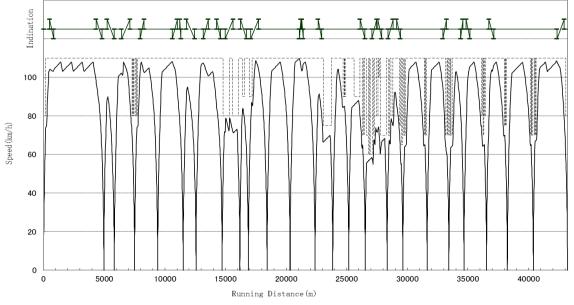
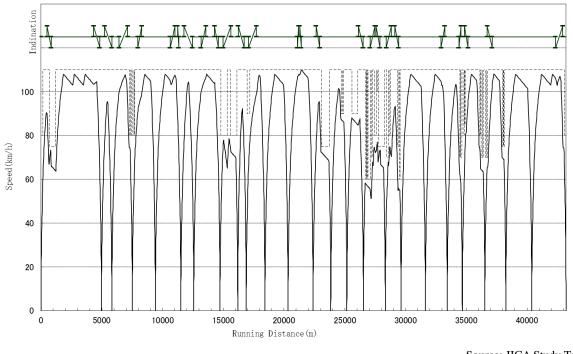
6) Train Movement Curve

Train movement curve of Circular Line (N-A1) is shown in Figure 5.3.29 for down line and Figure 5.3.30 for up line.

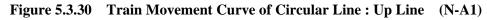


Source: JICA Study Team

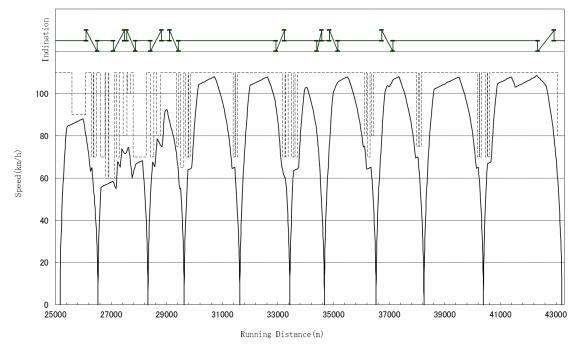
Figure 5.3.29 Train Movement Curve of Circular Line : Down Line (N-A1)



Source: JICA Study Team



Train movement curve of Extension Line (N-A1) between Drigh Road and Liyari station is shown in Figure 5.3.31 for down line and Figure 5.3.32 for up line.



Source: JICA Study Team

Figure 5.3.31 Train Movement Curve of Extension line : Down Line (N-A1)

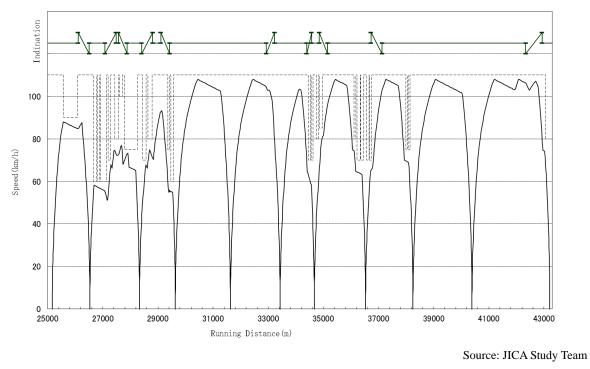


Figure 5.3.32 Train Movement Curve of Extension Line : Up Line (N-A1)

Train movement curve of Drigh Road - Shah Abdul Latif Line (N-B1) is shown in Figure 5.3.33 for down line and Figure 5.3.34 for up line.

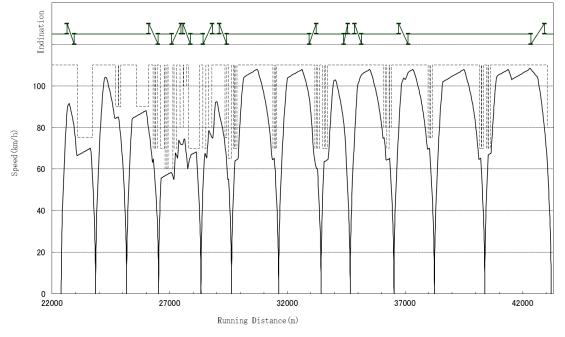


Figure 5.3.33 Train Movement Curve of Drigh Road - Shah Abdul Latif Line : Down Line (N-B1)

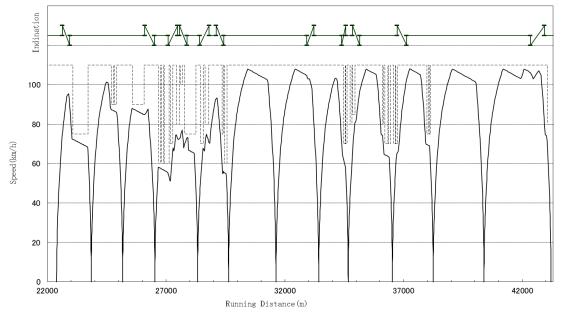


Figure 5.3.34 Train Movement Curve of Drigh Road - Shah Abdul Latif Line : Up Line (N-B1)

(4) Details of Simulation Results

1) Alladin Park TSS (N-A1, Normal Feeding)

a) Voltage, Current and Power

i) Maximum & Minimum values of voltage and current

Maximum & Minimum values of voltage, current, power and time of occurrence at Alladin Park TSS and SP1&2 between 7:00 and 9:00 is shown in Table 5.3.27 below.

Table 5.3.27 Maximum & Minimum Values of Alladin Park TSS (N-A1, Normal Feeding)

	It		PARK SS
	Item	Simulation Result	Occur Time
	minimum Vuv(kV)	131.772	7:03:11
	minimum Vvw(kV)	131.704	7:06:34
Incoming Voltage	minimum Vwu(kV)	131.862	7:03:11
	Max Effective Power(kW)	15438.8	7:01:00
	Average Voltage unbalance(%)	0.05	-
	minimum Voltage(kV)	27.326	7:01:09
	Max Current(A)	330.9	7:00:14
	Max Effective Power(kW)	8847	7:00:14
Teaser Feeding Bus	Max Reactive Power(kVar)	2436.5	7:08:22
	Electric Power Consumption(kWh)	5853.8	-
	Average Power Factor	0.93	-
	Max Current(A)	188.3	7:07:17
	Max Effective Power(kW)	5023.5	7:07:17
Feeding circuit (SP1 end)	Max Reactive Power(kVar)	1174.5	7:05:53
Up track	minimum Volltage at SP1(kV)	27.171	7:01:09
	Electric Power Consumption(kWh)	3349.8	_
	Average Power Factor	0.94	-
	Max Current(A)	190.8	7:01:00
	Max Effective Power(kW)	5106.8	7:01:00
Feeding circuit (SP1 end) Down track	Max Reactive Power(kVar)	1405.3	7:01:07
	minimum Volltage at SP1(kV)	27.171	7:01:09
	Electric Power Consumption(kWh)	2849.5	_
	Average Power Factor	0.92	-
	minimum Voltage(kV)	27.302	7:03:11
	Max Current(A)	285.4	7:03:11
	Max Effective Power(kW)	7329.7	7:03:11
Main Feeding Bus	Max Reactive Power(kVar)	2643.3	7:03:11
	Electric Power Consumption(kWh)	5403.6	-
	Average Power Factor	0.91	-
	Max Current(A)	160.4	7:03:11
	Max Effective Power(kW)	4247.2	7:03:11
Feeding circuit (SP2 end)	Max Reactive Power(kVar)	1069.2	7:03:11
Up track	minimum Volltage at SP2(kV)	27.185	7:03:11
	Electric Power Consumption(kWh)	2914.7	_
	Average Power Factor	0.92	_
	Max Current(A)	146.8	7:03:05
	Max Effective Power(kW)	3937.7	7:03:05
Feeding circuit (SP2 end)	Max Reactive Power(kVar)	1574.2	7:03:11
Down track	minimum Volltage at SP2(kV)	27.185	7:03:11
	Electric Power Consumption(kWh)	2682.8	_
	Average Power Factor	0.91	_

Source: JICA Study Team

ii) Unbalance and Fluctuation Rate of Receiving Voltage

Figure 5.3.35 and Figure 5.3.36 show fluctuation rate and unbalance rate of receiving voltage of Alladin Park TSS. From these figures, maximum voltage fluctuation rate of Alladin Park TSS is Vrs:0.17%, Vst:0.22% & Vtr:0.10% and maximum voltage unbalance rate is 0.18%.

As a result, both maximum fluctuation and unbalance rate of receiving voltage are not exceeding 5% which is limited by regulation.

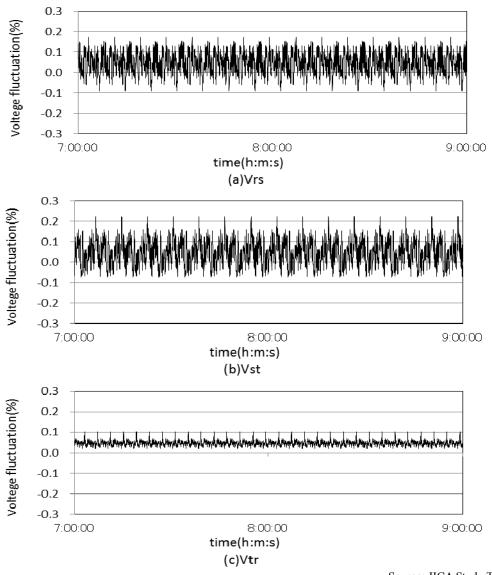


Figure 5.3.35 Fluctuation Rate of Receiving Voltage (Alladin Park TSS)

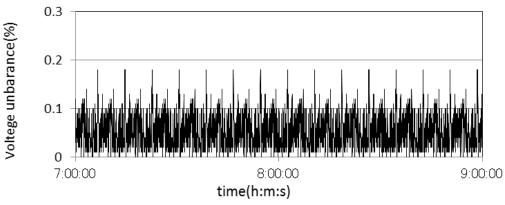


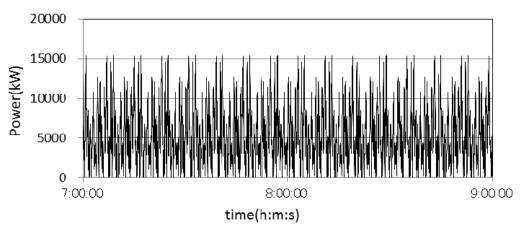
Figure 5.3.36 Unbalance Rate of Receiving Voltage (Alladin Park TSS)

iii) Receiving Power

Figure 5.3.37 and Figure 5.3.38 show receiving power transition and regenerative power transition of Alladin Park TSS respectively between 7:00 and 9:00.

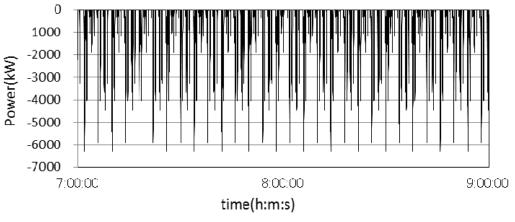
Maximum receiving power is 15,438kW at 7:01:00.

Power consumption for two hours is 11,256kWh, while regenerative power which is not consumed by accelerating cars but goes back to power company is -1,209kWh.



Source: JICA Study Team

Figure 5.3.37 Receiving Power Transition of Alladin Park TSS



Source: JICA Study Team

Figure 5.3.38Regenerative Power Transition of Alladin Park TSS

iv) Feeding Voltage, Current and Power

Figure 5.3.39 and Figure 5.3.40 show feeding voltage, current and power of Alladin Park TSS. Maximum feeding currents are 285A at Main phase bus and 331A at Teaser phase bus. Terminal voltage of feeding circuit at SP point is more than 27KV during 2 hours which is exceeding minimum feeding voltage of 20KV.

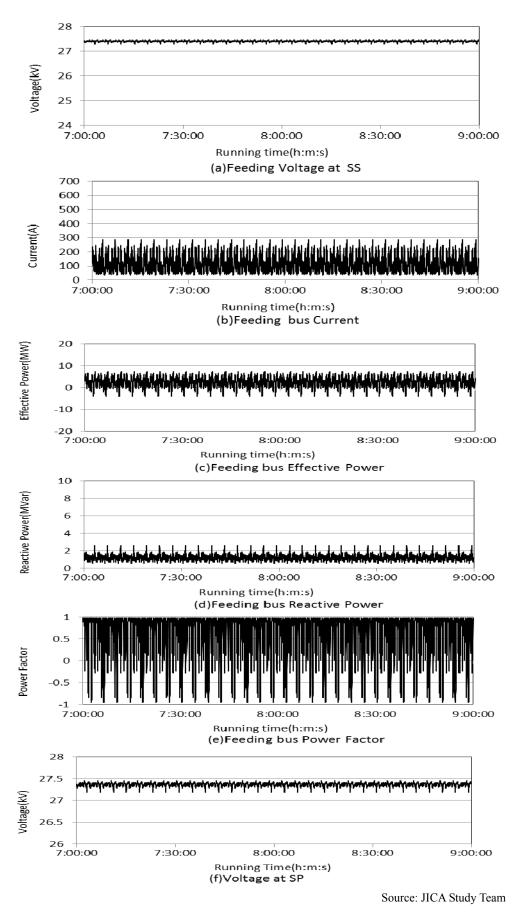
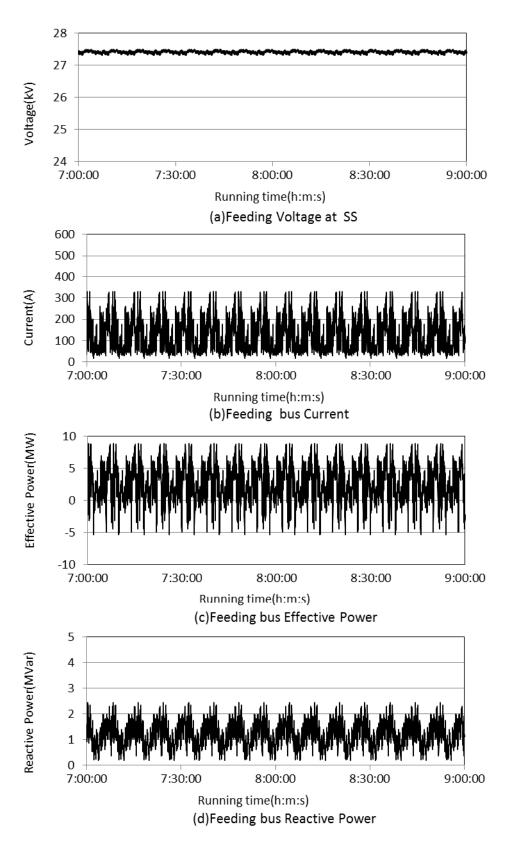


Figure 5.3.39 Feeding Voltage, Current & Power (Main Phase Bus) and Voltage at SP



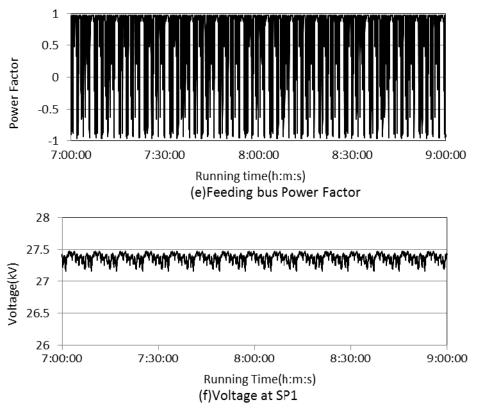


Figure 5.3.40 Feeding Voltage, Current & Power (Teaser phase Bus) and Voltage at SP

b) Capacity of Transformer

i) Feeding Transformer

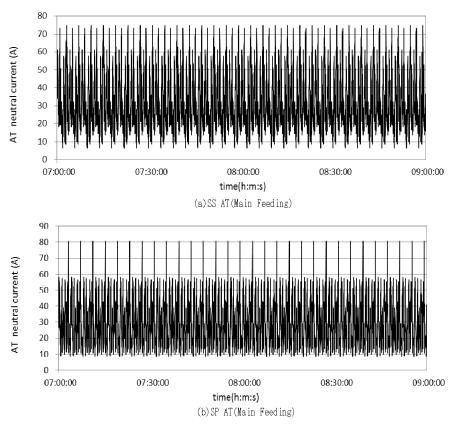
The maximum power of Main phase feeding bus of Alladin Park TSS is 8,847KW as shown in Table 5.3.27. Accordingly 17.6MVA ($8.8MVA \times 2$) is required for total capacity of Scott-Connected Transformer because total capacity is the sum of Main phase and Teaser phase capacity. However, taking 30% of safety factor into account, 23MVA will be appropriate capacity of feeding transformer in normal feeding case of N-A1.

ii) AT (Auto Transformer)

ii-1) AT Neutral Current

In case of Main phase, maximum AT neutral current at TSS is 75A and at SP is 81A as shown in Figure 5.3.41

In case of Teaser phase, maximum AT neutral current at TSS is 71A and at SP is 120A as shown in Figure 5.3.42.



Source: JICA Study Team

Figure 5.3.41 Neutral Current at Alladin Park TSS, Main Phase

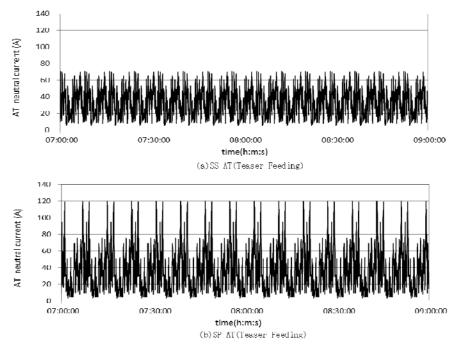
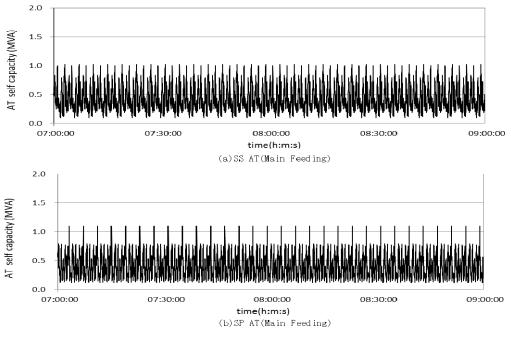


Figure 5.3.42 AT Neutral Current at Alladin Park TSS, Teaser Phase

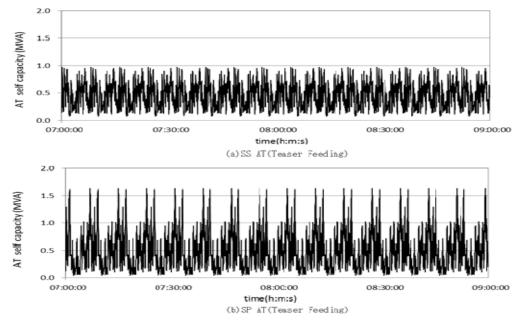
ii-2) AT Self Capacity

In case of Main phase, maximum AT self capacity at TSS is 1,024kVA and at SP is 1,097kVA as shown in Figure 5.3.43. In case of Teaser phase, maximum AT self capacity at TSS is 969kVA and at SP is 1,629kVA as shown in Figure 5.3.44.



Source: JICA Study Team

Figure 5.3.43 AT Self Capacity of Main Phase Feeder at Alladin Park TSS



Source: JICA Study Team

Figure 5.3.44 AT Self Capacity of Teaser Phase Feeder at Alladin Park TSS

Maximum AT neutral current and Maximum AT self capacity are summarized in Table 5.3.28 and Table 5.3.29 .

