Park	Margalla Hills	174	1980	V	
National Park	Hazar Ganji-Chiltan	156	1980	V	
National Park	Ayubia	17	1984	V	
National Park	Ayub	9	0	V	
National Park	Shandur-Hundrup	1,640	0	Not Reported	
National Park	Central Karakoram	0	1993	Not Reported	
National Park	K2	0	0	Not Reported	
National Park	Kirthar	3,087	1974	II	
National Park	Khunjerab	2,269	1975	II	
National Park	Dhrun	1,677	1988	II	
National Park	Chitral Gol	78	1984	II	
National Park	Chinji	61	1987	II	
National Park	Hingol	1,650	1988	II	
Nature Reserve	Tashikuerganyeshengdongwu	15,000	1984	V	
Wildlife Sanctuary	Keti Bunder South	230	1977	Not Reported	
Wildlife Sanctuary	Khurkhera	183	1972	Not Reported	
Wildlife Sanctuary	Chichawatni Plantation	47	1986	Not Reported	
Wildlife Sanctuary	Kamalia Plantation	43	1971	Not Reported	
Wildlife Sanctuary	Marho Kotri	310	1977	Not Reported	
Wildlife Sanctuary	Runn of Kutch	3,205	1980	IV	
Wildlife Sanctuary	Rasool Barrage	11	1974	IV	
Wildlife Sanctuary	Taunsa Barrage	66	1972	IV	*
Wildlife Sanctuary	Kharar Lake	2	1971	IV	
Wildlife Sanctuary	Chumbi Surla	559	1978	IV	
Wildlife Sanctuary	Nemal Lake	5	1970	IV	
Wildlife Sanctuary	Chashma Lake	331	1974	IV	
Wildlife Sanctuary	Takkar	435	1968	IV	
Wildlife Sanctuary	Kinjhar (Kalri) Lake	185	1977	IV	*
Wildlife Sanctuary	Hadero Lake	13	1977	IV	
Wildlife Sanctuary	Haleji Lake	17	1977	IV	*
Wildlife Sanctuary	Drigh Lake	2	1972	IV	*
Wildlife Sanctuary	Mahal Kohistan	706	1972	IV	
Wildlife Sanctuary	Hab Dam	272	1972	IV	*
Wildlife Sanctuary	Dhoung Block	21	1977	IV	
Wildlife Sanctuary	Lakhi	1	1977	IV	
Wildlife Sanctuary	Bijoro Chach	1	1977	IV	
Wildlife Sanctuary	Norange	2	1977	IV	
Wildlife Sanctuary	Cut Munarki Chach	4	1977	IV	
Wildlife Sanctuary	Haleji	3	1977	IV	
Wildlife Sanctuary	Keti Bunder North	0	1977	IV	
Wildlife Sanctuary	Sheikh Buddin	195	1977	IV	
Wildlife Sanctuary	Manglot	7	1976	IV	
Wildlife Sanctuary	Borraka	20	1976	IV	
Wildlife Sanctuary	Manshi	23	1977	IV	
Wildlife Sanctuary	Maslakh	466	1968	IV	
Wildlife Sanctuary	Sasnamana	66	1971	IV	
Wildlife Sanctuary	Ziarat Juniper	372	1971	IV	
Wildlife Sanctuary	Koh-e-Geish	244	1969	IV	
Wildlife Sanctuary	Kachau	217	1972	IV	

Type	Name	Area	Year	IUCN Category	Ramsal
Wildlife Sanctuary	Shashan	296	1972	IV	
Wildlife Sanctuary	Chorani	194	1972	IV	
Wildlife Sanctuary	Dureji	1,783	1972	IV	
Wildlife Sanctuary	Raghai Rakhshan	1,254	1971	IV	
Wildlife Sanctuary	Kolwah Kap	332	1972	IV	
Wildlife Sanctuary	Buzi Makola	1,451	1972	IV	
Wildlife Sanctuary	Salkhala	8	1982	IV	
Wildlife Sanctuary	Naltar	272	1975	IV	
Wildlife Sanctuary	Kargah	443	1975	IV	
Wildlife Sanctuary	Astore	415	1975	IV	
Wildlife Sanctuary	Baltistan	415	1975	IV	
Wildlife Sanctuary	Sodhi	54	1983	IV	
Wildlife Sanctuary	Bajwat	55	1964	IV	
Wildlife Sanctuary	Daphar	29	1978	IV	
Wildlife Sanctuary	Agram Basti	299	1983	IV	
Wildlife Sanctuary	Ras Koh	995	1962	IV	
Wildlife Sanctuary	Salpara	311	1975	IV	
Wildlife Sanctuary	Islamabad	70	1980	IV	
Wildlife Sanctuary	Nara Desert	2,236	1980	IV	
Sanctuary	Kachchh Desert	7,506	1986	IV	
Game Reserve	Gogi	78	1962	VI	
Game Reserve	Wam	104	1962	VI	
