The Islamic Republic of Pakistan
Ministry of Water and Power
National Transmission and Despatch Company Limited

Preparatory Survey
on
the Project for
Strengthening Training Center
on
Grid System Operation and Maintenance
in
the Islamic Republic of Pakistan

April 2016

Japan International Cooperation Agency

Asia Engineering Consultant Co., Ltd.
Yachiyo Engineering Co., Ltd.

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Preface

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey for the Project for Strengthening Training Center on Grid System Operation and Maintenance and entrusted the survey to consortium consulting (consist of Asia Engineering Consultant Co., Ltd. and Yachiyo Engineering Co., Ltd.).

The survey team held a series of discussions with the officials concerned of the Government of the Islamic Republic of Pakistan, and conducted a field investigations from January to October 2015. As a result of further studies in Japan, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Islamic Republic of Pakistan for their close cooperation extended to the survey team.

April, 2016

Yoshinobu IKURA
Director General,
Industrial Development of and Public Policy Department
Japan International Cooperation Agency

Summary

1. Country Overview

The Surface of the Islamic Republic of Pakistan (hereafter referred to as Pakistan) is 796,000 km^2 which is 2 times larger than that of Japan. The Population is 188.2 million (a population annual growth rate is 1.95%), according to the Pakistan Economic White Paper in 2014/2015, which is the 6^{th} largest population of the world.

The major industries are the agriculture and the textile industry. While the real Gross Domestic Product (GDP) is around 246.9 billion US$ (the World Bank in 2014), the Gross National Income (GNI) is about 1,398 US$ (the Pakistan Central Bank in 2014-2015). The real Economic Growth Rate is nearly 4.2% (the Economic White Paper in 2014-2015). The domestic recent price escalation rate is around 3.2% as stated by Pakistan Central Bank in May 2015.

2. Background of the Project

In Pakistan the power shortage has become a serious problem. In particular, in recent years the gap between the supply and demand of power is inflated to 4,500 ~ 5,500 MW (JICA "Data Collection Survey on Energy Sector Reform in the Islamic Republic of Pakistan," 2014). Accordingly, the entire country has been forced to increase load shedding over from 12 to 16 hours. The gap between the supply and demand is caused by the low operating rate of the existing power plant, which in turn is caused by the shortage of funds to purchase adequate amount of fuel. The shortage of funds can be traced to the fact that, while the power generation cost is high (20-30 PKR/kWh), the collection rate of electricity fees is very low (480 billion PKR is uncollected in 2013). These cause circulation debt (JICA "Least Cost Generation and Transmission Expansion Plan in Pakistan," 2015). Also in connection with the transmission and distribution network, as results of aging and inefficient operation & maintenance management, the accident rates and the power loss of transmission and distribution is at a high level of about 25%, compared with other countries (6.3% in Thailand, 9.4% in Indonesia, 11.5% in Philippine) (JICA, "Preparatory Survey for Power Improvement Project" 2014).

Because of the power situation mentioned above, both the developments of industry and people's daily lives are inhibited. The problem of economic loss due to the power outages and the inefficient operation of transmission and distribution network has been recognized as the most serious challenge to the country's economic activity. Operating these facilities efficiently, strengthening the transmission and transformation system in order to enable stable power supply, and developing the capacity building for operators and technicians are pressing issue.

Under these circumstances, "National Power Policy 2013" has been established in the power sector. Its policy actions include the extermination of outages and the reduction of power loss up to 16%. The Project for Strengthening Training Center on Grid System Operation and Maintenance (hereafter referred to as the Project) aims at developing the capabilities of the training department of National Transmission and Despatch Company Ltd (hereafter referred to as NTDC). By strengthening its training functions, the appropriate operation of transmission and transformation system is expected to be enhanced.

3. Contents of the Project

Based on these challenges, the Government of Pakistan requested Grant Aid to Japan to implement the "Project for Strengthening Training Center on Grid System Operation and Maintenance" in order to develop a training system focused on more practical needs.

Accordingly, JICA collected the relevant information and confirmed the necessity and the validity of the Project as being worthy of Grant Aid. The preparatory survey was conducted over nine months from February to October 2015 in order to establish a project design and to form a project cost outline. Through the survey, it was revealed that the capacity building for engineers and technicians are insufficient, while the power generator and the transmission facilities are strengthened, along with the augmentation of the power demand. Therefore, the facilities are not effectively operated.

The Project aims at strengthening training capability, related to the appropriate operation for transmission and transformation equipment, in the training department of NTDC, by way of the installation of training simulator and facility.

The Contents of the Project are shown as following:

(1) Construction of 1 building of the New Training Simulator Building (Floor Are: approximately 1,038.74 m², two-storey)

(2) Installation of 1 set of transmission and transformation training simulator, including 1 set of protection relay, spare parts, consumable supplies

(3) Consulting Service:

- Detailed Design, procurement consultation, project implementation, etc.

(4) Procurement method

- Major equipment is expected to be purchased in Japan.

(5) Responsible Authority and Execution Agency are shown as following:

- Responsible authority: Ministry of Water and Power
- Execution agency: NTDC

4. Duration and Cost of the Project

The duration of the project implementation period is 24 months, including the phases of the Detailed Design, the procurement, the civil works and the installation. The estimated overall cost borne by the Pakistan Side is 4.14 million PKR (equivalent to 5.42 million yen). The cost breakdown is shown as follows:

- Construction of 2 openings to connect to the new connecting corridor and installation of 2 doors in the existing TSG Training Center (Ground and First floors), the expansion joint cover, and etc.: 1.88 million PKR
- Change the power receiving transformer from 50 kVA to 200 kVA: 1.28 million PKR
- Removal of obstacles such as septic tanks (Man holes), wasted soil by septic tanks, electric poles, trees, and etc. in the Project site, and securing connection points of existing TSG power supply, water supply, and gas supply for New Training Simulator Building: 0.98 million PKR

5. Evaluation of the Project

(1) Validity of the Project

Along with the augmentation of the power demand, the power generator and the transmission and transformation facilities has been strengthened in Pakistan. However, skilled and experienced engineers and technicians who can operate these facilities seem to be lacking. This is due to the obsolete and lacking of training facilities which enable to effectuate troubleshooting training. Accordingly, installed equipment and facilities are not effectively utilized. Under these circumstances, the project contributes to the construction of the New Training Simulator Building and to the installation of training simulator in Training Service Group (hereafter referred to as TSG) of NTDC.

Based on the above, it is considered that the Project is expected to be highly adequate and

effective.

(2) Effectiveness of the Project

The traditional trainings have been conducted in a short time during the Grid System Operation Organization (hereafter referred to as GSO) operation's interval time. As a real simulator is used for the training, it is not only hazardous, but also very limited in terms of content. On the other hand, the new training simulation allows TSG to safely carry out training, and to reproduce postulated accidents which cannot be done in the traditional trainings. The quantitative and the qualitative effect are shown as below:

1) Quantitative effect

Index name	Baseline value in 2015 (actual value)	Target value in 2021 (3 years after the Project completion)
1. Number of training courses using simulator (course)	0	4
2. Number of implemented training courses using simulator (times/year)	0	22
3. Number of trainees with experience using of simulator (person/year)	0	120
4. Training course evaluation by trainees	3.0	3.4

(Note) Evaluation ranks of Row 4: 4.0=Very Good, 3.0=Good, 2.0=Average, 1.0=Not Good

In Row 4, while 3.0 of the baseline value in 2015 shows the average mark for the existing training courses, 3.4 of the target value shows the average mark of the training courses with the new course.

2) Qualitative effect

- The operation & maintenance for transmission and transformation is improved at trainees' institution.
- The economic infrastructure is strengthened, including the establishment of stable power supply, through the appropriate operation & maintenance for transmission and transformation.

CONTENTS

Location Map

Lahore

Overall view of Pakistan

Project Site

Site Location Map

Image of Completion

Image of GSO Operation Training Simulator

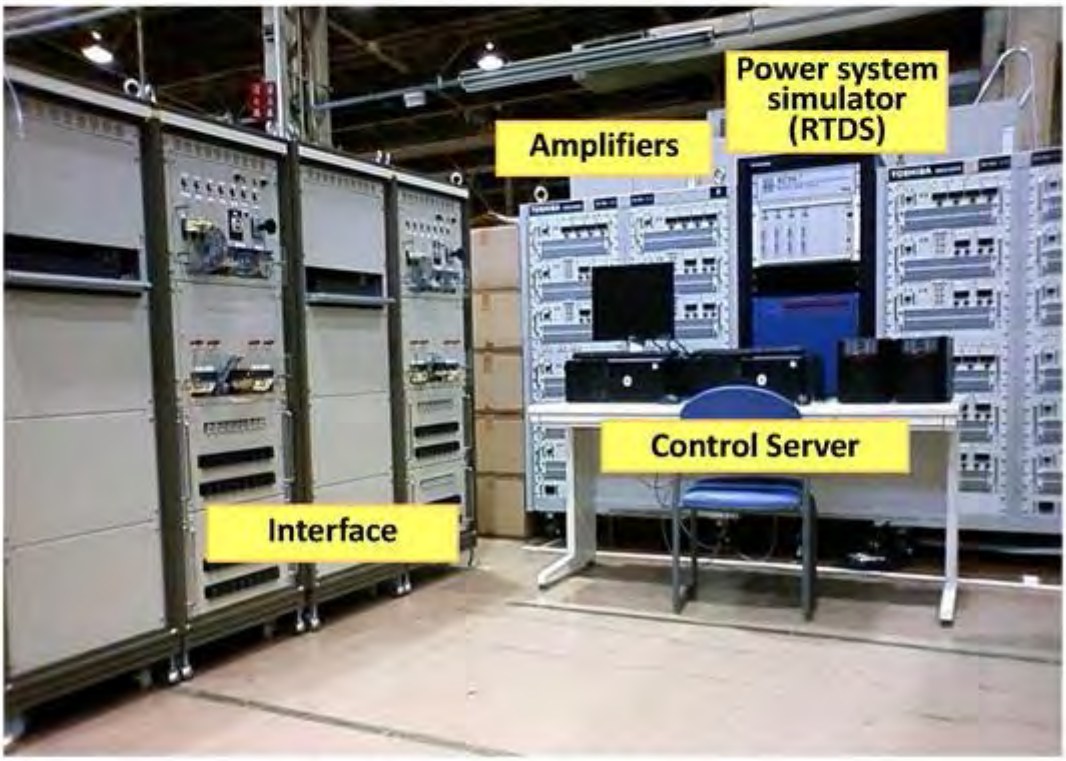


Image of Protection Relay Training Simulator

Figure and Table List

Chapter 1

Chapter 2

Abbreviations Table

No.	Abbreviation	Formal name
1	AC	Alternative Current
2	ADB	Asian Development Bank
3	AFM	Assistant Foreman
4	AKC/AEC	Asia Kyodo-Sekkei/Engineering Consultant Co.,Ltd.
5	ALM	Assistant Line Man
6	AP	Authorization to Pay
7	ASSA	Assistant Sub Station Attendant
8	AMP	Amplifire
9	B / A	Banking Arrangement
10	BHN	Basic Human Needs
11	CD	Construction Document
12	CE	Chief Engineer
13	CIDA	Canadian International Development Agency
14	CIF	Cost, Freight and Insurance
15	C&DF	Capacitance & Dissipation Factor
16	C/P	Counterpart
17	CT	Current Transformer
18	CTC	Circle Training Center
19	CPPA (G)	Central Power Purchasing Agency Guarantee
20	CPU	Central Processing Unit
21	DAC	Development Assistance Committee
22	DC	Direct Current
23	DES	Dielectric Strength
24	DISCO	Distribution Company
25	DLC	Dead Line Course
26	D/D	Detailed Design
27	EAD	Economic Affairs Division
28	EIA	Environment Impact Assessment
29	ETO	Excise Tax Office
30	EU	European Union
31	E/N	Exchange of Notes
32	FBR	Federal Board of Revenue
33	FTN	Free Tax Number
34	FOB	Free on Board
35	FM	Foreman
36	FY	Fiscal Year
37	GAVI	The Global Alliance for Vaccines and Immunizations
38	G/A	Grant Agreement
39	GDP	Gross Domestic Product
40	GENCO	Generation Company
41	GFATM	Global Fund to Fight AIDS, Tuberculosis and Malaria
42	GI	General Information
43	GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
44	GL	Ground Line
45	GNI	Gross National Income
46	GSO	Grid System Operation Organization
47	G/S	Grid Station
48	GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit

No.	Abbreviation	Formal name
49	HP	Home Page
50	HTCM	Hidel Training Center Mungla
51	IDA	the International Development Association
52	IFAD	International Fund for Agricultural Development
53	I / F	Interface
54	IMF	International Monetary Fund
55	I / O	Input and Output
56	IPP	Independent Power Producer
57	JET	JICA Expert Team
58	JCC	Joint Coordination Committee
59	JICA	Japan International Cooperation Agency
60	JICE	Japan International Cooperation Center
61	JS	Joint Secretary
62	KESC/KESCL	Karachi Electric Supply Company Limited
63	LCM	Leakage Current Measurement
64	LESCO	Lahore Electric Supply
65	LA	Lab Assistant
66	LCD	Liquid Crystal Display
67	LCPDP	Least Cost Power Development Plan
68	LM	Line Man
69	LS	Line Superintendent
70	MA	Machine Attendant
71	MCCB	Magnetizing Circuit Breaker
72	MD	Managing Director
73	MIMIC	Mimic Indicator
74	MTCE	Maintenance
75	MoWP	Ministry of Water and Power
76	M/M	Minutes of Meeting
77	MTDF	Midterm Term Development Framework
78	NEPRA	National Electric Power Regulatory Authority
79	NKLP	New Kot Lakhpat
80	NPCC	National Power Control Center
81		National Power Construction Company
82	NTDC	National Transmission and Despatch Company/Limited
83	ODA	Official Development Assistance
84	OLTC	On Load Tap Changer
85	O&M	Operation and Maintenance
86	PEPCO	Pakistan Electric Power Company Limited
87	PC-1	Planning Commission Form 1
88	PCM	Project Cycle Management
89	PDCA	Plan Do Check Action
90	PDM	Project Design Matrix
91	PO	Plan of Operation
92	PQ	Pre-Qualification
93	PTG	Portable Temporary Ground
94	PTW	Permit To Work
95	P&I	Protection and Instrumentation
96	R/D	Record of Discussion
97	R&D	Research& Development

No.	Abbreviation	Formal name
98	RTC	Regional Training Center
99	RTDS	Real Time Digital Simulator
100	SCADA	Supervisory Control And Data Acquisition
101	SE	Skill Enhancement
102	SOP	Standard Operating Procedure
103	SSA	Sub Station Attendant
104	SSO	Sub Station Operator
105	SVC	Static Var Compensator
106	TTS	Telegraphic Transfer Selling Rat
107	T/C	Training Center
108	TI	Test Inspector
109	T/L	Transmission Line
110	TOR	Term of Reference
111	TOT	Training of Trainers
112	TSG	Technical Service Group
113	TRD	Trained
114	TTR	Transformer Turns Ratio
115	UNICEF	United Nations Children's Fund
116	UPS	Uninterrupted Power Supply
117	U/T	Untrained
118	VT	Voltage Transformer
119	WASC	Wapda Administrative Staff Collage
120	WAPDA	Water and Power Development Authority
121	WEA	Wapda Engineering Academy
122	WeBoc	Web Based on Customs
123	WB	World Bank
124	WFP	United Nations World Food Program

CHAPTER 1 BACKGROUND OF THE PROJECT

Chapter 1 Background of the Project

1-1 Current Situation and Challenges of the Sector

1-1-1 Current Situation and Challenges

(1) Current Situation

In Pakistan the power shortage has become a serious problem. In particular, in recent years the gap between the supply and demand of power is inflated to 4,500 ~ 5,500 MW. Accordingly, the entire country has been forced to increase load shedding over from 12 to 16 hours. The gap between the supply and demand is caused by the low operating rate of the existing power plant, which in turn is caused by the shortage of funds to purchase adequate amount of fuel. The shortage of funds can be traced to the fact that, while the power generation cost is high, the collection rate of electricity fees is very low. These cause circulation debt. Also in connection with the transmission and distribution network, as results of aging and inefficient operation & maintenance management, the accident rates and the power loss of transmission and distribution is at a high level of about 25%.

(2) Challenges

Because of the power situation mentioned above, both the developments of industry and people's daily lives are inhibited. The problem of economic loss due to the power outages and the inefficient operation of transmission and distribution network, has been recognized as the most serious challenge to the country's economic activity. Operating these facilities efficiently, strengthening the transmission and transformation system in order to enable stable power supply, and developing the capacity building for operators and technicians are pressing issue.

Under these circumstances, "National Power Policy 2013" has been established in the power sector. Its policy actions include the extermination of outages and the reduction of power loss up to 16%. This project aims at developing the capabilities of the training department of NTDC. By strengthening its training functions, the appropriate operation of transmission and transformation system is expected to be enhanced. In support of the power sector of Pakistan by Japan, prior to this Project, JICA implemented technical assistance by way of the "Project for Improvement of Training Capacity on Grid System Operation and Maintenance" (2011-2014), for the purpose of developing the training capacity of the training department of NTDC, by updating training equipment and manuals, trainings in Japan, etc.

The technical assistance contributed to ameliorate the weak training capability, however, it is obviously still necessary for workers to deepen their understanding of protection coordination in

transmission and to enrich troubleshooting capabilities at substations.

TSG does not own its dedicated practical training institute, except Transmission Line (hereafter referred to as T/L). Therefore, workers are forced to learn the operation of the protection relay during the short periods of substation operation inactivity. Inefficiencies are scattered in education system. These improvements remain as a challenge.

1-2 Background and Overview of the Grant Aid

(1) Background of Grant Aid

So far, the improvement of the facilities and hardware related to power generation and transmission has been implemented as Japan's ODA loan. In the wake of the restructuring of the power sector, the needs for future cooperation in developing and improving the software side has increased, *i.e.* strengthening the organizations, management, and technology skills of various power companies.

Based on these new challenges, in regards to transmission and substation operation & maintenance management, the Government of Pakistan requested Grant Aid to Japan to implement the "Project for Strengthening Training Center on Grid System Operation and Maintenance" in order to develop a training system focused on more practical needs. Through the Project, by strengthening the training function of the transmission and transformation sector, further efficiency for the operation & maintenance of the transmission network is expected.

In Japan's Assistance Policy to Pakistan, the power sector, including the development of the power transmission and distribution infrastructure, is positioned as a priority issue, namely the "development of economic infrastructure." The project is consistent with these policies. In addition, the synergistic effects are expected from comprehensively supporting the Pakistani power sector along with the recent ODA Loan assistance as well as the technical assistance, the "Least Cost Generation and Transmission Plan."

Based on the above, JICA collected the relevant information and confirmed the necessity and the validity of the Project as being worthy of Grant Aid. The preparatory survey was conducted over nine months from February to October 2015 in order to preparer project design and implementation schedule, and to form project cost outline.

(2) Outline of the Project

1) Project objectives

To strengthen training capability, related to the appropriate operation for transmission and transformation equipment, in the training department of NTDC, by way of the installation of

training simulator and facility.

2) Contents of the Project

- a) Construction of 1 building of the New Training Simulator Building (Floor are :approximately 1,039 m^2, two-storeys)
- b) Installation of 1 set of transmission and transformation training simulator, including of 1 set of protection relay, spare parts, consumable supplies
- c) Consulting service

  Detailed Design, procurement consultation, project implementation, etc.

d) Procurement method

Major equipment is expected to be purchased in Japan.

3) Target Area

New Kot Lakhpat in Lahore City of Punjab Province (hereafter referred to as NKLP)

4) Responsible Authority and Execution Agency

- Responsible authority: Ministry of Water and Power
- Execution agency: National Transmission and Despatch Company Ltd

1-3 The Project site and surrounding circumstances

1-3-1 Natural conditions

Major obstacle by the natural conditions is not relation to the construction work. Latest observational data about climate conditions such as temperature, humidity, rainfall and wind velocity, and earthquakes record were collected by the preparatory survey. Topographic survey and soil investigation were carried out by the local contractor. Necessary natural conditions for the design and construction of the New Training Simulator Building for the Project shall be confirmed from those observational data. The result of the investigation for natural conditions is shown as follow:

(1) Climate

Lahore is a step climate, and April to September is severe heat. Maximum temperature exceeds mostly 40 °C and sometimes more than 50 °C. The monsoon season in July and August is hot and humid. Day time temperature of the winter season from November to March is winter season is around 20 ℃, however night time temperature becomes cold close to 0 ℃, therefore the difference between cold and warm is large.

Table 1-1 Monthly Average Maximum and Minimum Temperatures in Lahore [°C]

Month / Temp.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maximum	20.0	26.7	30.9	38.0	40.3	41.8	38.5	36.2	35.1	32.9	28.1	22.3
Minimum	5.6	8.1	12.9	17.9	22.9	26.5	25.2	24.8	24.4	18.4	11.3	7.0

Source: TSG data (mean for 2005-2014 by Pakistan Meteorological Department)

Humidity is high during day time and relatively low after sunset, and is around 50 % from April to June, and 70 % to 90 % in other months.

Table 1-2 Monthly Average Maximum Humidity in Lahore [%]

Month / Humidity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Morning	91	86	76	59	51	72	87	88	83	80	81	86
Afternoon	67	60	51	35	30	55	68	72	66	56	55	60

Source: TSG data (mean for 2005-2014 by Pakistan Meteorological Department)

Monthly mean rainfall in Lahore is 288 to 405 mm from July to September of rainy season and average of dry season is 56 mm from November to May. Annual mean rainfall is approximately 540 to 900 mm.

Table 1-3 Monthly Mean Rainfall in Lahore [mm]

Month / Monthly mean rainfall	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maximum	64.2	106.4	65.2	64.8	36.7	169.9	288.0	352.3	450.3	46.0	29.2	30.8

Source: TSG data (mean for 2005-2014 by Pakistan Meteorological Department)

Wind velocity is almost windless in the morning and is observed approximately 0.4 to 2.7 m/sec in the evening.

Table 1-4 Monthly Average Wind Velocity in Lahore [m/sec]

Month / Wind Velocity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Morning	0.6	1.0	1.1	1.5	1.8	1.9	1.5	1.1	0.9	0.9	0.4	0.4
Afternoon	1.6	2.1	2.5	2.7	2.2	2.3	1.9	1.9	1.7	1.6	1.1	0.8

Source: TSG data (mean for 2005-2014 by Pakistan Meteorological Department)

Most of wind direction is toward to the East in rainy season and toward to the West in dry season. Thunderstorms occur throughout the year. Annual thunderstorm days are about 45 days, and 12 days in a month of the monsoon season.

(2) **Record of Earthquake in Pakistan**

Earthquakes causing damage in Pakistan are shown in Table 1-5

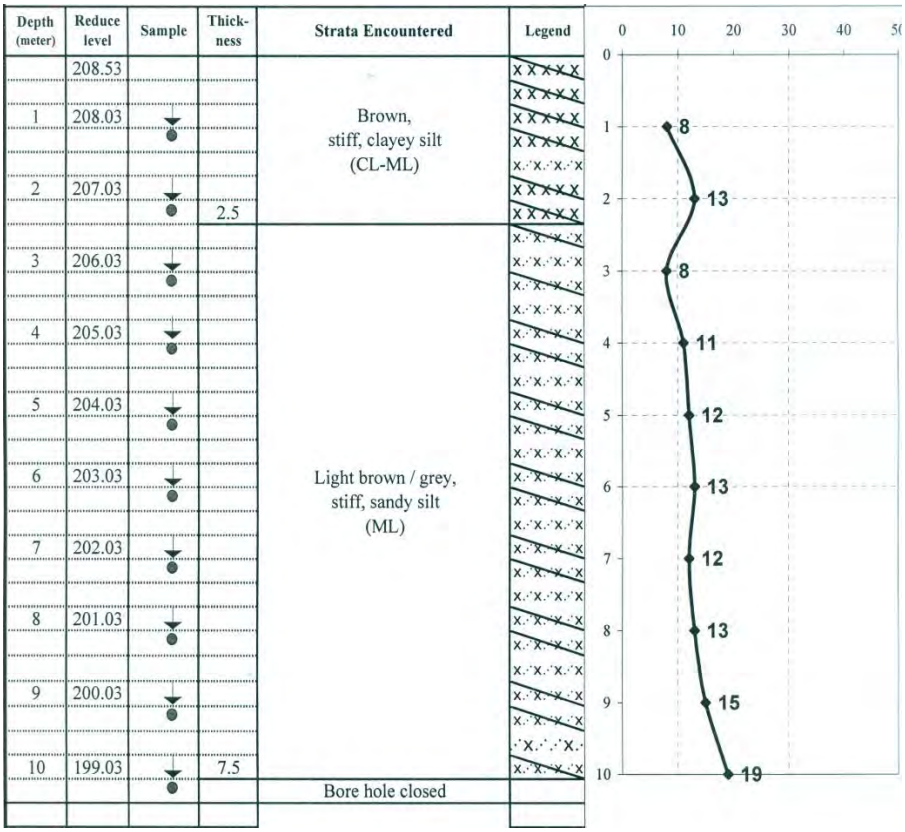
Table 1-5 List of Earthquakes Damage in Pakistan.

Year	Month	Day	Epicenter Area of Damage	Size (magnitude)	Damage (defunct)
893	-	-	Shahbandar, Sindh	8	150,000
1668	5	2	Shahbandar, Sindh	7.6	50,000
1819	6	16	Allahbund, Sindh	7.5	3,200
1827	9	24	Lahore, Punjab	7.8	1,000
1852	1	24	Kahan, Balochistan	8	-
1865	1	22	Peshawar	6	-
1883	-	-	Jhalawan, Balochistan	-	-
1889	-	-	Jhalawan, Balochistan	8	-
1892	12	20	Qilla Abdullah, Balochistan	6.8	-
1909	10	21	Sibi, Balochistan	7	100
1929	2	1	Sibi, Balochistan	7	-
1931	8	24	Sharigh Valley, Balochistan	7	-
1931	8	27	Mach, Balochistan	7.4	-
1935	5	31	Ali Jaan, Balochistan	7.7	30,000 - 60,000
1945	11	28	Balochistan	7.8	4,000
1974	12	28	Hunza, Hazara and Swat districts; North-West Frontier Province	6.2	5,300
2005	10	8	Muzaffarabad District, Azad State of Jammu and Kashmir& North-West Frontier Province, Pakistan	7.6 or 7.8	80,000
2008	10	29	Ziarat District, Quetta	6.4	215
2011	1	18	-	7.2	-
2013	9	24	Awaran District, Balochistan	7.8	370
2013	9	28	Awaran District, Balochistan	6.8	400

Source: WIKIPEDIA

(3) Soil Investigation

The objective of soil investigation is to analyze the allowable ground bearing capacity for the construction of the training simulator building. The standard penetration test was carried out in one location near the center of the building site. The soil sample was taken from the borehole in order to perform soil tests and to calculate the allowable ground bearing capacity. Results of the test are shown in Figure 1-3



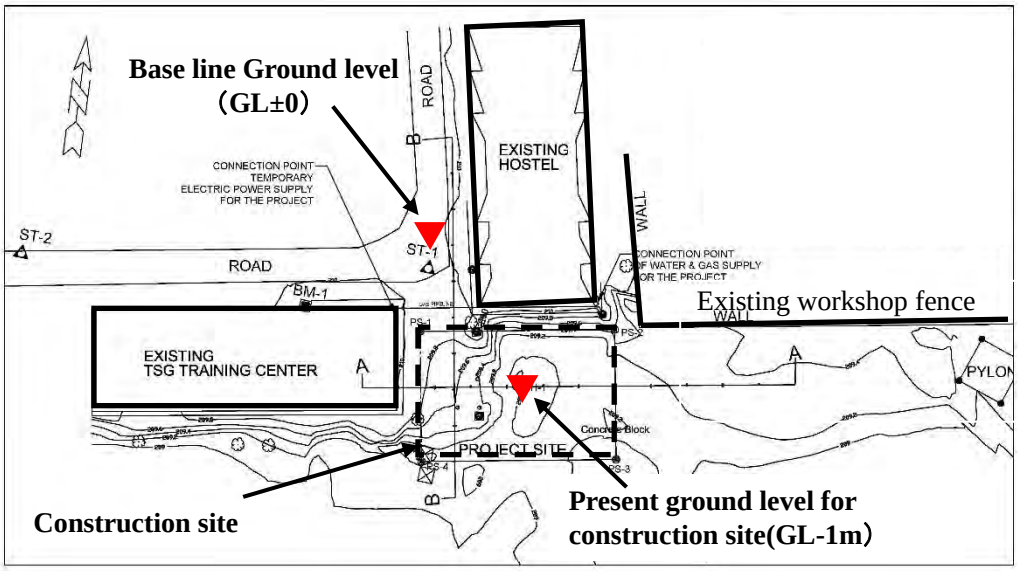
Source: Annex 7

Figure 1-1 Result of Standard Penetration Test of the Project site

The standard penetration test and indoor soil test show that the surface soil consists of viscous silt, while the soil of 1 m below from the ground level consists of sandy silt. This type of ground is not typically a cause of differential settlement of the building. In addition, groundwater was not observed until a depth of 10 m. It has been determined that the water level will not rise above a depth of GL-5.0 m during the rainy season. As a result of the investigation, it has been determined that the allowable ground bearing capacity will be about 100 kN / m² at GL-1.0 m deep.

(4) Topographical Survey

A topographical survey has been implemented at the construction site for the training simulator building, utilizing electro-optical distance measurement. In the survey, the positions of existing buildings, underground obstacles and pipes have been verified. In addition, a variety of topographical information has been collected. The result of survey is shown in Figure 1-4.



Source: Annex 7

Figure 1-2 Topographic Survey Map of the Project site and Surroundings

The Project site is located in the center of TSG. It is level land at 210 m above sea level. The size of the Project site is small, surrounded not only by the existing buildings, such as the TSG training center, hostel and workshop fences, but also by the construction site for the training model of grid station. The present ground level for the construction site is 1 m lower than that of the existing TSG training center, which is the baseline of the topographical survey. As a temporary access road is secured, there will be no problem for construction vehicles to pass to the Project site from the western entrance of TSG KNLP.

1-3-2 Environmental and Social Consideration Assessment

The objective of the Project is to expand on the existing TSG building site. Therefore, it will not cause any risk to the environment, nor the resettlement of habitants. The Project would be assessed as category C in the environmental and social consideration guidelines of JICA.

CHAPTER 2 CONTENTS OF THE PROJECT

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Overall Goal and the Project Objectives

While the constant improvement of the TSG training function has been achieved through the previous technical cooperation project, it is necessary to deepen understanding about protection coordination with transmission and transformation, and to promote the further enhancement of troubleshooting in the substation. TSG does not own the private practical training center without T/L. It is by using the short time during the rest period of the substation, to learn about operation of protection coordination. Such education is deemed to be lacking and this improvement is left as a problem.

Accordingly, this Project is intended to have the overall goal of contributing to the improvement of transmission and substation maintenance in-line with the basic policy of Pakistani power sector reform; "National Power Policy 2013".

In addition, the Project goal is to achieve an improvement of training procedures for equipment operation and accident response of the substation and transmission. This will be achieved with the installation of the training simulator and a training facility in NTDC training department.

2-1-2 Outline of the Project

In order to achieve the above objectives, this Project will be implemented in order to install the training simulator for the operation and maintenance of the electric power system, and to establish the New Training Simulaor Building to carry out training by using the simulator. In addition, necessary consulting services will be conducted throughout the Project.

As shown in the rendering above, the facilities and equipment will be accommodated in one building of the simulator training facilities for transmission and transformation (Floor Are: approximately 1,038.74 m^2, two-storey). This equipment is comprised of 1 set of training simulators of the transmission and the substation, 1 set for the protection relay and 1 set for spare parts. The final quantity will be determined based on the Detailed Design results in the implementation phase.

When the Project is completed, it is expected to develop human resources in order to contribute to the improvement of the power quality, by stabilization of "protection relay, and improvement of operation capacity of GSO", and also practice of the recovery measures during accident. Finally, the development of domestic Pakistan economic will be assisted by a stable power supply.

2-2 Outline Design of the Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Policy

The Project scope is centered on all electric power engineers in Pakistan, including engineers of NTDC, DISCOs, GENCOs and IPPs. The Project components are the procurement and installation of 2 types of training simulators, and the construction of the simulator building.

The site of the Project is in the space occupied by the current TSG training center located in NKLP, the substantially center portion of Punjab State, Pakistan, where many trainees may easily attend TSG training programs. Because NKLP district is adjacent to the TSG training center and GSOs, it is easy to utilize various electric power facilities and to dispatch many trainers from GSOs to the TSG training center.

Accordingly, basic design policy is defined as establishing a more practical training program based on the needs relating to the operation and maintenance of the GSO.

2-2-1-2 Policy regarding Natural Conditions

(1) Temperature, Humidity and Rainfall Conditions

According to weather data obtained from Pakistan Meteorological Department, the maximum temperature in the target area is 41.8 ℃ and the minimum temperature is 5.6 ℃, respectively. Humidity is around 50 % from April to June, and form 70 % to 90 % in other months. Condensation does not occur throughout the year in Pakistan.

Equipment used for the Project should take into account the above temperatures and should be operated in air-conditioned rooms. As outside air temperature is considered to be 40 ℃, maximum allowable temperature for operating equipment is 35 ℃ in the air-conditioned rooms, which maintains equipment performance and function efficiency.

Monthly mean rainfall in Lahore is 288 to 450 mm from July to September during the rainy season. Rainwater on roof of the New Training Simulator Building for the Project shall be directed to drain to the earth ground through the downspout. However, in consideration of unexpected cases of heavy rainfall, the ground floor level of the New Training Simulator Building is to be rained 60 cm higher from the present ground level of the existing TSG Training Center. Such measures should prevent rain water from entering in the New Training Simulator Building. Also, the present ground level on the south side is approximately 100 cm lower than that on the north side. When heavy rainfall comes, the rain water shall be directed to the lower side. Therefore, the water will not normally stay around the New Training Simulator Building, unless a flood which overflows the height difference of 1.6 m. In addition, the roof of the New Training Simulator Building should be covered with asphalt waterproofing. Its installation and quality control shall be provided by a Japanese construction company during the construction stage.

(2) Seismic Conditions

Earthquake region segments in Pakistan are classified into five regions throughout the country and the detailed design shall be built based on the risk of earthquake. The Project site in Lahore is classified in the second region from safe region Zone-2A. With calculation of seismic ground motion based on the result of soil investigation, horizontal force will be taken into account when designing the building.

(3) Soil Conditions

Following from the results of the soil investigation, it is determined that a ground allowable bearing capacity was approximately 100kN/m² at 1m below the present ground level. Therefore, the long-term allowable bearing capacity for the foundation structure design shall be 95 kN/m².

2-2-1-3 Policy regarding Social and Economic Conditions

The Project site is located within the NKLP/NTDC grounds. Although NKLP is adjacent to a busy highway, general residential areas are separated from the road. However, since there is a corporate NTDC housing at the same site, it should take the following countermeasures into consideration as much as possible during construction, i.e. not to cause inconvenience to local residents, and transportation and not to damage existing structures.

2-2-1-4 Policy regarding Construction and Procurement

The Project should be planned by utilizing local constructors while under the management of the Japanese constructor. In Pakistan, public and commercial buildings such as ten storey buildings of medium-size and two storey brick structures are common. Since local construction companies have ability to build these buildings, it is possible that they undertake construction work related to the Project.