In case of Main phase of Alladin Park TSS, maximum AT capacity is 1.02MVA at TSS and 1.10MVA at SP.

While in case of Teaser phase, maximum AT capacity is 0.97MVA at TSS and 1.63MVA at SP.

	Max AT neutral current				mean-square value			
substation	Main f	n feeding Teaser Feeding		Main feeding		Teaser Feeding		
	SS	SP	SS	SP	SS	SP	SS	SP
	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)
ALLADIN PARK	75	81	71	120	37	33	37	46

Table 5.3.28Maximum AT Neutral Current

Source: JICA Study Team

	Max self capacity					
	Main f	eeding	Teaser Feeding			
substation	SS	SP	SS	SP		
	(MVA)	(MVA)	(MVA)	(MVA)		
ALLADIN PARK	1.02	1.10	0.97	1.63		

Table 5.3.29Maximum AT Capacity

Source: JICA Study Team

c) Temperature Rise of Trolley Wire

Basic characteristics used for simulation:

- a. Trolley wire: PHC110mm², Messenger wire PH150mm²
- b. Diameter of trolley wire: 0.617 cm
- c. Wind speed: 0.5m/s
- d. Current shared ratio: Trolley wire 39%, Messenger wire 61%

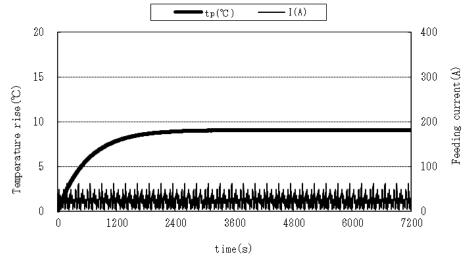
	Table 5.5.50 Dasic Characteristics for	Simulation	
No.	Item	Unit	Value
1	Diameter of electric wire d	cm	0.617
2	Resistance of electric wire (20°C) r0	Ω/cm	2.40E-06
3	Temperature coefficient of resistance (20°C) ar20	1/K	0.00381
4	Wind veloctiy v	m/s	0.5
5	Radiation coefficient η		0.9
6	Heat capacity of electric wire C	J∕°C	3.7871
7	Solar radiation amount Ws	W/cm^2	0.10
8	Initial temprature tp0	°C	0.0
9	Time intervals dt	s	1.0
	•	0	TICA Chil

 Table 5.3.30
 Basic Characteristics for Simulation

Source: JICA Study Team

Result of Temperature rise is shown in following figures below and maximum temperature rise is 9.1°C.

By adding 50°C of air temperature, maximum temperature of trolley wire is 59.1°C which is below permissible temperature of 90°C.



Source: JICA Study Team

Figure 5.3.45 Temperature Rise (Alladin Park TSS, Teaser phase Feeder)

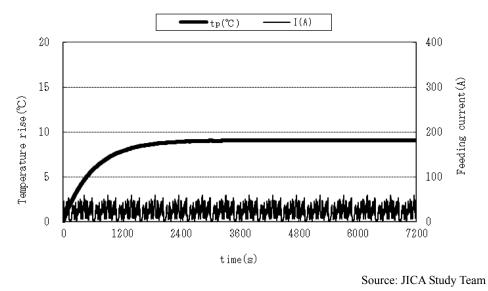


Figure 5.3.46 Temperature Rise (Alladin Park TSS, Main phase Feeder)

d) Power Consumption

Figure 5.3.47 shows power consumption per 15 minutes of Alladin Park TSS. Maximum power consumption per 15 minutes is 1,441kWh.

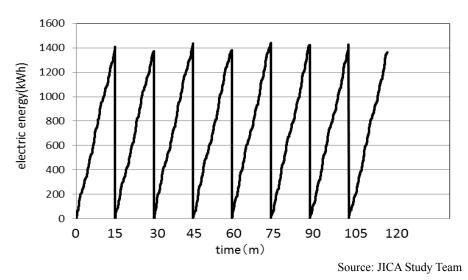


Figure 5.3.47 Power Consumption per 15 Minutes of Alladin Park TSS

e) Power Consumption With and Without Case of Regenerative System

Regenerative power generated by regenerative brake system during decelerating the speed is normally supplied to other accelerating cars on KCR track. This system contributes to reducing energy consumption. The result of power simulation is showing that total power consumption of Alladin Park TSS between 7:00 and 9:00 is 17,751kWh without regenerative system and 11,257kWh with regenerative system. Difference of 6,493kWh is saved by regenerative system and saved efficiency is 36.6%. Furthermore, peak load (max effective power) of 1,428kW is saved by regenerative system with 8.5% efficiency as shown in Table 5.3.31.

Table 5.3.31	Power Consumption With and Without Regenerative Power System	

	substation		ALLADIN	VPARK SS	
Item		regenerat	ive brake	difference	efficiency
		off	on	difference	(%)
Таалат	Max Effective Power(kW)	9105.9	8847	258.9	-
Teaser	Max Reactive Power(kVar)	1925.6	2436.5	-510.9	-
Feeding Bus	Electric Power Consumption(kWh)	8783.2	5853.8	2929.4	33.4
Dus	Average Power Factor	0.98	0.93	0.0	-
Main	Max Effective Power(kW)	10258.9	7329.7	2929.2	-
	Max Reactive Power(kVar)	2146.4	2643.3	-496.9	-
Feeding Bus	Electric Power Consumption(kWh)	8967.8	5403.6	3564.2	39.7
Dus	Average Power Factor	0.98	0.91	0.1	-
Incoming	Max Effective Power(kW)	16867.0	15439.0	1428.0	8.5
Bus	Electric Power Consumption(kWh)	17751.0	11257.4	6493.6	36.6

Note: Efficiency=Difference / Regenerative brake off

Source: JICA Study Team

2) Liyari TSS (N-A1, Normal Feeding)

a) Voltage, Current and Power

i) Maximum & Minimum values of voltage and current

Maximum & Minimum values of voltage, current, power and time of occurrence at Liyari TSS and SP1&2 between 7:00 and 9:00 is shown in Table 5.3.32 below.

		LIYAR	LIYARI SS			
	Item		Occur Time			
	minimum Vuv(kV)	218.965	7:01:06			
	minimum Vvw(kV)	218.415	7:00:05			
Incoming Voltage	minimum Vwu(kV)	219.747	7:02:04			
	Max Effective Power(kW)	22873.8	7:00:06			
	Average Voltage unbalance(%)	0.2				
	minimum Voltage(kV)	27.005	7:03:59			
	Max Current(A)	819.3	7:00:06			
	Max Effective Power(kW)	21582.7	7:00:06			
Teaser Feeding Bus	Max Reactive Power(kVar)	6267.3	7:03:59			
	Electric Power Consumption(kWh)	15302				
	Average Power Factor	0.9				
	Max Current(A)	437	7:21:29			
	Max Effective Power(kW)	11473.9	7:21:29			
Feeding circuit (SP1 end)	Max Reactive Power(kVar)	3234.3	7:26:10			
Up track	minimum Volltage at SP1(kV)	26.704	7:03:59			
	Electric Power Consumption(kWh)	7709.3				
	Average Power Factor	0.9				
	Max Current(A)	451.2	7:06:02			
	Max Effective Power(kW)	11856.8	7:06:02			
Feeding circuit (SP1 end) Down track	Max Reactive Power(kVar)	3587.1	7:01:06			
	minimum Volltage at SP1(kV)	26.704	7:03:59			
	Electric Power Consumption(kWh)	7875.6				
	Average Power Factor	0.9				
	minimum Voltage(kV)	27.35	7:03:39			
	Max Current(A)	216.9	7:00:26			
	Max Effective Power(kW)	5820.6	7:00:26			
Main Feeding Bus	Max Reactive Power(kVar)	2094	7:02:04			
	Electric Power Consumption(kWh)	4258.5				
	Average Power Factor	0.9				
	Max Current(A)	148.4	7:01:57			
	Max Effective Power(kW)	3982.4	7:01:57			
Feeding circuit (SP2 end)	Max Reactive Power(kVar)	1183	7:02:04			
Up track	minimum Volltage at SP2(kV)	27.325	7:01:12			
	Electric Power Consumption(kWh)	2213.2				
	Average Power Factor	0.9				
	Max Current(A)	134.9	7:00:29			
	Max Effective Power(kW)	3623	7:00:29			
Feeding circuit (SP2 end)	Max Reactive Power(kVar)	1099.2	7:00:38			
Down track	minimum Volltage at SP2(kV)	27.325	7:01:12			
	Electric Power Consumption(kWh)	2223.8				
	Average Power Factor	0.9				

Table 5.3.32	Maximum and	Minimum Values	of Li	vari TSS (N-A1)
	Trimmin with a	, initiatin , wiwes			

ii) Receiving Voltage Unbalance and Fluctuation Rate

Figure 5.3.48 shows receiving voltage fluctuation rate and Figure 5.3.49 shows receiving voltage unbalance rate of Liyari TSS. From these figures, maximum voltage fluctuation rates are Vrs:0.47%, Vst:0.72% & Vtr:0.12% and maximum voltage unbalance rate is 0.59%.

As a result, both maximum fluctuation and unbalance rates of receiving voltage are not exceeding 5% which is limited by regulation.

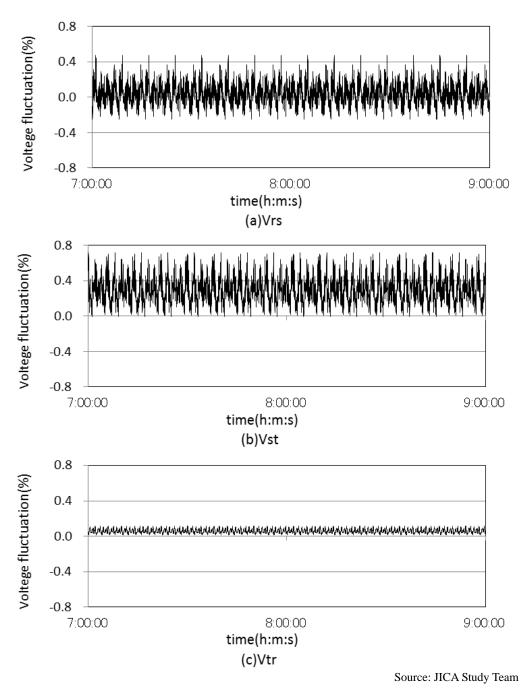


Figure 5.3.48 Fluctuation Rate of Receiving Voltage (Liyari TSS)

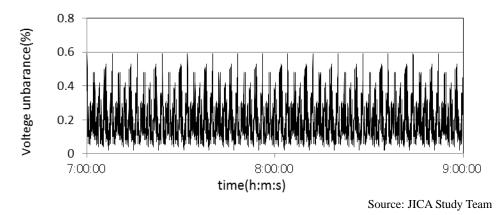


Figure 5.3.49 Unbalance Rate of Receiving Voltage (Liyari TSS)

iii) Receiving Power

Figure 5.3.50 shows receiving power transition between 7:00 and 9:00.

Maximum receiving power is 22,873kW at 7:00:06.

Power consumption for two hours is 19,551kW, while regenerative power which is not consumed by accelerating cars but goes back to power company network is -432kWh.

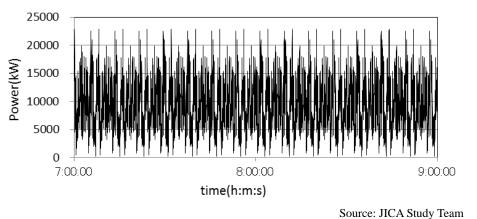


Figure 5.3.50 Receiving Power Transition (Liyari TSS)

iv) Feeding Voltage, Current and Power

Figure 5.3.51 shows feeding voltage, current and power of Main phase feeding bus and Figure 5.3.52 shows that of Teaser phase.

Maximum feeding currents are 217A at Main phase and 819A at Teaser phase bus. Terminal voltage of feeding circuit at SP point is more than 26.7kV during 2 hours which is exceeding minimum feeding voltage of 20KV.

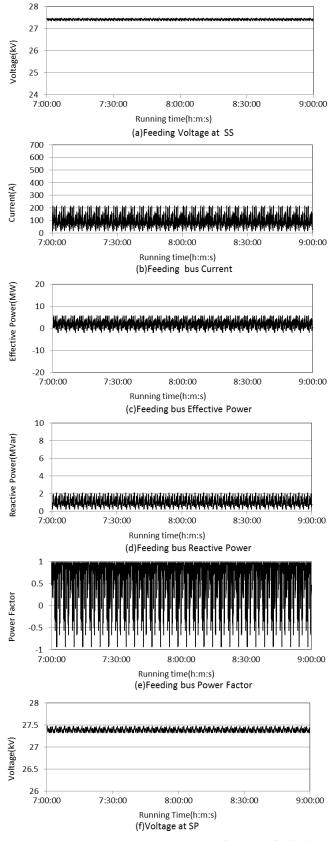


Figure 5.3.51 Feeding Voltage, Current & Power (Main Phase Bus) and Voltage at SP

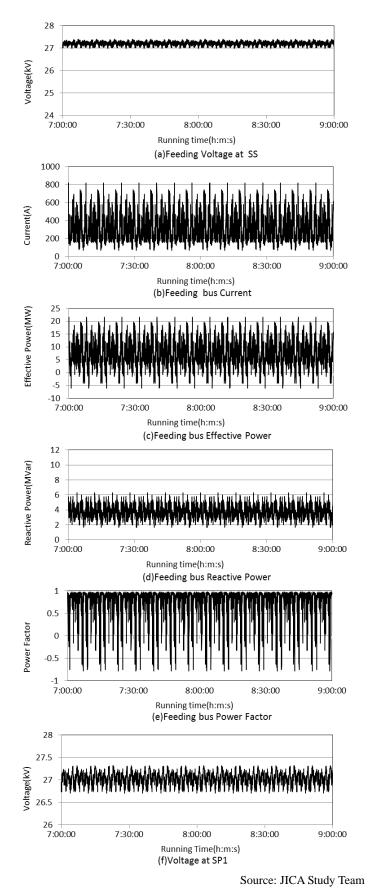


Figure 5.3.52 Feeding Voltage, Current & Power (Teaser Phase Bus) and Voltage at SP

b) Capacity of Transformer

i) Feeding Transformer

The maximum power of Teaser phase of Liyari TSS is 21,582kW as shown in Table 5.3.32. Accordingly 43.2MVA (21.6MVA $\times 2$) is required for total capacity of Scott-Connected transformer because total capacity is the sum of Main phase and Teaser phase capacity. However, taking 30% of safety factor into account, 56MVA will be appropriate capacity

ii) Capacity of AT

ii-1) AT neutral current

In case of Main phase, maximum AT neutral current is 77A at TSS and is 70A at SP as shown in Figure 5.3.53.

In Teaser phase, maximum AT neutral current is 246A at TSS and is 165A at SP as shown in Figure 5.3.54.

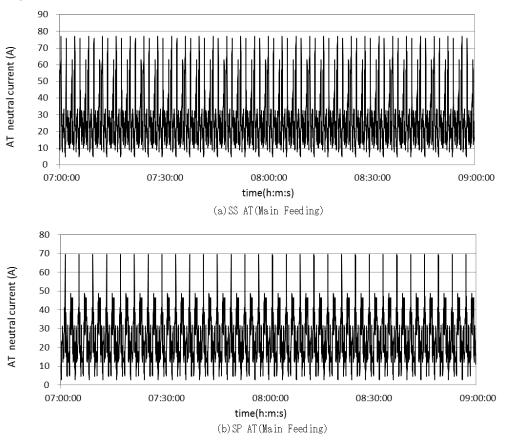


Figure 5.3.53 Neutral Current at Liyari TSS, Main phase Feeder

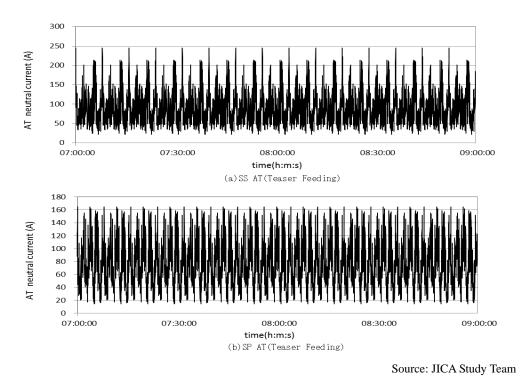
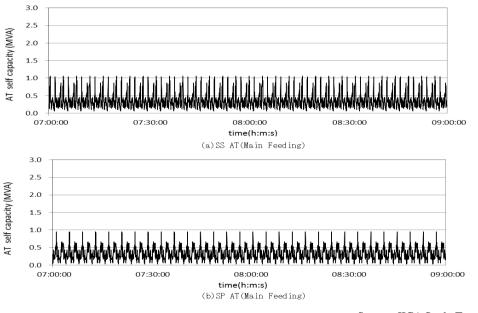


Figure 5.3.54 AT Neutral Current at Liyari TSS, Teaser phase Feeder

ii-2) AT self capacity

In case of Main phase feeder, maximum AT self capacity at TSS is 1,06MVA and at SP is 0.95MVA as shown in Figure 5.3.55. In case of Teaser phase feeder, maximum AT self capacity at TSS is 3.31MVA and at SP is 2.21MVA as shown in Figure 5.3.56.



Source: JICA Study Team

Figure 5.3.55 AT Self Capacity of Main phase Feeder at Liyari TSS

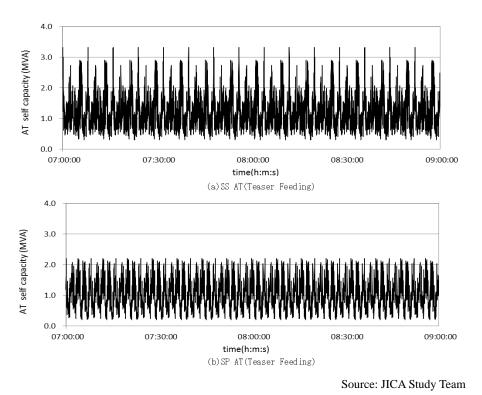


Figure 5.3.56 AT Self Capacity of Teaser phase Feeder at Liyari TSS

Maximum AT neutral current and Maximum AT capacity are summarized in Table 5.3.33 and Table 5.3.34 below.

In case of Main phase feeder of Liyari TSS, maximum AT capacity is 1.06MVA at TSS and 0.95MVA at SP. While in case of Teaser phase feeder, maximum AT capacity is 3.31MVA at TSS and 2.21MVA at SP.

