(2) Equipment Outline of the Overhead Contact System (OCS)

1) Basic Conditions

a) Electrification System:

Alternate Current (AC) 25kV (Frequency 50Hz), Autotransformer Feeding System, Different Phase Feeding for Directions

b) Overhead Catenary System:

Simple Catenary System

c) Climate Conditions:

Climate conditions in the project area are extraordinary: in nearby coast areas it includes brackish water and is located within 10km from the seashore. The atmosphere is saliferous, humid, and highly corrosive, so particular attention will be paid to these severely corrosive conditions. On average, rainfall is light, although sudden extremely heavy rainfall (monsoons) does occur.

According to the KESC's Specification-Technical Provisions on overhead line and power cable, design criteria are as follows:

- max. wind velocity：26.2m/s
- magnitude of wind load：43kg/m^2 (at wind velocity of 26.2m/s)
- max. ambient temperature：40°C (in closed rooms and in shade: 50°C)
- min. ambient temperature：0°C
- everyday ambient temperature：30°C
- max. temperature for copper and copper weld conductor：80°C
- max. relative humidity：90% (for power cable:100%)
- wind load on flat surfaces：146kg/m^2
- wind load on round surfaces：89kg/m^2
- wind velocity for conductor cooling：0.6m/s
- ice load on structure and conductors：no consideration
- isokraunic level days/annum ：9.7days

Based on information of climate conditions in Karachi City provided by the Meteorological Department, assumed defined values are as follows:

i) Ambient Temperature (°C)

Table 5.3.44 Ambient Temperature

Standard	Maximum	Minimum
30	40	10

Source: JICA Study Team

ii) Wind Velocity (m/s)

Table 5.3.45 Wind Velocity

For Intensity Calculation	For Deflection Calculation
20	15

Source: JICA Study Team

iii) Pollution Degree for Insulators

The classification of Japan during typhoon season is as follows and clarified as a very heavily polluted area located within 10km from the seashore. The project area also corresponds to this with regards to seasonal (not typhoon) winds. In northern industrial areas, heavy air pollution is presumed. Moreover, it hardly rains in the project area; therefore, it is not expected to be flushed out by rain.

Table 5.3.46 Valuation basis on Pollution level in Japan

Clarification	Middle	Very heavy	Super heavy
Assumed Maximum Salt Adhesion (mg)	100	200	300
Distance from Sea Shore(km) At Typhoon Season	10~50	3~10	0~3
At Seasonal Wind	3~10	1~3	0~3
Industrial Area	Surrounding	Central	Core

Source: JICA Study Team

Through the viewpoint of above, the project area is assumed to be very heavily polluted.

2) **Planning of the OCS Facility**

a) Supporting Structure

JICA Study Team highly recommends the landscape design for the supporting structure of the OCS in elevated sections be performed. It will be realized with consideration of esthetic harmonization between the surrounding sight along the rail line and the viaducts itself.

i) Electrification Mast

H-section steel mast will be used in on-ground sections and steel pipe masts in elevated sections.

ii) Mast Foundation

In on-ground sections, block foundation made from concrete will be used.

In elevated sections, chuck-in type foundation which has 1000mm depth will be used. Its design and construction work are performed cooperatively with civil engineering staff.

iii) Supporting Structure in Station Platform Sections

Brackets for overhead contact wire will be attached to platform-shed beams or pillars.

iv) Interval of Supporting Points

The maximum interval between supporting points is 60 m.

Moreover, the ratio of the distance between 2 adjoining support points is less than 1:1.5m.

v) Guy at Wire Termination

Classification of a guy is according to usage: overhead contact wire, feeding wire, and AT-protection wire. In elevated section, its design and construction are performed cooperatively with civil engineering staff.

vi) Beams

In elevated sections, cross-beams are mostly used for overlapping overhead contact wire.

Moreover, cross-beams are also used in drawing wires from TSS and SP.

In depot yards, V-truss and Warren-truss beams are mainly used because they are able to support many electric wires effectively.

vii) Supporting Arms

Supporting arm furnishings are to support electric wires, except overhead contact wire, and designed in consideration of balance and electrical clearance against other support structures.

b) Overhead Contact Wire

i) Overhead contact wire consists of the following:

In both the main line and depot yards, the JICA Study Team recommends a simple catenary system for its reliability, economic efficiency, maintainability, and proven safety. Composition of the overhead contact system is as follows:

Table 5.3.47 Configuration of Overhead Contact System

Section	Category System	Items	Line Type (mm2)	Tensing Force (kN)
Main Lines	Simple Catenary	Messenger Wire	PH150	19.6
		Contact Wire	PHC110	14.7
Depot Yards	Simple Catenary	Messenger Wire	St90	9.8
		Contact Wire	GT110	8.8

(Note) PH: Power Hard-drawn Copper Stranded Conductors, PHC: Precipitation Hardening Copper
St: Zinc-coated steel strands, GT: Hard-drawn Copper Grooved Trolly Wires

Source: JICA Study Team

ii) Methodology of construction is as follows:

a. The supporting method of overhead contact wire is fixed with a movable cantilever in the main line and with a span-wire connection in the depot yards.

b. The standard height of contact wire is 5.1m from the top of the rail and at a minimum of 4.55m.
(These should be examined at the next basic design stage by considering characteristics of the structural object concerned, civil, track, and architecture works.)

c. The system height (interval between messenger wire and contact wire) is assumed to be .0.85m.

d. Hanger intervals are assumed to be 5m.

e. Deviation of contact wires from track center is as follows:
- At straight sections:
  In Main Line, it is 200mm or less at any supporting point under zigzag formation.
  In Side Track and Depot Yards, It is 200mm or less at any supporting point under zigzag formation spanning 4 intervals per zigzag cycle.
- At curved sections, it is 300mm or less at any supporting point.

f. The gradient of contact wire is 5 per mill or less in main line.

g. The length of retaining sections as a contact wire is maximum 1.6km.
Automatic tensioning devices will be provided mainly for spring-types in the main line and pulley-types in depot yards.

d) Feeding Wire and Cable

Line type and tensioning force of feeder wire is as follows:

Table 5.3.48 Line Type and Tensioning Force of Feeding Wire

Items	Line Type (mm2)	Tensioning Force (kN)
AF Feeding Wire	40	5.9
TF Feeding Wire	PH150	8.8

(a) Feeding branches connecting feeder and contact wire will be PH150mm2.
(b) Feeding cable used for drawing from the gantry structure to TSS will be CAZV200mm^2.
Source: JICA Study Team

e) AT protective, Neutral, and Connecting wire of AT protective wire.

Line type and tensioning force of each wire is as follows:

Table 5.3.49 Line Type and Tensioning Force of Feeder Wire

Items	Line Type(mm2)	Tensioning Force (kN)
AF Protective Wire	Cu38	2.9
Neutral Wire	PH150	5.9

(a) Connecting wire of AT protective wire will be Cu38mm2 or 6.6kV CV100mm2.
Source: JICA Study Team