However, as it requires highly skilled technicians at the time of installation and also with equipment testing, we recommend that Japanese engineers be dispatched.

In addition, the procurement of construction materials, labor, and construction equipment are fully possible in Pakistan. Materials for concrete such as local crushed stone and river sand are suitable for the construction. Materials for the Project shall be procured from local suppliers wherever possible.

Equipment and materials for the simulator system procured in the Project are not manufactured in Pakistan. In consideration of past procurement experience for existing equipment, and capability of operation and maintenance on the Pakistan side, the simulator system shall be procured from Japan, and the equipment from third countries.

As a safety management during the construction work, there will be minimum effect to the surrounding neighborhood environment by construction work since the Project site is located within the premises NKLP. However, it will be important to plan safety measures such as temporary fence to secure the safety for the staffs of NKLP and construction workers during the construction period.

The construction conditions of the Project site are shown as follows:

Construction Conditions of the Project site

Water supply has already been from the elevated water tank located in the North side of NKLP to the existing hostel located near by the Project site. It is possible to secure the water supply for the New Training Simulator Building. However, the Contractor shall secure the temporary water for his construction since the water in the tank is limited. TSG shall provide the connection point of the water supply for the Project.

Elevated water tank

Sewer pipe has already been from the sewage treatment facility in NKLP to to the existing hostel located near by the Project site. It is possible to secure the sewer pipe connection for the New Training Simulator Building.

Sewage treatment facility

Sewer pipe connection point

TSG shall change existing 50 kVA/400 V transformer to new 200 kVA/400 V transformer, and supply electrical power for the New Training Simulator Building. TSG shall provide the temporary wat meter on the wall of the existing TSG training center for the construction work of the Project.

Existing transformer

Planned location of temporary wat meter

TSG shall remove training electrical poles, septic tanks and rejected tower foundation in the Project site before commencement of the construction work for the Project.

Training electrical poles and septic tank

Septic tank

Wasted tower foundation

2-2-1-5 Policy regarding Building and Equipment Grades

The building grade should be a reinforced concrete structure which is a common type of structure in Pakistan.

Grades for procured equipment shall be similar to the level of those which are used at Japan's electric power company's training. The specification of equipment is not specified but compatible to those installed in existing facilities and equipment. The equipment with minimum specifications and configurations will be procured and installed based on the policy, i.e. the procured simulator is specified for training purposes and is composed of versatile parts, that where possible, uncomplicated maintenance procedures. In order to keep designs economical, equipment specifications should use standard products that confirm to international standards where possible.

2-2-1-6 Policy regarding Maintenance and Management by the Recipient Country

TSG has conducted operation and maintenance of training equipment, as procured through "the Project for Improvement of Training Capacity of Grid System Operations and Maintenance", implemented by December 2014. Thus, TSG has the capacity to operate and maintain the training simulator that is planned to be procured for the Project.

Engineers with ability and knowledge for training simulator seem to be lacking at NTDC. Therefore, it is necessary to conduct a training program by TOT in Japan so that proper operation and maintenance technology for transmission and transformation can be successfully transferred.

In addition, a requisite minimum volume of spare parts will be procured so that effective and efficient operation and maintenance for training simulator can be conducted.

2-2-1-7 Policy regarding Construction and Procurement Methods

The equipment procured in Japan or in third countries will arrive at the Port of Karachi and will then be transported overland to the Project site more than 1,300 km away. This will entail 9 days of overland transportation by truck. Transportation duration from Japan to the site is approximately 60 days.

The Project site is located in the center of the premises of NKLP and has a relatively flat site. And also the Project site has a narrow area surrounded by the existing TSG training center, an existing hostel, a transformer workshop and a new project site for the training model grid station. The existing level of the Project site is lower than 1.0 meter from the level of the current TSG training center. A filling 1.0 meter around the new TSG Training Simulator Building will be planned to maintain the same floor level of the existing TSG training center. In addition, it has an available temporary access road for the Project vehicles to the Project site from the west side gate of the premises of NKLP through by the south of the existing TSG training center.

It is necessary to perform the removal of existing obstacles in the Project site by the Recipient Country before the commencement of the construction work by Japanese side. Also, the Recipient Country is required to complete the construction of the foundation for the generator procured by the Japan side. The completion of the foundation construction should be done before the commencement of the

installation work for the generator. An efficient dispatch schedule by the Consultant shall be planned with appropriate advice and guidance for the counterparts of the Recipient Country.

2-2-2 Basic Plan (Construction Plan/Equipment Plan

2-2-2-1 Design Conditions

(1) Weather and Site Conditions

Weather data shows mean values from 2005 to 2014 obtained from TSG

a) Site elevation from sea level: 215 m

b) Site power supply: AC 400 V (three phases), 230 V (single phase), 50 Hz

c) Temperature (annual mean):

- Low temperature; 5.6 °C
- High temperature; 41.8 °C

d) Humidity (annual mean):

- A.M.; 50 to 90%
- P.M.; 30 to 70%

e) Design basis wind velocity: 120 km/h (33.34 m/s), Building Code of Pakistan

f) Climate:

- Rainy season; June to September
- Dry season; October to May

g) Mean rainfall (annual mean): 450.5 mm

(2) List of Applicable Codes/Standards

Table 2-1 Applicable Codes/Standards

Name of codes/standards	Application
International Electrotechnical Commission (IEC)	Electrical products in general
International Organization for Standardization (ISO)	Industrial products in general
Japanese Industrial Standards (JIS)	Industrial products in general
Japanese Electrotechnical Committee (JEC)	Electrical products in general
Japan Electrical Manufacturers' Association (JEMA)	Electrical products in general
Japan Electric Association Code (JEAC)	Electrical products in general
Japanese Cable Makers' Association Standard (JCS)	Electrical cables
Electronic Industries Association of Japan (EIAJ)	Electrical products in general
International Telecommunication Union (ITU)	Electrical products in general
Japanese Building Code and Standards	Building design
Building Code of Pakistan Engineering Council	Building design

2-2-2-2 Construction Plan

(1) Facility Layout Plan

The New Training Simulator Building will be built in the premises of NKLP. As a request of TSG, the structural form of the building will be comprised of 2 storey to connect each floor of the existing TSG training center since the Project site area is limited space surrounded by the existing TSG training center, existing hostel, transformer workshop and new project site for Training model grid station.

(2) Structure Plan

As shown in Table 2-2, outline of the New Training Simulator Building is as follows:

Table 2-2 Outline of the New Training Simulator Building

Structure	Reinforced concrete frames 2 stories structure with penthouse	
Floor Are	Ground Floor:	507.70 m^2
	First Floor:	507.70 m^2
	Rooftop shack:	23.34 m^2
	Total:	1,038.74 m^2
Building Service	Equipment:	Lighting equipment, Emergency exit light, Ventilating equipment, Air conditioner, Plumbing and sanitary, Fire alarm system, Fire extinguisher
Furniture and Equipment	Furniture:	Desk, Chair, White board, Bookshelf, Equipment rack, Work desk, Work chair
	Equipment:	Projector, Projector screen, Desktop computer, Color printer, Uninterruptible Power Supply(UPS)

1) Floor Plan

In the New Training Simulator Building, more than 40 engineers/operators are to be trained per year. Naturally, 400 trainees can be trained using simulator during next 10 years. Floor area of each room necessary for training is shown in Table 2-3.

Table 2-3 Floor Area for each Room of the New Training Simulator Building

Floor	**Name of Room**	**Floor Area of Room**
Ground Floor	Protection Relay Room	109.58 m²
	CPU Room	38.66 m²
	Training Simulator Room	109.58 m²
	Battery Room	38.13 m²
	Electrical Room	21.61 m²
	Storage Room	12.44 m²
	Building Service Space	3.00 m²
	Corridor	55.00 m²
	Care Taker Room	11.03 m²
	Kitchen	11.03 m²
	Stair Case	22.05 m²
	Wash Room	44.74 m²
	Passage, etc.	30.85 m²
First Floor	Protection Relay Class Room	93.18 m²
	Instructor Room 2	18.53 m²
	Seminar Room	109.58 m²
	Simulator Class Room	74.66 m²
	Instructor Room 1	21.61 m²
	Storage Room	12.44 m²
	Building Service Space	3.00 m²
	Corridor	60.44 m²
	Care Taker Room	11.03 m²
	Kitchen	11.03 m²
	Stair Case	22.05 m²
	Wash Room	44.74 m²
	Passage, etc.	25.41 m²
Rooftop shack	Stair Case	23.34 m²

2) Section Plan

The connecting passageways shall be planned to connect between the existing TSG training center and the New Training Simulator Building at the ground and first floors. TSG shall undertake the demolition of walls for walls of the existing TSG training center, repairing around opened walls, and installation of doors and expansion joint covers. The existing ground level

of the Project site is lower than approximately 1.0 meter from the existing ground level of the existing TSG training center. Filling of 1.0 meter around the New Training Simulator Building shall be planned to keep same floor level of the existing TSG training center.

3) Structure Type and Allowable Load

The structural type is shown as below:

Storeys:	2 storeys, 1 rooftop shack
Height of Floor:	Ground floor 3.2 m and First floor 4.0 m
Span between columns:	6.0 m
Structure type:	Reinforced concrete frames
Foundation:	Mat foundation
External Wall:	Concrete Block (150 mm thickness)

Foundation plan shall be designed by the mat foundation with consideration of the long-term allowable bearing capacity of 95 kN/m² at 1 meter depth from the existing ground level from the results of the soil investigation. Frame structure plan shall be designed by the reinforced concrete structure which consisted frames such as columns and girders with consideration of durability, local natural and construction conditions, economy, and etc. The floor loading capacity of each room shall be conformed to the Japanese Building Code and Standards, and the floor loading capacities of main rooms are shown in the followings;

Training Simulator Room:	4,900 N/m²
Protection Relay Room:	8,000 N/m²
Protection Relay Class Room:	2,900 N/m²
Simulator Class Room:	2,900 N/m²
Seminar Room:	3,500 N/m²

4) Building Service Plan

Electricity for the New Training Simulator Building is supplied from an existing power panel of NKLP/TSG by the work of the Recipient Country. For electrical equipment for each room, electricity is supplied from a distribution board which installed in the building.

In consideration of maintenance and troubleshooting, an individual air conditioning system is recommended. The air conditioning system and ventilating system plans are shown in Table 2-4 and 2-5.

Table 2-4 Air Conditioning System Plan of the New Training Simulator Building

Name of Room	Design Temperature	Type
Training Simulator Room	28 °C	Exposed ceiling mounting type, 7.1 kW, 4 units
Protection Relay Room	28 °C	Exposed ceiling mounting type, 7.1 kW, 4 units
Seminar Room	28 °C	Exposed ceiling mounting type, 10.0 kW, 4 units
Protection Relay Class Room	28 °C	Exposed ceiling mounting type, 7.1 kW, 4 units
Simulator Class Room	28 °C	Exposed ceiling mounting type, 10.0 kW, 2 units

Table 2-5 Ventilating System Plan of the New Training Simulator Building

Name of Room	Ventilation frequency	Ventilation purpose
Wash Room	10 times/hour	Odor and Moisture
Battery Room	10 times/hour	Odor
Electrical Room	4 times/hour	Odor

5) Finishing Plan

The finishing schedule for the Project shall be planned by materials used commonly in Pakistan. The specifications and finishing contents of each room are shown in Table 2-6.

Table 2-6 Finishing Schedule of the New Training Simulator Building

Name of Room	Interior Finishing		
	Floor	Wall	Ceiling
Protection Relay Room CPU Room Training Simulator Room Protection Relay Class Room Seminar Room Simulator Class Room Instructor Room Care Taker Room Kitchen	Ceramic Tile (300x300 mm)	Emulsion Paint	Light Iron Suspended Frame, Makeup Plaster Board
Battery Room Electrical Room	Oil Proof Paint Finish	Emulsion Paint	Emulsion Paint
Stair Case	Ceramic Tile (300x300 mm)	Emulsion Paint	Emulsion Paint
Wash Room	Ceramic Tile (300x300 mm)	Emulsion Paint, Ceramic Tile (300x300 mm)	Light Iron Suspended Frame, Makeup Plaster Board
Storage Room	Dust Proof Paint Finish	Emulsion Paint	Emulsion Paint
Corridor	Ceramic Tile (300x300 mm)	Emulsion Paint	Light Iron Suspended Frame, Makeup Plaster

			Board
Building Service Space	Mortar Steel Trowel	Emulsion Paint	Emulsion Paint
Name of Structure	**External Finishing**		
Roof	Asphalt waterproof on top of concrete slab, Cover concrete 100 mm thickness (welded wire mesh, expansion joint 3 m pitch) on top of insulation material 50 mm thickness		
Wall	Column and Girder: Reinforced concrete, Wall: Painting on top of mortar on concrete block		

2-2-2-3 Equipment Plan

(1) Project Component Verification

In order to be specific about the new training simulator, it is necessary to examine types of simulators correspond to the present situation of the Recipient Country. Also, the types of engineers and operators who will use the simulator are specified as follows.

1) Power System Engineers in Pakistan

Pakistan power sector has several educational institutes, *i.e.* WAPDA (WEA, WASC, HTCM), which engage in conducting general education for senior engineers and senior managers. Academic educational institutes, such as University of Engineering and Technology (UET), Lahore, have department of electrical power engineering which engages in providing technical general education for college or university students.

Engineers engaged in power system network in the Pakistan power sector are divided into five categories shown below.

h) Engineers in planning department engaged in planning and designing the whole power system network in Pakistan
i) Engineers in the NPCC department engaged in conducting operations for planned blackouts, power system monitoring and power control demand
j) Engineers in system protection department under service division engaged in conducting setting of protection relay
k) Engineers/operators in each GSO engaged in conducting operation & maintenance for GSO
l) Engineers/operators in each DISCO engaged in conducting operation & maintenance for distribution substation.

Within these 5 categories of engineers, WAPDA (WEA) is in charge of education for category 1. None of department/education system is for category 2. TSG is for part of 3, 4, and 5.

As mentioned above, engineers and operators in each GSO and DISCO, who are trained technically by TSG, require more highly-professional individuals with practical education and training. In other words, more practical experience-oriented training for protection relay operation & GSO operation by using training simulators is required as well as classroom lectures

in order to understand the technology of power equipment, especially protection relays, and to obtain skills for the proper operation of the equipment.

A list of power system simulators, installed and utilized in power sector in Pakistan including WAPDA and academic educational institutes, are summarized in Table 2-7.

Table 2-7 List of Power System Simulators in Pakistan

	MoWP							**UET**
	NTDC				**WAPDA**			**Electrical Engineering**
	Planning	**NPCC**	**Service Division**		**Training**			**Electric Power Engineering**
			System Protection	**TSG**	**WEA**	**WASC**	**HTCM**	
Department mission	Planning for power system stabilization in all Pakistan	Modification of power system structure in all Pakistan	Protection for power equipment system using protection relay	Technical consultant and training	Education for senior engineer	Education for manager	Education for water power management	Education for student of power engineering
Assignment	Evaluation for introduction of new power networks/ generators	Operation for planned blackout, power system monitor and demand power control	Setting of protection relay and analysis/ removal of power system failure	Technical consultant for NTDC/ DISCOs and technical training for GSO engineers/ operators	Education for senior engineers with degrees including IPP engineers			Learning of technology for generation/ transmission/ distribution power network
Type of simulator	Digital (PSS/E)	Digital (E-TERRA)	n/a	n/a	Analog simulator for transmission line and digital network simulator	n/a	n/a	TERCO analog simulator for transmission line
Simulator application	Advance verification for phenomena in power system		(hand calculation)	Training for operation/ maintenance, accident	General education			General education
Location	Lahore	Islamabad	Lahore	Lahore	Faisalabad	Islamabad	Mangla	Lahore
Object person	Several engineers in planning department	Several tens of engineers in NPCC department	Several tens of engineers in system protection department	Several hundreds of NTDC, IPP, DISCOs engineers/ operators	Senior engineer managers of power system	Senior managers	Senior managers	College/ university students

WAPDA: Pakistan Water and Power Development Authority

WEA: Wapda Engineering Academy

WASC: Wapda Administrative Staff College

HTCM: Hydel Training Center Mungla

PSS/E*1 has been already introduced and operated in the planning department of NTDC, for the purpose of the power system development in Pakistan. Also, it is planned that RTDS*2 is to be introduced by the support of USAID. E-TERRA*4 introduced and operated in Central Load Dispatching Center (NPCC) with the SCADA system*3 is one of simulators used to change transmission and transformation network for the short-term.

*1 : The Power Transmission System Planning Software, manufactured by SIEMENS. It is possible to implement power system analysis.

*2 : The digital simulator for power system analysis, manufactured by RTDS Technologies

*3 : Supervisory Control And Data Acquisition

*4 : The power system simulator manufactured by ALSTOM

On the other hand, the power simulator has not been introduced to the system protection department and TSG as yet. In the system protection division, evaluation and protection relay settling, analysis and removal of system abnormality failure, and study of new power equipment connections have been done with manual calculation.

The training for hundreds of GSO operators is executed bringing the equipment during the maintenance of GSO. Therefore, OJT is inefficient and not enough.

In addition, the WEA of the training facility of WAPDA, the training simulator of the power transmission and substation was introduced by Germany GIZ support in 1985. For the senior level administrative engineers, the general education has been provided. The simulator has not been introduced to HTCM for the purpose of management training WASC and irrigation management. An analog type simulator has been introduced to electrical engineering of UET with JICA assistance, and the general power education has been implemented for students.

2) Types of Power System Simulators

In general, power system simulators are divided into two categories of simulator, i.e. “Analysis Simulator” and “Training Simulator”. “Analysis Simulator” can analyse various kinds of phenomena that occur in power system networks by simulating and can be utilized for designing and planning new power system networks, which is similar to simulators for design and analysis utilized by manufacturers. “Training Simulator” is specialized for the training of the operation for power equipment and power system, which is similar to simulators for training of operation for equipment and system in airline and railway industry.

An “Analysis Simulator” in power electric company can analyse various kinds of phenomena that occur in power system networks and can be utilized for designing and planning new power system networks by finding some problems and countermeasures beforehand. In general,

"Analysis Simulator" is divided into three types of simulator, *i.e.* "Digital Simulator", "Analog Simulator" and "Hybrid Simulator", which is combined analog-digital simulator.

a) A "Digital Simulator" can simulate a specified small time-domain phenomena. A single kind of "Digital Simulator" cannot simulate all kinds of time-domain phenomena. Therefore, at least three kinds of "Digital Simulator" are needed to simulate various kinds of time-domain phenomena that occur in power system networks.
b) An "Analog Simulator" and a "Hybrid Simulator" can simulate almost all kinds of time-domain phenomena occurring in power system networks. However, skilled engineers working with advanced technology can only make substantial use of large-scaled "Analog Simulator" or "Hybrid Simulator" to maximize simulator's functional capability.

In view of this situation, many engineers are utilizing a "Digital Analysis Simulator" as a means to analyse power system network phenomena, because a "Digital Simulator" is providing more user-friendly simulation environment for the engineers compared with an "Analog Simulator" and/or "Hybrid Simulator".

A positioning map for three types of power system training simulator, where department is plotted along the horizontal axis and technical level (large/small scale of power system network) is plotted along the vertical axis, is shown in Figure 2-1. As shown in the figure, the simulator procured in the Project will correspond to the needs of engineers (4, 3 and 5 of engineers categories mentioned 1).

The operation training in NPCC department of NTDC is required for the national power system of Pakistan, and E-TERRA of Alstrom is operating with the central power supply system. In the universities and WEA, the simulation of transmission line model of TERCO Co. and Simulation grid donated by GIZ, are operating for education and training. On the other hand, the training simulator has not been introduced to TSG and system protection department to educate engineers of GSO and DISCO as yet.

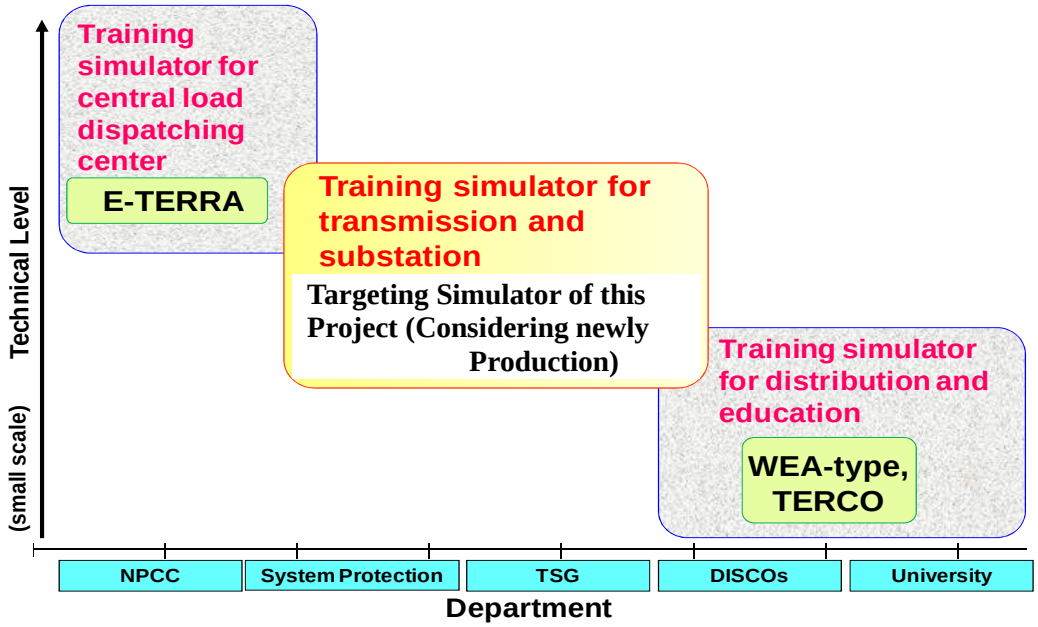


Figure 2-1 Positioning Map of the Simulator for Operation Training

3) Comparison of three types of power system training simulator

Examples by applications, target departments, individual subjects, purposes and features are summarized in Table 2-8 respectively to study the introduction situation described above. Since the target department is the TSG, the "simulator for analysis" is excluded. The training simulator can be considered for central power supply stations, the transmission and distribution and education. The simulator for central power supply station has already been introduced to NPCC and for education to WEA and UET.

As TSG will own the simulator on the Project for the first time, it should be noted not to select one with excessively high specifications. In the Project, TSG has been confirmed to make a selection according to the basic specifications necessary to simulate a simpler system and to perform the versatile training.

Table2-8 Comparison of Training Simulators

Simulator	**A: Simulator for central power system control center (Digital)**	**B: Training simulator for substation (Digital)**	**C: Simulator for education (Analog)**
Example	E-TERRA	Simulators, similar to those used for training of protection relay and substation operation by Japanese power companies	TERCO analog simulator
Department	NPCC	①TSG, ②System Protection	UET, WEA
Object person	Engineers in central power system control center	①GSO O&M engineers ②Protection relay engineers	Senior managers, senior engineers, students

Simulator	A: Simulator for central power system control center (Digital)	B: Training simulator for substation (Digital)	C: Simulator for education (Analog)
Purpose	Improvement of skills of power network engineers/ operators at NPCC	①Training for GSO operation and improvement of O&M skills. ②Training of protection relay setting, of examination of new protection relay, and of troubleshooting to incidents (It is also possible to train around 20 engineers/operators for system protection.)	①Education for senior engineers/ managers ②Leering fundamental theory for generation/ transmission/ distribution power network.
Features	Advanced technology of power system stability is indispensable, which means the simulator is suitable for advanced engineers.	①Two purposes: training for GSO operation and training of protection relay setting/ operation, which decreases recovery time from incidents ②Actual equipment of protection relay can be connected to training simulator, which is effective for GSO engineers/ operators.	①Parameters' changes need time. ②Stereotyped education is conducted, which is unsuitable for engineers/ operators in power electric company.
Cost-effectiveness	X	◎	X
	Cost-effectiveness is so small that NPC department consists of about 15 people.	The targets are engineers of more than 40 GSO. If 10% of TSG 400 trainees attend the training annually, 400 trainees will obtain the education and training for 10 years. It will have a ripple effect. It is possible that about 20 engineers of system protection obtain the education in the same time.	As a cost to change the model parameters is expensive, only routine education and training can be done. The trainees in the future will not belong to operation of GSO in some cases.
Initial cost	○	○	△
	Depending on the simulation scale, but it will be relatively cheap.	Limited to the substation of simulation scale, it will be relatively cheap.	Depending on the simulation scale.
Delivery	○	○	X
	In the case of ready-made software, fast delivery. In the case of custom software, the long delivery time.	It is so relatively short that content of simulation training is not special.	It takes the time to create the analog model.
Maintenance	○	○	△
	Data updates are required. Replacement of hardware is easy.	Software update is unnecessary.	Software update is unnecessary. Maintenance of power supply system is required.
Safety	◎	○	X

Simulator	A: Simulator for central power system control center (Digital)	B: Training simulator for substation (Digital)	C: Simulator for education (Analog)
	Ensure safety to simulate by the PC or WPS	Depending on the device configuration. It is relatively safe for rated voltage / current: 50 V / <125.	Danger. Rated voltage / current: 400 V / 16 A
Size	◎	○	X
	It is small and possible to be implemented by the PC or WPS.	Relatively small.	It is too large and needs miniature of actual equipment.

4) Study and consideration of optimal simulator to TSG

As mentioned above, among these simulator candidates, “B: training simulator for substation”. in other words, the simulators used for training of protection relay and substation operation by Japanese power companies seems to be the most optimal choice for TSG.

(2) Project Cost and Operation & Maintenance Cost

As shown in Table 2-8, in view of initial cost, delivery, safety, and size of the equipment, it is considered that the training simulator for transmission, substation and distribution is almost the same as that for the central power supply. In addition, in view of the maintenance requirements of the equipment, the training simulator for the central power supply requires frequent data update, but transmission, substation and distribution does not require a software update. However, the training simulator for transmission, substation and distribution requires maintenance, compared with that of the central power supply.

2-2-3 Outline Design Drawing

Equipment configuration of the operational training simulator is shown in table 2-9, and the simulated power system network in the simulator is shown in Figure 2-2. Details are shown in Appendix 5. Plans of equipment arrangement are shown in Figure 2-3 and Figure 2-4.

The GSO training simulator includes one and a half busbar[*5]) substation model. This feeding method has been used for many years in Pakistan and two generator models, where the operation of synchronization to the power system can be simulated. The GSO training simulator can simulate a 220/132/11-kV grid station, where trainees from DISCOs can be trained. The training simulator includes two 220/132-kV transformer models and one 132/11-kV transformer model, respectively. The training simulator includes a transformer protection relay, busbar protection relay and other protection relay models, except for a generator protection relay model because the power plant operation is outside the NTDC operation. Transmission line impedance can be changed between 0 and 200 ohm. The training simulator includes shunt reactor models in 220-kV power system in order to understand the effect of shunt reactors for keeping the voltage during a power system failure and Ferranti effect, though an actual 220-kV power

system has no shunt reactors for transmission lines. The SVC is contained the excellent software to simulate the basic phenomena for considering cost performance.

Overview of the planned operational training simulator is summarized as follows.

- To simulate the entire targeted substation.
- To simulate 220/132/11-kV grid station.
- To include two generator models.
- To include three-phase parallel two-line models.
- To be connected to actual protection relays.
- To output the various waveforms of current, voltage, frequency, etc.
- To simulate the appearance of a system fault of a short circuit and ground fault.
- To check the stabilization of the protection relay of operating value and time coordination, and to confirm the operating duty and the non-operating duty.
- To reproduce accident data of the actual system and to confirm the relay operation.
- Analysis range is the protection relay operating range.

*5 : （1-1/2）The power supply system is in the reliable bus system to maintain by another healthy bus in the case of the accident of the cutoff of single bus.

(1) Equipment configuration

The equipment configuration of the Project (draft) is shown in Table 2-9. Operation training simulators consist of two kinds of systems. They are the protection relay operational training simulator and the substation operational training simulator. In addition, the relay group will prepare to work in response to signals from the training simulator.

Table 2-9 Equipment Configurations

Classification		**Description**	**Unit**	**Qty**
GSO training simulator		Protection relay operation training simulator	1	Set
		GSO operation training simulator	1	Set
Protection relay		Distance relay	2	Unit
		Transformer differential protection relay unit	1	Unit
		Overcurrent protection relay	1	Unit
		Busbar voltage differential protection relay (high impedance)	1	Unit
		Busbar current differential protection relay (low impedance)	1	Unit
		Synchronizing check relay	1	Unit
		Breaker failure protection relay	1	Unit
		Line current differential protection relay	2	Unit
Replacement part	Operational training system of protection	Computer for I/F board	1	Set
		UPS	1	Set

	relay	Cable (various)	1	Set
		Others	1	Set
	Operational training system of substation	System simulation server	1	Set
		UPS	1	Set
		Monitor	1	Set
		Selector switch (various)	1	Set
		MCCB (various)	1	Set
		Push-button switch (various)	1	Set
		Indicator (various)	1	Set
		Auxiliary relay (various)	1	Set
		CPU unit	1	Set
		Cable (various)	1	Set
		Others	1	Set
Expendables		Printer paper	1	Set
		Toner cartridge	1	Set

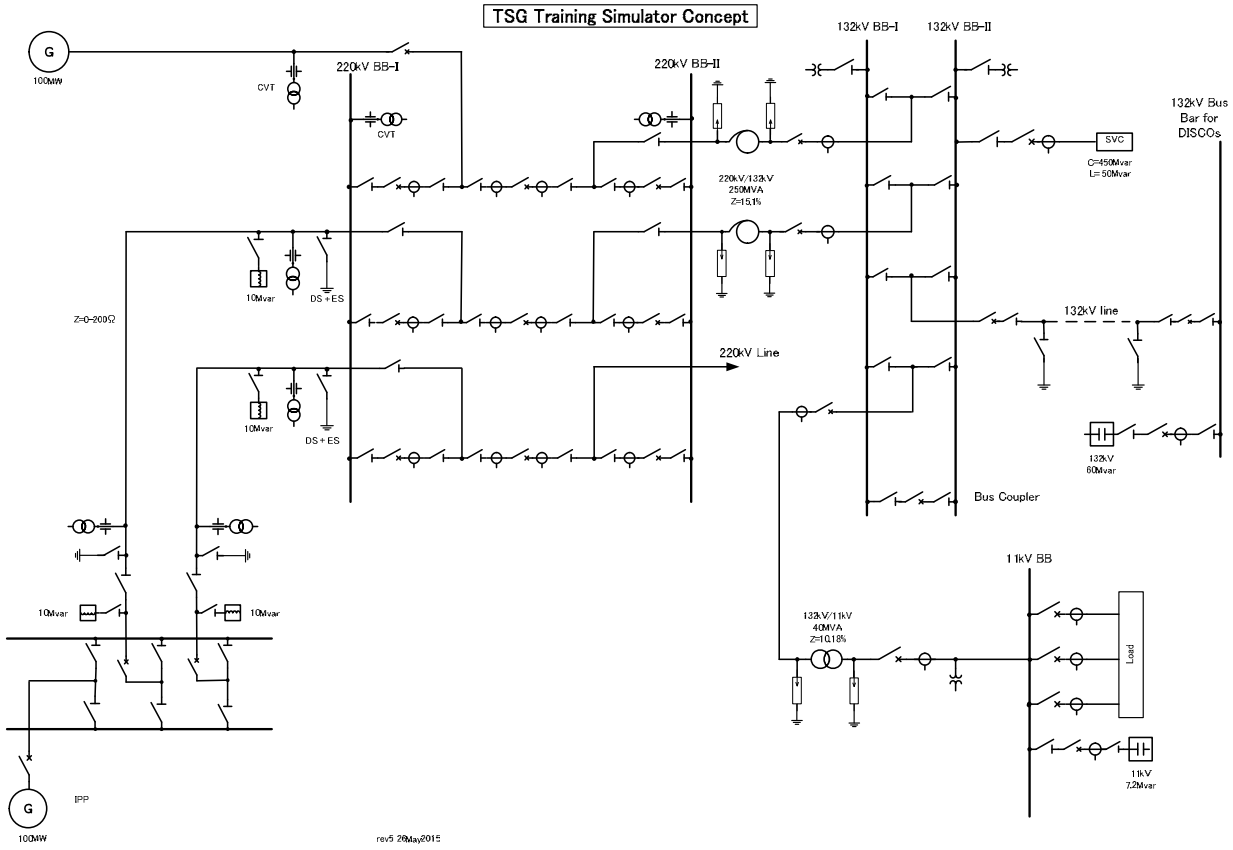


Figure 2-2 Diagram of Training Simulator for Power System

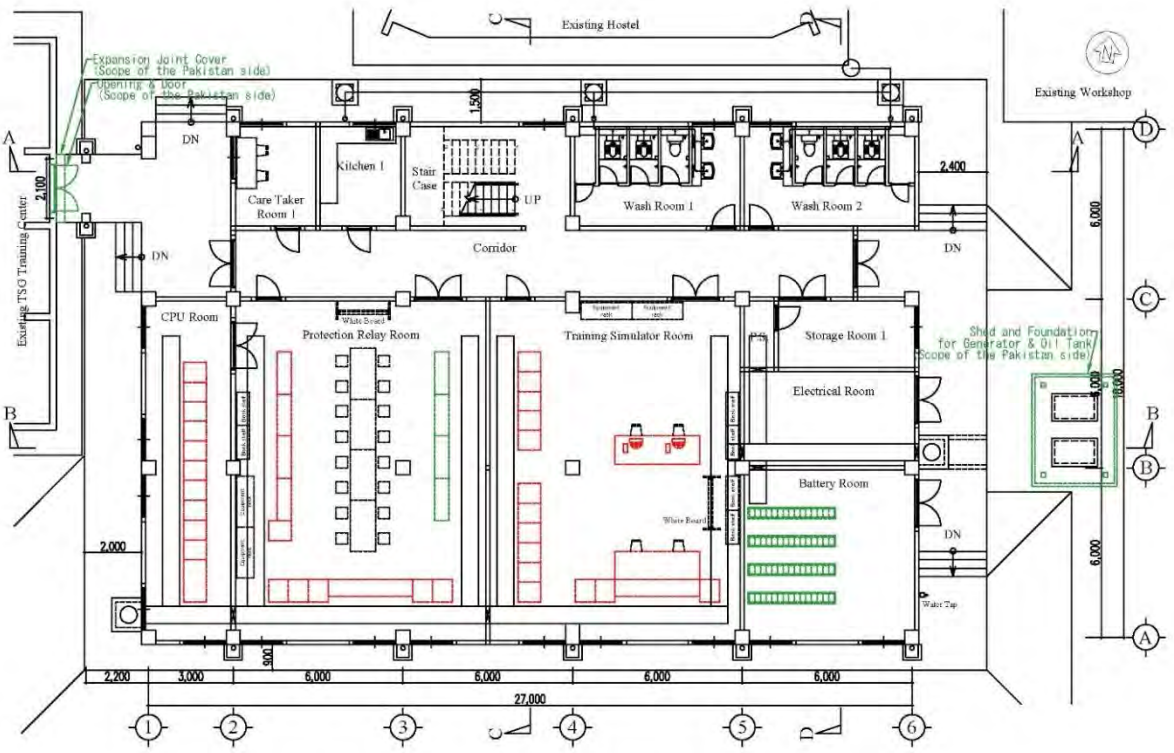


Figure 2-3 Ground Floor Plan of the New Training Simulator Building

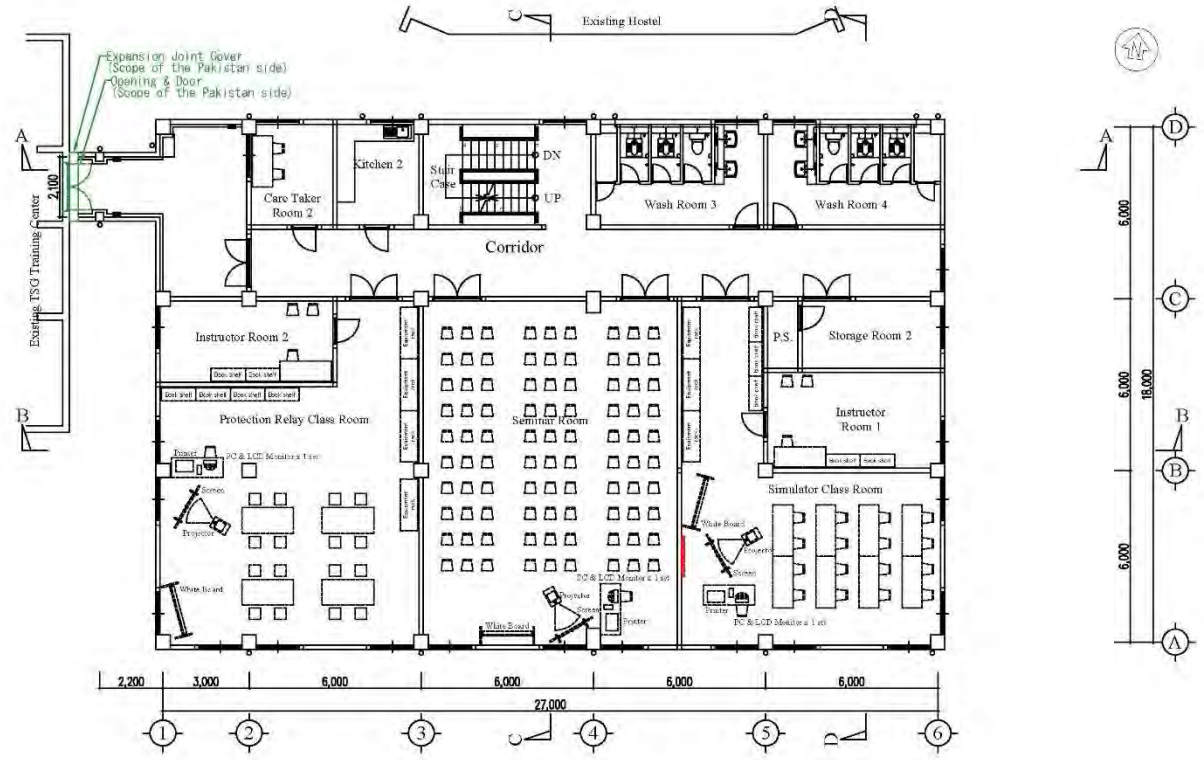


Figure 2-4 First Floor Plan of the New Training Simulator Building

(2) Outline Design Drawings

The outline design drawings for the New Training Simulator Building are shown in Table 2-10. Drawings shall be referred to Appendix-6.