	Max AT neutral current				mean-square value			
aubatatian	Main f	eeding	g Teaser Feeding		Main feeding		Teaser Feeding	
substation	SS	SP	SS	SP	SS	SP	SS	SP
	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)
LIYARI	77	70	246	165	31	27	101	85

Table 5.3.33Maximum AT Neutral Current

Source: JICA Study Team

		Max self capacity				
substation	Main f	Main feeding		Feeding		
substation	SS	SP	SS	SP		
	(MVA)	(MVA)	(MVA)	(MVA)		
LIYARI	1.06	0.95	3.31	2.21		

Table 5.3.34Maximum AT Capacity

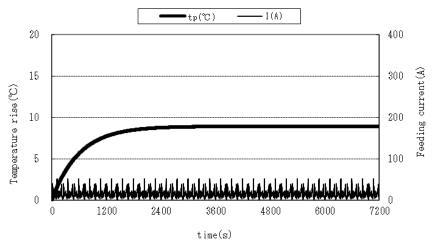
Source: JICA Study Team

c) Temperature Rise of Trolley Wire

Basic characteristics used for simulation:

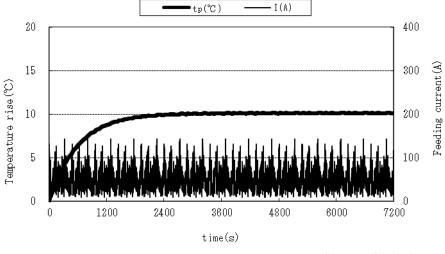
- a. Trolley wire: PHC110mm², Messenger wire PH150mm²
- b. Diameter of trolley wire: 0.617 cm
- c. Wind speed: 0.5m/s
- d. Current shared ratio: Trolley wire 39%, Messenger wire 61%

Result of Temperature rise is shown in following figures and maximum temperature rise is 10.1°C. By adding 50°C of outdoor air temperature, maximum temperature of trolley wire is 60.1°C which is below limited temperature of 90°C.



Source: JICA Study Team

Figure 5.3.57 Temperature Rise (Liyari TSS, Main phase Feeder)



Source: JICA Study Team

 Figure 5.3.58
 Temperature Rise (Liyari TSS, Teaser phase Feeder)

d) Power Consumption of TSS

i) Power Consumption

Maximum power consumption per 15 minutes is 2,477kWh of Liyari TSS as shown below.

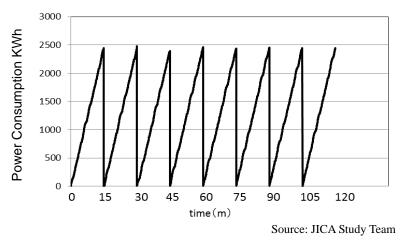


Figure 5.3.59 Power Consumption per 15 Minutes of Liyari TSS

ii) Power Consumption With and Without Case of Regenerative System

Regenerative power generated by electric cars with regenerative brake system while cars are decelerating the speed is normally supplied to other accelerating cars on KCR track. This system contributes to realizing lower energy consumption. The result of power simulation is showing that total power consumption of Liyari TSS without using regenerative system between two hours is 34,015Wh and power consumption with using regenerative system is 19,560kWh. Difference of 14,454kWh is saved by regenerative system and efficiency is 42.5%.

	substation		LIYA	ARI SS	
Item		regenerat	ive brake	difference	efficiency
iten		off	on	difference	(%)
Teaser	Max Effective Power(kW)	22383	21582.7	800.3	-
Feeding	Max Reactive Power(kVar)	5084.5	6267.3	-1182.8	-
Bus	Electric Power Consumption(kWh)	26423.5	15302	11121.5	42.1
Dus	Average Power Factor	0.98	0.9	0.1	-
Main	Max Effective Power(kW)	6569.8	5820.6	749.2	-
	Max Reactive Power(kVar)	1357.8	2094	-736.2	-
Feeding Bus	Electric Power Consumption(kWh)	7591.7	4258.5	3333.2	43.9
DUS	Average Power Factor	0.98	0.9	0.1	-
Incoming	Max Effective Power(kW)	26868.0	22874.0	3994.0	14.9
Bus	Electric Power Consumption(kWh)	34015.2	19560.5	14454.7	42.5

 Table 5.3.35
 Power Consumption With and Without Regenerative Power System

Note: Efficiency=Difference / Regenerative brake off

Source: JICA Study Team

3) Voltage at Pantograph of Electric Car

Minimum voltage at pantograph point is around 26.6kV which is exceeding minimum feeding voltage of 20KV as shown in following figure.

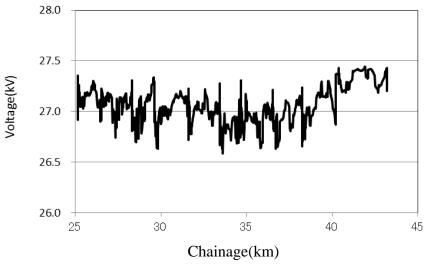
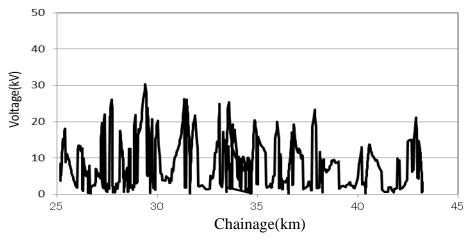


Figure 5.3.60 Voltage at Pantograph of Electric Car between Liyari SS and SP

4) Rail Voltage in Normal Train Operation With Protective Wire (PW) Earthing

Figure 5.3.61 shows rail voltage with PW earthing case. Maximum rail voltage is 30.4V which is not exceeding 120V limited by regulation.



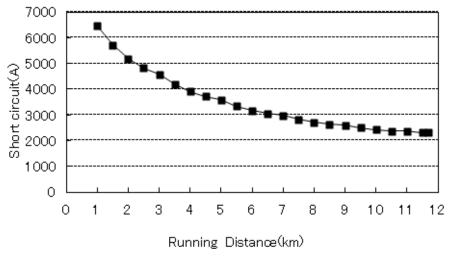
Source: JICA Study Team

Figure 5.3.61 Rail Voltage between TSS and SP in Case of PW Earthing

5) Case of Short Circuit Fault

a) Fault Current

Figure 5.3.62 shows fault current in case of short circuit failure between Trolley wire and Rail. Maximum and minimum fault current are 6,452A and 2,321A respectively.

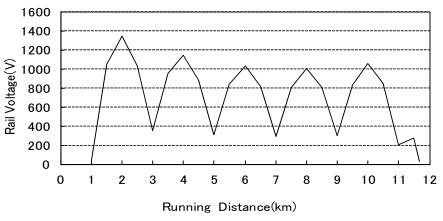


Source: JICA Study Team

Figure 5.3.62 Fault Current (Short Circuit between Trolley and Rail)

b) Rail Voltage with PW Earthing Case

Figure 5.3.63 shows rail voltage with PW earthing case when short circuit failure occurs between Trolley wire and Rail. Maximum rail voltage is 1,342V and fault current is 5,202A (Figure 5.3.62) in case that short circuit fault occurs at 2kM from TSS.

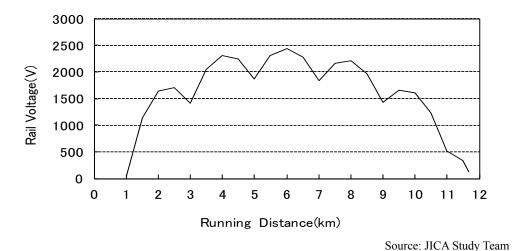


Source: JICA Study Team

Figure 5.3.63 Rail Voltage in Case of Short Circuit Fault (With PW Earthing Case)

c) Rail Voltage without PW Earthing Case

Figure 5.3.64 shows rail voltage without PW earthing case when short circuit failure occurs between Trolley wire and Rail. Maximum rail voltage is 2,438V and fault current is 3,176A (Figure 5.3.62) in case that short circuit fault occurs at 6KM from TSS.





d) **PW Earthing and Buried Earth Conductor**

From the result of Rail Voltage simulation in case short circuit fault occurs, PW has to be connected to earthing to reduce the rail voltage which does not exceed permissible level.

However, at detailed design stage, in order to install PW Earthing properly, earthing methods should be further reviewed and examined by measuring actual earthing resistance along KCR route. Besides, it is also required to clarify the necessity of Buried Earth Conductor based on the results of earthing resistance. If earthing resistance can't meet the minimum requirement, Buried Earth Conductor might be necessary to reduce the rail voltage for safety reason.

6) Liyari TSS (N-A1, Extended Feeding)

a) Voltage, Current and Power

i) Maximum and Minimum Values of Voltage, Current and Power

Maximum & minimum voltage, current, power and time of occurrence of Liyari TSS and SPs between 7:00 and 9:00 at peak hour is shown in Table 5.3.36.

Item S minimum Vuv(kV) minimum Vvv(kV) Incoming Voltage minimum Vvv(kV) Max Effective Power(kW) Average Voltage unbalance(%) Average Voltage unbalance(%) minimum Voltage(kV) Max Effective Power(kW) Max Effective Power(kW) Max Effective Power(kW) Max Reactive Power(kVar) Electric Power Consumption(kWh) Average Power Factor Max Effective Power(kA) Max Effective Power(kW) Feeding circuit (SP1 end) Max Reactive Power(kVar) Up track minimum Volltage at SP1(kV)	LIYARI Simulation Result 218.805 218.312 219.495 28679 0.2 26.873 906.1 23660.6	Occur Time 7:01:06 7:05:29 7:03:11 7:08:06 - 7:08:09
Incoming Voltage minimum Vvw(kV) i Max Effective Power(kW) A Average Voltage unbalance(%) i Average Voltage unbalance(%) i Max Effective Power(kW) i Max Effective Power(kW) i Max Effective Power(kW) i Max Effective Power(kW) i Max Reactive Power(kWar) i Electric Power Consumption(kWh) i Average Power Factor i Max Effective Power(kW) i Feeding circuit (SP1 end) i Max Reactive Power(kVar) i	218.312 219.495 28679 0.2 26.873 906.1	7:05:29 7:03:11 7:08:06 –
Incoming Voltage minimum Vwu(kV) Max Effective Power(kW) Average Voltage unbalance(%) minimum Voltage(kV) Max Current(A) Max Effective Power(kW) Max Reactive Power(kVar) Electric Power Consumption(kWh) Average Power Factor Max Effective Power(kW) Feeding circuit (SP1 end) Max Reactive Power(kVar) Max Reactive Power(kVar) Max Effective Power(kVar) Max Reactive Power(kVar) Max Reactive Power(kVar) Max Reactive Power(kVar) Max Reactive Power(kVar) Max Reactive Power(kVar)	219.495 28679 0.2 26.873 906.1	7:03:11 7:08:06 -
Max Effective Power(kW) Average Voltage unbalance(%) minimum Voltage(kV) Max Current(A) Max Effective Power(kW) Max Reactive Power(kVar) Electric Power Consumption(kWh) Average Power Factor Max Effective Power(kW) Feeding circuit (SP1 end) Max Reactive Power(kVar)	28679 0.2 26.873 906.1	7:08:06 –
Average Voltage unbalance(%) minimum Voltage(kV) Max Current(A) Max Effective Power(kW) Max Reactive Power(kVar) Electric Power Consumption(kWh) Average Power Factor Max Effective Power(kW) Feeding circuit (SP1 end) Max Reactive Power(kVar)	0.2 26.873 906.1	_
minimum Voltage(kV) Max Current(A) Max Effective Power(kW) Max Reactive Power(kVar) Electric Power Consumption(kWh) Average Power Factor Max Effective Power(kW) Feeding circuit (SP1 end) Max Reactive Power(kVar)	26.873 906.1	 7:08:09
Teaser Feeding Bus Max Current(A) Max Effective Power(kW) Max Reactive Power(kVar) Electric Power Consumption(kWh) Average Power Factor Max Effective Power(A) Max Effective Power(kW) Feeding circuit (SP1 end) Max Reactive Power(kVar)	906.1	7:08:09
Teaser Feeding Bus Max Effective Power(kW) Max Reactive Power(kVar) Electric Power Consumption(kWh) Average Power Factor Max Current(A) Max Effective Power(kW) Max Effective Power(kW) Feeding circuit (SP1 end) Max Reactive Power(kVar)		
Max Reactive Power(kVar) Electric Power Consumption(kWh) Average Power Factor Max Current(A) Max Effective Power(kW) Feeding circuit (SP1 end)	23660.6	7:08:06
Max Reactive Power(kVar) Electric Power Consumption(kWh) Average Power Factor Max Current(A) Max Effective Power(kW) Feeding circuit (SP1 end) Max Reactive Power(kVar)	20000.0	7:08:06
Average Power Factor Max Current(A) Max Effective Power(kW) Feeding circuit (SP1 end) Max Reactive Power(kVar)	7845.5	7:01:06
Max Current(A) Max Effective Power(kW) Feeding circuit (SP1 end) Max Reactive Power(kVar)	20014.5	-
Max Current(A) Max Effective Power(kW) Feeding circuit (SP1 end) Max Reactive Power(kVar)	0.90	-
Max Effective Power(kW) Feeding circuit (SP1 end) Max Reactive Power(kVar)	491.9	7:21:29
Feeding circuit (SP1 end) Max Reactive Power(kVar)	12774.7	7:21:29
Up track minimum Volltage at SP1(kV)	4116	7:21:35
	26.392	7:30:18
Electric Power Consumption(kWh)	9944.5	_
Average Power Factor	0.9	_
Max Current(A)	487.9	7:06:02
Max Effective Power(kW)	12745.3	7:06:02
Feeding circuit (SP1 end) Max Reactive Power(kVar)	4427.5	7:01:06
Down track minimum Volltage at SP1(kV)	26.392	7:30:18
Electric Power Consumption(kWh)	10223.2	_
Average Power Factor	0.9	_
minimum Voltage(kV)	27.182	7:03:11
Max Current(A)	393.3	7:03:11
Max Effective Power(kW)	10307	7:00:12
Main Feeding Bus Max Reactive Power(kVar)	3979.7	7:03:11
Electric Power Consumption(kWh)	9182.5	_
Average Power Factor	0.89	_
Max Current(A)	219.5	7:00:12
Max Effective Power(kW)	5794	7:00:12
Feeding circuit (SP2 end) Max Reactive Power(kVar)	2122.8	7:03:09
Up track minimum Volltage at SP2(kV)	26.92	7:03:11
Electric Power Consumption(kWh)	4623.2	_
Average Power Factor	0.9	_
Max Current(A)	218.9	7:01:05
Max Effective Power(kW)	5854.6	7:01:05
Feeding circuit (SP2 end) Max Reactive Power(kVar)	1930	7:00:37
Down track minimum Volltage at SP2(kV)	26.92	7:03:11
Electric Power Consumption(kWh)	4693.8	-
Average Power Factor	100010	

Maximum receiving power of Liyari TSS is 28,679kW at 7:08:06.

Power consumption for two hours is 29,186kW, while regenerative power which is not consumed by power running cars but goes back to power company network is -196kWh.

ii) Receiving Voltage Unbalance and Fluctuation Rate

Figure 5.3.65 shows receiving voltage fluctuation rate and Figure 5.3.66 shows receiving voltage unbalance rate of Alladin Park TSS. The maximum voltage fluctuation rate of Alladin Park TSS are Vrs:0.54%, Vst:0.77% & Vtr:0.23% and the maximum voltage unbalance rate is 0.61%.

As a result, both maximum receiving voltage fluctuation and unbalance rate do not exceed 5% which is limited by regulation.

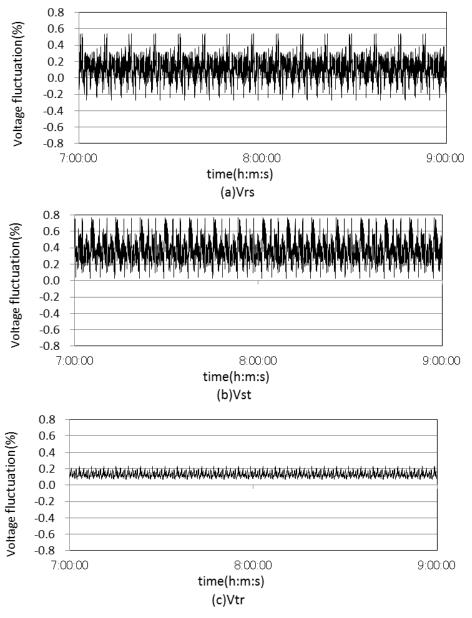
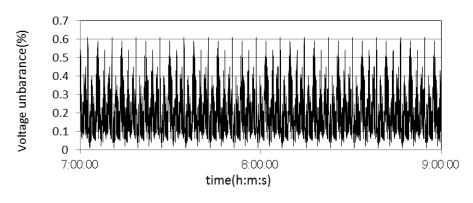


Figure 5.3.65 Fluctuation Rate of Receiving Voltage in Extended Feeding (Liyari TSS)



Source: JICA Study Team

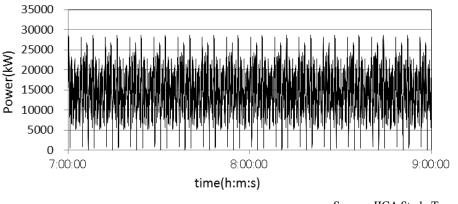
Figure 5.3.66 Unbalance Rate of Receiving Voltage in Extended Feeding (Liyari TSS)

iii) Receiving Power

Figure 5.3.67 shows receiving power transition between 7:00 and 9:00.

Maximum receiving power is 28,679kW at 7:08:06.

Power consumption for two hours is 29,816kWh, while regenerative power which is not consumed by power running cars but goes back to power company network is -196kWh.



Source: JICA Study Team

Figure 5.3.67 Receiving Power Transition (Liyari TSS)

iv) Feeding Voltage, Current and Power

Figure 5.3.68 and Figure 5.3.69 show feeding voltage, current and power of Main phase and Teaser phase feeding bus.

Maximum feeding currents are 393A at Main phase and 906A at Teaser phase. Terminal voltage of feeding circuit at SP point is 26.9KV at Main phase feeding circuit and 26.4KV at Teaser phase feeding circuit throughout 2 hours. Both of them are exceeding minimum feeding voltage of 20KV.

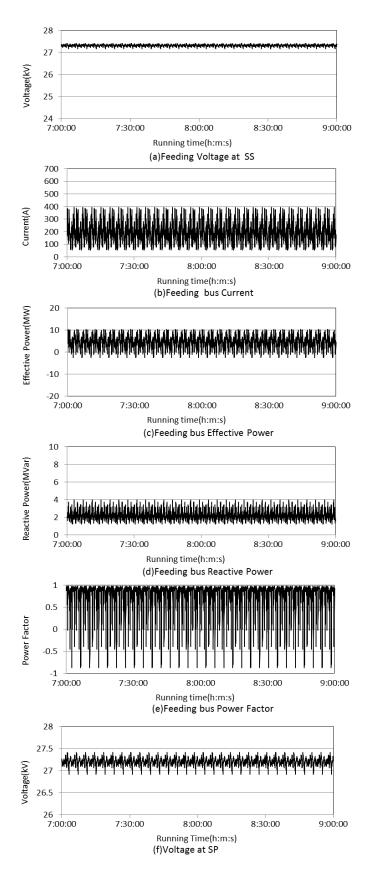


Figure 5.3.68 Feeding Voltage, Current & Power (Main Phase Bus) and Voltage at SP

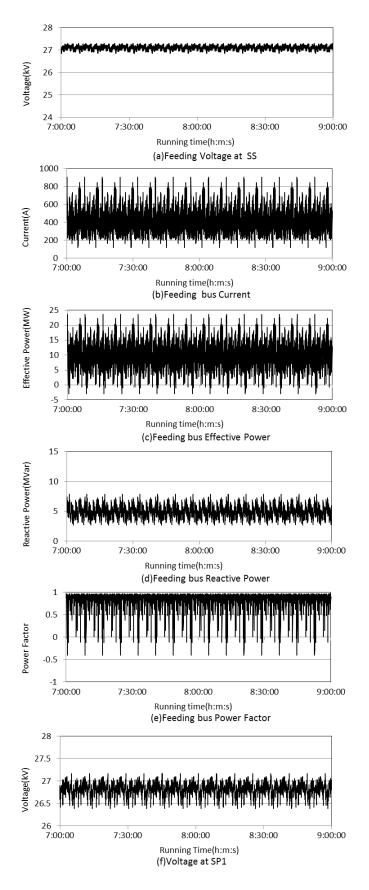


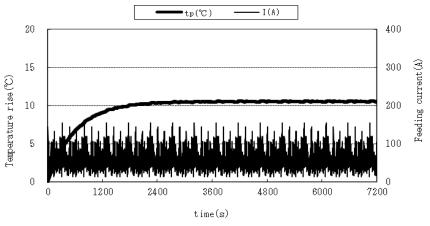
Figure 5.3.69 Feeding Voltage, Current & Power (Teaser Phase Bus) and Voltage at SP

b) Capacity of Feeding Transformer

The maximum power of Teaser phase feeding bus is 23,661KW as shown in Table 5.3.36. Accordingly 47.3MVA (23.66MVA \times 2) is required for total capacity of Scott-connected Transformer because total capacity is the sum of Main phase feeding and Teaser phase feeding circuit capacity. Taking 30% of safety factor into account, 62MVA will be appropriate capacity of feeding transformer.

c) Temperature Rise of Trolley Wire

Result of Temperature rise is shown in following figures and maximum temperature rise is 10.6°C. By adding 50°C of outdoor air temperature, maximum temperature of trolley wire is 60.6°C which is below limited temperature of 90°C.