3) General Outline of the OCS Facilities

a) Traction Power Feeding System

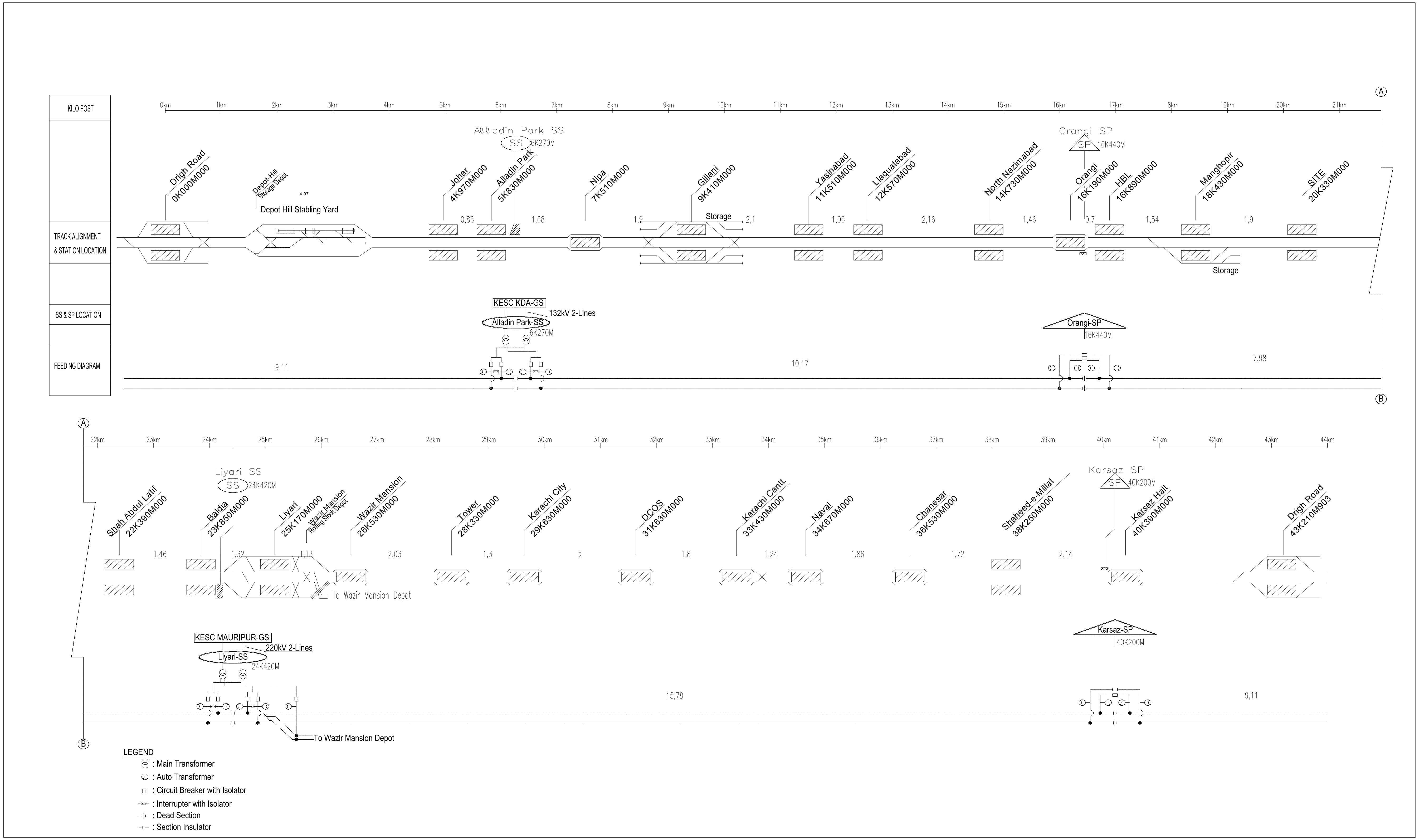
i) An insulated dead-section for sectionalizing traction power is furnished at nearby traction power substations (TSS).
ii) Feeding wire or cable will be drawn from the TSS to track way-side and connected to overhead AT feeding wire.
iii) In case of traction power failure at one TSS, the other TSS can supply sufficient power required for normal train operation instantly with a working circuit breaker in sectioning posts (SP).
iv) To ensure sufficient electric power for the Alladin Park depot facilities, a dedicated feeding line will be constructed from the KESC Mauripur grid station to the car depots.

b) Traction Power Feeding Network, OCS Schematic Plan and Mountings

i) The Proposed Traction power feeding network in main line is shown in Figure 5.3.82.

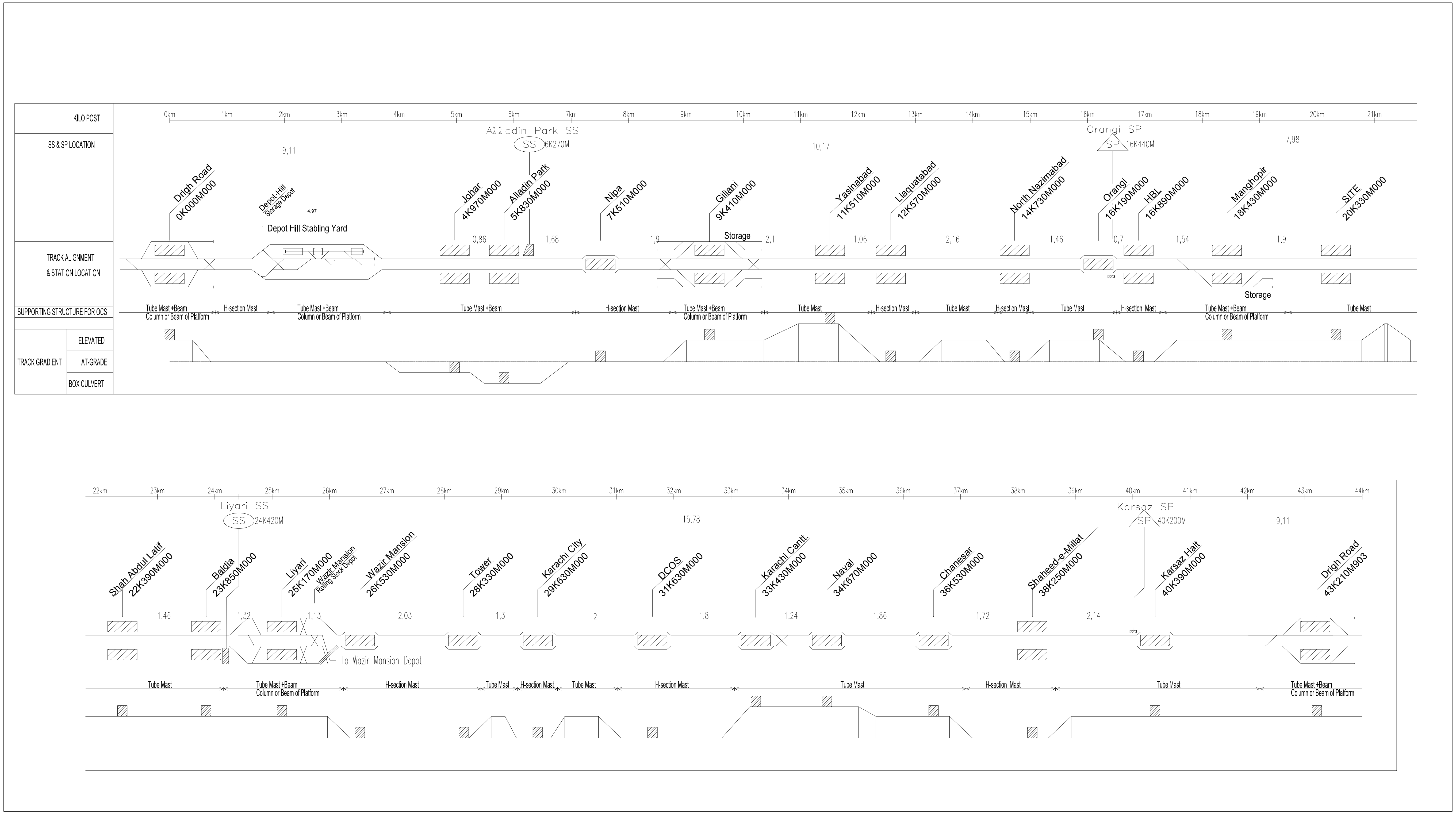
ii) The proposed OCS schematic plan in main line is shown in Figure 5.3.83.

iii) The proposed OCS standard mountings is shown in Figure 5.3.84.