Table 2-10 Outline Design Drawings

Number of Drawing	Title of Drawing
1	Site Layout Plan
2	Ground Floor Plan
3	First Floor Plan
4	Roofing Plan
5	South Elevation
6	North Elevation
7	East Elevation
8	West Elevation
9	Section A-A
10	Section B-B
11	Section C-C
12	Section D-D

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

As the Project shall be implemented based on the Japan's Grant Aid Scheme, it shall be approved by the Government of Japan. The Project shall be commenced after the Exchange of Notes (E/N) between two countries, and after the Grant Agreement (G/A) between JICA and the Government of Pakistan are exchanged. Basic policy and special considerations for the Project implementation are shown below:

(1) Project Implementation Body

The supervisory agency responsible for implementing the Project on the Pakistan side is NTDC, and the implementing agency is TSG. While SD is department responsible of project in NTDC, TSG will be in charge of operation & maintenance of the Project after completion. In order to keep the Project moving smoothly, SD of NTDC and TSG should appoint project representatives and keep close contact with Japanese consultants and contractors.

The appointed TSG Project representative should explain project details sufficiently to NTDC and TSG project staff, and habitants within the Project site to ensure cooperation with the implementation of the Project.

(2) Consultant

In order to procure and install necessary equipment for the Project, the Consultant will conclude a consultancy contract with NTDC and will conduct detailed design and supervision of the site work

for the Project. The Consultant will also prepare tender documents and execute pre-qualification and tender on behalf of NTDC, which is the Project implementing body.

(3) Contractor

The Contractor, which will be a Japanese corporation selected by the Pakistan side by means of open tender in accordance with the Japan's Grant Aid Scheme, will build a new building and conduct procurement and installation of new equipment. As it is deemed necessary for the Contractor to provide after-care in terms of the supply of spare parts and the repair of breakdowns in regard to new equipment, the Contractor should give proper consideration to establish a post-Project liaison system.

(4) Necessity to Dispatch Japanese Engineers

The Project is composed of procurement and installation of equipment and civil engineering related to the construction of a training building. Construction will also need to be coordinated with existing training facilities which are to be linked. Therefore, it is essential that foremen familiar with the Japan's Grant Aid Scheme should be dispatched from Japan to keep management and site guidance for whole works consistent in terms of scheduling, quality, completion and safety management.

Highly skilled engineers are needed during equipment installation and for post-installation adjustments and testing for training simulator, so local contractors cannot be utilized for anything besides labor. Engineers must be sent from Japan to fulfill these roles and handle quality control, technical guidance and schedule management.

2-2-4-2 Implementation Conditions

(1) Pakistan Construction Conditions and Technology Transfers

There are a number of general construction and electrical contractors in Lahore which can accept requisitions for labors, transportation vehicles and construction equipment within Pakistan, as well as general workers for the civil engineering and construction work for the New Training Simulator Building.

However, given that this is a Japan's Grant Aid Project and that it requires precise adjustment and total control for the training simulator that is custom-made precision equipment, it is essential that Japanese engineers should be dispatched to handle schedule management, quality control and safety management.

Also, the Japanese engineers are to provide TSG/NTDC engineers with on the job training (OJT) during the installation period as part of the technology transfer.

(2) Using Local Equipment and Materials

Aggregate, cement, reinforcing bar and other materials for use in the civil engineering and

construction work can be procured locally. Thus, in the interest of supporting the development of local industries, equipment that can be procured locally is to be used to the fullest extent possible when formulating the construction management plan.

However, Pakistan relies on imports for the principle equipment, i.e. power system training simulator that are needed for the Project. Local equipment is not usable, so equipment should be procured from Japan or third countries.

(3) Safety Countermeasures

In Pakistan, there is a general increase in crime following fasting and before and after religious holidays. The site for the Project is located in Lahore in Pakistan, an area that is easily accessible and where it is easy to monitor project execution. Still, security conditions could destabilize, and sufficient care must be taken to prevent equipment theft and ensure the safety of construction staff. While the Government of Pakistan should take necessary countermeasures for safety, the Japanese side should also implement safety countermeasures.

(4) Tax Exemption

The Pakistan exemption procedure, including VAT, for equipment and materials procured for the Project is as follows:

1) The Contractor requests TSG to exempt taxes.
2) TSG requests EAD (Economic Affair Division), via NTDC, to issue a tax exemption letter.
3) EAD issues the tax exemption letter to customs, with a copy to NTDC and the Contractor.
4) When procured equipment and materials arrive at port in Pakistan, the Contractor is required to attach the above copy of the tax exemption letter with the given shipping documents to be submitted to customs for tax exemption.

Care must be taken so that tax exemption delays do not impact Project progress. Especially in cases where government agency requests to issue a tax exemption letter, before announcement of tender, it is necessary to obtain FTN (Free Tax Number) issued by FBR (Federal Board of Revenue), which is one of the affiliate departments of EAD. Figure 2-5 shows procedure example of Pakistan tax exemption.

Table 2-11 Items of Pakistan Tax to be exempt from Charges for Imported Cargo

Items	Tax name	Authority	Remarks
Import	Duty	FBR/EAD	
	Import tax		
	Income Tax		
	Excise Tax		
	Withholding Tax		
	Infrastructure Tax	ETO of each province	Necessary whenever cargo is entered and transported in each province
Local procurement	Sales Tax	FBR/EAD	
	Withholding Tax		

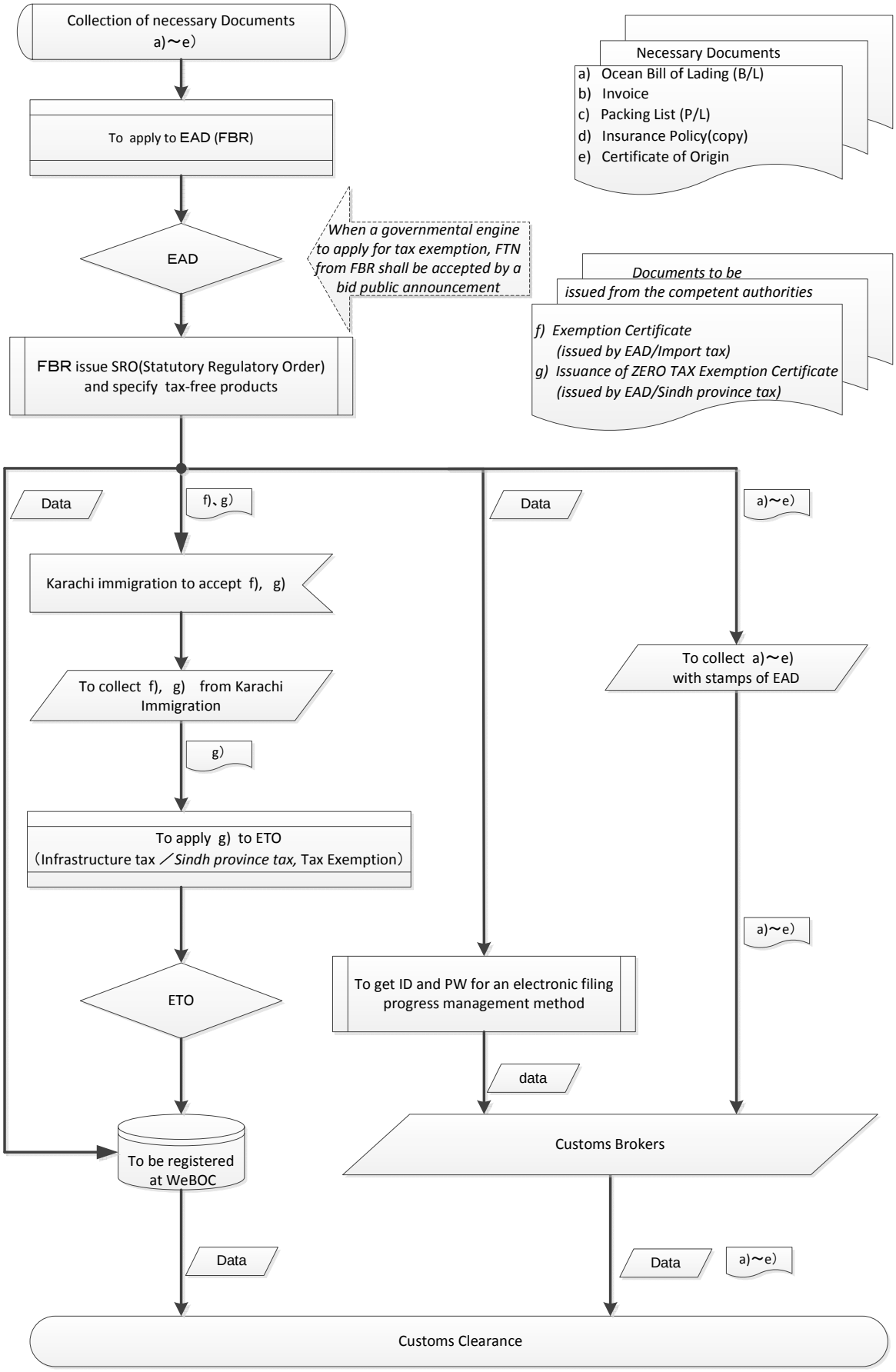


Figure 2-5 Procedure Example of Pakistan Tax Exemption for Imported Cargo

2-2-4-3 Scope of Works

Within the scope of the Project, the Japanese side should procure, install, test and adjust a new training simulator for the Project, and should perform necessary construction work. Pakistan side should prepare the construction site and connection between the new training building and existing TSG training building. General items to be covered by both sides for Grant Aid are as shown in Table 2-12. Specific items for the Project are also shown in Table 2-13.

Table 2-12 General Items to be covered by both Sides for the Project

No.	Items	To be covered by	
		Grant Aid	Recipient Side
1	to secure lots of land necessary for the implementation of the Project and to clear the sites	-	●
2	To construct the following facilities	-	-
	1) The building	●	-
	2) The gates and fences in and around the site	-	●
	3) The parking lot	●	-
	4) The road within the site	●	-
	5) The road outside the site (including access road)	-	●
3	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the sites	-	-
	1) Electricity	-	-
	a. The distributing power line to the site	-	●
	b. The drop wiring and internal wiring within the site	●	-
	c. The main circuit breaker and transformer	●	-
	2) Water Supply	-	-
	a. The city water distribution main to the site	-	●
	b. The supply system within the site (receiving and elevated tanks)	●	-
	3) Drainage	-	-
	a. The city drainage main (for storm sewer and others to the site)	-	●
	b. The drainage system (for toilet sewer, common waste, storm drainage and others) within the site	●	-
	4) Gas Supply	-	-
	a. The city gas main to the site	-	●
	b. The gas supply system within the site	●	-
	5) Telephone System	-	-
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building	-	●
	b. The MDF and the extension after the frame/panel	●	-
	6) Furniture and Equipment	-	-
	a. General furniture	-	●
	b. Project equipment	●	-
4	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the Recipient Country and to assist internal transportation of the products	-	-
	1) Marine (Air) transportation of the Products from Japan to the Recipient Country	●	-
	2) Tax exemption and custom clearance of the Products at the port of disembarkation	-	●
	3) Internal transportation from the port of disembarkation to the Project site	●	-

5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient Country with respect to the purchase of the products and the services be exempted	-	●
6	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work	-	●
7	To ensure that the Facilities and the products be maintained and used properly and effectively for the implementation of the Project	-	●
8	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	-	●
9	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A	-	-
	1) Advising commission of A/P	-	●
	2) Payment commission	-	●
10	To give due environmental and social consideration in the implementation of the Project.	-	●

Table 2-13 Specific Items to be covered by both Sides for the Project

No.	Items	To be covered by	
		Japan	Recipient Side
1	To procure equipment in Japan or in third countries	●	-
2	Utility construction in new training building (construction work)	-	-
	1) Primary power construction (including 200-kVA transformer)	-	●
	2) Electrical construction (connecting equipment to power supply board, wiring etc.)	●	-
	3) Air conditioning	●	-
	4) Telephone system	●	-
	5) Furniture	●	-
3	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products	-	-
	1) Marine transportation of the Products from Japan to Karachi port	●	-
	2) Tax exemption and custom clearance of the Products at Karachi port	-	●
	3) Internal transportation from Karachi port to Project Site	●	-
4	VAT exemption for equipment and materials procured at the Site	-	●
5	Residential & work permits required for Japanese Consultant, Supplier and Contractor, if necessary during the installation and construction work periods	-	●
6	Proper operation and maintenance for facilities and procured equipment	-	●
7	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	-	●
8	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A	-	-
	1) Advising commission of A/P	-	●
	2) Payment commission	-	●
9	To prepare and use budget for environmental and social consideration in the implementation of the Project	-	●

No.	Items	To be covered by	
		Japan	Recipient Side
10	To obtain permit for installation and construction works To permit access to restricted areas.	-	●
11	To keep parking space during construction works	-	●
12	Installation, adjustment and testing of the equipment	●	-
13	Temporary blackout during construction	-	●
14	Guidance on initial operation and maintenance	●	-
15	To keep security of person at the Project site	-	●
16	Foundation, fence and shed for Generator and Oil Tank	-	●
17	Securing of lands for New Training Simulator Building (hereafter referred to as "the Project site"), levelling and removal of the following obstacles in the Project site	-	●
	1) Septic Tanks (Man holes), Wasted Soil by Septic Tanks, Back filling after removal of Wasted Soil Septic Tanks (Man holes), Wasted Soil by Septic Tanks, Back filling after removal of Wasted Soil	-	●
	2) Electric Poles, Trees, and etc.	-	●
18	Removal of the part of plinth protection of New Training Center for the construction of the new connecting corridor to TSG Training Simulator Building	-	●
19	Construction of 2 openings to connect to the new connecting corridor and installation of 2 doors in New Training Center (Ground and First floors), the expansion joint cover	-	●
20	Connection points of existing TSG power supply, water supply, and gas supply for New Training Simulator Building	-	●
21	Securing of land of temporary material storage yard	-	●

2-2-4-4 Consultant Supervision

The Consultant should organize a project team to be responsible for detailed design and work supervision in a consistent manner in accordance with Japan's Grant Aid Scheme, in order to smoothly implement the Project. The Consultant will appoint one full-time on-site engineer to supervise the schedule, quality, work progress, and safety control at supervision stage. The Consultant will also dispatch expert engineers in accordance with the progress of the installation, test running and adjustment. Furthermore, the Consultant will arrange for Japanese experts to attend inspection of equipment manufactured in Japan at the manufacturing and pre-shipment stages, in order to prevent any equipment problems after the delivery to Pakistan.

(1) Basic Policy for Construction and Procurement

The Consultant is to supervise progress so that the work can be completed within the given construction period. Also, the Consultant is in charge of ensuring quality and date of delivery agreed in the contract. In addition, the Consultant shall supervise the construction so that the work is safely implemented. The following points should be taken into consideration at the stage of supervision.

1) Schedule Management

The Consultant should regularly (monthly or weekly) assess actual construction work progress and the planned schedule as per the contract. In order for the construction staff to adhere to and

respect delivery/construction deadline, the Consultant shall notify regarding any construction work delays. Also, the Consultant requests that the construction staff to submit their improvement plans in order to meet scheduled deadlines. Items to be checked by the Consultant are as following:

(1-1) Work progress (progress of equipment manufacturing/civil works)

(1-2) Equipment and materials carrying-in to the site (equipment and materials for transmission & transformation, and for civil works)

(1-3) Verification of state of temporary works and of construction machinery preparation

(1-4) Verification of M/M of engineers, technicians and other workers

2) Quality and Work Progress Control

The Consultant should determine whether the quality of the manufactured equipment, delivered or installed, and construction work shall satisfy those as agreed upon in contract. When satisfactory quality is not secured, the Consultant immediately requests that the contractor corrects, changes or revises relevant procedures. Items for supervision by the Consultant are shown as following:

(2-1) To verify drawings and specifications of equipment and civil works

(2-2) To attend factory inspections for equipment, or to verify result of inspections

(2-3) To verify packaging, transportation and temporary placements on the site

(2-4) To verify drawings of equipment installation and of civil works

(2-5) To verify equipment arrangement, testing and inspection report

(2-6) To supervise installation of equipment and to attend to arrangement, testing and inspections

(2-7) To verify state of installation and civil works

3) Safety Management

The Consultant should supervise the state of safety with the cooperation of a responsible member of the contractor's staff. Any accident at Project site, or involving third parties should be prevented. The following actions are to be taken for safety management:

(3-1) Establish safety control rules and to appoint a person responsible for safety

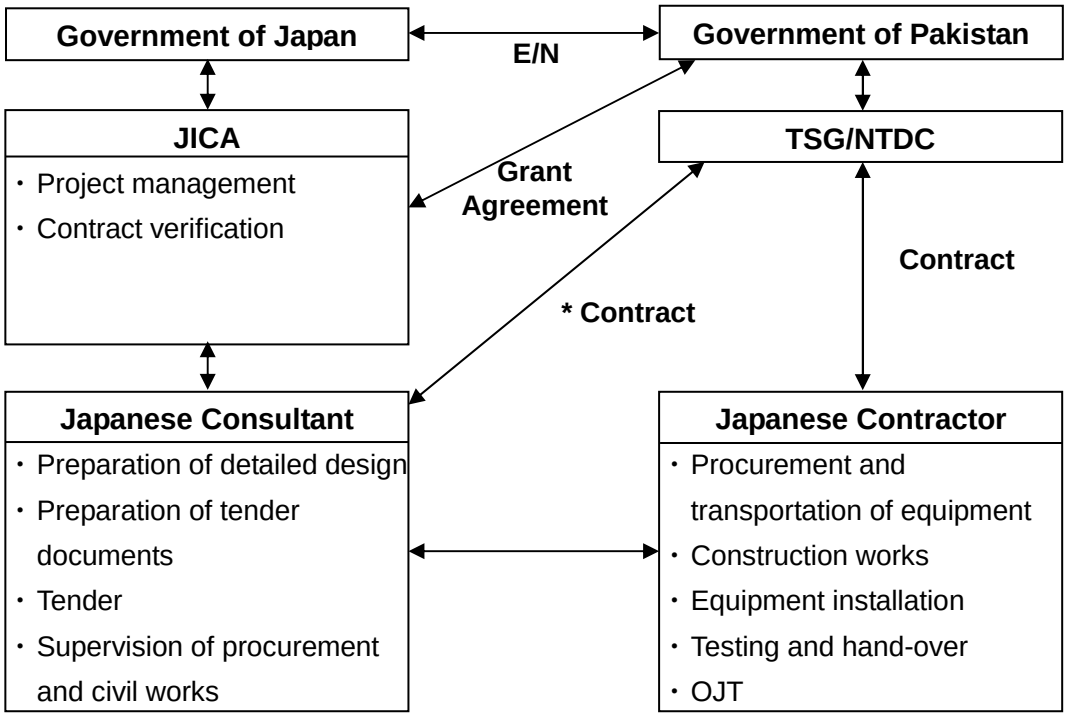
(3-2) Prevent accidents by periodic inspection for construction machinery

(3-3) Examine passage routes for work vehicles and construction machinery. Safe driving manners should be enforced at the site.

(3-4) Enforce safety measures during staying time

(2) Relationships of concerned partied for Project implementation

Relationships of concerned parties for the Project are shown as following:



* JICA should verify the contracts of the consulting service and the construction works

Figure 2-6 Project Implementation Relationships

(3) Construction Management

In addition to procurement, delivery of equipment and materials, the Contractor implements civil works for installation. In order to do so, the Contractor engages local construction companies, as subcontractors. Therefore, the Contractor should be responsible for making subcontractors fully aware of the implementation schedule, quality and safety of the work specified in the contract. Accordingly, the Contractor will dispatch engineers, who have experience of similar work abroad, to the Project site and provide advice to subcontractors. In terms of scale and contents of installation works of the Project, it is desirable to have Contractor's engineers on the Site, at least, as listed in Table 2-14.

Table 2-14 Engineers to be dispatched by the Contractor

Title of engineers	Number of engineers	Responsibilities
Inspector	1	- Confirmation and verification of drawings of training simulator - Confirmation and verification of factory inspection - Pre-shipping inspection and test for equipment
Local procurement supervisor	1	- Supervision of entire civil works - Coordination with related agency, acquisition of approval - Responsible of OJT - Equipment procurement management

		- Customs clearance procedures - Labor management and accounting
Driver	1	- Driving for local procurement supervisor

2-2-4-5 Quality Control Plan

Verification of specification of equipment shall be carried out at factory inspection before shipping. Also, quality control should be done based on management standards, as clarified in working instructions.

2-2-4-6 Procurement Plan

Training Simulator and related equipment are not manufactured in Pakistan. TSG has already participated in training courses in Japan, using training simulators. Through the experience, they resigned that the training courses are suitable for TSG training system, and requested to develop the training simulator owned by Japanese power companies in Pakistan.

However, various local conditions, such as ease of operation & maintenance, spare parts procurement, accident support and other post-delivery services, must be taken into account, when suppliers are selected. Therefore, the training simulator shall be procured in Japan, and it will be possible for other equipment to be procured in Pakistan or third countries. Suppliers' country of equipment for the Project are shown as follows:

Table 2-15 Eligible Source Countries for the Equipment and Construction Materials

	Equipment/materials	**Procurement in Japan**	**Procurement in Pakistan/third countries**	**Note**
	<Equipment>			
1	Training simulator	○		
2	Incoming panel, emergency power generator, equipment for distribution cable		○	
3	Protection relay (distant relay, transformer differential protection relay, Line current differential protection relay)	○		
4	Protection relay (Overcurrent protection relay, Busbar voltage differential protection relay (high/low		○	

	impedance), Synchronizing check relay, Breaker failure protection relay)			
5	Measuring equipment maintenance	○		
6	Spare parts	○		
7	Consuming items	○		
	<Construction materials>			
8	Aggregates for concrete		○	
9	Cement		○	
10	Reinforcing bar		○	
11	Concrete block		○	
12	Wood material		○	
13	Paint		○	
14	Door and Window		○	
15	Electric equipment procured in Japan	○		
16	Construction machinery		○	

Items procured in Japan should be packed properly to withstand lengthy marine transport, port unloading, inland transport to the Project site and storage. The port of discharge for equipment and materials will be Karachi Port. The port is well equipped with large-scale unloading facilities. Roads are well paved and suitable condition for transport from the port to the Project site.

2-2-4-7 Operational Guidance Plan

Initial guidance for operation & maintenance of equipment will be provided, before completion of the Project. The guidance is organized and effectuates OJT, following operation & maintenance manuals.

In order to efficiently implement the guidance, TSG is required to closely keep contact with the Consultant and the Contractor, and to appoint full-time engineers who participate in OJT. The engineers are required to share their newly acquired OJT knowledge and skills with other staff members. This will contribute to strengthen capacity of the operation & maintenance of TSG.

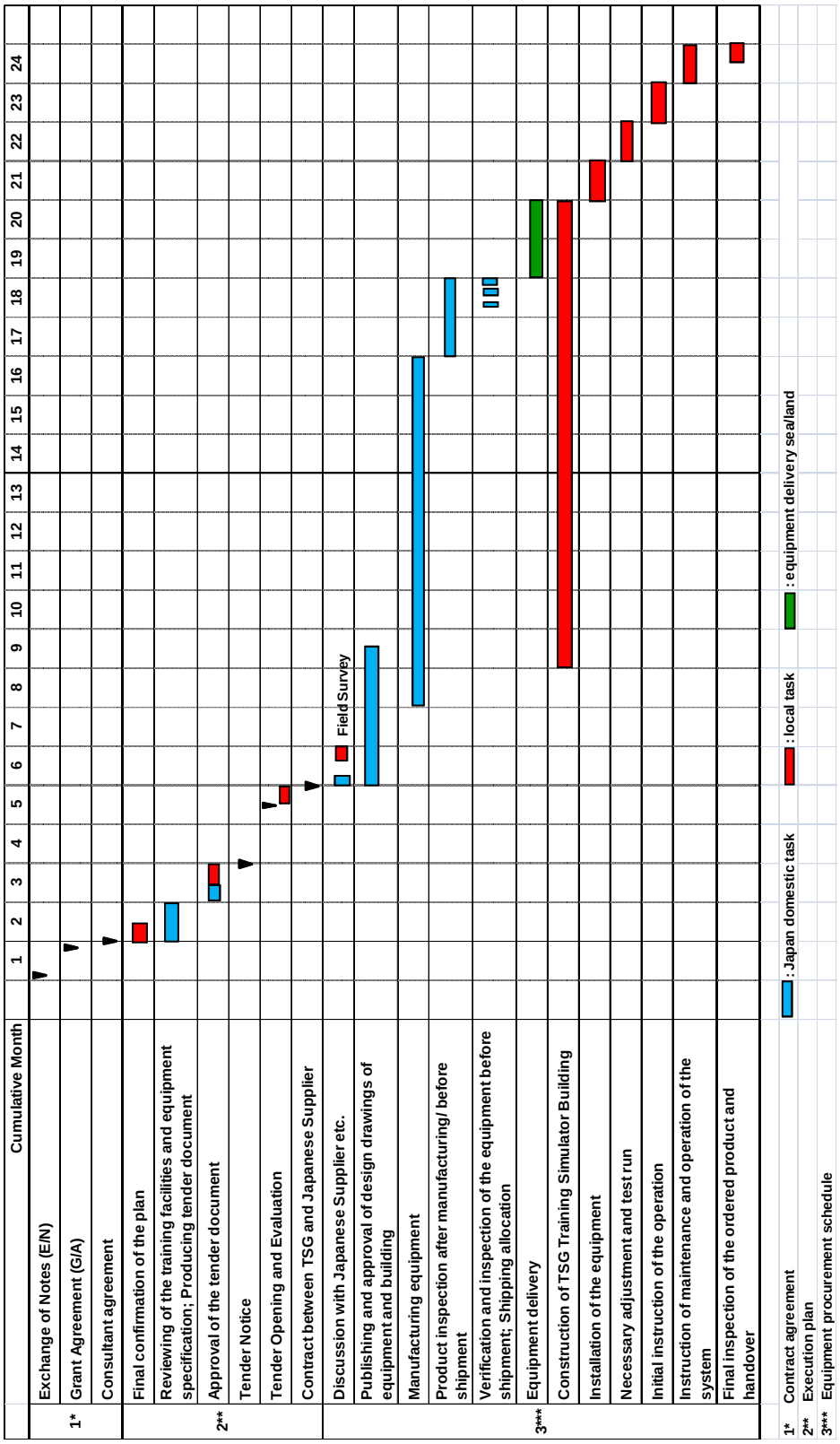
2-2-4-8 Soft Component (Technical Assistance) Plan

It seems difficult to conduct soft components during the installation of the training simulator, because of time limitations. On the other hand, TSG requested to effectuate counterpart training or technical cooperation. In detail, it seems effective to have a technical cooperation project with use of simulators and a training course with dispatched Japanese experts and TOT in Japan, etc. Efficiency will be enhanced by preparing a technical cooperation proposal which includes training in Japan, and to carry out “technical project” or “counterpart training”

2-2-4-9 Implementation Schedule

Based on the Japan's Grant Aid Scheme, the Project implementation schedule is shown in Figure 2-16.

Table 2-16 Project Implementation Schedule



2.3 Obligations of Recipient Country

Besides table 3-12 and 3-13, obligations of Pakistan side are shown below.

(1) Common Items:

(a) To provide the necessary data and information for the Project
(b) To secure tax exemption, customs clearance, unloading necessary equipment/materials at port
(c) To exempt taxes/tariffs and provide conveniences regarding equipment/materials, as well as dispatched Japanese individuals and companies
(d) To exempt business taxes regarding equipment/materials, as well as dispatched Japanese individuals and companies
(e) To bear excess weight charges for domestic transport
(f) To bear registration fees for the Consultant and the Contractor
(g) To pay commission fees to open account/payment at Japan's authorized foreign exchange bank
(h) To bear all items not covered under Japan's Grant Aid to implement the Project
(i) To appoint professional engineers to transfer operation & maintenance techniques. And to attend to inspection of the construction works and the quality control of equipment
(j) To properly and effectively maintain facilities and equipment procured under the Japan's Grant Aid.

(2) Preparation Work:

(a) To secure lots of land necessary for the implementation of the Project and to clear the sites
(b) To provide free-of-charge land for temporary offices, equipment/materials storage and temporary construction yard
(c) Removal of obstacles such as septic tanks (Man holes), wasted soil by septic tanks, electric poles, trees, and etc. in the Project site

(3) Construction in charge of Pakistan side

(a) To change the power receiving transformer from 50 kVA to 200 kVA
(b) To build foundation, fences and roof for generator and oil tank
(c) To build 2 openings to connect to the new connecting corridor and installation of 2 doors in the existing TSG Training Center (Ground and First floors), the expansion joint cover
(d) To build connection points of existing TSG power supply, water supply and gas supply toward the New Training Simulator Building

2-4 Project Operation Plan

2-4-1 Basic Policy

Proper operation & maintenance for training simulator and surrounding equipment is essential to enable stable and efficient training. In the Project, engineers dispatched from Japanese contractor plan to train

local engineers for operation & maintenance at the phase of installation, testing and adjustment. In addition, necessary spare parts, testing instruments, maintenance equipment, and operation & maintenance manuals will be provided by the Japanese side. At the same time, the Japanese side will advise for post-Project operation & maintenance system. This will contribute to enhance the efficiency of the Project.

2-4-2 Operation and Maintenance Plan

TSG is in charge of operation & maintenance after completion of the Project. TSG is planning to organize an implementation system with protection and instrumentation technical group, under supervision of the chief engineer (CE). Therefore, a proper organization and personnel for operation & maintenance shall be required. After completion of the Project, maintenance contract will be concluded between TSG/NDCL and Japanese manufacturing company as mentioned in PC-1. It is recommended that the contract will be smoothly concluded after the Project.

2-4-3 Regular Inspection Items

The standard regular inspection items for training simulator are shown in Table 2-17. Inspection items are classified as follows:

1) Daily inspections: sensory checks to detect abnormal heat, sound and smells from equipment
2) Regular inspections: normal checks for loose bolts, surface dirt, or damage to insulation and other items, which are not checked by daily inspections.
3) Detailed inspections: functional checks of interlock mechanisms between devices and precision maintenance of instrumentation.

While normal inspections should be conducted once every one to two years, detailed inspections should be done once every four years. Equipment parts, such as fuses, meters, relays and other components of switchboard which could suffer from quality deterioration, should be appropriately replaced following regular and detailed inspections.

Table 2-17 Standard Inspection Items for the Equipment

Inspection items	Details of inspection	Daily	Regular	Detailed
Visual appearance	State of switch indicators and display lights	●	●	-
	Abnormal noise and/or odor	●	●	-
	Overheat and discoloration of terminal parts	●	●	-
	Rust on mounting cases, frame etc.	●	●	-
	Abnormal heat	●	●	-
Operating devices and control panel	Indication on operation counters	-	●	●
	Dampness, rust or staining on operation box or panel	-	●	●
	Cleaning	-	●	●
	Clamping of distributing terminal parts	●	●	●
	Confirmation of switching display status	-	●	●
	Air or oil leaks	-	●	●
	Inspection of auxiliary switches and relays	-	●	●
	Inspection of control power source	●	-	-
Measure and test	Operation test of relay	-	●	●
	UPS Battery check	-	●	-

2-4-4 Spare Parts Purchasing Plan

(1) Spare parts

Spare parts covered by the Project are classified into two components: replacement parts and consumable parts.

- Consumable parts
- Replacement parts

(2) Classification of spare parts

- Consumable parts:

  Consumables parts are subjected to deterioration from daily usage, and are to be regularly replaced. It requires three times of the annual expected amount.

Table 2-18 List of Consumable Parts

Consumables for Printer	
Paper for printing	: 1 set
Toner cartridge	: 1 set

- Spare parts:

  Spare parts are not subjected to deterioration by daily operations, but are likely to be damaged and need to be changed. Expected amount requires within three years will be 100 percent.

Table 2-19 List of Spare Parts

Spare Parts	
For protection relay operation training simulator	
PCs for interface panels	: 1 set
UPS	: 1 set
Cables (various types)	: 1 set
Others	: 1 set
For GSO operation training simulator	
Server for GSO training simulator	: 1 set
UPS	: 1 set
Monitor	: 1 set
Selector switch (various types)	: 1 set
MCCB (various types)	: 1 set
Push-button switch (various types)	: 1 set
Indicator (various types)	: 1 set
Auxiliary relay (various types)	: 1 set
CPU unit	: 1 set
Cables (various types)	: 1 set
Other	: 1 set

(3) Budget of Spare Parts

Spare parts for the training simulator include those for replacement due to deterioration, and those that need to be replaced due to emergency situations, such as an accident. These spare parts need to be purchased once Pakistan side effectuate checks of necessary parts during regular

inspections. The Project plans to procure a minimum amount of consumable and replacement parts for three years. However, the Pakistan side is in charge of preparing a budget for purchasing additional necessary spare parts until one year after the completion of the Project.