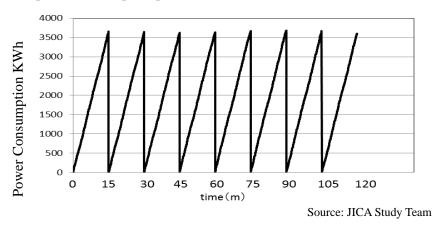


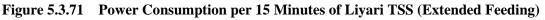
Source: JICA Study Team

Figure 5.3.70 Temperature Rise (Teaser phase Feeder)

d) **Power Consumption of TSS**

Maximum power consumption per 15 minutes is 3,678kWh.





e) Voltage at Pantograph of Electric Car

Minimum voltage at pantograph is around 26.3kV which is exceeding minimum feeding voltage of 20kV.

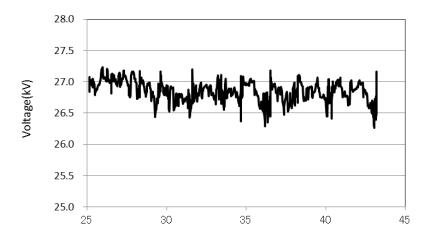


Figure 5.3.72 Voltage at Pantograph of Electric Car

f) Power Consumption With and Without Case of Regenerative System

The result of power simulation is showing that total power consumption of Liyari TSS between 7:00 and 9:00 is 51,446kWh without using regenerative power system and 29,197kWh with using regenerative power. Difference of 22,249kWh is saved by regenerative system and efficiency is 43.2 %.

Substation		LIYARI SS			
Item		regenerative brake		difference	efficiency
		off	on	difference	(%)
Teaser Feeding Bus	Max Effective Power(kW)	28724	23660.6	5063.4	-
	Max Reactive Power(kVar)	7222	7845.5	-623.5	-
	Electric Power Consumption(kWh)	34946.6	20014.5	14932.1	42.7
	Average Power Factor	0.97	0.9	0.1	-
Main Feeding Bus	Max Effective Power(kW)	15068.3	10307	4761.3	-
	Max Reactive Power(kVar)	3224.9	3979.7	-754.8	-
	Electric Power Consumption(kWh)	16499.8	9182.5	7317.3	44.3
	Average Power Factor	0.98	0.89	0.1	-
Incoming Bus	Max Effective Power(kW)	38407.0	28679.0	9728.0	25.3
	Electric Power Consumption(kWh)	51446.4	29197.0	22249.4	43.2

 Table 5.3.37
 Power Consumption With and Without Regenerative Power System

Note: Efficiency=Difference / Regenerative brake off

7) Liyari TSS (N-B1:Supply for Shah Abdul Latif - Drigh Road Line)

In this train operation, single TSS system is applied since power consumption is smaller than circular line. Liyari TSS is selected as single traction substation for KCR due to its location. Simulation was conducted between 7:00 and 8:00 because of short distance.

a) Voltage, Current and Power

i) Maximum and Minimum Values of Voltage, Current and Power

Maximum & minimum voltage, current, power and time of occurrence of Liyari TSS and ATP between 7:00 and 8:00 at peak hour is shown in Table 5.3.38.

Maximum receiving power of Liyari TSS is 29,674kW at 7:16:09.

Item minimum Vuv(kV) minimum Vvw(kV)	Simulation Result 219.152	Occur Time
minimum Vvw(kV)		7.00.00
		7:00:22
	217.838	7:16:35
Incoming Voltage minimum Vwu(kV)	219.734	7:00:19
Max Effective Power(kW)	29674.9	7:16:09
Average Voltage unbalance(%)	0.26	-
minimum Voltage(kV)	26.905	7:00:20
Max Current(A)	997.1	7:16:09
Max Effective Power(kW)	26236.6	7:16:09
Teaser Feeding Bus Max Reactive Power(kVar)	7758	7:00:20
Electric Power Consumption(kWh)	8989.3	-
Average Power Factor	0.9	-
Max Current(A)	498.7	7:16:09
Max Effective Power(kW)	13118.2	7:16:09
Feeding circuit (SP1 end) Max Reactive Power(kVar)	3760.2	7:48:20
Up track minimum Volltage at SP1(kV)	26.401	7:00:19
Electric Power Consumption(kWh)	4728.7	-
Average Power Factor	0.91	_
Max Current(A)	498.4	7:00:09
Max Effective Power(kW)	13118.4	7:00:09
Feeding circuit (SP1 end) Max Reactive Power(kVar)	3997.7	7:00:20
Down track minimum Volltage at SP1(kV)	26.401	7:00:19
Electric Power Consumption(kWh)	4389.2	-
Average Power Factor	0.89	_
minimum Voltage(kV)	27.323	7:00:19
Max Current(A)	372.5	7:00:35
Max Effective Power(kW)	9736	7:00:19
Main Feeding Bus Max Reactive Power(kVar)	2075.9	7:00:35
Electric Power Consumption(kWh)	2053.3	
Average Power Factor	0.96	-
Max Current(A)	214.9	7:00:12
Max Effective Power(kW)	5750.3	7:00:12
Feeding circuit (SP2 end) Max Reactive Power(kVar)	1192.1	7:00:12
Up track minimum Volltage at SP2(kV)	27.273	7:00:19
Electric Power Consumption(kWh)	945.4	-
Average Power Factor	0.95	-
Max Current(A)	211.6	7:00:35
Max Effective Power(kW)	5550.1	7:02:39
Feeding circuit (SP2 end) Max Reactive Power(kVar)	1179.6	7:00:35
Down track minimum Volltage at SP2(kV)	27.273	7:00:19
Electric Power Consumption(kWh)	1130.2	
Average Power Factor	0.96	_

 Table 5.3.38
 Maximum and Minimum Values of Liyari TSS (N-B1)

ii) Receiving Voltage Unbalance and Fluctuation Rate

Figure 5.3.73 shows receiving voltage fluctuation rate and Figure 5.3.74 shows receiving voltage unbalance rate of Liyari TSS. The maximum voltage fluctuation rates are Vrs:0.39%, Vst:0.98% & Vtr:0.12% and the maximum voltage unbalance rate is 0.87%.

As a result, both maximum receiving voltage fluctuation and unbalance rate do not exceed 5% which is limited by regulation.

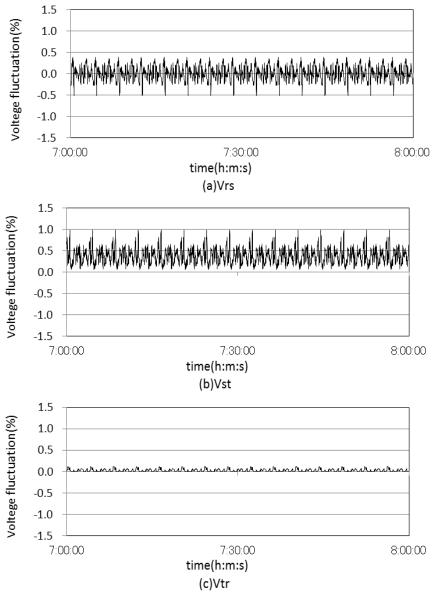
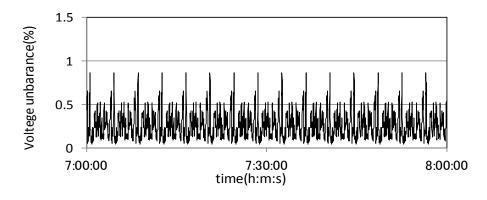


Figure 5.3.73 Fluctuation Rate of Receiving Voltage (Liyari TSS)



Source: JICA Study Team

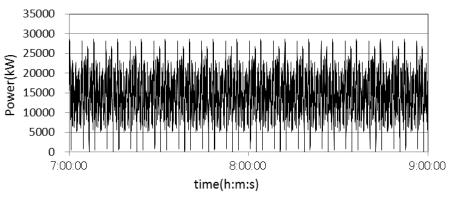
Figure 5.3.74 Unbalance Rate of Receiving Voltage (Liyari TSS)

iii) Receiving Power

Figure 5.3.75 shows receiving power transition of Liyari TSS between 7:00 and 8:00.

Maximum receiving power is 29,674kW at 7:16:09.

Power consumption for one hour is 11,029kWh, while regenerative power which is not consumed by accelerating cars but goes back to power company network is -679kWh.



Source: JICA Study Team

Figure 5.3.75 Receiving Power Transition (Liyari TSS)

iv) Feeding Voltage, Current and Power

Figure 5.3.76 and Figure 5.3.77 show feeding voltage, current and power of Main phase and Teaser phase feeding bus of Liyari TSS.

Maximum feeding currents are 373A at Main phase bus and 997A at Teaser phase bus. Minimum terminal voltage of feeding circuit at SP point is 26.4kV which is exceeding minimum feeding voltage of 20kV.

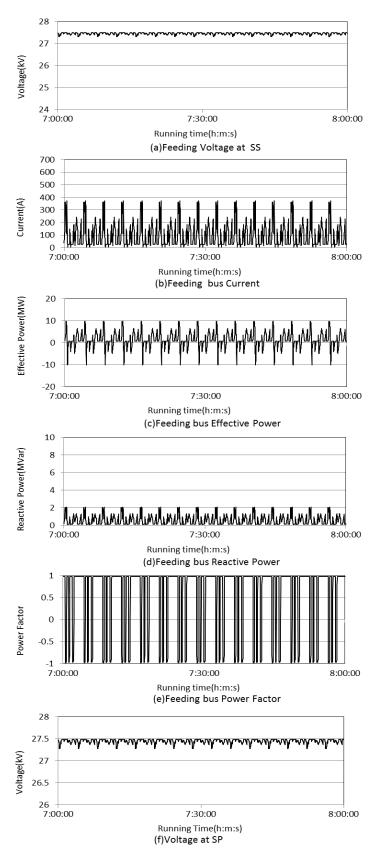


Figure 5.3.76 Feeding Voltage, Current & Power (Main Phase Bus) and Voltage at ATP

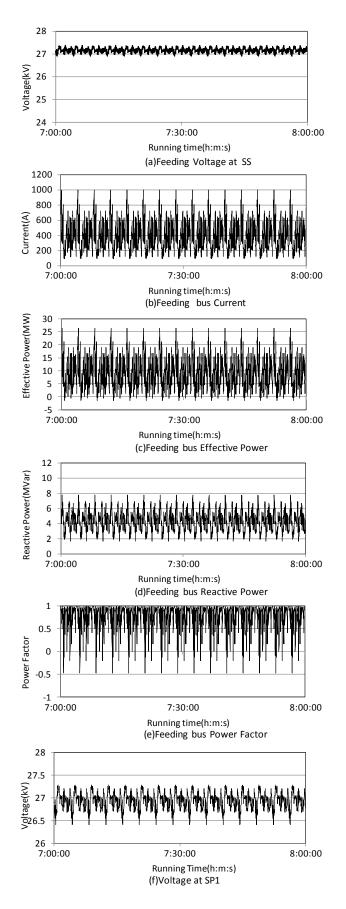


Figure 5.3.77 Feeding Voltage, Current & Power (Teaser Phase Bus) and Voltage at ATP

b) Capacity of Transformer

i) Feeding Transformer

The maximum power of Teaser phase feeding bus is 26,236KW as shown in Table 5.3.38. Accordingly 52.4MVA (26.2MVA $\times 2$) is required for total capacity of Scott-connected transformer because total capacity is the sum of Main phase feeding and Teaser phase feeding circuit capacity. Taking 30% of safety factor into account, 68MVA will be appropriate capacity of feeding transformer.

ii) Auto Transformer (AT)

Maximum AT neutral current is shown in Table 5.3.39 and Maximum AT capacity is shown Table 5.3.40. In case of Teaser phase feeder of Liyari TSS, maximum AT capacity is 2.77MVA at TSS 2.95MVA at SSP and 1.76MVA at ATP. While in case of Main phase feeder, maximum AT capacity is 1.08MVA at TSS and 1.49 MVA at ATP.

 Table 5.3.39
 Maximum and Mean-Square Value of AT Neutral Current

		Max A	T neutral c	urrent	
substation	Τe	easer Feedi	Main feeding		
substation	SS	SSP	ATP	SS	ATP
	(A)	(A)	(A)	(A)	(A)
LIYARI	206	222	133	79	109

Source: JICA Study Team

		Ma	x self capa	city	
substation	Τe	easer Feedi	Main feeding		
substation	SS	SSP	ATP	SS	ATP
	(MVA)	(MVA)	(MVA)	(MVA)	(MVA)
LIYARI	2.77	2.95	1.76	1.08	1.49

Table 5.3.40Maximum AT Capacity

Source: JICA Study Team

c) Temperature Rise of Trolley Wire

Result of Temperature rise is shown in following figures and maximum temperature rise is 10.4°C. By adding 50°C of outdoor air temperature, maximum temperature of trolley wire is 60.4°C which is below limited temperature of 90°C.

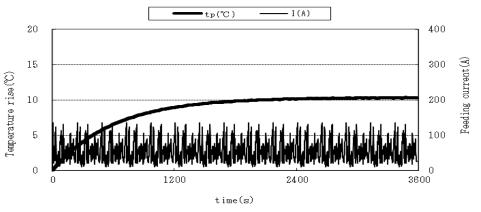


 Figure 5.3.78
 Temperature Rise (Teaser Phase Feeder)

d) Power Consumption of TSS

Figure 5.3.79 shows power consumption per 30 minutes of Liyari TSS. Maximum power consumption per 30 minutes is 2,790kWh.

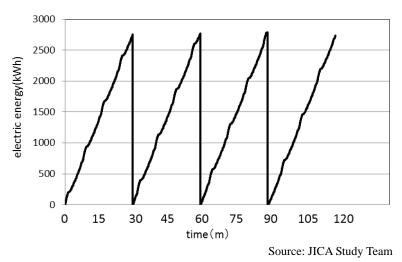
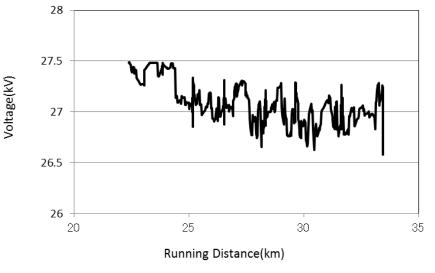


Figure 5.3.79 Power Consumption per 30 Minutes of Liyari TSS (Extended Feeding)

e) Voltage at Pantograph Point of Electric Car

Minimum voltage at pantograph point is around 26.6kV which is exceeding minimum feeding voltage of 20kV.

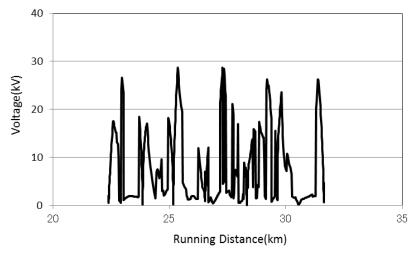


Source: JICA Study Team

Figure 5.3.80 Voltage at Pantograph Point of Electric Car

i) Rail Voltage With PW (Protective Wire) Earthing"

Figure 5.3.81 shows rail voltage with PW earthing case. Maximum rail voltage is 28.7kV which is not exceeding 120kV limited by regulation.



Source: JICA Study Team

Figure 5.3.81 Rail Voltage with PW Earthing

f) Power Consumption With and Without Case of Regenerative System

The result of power simulation is showing that total power consumption of Liyari TSS between 7:00 and 8:00 is 17,985kWh without using regenerative power system and 11,042kWh with using regenerative power. Difference of 6,942kWh is saved by regenerative system and efficiency is 38.6 %.

Table 5.3.41	Power Consumption With an	d Without Regenerative Power System
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	substation		LIYA	ARI SS	
Item		regenerat	ive brake	difference	efficiency
nem		off	on	unterence	(%)
Teaser	Max Effective Power(kW)	26236.6	26236.6	0.0	-
Feeding	Max Reactive Power(kVar)	6016.5	7758	-1741.5	-
Bus	Electric Power Consumption(kWh)	15704.6	8989.3	6715.3	42.8
Dus	Average Power Factor	0.98	0.9	0.1	-
Main	Max Effective Power(kW)	9736	9736	0.0	-
Feeding	Max Reactive Power(kVar)	2017.4	2075.9	-58.5	-
Bus	Electric Power Consumption(kWh)	2280.6	2053.3	227.3	10.0
DUS	Average Power Factor	0.98	0.96	0.0	-
Incoming	Max Effective Power(kW)	35602.0	29675.0	5927.0	16.6
Bus	Electric Power Consumption(kWh)	17985.2	11042.6	6942.6	38.6

Note: Efficiency=Difference / Regenerative brake off

5.3.5 Power Distribution Facility

(1) Current Conditions

1) Distribution Facility of KESC

In KESC grid stations, most current distribution equipment such as transformers, distribution apparatus, and control panels are from abroad. Sizes are a bit bigger compared to Japanese.

2) Distribution Facility of the Currently Inactive KCR

According to the result of the site survey, there are no distribution facilities in the currently inactive circular line.

3) Local Procurement of Distribution Equipment, Electric Wire, and Power Cable

Since 11kV power cables are commonly used for distribution equipment and manufactured locally, procurement is expected to be easy. Many other types of wires are expected to be procured locally, as well. However, technical specifications need to be carefully checked in accordance with Japanese standards.

(2) Planning of the Distribution Facility

Normally, distribution systems consist of the following:

- High Voltage Distribution Lines
- Switching Rooms
- Power Distribution Facilities for the Stations, the OCC, and the Rolling Stock Workshop
- Lighting Facilities for the Two Depots
- Power Distribution Facilities along the Railway Tracks

Designing policies for each distribution facility are as follows:

1) High Voltage Distribution Lines

a) Power Supply

Electric power to high voltage distribution lines will be supplied from Liyari and Alladin Park traction substations (TSS) through three-phase 11kV distribution cable (double circuit) installed between substations. Two 11kV distribution transformers will be installed in TSS.

Three-phase 11kV distribution cable for rolling stock depot is installed dedicatedly from the Liyari TSS.

b) Technical Standards for Laying Cable

Elevated and Underground Sections: in- duct

On-ground Sections: underground

For laying cables, Pakistan Technical Standards will be applied.

c) Types of Power Cables

Cross Linked Polyethylene (XLPE) cable common in Pakistan will be used, taking into consideration ease of future maintenance work.