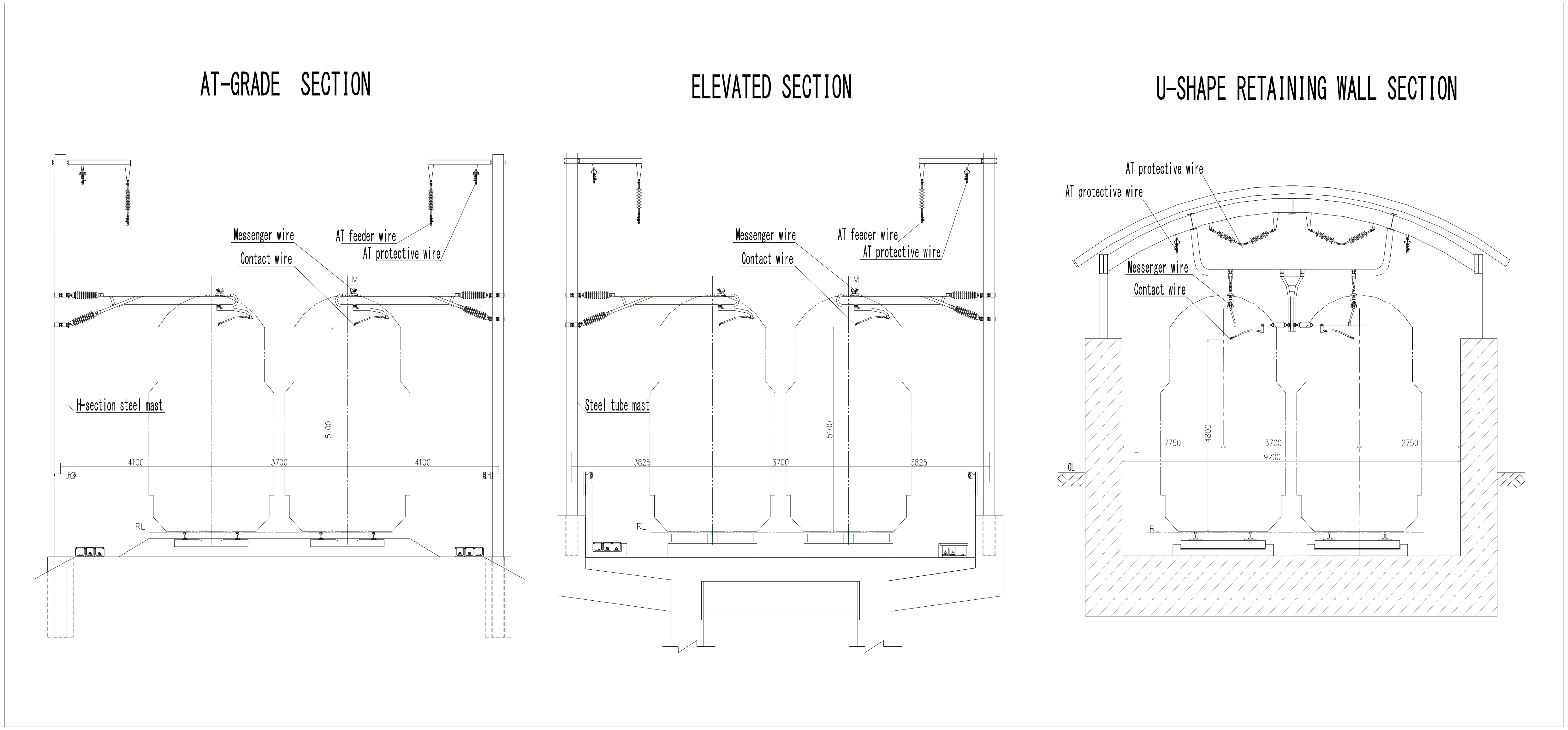
Source: JICA Study Team

Figure 5.3.82 Proposed Traction Power Feeding Network in Main Line



Source: JICA Study Team

Figure 5.3.83 Proposed OCS Schematic Plan



Source: JICA Study Team

Figure 5.3.84 Proposed OCS Mountings Plan

(3) Issues to be solved

1) Electric Shock Prevention

Since there are possibilities, people may receive an electric shock from nearby overhead contact wire, AT feeding wire, and protective wire located at U-shape retaining walls and bridges across the railroad, safeguards such as protective boards and guard fences should be furnished.

2) Investigation of Existing Road Bridge Height

The height of road bridges over the proposed KCR track should be examined together with related sections to ascertain whether the minimum height required for electrification is secured for clearance.

3) Introduction and Adoption of Local Material

After performing market research on local materials, aggregate, and steel produced in Pakistan, possibility of adoption will be considered after checking their performance and characteristics in conformity to Japanese standards.

4) Necessity for Burial of Earthing Wire

If burial earthing wires are required depend on the results of the computerized power load simulations, it is necessary to examine its burial depth, position, and routes, wiring protective method etc.

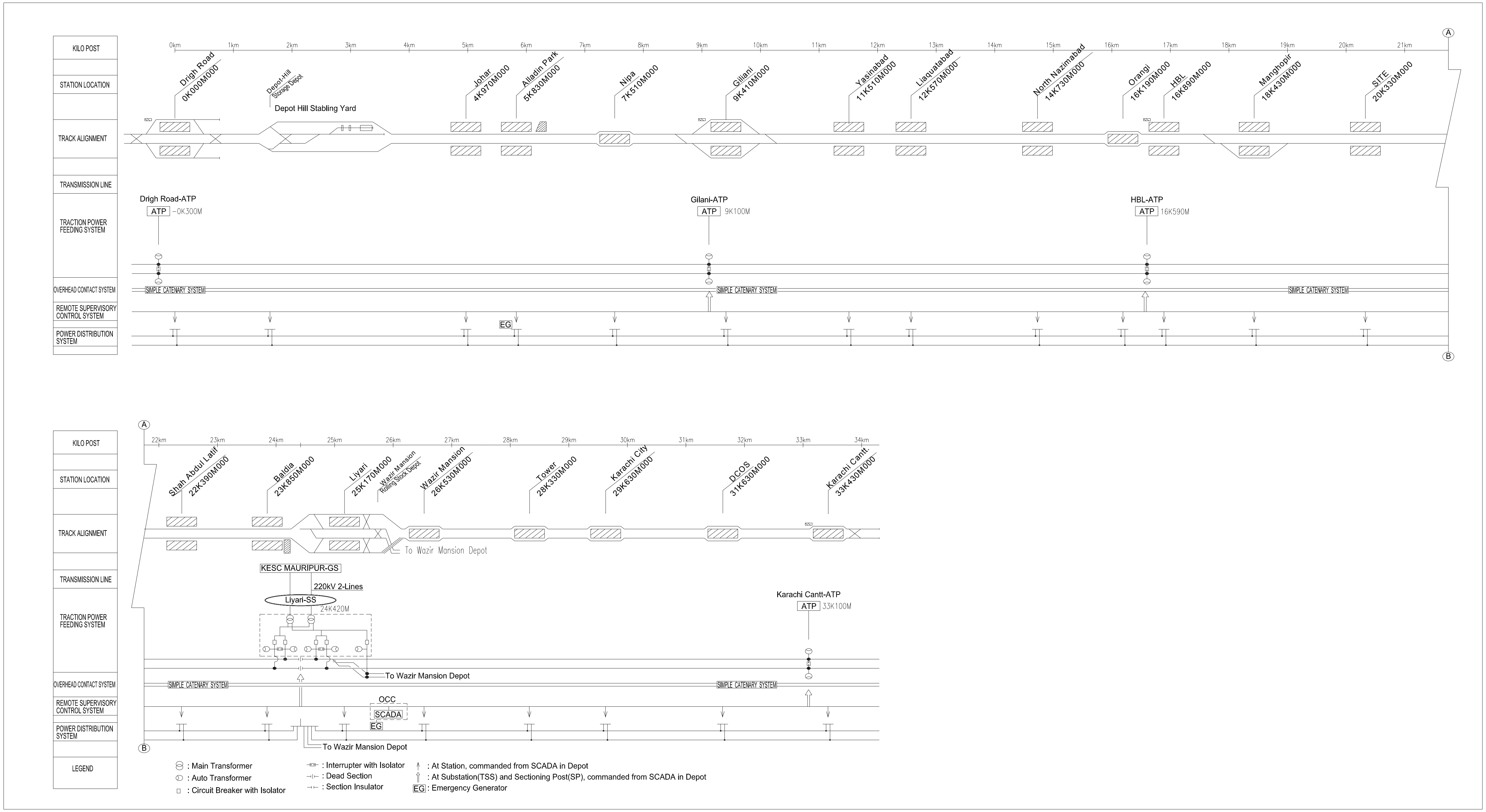
5) Landscape Design for the OCS Supporting Structure

In elevated sections, OCS supporting structure is required for esthetic harmony with the surrounding environment and the viaduct structure itself. Further, the JICA study team would like to propose various mountings and components.