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

(1) Japan side

Withheld until approval of conclusion of contract

(2) Pakistan side

Estimated overall cost for the Pakistan side is 5.42 million JPY (equivalent to 4.14 million PKR), *6 as shown in Table 2-20.

Table 2-20 Cost Estimation Borne by the Government of the Islamic Republic of Pakistan

№	Items	Estimated cost	
		million PKR	(million JPY)
1	Change the Power Capacity of transformer from 50 kVA to 200 kVA	1.28	1.68
2	Construction of 2 openings to connect to the new connecting corridor and installation of 2 doors in the existing TSG Training Center (Ground and First floors), the expansion joint cover, and etc.	1.88	2.46
3	Removal of obstacles such as septic tanks (Man holes), wasted soil by septic tanks, electric poles, trees, and etc. in the Project site	0.30	0.39
4	Securing connection points of existing TSG power supply, water supply, and gas supply for New Training Simulator Building	0.53	0.69
5	Payment of bank commission for B/A	0.15	0.20
	Total	4.14	5.42

*6: foreign exchange rate 1.31 yen/PKR (average exchange rate of September/October/ November, 2015)

(3) Estimation Criteria

№	Items	Contents	
1	Date of estimation	April, 2015	
2	Foreign exchange rates	1 US$ = ¥ 120.15	TTS average from January to March, 2015
		1 PKR = ¥ 1.33	TTS average from January to March, 2015
3	Procurement and construction periods	Periods for detailed design, equipment procurement and installation are as shown in the Project implementation schedule.	
4	Others	The Project will be implemented in accordance with the Grant Aid Scheme of the Government of Japan.	

2-5-2 Operation and Maintenance Cost

TSG will be in charge of operation & maintenance of the training simulator after procurement. Therefore, existing TSG lecturers and staff will be working on it. While operation & maintenance cost needs 5 million yen per year, it will be covered by 8 million PKR which is collected by trainees, as noted in PC-1 budget list.

In order to properly operate the training simulator, it is necessary to implement standard inspections of equipment, as mentioned in Table 2-19. Also, it will be necessary to prepare sufficient consumable and replacement spare parts. In addition, it may be necessary to purchase alternative equipment in case of breakdown, which costs around 15-25 million yen every 4-5 years. However, according to PC-1, it is clearly stated that NTDC will conclude the maintenance contract with the simulator manufacture company. Therefore, it will be possible for TSG to demand NTDC to secure the necessary amount as a normal service maintenance cost.

CHAPTER 3 PROJECT EVALUATION

Chapter 3 Project Evaluation

3-1 Preconditions

(1) The approved budget for the Project, PC-1, is smoothly allocated to cover the cost to Pakistan Side, as noted in Table 3-20.

(2) Organizational structure of TSG, the implementing agency of the Project, is largely unchanged.

3-2 Necessary Inputs by Recipient Country

(1) On the Project, Japan Side implements Training Simulator procurement/installation and the construction of the New Training Simulator Building. Before commencement of these procedures, Pakistan Side is required to complete following actions: acquisition of necessary land and its use permission for construction works, removal of waste materials and unnecessary buildings, and cutting down trees. In order to carry out these actions smoothly, Pakistan Side is required to organize construction team, and to establish construction/installment implementation and manning schedule.

(2) In the case that implementation of the above actions of Pakistan Side is delayed, it could negatively impact the Project implementation. Therefore, these actions are required to be carried out without delay, in accordance with Japan Side's construction work progress.

(3) After completion of the Project, in order to continue its positive effect, continuous involvement of human resources and financial support from NTDC is essential. Particularly, suitable allocation of TSG lecturers is the most important element for training.

3-3 Important Assumptions

5 Important Assumptions to maintain positive effect of the Project are following:

(1) Human resource development policy of the power sector in the Government of Pakistan and NTDC is largely unchanged.

(2) Engineers and technicians trained at TSG continue to be involved in maintenance of transmission and transformation works in Pakistan.

(3) Modernization of transmission and transformation facilities in Pakistan is continuously updated.

(4) Aid policy of other donors is not changed in the wrong direction, which can negatively impact the Project.

(5) Lecturers trained in technique transfer by the Project will continue training work at TSG.

3-4 Project Evaluation

3-4-1 Relevance

As human resource development needs in the power sector in Pakistan are high, it is safe to say that validity of the Project is mostly high.

In Japan's Grant Aid Policy to Pakistan, the power sector, including infrastructure facility development related to transformation and transmission, is positioned as a priority subject. The Project is in accordance with the Grant Aid Policy.

In addition, the Project is expected to be a part of comprehensive assistance to the power sector as a whole, with other projects, such as ODA loan projects in recent years and technical assistance being executed, i.e. "the Project for Least Cost Generation and Transmission Expansion Plan".

3-4-2 Effectiveness

This project contributes to procurement and installation of a Training Simulator set, and to construction of the New Training Simulator Building which offers a comfortable training environment. These enable TSG to conduct several training sessions using the Training Simulator, such as protection relay operation training, and decision-making training for accidents related to transmission network and other power facilities.

Traditionally, such training has been conducted in a short time during GSO operation interval time. As a real simulator is used in the training, it is not only hazardous, but also very limited in terms of content. On the other hand, the new Training Simulation allows TSG to safely carry out training, and to reproduce postulated accidents which cannot be done in traditional training. In addition, it is also possible to learn appropriate responses to different types of accident, to shorten recovery time from blackouts, and to master troubleshooting. Therefore, the effectiveness of the Project seems to be high.

Besides, it is also possible to share effectual information, not only for GSO members, but also for engineers in different departments of NTDC, in charge of system protection, planning, and power distribution surveillance. Such information sharing enables the relevant departments to dispatch lecturers to TSG. As a result, through these experiences, capacity building for TSG lectures is enhanced, in terms of quality and quantity.

(1) Quantitative effect

Index name	Baseline value in 2015 (actual value)	Target value in 2021 (3 years after the Project completion)
1. Number of training courses using simulator (course)	0	4
2. Number of implemented training courses using simulator (times/year)	0	22
3. Number of trainees with experience using of simulator (person/year)	0	120
4. Training course evaluation by trainees (average mark)	3.0	3.4

(Note) Evaluation ranks of Row 4: 4.0=Very Good, 3.0=Good, 2.0=Average, 1.0=Not Good
In Row 4, while 3.0 of the baseline value in 2015 shows the average mark for the existing training courses, 3.4 of the target value shows the average mark of the training courses with the new course.

(2) Qualitative effect

✓ The operation & maintenance of transmission and transformation is improved at trainee's institution.

✓ The economic infrastructure is strengthened, including the establishment of stable power supply, through the appropriate operation & maintenance of transmission and transformation.

From the above, it is determined that the validity and effectiveness of the Project is high.

APPENDICES

APPENDIX 1

MEMBER LIST OF THE STUDY TEAM

Appendix 1 Member List of the Project Team

The members of the Team are as follows;

(1) First Field Survey from 1 Feb. 2015 to 12 Feb. 2015

Name	Assignment	Organization
Mr. Fuyuki Sagara	Team leader	Japan International Cooperation Agency
Mr. Shingo Naito	Planning management	Japan International Cooperation Agency
Mr. Kenji Nandoh	Chief consultant, Training planning on grid system	Asia Engineering Consultant Co., Ltd.
Mr. Masafumi Kawanaka	Grid system operation and maintenance	Asia Engineering Consultant Co., Ltd.
Mr. Kazuyoshi Yoshida	Equipment planning/ procurement, Cost estimation	Asia Engineering Consultant Co., Ltd.

(2) Second Field Survey from 22 Mar. 2015 to 18 Apr. 2015

Name	Assignment	Organization
Mr. Kenji Nandoh	Chief consultant, Training planning on grid system	Asia Engineering Consultant Co., Ltd.
Mr. Masafumi Kawanaka	Grid system operation and maintenance	Asia Engineering Consultant Co., Ltd.
Mr. Kazuyoshi Yoshida	Equipment planning/ procurement, Cost estimation	Asia Engineering Consultant Co., Ltd.
Mr. Teruo Kurumada	Facilities planning	Yachiyo Engineering Co., Ltd.
Mr. Hironori Komatsu	Construction planning, Cost estimation	Yachiyo Engineering Co., Ltd.

(3) Third Field Survey from 30 Sep. 2015 to 17 Oct. 2015

Name	Assignment	Organization
Mr. Tadayuki Ogawa	Team leader	Japan International Cooperation Agency
Ms. Kuri Orui	Planning management	Japan International Cooperation Agency
Mr. Kenji Nandoh	Chief consultant, Training planning on grid system	Asia Engineering Consultant Co., Ltd.
Mr. Masafumi Kawanaka	Grid system operation and maintenance	Asia Engineering Consultant Co., Ltd.
Mr. Kazuyoshi Yoshida	Equipment planning/ procurement, Cost estimation	Asia Engineering Consultant Co., Ltd.

APPENDIX 2
STUDY SCHEDULE

Appendix 2 Study Schedule

(1) First Field Survey

Date	Activity	Survey Team	Action by	Stay
1/Feb (sun)	NRT-BKK-LHE	JICA,AEC		LHE
2/Feb (Mon)	AM: TSG Explaining about next Project and Grant PM: NTDCL Explain about next Project andGrant	JICA,AEC	TSG: Mr. Mohammad Arshad Mirza(CE) NTDCL: Mr. Muhammad Arshad(MD) Mr. Abdul Rehman(SD/GM)	LHE
3/Feb (Tue)	AM: TSG Discussing on next Project PM: NTDCL Explain about next Project and Grant	JICA,AEC	TSG: Mr. Mohammad Arshad Mirza(CE) NTDCL: Mr. Sabzali Khan(GSO/GM) Mr. R. S. Rehan(Planning/GM)	LHE
4/Feb (Wed)	Moving from LHE to- ISB 11:00: EAD Discussing next Project 14:00: MoWP Discussing next Project	JICA,AEC	EAD: Mr. Syed Mujtaba Hussain(JS) Mr. Shahid Ahmed Vakil(DS) MoWP: Mr. Zafar Abbass(JS(NTDC))	ISB
5/Feb (Thu)	Make up M/D(drift)	JICA,AEC		ISB
6/Feb (Fri)	MoWP: Sign up M/D after meeting JICA Pakistan: Reporting EOJ: courtesy visit	JICA,AEC	MoWP: Mr. (AS) Mr. Zafar Abbass(JS(NTDC)) NPCC: Mr. Aziz-ur-Rehman(GM) JICA Pakistan: Mr. Ken kato(Senior Rep.) EOJ: Mr. Shunichi Amada(First Secretary)	ISB
7/Feb (Sat)	JICA return from ISB to Japan Moving from ISB to LHE	JICA,AEC		LHE
8/Feb (Sun)	Internal meeting	AEC		LHE
9/Feb (Mon)	TSG: Explaining next project, Discussing about SPEC of simulator, PC-1, and Grant	AEC	TSG: Mr. Mohammad Arshad Mirza(CE) Mr. Mohammad Mustafa(Mgr, P&I)	LHE
10/Feb (Tue)	System Protection: Explaining next Project, Discussing aboutnext Project, SPEC of Simulator TSG: Discussing SPEC of Simulator and C/N	AEC	NTDCL/SD: Mr. Muhammad Shafique (System Protection/CE) Mr. Taqi-ud-Din(System Protection/DM) TSG: Mr. Mohammad Arshad Mirza(CE)	LHE
11/Feb (Wed)	TSG: Make up C/N after meeting Come back to Japan	AEC	TSG: Mr. Mohammad Arshad Mirza(CE)	Airplain
12/Feb (Thu)	Arriving NRT	AEC		

(2) 2nd Field Survey

Date	Activity		Action by	Stay
	< Equipment > AEC	< Building > YEC		
3/22 (Sun)	Moving from NRT to LHE			Lahore
3/23 (Mon)	Internal meeting			Lahore
3/24 (Tue)	Discussing about next project and layout of building		**TSG:** Mr. Mohammad Mustafa (Mgr, P&I) Mr. Muhammad Akram (Mgr, Grids)	Lahore
3/25 (Wed)	Discussing about layout of building, SPEC of simulator, PC-1 and Grant		Mr. Mohammad Mustafa (Mgr, P&I) Mr. Muhammad Akram (Mgr, Grids)	Lahore
3/26 (Thu)	Discussing about SPEC of simulator, PC-1 and Grant		**TSG:** Mr. Mohammad Mustafa (Mgr, P&I) Mr. Muhammad Akram (Mgr, Grids)	Lahore
3/27 (Fri)	Lecture about simulator Discussing about next Project and SPEC of simulator		**NTDCL/SD/System Protection:** Mr. Taqi-ud-Din (DM) Mr. M. Kamran Siddiqui (Addl Mgr) **GSO NKLP:** Mr. Anwar Ahmad Khan (Addl Mgr, P&I) **TSG:** Mr. Mohammad Arshad Mirza (CE) Mr. Mohammad Mustafa (Mgr, P&I) Mr. Muhammad Akram (Mgr, Grids)	Lahore
3/28 (Sat)	Internal meeting			Lahore
3/29 (Sun)	Moving from Lahore to Faisalabad	Moving from NRT to LHE		AEC: Faisalabad YEC: Lahore
3/30 (Mon)	1) Visiting on WEA Explaining next Project, Survey simulator equipment 2) Visiting on Gatti GSO Survey Equipment Moving from Faisalabad to Lahore	1) Survey surrounding field 2) Discussing layout of building	< Equipment > **WEA:** Mr. Shahzad Bashir (CE) **TSG:** Mr. Mohammad Arshad Mirza (CE) < Building > **TSG:** Mr. Mohammad Mustafa (Mgr, P&I) Mr. Muhammad Akram (Mgr, Grids) Mr. Saqib Majeed (Addl Mgr, Grids)	Lahore
3/31 (Tue)	Discussing SPEC of Equipment and Model Grid Station	Discussing layout of building Comfirming standard on field	**TSG:** Mr. Mohammad Mustafa (Mgr, P&I) Mr. Muhammad Akram (Mgr, Grids) Mr. Saqib Majeed (Addl Mgr, Grids)	Lahore
4/1 (Wed)	1)Visiting on NTDCL/GSO Explaining next Project 2)Visiting on System Protection Explaining next project and SPEC of simulator	Same as above	< Equipment > **NTDCL/GSO:** Mr. Ashraf Elahi (CE) **NTDCL/SD:** Mr. Taqi-ud-Din (System Protection/DM) **TSG:** Mr. Mohammad Arshad Mirza (CE) < Building > **TSG:** Mr. Muhammad Akram (Mgr, Grids) Mr. Saqib Majeed (Addl Mgr, Grids)	Lahore

Date	Activity		Action by	Stay
	< Equipment > AEC	< Building > YEC		
4/2 (Thu)	Discussing of SPEC of Equipment	Discussing layout of building and CP-1	**TSG:** Mr. Mohammad Mustafa (Mgr, P&I) Mr. Muhammad Akram (Mgr, Grids) Mr. Saqib Majeed (Addl Mgr, Grids)	Lahore
4/3 (Fri)	Discussing about SPEC of Equipment and Grant	Discussing about CP-1 Comfirming surrounding field	**TSG:** Mr. Mohammad Mustafa (Mgr, P&I) Mr. Muhammad Akram (Mgr, Grids) Mr. Saqib Majeed (Addl Mgr, Grids)	Lahore
4/4 (Sat)	Internal meeting			Lahore
4/5 (Sun)	Same as above			Lahore
4/6 (Mon)	Discussing about C/N		**TSG:** Mr. Mohammad Mustafa (Mgr, P&I) Mr. Muhammad Akram (Mgr, Grids) Mr. Saqib Majeed (Addl Mgr, Grids)	Lahore
4/7 (Tue)	Sign up C/N after meeting	Sigb up C/N after meeting Presence Soil Investigation and Topographic Survey Map	**TSG:** Mr. Mohammad Arshad Mirza (CE) Mr. Mohammad Mustafa (Mgr, P&I) Mr. Muhammad Akram (Mgr, Grids) Mr. Saqib Majeed (Addl Mgr, Grids)	Lahore
4/8 (Wed)	Moving from Lahore to Islamabad	Making basic draft Making up additional C/N material	**TSG:** Mr. Mohammad Arshad Mirza (CE)	AEC-1: Islamabad YEC: Lahore
4/9 (Thu)	Moving from Islamabad to Tarbela Survey Tarbela training Center	Same as above	**TSG:** Mr. Tariq Ali Shah (Principal)	Lahore
4/10 (Fri)	Courtesy visit on JICA Pakistan office Moving from Lahore to NRT	Same as above	**JICA Pakistan Office:** Mr. Kenji Ogasahara (Rep.)	AEC-1: In Airplane YEC: Lahore
4/11 (Sat)	Arriving NRT	Internal meeting		Lahore
4/12 (Sun)		Same as above		Lahore
4/13 (Mon)		Discussing additional C/N, SPEC of building. Survey existent building	**TSG:** Mr. Muhammad Akram (Mgr, Grids) Mr. Saqib Majeed (Addl Mgr, Grids)	Lahore
4/14 (Tue)		Discussing additional C/N Survey existent building. Presence Soil Investi-gation Survey surrounding cir--Cumstance.	**TSG:** Mr. Muhammad Akram (Mgr, Grids) Mr. Saqib Majeed (Addl Mgr, Grids)	Lahore
4/15 (Wed)		Survey surrounding cir--Cumstance.		Lahore
4/16 (Thu)		Sign up additional C/N after meeting	**TSG:** Mr. Mohammad Arshad Mirza (CE) Mr. Mohammad Mustafa (Mgr, P&I) Mr. Muhammad Akram (Mgr, Grids) Mr. Saqib Majeed (Addl Mgr, Grids)	Lahore
4/17 (Fri)		Moving from Lahoreto NRT		Airplane

Date	Activity		Action by	Stay
	< Equipment > AEC	**< Building > YEC**		
4/18 (Sat)		Arriving NRT		

(3) 3rd Field Survey

Date	Time	Assignment & Schedule / Visits	Action by	JICA	AEC
(Wed) 30 Sep	whole day	12:00 Narita(TG643) －16:30 BKK 20:30 BKK(TG345) －23:00 LHE		—	LHE
(Thu) 1 Oct	9:30-15:30	3rd FS local assignment plan introductory presentation 1)Undertakings to be taken by Pakistan 2)FS project report (draft)	CE/TSG/Mr.Mirza Mr. Saqib、Mr.Mustafa、Mr. Muhammad Akram	—	LHE
(Fri) 2 Oct	9:30-15:30	To study equipment specification Preparation and completion of JCC MM original plan	CE/TSG/Mr.Mirza Mr. Saqib、Mr.Mustafa、Mr. Muhammad Akram	—	LHE
(Sat) 3 Oct	whole day	Ad hoc Preparation for reporting documents		—	LHE
(Sun) 4 Oct	whole day	AEC: Preparation for reporting documents JICA: 12:00 Narita(TG643) －16:30 BKK 20:30 BKK(TG345) －23:00 LHE		LHE	LHE
(Mon) 5 Oct	9:30-15:30	AM: Project report presentation Discussion re JCC MM original plan, To study equipment specification PM: Meeting with MD/NTDCL Project report presentation Discussion re JCC MM original plan	CE/TSG/Mr.Mirza Mr. Saqib、Mr.Mustafa、Mr. Muhammad Akram MD/NTDCL/ Mr.Arshad Chaudhry	LHE	LHE
(Tue) 6 Oct	5:30- **11:00** **17:00-**	On transfer（LHE→ISB）via land EAD preparatory presentation MoWP preparatory presentation	Dy.Secretary (Japan)/EAD/ Mr. Shahid Vakeel MoWP/JS/ Mr. Zafar Abbass	ISB	ISB
(Wed) 7 Oct	10:00-12:00 14:00-15:30	AM:JCC MM agreement and confirmation To study simulator at NPCC(National Power Control Centre)	do. MD/NTDCL/ Mr.Arshad Chaudhry GM(SO) NPCC Mr Ilyas Ahmed	ISB	ISB
(Thu) 8 Oct	9:30-15:30	Reporting to Empassy of Japan Repoting to JICA Pkistan office	EoJ/Mr Amada (1st Secretary), Mr Kamoshida(Counselor) JICA Pakistan office/ Mr Kato(Sr. Rep.), Mr Ogasawara(Rep.)	ISB	ISB
(Fri) 9 Oct	9:30-15:30	Project report explanation to Tarbela Instructors JICA＋AEC/Yoshida：leave for JPN 23:20 ISB (TG350) – BKK 6:25 +1	TSG/Tarberla/principal Mr.Tariq, Mr.A,Baksh, Mr.Qaiser.Mr. Shoaib,etc	Air	ISB
(Sat) 10 Oct	whole day	AEC: Preparation for reporting documents JICA＋AEC/Yoshida： 07:35 BKK（TG676）-NRT 15:45		—	ISB

(Sun) 11 Oct	whole day	AEC：On transfer（ISB→FSB） via land		—	FSB
(Mon) 12 Oct	9:30-15:30	To study confirmation way of the education result and qualification scheme @ WEA	WEA/CE/Mr. Shahzad Bashir	—	LHE
(Tue) 13 Oct	9:30-15:30	Meeting with Planning Div./NTDCL 1)Project report presentation 2)PC-1 3)Undertakings to be taken by Pakistan 4)Another Donnars for NTDCL	GM/Planning Mr.RS Rehan CE/TSG/Mr.Mirza	—	LHE
(Wed) 14 Oct	9:30-15:30	Meeting with Service Div./NTDCL Project report presentation (Equipment,Project target/evaluation, Maintenance budget)	GM/SD/ Mr.Abdul Rehman GM/GSO Mr. Sabz Ali Khan	—	LHE
(Thu) 15 Oct	9:30-15:30	To work on equipment specification (Power system diagram,Minic board, operation method) & TOT, To plan C/N (draft)	CE/TSG/Mr.Mirza Mr. Saqib、Mr.Mustafa、Mr. Muhammad Akram、Mr.Abid	—	LHE
(Fri) 16 Oct	9:30-15:30	To wok on equipment specification Preparation of C/N 24:10 LHE (TG346) – BKK 6:40 +1（TG676）	CE/TSG/Mr.Mirza Mr. Saqib、Mr.Mustafa、Mr. Muhammad Akram	—	air
(Sat) 17 Oct	whole day	07:35 BKK-NRT 15:45		—	—

APPENDIX 3

LIST OF PARTIES CONCERNED IN THE RECIPIENT COUNTRY

Appendix 3 List of Parties Concerned in the Recipient Country

Ministry of Water and Power (MoWP)

Mr. Zafar Abbass	Joint Secretary(NTDC)

Econimic Affair Division (EAD)

Mr. Syed Mujtaba Hussain	Joint Secretary
Mr. Shahid Ahmed Vakil	Deputy Secretary(Japan)
Ms. Yasmin Sadiq	Section Officer

Wapda Engineering Academy (WEA)

Mr. Shahzad Bashir	Chief Enginner

National Transmission and Despatch Company, Limited (NTDC)
Head Office

Mr. Ch. Muhammad Arshad	Managing Director

Planning Power

Mr. R. S. Rehan	General Manager
Mr. Muhammad Waseem Younas	Additional Manager, Power System Studies

National Power Control Centre (NPCC)

Mr. Aziz-ur-Rehman	General Manager
Mr. Bashir Ahmad	Manager, Load Dispatch Project
Mr. Muhammad Aamer	Deputy Manager, SCADA
Mr. Muzammil	Manager, Region Control Center

Transmission and Grid Station Construction Projects

Mr. Abdul Razzaq Cheema	General Manager

Grid Station Operation

Mr. Sabz Ali Khan	General Manager
Mr. Anwar Ahmad Khan	Manager, GSO Lahore

Service Division

Mr. Abdul Rehman	General Manager

Service Division/System Protection

Mr. Muhammad Shafique	Chief Enginner
Mr. Taqi-ud-Din	Deputy Manager

Service Division/Technical Service Group (TSG)

Mr. Muhammad Arshad Mirza	Chief Enginner
Mr. Muhammad Mustafa	Manager, P&I
Mr. Muhammad Akram	Manager, Grids
Mr. Tariq Ali Shah	Principal/Manager Tarbela (Former Manager, T/L)
Mr. Falak Sher Javed	Manager, R&D
Mr. Saqib Majeed	Additional Manager, Grids
Mr. Abid Hussain Gondal	Deputy Manager, P&I
Mr. Naveed Rushdi	Additional Manager, P&I
Mr. Munir Hussain Shah	Assistant Manager, P&I
Mr. Naeem Akhtar	Former Principal/ Tarbela
Mr. Qaiser Khan	Additional Manager, P&I/ Tarbela
Mr. Muhammad Shoaib	Deputy Manager, Grids/ Tarbela
Mr. Allah Bakhsh	Additional Manager, T/L/ Tarbela
Mr. Muhammad Aslam Khan	Deputy Manager, Grids/Gatti

Embassy of Japan in Pakistan

Mr. Takashi Harada	Counsellor (Economic & Development)
Mr. Shunichi Amada	First Secretary
Mr. Naoaki Kamoshida	Former Counsellor (Economic & Development)

JICA Pakistan Office

Mr. Mitsuyoshi Kawasaki	Chief Representative
Mr. Ken Kato	Senior Representative
Mr. Yoshihiro Ozaki	Former Representative
Mr. Kenji Ogsawara	Representative

APPENDIX 4

MINUTES OF DISCUSSIONS (M/D)

Minutes of Discussions
on the Preparatory Survey
on the Project for Strengthening of Training Center
on Grid System Operations and Maintenance
in the Islamic Republic of Pakistan
(First Field Survey)

In response to the request from the Government of the the Islamic Republic of Pakistan (hereinafter referred to as "Pakistan"), the Japan International Cooperation Agency (hereinafter referred to as "JICA"), in consultation with the Government of Japan, decided to conduct a Preparatory Survey (hereinafter referred to as "the Survey") on the Project for Strengthening of Training Center on Grid System Operations and Maintenance (hereinafter referred to as "the Project") .

JICA sent to Pakistan the Preparatory Survey Team (hereinafter referred to as "the Team") headed by Mr. Fuyuki Sagara, Advisor, Team 1, Energy and Mining Group, Industrial Development and Public Policy Department, JICA, to conduct the first field survey and the Team is scheduled to stay in the country from 1st February to 12th February, 2015.

The Team held discussions with the concerned officials of Pakistan and conducted a field survey in Pakistan.

In the course of the discussions, both sides have confirmed the main items described in the attached sheets hereto. The Team will proceed with further study and prepare the preparatory survey report.

Islamabad, Pakistan
6th February, 2015

Mr. Fuyuki Sagara
Leader
Preparatory Survey Team
Japan International Cooperation Agency

Mr. Zaffer Abbas
Joint Secretary (NTDC)
Ministry of Water and Power

Mr. Syed Mujtaba Hussain
Joint Secretary
Economic Affairs Division

Mr.Abdul Rehman
General Manager
Services Division
National Transmission and Despatch Company Limited

Mr. Mohammad Arshad Mirza
Chief Engineer
Technical Service Group
National Transmission and Despatch Company Limited

ATTACHMENT

1. Objective of the Project

The objective of the Project is to improve capacity of power grid system operations and maintenance by installing Grid Training Simulator and facilities for conducting technical training in Technical Service Group, National Transmission and Despatch Company Limited.

2. Title of the Project

The title of the project is "The Project for Strengthening of Training Center on Grid System Operations and Maintenance".

3. Project Site

The Project sites are located in Lahore, Pakistan, as shown in Annex-1.

4. Responsible and Implementing Organizations

4-1 The responsible ministry is the Ministry of Water and Power (MoWP).

4-2 The implementing agency is National Transmission and Despatch Company Limited (NTDC). Technical Service Group (TSG), NTDC will be the main department in charge of the Project.

4-3 The organization structures of MoWP and NTDC are shown in Annex-2 and Annex-3.

5. Items Targeted in the Project

5-1 As the result of discussions, the components to be targeted in the Project have been identified as follows;

5-1-1 Grid Training Simulator

Main purposes of Grid Training Simulator are

A. To improve capacity for grid operation and maintenance by understanding basic power system phenomena.

B. To improve capacity for operating protection relay

Detailed subjects are mainly as follows;

A:

- Fundamental knowledge of interlock operating procedures
- Flexible parallel operations of transformers
- Synchronized closings and reclosings.

B:

- Confirming settings for protection relay
- Clarifying reasons for improper operations of protection relay in various incidents
- Establishing countermeasures for preventing improper operations of protection relay
- Understanding mechanism and influences of various types of inrush current in transformer and various phenomena in power networks.

5-1-2 Classroom building for simulator

A two story building including simulator room, classroom, generator room, administration room and utility space.

5-2 The Team will study and discuss with TSG further the appropriateness of each component and technical specifications from the viewpoint of necessity and relevance as Japan's Grant Aid scheme, and will compile the findings into the preparatory survey report for the project appraisal.

6. Japan's Grant Aid Scheme

6-1 The Pakistan side has understood Japan's Grant Aid Scheme explained by the Team as described in Annex-4 and Annex-5.

6-2 The Pakistan side will take the necessary undertakings, as described in Annex-6, for smooth implementation of the Project.

7. Schedule of the Study

7-1 The First Field Survey Team will continue its work in Pakistan until 12th February, 2015.

7-2 The Second Field Survey Team will be dispatched from March to April 2015.

7-3 JICA will prepare the draft report of the Preparatory Survey and dispatch a team to Pakistan in August 2015 in order to explain its contents.

8. Other Relevant Issues

8-1 Allocation of instructors

The team strongly recommended NTDC to allocate adequate personnel with sufficient capacity as instructors for the training of simulator. NTDC assured to allocate excellent engineers to be trained as instructors for simulator. The Pakistan side proposed that engineers of NTDC have opportunity to be trained as instructor for simulator by Japanese experts both in Pakistan and Japan.

8-2 Collaboration among training centers

The team also recommended TSG to work on improving training system for Grid Training Simulator in collaboration with instructors of 3 training centers (Tarbela, Gatti and New Kot Lakhpat) so that each curricula and syllabi will be effectively linked to the practical training using simulator.

8-3 Construction permission

The Pakistan side confirmed construction permission for classroom building for simulator.

8-4 Questionnaire requested by the Team to the Pakistan side

The Pakistan side will answer the questionnaire requested by the Team by 12th Feb 2015.

8-5 Project approval procedure by the Pakistan side

The team plans to submit a draft report to the Pakistan side in August 2015. The team explained that, after receiving the draft report, it is necessary for the Pakistan side to work on the PC-1 approval procedure for the Project in the Government of Pakistan in a timely manner before the appraisal process by the Japanese side. The Pakistan side fully understood and promised as soon as they received draft report, NTDC and MoWP jointly strive for the earliest PC-1 approval.