Fire prevention cable will be used for the U-Shaped retaining wall section.

2) Switching Rooms

31 switching rooms will be constructed at each station, maintenance depots, the OCC, and the rolling stock depot.

a) Power Supply for Switching Rooms

Power will be supplied through double circuit (No1 and No2) 11kV high voltage distribution lines installed between TSS.

An emergency diesel generator will be installed at underground stations and the Wazir Mansion rolling stock depot.

Alladin Park and Johar are underground stations where an emergency diesel generator will be installed in case of emergency with no power supply from TSS. Because important machinery and equipment for safety measures such as fire extinguishing, smoke extraction equipment, tunnel lighting and drainage pumping machine are installed at underground stations.

Alladin Park rolling Stock Depot is also where an emergency diesel generator will be installed in case of emergency with no power supply from TSS. Electric power for the maintenance depot, OCC, and rolling stock workshop is supplied from Liyari TSS through double circuit 11kV high voltage distribution lines. To handle an emergency situation with no power supply from TSS, an emergency diesel generator is installed in the OCC. Because the OCC has various important facilities for safe train operation control and the OCC must be kept in operating condition at anytime.

b) Distribution Panels in Switching Rooms

Distribution panels in switching room consist of

- high voltage distribution panel
- · low voltage distribution panel

3) Power Distribution Facility for Stations, the OCC and the Rolling Stock Workshop

A distribution system for stations, the OCC, and the rolling stock workshop will be installed based on each of their requirements.

4) Lighting Facilities for the Two Depots

Mercury lamps on beams will be used for the lighting system to illuminate entire tracks in depot. In addition, bracket and pole lights will also be used for lighting in depot.

5) **Power Distribution Facilities along the Railway Track**

Tunnel Lighting

In the tunnel section near Alladin Park and Liyari stations, tunnel lighting will be installed along railway tracks with intervals of 20m. Electric power will be supplied through distribution lines from each station.

• Drainage Pumping Facilities

In underground stations, drainage pumps will be installed to drain ground and rain water.

(3) Issues to be solved

1) Load Demand Estimation

Accurate load demand estimation will be required for appropriate planning of distribution facility at basic design stage.

2) Theft Prevention

To prevent theft of distribution cables on the ground, proper countermeasures for theft will be required. A survey for theft prevention method applied to existing electric power company should be conducted to get useful information.

3) Layout Plan for Switching Rooms

A layout plan for switching rooms in stations, the OCC and rolling stock workshop should be carefully checked to avoid interference with signaling & telecommunication equipment and air-conditioning machinery.

4) Space for Emergency Diesel Generator

Since an emergency generator is installed at underground stations and the OCC, coordination is required to properly accommodate the generator considering the layout plan of other facilities.

5) Fire Prevention Standard

Fire prevention standard applied to KCR should be carefully reviewed and examined with KUTC.

5.3.6 Overhead Contact System

(1) Results of the On-Site Investigation

In the previous SAPROF (I) study, a comparison about Alternate-Current (AC) and Direct-Current (DC) electrification systems is mainly conducted, and description of the Overhead Contact System (OCS) facilities is hardly found. However, the composition of the overhead wires has been described that in case of an AC electrification system being used, SAPROF (I) recommends a simple catenary system which consists of contact wire for Cu110mm2 and messenger wire for Cu60mm2. In this study, based on the conclusion of the previous SAPROF (I) study, OCS facilities will be built on the assumption that an AC electrification system with an AT feeding system of 2x25 kV will be used. Although the feeding voltage is the same as that of a Shinkansen in Japan, KCR does not require such for high speed train operation due to urban railway systems operating at slower speeds. The OCS will be built by referring to "Tsukuba Express" which adequately accommodates these conditions and introduced the latest railway system in Japan.

1) Data and Information Collected in the Field Study

a) Associated Data of Pakistan Railway

The current status of electrified facilities of Pakistan Railway (PR) was investigated and resulted in acquiring PR design criteria and rules, which will be used in the coming basic design stage. The main collected data and information are as follows:

i) Construction Rule "SCHEDULE OF DEMENSIONS 1676mm GAUGE"

This includes the following information.

- construction gauge and vehicle gauge
- permitted electric clearance from nearby structures
- standard of rail track construction
- standard height of a contact wire

ii) Design and Construction Standard for PR

- Electric Traction Power Supplies Manual
- Electric Traction Overhead Line Manual

These manuals were enacted in 1973 and became the standard of electrification design and construction. Since then and despite being used until now, there has been no revision. Although the existing electrification system of Pakistan railway differs from our proposed system, the management methodology of facilities and the demarcation responsibilities will be consulted with an electric supply company.

iii) Related Data for Ongoing Electrification Line Plan

The following information covers the outline of future electrification and double-tracking currently planned by PR.

- feeding network (Karach City ~ Pana Akil)
- · double-tracking plan route diagram

b) Karachi Electric Supply Company (KESC)

i) Karachi Electric Supply Company E.H.T. Network

This network indicates the transmission network and supply voltage level of the entire KESC jurisdiction. JICA Study Team assumed the optimal transmission line from KESC Grid Station (GS) to KCR traction power substation (TSS) based on this diagram.

ii) Grid Station Single Track Wire Connection Figure

This figure is a typical single line diagram of a dispatch center.

iii) Annual Report 2010-11 issued by Karachi Electric Supply Company

This book mainly explains financial and organization information, but the facilities track record of transmission line in this book will be useful for design.

c) Climate Conditions in Karachi City

To determine the basal condition of the overhead contact system, various meteorological data for the past ten years in the KCR project area was collected from the Meteorological Department of the Ministry of Defense.

The contents of collected data are as follows

- a. minimum, maximum, and average temperature
- b. average humidity
- c. month-long precipitation
- d. month-long average wind velocity
- e. average wind direction
- f. month-long thunderstorm days

This acquired data is shown in Table 5.3.42.

Temperature (Mean)							onun	UIIS III	Karac		J			
(wean)	Month	1	2	3	4	5	6	7	8	9	10	11	12	Annual
	2001	19.4	22.3	26.4	29.2	31.6	32.3	29.6	29.4	29.5	36	26	23.1	27.9
	2002	19.9	21	26.4	29.6	31.3	31.6	29.5	28.3	28	29.4	25.1	21.4	26.8
	2003	20.1	22.7	26.1	30.3	30.6	31.4	30.9	29.7	28.9	28.9	23.7	20.1	26.9
	2004	19.7	22.2	27.7	30.2	32	32.1	30.6	29.5	29	28.1	24.3	22.4	27.3
	2005	18.6	20.8	25.9	29.1	30.9	32.3	30.3	29.4	30.4	20.1	24.0		27.0
	2006	18.0			29.1	30.9	32.3	30.3	29.4		30.4	26.4	20.7	27.4
	2000			25.7						30.5				
		19.9		25.5	30.3	31.8	32.5	31.3	30.1	30.6	28.6	26.2	20	27.5
	2008	17.2	19	27	29.2	30.6	32.1	30.7	29.4	30.7	29.6	25	21	26.8
	2009	20.5	23.1	26.9	29.9	32.2	32.2	31.3	30.3	29.6	29.3	25	21.3	27.6
	2010	19.9	22		30.5	32.3	31.5	31.5	30.2	30.2	29.9	25.1	19.6	27.5
	Monthly mean	19.4	22.1	26.5	29.8	31.4	32.0	30.7	29.5	29.7	29.9	25.3	21.0	27.3
Temperature (Max)	Month	1	2	3	4	5	6	7	8	9	10	11	12	Annual
	2001	27.2	29.6	33.1	34.6	35.1	34.8	32.1	32.3	33.1	36	33.5	30.4	32.6
	2002	27	28.2	33.3	35.4	35.6	35.1	32.2	31	31.3	36.5	32.7	28.1	32.2
	2003	27.6			36.6	35.7	34.8	34.1	33.5	32.5	37	32.2	28.3	32.8
	2004	26.6		36.2	35.4	36.8	35.6	33.5	32.6	32.8	33.7	30.7	29.4	32.8
	2004	20.0	26.2	31.4	35.2	35.4	36.1	33.2	32.0	34.2	35.2	33.1	28.4	32.0
<u> </u>	2005													
<u> </u>		26	31.3	31.8	34.3	34.6	35.4	33.9	31	34.2	35	33.4	26.3	32.3
L	2007	26.8	29.4	31.3	36	36	36.3	34.7	32.8	34.5	35.9	33.9	27.1	32.9
L	2008	24.4	26.9	34.3	34.4	33.9	35.1	33.5	31.9	34.7	35.5	32.5	27.2	32
	2009	26.2			36	36.8	35.7	34.5	33	32.8	35.9	33		
	2010	27.5	29.2	34	35.7	36.5	34.7	34.6	33.2	34.5	35.9	32.7	28	33
	Monthly mean	26.4	28.9	33.1	35.4	35.6	35.4	33.6	32.4	33.5	35.7	32.8	28.2	32.6
Temperature	Month													
(Min)	Year	1	2	3	4	5	6	7	8	9	10	11	12	Annual
	2001	11.5	14.9	19.7	23.8	28.1	29.8	27.1	26.5	25.9	24.4	18.5	15.9	22.2
	2002	12.8	13.8		23.9	27	28.1	26.9	25.6	24.7	22.2	17.6		
	2003	12.0	16.9	19.8	24.1	25.6	28.1	27.6	26	25.3	20.9	15.2	12	21.2
	2000	12.7	14.5		24.8	23.0	28.7	27.0	26.3	25.3	20.3	17.9	15.4	21.2
	2005	12.3		20.3	22.9	26.4	28.4	27.4	26.6	26.6	22.9	18.9	13	
	2006	11.7	18.1	19.6	24.5	27.5	28.5	28.3	26.3	26.8	25.7	19.4	14	
	2007	13		19.7	24.7	27.5	28.7	29	27.5	26.9	21.3	18.4	12.8	22.2
	2008	10.1	11.1	19.6	24	27.3	29.1	27.9	26.8	26.6	23.8	17.6	14.9	21.6
					00.0	27.6	28.7	28.1	27.5	26.5	22.6	17	13.9	22.3
	2009	14.7	16.5	20.8	23.8				07.0	05.0			10.0	22.3
	2009 2010	14.7 12.2	16.5 14.7	20.8 21.3	23.8	28	28.2	28.3	27.2	25.8	23.9	17.4	11.1	22.3
						28 27.2	28.2 28.6	28.3 27.8	27.2 26.6	25.8 26.0	23.9 23.0			
Humidity (Mean)	2010 Monthly mean	12.2 12.4	14.7 15.3	21.3 19.9	25.2 24.2	27.2	28.6	27.8	26.6	26.0	23.0	17.4 17.8	11.1 13.8	21.9 21.9
Humidity (Mean) at 0000	2010 Monthly mean Year	12.2 12.4	14.7 15.3 2	21.3 19.9 3	25.2 24.2 4	27.2	28.6 6	27.8 7	26.6 8	26.0 9	23.0 10	17.4 17.8 11	11.1 13.8 12	21.9 21.9 Annual
	2010 Monthly mean Year 2001	12.2 12.4 1 57	14.7 15.3 2 68	21.3 19.9 3 68	25.2 24.2 4 78	27.2 5 79	28.6 6 77	27.8 7 82	26.6 8 80	26.0 9 82	23.0 10 83	17.4 17.8 11 65	11.1 13.8 12 67	21.9 21.9 Annual 73.8
	2010 Monthly mean Year 2001 2002	12.2 12.4 1 57 56	14.7 15.3 2 68 59	21.3 19.9 3 68 72	25.2 24.2 4 78 71	27.2 5 79 79	28.6 6 77 81	27.8 7 82 80	26.6 8 80 81	26.0 9 82 81	23.0 10 83 80	17.4 17.8 11 65 72	11.1 13.8 12 67 66	21.9 21.9 Annual 73.8 73.2
	2010 Monthly mean Year 2001 2002 2003	12.2 12.4 1 57 56 67	14.7 15.3 2 68 59 67	21.3 19.9 3 68 72 68	25.2 24.2 4 78 71 63	27.2 5 79 79 75	28.6 6 77 81 81	27.8 7 82 80 83	26.6 8 80 81 81	26.0 9 82 81 78	23.0 10 83 80 73	17.4 17.8 11 65 72 67	11.1 13.8 12 67 66 67	21.9 21.9 Annual 73.8 73.2 72.5
	2010 Monthly mean Year 2001 2002 2003 2004	12.2 12.4 1 57 56 67 67	14.7 15.3 2 68 59 67 72	21.3 19.9 3 68 72 68 69	25.2 24.2 4 78 71 63 74	27.2 5 79 79 75 79	28.6 6 77 81 81 79	27.8 7 82 80 83 81	26.6 8 80 81 81 83	26.0 9 82 81 78 81	23.0 10 83 80 73 74	17.4 17.8 11 65 72 67 68	11.1 13.8 12 67 66 67 56	21.9 21.9 Annual 73.8 73.2 72.5 73.6
	2010 Monthly mean 2001 2002 2003 2004 2005	12.2 12.4 1 57 56 67 67 67 59	14.7 15.3 2 68 59 67 72 66	21.3 19.9 3 68 72 68 69 75	25.2 24.2 4 78 71 63 74 67	27.2 5 79 79 75 79 75 79 77	28.6 6 77 81 81 79 79 79	27.8 7 82 80 83 81 79	26.6 8 80 81 81 83 83 80	26.0 9 82 81 78 81 78 81 79	23.0 10 83 80 73 74 72	17.4 17.8 11 65 72 67 68 69	11.1 13.8 12 67 66 67 56 60	21.9 21.9 Annual 73.8 73.2 72.5 73.6 71.8
	2010 Monthly mean 2001 2002 2003 2004 2005 2006	12.2 12.4 1 57 56 67 67 67 59 61	14.7 15.3 2 68 59 67 72 66 73	21.3 19.9 3 68 72 68 69 75 75 70	25.2 24.2 4 78 71 63 74 67 78	27.2 5 79 79 75 79 79 77 79 77	28.6 6 77 81 81 81 79 79 79 79	27.8 7 82 80 83 81 79 81	26.6 8 8 80 81 81 83 83 80 88	26.0 9 82 81 78 81 79 83	23.0 10 83 80 73 74 72 78	17.4 17.8 11 65 72 67 68 69 78	11.1 13.8 12 67 66 67 56 60 73	21.9 21.9 Annual 73.8 73.2 72.5 73.6 71.8 76.8
	2010 Monthly mean 2001 2002 2003 2004 2005 2006 2007	12.2 12.4 1 57 56 67 67 59 61 59	14.7 15.3 2 68 59 67 72 66 73 80	21.3 19.9 3 68 72 68 69 75 70 77	25.2 24.2 4 78 71 63 74 67 78 80	27.2 5 79 79 75 79 77 79 82	28.6 6 77 81 81 81 79 79 79 79 81	27.8 7 82 80 83 81 79 81 80	26.6 8 8 80 81 81 83 83 80 88 88 84	26.0 9 82 81 78 81 79 83 80	23.0 10 83 80 73 74 72 78 78 74	17.4 17.8 11 65 72 67 68 69 78 80	11.1 13.8 12 67 66 67 56 60 73 64	21.9 21.9 Annual 73.8 73.2 72.5 73.6 71.8 76.8 76.8
	2010 Monthly mean 2001 2002 2003 2004 2005 2006 2007 2008	12.2 12.4 1 57 56 67 67 67 59 61	14.7 15.3 2 68 59 67 72 66 73	21.3 19.9 3 68 72 68 69 75 75 70	25.2 24.2 4 78 71 63 74 67 78	27.2 5 79 79 75 79 79 77 79 77	28.6 6 77 81 81 81 79 79 79 79	27.8 7 82 80 83 81 79 81	26.6 8 8 80 81 81 83 83 80 88	26.0 9 82 81 78 81 79 83	23.0 10 83 80 73 74 72 78	17.4 17.8 11 65 72 67 68 69 78	11.1 13.8 12 67 66 67 56 60 73	21.9 21.9 73.8 73.2 72.5 73.6 71.8 76.8 76.8 76.8 73
	2010 Monthly mean 2001 2002 2003 2004 2005 2006 2007	12.2 12.4 1 57 56 67 67 59 61 59	14.7 15.3 2 68 59 67 72 66 73 80 64	21.3 19.9 3 68 72 68 69 75 70 77	25.2 24.2 4 78 71 63 74 67 78 80	27.2 5 79 79 75 79 77 79 82	28.6 6 77 81 81 81 79 79 79 79 81	27.8 7 82 80 83 81 79 81 80	26.6 8 8 80 81 81 83 83 80 88 88 84	26.0 9 82 81 78 81 79 83 80	23.0 10 83 80 73 74 72 78 78 74	17.4 17.8 11 65 72 67 68 69 78 80	11.1 13.8 12 67 66 67 56 60 73 64	21.9 21.9 Annual 73.8 73.2 72.5 73.6 71.8 76.8 76.8
	2010 Monthly mean 2001 2002 2003 2004 2005 2006 2007 2008 2009	12.2 12.4 1 57 56 67 67 59 61 59 61 59	14.7 15.3 2 68 59 67 72 66 73 80 64	21.3 19.9 3 68 69 75 70 77 72 76	25.2 24.2 4 78 71 63 74 67 78 80 77	27.2 5 79 79 75 79 77 79 82 82 82	28.6 6 77 81 81 79 79 79 79 81 79	27.8 7 82 80 83 81 79 81 80 78	26.6 8 80 81 81 83 83 80 88 88 84 82	26.0 9 82 81 78 81 79 83 80 75	23.0 10 83 80 73 74 72 78 74 74 77	17.4 17.8 11 65 72 67 68 69 78 80 78 80 62	11.1 13.8 12 67 66 67 56 60 73 64 71	21.9 21.9 73.8 73.2 72.5 73.6 71.8 76.8 76.8 76.8 73
	2010 Monthly mean 2001 2002 2003 2004 2005 2006 2007 2008	12.2 12.4 1 57 56 67 67 67 59 61 59 57 65	14.7 15.3 2 68 59 67 72 66 73 80 64 74	21.3 19.9 3 68 69 75 70 77 72 76	25.2 24.2 4 78 78 74 67 78 80 77 78 80 77	27.2 5 79 79 75 79 79 79 79 82 82 82 78	28.6 6 77 81 81 79 79 79 81 79 81	27.8 7 82 80 83 81 79 81 80 78 83	26.6 8 80 81 81 83 83 80 88 84 82 83	26.0 9 82 81 78 81 79 83 80 75 83	23.0 10 83 80 73 74 72 78 74 77 81	17.4 17.8 11 65 72 67 68 69 78 80 978 80 62 62	11.1 13.8 12 67 66 67 56 60 073 64 71 59	21.9 21.9 Annual 73.8 73.2 72.5 73.6 71.8 76.8 76.8 76.8 76.8 76.8 76.8 76.8
at 0000	2010 Monthly mean Year 2001 2002 2003 2004 2005 2006 2007 2006 2007 2008 2009 2010 Monthly mean	12.2 12.4 1 57 56 67 67 67 59 61 59 57 65 71	14.7 15.3 2 68 59 67 72 66 67 73 80 0 64 74 68	21.3 19.9 3 68 72 68 69 75 70 777 72 76 79	25.2 24.2 4 78 71 63 74 67 78 800 77 67 67 76	27.2 5 79 75 79 77 79 79 82 82 82 78 81	28.6 6 77 81 81 79 79 79 79 81 79 81 82	27.8 7 82 80 83 83 83 81 80 78 83 83 82	26.6 8 80 81 81 83 80 88 84 84 82 83 83 84	26.0 9 82 81 78 83 80 75 83 80 75 83 80	23.0 10 83 80 73 74 72 78 74 77 81 78 78	17.4 17.8 11 65 72 67 68 69 78 800 62 62 62 62	11.1 13.8 12 67 66 67 56 60 73 64 71 1 59 61	21.9 21.9 73.8 73.2 72.5 73.6 71.8 76.8 76.8 76.8 76.8 76.8 76.3 74.3 75.3
	2010 Monthly mean 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 Monthly mean Year Month	12.2 12.4 1 57 56 67 67 67 59 61 59 57 57 65 71 61.9	14.7 15.3 2 68 59 67 72 66 73 80 64 74 68 69.1 2	21.3 19.9 3 68 68 69 75 70 77 72 76 79 72.6 3	25.2 24.2 4 78 71 63 3 74 67 78 80 77 7 76 7 76 73.1 4	27.2 5 79 79 75 79 77 79 82 82 78 81 79.1 5	28.6 6 77 81 81 79 79 81 79 81 82 79.9 81 82 79.9 6	27.8 7 82 80 83 81 79 81 80 78 83 83 82 80.9 7	26.6 8 80 81 83 83 80 88 84 82 83 84 82.6 83 84	26.0 9 82 81 78 81 79 83 80 75 83 80 80.2 80.2	23.0 10 83 80 73 74 72 78 74 77 81 78 77.0 10	17.4 17.8 11 65 72 67 68 69 78 80 69 78 80 62 62 62 61 68.4 11	11.1 13.8 12 67 66 67 56 66 60 73 64 71 59 61 64.4	21.9 21.9 Annual 738 73.2 72.5 73.6 71.8 76.8 73.8 76.8 73 74.3 74.3 74.3 74.1 Annual
at 0000	2010 Monthly mean 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 Monthly mean Year 2001	12.2 12.4 1 57 56 67 67 67 59 61 59 61 59 57 1 61.9 1 26	14.7 15.3 2 68 59 67 72 66 73 80 64 74 68 69.1 2 32	21.3 19.9 3 68 69 75 70 77 76 6 79 72.6 3 35	25.2 24.2 4 78 71 63 74 67 78 80 77 67 76 73.1 4	27.2 5 79 79 75 79 77 9 79 77 82 82 82 78 81 79.1 55	28.6 6 77 81 81 79 79 79 81 81 82 79.9 6 6	27.8 7 82 80 83 81 79 81 80 78 83 80 9 80.9 7 7 7	26.6 8 80 81 81 83 80 88 83 83 84 82 83 83 84 82.6 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	26.0 9 82 81 78 81 79 83 80 75 83 80 75 83 80 80.2 9 59	23.0 10 83 80 73 74 72 78 74 77 81 78 77.0 10 47	17.4 17.8 11 65 72 67 68 69 78 80 69 78 80 62 62 62 61 68.4 11 30	11.1 13.8 12 67 66 67 56 66 60 73 64 73 64 4 71 59 61 64.4 12 39	21.9 21.9 Annual 73.8 73.2 72.5 73.66 71.8 76.8 73.6 74.1 74.3 74.3 74.1 74.1 74.1 74.1 74.1 74.1 74.1 74.1
at 0000	2010 Monthly mean Year 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 Monthly mean Year Month Year	12.2 12.4 1 57 56 67 67 59 61 59 61 59 61 59 61 71 61.9 1 26 27	14.7 15.3 2 68 59 67 72 66 6 73 80 64 74 68 69.1 2 2 32 27	21.3 19.9 3 68 72 68 69 9 75 70 77 72 76 79 72.6 3 35 33	25.2 24.2 4 78 71 63 74 67 78 80 77 67 76 76 73.1 4 4 47	27.2 5 79 79 75 79 77 79 82 82 82 81 79.1 5 59 57	28.6 6 77 81 81 79 79 79 81 82 79.9 6 6 63 62	27.8 7 82 80 83 81 79 81 80 78 83 82 80.9 7 7 71 66	26.6 8 80 81 83 80 88 84 82 83 84 82.6 8 8 65 65	26.0 9 82 81 78 83 80 75 83 80 80.2 9 9 59 63	23.0 10 83 80 73 74 72 78 74 77 81 78 77.0 10 47 39	17.4 17.8 11 65 72 67 68 69 78 80 62 62 61 68.4 11 30 34	11.1 13.8 12 67 66 67 56 60 73 64 71 59 61 64.4 12 39 33	21.9 21.9 Annual 73.8 73.2 72.5 73.6 73.6 73.6 73.6 73.6 73.6 73.6 73.6
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at 0000	2010 Monthly mean 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 Monthly mean Vear 2001 2002 2003 2004 2002 2003 2004 2002 2003 2004 2005 2006 2007 2008	122 12.4 1 57 57 67 67 67 67 67 67 67 67 67 67 67 67 67	14.7 15.3 2 68 59 67 72 66 73 800 64 74 68 69.1 2 27 35 33 41 37 44 430	21.3 19.9 3 68 72 68 69 75 70 77 72 76 79 72.6 3 3 3 3 3 3 3 3 3 3 4 3 3 6 4 6 4 6 4 6 8 6 8 6 8 6 9 7 7 7 7 7 7 7 7 7 7 7 7 7	25.2 24.2 4 78 71 63 74 67 78 800 77 67 76 73.1 4 4 47 43 355 47 33 9 49 49	27.2 5 79 79 75 79 77 79 82 82 82 82 78 81 79.1 5 5 55 55 55 55 55 55 62 2 62 2 57 66	28.6 6 77 81 81 79 79 81 79 81 82 79.9 6 6 63 62 63 62 59 59 59 59 64 4 62	27.8 7 82 80 83 81 79 81 80 78 83 82 80.9 7 7 7 71 66 71 66 71 66 671 64 65 68 66 8 66 8	26.6 8 8 8 8 8 8 8 8 8 8 8 8 8	26.0 9 82 81 78 83 80 75 83 80 75 83 80 80.2 9 9 63 57 59 60 61 1 59 58	23.0 10 83 80 73 74 72 78 74 77 81 78 77.0 10 47 39 34 43 37 54 35 48	17.4 17.8 11 65 72 67 68 69 78 800 62 62 62 62 61 68.4 11 300 344 311 322 366 388 411 31	11.1 13.8 12 67 66 67 56 60 73 64 71 59 61 64.4 12 39 33 34 42 55 300 40 311 47 7	21.9 21.9 Annual 73.8 73.2 72.55 73.6 71.8 76.8 76.8 76.8 76.8 76.8 76.8 76.3 74.3 74.3 74.3 74.3 74.3 75.3 74.1 45.5 46.6 51.5 45.5 46.6 51.1 49.2 48.8