5.3.7 Plan of Option N-B1

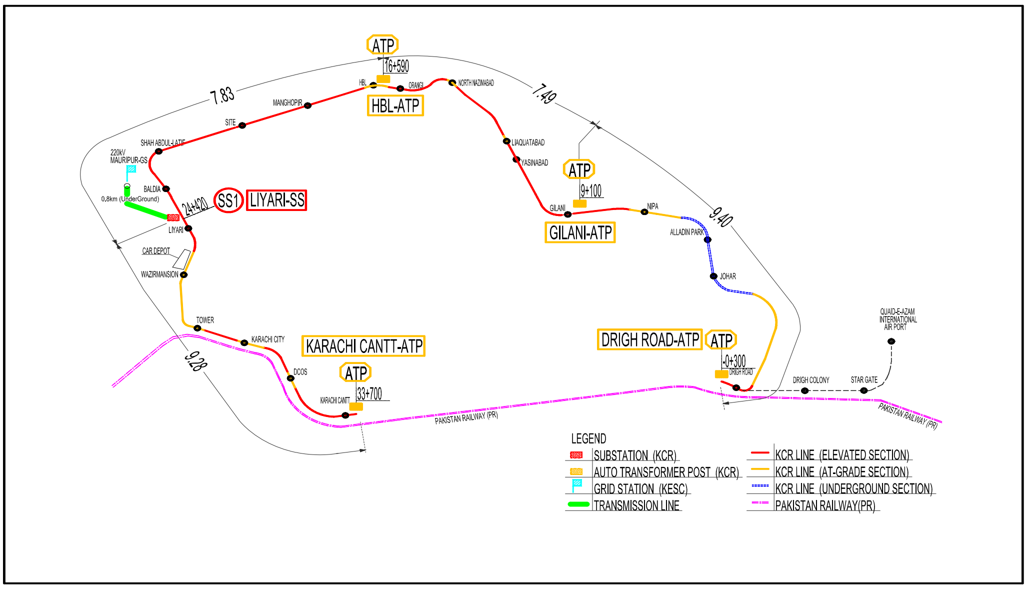
At initial stage, Option B was examined as partial operation plan. The section is approximately 35km between Drigh Road and Karachi Cantt through Orangi. Substation system consists of one (1) TSS and four (4) ATPs which are installed for the purpose of saving voltage drop on feeding system. Configuration of the overall power supply system and location of TSS, ATPs are shown in Figure 5.3.85 and Figure 5.3.86 as reference. After Option B, Plan of Option N-B1 has been raised based on the results of reviewing the demand forecast including bus way planning.

Those results of examination in Option B was taken over to Option N-B1 as mentioned below.



Source: JICA Study Team

Figure 5.3.85 Configuration of overall power supply system of Option B



Source: JICA Study Team

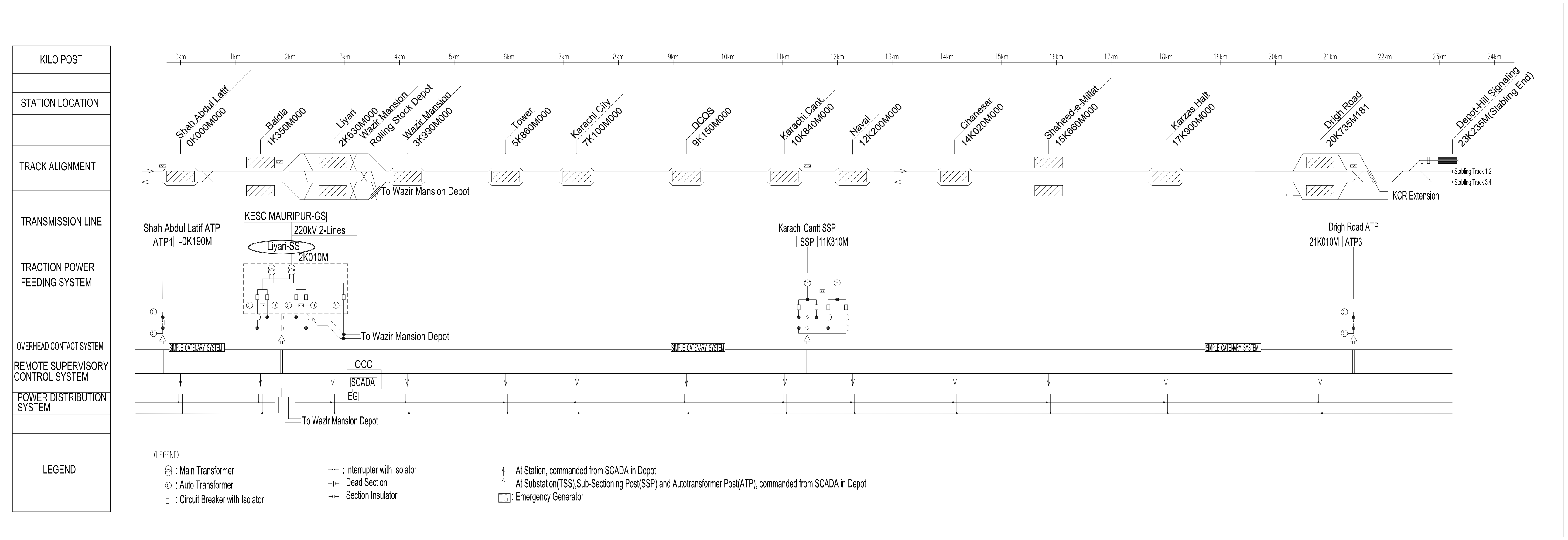
Figure 5.3.86 Location of KESC's GS, KCR's TSS and ATP of Option B

(1) Planned Section of N-B1

Planned section is proposed that had been determined based on the current traffic condition and to deal with the possibility of future demand expected mostly for KCR train operation system. Required train formation, number of cars per one train formation and scheduled speed were assumed based on the above future demand forecast. The proposed section is approximately 21 km from Shah Abdul Latif to Drigh Road via Karachi Cantt and additionally, 2.3km for shopping in-out-track from Drigh Road to Depot Hill, including 13 stations with five (5) elevated and eight (8) on-grounds.

(2) Configuration of Overall Power Supply System of N-B1

Traction power for train operation of the main line is supplied through feeding lines from Liyari TSS. Similarly, in Wazir Mansion Depot it is supplied through dedicated feeding lines from Liyari TSS. Required electrical power at each station is supplied through the distribution lines which are laid along track sides. These power supply systems are controlled by SCADA centralized in OCC. On the assumption that electrical power cannot be supplied from Liyari TSS, an emergency generator is installed in OCC for providing an essential power source for train operation. Configuration of the overall power supply system is shown in Figure 5.3.87.

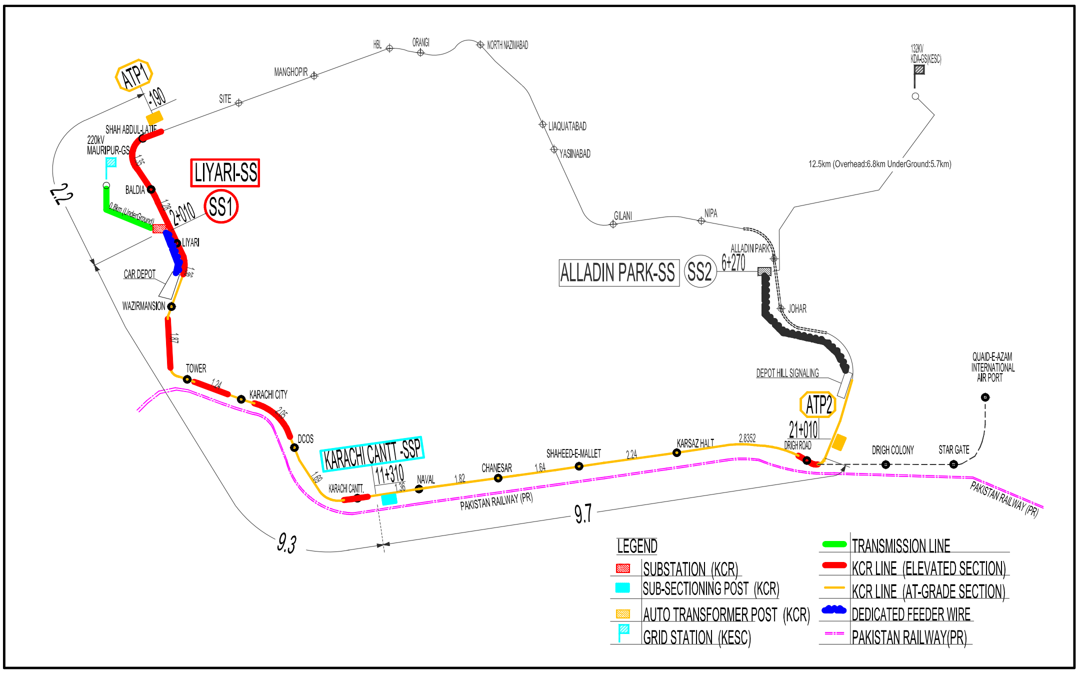


Source: JICA Study team

Figure 5.3.87 Configuration of Overall Power Supply System of N-B1

(3) Location of KESC's Grid Station, KCR's SSP and ATP of N-B1

A receiving substation is installed in the Liyari Riverside, as is the case with the plan of Option-B. Electric power for KCR train operation is supplied from Liyari TSS connected to KESC's Mauripur Grid Station through dedicated transmission lines which will be newly constructed for KCR. To enhance redundancy further, the required power source for train operation in Wazir Mansion Depot is supplied through dedicated feeding lines from Liyari TSS. For the purpose of the measures against voltage drop, Auto-Transformer Post (ATP) is installed at arrival stations such as Shah Abdul Latif and Drigh Road. Moreover, since intervals of approximately 19 km between Liyari TSS and Drigh Road ATP is very long, Sub-Sectioning Post (SSP) having the function to limit any power outage area, is installed at Karachi Cantt near its midpoint. On completion of the entire plan of the circular line, one substation (Alladin Park TSS) and two Sectioning Posts (Orangi SP and Kasaz SP) were finally and additionally constructed. If the entire plan will be coming up along the way of this plan, the concerned parties might redesign taking into account the appropriate location of substation facilities. Location of KCR's TSS, SSP, ATP, and KESC's Grid Station is shown in Figure 5.3.88.