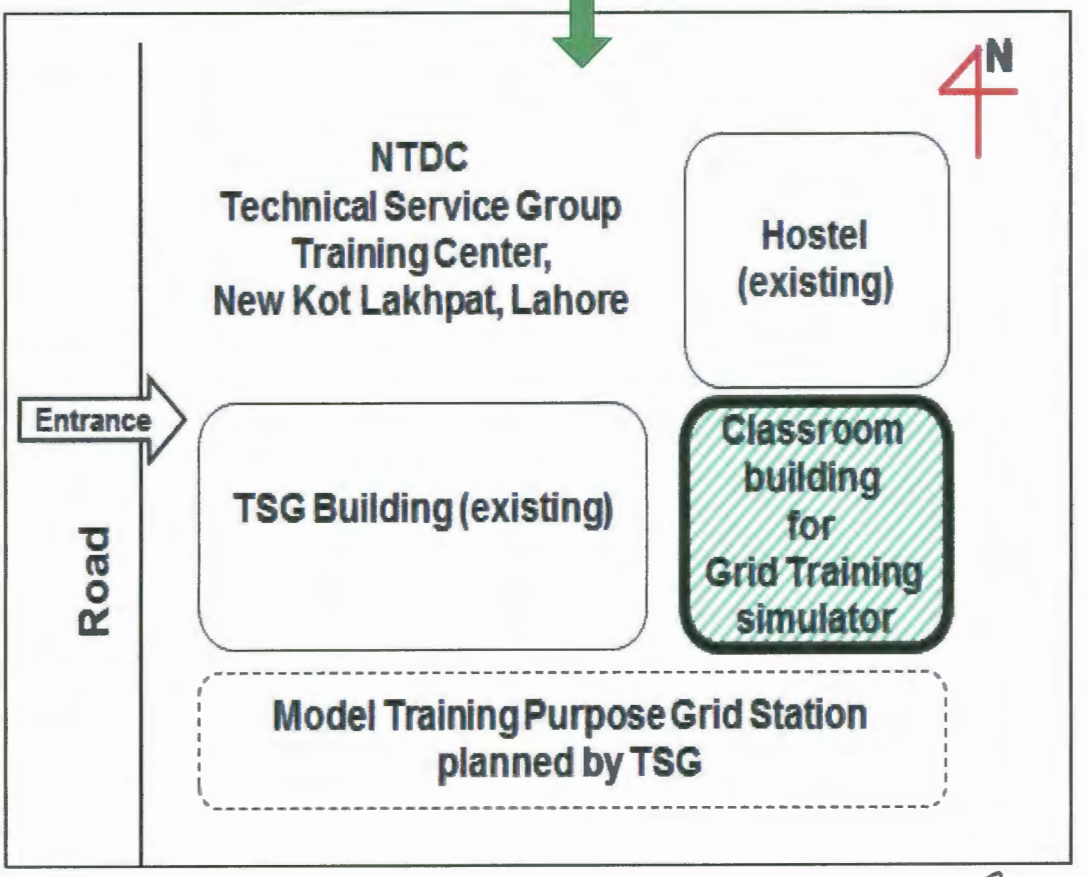
(End)

<List of Annex>

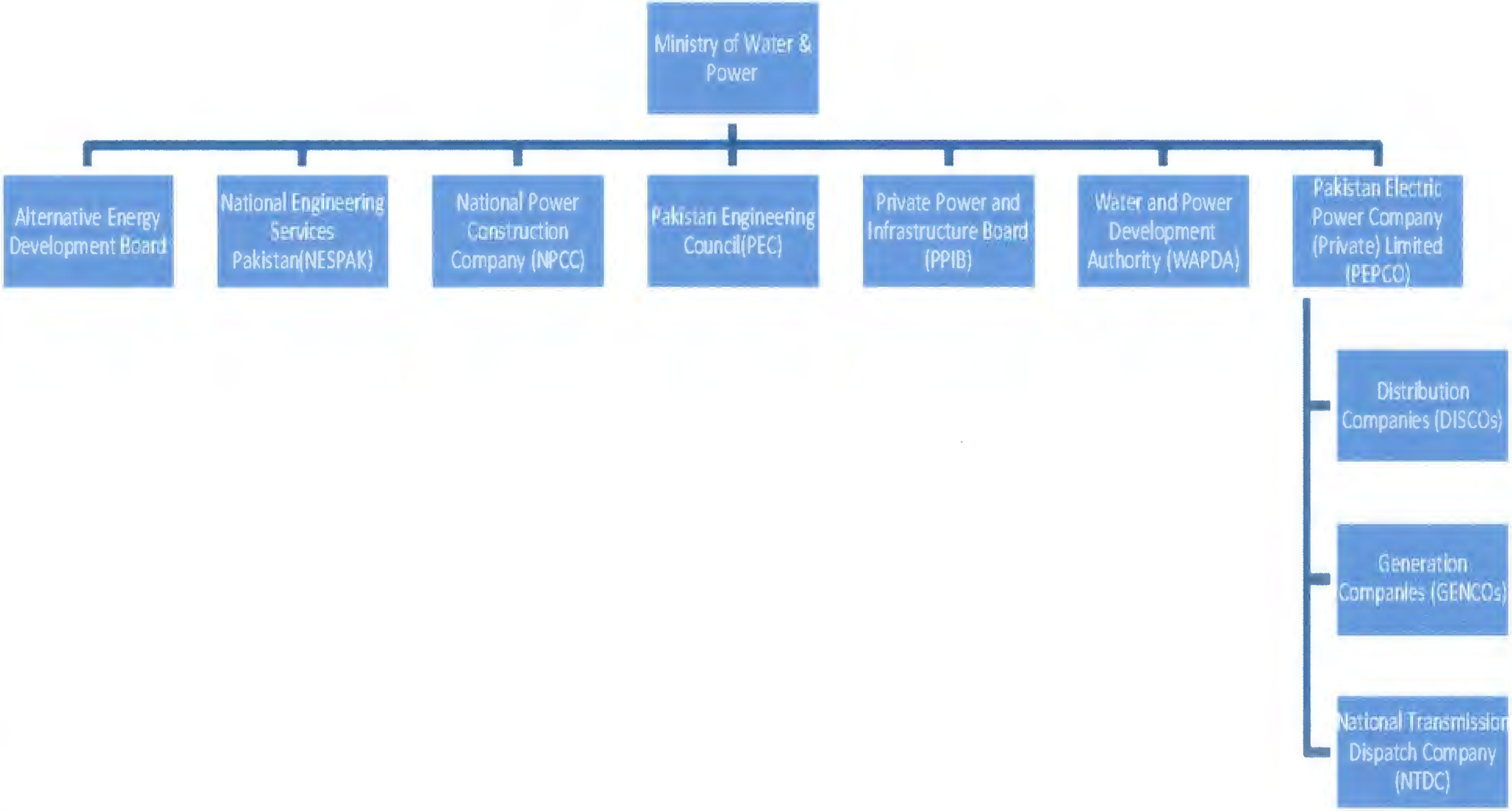
LOCATION OF THE PROJECT SITE

Annex - 1

The location of TSG Training Centre NTDC

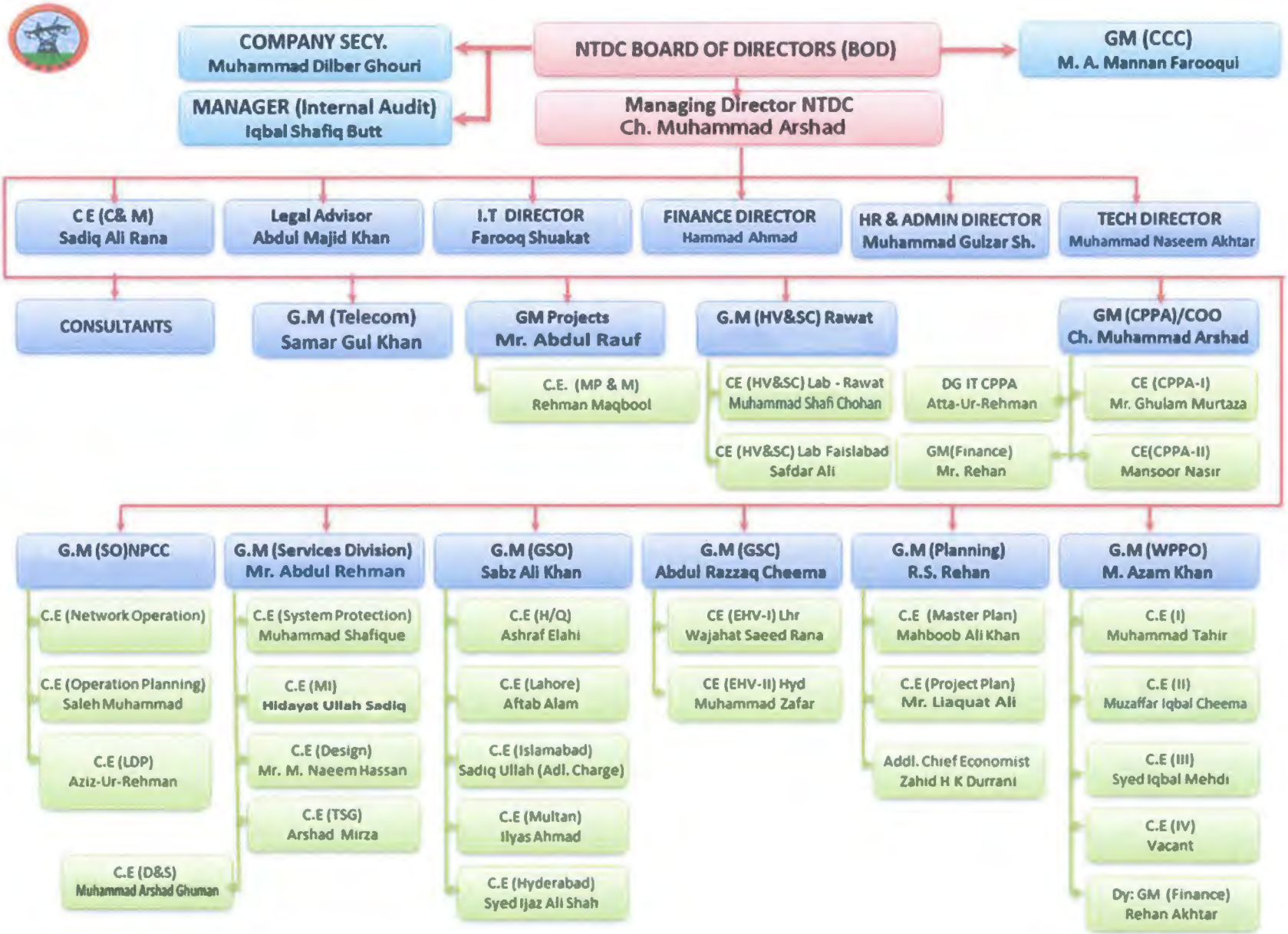


ORGANIZATION STRUCTURE OF MINISTRY OF WATER AND POWER



Annex-2

ORGANIZATION STRUCTURE OF NATIONAL TRANSMISSION AND DESPATCH COMPANY LIMITED



Annex-3

JAPAN'S GRANT AID

Based on the new JICA law entered into effect on October 1, 2008, JICA is designated as the executing agency of the Grant Aid for General Projects, for Fisheries and for Cultural Cooperation, etc.

The Grant Aid is non-reimbursable fund provided to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

1.Grant Aid Procedures

The Japanese Grant Aid is supplied through following procedures :

・Preparatory Survey
- The Survey conducted by JICA

・Appraisal &Approval
- Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet

・Authority for Determining Implementation
- The Notes exchanged between the GOJ and a recipient country

・Grant Agreement (hereinafter referred to as "the G/A")
- Agreement concluded between JICA and a recipient country

・Implementation
- Implementation of the Project on the basis of the G/A

2. Preparatory Survey

(1) Contents of the Survey

The aim of the preparatory Survey is to provide a basic document necessary for the appraisal of the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of a outline design of the Project.
- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Outline Design of the Project is confirmed based on the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the Report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the appropriateness of the Project.

3. Japan's Grant Aid Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes(hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and G/A.

(3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

(4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to fulfill accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex-7.

(6) "Proper Use"

The Government of the recipient country is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant Aid, to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Grant Aid.

(7) "Export and Re-export"

The products purchased under the Grant Aid should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). JICA will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

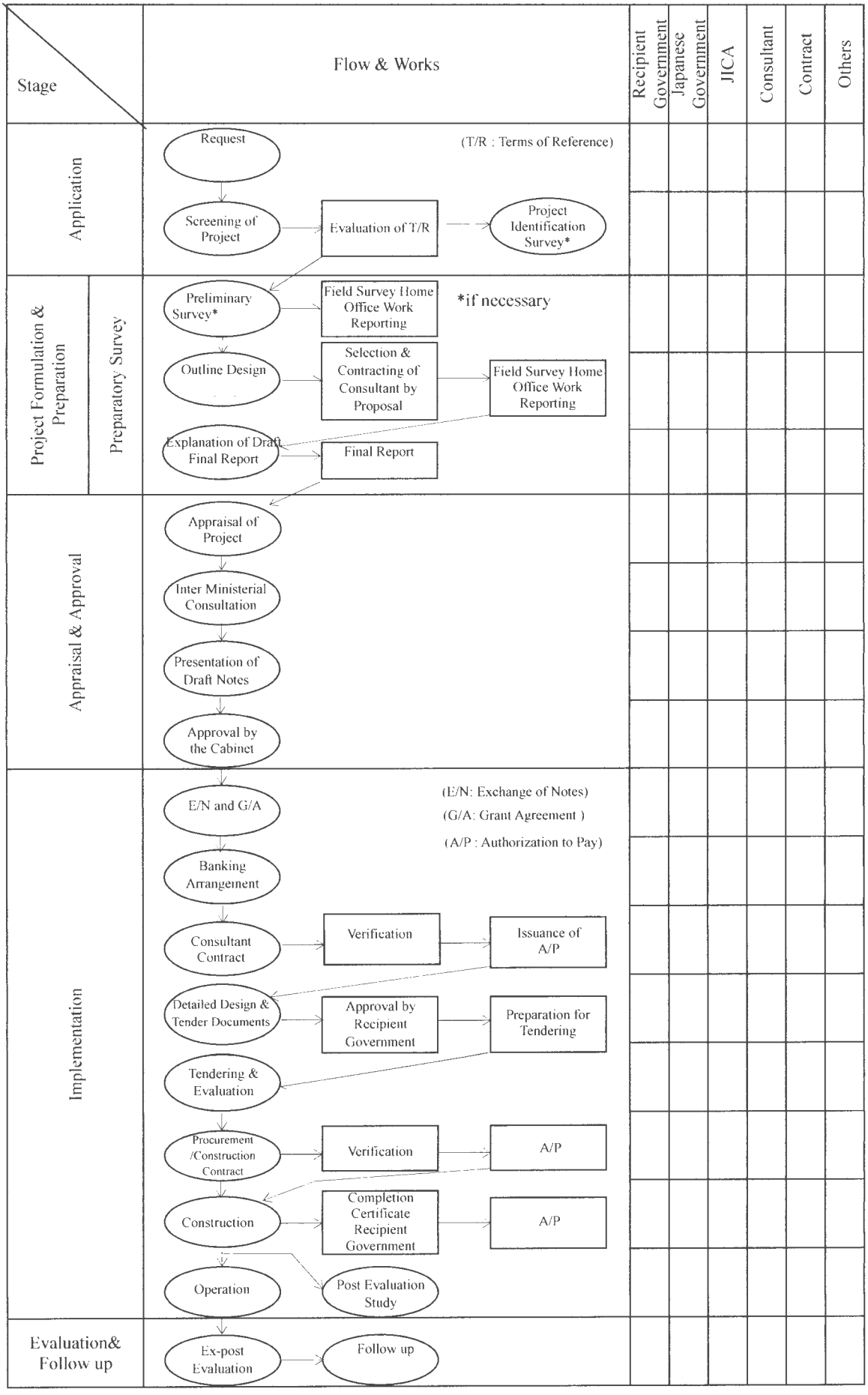
The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

(10) Social and Environmental Considerations

A recipient country must carefully consider social and environmental impacts by the Project and must comply with the environmental regulations of the recipient country and JICA socio-environmental guidelines.

(End)

FLOW CHART OF JAPAN'S GRANT AID PROCEDURES



Major Undertakings to be taken by Each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	to secure lots of land necessary for the implementation of the Project and to clear the sites;		●
2	To construct the following facilities		
	1) The building	●	
	2) The gates and fences in and around the site		●
	3) The parking lot	●	
	4) The road within the site	●	
	5) The road outside the site (including Access road)		●
3	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the sites		
	1)Electricity		
	a. The distributing power line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer	●	
	2) Water Supply		
	a. The city water distribution main to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The city drainage main (for storm sewer and others to the site)		●
	b. The drainage system (for toilet sewer, common waste, storm drainage and others) within the site	●	
	4) Gas Supply		
	a. The city gas main to the site		●
	b. The gas supply system within the site	●	
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building		●
	b. The MDF and the extension after the frame/panel	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
4	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the Products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services be exempted		●
6	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
7	To ensure that the Facilities and the products be maintained and used properly and effectively for the implementation of the Project		●
8	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●
9	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
10	To give due environmental and social consideration in the implementation of the Project.		●

(B/A : Banking Arrangement, A/P : Authorization to pay)

Fd

2

Confirmation Notes

on the Preparatory Survey

on the Project for Strengthening of Training Center

on Grid System Operation and Maintenance

in the Islamic Republic of Pakistan

(First Field Survey)

In response to the request from the Government of the Islamic Republic of Pakistan for Japanese Technical Cooperation on the Project for Strengthening of Training Center on Grid System Operation and Maintenance in Pakistan (hereinafter referred to as "the Project"), Japan International Cooperation Agency (hereinafter refer to as "JICA") dispatched the JICA Expert team (hereinafter refer to as "the team") first field survey since February, 2015 to survey the Project feasibility in Technical Services Group (hereinafter refer to as "TSG") under National Transmission and Despatch Company Ltd. (hereinafter refer to as "NTDCL"), stakeholders surrounding TSG such as Planning Department, NPCC (National Power Control Center), GSO Department and System Protection/Service Division under NTDCL, and their regulatory agencies *i.e.* MoWP (Ministry of Water and Power), EAD (Economic Affairs Division).

From February 1st to 12th, 2015, the first field survey was mainly implemented to discuss the Project feasibility and agree the minutes of discussion between the Pakistan side and the Japan side and to discuss and confirm the general specification of simulator, which will be installed in TSG. As a result of these discussions, the contents of agreed and confirmed topics are described in the sheets attached hereby.

Lahore, February 11th, 2015

11th Feb. 2015

Kenji Nandoh
Team Leader
JICA Expert

Mr. Mohammad Arshad Mirza
Chief Engineer,
TSG, NTDCL

ATTACHMENTS

1. General Simulator Specifications

From February 1st to 12th, 2015, the Team discussed the Project feasibility with TSG and discussed and confirmed the general specification of simulator which will be installed in TSG. As a result of these discussions, the contents of agreed and confirmed topics are described in the sheets attached Annex-1.

2. Questionnaire/Information Required

From February 1st to 12th, 2015, the Team discussed the Project feasibility with TSG and discussed questionnaire. As a result of these discussions, the reply for contents of questionnaire/information required have been completed and attached Annex-2.

3. Persons in Charge

TSG agreed that the person in charges of simulator and construction will be Manager (P&I) and Manager (Grids), respectively.

Annex-1: Concept of Simulator Specification
Annex-2: Questionnaire/Information Required

Annex-1

Concept of Simulator Specification

A-4-2-3

February 11, 2015

1. Training of O&M for GSO

1.1 To clarify the purpose for introducing simulator

a. Fundamental operation (Circuit breaker, Isolator, Earth Switch, interlock procedures)

b. Operation procedures for disconnecting/reconnecting lines and transformers

c. Parallel operation of transformers

d. Parallel operation of different power network systems

1.2 To clarify GSO spec for simulating

500/220 kV, one and a half busbar module @ NTDCL

Single circuit breaker and double busbar @ DISCOs

1.3 To clarify hardware specification

a. LCD displays (specific control panel)

b. models of transformers

1-phasex3(auto-Yna0d1)(x2) @ 500/220/22 kV, 3-phase(auto-Yna0d1)(x2) @ 220/132/11 kV, 3-phase(Δy11)(x2) @ 132/11 kV

2. Relay settings and analysis (1)

2.1 To clarify the scale of power system network

a. To clarify network spec: 500/220 kV, 220/132 kV, 132/11 kV

b. To clarify length of transmission lines:
400 km (500/220 kV), 100 km (132 kV)

c. To clarify nominal short-circuited current:
40~50~63kA (500kV), 40~50~63kA (220kV), 40kA (132kV)

2.2 To specify each model

a. Generation model: Japan Std.

b. T/L impedance: R+jX (%Z/km), 500/220/132 kV, 100 MVA based
To refer Table-X

c. Transformer Capacity(MVA) & Impedance: Zp-s, Zs-t, Zp-t
MVA based impedance
500/220/22 kV: 600 MVA, 11.93 %, (500/220/22 kV: 450 MVA, 12.43 %)
220/132/11 kV: 250 MVA, 15.51 %, (220/132/11 kV: 160 MVA, 12.2 %)
(132/11 kV: 40 MVA, 10.98 %)
132/11 kV: 26 MVA, 12.80 %, (132/11 kV: 13 MVA, 11.21 %)

d. Load model: constant impedance & power models

2. Relay settings and analysis (2)

2.3 How to connect real equipment

a. Interface between real equipment(Relay, CB, Isolator, Earth SW, TR) and simulator: 1A/110VAC(NTDCL), 5A/110VAC (DISCOs)

b. To install models for Relay, CB, Isolator, Earth SW, TR

Table-X

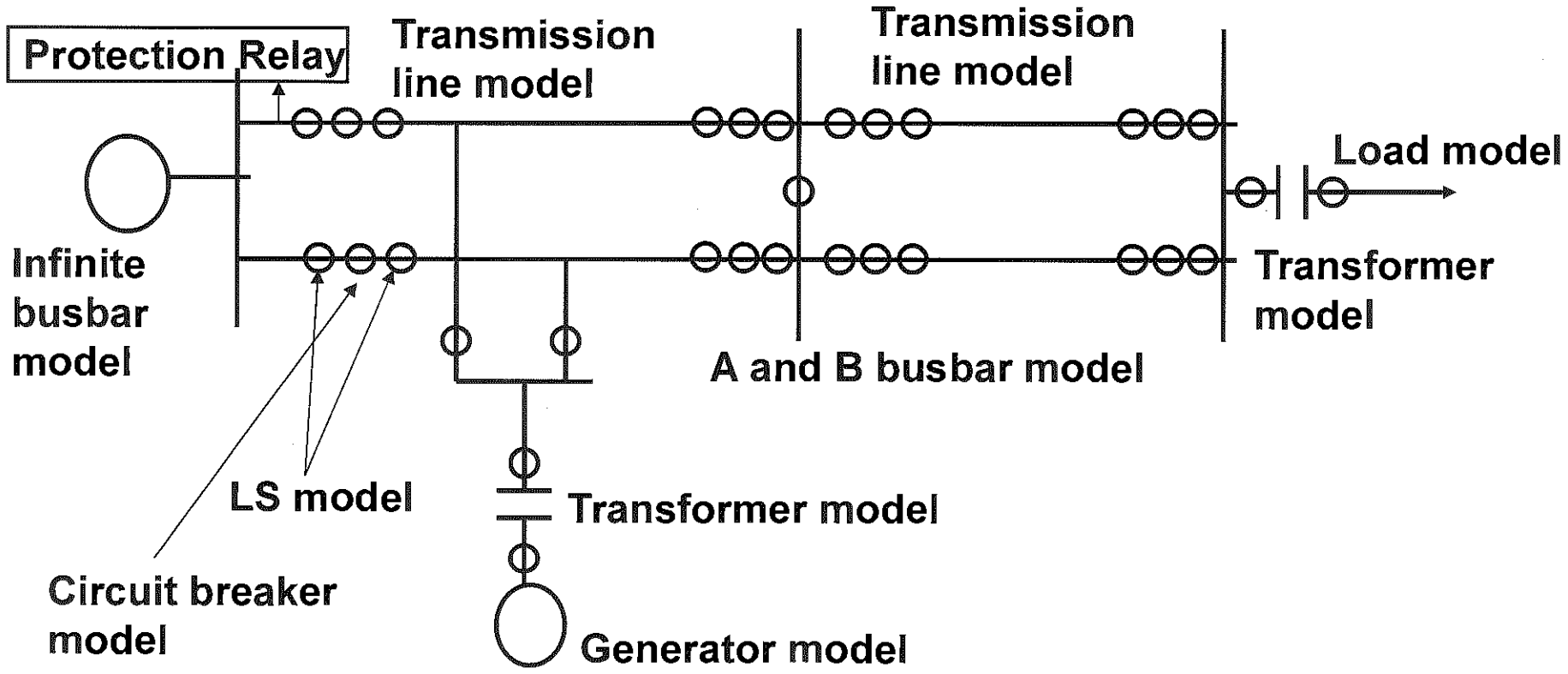
ACSR	POSITIVE SEQUENE IMPEDANCE.				ZERO SEQUENE IMPEDANCE.				EARTH COMPENSATION			COSØ	Amp Capacity.
	Ohms per Phase		Mag.	Ang.	Ohms per Phase		Mag.	Ang.	K0	RE / RL	XE / XL		
	R1+j X1		Z1	Theta	Ro+j Xo		Zo	Theta					
Arvidal 500	0.0269 +j	0.2838	0.2851	84.59	0.3056 +j	0.9544	1.0021	72.24	0.84	3.45	0.79	0.094	2331
ASO 500x3RU	0.0213 +j	0.3094	0.3101	88.06	0.2206 +j	0.8006	0.8304	74.59	0.56	3.12	0.53	0.069	2470
BBC 7/0.193	0.1625 +j	0.35	0.3859	65.10								0.421	323
Beaver	0.3841 +j	0.4629	0.6015	50.32	0.5629 +j	1.3013	1.4178	66.61	0.45	0.16	0.60	0.639	281
Chinese (L6JQ)	0.069 +j	0.3338	0.3409	78.32	0.3488 +j	1.0431	1.0999	71.51	0.74	1.35	0.71	0.202	
Coffer	0.3799 +j	0.4368	0.5789	48.99	0.5556 +j	1.3216	1.4336	67.20	0.49	0.15	0.68	0.656	138
Copper1	0.2825 +j	0.4359	0.5194	57.05	0.5116 +j	1.2094	1.3132	67.07	0.51	0.27	0.59	0.544	
Copper2	0.3875 +j	0.4514	0.5949	49.36	0.5737 +j	1.2713	1.3948	65.71	0.45	0.16	0.61	0.651	322
Covoto	0.2198 +j	0.4232	0.4768	62.58	0.3884 +j	1.2114	1.2721	72.22	0.56	0.26	0.62	0.461	395
Cuxkoo	0.0718 +j	0.4185	0.4246	80.26	0.2498 +j	1.2185	1.2438	78.41	0.64	0.83	0.64	0.169	781
Dog	0.2738 +j	0.44	0.5182	58.11	0.46 +j	1.2944	1.3737	70.44	0.55	0.23	0.65	0.528	345
Draket3	0.0288 +j	0.2813	0.2828	84.15	0.2949 +j	0.9719	1.0157	73.12	0.86	3.08	0.82	0.102	
Drake/Greely	0.0844 +j	0.575	0.5812	81.65	0.3794 +j	1.3876	1.4385	74.71	0.49	1.17	0.47	0.145	788
Eagle	0.105 +j	0.3925	0.4063	75.02	0.2509 +j	1.721	1.7392	81.71	1.09	0.46	1.13	0.258	500
Greely*2	0.035 +j	0.3119	0.3139	83.60	0.3544 +j	1.4206	1.4641	75.99	1.22	3.04	1.18	0.112	790*2
Greely*3	0.0288 +j	0.2813	0.2828	84.15								0.102	791*3
Lynx	0.1583 +j	0.4004	0.4306	68.43	0.3246 +j	1.228	1.2702	75.19	0.65	0.35	0.69	0.388	487
Rabbit	0.5435 +j	0.4169	0.6850	37.49	0.7371 +j	1.3051	1.4989	60.54	0.40	0.12	0.71	0.793	227
Raccon	0.3653 +j	0.446	0.5765	50.68	0.5489 +j	1.325	1.4342	67.50	0.50	0.17	0.66	0.634	290
Rail	0.06 +j	0.3921	0.3967	81.30	0.2461 +j	1.1248	1.1514	77.66	0.63	1.03	0.62	0.151	868
Rail (double)	0.0311 +j	0.2852	0.2869	83.78	0.123 +j	0.8	0.8094	81.26	0.61	0.98	0.60	0.108	
Raven	0.55 +j	0.502	0.7447	42.39	0.7834 +j	1.2803	1.5010	58.54	0.54	0.14	0.52	0.739	229
S.D.C.	0.0444 +j	0.575	0.5767	85.58	0.1188 +j	1.5525	1.5570	85.62	0.57	0.56	0.57	0.077	
Tiger	0.2221 +j	0.4161	0.4717	61.91	0.388 +j	1.2288	1.2886	72.48	0.58	0.25	0.65	0.471	398
Wolf	0.1841 +j	0.4236	0.4619	66.51	0.3996 +j	1.1316	1.2001	70.55	0.53	0.39	0.56	0.399	445
Zebra	0.0881 +j	0.4044	0.4101	80.44	0.2275 +j	1.1719	1.1938	79.01	0.64	0.78	0.63	0.166	811
Zigolo	0.1493 +j	0.4034	0.4303	69.70	0.3181 +j	1.2288	1.2693	75.49	0.65	0.38	0.68	0.347	498

500kV

132kV

220kV

Planned Model of Power System Simulator



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	QUESTIONNAIRE / INFORMATION REQUIRED	Organization :	
PROJECT NAME: The Survey for Improvement of Training capacity on Grid System Operations and Maintenance in the Islamic Republic of Pakistan		Ref. No. :	
		Issue Date :	
		Revision Date :	

Table 1

To: MoWP／JS

Annex-2

No.	Questionnaire / Information Required	Reply	Remarks
Basic Organizational Information of Relevant Departments			
1	Please advise any issue to achieve Energy Policy 2013 in Pakistan.		
2	Please show the general technical education system of power generation ~ distribution, such as which division is in charge of which class of engineers and future plan (i.e. expansion, consolidation)		
3	Please advise any request and /or improvements for JICA aid comparing to the other countries.		
4	Please show the legal groundwork, regulation standard, environmental guidelines for the Project.	TSG will follow the regulations of GoP. There is no issue about the environment, construction etc. for the Project.	
6			

A-4-2-8

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	QUESTIONNAIRE / INFORMATION REQUIRED	Organization :	
PROJECT NAME: The Survey for Improvement of Training capacity on Grid System Operations and Maintenance in the Islamic Republic of Pakistan		Ref. No. :	
		Issue Date :	
		Revision Date :	

Table 2

To: MoWP／NTDCL／MD

No.	Questionnaire / Information Required	Reply	Remarks
Basic Organizational Information of Relevant Departments			
1	Please show its functions, the latest organizational structure and division of duties and number of personnel of NTDCL.	There are about 10 thousand personnel in NTDCL.	
2	Please advise any aid from both WB and ADB for Electric Power.		
3	Please show the legal groundwork, regulation standard, environmental guidelines for the Project.	TSG will follow the regulations of GoP. There is no issue about the environment, construction etc. for the Project.	
4	Please provide financial information from 2010 to 2014.	NTDCL budget for 2014 - 2015 is 23,583 million Rs under Public Sector Development Program(PSDP).	
5			

A-4-2-9

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	QUESTIONNAIRE / INFORMATION REQUIRED	Organization :	
PROJECT NAME: The Survey for Improvement of Training capacity on Grid System Operations and Maintenance in the Islamic Republic of Pakistan		Ref. No. :	
		Issue Date :	
		Revision Date :	

Table 3

To: NTDCL／Sservice Division

No.	Questionnaire / Information Required	Reply	Remarks
Basic Organizational Information of Relevant Departments			
1	Please show the future plan, request, and issues for SD and TSG.	TSG long term strategy for 2015 - 2022 was received.	
2	Please show the accident information (i.e. number of times, power distribution outage period, and details for the accidents)	There are three outages all over the country in a year 2014 - 2015. Also there are many load shedding due to shortage of electricity.	
3	Please show the revenue and expense of TSG (such as training income, other income and expense, personnel expense, tool and equipment cost, building maintenance and operation, operating cost etc.)	The budget for last fiscal year (FY) 2013 - 2014 is 98.663 million Rs. The budget for FY 2014 - 2015 is 124.475 million Rs. (For O&M: 101.475 MRs, for training facility upgradation: 13 MRs, for development: 10 MRs.)	
4	Please advise if there are any obstructive factors for “Model Grid Station” to be implemented to TSG.	There are no obstructive factors for this facility.	
5	Please advise any comment (case, cost, term, contents of lecture, outcome) for visiting lecturer providing system to TSG.	There are no obstructive factors for this facility.	
6	Please provide your estimation of quantitative effect (i.e. reduction of power failure time, number of failure, and system maintenance cost) when the Project	If this training program is strengthened, it will improve the quality of O&M of Grid system.	

	equipment is in operation.		
7	Please show your various criteria applying to the Project as follows. 1) Design a) Structural design b) Architectural design c) Electrical system design d) Water supply and drainage/sanitation facilities design e) Air conditioning/ventilating design 2) Construction and Installation a) Skelton construction b) Finish work c) Electrical equipment construction d) Water supply and drainage/sanitation facilities construction e) Air conditioning/ventilation construction	This information will be collected in the second field survey in March 2015.	
8	Upon construction, please show the weather conditions (i.e. rainy season, high temperature season) of the site (near NKLP), traffic conditions(road widening repair plan around the site), schedule (election, religious event, rites and festivals period etc.), underground and ground condition(embedded object, existing facility, overhead wires etc.)	Raining season from July to August. High temperature season from May to July. No traffic issues around the Project site. Schedule will not be affected by election, religious event, rites and festivals period etc. Underground conditions are clear.	

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	QUESTIONNAIRE / INFORMATION REQUIRED	Organization :	
PROJECT NAME: The Survey for Improvement of Training capacity on Grid System Operations and Maintenance in the Islamic Republic of Pakistan		Ref. No. :	
		Issue Date :	
		Revision Date :	

Table 4

To: **NTDCL／Planning**

No.	Questionnaire / Information Required	Reply	Remarks
Basic Organizational Information of Relevant Departments			
1	Please show its functions, the latest organizational structure and division of duties and number of personnel of Planning department.	Information has been already obtained.	
2	Please show the purpose of use, concrete analysis example for Digital Simulator（RTDS）.	USAID is now introducing RTDS in planning department in NTDCL.	
3	Please advise if a simulator installing to TSG can also be used by Planning department.	Simulator at TSG will only be offered for training purposes. Planning can use this simulator for special cases.	
4	Please advise if planning people will be appointed to lecturers of the Simulator to be installed to TSG.	TSG will coordinate with planning people for lecture using simulator.	
5	Upon installing the Simulator to TSG, can planning people advise TSG operation method, maintenance cost, operating personnel, test working adjustment, and text book etc.	TSG will coordinate with planning people for lecture using simulator.	

A-4-2-12

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	QUESTIONNAIRE / INFORMATION REQUIRED	Organization :	
PROJECT NAME: The Survey for Improvement of Training capacity on Grid System Operations and Maintenance in the Islamic Republic of Pakistan		Ref. No. :	
		Issue Date :	
		Revision Date :	

Table 5

To: **NTDCL／SD／TSG**

No.	Questionnaire / Information Required	Reply	Remarks
Basic Organizational Information of Relevant Departments			
1	Please show its functions, the latest organizational structure and division of duties and number of personnel of each department.	There are 230 personnel (NKLP, Tarbela and Gatti) in TSG.	
2	Please show the candidates including job before TSG, duties of division, technical qualifications as engineers, educational background/	This information will be collected in the second field survey in March 2015.	
3	Please show an annual budgetary estimated results and actual results.	In FY 2013 - 2014 the annual estimated budget was 98.663 MRs and actual expenditures was 97.598 MRs.	
4	Please show the issues and countermeasures of P&I department.	OJT is not proper. After installing simulator, the quality of OJT will be improved.	
5	Please provide the specifications for Simulator and P&I Relay board, and connection method (input-output spec for relay).	This information will be collected in the second field survey in March 2015.	
6	Please provide the documentation for the details of	This information will be collected in the second field survey in	

	external connection Relay board.	March 2015.	
7	Please advise who will be the main person in charge of TSG side upon installing Simulator.	Manager of P&I and Grids will be the main persons in charge of TSG side upon installing simulator.	
8	Please advise the new educational method of using Simulator by assuming showing the difference, change against current education.	Relay setting calculations implementations and fault analysis education will be improved.	
9	We are planning the training by using Simulator after commissioning, please advise your request if any.	TSG agreed with the proposal.	
10	Please provide specific wiring diagram of the Model Grid Station and information of placement equipment.	This information will be collected in the second field survey in March 2015.	
11	We are planning that building for the Project will be two-story structure by placing Simulator body at 1F, display device and operating PC at 2F. Please advise your request if any.	TSG agreed with the proposal.	
12	Please provide your estimation of quantitative effect (i.e. reduction of power failure time, number of failure, and system maintenance cost) when the Project equipment is in operation.	If this training program is strengthened, it will improve the quality of O&M of Grid system.	

Table 1. Weather information (past 10 years) around the site

No.	Description	Data	Design Conditions
1.	Temperature [°C]		
	1) Highest	48.9	
	2) Average	23.9	
	3) Lowest	-2.2	
2.	Average sea level height of the site [m]	215 m	
3.	Relative humidity [%]		
	1) Highest		
	2) Average	81/47 %	
	3) Lowest		
4.	Rainfall		
	1) Month	August	507.6 mm
	2) Year	1996	
5.	Rain days	13 days	
	1) Month	July	
	2) Year		
6.	Rainfall intensity [mm/hour]		221 mm/day
7.	Hours of sunlight [hours]		Max 14 hrs, Min. 10 hrs

8.	Wind on the ground 10m height		
	1) Maximum wind speed [km/h]		80 - 85 knot
	2) Average wind speed [km/h]		3 - 4 knot
	3) Main wind direction		North to West (Oct. Apr.), South to East/West (Jun. to Sep.)
9.	Earthquake zone map		
10.	Solar radiation average [w/m²]		
11.	Atmospheric salinity [mg/cm²]		
12.	Thunder, the number of days of storm		Max up to 3 days
13.	The resistivity of the ground [ohm-meter]		

Technical Confirmation Notes
on the Preparatory Survey
on the Project for Strengthening of Training Center
on Grid System Operations and Maintenance
in the Islamic Republic of Pakistan
(Second Field Survey)

Based on the Minutes of Discussions signed on 6th February, 2015 between JICA Preparatory Survey Team and the authorities concerned of the Pakistan with regard to the Preparatory Survey (hereafter referred to as "the Survey") on the Project for Strengthening of Training Center on Grid System Operations and Maintenance (hereafter referred to as "the Project"), JICA sent the Team to Pakistan to conduct the second field survey since March, 2015 to study technical feasibility of the Project in Technical Services Group (hereafter referred to as "TSG") under National Transmission and Despatch Company Ltd. (hereafter referred to as "NTDCL"), and to discuss with the stakeholders of the Project, such as TSG, Planning Department, DISCOs (Distribution Companies) and System Protection/Service Division under NTDCL, and their regulatory agencies *i.e.* MoWP (Ministry of Water and Power), EAD (Economic Affairs Division).

As a result of the second field survey, and in accordance with the Minutes of Discussions agreed, both the sides confirmed on the technical issues on the Project as described in the attached sheets hereto.

NKLP, Lahore, Pakistan
7th April, 2015

Mr. Kenji Nandoh
Team Leader
Preparatory Survey Team
JICA Experts

Mr. Mohammad Arshad Mirza
Chief Engineer
Technical Service Group
National Transmission and Despatch Company Limited

ATTACHMENT

1. Outline of Grid Training Simulator

The Team discussed the Project feasibility with TSG and as a result of these discussions, the desired specifications of grid training simulator are described below:

It is important for both sides to understand that no commitment is made from Japanese side to realize the Project at the stage of the Survey. In August 2015, JICA will submit the draft final report, which describes the draft final component of the Project.