 Table 5.3.42
 Climate Conditions in Karachi City

	Month													
Precipitation	Year	1	2	3	4	5	6	7	8	9	10	11	12	Annual
	2001	0	0	0	0	0	10.6	73.6	16.2	0.1	0	0	0	100.4
	2002	0	2.4	0	0	0	0.1	0.3	52.2	0.1	0	0.5	0.4	55.8
	2003	6.4	21.8	0	0	0	16.3	270.4	9.8	0.1	0	0.2	0	324.9
	2004	13.7	0	0	0	0	0.1	3	5.6	0.1	39.3	0	4.3	65.9
	2005	10.8	12.8	0.1	0	0	0.1	1.3	0.3	54.9	0	0	17.1	97.2
	2006	0.1	0	0.1	0	0	0	66.2	148.6	21.9	0	3.1	61.3	301.1
	2007	0	13.2	33.4	0	0	110.2	41	250.4	0	0	0	17.4	465.6
	2008 2009	8	0.1	1.1	0 1	0	0	54 159.9	37.5	0.1	0	0	21	121.6 279.9
	2009	3 0	0.1 0.5	0	0.1	0	2.6 97.4	120.4	44 111.5	68.9 42.7	0.4	0.1	1.5	372.9
	Monthly mean	4.2	5.1	3.5	0.0	0.0	23.7	79.0	67.6	18.9	4.0	0.1	12.3	218.5
Wind Speed at 0000	Month Year	1	2	3	4	5	6	7	8	9	10	11	12	Annual
	2001	1.7	2.2	2.6	4.3	6.5	7.9	6.2	7.5	4.9	2	1.6	1	4
	2002 2003	2.5	1.6	2.7 3.2	5.3	8	8	10.4	6	6.5	1.1	1.3	1.6	4.6
	2003	1.8 2.1	3.1 2.1	2.1	4.8 3.9	6 6	7.7	4.8 8.6	6.6 9.5	4.9 5.5	0.8 2.3	1.7 0.4	2.1	4.4
	2004	2.1	4	3.7	3.1	4.3	5.5	8.6	7.1	5.1	1.7	0.4	0.8	3.9
	2006	1.5	1.6	1.6	4.3	7.2	6.7	8.6	5.9	4	3	0.9	1.6	3.9
	2007	0.8	1.4	2.3	2.3	3.9	3.9	3.5	4.5	4.1	1.1	0.6	1.0	2.5
	2008	1.5	2.3	2.3	3.4	7.7	4.9	6.6	6.3	5.2	2.2	1.3	2.1	3.8
	2009	3.4	1.3	2.5	2.6	3.4	5	6.4	6.5	5.5	1.3	2.5	2.7	3.6
	2010	1.9	2.7	2.6	4.1	6.3	7.3	5.8	6	4.6	1.7	2	2.3	3.9
	Monthly mean	1.9	2.2	2.6	3.8	5.9	6.5	7.0	6.6	5.0	1.7	1.3	1.8	3.9
Wind Speed	Month					_	_	_			10		40	
at 1200	Year	1	2	3	4	5	6	7	8	9	10	11	12	Annual
	2001	4.5	5.7	7.9	9.5	12.2	12.3	8.5	9.8	8.2	5.7	4.2	4.3	7.7
	2002	6	7	8.6	10.9	12.6	9.1	14.1	9.7	11	5.8	5.8	5.2	8.8
	2003 2004	7.1	8.3	9.2	10.1	11.2	10.5	7.9	9.6	7.3	6.2	4.7 3.8	4.1	8 8.7
	2004	6.3 4.5	7.2 6.9	7.2 7.8	10.1 9.5	11.9 10.1	12.2 9.9	12.5 11.2	11.9 10.7	9.4 8.1	6.7 5.9	3.8 4.4	4.9 4.5	8.7
	2005	4.5	6	7.8	9.3 8.9	10.1	10.8	11.2	8.9	6.5	7.9	4.4	4.5	7.8
	2000	4.1	7.5	6.8	7.8	10.3	10.5	8.6	9.4	8	5.8	6.2	3.3	7.4
	2008	4.3	7.6	8.2	10.5	12.6	7.6	11	9.3	8.7	6.6	5.1	3.9	7.9
	2009	7	7.2	7.9	9.3	9.8	9.7	9.5	9.3	9.1	6.1	5	3.9	7.8
	2010	5	6.8	7.7	8.2	9.8	9.3	8.8	7.2	1.5	6.2	4.9	5	6.7
	Monthly mean	5.4	7.0	7.9	9.5	11.1	10.2	10.3	9.6	7.8	6.3	4.8	4.4	70
		J.4	7.0	1.9	9.0	11.1	10.2	10.0	0.0		0.0	7.0	7.7	7.9
	_													/.9
Wind Direction at 0000	Year	1	2	3	4	5	6	7	8	9	10	11	12	7.9
Wind Direction	Year 2001	1 N43E	2 N16W	3 N76W	4 \$73W	5 S62W	6 S49W	7 S67W	8 S62W	9 S53W	10 S82W	11 N18E	12 N22E	7.9
Wind Direction	Year 2001 2002	1 N43E N16E	2 N16W N07E	3 N76W N79W	4 \$73W \$87W	5 S62W S67W	6 S49W S45W	7 S67W S68W	8 S62W S66W	9 S53W S51W	10 S82W N68W	11 N18E N17E	12 N22E N29E	7.9
Wind Direction	Year 2001 2002 2003	1 N43E N16E N40E	2 N16W N07E N45W	3 N76W N79W S81W	4 \$73W \$87W \$72W	5 S62W S67W S57W	6 S49W S45W S54W	7 S67W S68W S68W	8 S62W S66W S95W	9 S53W S51W S66W	10 S82W N68W N06W	11 N18E N17E N45E	12 N22E N29E N55E	
Wind Direction	Year 2001 2002 2003 2004	1 N43E N16E N40E S	2 N16W N07E N45W N06E	3 N76W N79W S81W N77E	4 S73W S87W S72W N56W	5 S62W S67W S57W S32W	6 S49W S45W S54W S51W	7 S67W S68W S68W S46W	8 S62W S66W S95W S56W	9 S53W S51W S66W S56W	10 S82W N68W N06W N51W	11 N18E N17E N45E N	12 N22E N29E N55E N32E	
Wind Direction	Year 2001 2002 2003 2004 2005	1 N43E N16E N40E S N38E	2 N16W N07E N45W N06E N14W	3 N76W N79W S81W N77E N79W	4 \$73W \$87W \$72W \$56W \$73W	5 S62W S67W S57W S32W S57W	6 S49W S45W S54W S51W S51W S54W	7 S67W S68W S68W S46W S55W	8 S62W S66W S95W S56W S57W	9 S53W S51W S66W S56W S56W S79W	10 S82W N68W N06W N51W S89W	11 N18E N17E N45E N N	12 N22E N29E N55E N32E N45E	
Wind Direction	Year 2001 2002 2003 2004 2005 2006	1 N43E N16E N40E S N38E N27E	2 N16W N07E N45W N06E N14W S74W	3 N76W N79W S81W N77E N79W S84W	4 \$73W \$87W \$72W \$72W \$56W \$73W \$73W	5 S62W S67W S57W S32W S57W S77W	6 S49W S45W S54W S51W S54W S72W	7 S67W S68W S68W S46W S55W S75W	8 S62W S66W S95W S56W S57W S88W	9 S53W S51W S66W S56W S79W S72W	10 S82W N68W N06W N51W S89W S74W	11 N18E N17E N45E N N N22E	12 N22E N29E N55E N32E N45E N32E	1.9
Wind Direction	Year 2001 2002 2003 2004 2005	1 N43E N16E N40E S N38E	2 N16W N07E N45W N06E N14W	3 N76W N79W S81W N77E N79W	4 \$73W \$87W \$72W \$56W \$73W	5 S62W S67W S57W S32W S57W	6 S49W S45W S54W S51W S51W S54W	7 S67W S68W S68W S46W S55W	8 S62W S66W S95W S56W S57W	9 S53W S51W S66W S56W S56W S79W	10 S82W N68W N06W N51W S89W	11 N18E N17E N45E N N	12 N22E N29E N55E N32E N45E	1.9
Wind Direction	Year 2001 2002 2003 2004 2005 2006 2007	1 N43E N16E N40E S N38E N27E N45E	2 N16W N07E N45W N06E N14W S74W CALM	3 N76W N79W S81W N77E N79W S84W N88W	4 \$73W \$87W \$72W \$72W \$72W \$73W \$73W \$69W	5 S62W S67W S57W S32W S57W S77W S61W	6 S49W S45W S54W S51W S54W S72W S45W	7 S67W S68W S68W S46W S55W S55W S55W	8 S62W S66W S95W S56W S57W S88W S71W	9 \$53W \$51W \$66W \$56W \$79W \$72W \$71W	10 S82W N68W N06W N51W S89W S74W N37W	11 N18E N17E N45E N N N22E N37W	12 N22E N29E N55E N32E N45E N32E N29E	
Wind Direction	Year 2001 2002 2003 2004 2005 2006 2007 2008	1 N43E N16E N40E S N38E N27E N45E N30E	2 N16W N07E N45W N06E N14W S74W CALM N14E	3 N76W N79W S81W N77E N79W S84W N88W N88W N87W	4 S73W S87W S72W N56W S73W S73W S69W S71W	5 S62W S67W S57W S32W S57W S57W S77W S61W S61W	6 S49W S45W S54W S51W S54W S72W S45W S52W	7 S67W S68W S68W S46W S55W S55W S55W S55W	8 S62W S66W S95W S56W S57W S88W S71W S57W	9 \$53W \$51W \$66W \$56W \$79W \$72W \$72W \$71W \$75W	10 S82W N68W N06W N51W S89W S74W N37W S75W	11 N18E N17E N45E N N N22E N37W N17E	12 N22E N29E N55E N32E N45E N32E N29E N35E	
Wind Direction at 0000	Year 2001 2002 2003 2004 2005 2006 2007 2008 2009 2009 2010	1 N43E N16E N40E S N38E N27E N45E N30E N55E N40E	2 N16W N07E N45W N06E N14W S74W CALM N14E N3E N24W	3 N76W N79W S81W N77E N79W S84W N88W N88W N88W N87W S66W S68W	4 \$73W \$87W \$72W \$56W \$73W \$73W \$69W \$71W \$72W \$80W	5 S62W S67W S57W S57W S57W S57W S61W S61W S61W S72W S88W	6 S49W S45W S54W S51W S54W S72W S45W S52W S55W S72W	7 S67W S68W S68W S55W S55W S55W S55W S57W S65W S77W	8 S62W S66W S55W S57W S57W S57W S57W S57W S51W S51W	9 \$53W \$51W \$66W \$56W \$79W \$72W \$71W \$75W \$75W \$75W \$83W	10 S82W N68W N06W N51W S89W S74W N37W S75W S76W N75W	11 N18E N45E N N N22E N37W N17E N30E N43E	12 N22E N55E N32E N45E N32E N32E N35E N35E N35E N34E	
Wind Direction	Year Month 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 Year Month	1 N43E N40E S N38E N45E N45E N30E N55E N40E	2 N16W N07E N45W N06E N14W S74W CALM N14E N3E N24W 2	3 N76W N79W S81W N77E N79W S84W N88W N88W N88W N87W S66W S66W S68W	4 \$73W \$87W \$72W \$72W \$73W \$73W \$69W \$71W \$69W \$71W \$69W \$72W \$80W 4	5 S62W S67W S57W S57W S77W S61W S61W S61W S61W S72W S88W	6 S49W S45W S54W S51W S51W S72W S45W S52W S55W S72W 6	7 S67W S68W S68W S46W S55W S55W S55W S55W S55W S57W S65W S77W	8 S62W S66W S95W S56W S57W S88W S71W S57W S57W S51W S84W 8 8	9 \$53W \$51W \$66W \$56W \$79W \$72W \$71W \$71W \$75W \$75W \$83W 9	10 \$82W N68W N51W \$89W \$74W \$75W \$75W \$75W \$75W \$76W N75W	11 N18E N17E N45E N N N22E N37W N17E N30E N43E 11	12 N22E N29E N55E N32E N32E N32E N32E N35E N35E N35E N34E 12	
Wind Direction at 0000	Month 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 Year 2001	1 N43E N16E S N38E N27E N45E N35E N55E N55E N40E 1 N24E	2 N16W N07E N45W N06W N14W S74W CALM N14E N3E N3E N24W 2 N05E	3 N76W N79W S81W N79W S84W N87W S84W S84W S66W S68W S68W S68W	4 \$73W \$87W \$72W \$73W \$73W \$73W \$69W \$71W \$72W \$80W 4 \$72W	5 S62W S67W S57W S57W S57W S77W S61W S61W S61W S61W S61W S72W S88W	6 S49W S45W S54W S54W S54W S72W S45W S52W S52W S72W S72W S72W S72W	7 S67W S68W S68W S46W S55W S55W S55W S55W S57W S65W S77W 7 S59W	8 S62W S66W S95W S56W S57W S57W S57W S57W S57W S51W S51W S84W 8 8 8 8	9 \$53W \$51W \$66W \$56W \$79W \$72W \$71W \$75W \$75W \$83W 9 \$61W	10 \$82W N68W N06W N51W \$89W \$74W N37W \$75W \$75W \$76W N75W 10 \$76W	11 N18E N17E N45E N N22E N37W N17E N30E N43E 11 N18E	12 N22E N29E N35E N32E N35E N35E N35E N35E N35E N34E 12 N34E	
Wind Direction at 0000	Year Month 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 Year Month 2001 2001 2001 2002	1 N43E N16E N40E S N38E N27E N45E N30E N55E N40E 1 N24E N38E	2 N16W N07E N45W N06E N14W S74W CALM N14E N3E N24W 2 N05E N34E	3 N76W N79W S81W N79W S84W N88W N87W S86W S66W S66W S66W S66W S66W	4 \$73W \$87W \$72W \$73W \$73W \$73W \$73W \$73W \$73W \$72W \$80W 4 \$72W \$82W	5 S62W S67W S57W S57W S77W S61W S61W S72W S88W 5 S51W S68W	6 \$49W \$45W \$54W \$54W \$54W \$54W \$52W \$52W \$52W \$55W \$72W \$55W \$55W \$55W \$51W \$51W \$59W	7 S67W S68W S68W S55W S55W S55W S55W S55W S57W S65W S77W 7 S59W S72W	8 S62W S66W S95W S57W S57W S57W S57W S57W S57W S51W S51W S61W	9 \$53W \$51W \$66W \$56W \$72W \$72W \$75W \$75W \$75W \$83W 9 \$61W \$77W	10 \$82W N68W N06W \$89W \$74W \$75W	11 N18E N17E N45E N N22E N37W N17E N30E N43E 11 N18E N29E	12 N22E N29E N55E N32E N45E N32E N35E N34E 12 N34E N34E	
Wind Direction at 0000	Year Month 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 Year Month 2001 2001 2002 2001	1 N43E N16E N40E S N38E N27E N45E N30E N55E N40E 1 N24E N38E N30E	2 N16W N07E N45W N06E N14W CALM N14E N3E N24W 2 2 N05E N34E N41E	3 N76W N79W S81W N77E N79W S84W N88W N88W N87W S66W S66W S66W S66W S68W	4 \$73W \$87W \$72W \$73W \$73W \$69W \$73W \$73W \$73W \$73W \$73W \$73W \$73W \$73W \$73W \$73W \$73W \$73W \$72W \$72W \$72W \$72W \$72W \$72W \$72W \$72W \$72W \$72W \$72W \$72W \$72W \$72W \$73W \$72W \$73W \$72W \$73W \$73W \$72W \$72W \$72W \$72W \$73W \$73W \$72	5 S62W S67W S57W S57W S77W S61W S61W S72W S88W 5 S51W S68W S69W	6 \$49W \$45W \$54W \$54W \$54W \$72W \$45W \$52W \$55W \$72W 6 \$51W \$59W \$53W	7 S67W S68W S68W S55W S55W S55W S55W S57W S65W S77W S77W 7 S59W S72W S62W	8 S62W S66W S95W S57W S57W S57W S57W S51W S88W S71W S61W S61W S52W	9 \$53W \$51W \$66W \$79W \$72W \$72W \$75W \$75W \$75W \$35W \$35W \$35W \$35W \$35W \$37W \$35W \$37W \$35W \$30	10 \$82W N68W N06W N51W \$89W \$75W \$7	11 N18E N17E N45E N N N22E N37W N17E N30E N43E 11 N18E N29E N38E	12 N22E N29E N55E N32E N32E N32E N35E N35E N34E N34E N34E N38E N45E	