Source: JICA Study team

Figure 5.3.88 Location of KCR's TSS, SSP, ATP, and KESC's Grid Station of N-B1

(4) Transmission Line from KESC's Grid Station to Liyari Substation

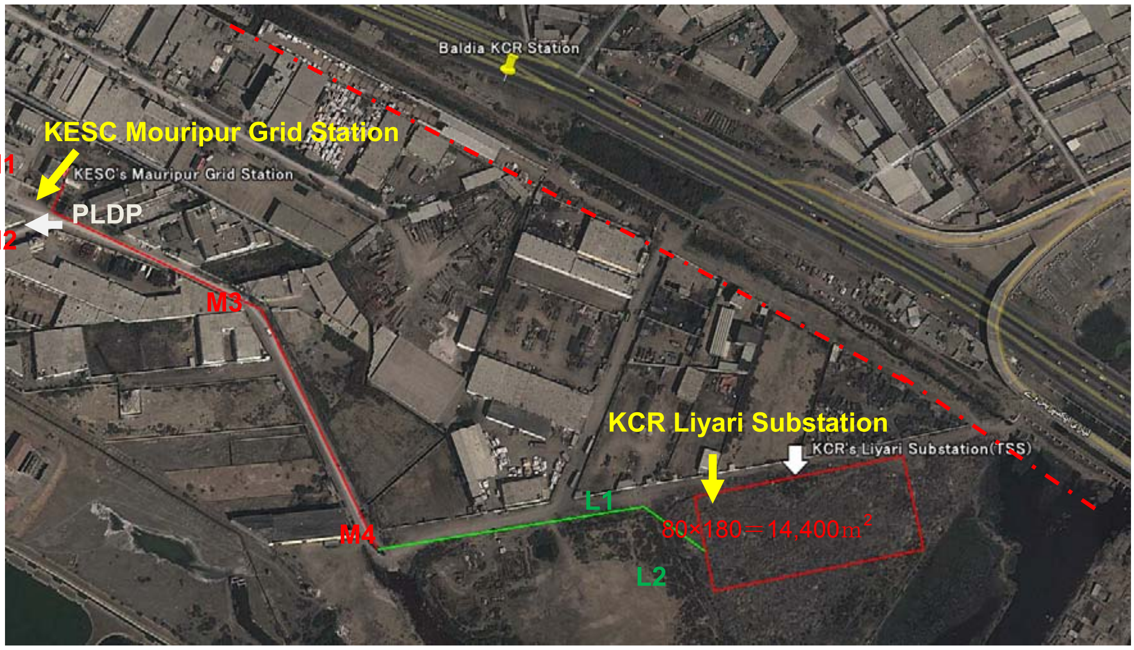
Electric power is provided by two circuits for exclusive use from the 220kV transmission network of KESC's Mauripur Grid Station, and transmits electricity with underground cable to Liyari Substation. The transmission line route from KESC's Mauripur Grid Station to KCR's Liyari TSS is shown in Figure 5.3.89. The existing KESC's overhead transmission line occupied roadside space of approximately 450m (between "M1" and "M4" in the figure). If a new transmission line as overhead wire for KCR is installed parallel to the road, it is required to have additional land space for new towers, because new towers have to keep over 30m of clearance between new and existing towers. The current situation of KESC's transmission line route is that about 450m distances between "M1" and "M4" had already been constructed with overhead wires and accessories along the road. If new overhead wires are installed parallel to existing overhead wires, by conforming to KESC regulation, it is necessary to secure a horizontal separation distance of 30m or more between the towers.

This road width is only about 11m, therefore additional land space for tower construction is required.

And to make matters worse, the land that should be acquired seems to be privately owned. Power Line Drop Platform (PLDP) is needed to connect overhead wires and power cables adjacent to KESC Mauripur Grid Station. However, no land space found is suitable at all. Existing PLDP in KESC Mauripur Grid Station is shown in Figure 5.3.90.

As a result of considering the various conditions, we can only conclude the best installation method is to lay down underground cables along the road. Burial depth of 220kV transmission underground cable is specified greater than or equal to 2m from the ground surface. As for about the 350m area located on the Liyari river bank between "M4" to "L2" in Figure 5.3.89, there is a threat of flooding during the rainy season, so special consideration should be given to countermeasures referring to the in-depth soil condition data. Information or technical data needed to be examined at Basic Design stage hereafter will be integrated into design criteria of substation facilities, and reflected to the civil engineering design for the embankment construction within the premises of Liyari Substation. Its major information is the maximum weight and position of substation facilities, earthing installation method etc.

In case of flood, a countermeasure for the cable protection is to use the power cable excellent in waterproofs or to install cables inside of a concrete culvert constructed underground. KESC's power cables installed in similar land conditions adjacent to a river were already investigated and JICA study team confirmed its possibility.



Source: JICA Study Team

(Legend) ———: Cable route along the road from M1 to M4
———: Cable route in soft ground condition from M4 to L2
–·–·–: PR existing track and KCR proposed line
PLDP : Power Line Drop Platform

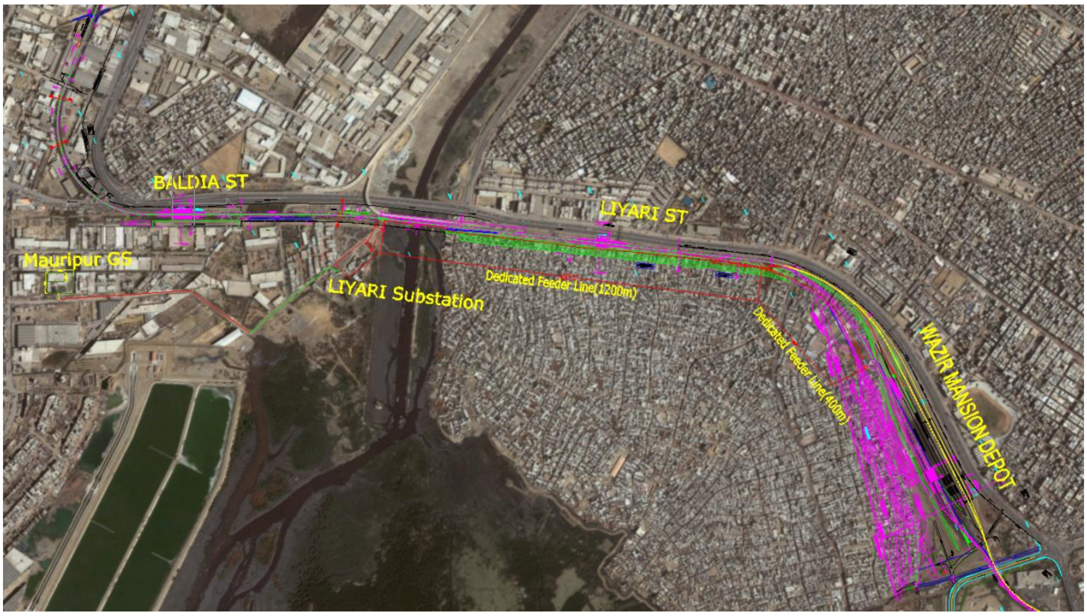
Figure 5.3.89 Transmission Line Route from KESC's Mauripur Grid Station to KCR's Liyari TSS

Source: JICA Study Team

Figure 5.3.90 Power Line Drop Platform (PLDP) in KESC Mauripur Grid Station and Existing Overhead Transmission Lines (M2→M3→M4)

(5) Dedicated Feeding Cable from Liyari TSS to Wazir Mansion Depot

Outgoing feeder wires from Liyari TSS are supported by a steel gantry structure constructed in the viaduct of KCR, and then they cross Liyari River with overhead wires or cables. After carrying out the final designs of a new Liyari bridge structure with the inclusion of considering an availability of reuse for the existing KCR Liyari River concrete bridge, the most appropriate installation method with wires or cables will be chosen in the next Basic Design stage. Main feeder wire is installed with fixed electrical poles erected in new viaducts and on-ground. Moreover, dedicated feeding cable from Liyari TSS to Wazir Mansion Depot is installed by the underground cable method along track sides in conformity with KESC's regulation. The dedicated feeder line route from Liyari TSS to Wazir Mansion Depot is shown in Figure 5.3.91.