1-1 Contents of planned Grid Training Simulator

Contents of planned Grid Training Simulator are

A: To simulate a grid station.
B: To improve operation and maintenance skills for GSO's operators.
C: To improve GSO operation and maintenance skills by training on protection relays operation.

1-2 Detailed planned subjects of Grid Training Simulator

Detailed planned subjects of each purpose are mentioned as follows:

A: To simulate a grid station.
a1: To simulate 220/132/11 kV grid station.
a2: To contain two generator models.
a3: To contain two transmission line model with three phases.
a4: To connect actual protection relays with Grid Training Simulator.
a5: To study various kinds of wave forms using oscilloscope.
a6: To simulate short circuit fault and earth fault.

A typical GSO power diagram is shown in Annex-1.

B: To improve operation and maintenance skills for GSO's operators.
b1: To train basic operation for equipment in GSO.
b2: To understand inter-locking schemes in operation of circuit breakers, isolators and earth switches.
b3: To train transmission line stop operation for transmission line maintenance and PTW (Permit to Work) issuance.
b4: To train transformer stop operation for transformer maintenance and PTW issuance.
b5: To improve transformer parallel operation skills.

Detailed planned software specification is shown in Annex-2, which is requested by TSG.

C: To improve GSO operation and maintenance skills by training on protection relays operation.
c1: To calculate setting of protection relays.
c2: To understand transformer protection relay.
c3: To understand transmission line protection relay.
c4: To understand busbar protection relay.
c5: To review incidents and to check operation of protection relays under the real incident records.

Detailed planned software specification is shown in Annex-2, which is requested by TSG.

1-3 Planned hardware specification of Grid Training Simulator

Detailed planned specification is shown in Annex-3. In Annex-3, "J" indicates equipment planned to be procured from Japanese manufacturers and "P" indicates equipment planned to be procured

from Pakistani manufacturers through Grant Aid. "PC-1" indicates equipment planned to be procured by the budget of NTDCL.

2. Layout Outline of TSG Training Simulator Building

Layout Outline of TSG Training Simulator Building is shown in Annex-4.

3. Work Demarcation of the Project

Equipment and facility of work demarcation of the Project is shown in Annex-5.

4. Planned PC-1 Budget

Planned PC-1 budget by TSG is shown in Annex-6. The PC-1 budget consists of three categories *i.e.* "Equipment for Model Grid Station", "Equipment for Training Simulator" & "General Facilities and Protection Relays". The total amount of budget is expected to be approximately 200 M Pk Rs. This PC-1 budget plan will be submitted to NTDCL Planning Department and be approved by NTDCL BOD (Board of Directors) and their regulatory agencies.

5. Counterpart Training

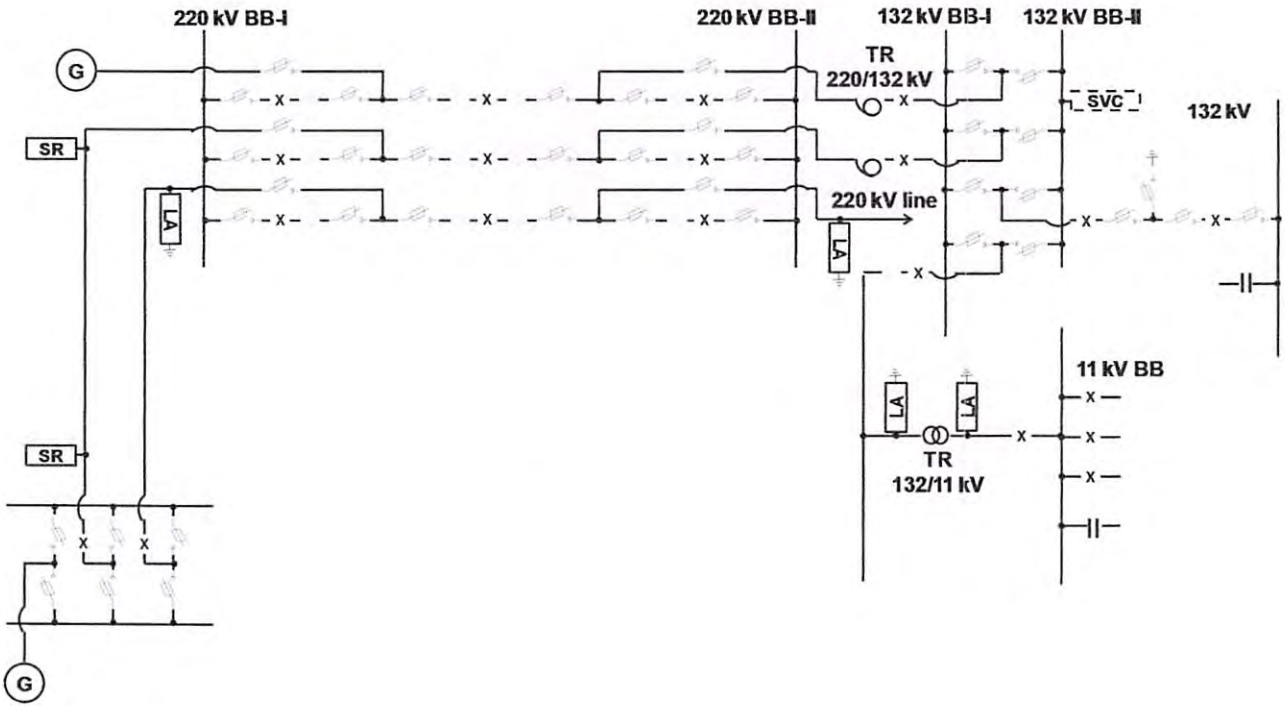
TSG requested that Counterpart Training for TSG instructors will be conducted in Japan to improve their capacity and capability by Japanese experts during a certain period. Japanese electric power companies have a lot of experience for establishing and operating training system by using training simulators. Therefore, counterpart training by Japanese experts at manufacturer works/electric power company in Japan will be very beneficial as TSG instructors to make new curricula, syllabi and textbooks of training courses by using training simulator in Pakistan.

(End)

List of Annex

Annex-1	Planned TSG Training Simulator Diagram
Annex-2	Planned Software Specification Outline of TSG Training Simulator
Annex-3	Planned Hardware Specification Outline of TSG Training Simulator
Annex-4	Planned Layout Outline of TSG Training Simulator Building
Annex-5	Planned Work demarcation of the Project
Annex-6	Planned PC-1 Budget

Planned TSG Training Simulator Diagram



Planned Software Specification Outline of TSG Training Simulator

No.	Description
1	**Improvement of operation and maintenance skills for GSO's operators**
1.1	Training of basic operation for equipment in GSO
1.2	Understanding inter-locking schemes in operation of circuit breakers, isolators and earth switches
1.3	Training of transmission line stop operation for transmission line maintenance and PTW issuance
1.4	Training of transformer stop operation for transformer maintenance and PTW issuance
1.5	Transformer parallel operation
1.6	Standard operation procedure in the unlikely event of serious incident
1.7	Standard operation procedure in the event of incident in power system
1.8	Operation of synchronization to power system
2	**Improvement of GSO operation and maintenance skills by training of protection relay operation**
2.1	Calculation of setting of protection relay
2.2	Understanding transformer protection relay
2.3	Understanding transmission line protection relay
2.4	Understanding busbar protection relay
2.5	Reviewing of incidents and operation check of protection relay under the real incident records
2.6	Understanding relay co-ordination, i.e. current co-ordination and time co-ordination
2.7	Analysis of the effect of single pole tripping and auto-reclosing on power system stability
2.8	Effect of inrush current and its effect on power system
2.9	Analysis of the effect of SOTF on power system
2.10	Analysis of the islanding effect in power system
2.11	Understanding and analysis of power system parameters
2.12	Understanding of breaker failure scheme
2.13	Understanding of busbar differential scheme
2.14	Analysis of weak infeed condition when two generators of different capacity feed a fault in power system
2.15	Effects of power factor improvement capacitors on power system
2.16	Effect of shunt reactors on stability of power system
2.17	Power swing protection
2.18	Stub protection understanding
2.19	Understanding the effect of SVC on power system
2.20	Understanding of 132 kV shunt capacitor bank
2.21	Understanding of 11 kV shunt capacitor bank

Planned Hardware Specification Outline of TSG Training Simulator

Priority	No.	Description	J	P	PC-1
S	1	**Training Simulator Room**			
	1.1	CPU for simulator	o		
	1.2	Interface panel	o		
	1.3	UPS	o		
	1.4	Air conditioner for CPU	o		
	1.5	Training simulator system diagram panel	o		
	1.6	Operation desk for trainees	o		
	1.7	Indication panel	o		
	1.8	Oscilloscope panel	o		
	1.9	Record printer	o		
	1.10	Power supply for equipment (400/230 V, AC30 kVA)		o	
	1.11	Data acquisition panel	o		
	1.12	Trainer desk for setting	o		
	1.13	Simulation setting PC & LCD	o		
	1.14	Spare parts from manufacturer	o		
	1.15	CVVS cable, 5 mm^2, 6 core, 200 m	o		
	1.16	CVVS cable, 5 mm^2, 2 core, 100 m	o		
	1.17	Connector	o		
	1.18	Telephone system	o		
	1.19	Video system	o		
	1.20	Equipment rack		o	
	1.21	Office chair		o	
	1.22	White board		o	
	1.23	Book shelf		o	
S	2	**Protection Relay Training Room**			
	2.1	Protection relay training panel	o		
	2.2	Signal amplifier panel for relay unit	o		
	2.3	Control panel for model grid station			o
	2.4	Relay panel for model grid station			o
	2.5	Distance relay with auto-recloser feature unit		o	
	2.6	Transformer differential protection relay unit		o	
	2.7	Overcurrent protection relay unit including E/F		o	
	2.8	Busbar differential protection relay unit		o	
	2.9	Synchronizing check relay unit		o	
	2.10	Breaker failure protection relay		o	
	2.11	Telephone system	o		
	2.12	Work desk		o	
	2.13	Work chair		o	
	2.14	White board		o	
	2.15	Equipment rack		o	
	2.16	Book shelf		o	
	2.17	Power supply for equipment (400/230 V, AC10 kVA)		o	
	2.18	Power supply box for relay testing (400/230 V, AC3 kVA)		o	
S	3	**Electrical Room**			
	3.1	Power supply panel for equipment (400/230 V, 50 kVA)		o	
	3.2	220 VDC battery charger			o
A	4	**Generator Unit**			
	4.1	Generator (30 kVA) 400/230 V		o	
	4.2	Oil storage tank		o	

	4.3	Generator house			o
A	**5**	**Battery Room**			
	5.1	DC battery bank (220 VDC, 300 AH)			o
	5.2	Battery stand			o
A	**6**	**Simulator Class Room**			
	6.1	Office desk		o	
	6.2	Office chair		o	
	6.3	White board		o	
	6.4	Projector set		o	
	6.5	LCD monitor (65 inch)		o	
	6.6	PC & LCD monitor		o	
	6.7	UPS (1 kVA)		o	
	6.8	Printer		o	
	6.9	Telephone system	o		
	6.10	Book shelf		o	
	6.11	Equipment rack		o	
A	**7**	**Protection Relay Class Room**			
	7.1	Work desk		o	
	7.2	Office desk		o	
	7.3	Work chair		o	
	7.4	Office chair		o	
	7.5	White board		o	
	7.6	Projector set		o	
	7.7	PC & LCD monitor		o	
	7.8	Book shelf		o	
	7.9	Equipment rack		o	
A	**8**	**Seminar Room**			
	8.1	Office chair		o	
	8.2	White board		o	
	8.3	Projector set		o	
	8.5	PC & LCD monitor		o	
A	**9**	**Instructor Room 1, 2**			
	9.1	Office desk		o	
	9.2	Office chair		o	
	9.3	Book shelf		o	
A	**10**	**Care Taker Room 1, 2**			
	10.1	Office desk		o	
	10.2	Office chair		o	

Note:
S: Highest priority for this Project
A: High priority for this Project

Planned Layout Outline of TSG Training Simulator Building

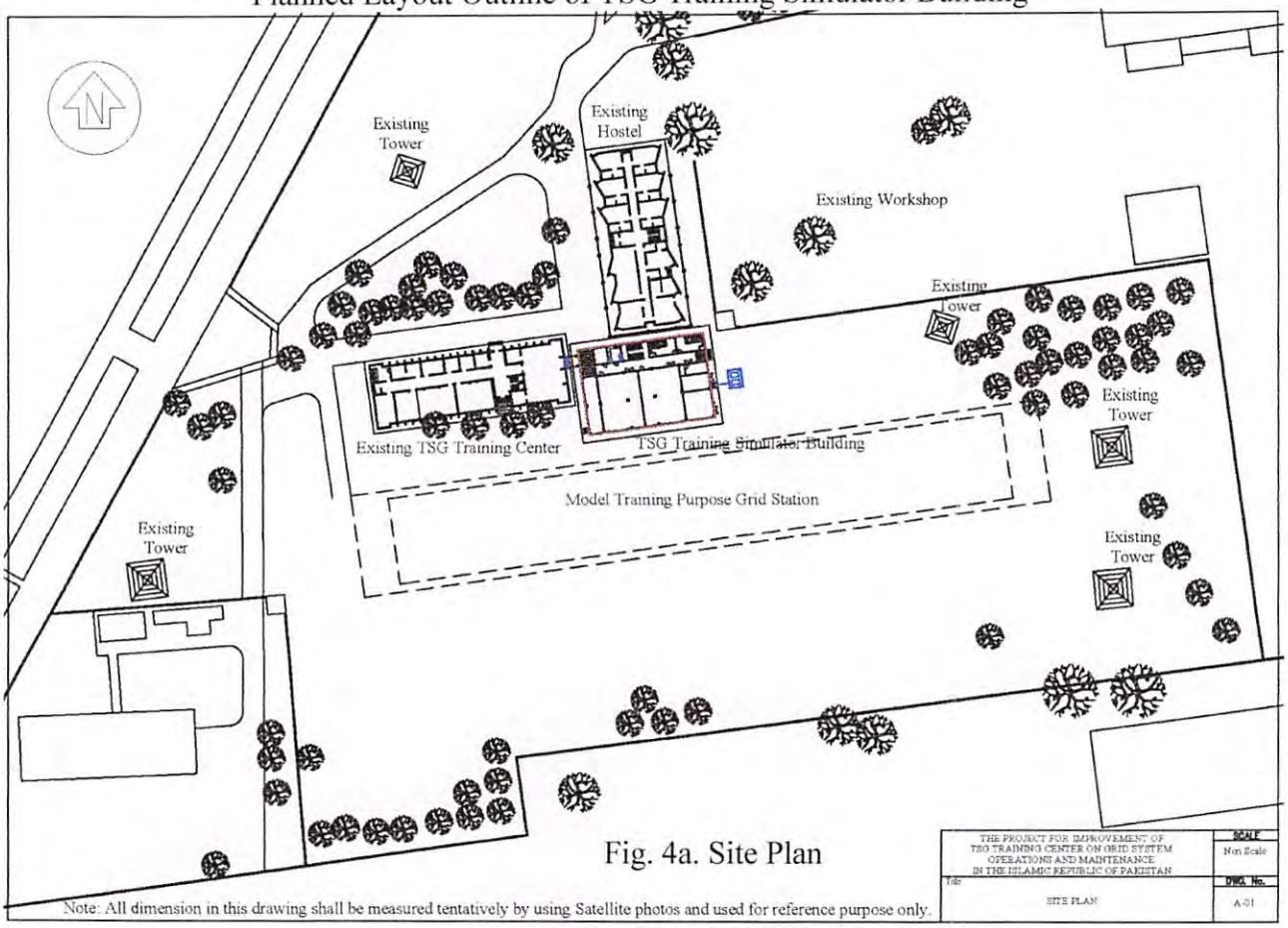


Fig. 4a. Site Plan

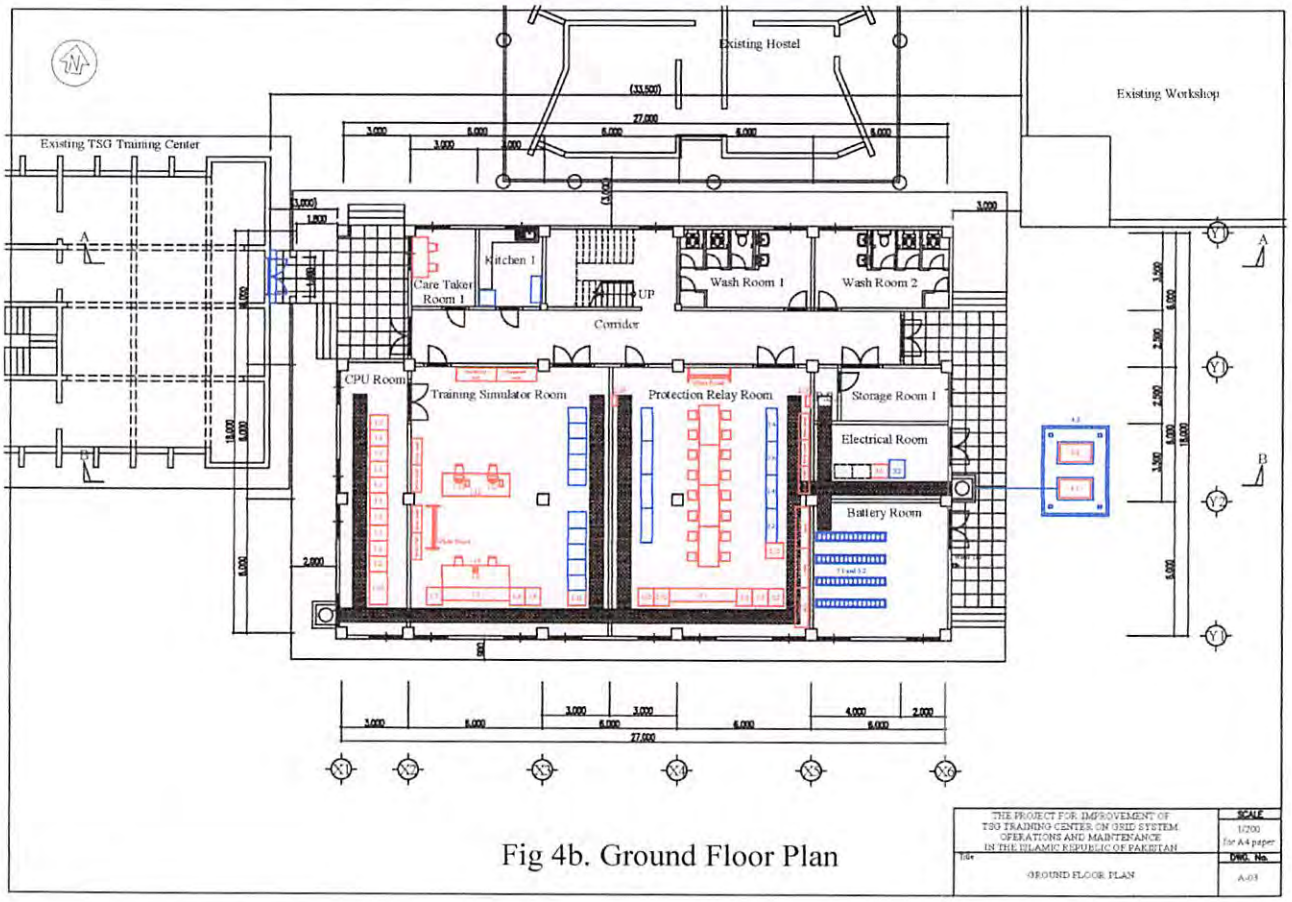


Fig 4b. Ground Floor Plan

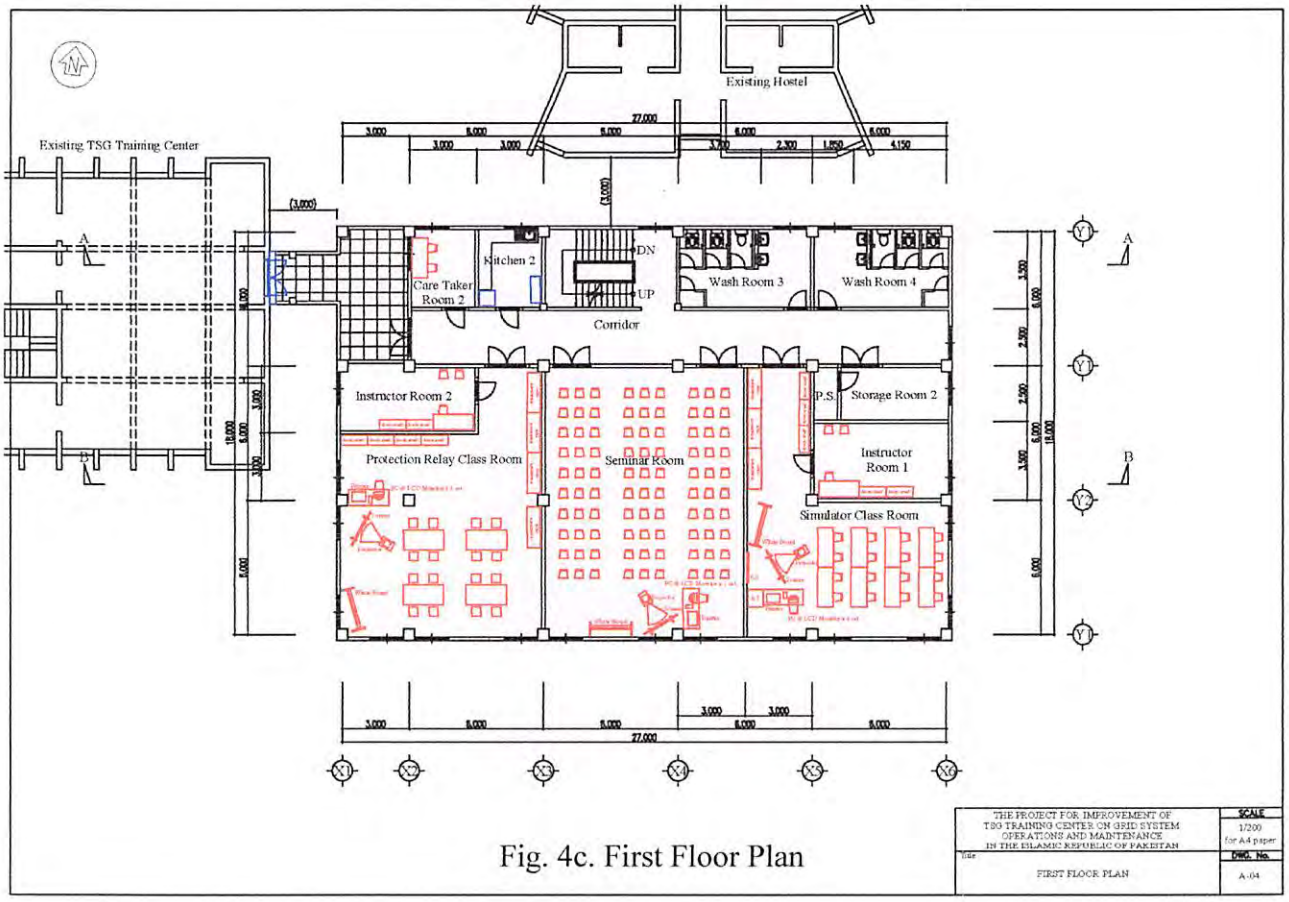


Fig. 4c. First Floor Plan

Planned Work Demarcation of the Project

No.	Descriptions of Undertakings	To be covered by		Notes
		Japan	Pakistan	
1	**Grid Training Simulator**			
1-1	Foundation, fence and shed for Generator and Oil Tank		○	
2	**TSG Training Simulator Building**			
2-1	Securing of lands for TSG Training Simulator Building (hereafter referred to as "the Project site"), levelling and removal of the following obstacles in the Project site 1) Septic Tanks (Man holes) 2) Wasted Soil by Septic Tanks 3) Back filling after removal of Wasted Soil 4) Electric Poles, Trees, and etc.		○	
2-2	Removal of the part of plinth protection of TSG Training Center for the construction of the new connecting corridor to TSG Training Simulator Building		○	
2-3	Construction of 2 openings to connect to the new connecting corridor and installation of 2 doors in TSG Training Center (Ground and First floors), the expansion joint cover		○	
2-4	Connection points of existing TSG power supply, water supply, and gas supply for TSG Training Simulator Building		○	
2-5	Securing of land of temporary material storage yard		○	
2-6	Securing of disposal area in the compound of TSG NKLP for useless excavated soil, if necessary		○	
2-7	Temporary facilities as followings for the Project during the installation and construction work periods in the compound of TSG NKLP, if necessary 1) Offices 2) Toilets 3) Safety fences 4) Gate 5) Guardhouse & Security	○		
2-8	Watt/hour meter for temporary power supply during the installation and construction work periods to the Project site		○	
2-9	Temporary water supply during the installation and construction work periods to the Project site	○		
2-10	Water supply pump for TSG Training Simulator Building after the completion of the Project, if necessary		○	

Planned PC-1 Budget

No.	Items	Specifications	Qty	unit price (Rs)	total price (M Pk Rs)
1	**Equipment for Model Grid Station**				
1.1	Transformer	160 MVA, 220 kV/132 kV/11 kV	1		
1.2	Transformer	20/26 MVA, 132/11.5 kV	1		
1.3	Wave/Line Trap (PLC)		1		
1.4	CB for 220kV		3		
1.5	CB for 132kV		2		
1.6	DS for 220kV		8		
1.7	DS for 132kV		4		
1.8	CT for 220kV		4		
1.9	CT for 132kV		2		
1.10	PT for 132kV		1		
1.11	CVT for 220kV		4		
1.12	Lightning arrestor for 220 kV		2		
1.13	Lightning arrestor for 132 kV		2		
1.14	Lightning arrestor for 11 kV		1		
1.15	Busbar	220 kV	2		
1.16	Busbar	132 kV	2		
1.17	Busbar	11 kV	1		
1.18	Power and control wiring (AC/DC)		1		
1.19	Construction of foundations of equipment and cable trenches		1		
1.20	Construction of walk/crane ways in the switch yard		1		
1.21	Earth filling in the switch yard		1		
1.22	Construction hardware (220/132 kV gantries, beams, busbar conductor, busbar connectors & terminals, disc insulators strings including tension & suspension type, overhead shielding wire, connectors & terminals etc.)		1		
1.23	Earthing mesh conductors, connectors, grounding rods etc.		1		
2	**Equipment for Training Simulator**				
2.1	Control panel for model grid station		1		
2.2	Relay panel for model grid station		3		
2.3	220VDC battery charger		1		
2.4	DC battery bank	220VDC 300AH	1		
2.5	Battery stand		1		
2.6	Distribution transformer	200kVA	1		
2.7	Bridge between existing building and simulator building		1		
2.8	Reforming & modification of existing building		1		
2.9	Generator house		1		
2.10	Oil tank		1		
2.11	Utensil & appliance for kitchen etc.		1		
3	**General Facilities and Protection Relays**				
3.1	Distance protection relay		1		
3.2	O/C + E/F protection relay		1		
3.3	Differential protection relay		1		
3.4	Busbar differential protection relay		1		
3.5	U/F protection relay		1		
3.6	Over excitation relay		1		
3.7	Synchronizing check relay		1		
3.8	Synchroscope for control panel		1		
	Total Budget				**200**

Additional Technical Confirmation Notes on the Preparatory Survey on the Project for Strengthening of Training Center on Grid System Operations and Maintenance in the Islamic Republic of Pakistan (Second Field Survey)

The Technical Confirmation Notes describe several Additional Memorandums for the "Technical Confirmation Notes on the Strengthening of Training Center on Grid System Operations and Maintenance in the Islamic Republic of Pakistan (Second Field Survey)" between Preparatory Survey Team and Technical Service Group (TSG), National Transmission and Despatch Company Limited (NTDCL) on 7th April, 2015. Both the Preparatory Survey Team and TSG, NTDCL confirmed the additional technical issues of the Project as described in the attached sheets hereto.

NKLP, Lahore, Pakistan
16th April, 2015

車田 輝雄

Mr. Teruo Kurumada
Team Member
Preparatory Survey Team
JICA Experts

Mr. Mohammad Arshad Mirza
Chief Engineer
Technical Service Group
National Transmission and Despatch Company Limited

APPENDIX

It is important for both the Team and TSG sides to understand that no commitment is made from Japanese side to realize the Project at the stage of the Survey. In August 2015, JICA will submit the draft final report, which describes the draft final component of the Project.

6. Outline of Design for TSG Training Simulator Building

The Team discussed the Project feasibility with TSG and as a result of these discussion, the desired specifications of Design for TSG Training Simulator Building are described below:

6-1. Procedure of the approval for the design and construction from the Pakistan government

It requires the approval by the Chief Engineer of TSG for the design and construction of TSG Training Simulator Building, and other approval by any relevant organization of the government of Pakistan shall be not required. All procedures for the approval shall be undertaken by TSG, if necessary.

6-2. Design code for structure and building service

Design shall be carried out in accordance with the followings;

Building Code of the Pakistan Engineering Council or
Japanese Building & Civil Standard Code or
International Code equivalent with above mentioned codes

6-3. Requested Facilities Overview

Building Area:	Approximately 27 x 18 m = 486 m2
Floor Area:	Approximately 27 x 18 m x2 = 972 m2
Number of Story:	2 stories
Structure	Reinforced Concrete Structure
Wall:	Brick or Concrete Block
Flooring Finishing:	Ceramic tile
Remarks:	Connecting Corridor to TSG Training Center
	Firefighting and Fire detection facilities
	Water Tank

7. Location of Temporary Storage Yard and etc.

Location of Temporary Storage Yard for the Project, and connection points of water supply, gas supply, sewerage pipe, and temporary electric power supply are shown in Annex-7.
Temporary water for the construction work shall be procured by the Supplier or the Constructor.

8. Elevation and Section of TSG Training Simulator Building

Elevation and Section of TSG Training Simulator Building is shown in Annex-8.

9. Work Demarcation of the Project

Appendix for the facility of work demarcation of the Project is shown in Annex-9.

(End)

List of Annex

Annex-7	Planned Location of Temporary Storage Yard and etc.
Annex-8	Planned Elevation and Section of TSG Training Simulator Building
Annex-9	Planned Work demarcation of the Project

Planned Location of Temporary Storage Yard and etc.

LEGEND

- : Project site
- : Temporary Storage Yard for the Project
- : Proposed site for New TSG Office Building
- : Proposed site for Extension of Existing Hostel
- : Proposed site for Model Training Purpose Grid Station
- : Existing Sewerage Pit
- : GSO Water Tank
- 1 : Connection Point for Existing Sewerage, Water & Gas supplies
- 2 : Connection Point for Temporary Electric Power supply
- : Gate for TSG NKLP
- : Access to the Project site

Planned Elevation and Section of TSG Training Simulator Building

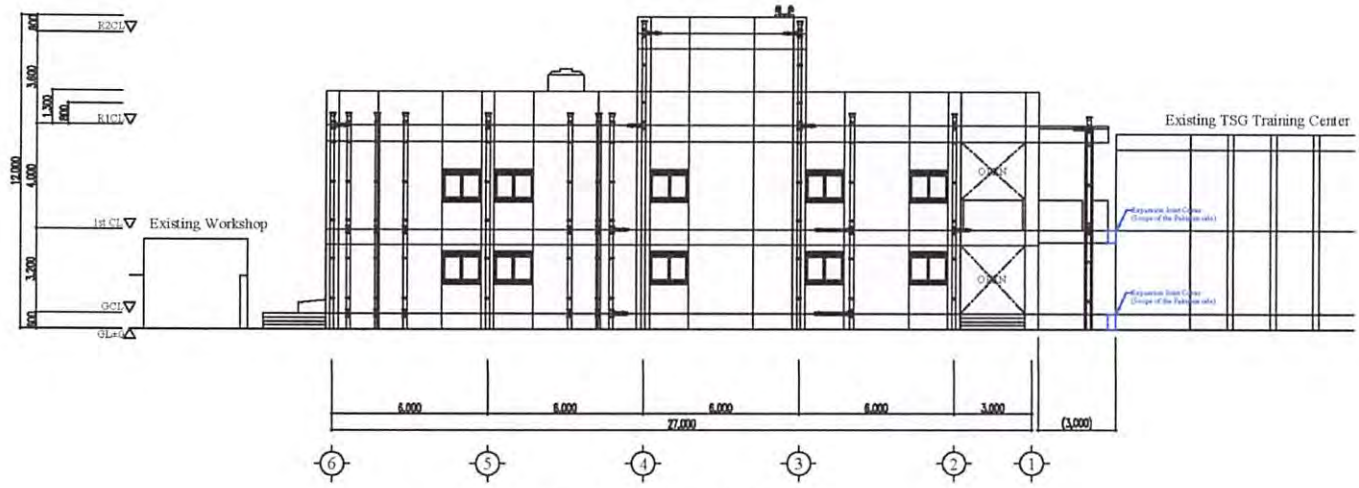


Fig. 2-1. Elevation (North)

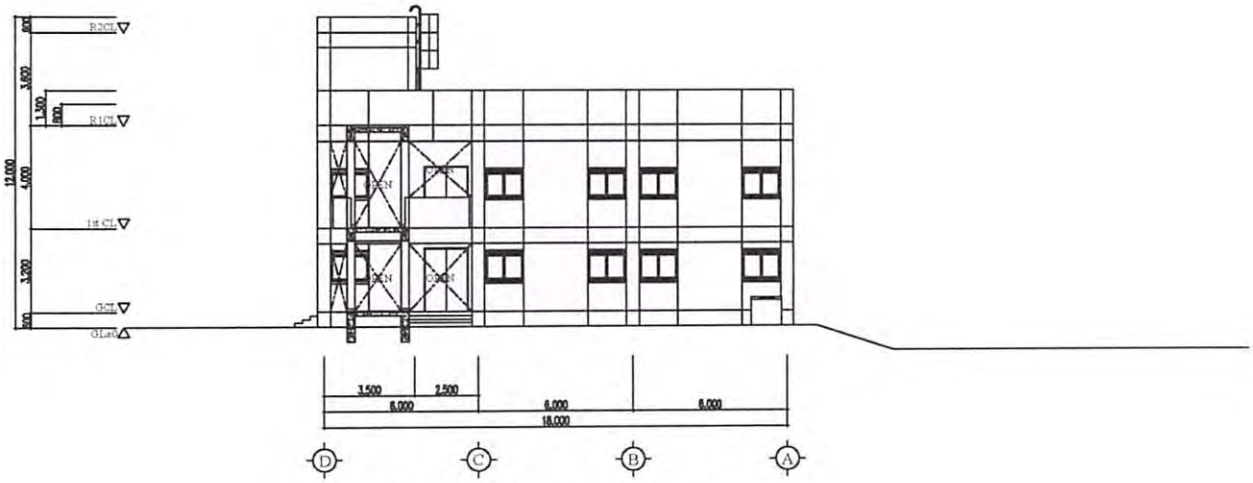


Fig. 2-2. Elevation (West)

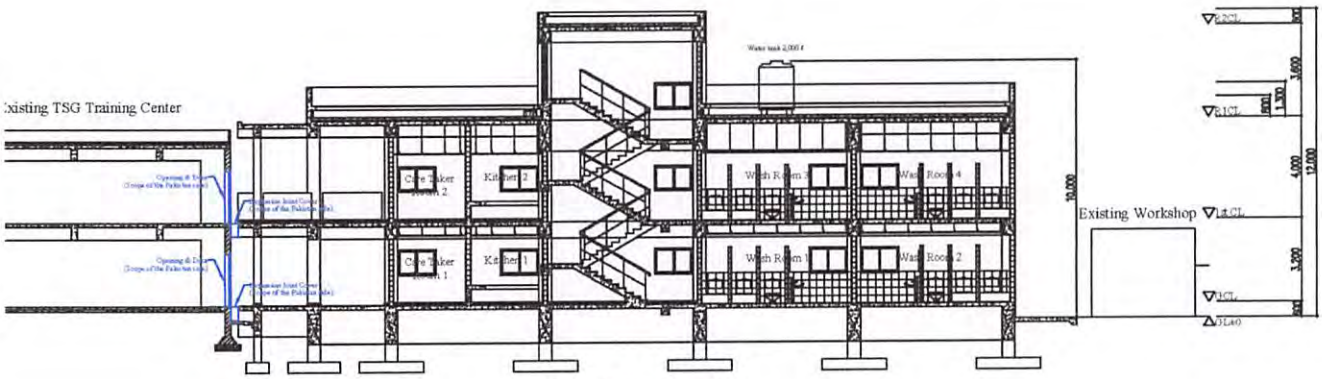


Fig. 2-3. Section

Annex-9

Planned Work Demarcation of the Project

No.	Undertakings	To be covered by		Notes
		Japan	Pakistan	
2	**TSG Training Simulator Building**			
2-11	Procedure of approval from the Pakistan Government, if necessary		○	
2-12	Drainage System for rain water from TSG Training Simulator Building, if necessary		○	

Minutes of Discussions
on the Preparatory Survey for the Project for
Strengthening of Training Center on Grid System Operations and Maintenance in the Islamic Republic of Pakistan
(Explanation on Draft Preparatory Survey Report)

On the basis of the discussions and field survey in the Islamic Republic of Pakistan (hereinafter referred to as "Pakistan") in Febrary 2015, and the subsequent technical examination of the results in Japan, the Japan International Cooperation Agency (hereinafter referred to as "JICA") prepared a draft Preparatory Survey Report on the Project for Strengthening of Training Center on Grid System Operations and Maintenance (hereinafter referred to as "the Draft Report").