Wind Direction at 0000	Month 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 Year 2001 2002 2003 2003 2004	1 N43E N16E N40E S N27E N27E N30E N55E N40E 1 N25E N40E N30E N30E N30E N45E	2 N16W N07E N45W N06E N14W CALM N14E N3E N24W 2 N05E N34E N41E N37E	3 N76W N79W S81W N77E S84W N88W N88W N88W N87W S86W S66W S66W S66W S66W S68W S68W S68	4 \$73W \$87W \$72W \$72W \$73W \$69W \$71W \$73W \$69W \$71W \$72W \$80W \$72W \$80W \$72W \$82W \$81W \$57W	5 S62W S67W S57W S57W S72W S61W S72W S61W S72W S88W S51W S68W S69W S61W	6 S49W S45W S54W S51W S52W S72W S52W S55W S72W 6 6 S51W S53W S53W	7 S67W S68W S68W S46W S55W S75W S55W S57W S65W S77W S59W S72W S62W S62W S62W S62W S64W	8 S62W S66W S95W S57W S57W S57W S57W S51W S84W 8 8 8 8 8 8 8 8 8 8 8 8 8	9 \$53W \$51W \$66W \$79W \$75W \$72W \$71W \$75W \$75W \$83W 9 \$61W \$77W \$63W \$63W	10 \$82W N68W N51W \$89W N51W \$75W \$7	11 N18E N17E N45E N22E N37W N17E N30E N43E 11 N18E N29E N38E N19E	12 N22E N29E N55E N32E N32E N32E N32E N35E N35E N34E N34E N38E N38E N38E N39E	
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Wind Direction at 0000 Wind Direction at 0300 Thander storm	Month 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 Year Month 2002 2003 2001 2009 2010 2001 2002 2003 2006 2007 2006 2007 2008 2009 2010 Month Year 2001 2001 2002 2003 2004	1 N43E N46E N40E S N38E N27E N45E N45E N45E N45E N40E 1 N24E N38E N24E N38E N24E N38E N24E N38E N24E N37E N45E S N45E S 0 0 0 0 0 0 0	2 N16W N07E N45W N07E N46W S74W CALM N14W S74W CALM N32E N32E N32E N34E N34E N37E N7W N63W N45E N34E N45E N34E 2 0 0 0 0 0 0 0 0 0	3 N76W N79W S81W N77E N79W S84W N88W N87W S66W S66W S66W S66W S66W S66W S68W S66W S68W S68	4 S73W S72W S72W S73W S73W S73W S73W S73W S73W S73W S73	5 S62W S67W S57W S57W S77W S61W S61W S72W S88W S88W S61W S68W S68W S61W S65W S65W S67W S67W S67W S67W S67W S67W S61W S61W S61W S61W S61W S61W S61W S61W S72W S61W S72W S61W S72W S61W S72W S61W S72W S61W S72W S61W S72W S61W S72W S61W S61W S72W S61W S72W S61W S61W S72W S61W S61W S72W S61W S61W S72W S61W S72W S61W S61W S62W S72W S61W S61W S62W S62W S61W S62W S62W S61W S62W S62W S61W S62W S61W S62W S62W S61W S62W S62W S61W S61W S62W S62W S62W S61W S62W S7W S7W S7W S62W S7W S7W S7W S7W S7W S7W S7W S	6 \$\$49W \$\$45W \$\$54W \$\$51W \$\$52W \$\$55W \$\$55W \$\$53W \$\$53W \$\$53W \$\$53W \$\$53W \$\$55W \$\$55W \$\$6 1 0 0 0 0 0 0 0	7 S67W S68W S68W S55W S55W S55W S55W S55W S57W S65W S77W 7 7 S59W S72W S62W S65W S63W S63W S63W S65W S63W S63W S63W S63W S63W S63W S64W S64W S64W S64W S64W S64W S64W S65W S72W S72W S65W S65W S65W S72W S65W S72W S65W S72W S65W S72W S65W S65W S72W S72W S65W S72W S72W S65W S72W S72W S72W S72W S65W S72	8 S62W S66W S95W S57W S88W S71W S57W S51W S61W S61W S61W S52W S61W S52W S61W S52W S61W S62W W S60W W S60W S60W S60W S60W S60W S60W S60W S55W S60W S57W S57W S57W S57W S60W S57W S60W S57W S60W S60W S57W S60W S71W S70	9 S53W S51W S66W S79W S72W S71W S75W S75W S83W 9 S61W S77W S63W S61W S77W S63W S75W S75W S75W S75W S75W S90W S75W	10 S82W N68W N06W N51W S89W S74W N37W S75W N75W 10 S76W N45W N45W N45W N45W N45W N45W N45W N45W N45W N45W N37W N37W S73W N11W S84W N8W N8W N8W N8W	11 N18E N17E N45E N N22E N37W N17E N30E N17E N30E N18E N29E N38E N19E N35E N37E N45E N34E N39E 11 0 0 0 0 0 0 0 0 0 0 0 0 0 0	12 N22E N29E N35E N32E N35E N34E 12 N34E N37E 12 0 0 0 1 0 0	Amount 3 1 3 3 1 3 9
Wind Direction at 0000 Wind Direction at 0300 Thander storm	Month Year Month 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 Year Month Year 2001 2003 2004 2005 2006 2007 2008 2006 2007 2008 2009 2010 Month Year Month Year 2001 2009 2010 Year Month Year 2001 2002 2003 2004 2005 2005 2006	1 N43E N16E N40E S N38E N27E N45E N30E N55E N40E 1 N24E N30E N45E N30E N45E N30E N45E N32E N37E N45E N60E 1 0 1 0 0 0 0 0 0 0	2 N16W N07E N45W N06E N14W CALM N14W CALM N14E N3E N24W 2 N05E N34E N41E N37E N37E N41E N37E N45E N8E N45E N8E N45E N8E N45E 0 0 0 0 0 0 0	3 N76W N79W S81W N79W S81W N79W S84W N88W N87W S66W 3 N67W S66W 3 N67W N37W S81W N58E N84W N58E N84W N58E N84W N58B N84W S88W S86W 3 0 0 0 0 0 1	4 \$73W \$72W \$72W \$73W \$73W \$73W \$73W \$73W \$73W \$73W \$73W \$72W \$80W \$72W \$80W \$272W \$82W \$82W \$81W \$57W \$82W \$82W \$82W \$757W \$82W \$82W \$757W \$82W \$82W \$757W \$80W \$77W \$80W \$77W \$77W \$80W \$77W \$70W \$	5 S62W S67W S57W S32W S77W S61W S61W S61W S61W S61W S61W S61W S61W S68W S61W S61W S61W S61W S64W S67W S78W S67W S58W S91W 5 0 0 0 0 0 0 0 0	6 \$\$49W \$\$54W \$\$54W \$\$54W \$\$54W \$\$54W \$\$54W \$\$52W \$\$55W \$\$55W \$\$55W \$\$55W \$\$55W \$\$55W \$\$53W \$\$53W \$\$53W \$\$53W \$\$53W \$\$53W \$\$55W \$\$65W \$\$65W \$\$65W \$\$65W \$\$65W \$\$65W \$\$60 1 0 0 0 0 0	7 S67W S68W S68W S55W S55W S55W S55W S57W S55W S77W S65W S77W 7 7 S59W S62W S46W S62W S46W S62W S46W S62W S46W S62W S65W S77W S65W S77W S65W S77W S65W S77W S65W S77W S65W S77W S62W S7W S7W S7W S7W S7W S7W S7W S7	8 S62W S66W S95W S57W S57W S57W S51W S51W S51W S61W S61W S61W S52W S61W S52W S61W S62W S64W S62W S60W W S60W S60W S60W S60W S60W S60W S60W S60W S60W S60W S60W S60W S60W S60W S60W S60W S70W	9 S53W S51W S66W S79W S72W S75W S75W S75W S75W S75W S61W S77W S63W S77W S63W S77W S75	10 \$82W N68W N06W \$71W \$89W \$75W \$73W \$73W \$78W \$78W \$78W \$73W \$78W \$78W \$73W \$78W \$73W \$73W \$70D \$7	11 N18E N17E N45E N N22E N37W N17E N30E N43E 11 N18E N29E N38E N19E N37E N435E N30E N34E N39E 11 0 0 0 0 0 0 0 0 0 0 0 0 0	12 N22E N29E N55E N32E N32E N32E N32E N34E N37E 12 0 0 0 1	Amount 3 1 1 0 5 2
Wind Direction at 0000 Wind Direction at 0300 Thander storm	Month Year Month 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 Year Month 2001 2002 2003 2004 2006 2007 2008 2009 2001 2006 2009 2010 Month Year 2001 2008 2009 2010 Month Year 2001 2002 2003 2004 2005 2006 2007 2006 2007 2006	1 N43E N16E N40E S N38E N27E N45E N30E N55E N40E 1 N24E N38E N30E N45E N30E N45E N37E N45E N00E 1 0 0 0 0 0 0 0 0 0 0 0 0	2 N16W N07E N45W N06E N14W S74W CALM N14E N3E N24W 2 N05E N34E N41E N37E N7W N63W N45E N34E N45E N34E 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	3 N76W N79W S81W N77E N79W S84W N87W S66W S66W 3 N67W N37W S81W N58E N84W N45W N72W S79W S88W 3 0 0 0 0 0 0 1 1 1	4 S73W S72W S72W S72W S73W S73W S73W S73W S73W S73W S73W S71W S72W S80W 4 S72W S81W S57W S81W S57W S82W S72W S72W S72W S72W S72W S72W S72W S7	5 S62W S67W S57W S57W S77W S61W S61W S61W S61W S77W S61W S61W S61W S68W S68W S69W S64W S67W S64W S67W S64W S67W S64W S07W S64W S67W S64W S67W S64W S00 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6 \$\$49W \$\$45W \$\$54W \$\$54W \$\$54W \$\$54W \$\$52W \$\$53W \$\$54W \$\$55W 6 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	7 S67W S68W S68W S55W S55W S55W S55W S57W S57W S77W S72W S72W S72W S62W S62W S63W S63W S63W S63W S63W S63W S63W S63W S63W S62W S7W S7W S7W S7W S7W S7W S7W	8 S62W S66W S95W S57W S57W S57W S57W S57W S57W S57W S57W S57W S57W S57W S57W S61W S61W S52W S61W S61W S62W S62W S62W W S60W 8 S60W S60W S60W S60W S60W S60W S60W S60W S60W S60W S60W S60W S60W S60W S60W S60W S60W S60W S60W S57W S60W S60W S60W S57W S60W S60W S57W S60	9 S53W S51W S66W S79W S72W S71W S75W S75W S75W S83W 9 S61W S77W S63W S77W S63W S77W S75W S71W S75W S71W S75W S71W S72W S71W S72W S71W S71W S83W 9 0 0 0 0 0 0 0 0 0 0 0 0 0	10 S82W N68W N06W N51W S89W S74W N37W S75W S76W N75W 10 S76W N45W N50W N45W N45W N83W N83W N83W N80W N80W N80W N60W N11W N80W N60W N50W N11W N60W N60W N11W N60W N60W N11W N60W N11W N60W N60W N11W N60W N60W N11W N60W N60W N11W N60W N60W N11W N60W N60W N60W N11W N60W N60W N60W N11W N60W N60W N60W N60W N11W N60W	11 N18E N17E N45E N N22E N37W N17E N30E N38E N19E N38E N38E N37E N32E N37E N32E N37E N32E N37E N32E N30E N34E 0 0 0 0 0 0 0 0	12 N22E N29E N55E N32E N45E N35E N34E N37E 0 0 0 0 0 0 0 0 0 0 0 0	Amount 3 1 10 5 2 9 7
Wind Direction at 0000 Wind Direction at 0300 Thander storm	Month Year 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2001 2002 2003 20001 2002 2003 2004 2005 2006 2007 2008 2009 2010 Year 2001 2009 2010 Year 2001 2001 2003 2001 2003 2003 2004 2005 2006 2007 2008	1 N43E N16E N40E S S N38E N27E N45E N30E N55E N30E N40E 1 N24E N32E N37E N45E N37E N45E N37E N45E 0 0 0 0 0 0 0 0 0 1 0 0 1	2 N16W N07E N45W N06E N14W S74W CALM N14E N3E N24W 2 N05E N34E N41E N37E N37E N7W N63W N45E N8E N45E N34E 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	3 N76W N79W S81W N77E N79W S84W N88W N87W S66W S66W S66W S66W S66W S66W S68W S68	4 S73W S72W S72W S72W S73W S73W S73W S73W S73W S73W S73W S71W S72W S80W S71W S72W S80W S72W S81W S72W S81W S72W S72W S72W S72W S72W S72W S72W S72	5 S62W S67W S57W S57W S77W S61W S61W S72W S61W S61W S68W S69W S65W S65W S65W S65W S65W S65W S65W S65W S67W S67W S67W S61W S60	6 S49W S45W S54W S54W S54W S52W S52W S52W S52W S52W S52W S52W S53W S53W S53W S53W S53W S53W S54W S55W S65W 6 1 0 0 0 0 0 0 0 0 0	7 S67W S68W S68W S55W S55W S55W S57W S55W S77W S62W S72W S62W S72W S62W S46W S62W S62W S62W S65W S72W S65W S72W S65W S72W S62W S7W S7W S7W S7W S7W S7W S7W S7	8 S62W S66W S95W S56W S57W S88W S71W S57W S88W S71W S57W S61W S61W S61W S61W S61W S62W S64W S62W S64W S62W S64W S62W S64W S62W S64W S62W S61W S61W <td>9 S53W S51W S66W S72W S72W S75W S75W S75W S75W S75W S83W 9 S61W S77W S63W S77W S75W</td> <td>10 S82W N68W N06W N51W S79W S75W S75W S75W N75W N75W N75W N75W N75W N45W N51W N50W N5</td> <td>11 N18E N17E N45E N N22E N37W N17E N30E 11 N18E N29E N38E N19E N38E N37E N34E N34E N34E N34E N34E N30E 11 0</td> <td>12 N22E N29E N55E N32E N45E N32E N34E N37E N37E 12 0</td> <td>Amount Amount 3 1 1 0 5 2 9 7 6</td>	9 S53W S51W S66W S72W S72W S75W S75W S75W S75W S75W S83W 9 S61W S77W S63W S77W S75W	10 S82W N68W N06W N51W S79W S75W S75W S75W N75W N75W N75W N75W N75W N45W N51W N50W N5	11 N18E N17E N45E N N22E N37W N17E N30E 11 N18E N29E N38E N19E N38E N37E N34E N34E N34E N34E N34E N30E 11 0	12 N22E N29E N55E N32E N45E N32E N34E N37E N37E 12 0	Amount Amount 3 1 1 0 5 2 9 7 6

Source: the Meteorological Department of the Ministry of Defense

2) Site Situation of Proposed Stations and Surrounding Environments

The result of the on-site investigation is shown in Table 5.3.43.