Game Reserve	Indus River#1	442	1974	Not Reported	
Game Reserve	Bilyamin	40	1974	Not Reported	
Game Reserve	Bund Khush Dil Khan	13	1983	Not Reported	
Game Reserve	Khari Murat	56	1964	Not Reported	
Game Reserve	Gat Wala	59	1978	Not Reported	
Game Reserve	Kathar	11	1978	Not Reported	
Game Reserve	Chaupalia	99	1960	Not Reported	
Game Reserve	Rahri Bungalow	55	1978	Not Reported	
Game Reserve	Bhono	21	1955	Not Reported	
Game Reserve	Bhon Fazil	27	1978	Not Reported	
Game Reserve	Head Qadirabad	29	1978	Not Reported	
Game Reserve	Bahwaalpur Plantation	5	1978	Not Reported	
Game Reserve	Kot Zabzai	101	1978	Not Reported	
Game Reserve	Head Islam/Chak Kotora	31	1978	Not Reported	
Game Reserve	Diljabba-Domeli	1,181	1972	Not Reported	
Game Reserve	Cholistan	20,327	1975	Not Reported	
Game Reserve	Abbasia	101	1979	Not Reported	
Game Reserve	Daulana	23	1965	Not Reported	
Game Reserve	Indo-Pak Border	0	1982	Not Reported	
Game Reserve	Deh Sahib Saman	3	1966	Not Reported	
Game Reserve	Deh Jangisar	4	1965	Not Reported	
Game Reserve	Mirpur Sakro	8	1965	Not Reported	
Game Reserve	Nara	1,100	1962	Not Reported	
Game Reserve	Surjan, Sumbak, Eri and Hothiano	406	1976	Not Reported	
Game Reserve	Mando Dero	12	1972	Not Reported	
Game Reserve	Dosu Forest	23	1973	Not Reported	
Game Reserve	Khipro	39	0	Not Reported	
Game Reserve	Tando Mitha Khan	53	0	Not Reported	
Game Reserve	Pai	20	1976	Not Reported	
Game Reserve	Darosh Gol	21	1979	Not Reported	
Game Reserve	Gehrait Gol	48	1979	Not Reported	

Type	Name	Area	Year	IUCN Category	Ramsal
Game Reserve	Parit Gol/Ghinar Gol	64	1979	Not Reported	
Game Reserve	Totali	170	1984	Not Reported	
Game Reserve	Swegali	18	1984	Not Reported	
Game Reserve	Shina-Wari Chapri	10	1974	Not Reported	
Game Reserve	Resi	51	1976	Not Reported	
Game Reserve	Thanadarwala	40	1976	Not Reported	*
Game Reserve	Nizampur	8	1976	Not Reported	
Game Reserve	Makhnial	41	1977	Not Reported	
Game Reserve	Zawarkhan	39	1963	Not Reported	
Game Reserve	Machiara	135	1982	Not Reported	
Game Reserve	Moji	39	1982	Not Reported	
Game Reserve	Qazi Nag	48	1982	Not Reported	
Game Reserve	Killan	4	1982	Not Reported	
Game Reserve	Mori Said Ali	2	1982	Not Reported	
Game Reserve	Phala/Kuthnar	3	1982	Not Reported	
Game Reserve	Vatala	5	1982	Not Reported	
Game Reserve	Ghamot	273	1982	Not Reported	
Game Reserve	Danyor Nallah	443	1974	Not Reported	
Game Reserve	Sher Qillah	168	1975	Not Reported	
Game Reserve	Kilik/Mintaka	650	1975	Not Reported	
Game Reserve	Pakora	75	1975	Not Reported	
Game Reserve	Nazbar Nallah	334	1975	Not Reported	
Game Reserve	Chassi/Baushdar	371	1975	Not Reported	
Game Reserve	Tangir	143	1975	Not Reported	
Game Reserve	Askor Nallah	130	1987	Not Reported	
Game Reserve	Nar/Ghoro Nallah	73	1975	Not Reported	
Game Reserve	Zangi Nawar	11	1982	Not Reported	
Game Reserve	Thal	713	1978	Not Reported	
Game Reserve	Goleen Gol	10	1965	Not Reported	
Game Reserve	Kala Chitta	1,326	1983	Not Reported	
Game Reserve	Kazinag	0	0	Not Reported	
Other Area	Ayub 'National Park'	9	0	Not Reported	
Private Reserve	Kalabagh Game Reserve	16	1966	Not Reported	
Protected Area	Gando	0	0	Not Reported	