In order to explain the Draft Report and to consult with the concerned officials of the Government of Pakistan on its contents, JICA sent to Pakistan the Preparatory Survey Team for the explanation of the Draft Report (hereinafter referred to as "the Team"), headed by Mr. Tadayuki Ogawa, Senior Advisor, Industrial Development and Public Policy Department, JICA, and is scheduled to stay in the country from 30th September to16th October, 2015.

As a result of the discussions, both sides confirmed the main items described in the attached sheets.

Islamabad, 7th October, 2015

Mr. Tadayuki Ogawa
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Mr. Syed Mujtaba Hussain
Joint Secretary
Economic Affairs Division
Pakistan

Mr. Zaffer Abbas
Joint Secretary (NTDC)
Ministry of Water and Power
Pakistan

Mr. Abdul Rehman
General Manager
Services Division
National Transmission and Despatch Company Ltd.,
Pakistan

Mr. Mohammad Arshad Mirza
Chief Engineer
Technical Service Group
National Transmission and Despatch Company Ltd.,
Pakistan

ATTACHEMENT

1. Contents of the Draft Report

   After the explanation of the contents of the Draft Report by the Team, the Pakistan side agreed in principle to its contents.

2. Line Agency and Executing Agency

   Both sides confirmed the line agency and executing agency as follows:

   2-1. The line agency is Ministry of Water and Power (MoWP), which would be the agency to supervise the executing agency.

   2-2. The executing agency is National Transmission and Despatch Company Limited (NTDC). Technical Service Group (TSG), NTDC will be the main department in charge of the Project. The executing agency shall coordinate with all the relevant agencies to ensure smooth implementation of the Project and ensure that the Undertakings are taken by relevant agencies properly and on time. The organization charts are shown in Annex 1.

3. Cost Estimation

   Both sides confirmed that the Project cost estimation described in the Draft Report was provisional and would be examined further by the Government of Japan for its final approval. The project cost estimation is shown in Annex 2.

4. Confidentiality of the Cost Estimation and Specifications

   Both sides confirmed that the Project cost estimation and technical specifications in the Draft Report should never be duplicated or disclosed to any third parties until all the contracts of the Project are concluded.

5. Japanese Grant Scheme

   The Pakistan side understands the Japanese Grant Scheme and its procedures as described in Annex 3 and Annex 4, and necessary measures to be taken by the Government of Pakistan.

6. Project Implementation Schedule

   The Team explained to the Pakistan side that the expected implementation schedule is as attached in Annex 5.

7. Expected outcomes and Indicators

Both sides agreed that key indicators for expected outcomes are as follows. The Pakistan side has responsibility to monitor the progress of the indicators and achieve the target in year 2021.

[Quantitative Effect]

Indicators	Reference value (Actual in 2014)	Target by 2021 【after 3 years of completion】
(1) Number of training courses using simulator	0	4 courses
(2) Number of times for training courses using simulator	0	22 times/year
(3) Number of trainees who participated in the training courses using simulator	0	120 persons/year
(4) Avarage score of Training Quality Evaluation Score for all related courses (Grid, P&I and T/L)	3.0	3.4

[Qualitative Effect]

- Improvement of operation and maintenance skills for transmission lines and substations

8. Undertakings Taken by Both Sides

Both sides confirmed undertakings described in Annex 6. The Pakistan side assured to take the necessary measures and coordination including allocation of the necessary budget which are preconditions of implementation of the Project. It is further agreed that the costs are indicative, i.e. at Outline Design level. More accurate costs will be calculated at the Detailed Design stage. Contents of Annex 2 will be updated as the Detailed Design progresses, and will finally be the Attachment to the Grant Agreement.

9. Monitoring during the Implementation

The Project will be monitored every 3 months by the executing agency and using the Project Monitoring Report (PMR). The template of PMR is shown in Annex 7 .

10. Ex-Post Evaluation

JICA will conduct ex-post evaluation three (3) years after the project completion

with respect to five evaluation criteria (Relevance, Effectiveness, Efficiency, Impact, Sustainability) of the Project. Result of the evaluation will be publicized. The Pakistan side is required to provide necessary support for them.

11. Issues to be Considered for the Smooth Implementation of the Project

Both sides confirmed to the issues to be considered and taken necessary measures for the smooth implementation of the Project described in Annex 5.

12. Schedule of the Study

JICA will complete the Final Report of the Preparatory Survey in accordance with the confirmed items and send it to the Pakistan side around Feburary 2016.

13. Environmental and Social Considerations

The project is likely to have minimal adverse impact on the environment under the 'JICA Guidelines for Environmental and Social Considerations (April 2010)'.

14. Other Relevant Issues

14-1. Operation and Maintenance of the Equipment

The team explained the importance of operation and maintenance of the equipment procured by the Project considering that proper asset management impacts greatly on life-span of the equipment and its maintenance cost. The Pakistan side shall secure enough staff and budgets necessary for appropriate operation and maintenance of the equipment.

The team strongly recommended to conclude the Maintenance Contract between NTDC and Japanese manufacturer of the simulator, in order to ensure the implementation of periodical maintenance by the manufacturer.

14-2. Allocation of instructors

The team requested NTDC to allocate adequately skilled instructors (2 for operation of substation, 2 for relay coordination) for the training of simulators, by the conclusion of procurement contract between NTDC and the Contractor. The Pakistan side assured to allocate enough engineers to be trained as instructors.

14-3. PC-1 approval procedure by the Pakistan side

The team explained that timely implementation of PC-1 approval is critical for the Government of Japan to make a commitment of the Project. The Pakistan side

agreed on key actions for PC-1 procedure with timetable as below. The Pakistan side also agreed to monitor and expedite the progress with reference to the said timetable.

(1) End of October 2015: Submission of PC-1 from Ministry of Water and Power
(2) Mid of November 2015: Submission of PC-1 to Planning Commission
(3) No later than the mid of December 2015: Approval of PC-1 by Central Development Working Party (CDWP) and if necessary Executive Committee of National Economic Council (ECNEC)

14-4. The Equipment which may be procured from third countries

The team explained that the equipment for the Project will be basically procured from Japan. However, some of the equipment listed as below will be procured from third countries due to availability and commercial competency of products. The Pakistan side agreed on the explanation by the team.

(1) Power distribution board
(2) Protection relays
(3) Emergency generator
(4) Cable connection materials

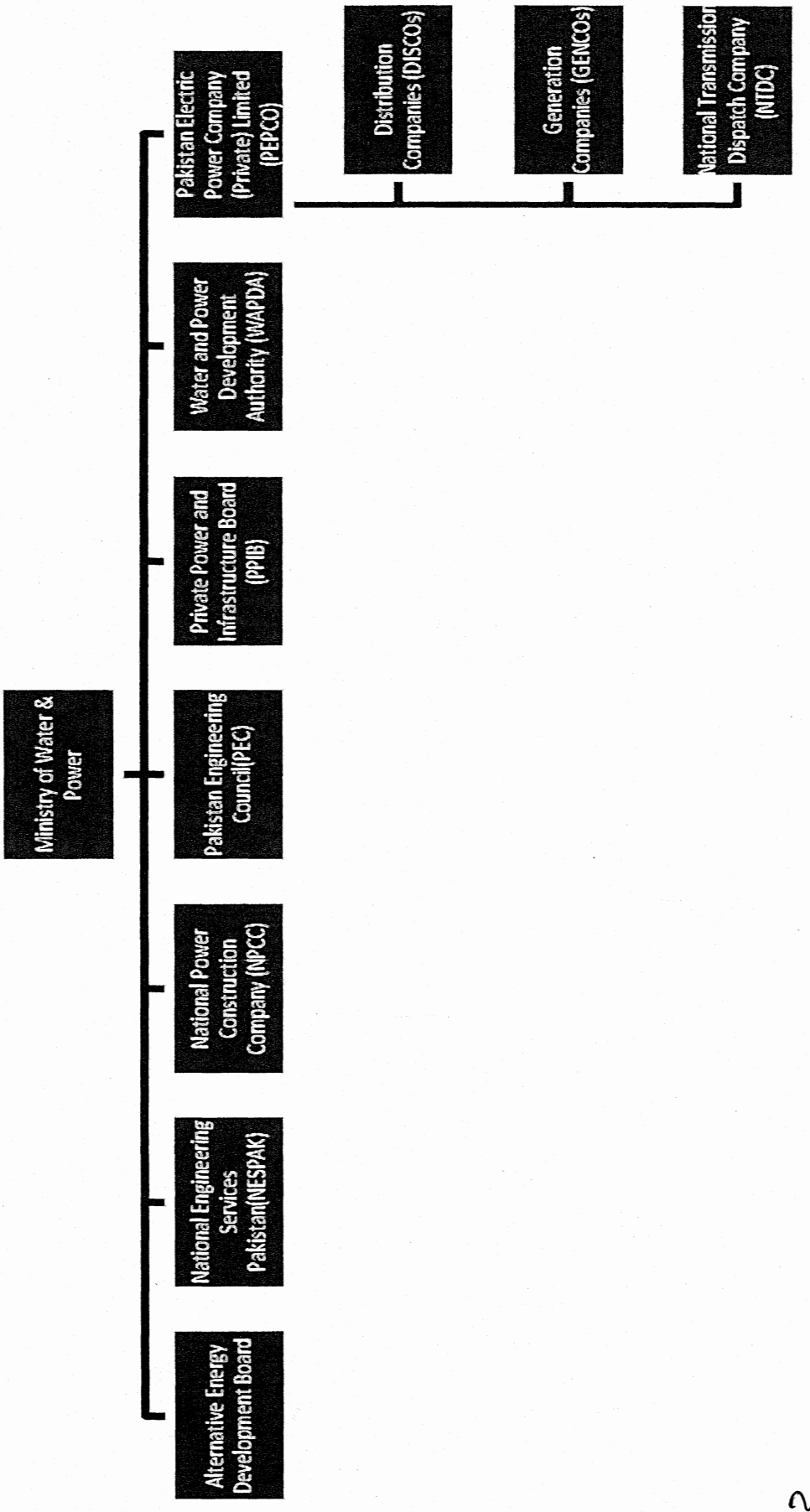
14-5. Disclosure of Information

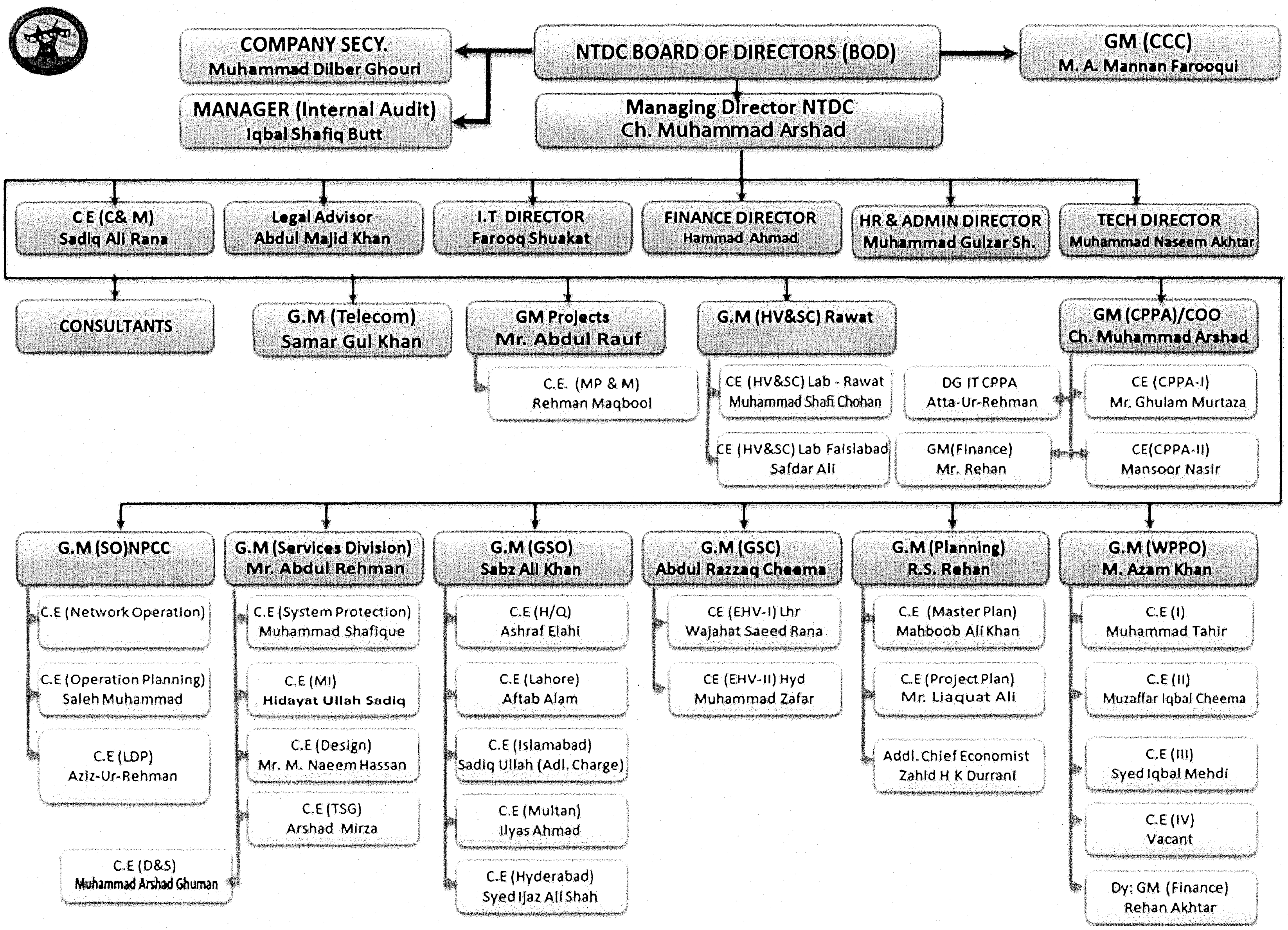
Both sides confirmed that the study results excluding the Project cost will be disclosed to the public after completion of the Preparatory Survey. All the study results including the project cost will be disclosed to the public after all the contracts for the Project are concluded.

Annex 1 Organization Chart
Annex 2 Project Cost Estimation
Annex 3 Japanese Grant
Annex 4 Flow Chart of Japanese Grant Procedures
Annex 5 Project Implementation Schedule
Annex 6-1 Major Undertakings to be taken by Recipient Government
Annex 6-2 Major Undertakings to be Covered by the Japanese Grant
Annex 7 Project Monitoring Report (template)

Annex 1 Organization Chart

ORGANIZATION STRUCTURE OF MINISTRY OF WATER AND POWER





ORGANIZATION STRUCTURE OF NATIONAL TRANSMISSION AND DESPATCH COMPANY LIMITED

Annex 2 Project Cost Estimation (Confidential)

The cost of the Project will be approximately million in total. The content of the project cost are shown separately for the Japanese borne portion and the Pakistan side borne portion in accordance with the conditions in term 3 below.

The cost estimate is provisional and subject to change as a result of examination by the Government of Japan for the approval of the Grant.

1. Estimated cost for the Japan side

№	Items		
1	Construction Facilities	2 stories 1039 m^2	
2	Equipment	Training Simulator, Relays	
3	Consulting Services	- Detailed design - Procurement Management - Construction Supervision	
4	Contingencies		
	Total		

2. Estimated cost for the Pakistan side

№	Items	Estimated cost million PKR
1	Replacement of existing transformer (50kVA) to a new transformer (200kVA)	1.28
2	Auxiliary work for connecting new building and the existing building	1.88
3	Auxiliary work for conducting ground leveling/ weeding and for removing obstacles at the Project sites	0.30
4	Auxiliary work for water supply and drainage work	0.53
5	Payment of A/P commission based on B/A	0.15
	Total	4.14

3. Estimation criteria

№	Items	Contents	
1	Date of estimation	April, 2015	
2	Foreign exchange rates	1 US$ = ¥ 120.15	TTS average from January to March, 2015
		1 PKR = ¥ 1.33	TTS average from January to March, 2015
3	Procurement and construction periods	The detailed design, equipment procurement and installation periods are as shown in the Project implementation schedule.	
4	Others	The Project will be implemented in accordance with the grant aid scheme of the Government of Japan.	

Annex 3 Japanese Grant

The Japanese Grant (hereinafter referred to as the "Grant") is non-reimbursable fund provided to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. The Grant is not supplied through the donation of materials as such.

Based on a JICA law which was entered into effect on October 1, 2008 and the decision of the GOJ, JICA has become the executing agency of the Japanese Grant for Projects for construction of facilities, purchase of equipment, etc.

1. Grant Procedures

The Grant is supplied through following procedures :

・Preparatory Survey
- The Survey conducted by JICA

・Appraisal &Approval
-Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet

・Authority for Determining Implementation
-The Notes exchanged between the GOJ and a recipient country

・Grant Agreement (hereinafter referred to as "the G/A")
-Agreement concluded between JICA and a recipient country

・Implementation
-Implementation of the Project on the basis of the G/A

2. Preparatory Survey

(1) Contents of the Survey

The aim of the preparatory Survey is to provide a basic document necessary for the appraisal of the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant project. The Outline Design of the Project is confirmed based on the guidelines of the Japanese Grant scheme.

JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the Report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the appropriateness of the Project.

3. Japanese Grant Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes(hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles, in accordance with the E/N, to implement the Project, such as payment conditions,

responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and G/A.

(3) Eligible source country

Under the Grant, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. The Grant may be used for the purchase of the products or services of a third country, if necessary, taking into account the quality, competitiveness and economic rationality of products and services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals", in principle.

(4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals, in principle. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to fulfill accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Project, the recipient country is required to undertake such necessary measures as Annex. The Japanese Government requests the Government of the recipient country to exempt all customs duties, internal taxes and other fiscal levies such as VAT, commercial tax, income tax, corporate tax, resident tax, fuel tax, but not limited, which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract, since the Grant fund comes from the Japanese taxpayers.

(6) "Proper Use"

The Government of the recipient country is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant, to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Grant.

(7) "Export and Re-export"

The products purchased under the Grant should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"), in principle. JICA will execute the Grant by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

(10) Environmental and Social Considerations

The Government of the recipient country must carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the recipient country and JICA Guidelines for Environmental and Social Consideration (April, 2010) .

(11) Monitoring

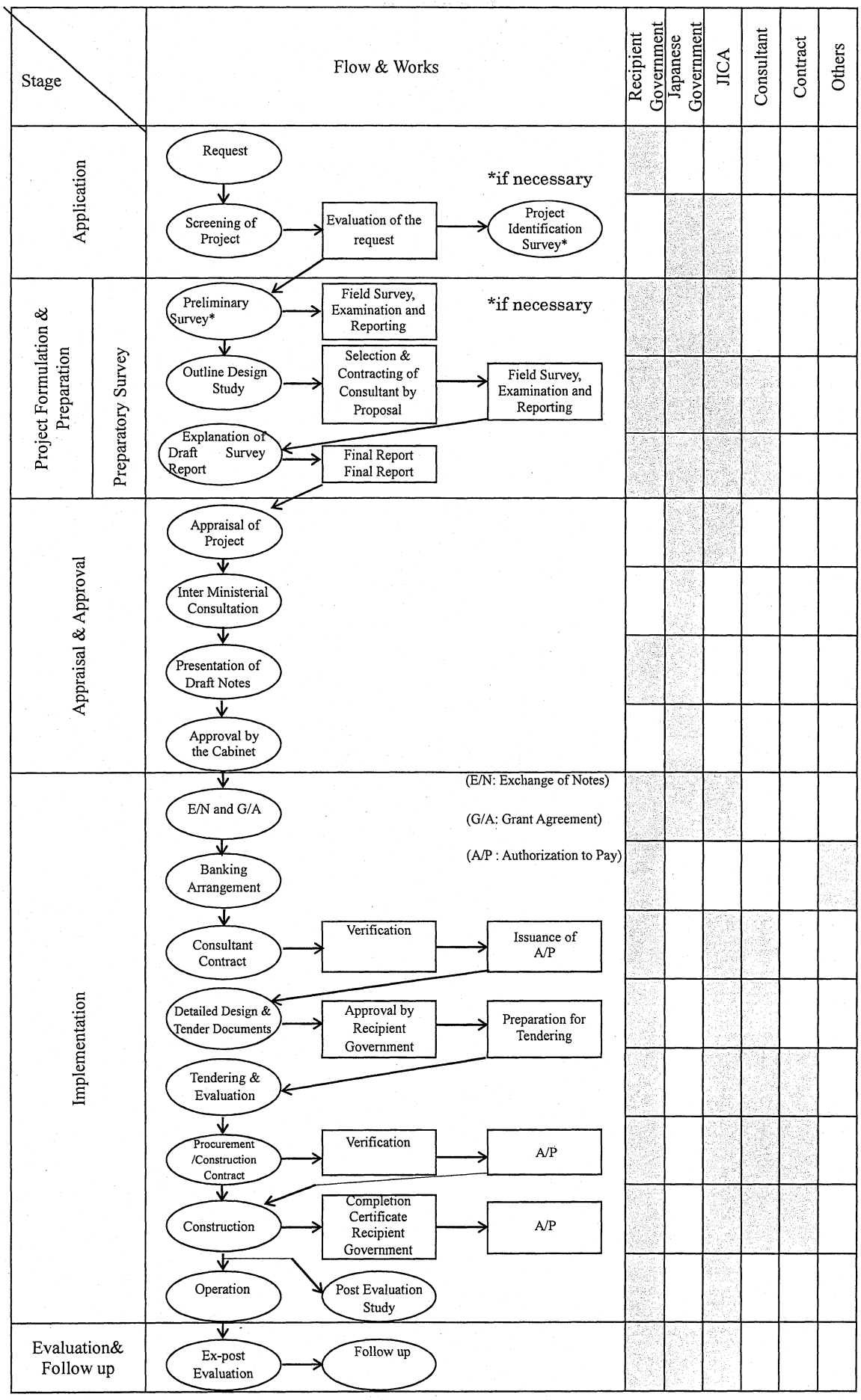
The Government of the recipient country must take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and must regularly report to JICA about its status by using the Project Monitoring Report (PMR).

(12) Safety Measures

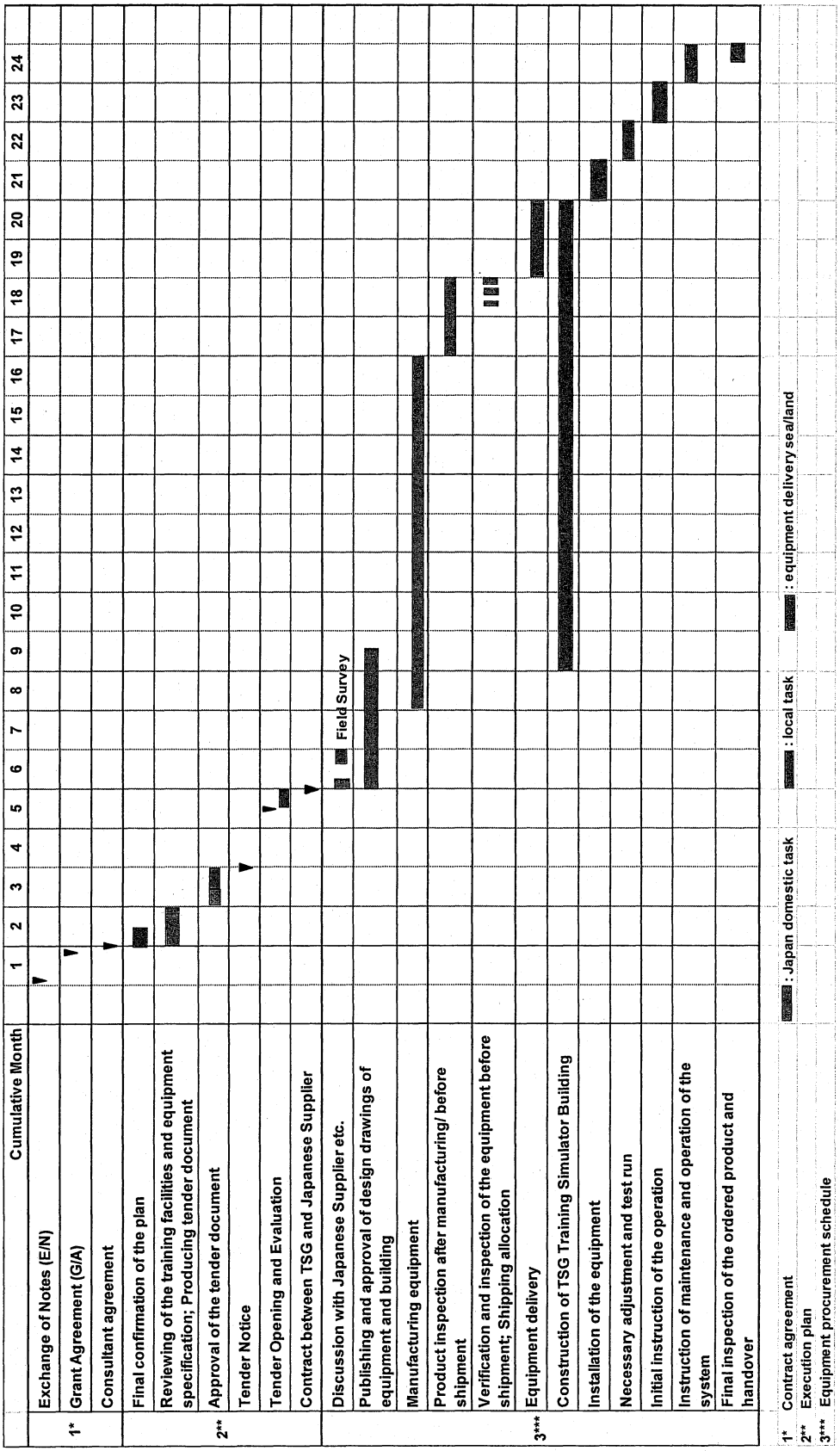
The Government of the recipient country must ensure that the safety is highly observed during the implementation of the Project.

(End)

Annex 4 Flow Chart of Japanese Grant Procedures



Annex 5 Project Implementation Schedule



Annex 6-1 Major Undertakings to be taken by Recipient Government

	NO.	Items	Dead line	In charge	Cost (Mil. PKR)	Ref.
Before the Tender	1	To open Bank Account (Banking Arrangement (B/A))	within 1 month after G/A	EAD/ SBP		MD of 1st survey
	2	To obtain the planning, zoning, building permit and to permit access to restricted areas.	before notice of the tender document	TSG		
	3	To secure lots of land necessary for the implementation of the Project and to clear the sites		TSG		
During the Project Implementation	4	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the sites		TSG		
	1)	The distributing power line to the site				
	2)	The city water distribution main to the site				
	3)	The city drainage main (for storm sewer and others to the site)				
	4)	The city gas main to the site				
	5)	The telephone trunk line to the main distribution frame/panel of the building				
	5	To bear the following commissions to a bank of Japan for the banking services based upon the B/A				MD of 1st survey
	1)	Advising commission of A/P	within 1 month after G/A	NTDC (Finance)	0.075	
	2)	Payment commission for A/P	every payment	NTDC (Finance)	0.075	
	6	To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country		NTDC /EAD		Draft of Preparatory Survey Report (Page 36,37 2-4-2-4 Tax Exemption)
	1)	Tax exemption and customs clearance of the products at the port of disembarkation	during the Project			
	7	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the Products and/or the Services be exempted / be borne by its designated authority without using the Grant]; Such customs duties, internal taxes and other fiscal levies mentioned above include VAT, commercial tax, income tax and corporate tax of Japanese nationals, resident tax, fuel tax, but not limited, which may be imposed in the recipient country with	during the Project	EAD		

		respect to the supply of the products and services under the verified contract				
	8	To accord Japanese nationals and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work	during the Project	NTDC (HR & Admin.)/ EAD/ MOI		
	9	To bear all the expenses, other than those to be borne by the Grant Aid, necessary for construction of the facilities as well as for the transportation and installation of the equipment	during the Project	NTDC (Finance)		
After the Project	10	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid				
	1)	Allocation of maintenance cost	After completion of the construction	TSG		
	2)	Operation and maintenance structure				
	3)	Routine check/Periodic inspection				
Specific work	11	Utility construction in new training building (construction work)				
	1)	Replacement of existing transformer (50kVA) to a new transformer (200kVA)	before commencement of the construction work	TSG	1.28	PC-1
	12	To ensure Residential Permits & Work Permits required for the Japanese Consultant and the Supplier or the Contractor, if necessary during the installation and construction work periods	before commencement of the construction work	NTDC (HR & Admin.)		
	13	To keep parking space during construction	during the Project	TSG		
	14	Temporary shut down during construction	during the Project	TSG		
	15	Foundation, fence and shed for Generator and Oil Tank	during the Project	TSG		
	16	Securing of lands for TSG Training Simulator Building, levelling and removal of the following obstacles in the Project site Soil				
	1)	Removal Septic Tanks (Man holes)	before commencement of the construction work	TSG	0.30	PC-1
	2)	Removal Wasted Soil by Septic Tanks				
	3)	Back filling after removal of Wasted				
	4)	Removal of Electric Poles and foundation.				
	17	Removal of the part of plinth protection of TSG Training Center for the construction of the new connecting corridor to TSG Training Simulator Building	before commencement of the construction work	TSG	1.88	

	18	Construction of two openings to connect to the new connecting corridor and installation of two doors in TSG Training Center (Ground and First floors), the expansion joint cover	after completion of the construction work, before completion of the installation work	TSG		
	19	Reconnection of existing TSG power supply, water supply, and gas supply for TSG Training Simulator Building	after completion of the construction work, before completion of the installation work	TSG	0.53	PC-1
	20	Securing of land of temporary material storage yard	before commencement of the construction work	TSG		
	21	Securing of disposal area in the compound of TSG NKLP for useless excavated soil, if necessary	during the construction work	TSG		
	22	Watt/hour meter for temporary power supply during the installation and construction work periods to the Project site	before commencement of the construction work	TSG	0.004	Manufacturer's website
	23	Water supply pump for TSG Training Simulator Building after the completion of the Project, if necessary	after the Project	TSG		
		Drainage System for rain water from TSG Training Simulator Building, if necessary	after the Project	TSG		
	24	Bush and grass clear in the Project site before the commencement of the Construction	before commencement of the construction work	TSG		
	25	Installation of steps to access connecting corridor from TSG Training Center, if necessary	after completion of the construction work, before completion of the installation work	TSG		
	26	Preparation of Septic Tanks (Man hole), and Drainages for rain and sewerage water from TSG Training Simulator Building, if necessary	after the Project	TSG		

Annex 6-2 Major Undertakings to be Covered by the Japanese Grant

NO.	Items	Dead line	Cost Estimated (Million JPY)*
1	Facility Construction	before delivery of the equipment	215
2	Procurement and Installation of Equipment	before adjustment and test run of the equipment	645
3	Detailed design, tender opening & evaluation, supervision for installation works	during the Project	114
4	Contingencies	during the Project	16
	Total		990

***; The cost estimates are provisional. This is subject to the approval of the Government of Japan.**

Project Monitoring Report
on
the Project for Strengthening of Training Center on Grid System Operation and Maintenance in the Islamic Republic of Pakistan
Grant Agreement No. XXXXXXX

20XX, Month

Organization Information

Authority (Signer of the G/A)	_____ Person in Charge _____ (Division) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____
Executing Agency	_____ Person in Charge _____ (Division) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____
Line Agency	_____ Person in Charge _____ (Division) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____

Outline of Grant Agreement:

Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____
Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:

1: Project Description

1-1 Project Objective

As the overall objective of the Project, the capacity of operation & maintenance of power system shall be enhanced through implementation of the Project. the Project objective is defined as "to strengthen the capacity of Technical Services Group (TSG) training center", which is achieved by procuring and installing the power system training simulator and other related equipment, as well as construction of a building for them.

1-2 Necessity and Priority of the Project

- Consistency with development policy, sector plan, national/regional development plans and demand of target group and the recipient country.

JICA have implemented the Technical Cooperation project for improvement of training capacity of grid system operations and maintenance. As a result of the project, training capacity of TSG was improved to a certain level. However, still it is necessary to improve the quality of training for P&I (Protection and Instruments) technology and restoration from power outage. In order to increase the efficiency of OJT, it was judged necessary to introduce the training simulator at TSG.