SectionIternedSP will be able to acquire.10HBL16+890Use of the employee of National Industrial Area is expected.11MANGHOPIR18+430Sewage are flowing into station yard from adjointed textile factory.Many factories(electronic manufacturer,textile company) are located.12SITE20+330KCR line cross right-angled to the road.The beverage plant is located in the neighborhood.13SHAH ABDUL LATIF22+390Proposed station will be newly constracted in the same location where is the existing station.There is an automoble factory along KCR line at the station.14BALDIA23+850A vacant land (ornered by PR) is located on the back side which is big intersection.PR land was made a studied for receiving Substation from KESC Mouripur grid station.15LIYARI25+170Proposed station faces on the south of the LIYARI river.New substation will be constructed in the dry riverbed of the north side.16WAZIRMANSION26+530A new station is adjoined, Car depot of KCR is constructed next to proposed station.KESC transmission line tower exists in Car depot17TOWER28+330The vast vacant land spreads out.18KARACHI CITY29+630Pakistan Railways branch office is located in the station yard. Road bridges exist in DCOS side.19DCOS31+630Sufficient land for SSP at the time of Revised Option-B plan will be able to acquire.20KARACHI CANTT.33+430Sufficient land for SSP at the time of Revised Option-B plan will be able to acquire.21NAVAL34+670The proposed station site i		Tab	ole 5.3.43	Site Situation of Proposed Stations
1 DRIGH ROAD 0+000 posibility as a proposed site for SS.Check of transmission route is required. 2 JOHAR 4+970 The proposed station site is a stagnant water area currently.Around 1.5km interval from KESC Hospital Grid. 3 ALLADIN PARK 5+830 The proposed station site is surrounded by private houses. The amusement park is located in the opposite side of KCR track. 4 NIPA 7+510 Two road bridges crosses right-angled to KCR line, and the height from the ground to undersurface of bridge is 6.3m. 5 GILANI 9+410 There is a vacant land in which Stabling of 2 to 3 lines is possible in the direction of Yasinabad Station. Surroundings is a housing hight density area. 6 YASINABAD 11+510 The proposed station site adjoins a road bridge and the neighborhood is a residential area. Many KESC transmission lines run in the vicinity. 7 LIAQUATABAD 12+570 The proposed station site adjoins a road bridge and the neighborhood is a residential area. Many KESC transmission lines run in the vicinity. 8 NORTH NAZIMABAD 14+730 Station square is large and the level crossing adjoins. Sufficient land for SP will be able to acquire. 10 HBL 16+890 Use of the employee of National Industrial Area is expected. 11 MANGHOPIR 18	No	Station Name	Kilo Post	Site Situation
2 JORAR 4+970 1.5km interval from KESC Hospital Grid. 3 ALLADIN PARK 5+830 The proposed station site is surrounded by private houses. The amusement park is located in the opposite side of KCR track. 4 NIPA 7+510 Two road bridges crosses right-angled to KCR line, and the height from the ground to undersurface of bridge is 6.3m. 5 GILANI 9+410 There is a vacant land in which Stabling of 2 to 3 lines is possible in the direction of Yasinabad Station. Surroundings is a housing hight density area. 6 YASINABAD 11+510 The proposed station site adjoins a road bridge and the neighborhood is a residential area.Many KESC transmission lines run in the vicinity. 8 NORTH NAZIMABAD 14+730 An road bridge is adjoined and there is a close resemblance to land situation of LIAQUATABAD station. 9 ORANGI 16+190 A station square is large and the level crossing adjoins.Sufficient land for SP will be able to acquire. 11 MANGHOPIR 18+430 Sewage are flowing into station yard from adjointed textile factory.Many factories(electronic manufacturer,textile company) are located. 12 SITE 20+330 KCR line cross right-angled to the roat. The beverage plant is located in the neighborhood. 14 BALDIA 23+850 intersection.PR land was made a studied for receiving Substation where i	1	DRIGH ROAD	0+000	posibility as a proposed site for SS.Check of transmission route is required.
ALLADIN PARK Stool amusement park is located in the opposite side of RCR track. 4 NIPA 7+510 Two road bridges crosses right-angled to KCR line , and the height from the ground to undersurface of bridge is 6.3m. 5 GILANI 9+410 direction of Yasinabad Station. Surroundings is a housing hight density area. 6 YASINABAD 11+510 The proposed station site adjoins a busy crossing and crowded with furniture shops. 7 LIAQUATABAD 12+570 The proposed station site adjoins a road bridge and the neighborhood is a residential area. Many KESC transmission lines run in the vicinity. 8 NORTH NAZIMABAD 14+730 An road bridge is adjoined and there is a close resemblance to land situation of LIAQUATABAD station. 9 ORANGI 16+190 A station square is large and the level crossing adjoins. Sufficient land for SP will be able to acquire. 10 HBL 16+890 Sewage are flowing into station yard from adjointed textile factory.Many factorise(electronic manufacturer,textile company) are located. 12 SITE 20+330 KCR line cross right-angled to the road. The beverage plant is located in the neighborhood. 13 SHAH ABDUL LATIF 22+390 the existion.There is an automobile factory along KCR line at the station.	2	JOHAR	4+970	1.5km interval from KESC Hospital Grid.
4 NIPA 74510 the ground to undersurface of bridge is 6.3m. 5 GILANI 9+410 There is a vacant land in which Stabiling of 2 to 3 lines is possible in the direction of Yasinabad Station. Surroundings is a housing hight density area. 6 YASINABAD 11+510 The proposed station site adjoins a busy crossing and crowded with furniture shops. 7 LIAQUATABAD 12+570 The proposed station site adjoins a read bridge and the neighborhood is a residential area. Many KESC transmission lines run in the vicinity. 8 NORTH NAZIMABAD 14+730 An road bridge is adjoined and there is a close resemblance to land situation of LAQUATABAD station. 9 ORANGI 16+190 A station square is large and the level crossing adjoins.Sufficient land for SP will be able to acquire. 10 HBL 16+890 Use of the employee of National Industrial Area is expected. 11 MANGHOPIR 18+430 Sewage are flowing into station yard from adjointed textile factory.Many factories(electronic manufacturer, textile company) are located. 12 SITE 20+330 KCR line cross right-angled to the road.The beverage plant is located in the neighborhood. 13 SHAH ABDUL LATIF 22+900 the existing station.There is an automoble factory along KCR line at the station. 14 BALDIA	3	ALLADIN PARK	5+830	amusement park is located in the opposite side of KCR track.
5 GILANI 9+410 direction of Yasinabad Station. Surroundings is a housing hight density area. 6 YASINABAD 11+510 The proposed station site adjoins a busy crossing and crowded with furniture shops. 7 LIAQUATABAD 12+570 The proposed station site adjoins a road bridge and the neighborhood is a residential area.Many KESC transmission lines run in the vicinity. 8 NORTH NAZIMABAD 14+730 An road bridge is adjoined and there is a close resemblance to land situation of LIAQUATABAD station. 9 ORANGI 16+190 A station square is large and the level crossing adjoins.Sufficient land for SP will be able to acquire. 10 HBL 16+890 Use of the employee of National Industrial Area is expected. 11 MANGHOPIR 18+433 Sewage are flowing into station yard from adjoined textile factory.Many factories(electronic manufacturer,textile company) are located. 12 SITE 20+330 KCR line cross right-angled to the road.The beverage plant is located in the station. 14 BALDIA 23+850 intersection.PR land was made a studied for receiving Substation from KESC Mouripur grid station. 15 LIYARI 25+170 Proposed station faces on the south of the LIYARI river.New substation will be constructed in the reighborhood. 16 WAZIRMANSION <	4	NIPA	7+510	the ground to undersurface of bridge is 6.3m.
6 TASINABAD 111+510 furniture shops. 7 LIAQUATABAD 12+570 The proposed station site adjoins a road bridge and the neighborhood is a residential area.Many KESC transmission lines run in the vicinity. 8 NORTH NAZIMABAD 14+730 An road bridge is adjoined and there is a close resemblance to land situation of LIAQUATABAD station. 9 ORANGI 16+190 As station square is large and the level crossing adjoins. Sufficient land for SP will be able to acquire. 10 HBL 16+890 Use of the employee of National Industrial Area is expected. 11 MANGHOPIR 18+430 Sewage are flowing into station yard from adjointed textile factory.Many factories(electronic manufacturer,textile company) are located. 12 SITE 20+330 KCR line cross right-angled to the road. The beverage plant is located in the neighborhood. 13 SHAH ABDUL LATIF 22+390 Proposed station will be newly constracted in the same location where is station. 14 BALDIA 23+850 A vacant land (ornered by PR) is located on the back side which is big intersection.PR land was made a studied for receiving Substation from KESC Mouripur grid station. 15 LIYARI 25+170 Proposed station faces on the south of the LIYARI river.New substation will be constructed in the ord riverbed of the north side.	5	GILANI	9+410	direction of Yasinabad Station. Surroundings is a housing hight density
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3 NORTH NAZIWABAD 14+730 situation of LIAQUATABAD station. 9 ORANGI 16+190 A station square is large and the level crossing adjoins.Sufficient land for SP will be able to acquire. 10 HBL 16+890 Use of the employee of National Industrial Area is expected. 11 MANGHOPIR 18+430 Sewage are flowing into station yard from adjointed textile factory.Many factories(electronic manufacturer,textile company) are located. 12 SITE 20+330 KCR line cross right-angled to the road. The beverage plant is located in the neighborhood. 13 SHAH ABDUL LATIF 22+390 the existing station. There is an automoble factory along KCR line at the station. 14 BALDIA 23+850 A vacant land (ornered by PR) is located on the back side which is big intersection.PR land was made a studied for receiving Substation from KESC Mouripur grid station. 15 LIYARI 25+170 Proposed station is adjoined, Car depot of KCR is constructed next to proposed station. KESC transmission line tower exists in Cardepot of KCR is constructed next to proposed station station station state. 17 TOWER 28+330 The vast vacant land spreads out. 18 KARACHI CITY 29+630 Pakistan Railways branch office is located in the station yard. Road bridges exist in DCOS side. 19 <td< td=""><td>7</td><td>LIAQUATABAD</td><td>12+570</td><td></td></td<>	7	LIAQUATABAD	12+570	
Sector NetworkIf SeriesSP will be able to acquire.10HBL16+890Use of the employee of National Industrial Area is expected.11MANGHOPIR18+430Sewage are flowing into station yard from adjointed textile factory.Many factories(electronic manufacturer,textile company) are located.12SITE20+330KCR line cross right-angled to the road. The beverage plant is located in the neighborhood.13SHAH ABDUL LATIF22+390Proposed station will be newly constracted in the same location where is station.14BALDIA23+850Proposed station There is an automoble factory along KCR line at the station.15LIYARI25+170Proposed station faces on the south of the LIYARI river.New substation will be constructed in the dry riverbed of the north side.16WAZIRMANSION26+530A new station is adjoined, Car depot of KCR is constructed next to proposed station KESC transmission line tower exists in Car depot17TOWER28+330The vast vacant land spreads out.18KARACHI CITY29+630Propuly Control Store is located in the neighborhood. Two road bridges exist in DCOS side.19DCOS31+630Sufficient land for SSP at the time of Revised Option-B plan will be able to acquire.21NAVAL34+670The proposed station site is located between road bridges.22CHANESAR36+530The location is straight line section with double tracks of PR North side is residential areas.23SHAHEED-E-MILLAT38+250Just as Chanesar, so it is along PR double tracks. Railway side	8	NORTH NAZIMABAD	14+730	
11 MANGHOPIR 18+430 Sewage are flowing into station yard from adjointed textile factory.Many factories(electronic manufacturer,textile company) are located. 12 SITE 20+330 KCR line cross right-angled to the road. The beverage plant is located in the neighborhood. 13 SHAH ABDUL LATIF 22+390 Proposed station will be newly constracted in the same location where is the existing station. There is an automoble factory along KCR line at the station. 14 BALDIA 23+850 A vacant land (ornered by PR) is located on the back side which is big intersection.PR land was made a studied for receiving Substation from KESC Mouripur grid station. 15 LIYARI 25+170 Proposed station faces on the south of the LIYARI river.New substation will be constructed in the dry riverbed of the north side. 16 WAZIRMANSION 26+530 A new station is adjoined, Car dept of KCR is constructed next to proposed station.KESC transmission line tower exists in Car dept of bridges exist in DCOS side. 19 DCOS 31+630 PR Deputy Control Store is located in the neighborhood.Two road bridges exist in the Karachi Cantt side. 20 KARACHI CANTT. 33+430 Sufficient land for SSP at the time of Revised Option-B plan will be able to acquire. 21 NAVAL 34+670 The proposed station site is located between road bridges. 22 CHANESAR	9	ORANGI	16+190	A station square is large and the level crossing adjoins.Sufficient land for SP will be able to acquire.
11MANGHOPIR18+430Sewage are flowing into station yard from adjointed textile factory.Many factories(electronic manufacturer,textile company) are located.12SITE20+330KCR line cross right-angled to the road.The beverage plant is located in the neighborhood.13SHAH ABDUL LATIF22+390Proposed station will be newly constracted in the same location where is the existing station.There is an automoble factory along KCR line at the station.14BALDIA23+850A vacant land (ornered by PR) is located on the back side which is big intersection.PR land was made a studied for receiving Substation from KESC Mouripur grid station.15LIYARI25+170Proposed station is adjoined, Car depot of KCR is constructed next to proposed station.KESC transmission line tower exists in Car depot 1716WAZIRMANSION26+530A new station is adjoined, Car depot of KCR is constructed next to proposed station.KESC transmission line tower exists in Car depot bridges exist in DCOS side.19DCOS31+630PR Deputy Control Store is located in the neighborhood.Two road bridges exist in the Karachi Cantt side.20KARACHI CANTT.33+430Sufficient land for SSP at the time of Revised Option-B plan will be able to acquire.21NAVAL34+670The proposed station site is located between road bridges.22CHANESAR36+530The location is straight line section with double tracks.Railway side is partly occupied by illegal intruder.	10	HBL	16+890	Use of the employee of National Industrial Area is expected.
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13SHAH ABDUL LATIF22+390the existing station. There is an automoble factory along KCR line at the station.14BALDIA23+850A vacant land (ornered by PR) is located on the back side which is big intersection.PR land was made a studied for receiving Substation from KESC Mouripur grid station.15LIYARI25+170Proposed station faces on the south of the LIYARI river.New substation will be constructedt in the dry riverbed of the north side.16WAZIRMANSION26+530A new station is adjoined, Car depot of KCR is constructed next to proposed station.KESC transmission line tower exists in Car depot17TOWER28+330The vast vacant land spreads out.18KARACHI CITY29+630Pakistan Railways branch office is located in the station yard. Road bridges exist in DCOS side.19DCOS31+630Sufficient land for SSP at the time of Revised Option-B plan will be able to acquire.21NAVAL34+670The proposed station site is located between road bridges.22CHANESAR36+530The location is straight line section with double tracks of PR North side is residential areas.23SHAHEED-E-MILLAT38+250Just as Chanesar, so it is along PR double tracks.Railway side is partly occupied by illegal intruder.	12	SITE	20+330	KCR line cross right-angled to the road. The beverage plant is located in
14BALDIA23+850intersection.PR land was made a studied for receiving Substation from KESC Mouripur grid station.15LIYARI25+170Proposed station faces on the south of the LIYARI river.New substation will be constructed in the dry riverbed of the north side.16WAZIRMANSION26+530A new station is adjoined, Car depot of KCR is constructed next to proposed station.KESC transmission line tower exists in Car depot17TOWER28+330The vast vacant land spreads out.18KARACHI CITY29+630Pakistan Railways branch office is located in the station yard. Road bridges exist in DCOS side.19DCOS31+630PR Deputy Control Store is located in the neighborhood.Two road bridges exist in the Karachi Cantt side.20KARACHI CANTT.33+430Sufficient land for SSP at the time of Revised Option-B plan will be able to acquire.21NAVAL34+670The proposed station site is located between road bridges.22CHANESAR36+530The location is straight line section with double tracks of PR North side is residential areas.23SHAHEED-E-MILLAT38+250Just as Chanesar, so it is along PR double tracks.Railway side is partly occupied by illegal intruder.	13	SHAH ABDUL LATIF	22+390	• • •
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16WAZIRMANSION26+530A new station is adjoined, Car depot of KCR is constructed next to proposed station.KESC transmission line tower exists in Car depot17TOWER28+330The vast vacant land spreads out.18KARACHI CITY29+630Pakistan Railways branch office is located in the station yard. Road bridges exist in DCOS side.19DCOS31+630PR Deputy Control Store is located in the neighborhood.Two road bridges exist in the Karachi Cantt side.20KARACHI CANTT.33+430Sufficient land for SSP at the time of Revised Option-B plan will be able to acquire.21NAVAL34+670The proposed station site is located between road bridges.22CHANESAR36+530The location is straight line section with double tracks of PR North side is residential areas.23SHAHEED-E-MILLAT38+250Just as Chanesar, so it is along PR double tracks.Railway side is partly occupied by illegal intruder.	15	LIYARI	25+170	
18 KARACHICITY 29+630 Pakistan Railways branch office is located in the station yard. Road bridges exist in DCOS side. 19 DCOS 31+630 PR Deputy Control Store is located in the neighborhood. Two road bridges exist in the Karachi Cantt side. 20 KARACHICANTT. 33+430 Sufficient land for SSP at the time of Revised Option-B plan will be able to acquire. 21 NAVAL 34+670 The proposed station site is located between road bridges. 22 CHANESAR 36+530 The location is straight line section with double tracks of PR North side is residential areas. 23 SHAHEED-E-MILLAT 38+250 Just as Chanesar, so it is along PR double tracks.Railway side is partly occupied by illegal intruder.	16	WAZIRMANSION	26+530	A new station is adjoined, Car depot of KCR is constructed next to
16 KARACHICHY 29+630 bridges exist in DCOS side. 19 DCOS 31+630 PR Deputy Control Store is located in the neighborhood.Two road bridges exist in the Karachi Cantt side. 20 KARACHICANTT. 33+430 Sufficient land for SSP at the time of Revised Option-B plan will be able to acquire. 21 NAVAL 34+670 The proposed station site is located between road bridges. 22 CHANESAR 36+530 The location is straight line section with double tracks of PR North side is residential areas. 23 SHAHEED-E-MILLAT 38+250 Just as Chanesar, so it is along PR double tracks.Railway side is partly occupied by illegal intruder.	17	TOWER	28+330	The vast vacant land spreads out.
19DCOS31+630PR Deputy Control Store is located in the neighborhood. Two road bridges exist in the Karachi Cantt side.20KARACHI CANTT.33+430Sufficient land for SSP at the time of Revised Option-B plan will be able to acquire.21NAVAL34+670The proposed station site is located between road bridges.22CHANESAR36+530The location is straight line section with double tracks of PR North side is residential areas.23SHAHEED-E-MILLAT38+250Just as Chanesar, so it is along PR double tracks. Railway side is partly occupied by illegal intruder.	18	KARACHICITY	29+630	
20 NARACHICANTL 33+430 to acquire. 21 NAVAL 34+670 The proposed station site is located between road bridges. 22 CHANESAR 36+530 The location is straight line section with double tracks of PR North side is residential areas. 23 SHAHEED-E-MILLAT 38+250 Just as Chanesar, so it is along PR double tracks.Railway side is partly occupied by illegal intruder.	19	DCOS	31+630	
21 NAVAL 34+670 The proposed station site is located between road bridges. 22 CHANESAR 36+530 The location is straight line section with double tracks of PR North side is residential areas. 23 SHAHEED-E-MILLAT 38+250 Just as Chanesar, so it is along PR double tracks.Railway side is partly occupied by illegal intruder.	20	KARACHI CANTT.	33+430	· · ·
22 CHANESAR 36+530 The location is straight line section with double tracks of PR North side is residential areas. 23 SHAHEED-E-MILLAT 38+250 Just as Chanesar, so it is along PR double tracks.Railway side is partly occupied by illegal intruder.	21	NAVAL	34+670	
23 SHAHEED-E-IVIILLAT 38+250 occupied by illegal intruder.				The location is straight line section with double tracks of PR North side is residential areas.
	23	SHAHEED-E-MILLAT	38+250	Just as Chanesar, so it is along PR double tracks.Railway side is partly
	24	KARSAZ HALT	40+390	

Table 5.3.43	Site Situation of Proposed Stations
1 4010 010110	Site Situation of Freposed Stations