Source: JICA Study Team

Figure 5.3.91 Dedicated Feeder Line Route from Liyari TSS to Wazir Mansion Depot

The view of existing Liyari Bridge and planned Liyari TSS are shown in Figure 5.3.92.

Source: JICA Study Team

Figure 5.3.92 Existing Liyari Bridge viewed from planned Liyari TSS (Left) and Planned Liyari TSS Site (Right)

A sample 220kV receiving substation in Japan is shown in Figure 5.3.93.

Source: JICA Study Team

Figure 5.3.93 Sample 220kV Receiving Substation in Japan

(6) Required Land Area for SSP and ATP

1) Required Land Area According to Outdoor-Type and Indoor-Type Facilities

Table 5.3.50 shows required land area for SSP and ATP, respectively.

Table 5.3.50 Required Land Area for SSP and ATP

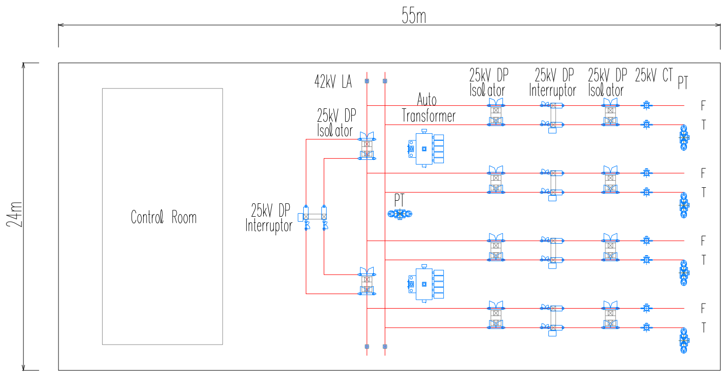
Facilities	Types	Required Land Area (m2)	Dimension(m)
Sub-Sectioning Post (SSP)	Outdoor	1,320	24×55
	Indoor	250	10×25
Auto-Transformer Post (ATP)	Outdoor	1,260	30×42
	Indoor	180	10×18

Source: JICA Study Team

2) Typical Layout Plan for Facilities

a) Sub-Sectioning Post (SSP)

A typical layout plan for SSP facilities is shown in Figure 5.3.94.

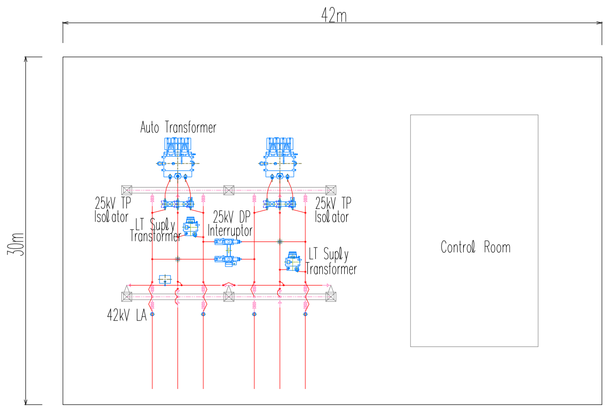


Source: JICA Study Team

Figure 5.3.94 Typical Layout Plan for SSP Facilities

b) Auto-Transformer Post (ATP)

A typical layout plan for ATP facilities is shown in Figure 5.3.95.



Source: JICA Study Team

Figure 5.3.95 Typical Layout Plan for ATP Facilities

(7) Sub-Sectioning Post (SSP)

Sub-Sectioning Post composed of Auto-Transformer, switchgears and air sections, which is installed for the purpose of ensuring maintenance time and to restrict the range of power failure occurred on Overhead Contact Line. The usual status is closing the feeder circuit In the case of restricting the range of power failure, it is opening. Opening and closing operation is carried out by remote control in Operation Control Center.

A sample Sub-Sectioning Post in Japan is shown in Figure 5.3.96.

Source: JICA Study Team

Figure 5.3.96 A Sample Sub-Sectioning Post in Japan

1) Previous Candidate Site

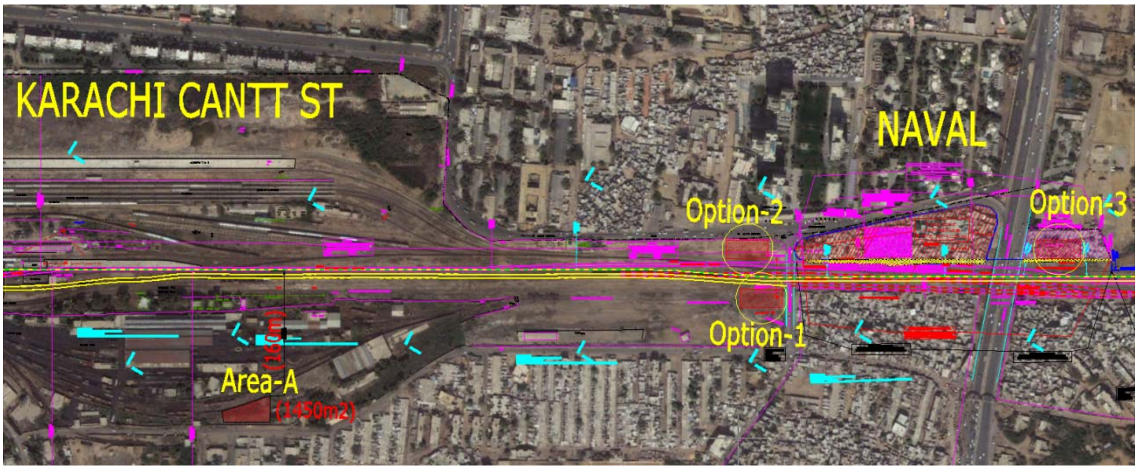
In the previous site survey on April 2012, KUTC proposed a vacant land of 1450m^2 located in the premises of the existing Karachi Cantt station of PR. (Shown in Figure 5.3.97 as" Area-A"). As results by taking into account appropriateness for a SSP installation site, the following items were found.

a. Outgoing feeder wires and cables from the proposed SSP will require an installation method which crosses over an existing platform shed by overhead wires or under passing rail tracks and the platform by underground cables. Accordingly, we can assume to encounter difficulties in either case.
b. As the site is located at intervals of 160m from KCR line, there is concern that some difficulties about maintenance work and administrative problems will appear.

As mentioned above, it was concluded that this site is not an appropriate candidate for SSP by JICA Study Team.

2) New Candidate Site

KUTC proposed new alternate vacant lands instead of the "Area-A "above. These are located on both sides of the road bridge existed between Karachi Cantt station and Naval station. Candidate sites for SSP in Karachi Cantt is shown in Figure 5.3.97.



Source: JICA Study Team

Figure 5.3.97 Candidate Sites for SSP in Karach Cantt

a) Option-1:

The site owned by PR is the most promising candidate and can sufficiently secure the land of 1320 m^2 (24m × 55m) required for SSP. As the soil condition is good, ground leveling seems easy. In addition, it is advantageous to transport power equipment to SSP because the site is adjacent to the road. However, since the existing line of PR remain phases between the proposed site and the planned KCR line, feeder cables are installed overhead or underground. In the case of overhead cabling, feeder cables cross the existing road bridge with suitable protection. Underground cabling on the other hand, will be buried to the depth of over than 1.5 m under existing PR rail tracks. Its crossing distance is about 30 m.

Source: JICA Study Team

Figure 5.3.98 Candidate Site of Option-1

b) Option-2:

The site is located on the opposite side of Option-1, across from the existing PR lines. From a standpoint of relative position between the site and proposed KCR line, the site is an appropriate land to construct SSP. However, the steep slope toward the site from the road parallel to KCR needs to be flattened to ensure the breadth needed for SSP. This can be achieved and a large-scale vertical earth retaining wall must be installed along the road. Consequently, JICA Study Team estimated that this option is not realistic.

Source: JICA Study Team

Figure 5.3.99 Candidate Site of Option-2

c) Option-3:

The candidate site is located within the premises of Naval station adjacent to Korangi Road. On the requirement, KUTC said that the land owned by PR has been illegally occupied by encroachers and several difficulties will arise to acquire the land.

Source: JICA Study Team

Figure 5.3.100 Candidate Site of Option-3

As a result of a site survey and technical examination, JICA Study Team decided that Option-1 is the most appropriate site for SSP.

(8) Auto-Transformer Post (ATP)

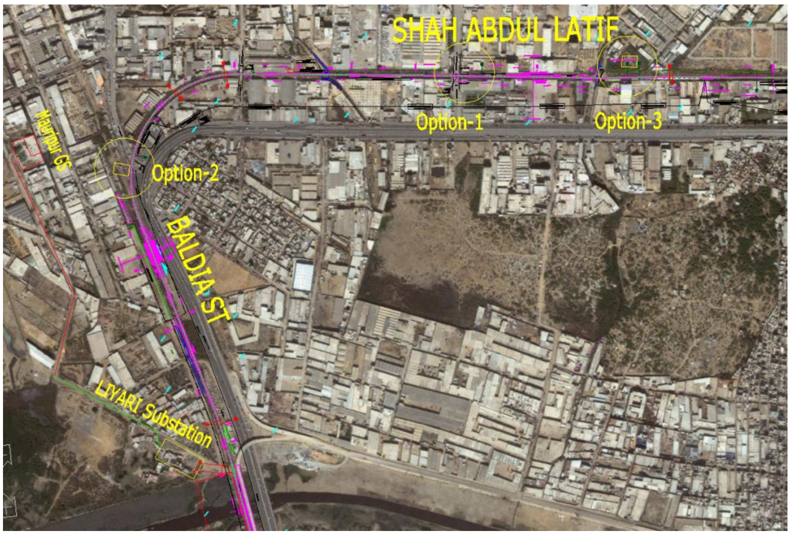
Auto-Transformer Post composed of transformers and switchgears is installed for the purpose of saving voltage drop on feeding system and to restrict the range of power failure which occurred on Overhead Contact Line. The usual status is closing the feeder circuit, once a power failure occurred switchgear is opened due to separation of Up and Down lines. A sample Auto-Transformer Post in Japan is shown in Figure 5.3.101.

Source: JICA Study Team

Figure 5.3.101 A sample Auto-Transformer Post (ATP) in Japan

JICA Study Team planned ATP in two places of Shah Abdul Latif and Drigh Road which are both terminated stations.

1) Shah Abdul Latif ATP (a proposed construction site for ATP near Shah Abdul Latif is shown in Figure 5.3.102)



Source: JICA Study Team

Figure 5.3.102 Proposed Construction Site for ATP near Shah Abdul Latif

a) Option-1:

Plan for construction under the viaduct with introductory indoor-type facilities.

Given that the compact-type (GIS-Type) equipment which has been adopted for ATP of Tsukuba-Express in Japan will be introduced, the site requires a small space of 200m2 (10 × 20m) under the viaduct. Breakdown of the ground-floor area of 200m2 is as an Auto-Transformer room of 160m2 and a distribution & testing room of 40m2, the ceiling height from floor level is 4.52m. As the planned height of viaduct in the site is about 6m from the ground up to the under surface of the beam, its width is 11m, and span length is 20m up to 30m. Under these conditions, it is possible to construct ATP under the viaduct in the site. A planned site of proposed Shah Abdul Latif Station is shown in Figure 5.3.103.

Source: JICA Study Team

Figure 5.3.103 Planned site of proposed Shah Abdul Latif Station

b) Option-2: (plan for construction in north side of Baldia station with introductory outdoor-type facilities)

The site owned by PR is located in the north side of KCR Baldia station and had been examined as a candidate site of TSS from the aspects of substation facility layout. As it turned out, it was found that the site is insufficient space to construct TSS. However, the site has satisfactory commodious space for ATP out-door facility layout. Feeder cable of about 1km should be installed from ATP up to the terminal end in the premise of Shah Abdul Latif station. The construction cost is cheaper than Option-1 because of the introduction of out-door type facilities, even if including feeder cable installation. It is necessary to carefully examine the laying method of feeder cable on the viaduct in the Basic Design stage. A candidate site for the planned ATP near Baldia Station is shown in Figure 5.3.104.

Source: JICA Study Team

Figure 5.3.104 Candidate Site for Planned ATP near Baldia Station

c) Option-3: (plan for construction in the vacant land 400 meter from Shah Abdul Latif station in the direction of SITE station with introductory outdoor-type facilities)

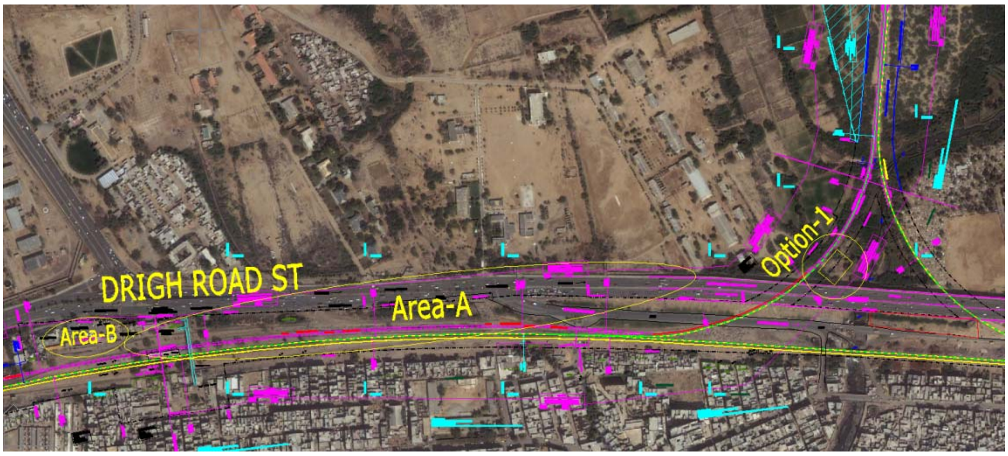
The site was investigated thoroughly as the third option. As a result, the site currently has been disputed in a court by 2 claiming ownership. They have no prospects of conclusion about these problems. For all these situations, KUTC strongly objected to carry out a land acquisition process. A candidate site for the planned ATP between Shah Abdul Latif and SITE is shown in Figure 5.3.105.

Note: the site is located inside the left fence. Source: JICA Study Team

Figure 5.3.105 Candidate Site for Planned ATP between Shah Abdul Latif and SITE

2) Drigh Road ATP

A proposed construction site for ATP near Drigh Road is shown in Figure 5.3.106.



Source: JICA Study Team

Figure 5.3.106 Proposed Construction Site for ATP near Drigh Road

a) Option-1: (plan for construction sites in diverged place of KCR & PR near Drigh Road station with introductory outdoor-type facilities)

The site is located on the left side of the triangle place near the branch point of PR and KCR, where KCR lines run through under the viaduct of Faisal Road. Its ground condition is good near side of KCR track. Since this triangle has a flowing river closer to the airport that has become a swamp. Therefore, to secure a position as much as possible close to the KCR track. A candidate site for the planned ATP near Drigh Road station is shown in Figure 5.3.107 and Figure 5.3.108.

Source: JICA Study Team

Figure 5.3.107 Candidate Site for Planned ATP near Drigh Road station (Viewed from the depot hill station side)

Source: JICA Study Team

Figure 5.3.108 Candidate Site for Planned ATP near Drigh Road Station (Viewed from Fasal Road side)

b) Area-A:

A result of the consideration as a candidate within the premises of Drigh Road station, the area has been a planned viaduct with 4 tracks and 2 platforms for the KCR main line and 2 tracks for the Airport line. Moreover, under the viaduct, PR existing tracks will be occupied on-ground. Consequently, JICA Study Team could not find suitable places for introducing outdoor-type facilities in this area. Regarding indoor-type, at the Basic Design stage of viaduct layout, it will remain to examine for possibility of ensuring necessary space for ATP (200m2 required) in the middle or track floor. Land condition of Area-A is shown in Figure 5.3.109.

Source: JICA Study Team

Figure 5.3.109 Land Condition of Area-A (Viewed from PR Drigh Road Station Side)

c) Area-B:

The place adjacent to Drigh Road station of Area-B, currently, is occupied by National Highway Authority, and a mosque next to them. Therefore, JICA Study Team could not find suitable places in this area. Land condition of Area-B is shown in Figure 5.3.110.

Source: JICA Study Team

Figure 5.3.110 Land Condition of Area-B (Within the Premises of Drigh Road Station)

(9) Dedicated Feeding Cable from Alladin-P TSS to Depot Hill

Source: JICA Study Team

Figure 5.3.111 Dedicated Feeder Line Route from Alladin-P TSS to Depot Hill

Although the section is out of scope of N-B1, it is considered essential to complete the entire plan, so JICA Study Team conducted the survey to find a dedicated power cable route from Alladin-Park to Depot Hill. This power cable provides traction power to cars in the Depot Hill yard anytime, day or night, separately from the main line train operation. Civil structure from Alladin-Park TSS to Johar ST is U-shape, retaining wall section continuously without the premises of stations (Alladin-Park and Johar ST). Both stations are Box-culvert underground stations. In those sections, dedicated power cable is laid inside a concrete duct installed independently along the main track. In on-ground sections, from Johar ST (excepted premises) to the Depot Hill yard, they are laid inside a concrete trough installed underground. Candidate site for proposed stations and Depot yard are shown in Figure 5.3.112.

①Alladin-Park Station ② Johar Station ③ Depot Hill yard

Source: JICA Study Team

Figure 5.3.112 Candidate Site for Proposed Stations and Depot Yard

(10) Countermeasures against Power Supply in Case of Emergency

The substation which supplies electric power to a railway system is required to ensure stable and reliable traction and service power from the aspect of responsibility for public transportation. Although recent power supply and distribution facilities have been highly reliable, if perchance a power failure occurs in such equipment, the power supply system should be shut down safely and instantly. As well, reacting to launch auxiliary power supply system to backup traction power and ensuring essential power for the computer which manages train operation control and customer service should be immediate. This system can be defined as two types of power load as follows, based on saving electricity objectives.

1. Traction power to evacuate trains stopped between stations

  - power load used for conducting the trains stopped between stations to the nearest station

2. Essential power load to back up service facilities

  - power load used for train control and command system, disaster prevention equipment under the Fire Defense Law, and emergency lighting on the premise of the station

In case of power failure occurring in Liyari TSS, it will be unable to provide traction power for train operation, as mentioned in the item 1. above. Traction power is provided from Alladin Park Simple Substation located at one extremity of the main line by connecting the circuit breaker of Drigh Road ATP. Meanwhile, essential power load, as mentioned in the item 2. above, is provided with the emergency generator installed in Wazir Mansion car depot. Differences between two power sources from the aspect of its purpose, location, implementation system, supplying method, and assumed power supply capacity are summarized in Table 5.3.51.

Table 5.3.51 Differences between 2 Backup Powers

Type	Purpose	Location	Implementation System	Supplying Method	Assumed Power Supply Capacity
Traction Power	●(at power outage in Liyari TSS) To conduct stopped trains to nearby stations safely and quickly. ●(at normal operation) To provide traction power for train operation between Drigh Road and Depot Hill stabling yard.	Alladin Park TSS	AC 25kV Simple Feeding System	Traction power is supplied through dedicated feeding lines from Alladin Park TSS to Depot Hill stabling yard with underground cables buried along KCR track.	3MVA
Service Power	●(at power outage in Liyari TSS) A power generator provides essential power load for station lighting, fire extinguishing, smoke extraction equipment, telecommunication, and signal systems.	Operation Control Center (OCC) in Wasir Mansion Car Depot	Diesel Power Generator	Service power is supplied to stations and OCC with the emergency generator through distribution cables laid down along the main line and Depot yard.	1MVA

Source: JICA Study Team

(11) Auxiliary Electricity Supply System in Case Power Failure Occurs in Liyari TSS

Traction power for train operation on Option N-B1 between Shah Abdul Latif and Depot Hill via Karachi Cantt is provided from a single source of KESC's Mauripur GS with double incoming lines through Liyari TSS. In case of power failure of both lines at the same time, an accident will cause huge damage to the whole train operation consequently. The most important activity in this case is to evacuate passengers confined in cars from the site to the nearest station in a safe and expeditious way. As a countermeasure against realizing to establish a backup system instead of a single source from KESC Grid station, JICA Study team proposed the following systems.

1) First option: Establishment of Simple Substation System

Since Depot Hill facilities require a dedicated power source independently from the main line in order to operate trains at any time of the day or night in the stabling yard, this traction power is provided from Alladin Park TSS connected to Hospital GS with a 132kV transmission line of about 2.1km. This traction substation is small-scale by introducing Simple Feeding System. Usually this substation provides traction power for train operation between Drigh Road and Depot Hill stabling yard. Once a power failure occurs in Liyari TSS, traction power should be provided to trains, along the main line up to Shah Abdul Latif station immediately. Transmission-Feeding Line Route, Alladin Park TSS and KESC Hospital Grid Station are shown in Figure 5.3.113 and Figure 5.3.114.

Source: JICA Study team

Figure 5.3.113 Transmission-Feeding Line Route from Hospital GS to Depot Hill

Source: JICA Study team

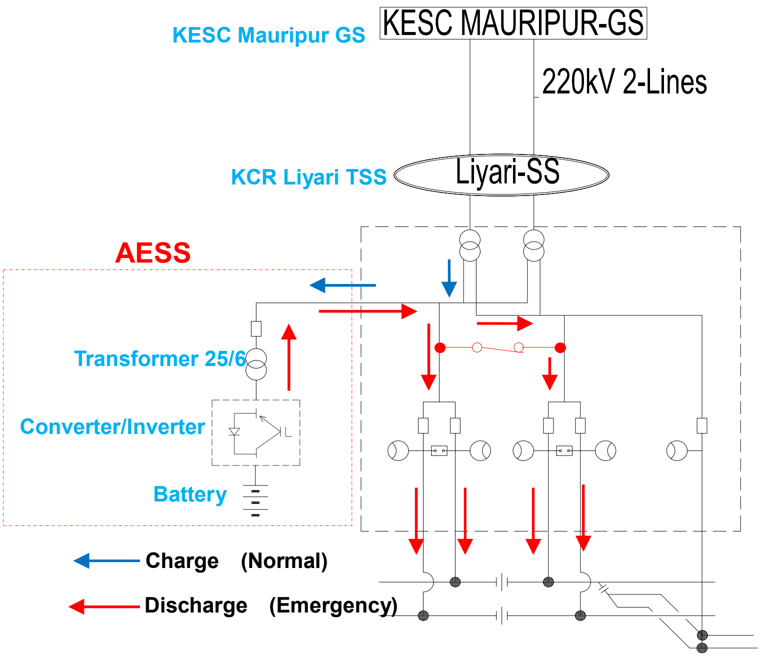
Figure 5.3.114 Alladin Park TSS and KESC Hospital Grid Station

2) Second option: Regenerative Energy Storage System on the Ground

This system stores the surplus regenerative electric power generated by regeneration vehicles into batteries installed on the premise of Liyari TSS. At the same time, it is given full charge of electricity from AC traction power through contact wires. Currently, the system still has not had a practical use in AC electrification systems. Therefore adoption of the system necessitates paying attention to further technical trends.

Auxiliary Electricity Supply System (AESS) combines Railway static Power Conditioner (RPC) and Regenerative electric Power Storage System (RPSS).

RPC has been developed for effective use of traction power in AT-feeding systems, and is a traction power equalized system at each phase of the primary side of a traction-transformer, with compensating reactive and accommodating effective power. Schematic diagram of Regenerative Energy Storage System on the Ground is shown in Figure 5.3.115.



Source: JICA Study Team

Figure 5.3.115 Regenerative Energy Storage System on the Ground

3) Third option: Introducing On- On-Vehicle Battery System

Surplus regeneration electric power is stored in each storage battery, equipped on-vehicle separately from the standard equipped battery for Auxiliary Machine. Stopped trains can convey passengers to the nearest station by using storage power.