1-3 Effectiveness and the indicators

- Effectiveness by the project

Quantitative Effect (Operation and Effect indicators)		
Indicators	Original (Yr 2014)	Target (Yr 2021)
Number of training courses using simulator (courses)	0	4
Number of times for training courses using simulator (times/year)	0	22
Number of trainees who participated in the training courses using simulator (person/year)	0	120
Average score of Training Quality Evaluation Score for all related courses (Grid, P&I and T/L)	3.0	3.4
Qualitative Effect		
➢ Improvement of O&M skills for transmission lines and substations		

2: Project Implementation

2-1 Project Scope

Table 2-1-1a: Comparison of Original and Actual Location

Location	**Original:** *(M/D)* TSG Training Center, New Kot Lakhpat, Lahore	**Actual:** *(PMR)* **Attachment(s):Map**

	Attachment(s):Map	

Table 2-1-1: Comparison of Original and Actual Scope

Items	Original	Actual
1. TSG Training Simulator Building	- One (1) building - two (2) stories - Concrete structure - Roof area: 507 m^2 - Floor area: 1038 m^2	
2. Training Simulators	- Protection relay operation training simulator 1set - Grid System Operation (GSO) training simulator 1 set	
3. Protection relays	- distance relay 2 units - transformer differential protection relay 1 unit - overcurrent protection relay 1 unit - busbar voltage differential protection relay 1 unit - busbar current differential protection relay 1 unit - synchronizing check relay 1 unit - breaker failure protection relay 1 unit - line current differential protection relay 2 units	
4. Spare parts	For the protection relay operation training simulator: - PC 1 set - UPS 1 set - Cables 1 set etc. For GSO training simulator: - Server 1 set - UPS 1 set - Monitor 1 set - Selector switch 1 set - MCCB 1 set - Push-button switch 1 set - Indicator 1 set - Auxiliary relay 1 set - CPU unit 1 set - Cables 1 set etc.	
5. Consumables	- Paper for printing 1 set - Toner cartridge 1 set	

2-2 Implementation Schedule

2-2-1 Implementation Schedule

Table 2-2-1: Comparison of Original and Actual Schedule

Items	Original		Actual
	DOD	G/A	
PC-1 Cabinet approval E/N G/A Detailed Design Tender Notice Construction Period Installation of Equipment Project Completion Date Defect Liability Period	Dec. 2015 Feb. 2016 (Tentative)		

*Project Completion was defined as _____ at the time of G/A.

2-2-2 Reasons for any changes of the schedule, and their effects on the project.

2-3 Undertakings by each Government

2-3-1 Major Undertakings

See Attachment 2.

2-3-2 Activities

See Attachment 3.

2-4 Project Cost

2-4-1 Project Cost

Table 2-4-1a Comparison of Original and Actual Cost by the Government of Japan
(Confidential until the Tender)

Items			Cost (Million Yen)	
	Original	Actual	Original	Actual
Construction Facilities	2 stories building 1039 m²		215	
Equipment	Training Simulators, Relays		645	
Consulting Services	- Detailed design - Procurement Management - Construction Supervision		114	
Contingencies			16	
Total			990	

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

Table 2-4-1b Comparison of Original and Actual Cost by the Government of Pakistan

	Items		Cost (Million PKR)	
	Original	Actual	Original	Actual
(1)	Replacement of existing transformer (50kVA) to a new transformer (200kVA)		1.28	
(2)	Auxiliary work for connecting new building and the existing building		1.88	
(3)	Auxiliary work for conducting ground leveling/ weeding and for removing obstacles at the Project sites		0.30	
(4)	Auxiliary work for water supply and drainage work		0.53	
(5)	Payment of bank commission based on banking		0.15	
Total			4.14	

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = (local currency)

2-4-2 Reason(s) for the wide gap between the original and actual, if there have been any, the remedies you have taken, and their results.

(PMR)

2-5 Organizations for Implementation

2-5-1 Executing Agency:

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original: *(M/D)*
The line agency is Ministry of Water and Power (MoWP), which would be the agency to supervise the executing agency.
The executing agency is National Transmission and Despatch Company Limited (NTDC). Technical Service Group (TSG), NTDC will be the main department in charge of the Project. The executing agency shall coordinate with all the relevant agencies to ensure smooth implementation of the Project and ensure that the Undertakings are taken by relevant agencies properly and on time.

Actual, if changed: *(PMR)*

3: Operation and Maintenance (O&M)

3-1 O&M and Management

- Organization chart of O&M
- Operational and maintenance system (structure and the number ,qualification and skill of staff or other conditions necessary to maintain the outputs and benefits of the project

soundly, such as manuals, facilities and equipment for maintenance, and spare part stocks etc)

Original: *(M/D)* The team explained the importance of operation and maintenance of the equipment procured by the Project considering that proper asset management impacts greatly on life-span of the equipment and its maintenance cost. The Pakistan side shall secure enough staff and budgets necessary for appropriate operation and maintenance of the equipment. The team strongly recommended to conclude the Maintenance Contract between NTDC and Japanese manufacturer of the simulator, in order to ensure the implementation of periodical maintenance by the manufacturer.
Actual: *(PMR)*

3-2 O&M Cost and Budget

- The actual annual O&M cost for the duration of the project up to today, as well as the annual O&M budget.

Original: *(M/D)*

4: Precautions (Risk Management)

- Risks and issues, if any, which may affect the project implementation, outcome, sustainability and planned countermeasures to be adapted are below.

Original Issues and Countermeasure(s): *(M/D)*	
Potential Project Risks	Assessment
1.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action during the Implementation:
	Contingency Plan (if applicable):
2.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:

	Action during the Implementation:
	Contingency Plan (if applicable):
3.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action during the Implementation:
	Contingency Plan (if applicable):
Actual issues and Countermeasure(s)	
(PMR)	

5: Evaluation at Project Completion and Monitoring Plan

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan for the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

Attachment

1. Project Location Map
2. Undertakings to be taken by each Government
3. Monthly Report
4. Report on RD
5. Environmental Monitoring Form / Social Monitoring Form
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (Final Report Only)

Monitoring sheet on price of specified materials

1. Initial Conditions (Confirmed)

	Items of Specified Materials	Initial Volume A	Initial Unit Price (¥) B	Initial total Price C=A×B	1% of Contract Price D	Condition of payment	
						Price (Decreased) E=C－D	Price (Increased) F=C+D
1	Item 1	●●t	●	●	●	●	●
2	Item 2	●●t	●	●	●		
3	Item 3						
4	Item 4						
5	Item 5						

2. Monitoring of the Unit Price of Specified Materials

(1) Method of Monitoring : ●●

(2) Result of the Monitoring Survey on Unit Price for each specified materials

	Items of Specified Materials	1st ●month, 2015	2nd ●month, 2015	3rd ●month, 2015	4th	5th	6th
1	Item 1						
2	Item 2						
3	Item 3						
4	Item 4						
5	Item 5						

(3) Summary of Discussion with Contractor (if necessary)

-
-
-

Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)
(Actual Expenditure by Construction and Equipment each)

	Domestic Procurement (Recipient Country) A	Foreign Procurement (Japan) B	Foreign Procurement (Third Countries) C	Total D
Construction Cost	(A/D%)	(B/D%)	(C/D%)	
Direct Construction Cost	(A/D%)	(B/D%)	(C/D%)	
others	(A/D%)	(B/D%)	(C/D%)	
Equipment Cost	(A/D%)	(B/D%)	(C/D%)	
Design and Supervision Cost	(A/D%)	(B/D%)	(C/D%)	
Total	(A/D%)	(B/D%)	(C/D%)	

APPENDIX 5
EQUIPMENT SPECIFICATION

Equip. No.: 1	Description: GSO training simulator	Qty: 1 set
Comp. No.: A1, A2		

Purpose

Contents of Grid Training Simulator are

A: To simulate a grid station as described in Fig. 1.

B: To improve operation and maintenance skills for GSO's operators.

C: To improve GSO operation and maintenance skills by training on protection relay operation.

Component

1-1. Protection relay operation training simulator : 1 set

1-2. GSO operation training simulator : 1 set

1-3. Infrastructure equipment : 1 set

1-1. Protection relay operation training simulator

1-1.(a) Hardware Specification

(1)	Ambient temperature and humidity	:	In operation: 10 ～ 40 ℃, 20 ～ 80 %, Air conditioning for CPU should be operated. Out of service: -10 ～ 55 ℃, 20 ～ 80 %
(2)	Applicable standard	:	IEC、JIS、JEC、JEMA or equivalent standard
(3)	Model	:	Enclosed type metal panel
(4)	Countermeasure for power failure	:	To supply electric power by activating generator system within 2 minutes when power failure occurs. To deactivate generator system within 2 minutes when utility power is supplied again. When PCs (installed in A1 and C1 class rooms) detect power failure, PCs save the simulation instruction data and analysis results to the memory equipment automatically and are shut down by using UPS. When utility power is supplied again, PCs are rebooted manually and training courses are conducted again.
(5)	Control function	:	To control training simulator system for GSO operation and relay operation.
(6)	Input function	:	To input various kinds of data for power electric equipment and power electric system. To input simulation instruction data.
(7)	Processing function	:	To conduct calculation and processing using input data set.
(8)	Measuring function	:	To conduct measurement and acquisition of output data set.
(9)	Display function	:	To display and output the compiled data.
(10)	Training class room	:	GSO/relay operation training simulator is installed respectively in four training class rooms, i.e. A1a: Training Simulator Room, A2: Protection Relay Room, C1: Simulator Class Room, C2: Protection Class Room.
(11)	Two CPUs	:	GSO/relay operation training simulator consists of two CPUs, which can control GSO operation training simulator and protection relay operation training simulator, independently.
(12)	Telephone system	:	People in A1a and C1 class room can communicate with each other. People in A2 and C2 class room can communicate with each other.
(13)	Attachments	:	Cables, connectors, manuals written in English etc.

1-1.(b) Functional Specification

Ⅰ. To simulate a grid station as described in Fig.1.

The training simulator can simulate transmission line protection, busbar protection, transformer protection, respectively. The training simulator do not include SVC models and phase modifier models.

(1) To simulate two 220/132/11-kV grid stations.

(2) To include two generator models.

(3) To include three-phase parallel two-line models. To change transmission line impedance between 0 and 200 Ω.

(4) To be connected to actual protection relays.

(5) To output various kinds of waveform, i.e. current, voltage and frequency waveform.

The simulator can control printers for outputting waveforms indicated by PCs.

(6) To confirm the motion of the protection relay by the incidents like a short-circuit fault and a earth fault in the simulator.

(7) To calculate setting parameter of protection relay, i.e. operating parameter and operating time.

Setting of protection relay is conducted by using the simulator.

(8) To estimate set values of the protection relay by analysis of relay action, incident situation and incident point using the record from oscilloscope.

Incident scenarios, based on the analysis of incident situation on power system, are programmed and simulated in the simulator.

(9) To change a fault point resistance between 1 to 6 LGS (Line Ground Short) in incident simulator. To simulate continuous faults in incident simulator.

(10) To analyze power system phenomena occurred within a range where protection relay can operate.

Power system phenomena are simulated in a power system where a parallel two-line power transmission line and protection relay system with a directionality comparing function are introduced.

Ⅱ. To improve GSO operation and maintenance skills by training on protection relays operation as shown below.

(1) Calculation of setting of protection relay

Trainees can calculate setting of protection relay by using interface board. Response and operation of protection relay and state variation of power system are simulated.

(2) Understanding transformer protection relay (differential protection relay)

(3) Understanding transmission line protection relay (current differential protection relay and distance protection relay)

(4) Understanding busbar protection relay (differential protection relay)

(5) Reviewing of incidents and operation check of protection relay under the real incident records

Trainees can review incidents and check operation of protection relay by changing parameters of generator and power system arbitrarily.

(6) Understanding relay co-ordination, i.e. current co-ordination and time co-ordination

Relay co-ordination can be simulated. Response and operation of protection relay and state variation of power system are simulated.

(7) Analysis of the effect of single pole tripping and auto-reclosing on power system stability

Auto-reclosing on power system stability is simulated by the response and operation of protection relay. Three-phase type auto-reclosing is simulated.

(8) Effect of inrush current and its effect on power system

Amount of inrush current can be set at three levels and its effect on power system is simulated.

(9) Analysis of the effect of SOTF (Switch-on-to- Fault) on power system

Response and operation of protection relay are simulated by conducting fault calculation of voltage and current in power system when short circuit fault or earth fault occurs. Trip sequence is simulated including relay characteristics, operating time, recovery time and timer device.

When incident cannot be removed after a certain period of time, protection relay action is simulated again. When incident is removed, recovery operation can be conducted by trainees using training simulator.

(10) Analysis of the islanding effect in power system

Various figures of power system such as frequency can be simulated when a single separate system arises in a power system.

(11) Understanding of breaker failure scheme

Response and operation of protection relay and state variation of power system are simulated, when circuit breaker is not operated by the tripping signal of protection relay. On and off operation of circuit breaker failure is performed by trainer.

(12) Understanding of busbar differential scheme

As described in (1) section.

(13) Analysis of weak infeed condition when two generators of different capacity feed a fault in power system

UFR(under frequency relay) is operated due to decreasing voltage and frequency when power down occurs.

(14) Effects of power factor improvement capacitors on power system

Voltage and power factor can be simulated when performing on and off operation of power factor improvement capacitors.

(15) Effect of shunt reactors for keeping the voltage in a power system

Voltage and power factor can be simulated when performing on and off operation of shunt reactors.

(16) Power swing protection

When power swing occurs, system phenomena can be shown with prepared various scenarios simulated by Y-method power system dynamics analysis program.

(17) Understanding the effect of 132-kV SVC on power system

Trainees can understand that SVC provides excellent automatic-voltage-adjusting-function compared with other phase adjusters. Because phenomena, i.e. reactive power is changed in accordance with a voltage change, can be simulated.

(18) Understanding of 132-kV or 11-kV shunt capacitor bank

Voltage and power factor can be simulated when performing on and off operation of 132-kV or 11-kV shunt capacitor bank.

1-2. GSO operation training simulator

1-2.(a) Hardware Specification

the same as 1.1(a) Hardware Specification

1-2.(b) Functional Specification

Ⅰ. To simulate a grid station as described in Fig.1.
The training simulator can simulate transmission line protection, busbar protection, transformer protection, respectively. The training simulator do not include SVC models and phase modifier models.

(1) To simulate two 220/132/11-kV grid stations.

(2) To include two generator models.

(3) To include three-phase parallel two-line models. To change transmission line impedance between 0 and 200 Ω.

(4) To be connected to actual protection relays.

(5) To output various kinds of waveform, i.e. current, voltage and frequency waveform.
The simulator can control printers for outputting waveforms indicated by PCs.

(6) To confirm the motion of the protection relay by the incidents like a short-circuit fault and a earth fault in the simulator.

(7) To calculate setting parameter of protection relay, i.e. operating parameter and operating time.
Setting of protection relay is conducted by using the simulator.

(8) To estimate set values of the protection relay by analysis of relay action, incident situation and incident point using the record from oscilloscope.
Incident scenarios, based on the analysis of incident situation on power system, are programmed and simulated in the simulator.

(9) To change a fault point resistance between 1 to 6 LGS (Line Ground Short) in incident simulator. To simulate continuous faults in incident simulator.

(10) To analyze power system phenomena occurred within a range where protection relay can operate.
Power system phenomena are simulated in a power system where a parallel two-line power transmission line and protection relay system with a directionality comparing function are introduced.

Ⅱ. To improve operation and maintenance skills for GSO's operators by training as shown below.

(1) Training of basic operation for equipment in GSO
Power system operation training for conducting maintenance of transmission line is done by using the training simulator. Trainees are trained to operate power system with telephonic communication to trainer. Fluctuation of power system is simulated in accordance with the trainees' operational behavior to control panel.

(2) Understanding inter-locking schemes in operation of circuit breakers, isolators and earth switches
Interlock procedures for making a decision to allow trainees' operational behavior to control panel are simulated.

(3) Training of transmission line stop operation for transmission line maintenance and PTW issuance
Interlock procedures for operating switchgear and connecting/disconnecting to earth are simulated, including fluctuation of voltage, current and active/reactive power.

(4) Training of transformer stop operation for transformer maintenance and PTW issuance

(5) Transformer parallel operation

(6) Standard operation procedure in the unlikely event of serious incident
For example, operation training to shut down 66-kV and 11-kV GSO due to shutdown of 132-kV GSO is conducted by using the training simulator.

(7) Standard operation procedure in the event of incident in power system
Response and operation of protection relay are simulated by conducting fault calculation of voltage and current in power system when short circuit fault or earth fault occurs. Trip sequence is simulated including relay characteristics, operating time, recovery time and timer device.
When incident cannot be removed after a certain period of time, protection relay action is simulated again. When incident is removed, recovery operation can be conducted by trainees using training

simulator.

(8) Operation of synchronization to power system

Synchronous input operation training can be conducted by adjusting the phase and voltage of IPP generator in training simulator.

Load-flow calculation can simulate to change phase angle of voltage due to power supply-demand situation. When synchroscope determines to synchronize, closing operation can be allowed. When synchroscope determines not to synchronize, closing operation cannot be allowed.

Even when closing operation is conducted in the power system where synchronization cannot be conducted, fluctuation of power system is not simulated.

1-3. Infrastructure equipment

1-3.(a) Hardware Specification

(1)	Rated voltage	:	AC single-phase 230 V or three-phase 400 V(three-phase four-wire system)
(2)	Inner structure		Power supply unit consists of transformer, AC/DC converter and so on in power distribution panels in each traininig room, in order to supply three kinds of electric power as mentioned below: 1) AC 100 V: for GSO operation training simulator CPU, PC etc. 2) AC 200 V: for amplifier, air conditioning etc. 3) DC 100 V: for protection relay operation training simulator CPU, interface panel etc.
(3)	Rated capacity	:	Not exceeding 50 kVA
(4)	Rated frequency	:	50 Hz
(4)	Phase	:	Three-phase or single-phase
(5)	Cooling function	:	Air cooling. Air conditioning for CPU is installed for maintaining proper conditions for GSO operation training simulator and relay operation training simulator.

Spare parts

1.	For protection relay operation training simulator		
(1)	PCs for interface panels	:	1 set
(2)	UPS	:	1 set
(3)	Cables (various types)	:	1 set
(4)	Etc.	:	1 set
2.	For GSO operation training simulator		
(1)	Server for GSO training simulator	:	1 set
(2)	UPS	:	1 set
(3)	Monitor	:	1 set
(4)	Selector switch (various types)	:	1 set
(5)	MCCB (various types)	:	1 set
(6)	Push-button switch (various types)	:	1 set
(7)	Indicator (various types)	:	1 set
(8)	Auxiliary relay (various types)	:	1 set
(9)	CPU unit	:	1 set
(10)	Cables (various types)	:	1 set
(11)	Etc.	:	1 set

Consumables

1.	For protection relay operation training simulator and GSO operation training simulator		
(1)	Paper for printing	:	1 set
(2)	Toner cartridge	:	1 set

Other special instructions			
(1)	Maintenance manual	:	1 set
(2)	ODA sticker	:	1 set

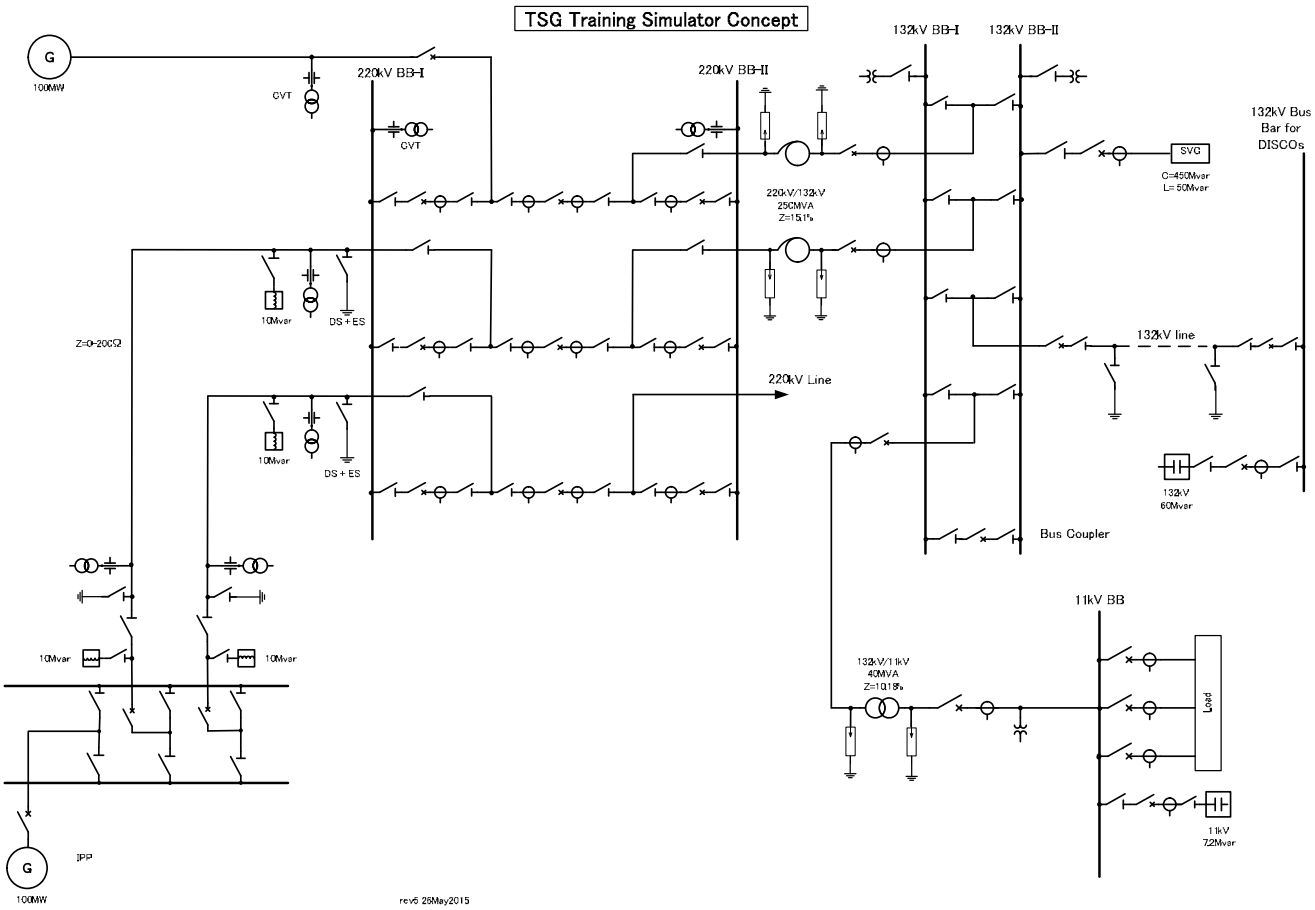


Fig. 1 Power system diagram for TSG training simulator

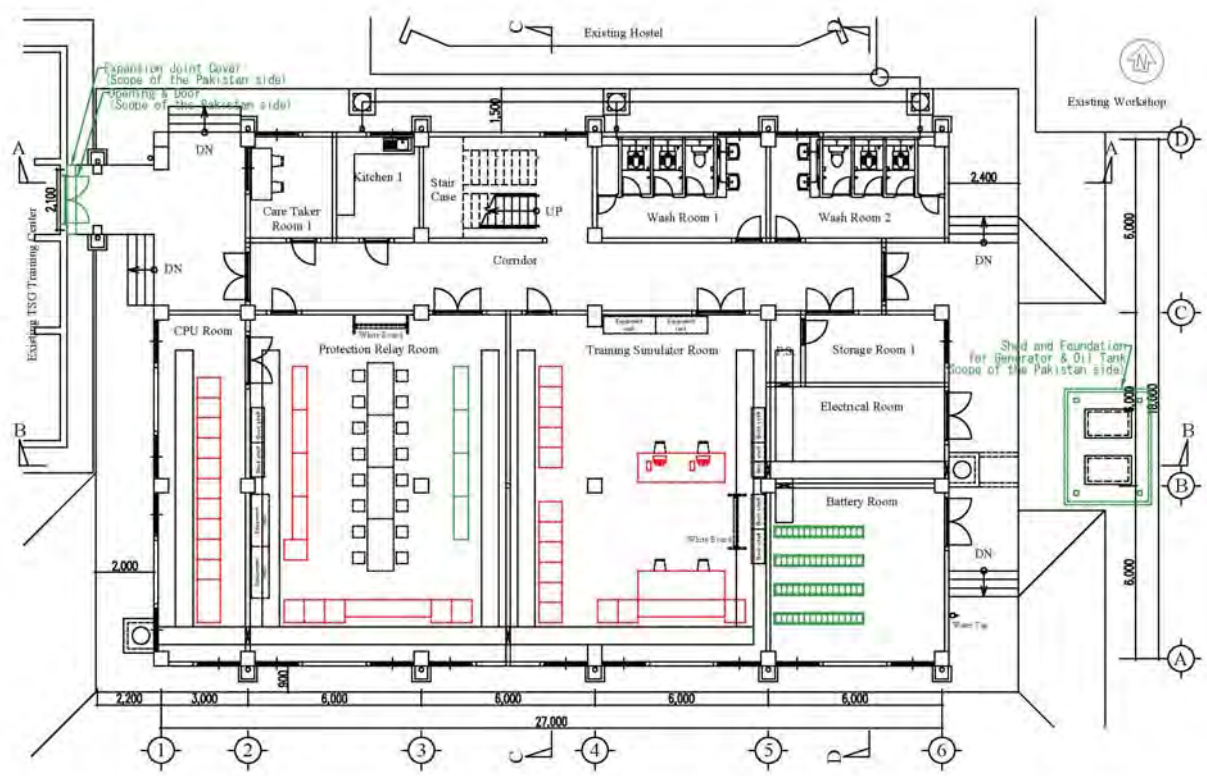


Fig. 2(a) Ground floor layout

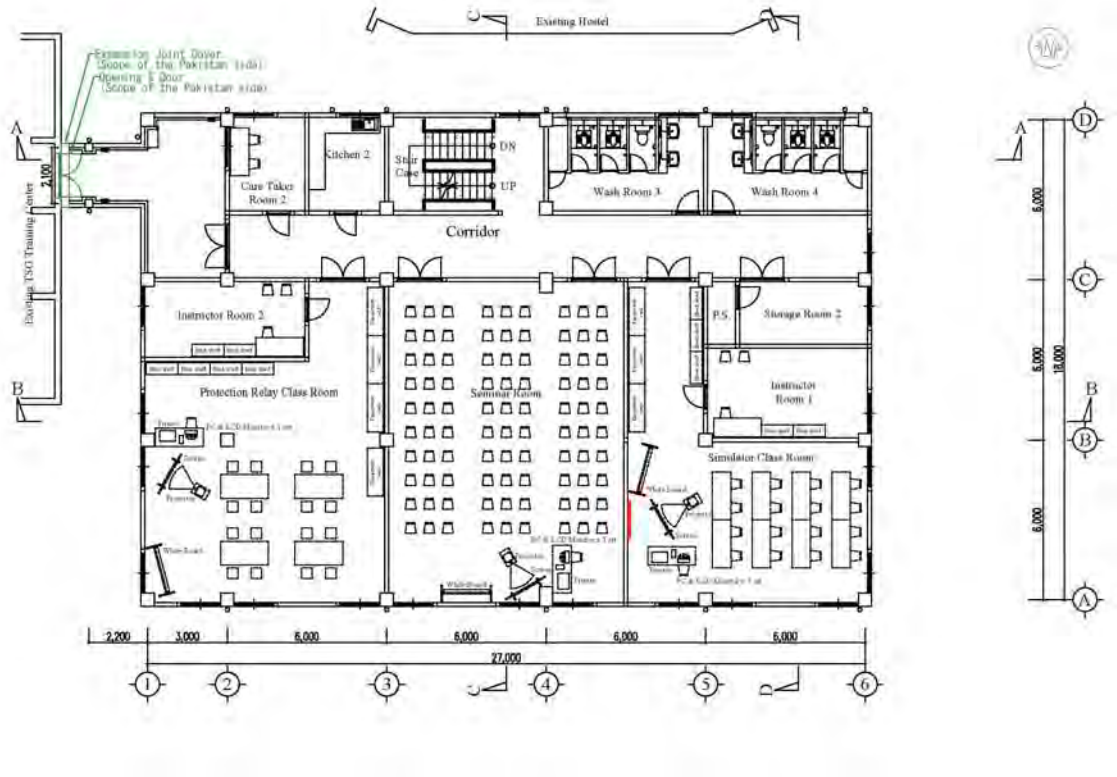


Fig. 2(b) First floor layout

Equip. No.: 2	Description: Distance relay with auto-recloser feature unit	Qty: 2 units
Comp. No.: A2-1		

Purpose

The relay unit is operated with the current/voltage signals produced by the GSO training simulator. Trainees can improve operation and maintenance skills by training on protection relay operation.

Component

1. Main unit : 1 set

Specification

1. Distance relay with auto-recloser feature unit

(1)	CT	:	AC 1 A / 5 A
(2)	VT	:	AC 110 V
(3)	Installation	:	Flush mounting
(4)	Terminal	:	Ring lug type terminal
(5)	Ambient temperature / humidity	:	-10 ～ 55℃ / N/E 95 %
(6)	Applicable standard	:	IEC, JIS, JEC, JEMA or equivalent standard
(7)	Model	:	Enclosed type
(8)	Rated voltage	:	DC 220 V +20 % -15 %
(9)	Rated frequency	:	50 Hz
(10)	Attachments	:	connectors etc.

Spare parts

n/a

Consumables

n/a

Other special instructions

(1)	Manual	:	1 set
(2)	ODA sticker	:	1 set

Equip. No.: 3	Description: Transformer differential protection relay unit	Qty: 1 unit
Comp. No.: A2-2		

Purpose

The relay unit is operated with the current/voltage signals produced by the GSO training simulator. Trainees can improve operation and maintenance skills by training on protection relay operation.

Component

1. Main unit : 1 set

Specification

1. Transformer differential protection relay unit

(1)	CT	:	AC 1 A / 5 A
(2)	VT	:	AC 110 V
(3)	Installation	:	Flush mounting
(4)	Terminal	:	Ring lug type terminal
(5)	Ambient temperature / humidity	:	-10 ～ 55℃ / N/E 95 %
(6)	Applicable standard	:	IEC, JIS, JEC, JEMA or equivalent standard
(7)	Model	:	Enclosed type
(8)	Rated voltage	:	DC 220 V +20 % -15 %
(9)	Rated frequency	:	50 Hz
(10)	Attachments	:	connectors etc.

Spare parts

n/a

Consumables

n/a

Other special instructions

(1)	Manual	:	1 set
(2)	ODA sticker	:	1 set

Equip. No.: 4	Description: Overcurrent protection relay unit including E/F	Qty: 1 unit
Comp. No.: A2-3		

Purpose

The relay unit is operated with the current/voltage signals produced by the GSO training simulator. Trainees can improve operation and maintenance skills by training on protection relay operation.

Component

1. Main unit : 1 set

Specification

1. Overcurrent protection relay unit including E/F

(1)	CT	:	AC 1 A / 5 A
(2)	VT	:	AC 110 V
(3)	Installation	:	Flush mounting
(4)	Terminal	:	Ring lug type terminal
(5)	Ambient temperature / humidity	:	-10 ～ 55 ℃ / N/E 95 %
(6)	Applicable standard	:	IEC, JIS, JEC, JEMA or equivalent standard
(7)	Model	:	Enclosed type
(8)	Rated voltage	:	DC 220 V +20 % -15 %
(9)	Rated frequency	:	50 Hz
(10)	Attachments	:	connectors etc.

Spare parts

n/a

Consumables

n/a

Other special instructions

(1)	Manual	:	1 set
(2)	ODA sticker	:	1 set

Equip. No.: 5	Description: Busbar differential protection relay unit (high impedance)	Qty: 1 unit
Comp. No.: A2-4-1		

Purpose

The relay unit is operated with the current/voltage signals produced by the GSO training simulator. Trainees can improve operation and maintenance skills by training on protection relay operation.

Component

1. Main unit : 1 set

Specification

1. Busbar differential protection relay unit (high impedance)

(1)	CT	:	AC 1 A / 5 A
(2)	VT	:	AC 110 V
(3)	Installation	:	Flush mounting
(4)	Terminal	:	Ring lug type terminal
(5)	Ambient temperature / humidity	:	-10 ～ 55 ℃ / N/E 95 %
(6)	Applicable standard	:	IEC, JIS, JEC, JEMA or equivalent standard
(7)	Model	:	Enclosed type
(8)	Rated voltage	:	DC 220 V +20 % -15 %
(9)	Rated frequency	:	50 Hz
(10)	Attachments	:	connectors etc.

Spare parts

n/a

Consumables

n/a

Other special instructions

(1)	Manual	:	1 set
(2)	ODA sticker	:	1 set

Equip. No.: 6	Description: Busbar differential protection relay unit (low impedance)	Qty: 1 unit
Comp. No.: A2-4-2		

Purpose

The relay unit is operated with the current/voltage signals produced by the GSO training simulator. Trainees can improve operation and maintenance skills by training on protection relay operation.

Component

1. Main unit : 1 set

Specification

1. Busbar differential protection relay unit (low impedance)

(1)	CT	:	AC 1 A / 5 A
(2)	VT	:	AC 110 V
(3)	Installation	:	Flush mounting
(4)	Terminal	:	Ring lug type terminal
(5)	Ambient temperature / humidity	:	-10 ～ 55 ℃ / N/E 95 %
(6)	Applicable standard	:	IEC, JIS, JEC, JEMA or equivalent standard
(7)	Model	:	Enclosed type
(8)	Rated voltage	:	DC 220 V +20 % -15 %
(9)	Rated frequency	:	50 Hz
(10)	Attachments	:	connectors etc.

Spare parts

n/a

Consumables

n/a

Other special instructions

(1)	Manual	:	1 set
(2)	ODA sticker	:	1 set

Equip. No.: 7	Description: Synchronizing check relay unit	Qty: 1 unit
Comp. No.: A2-5		

Purpose

The relay unit is operated with the current/voltage signals produced by the GSO training simulator. Trainees can improve operation and maintenance skills by training on protection relay operation.

Component

1. Main unit : 1 set

Specification

1. Synchronizing check relay unit

(1)	CT	:	AC 1 A / 5 A
(2)	VT	:	AC 110 V
(3)	Installation	:	Flush mounting
(4)	Terminal	:	Ring lug type terminal
(5)	Ambient temperature / humidity	:	-10 ～ 55℃ / N/E 95 %
(6)	Applicable standard	:	IEC, JIS, JEC, JEMA or equivalent standard
(7)	Model	:	Enclosed type
(8)	Rated voltage	:	DC 220 V +20 % -15 %
(9)	Rated frequency	:	50 Hz
(10)	Attachments	:	connectors etc.

Spare parts

n/a

Consumables

n/a

Other special instructions

(1)	Manual	:	1 set
(2)	ODA sticker	:	1 set

Equip. No.: 8	Description: Breaker failure protection relay unit	Qty: 1 unit
Comp. No.: A2-6		

Purpose

The relay unit is operated with the current/voltage signals produced by the GSO training simulator. Trainees can improve operation and maintenance skills by training on protection relay operation.

Component

1. Main unit : 1 set

Specification

1. Breaker failure protection relay unit

(1)	CT	:	AC 1 A / 5 A
(2)	VT	:	AC 110 V
(3)	Installation	:	Flush mounting
(4)	Terminal	:	Ring lug type terminal
(5)	Ambient temperature / humidity	:	-10 ～ 55℃ / N/E 95 %
(6)	Applicable standard	:	IEC, JIS, JEC, JEMA or equivalent standard
(7)	Model	:	Enclosed type
(8)	Rated voltage	:	DC 220 V +20 % -15 %
(9)	Rated frequency	:	50 Hz
(10)	Attachments	:	connectors etc.

Spare parts

n/a

Consumables

n/a

Other special instructions

(1)	Manual	:	1 set
(2)	ODA sticker	:	1 set

Equip. No.: 9	Description: Line differential protection relay unit	Qty: 2 units
Comp. No.: A2-7		

Purpose

The relay unit is operated with the current/voltage signals produced by the GSO training simulator. Trainees can improve operation and maintenance skills by training on protection relay operation.

Component

1. Main unit : 1 set

Specification

1. Line differential protection relay unit

(1)	CT	:	AC 1 A / 5 A
(2)	VT	:	AC 110 V
(3)	Installation	:	Flush mounting
(4)	Terminal	:	Ring lug type terminal
(5)	Ambient temperature / humidity	:	-10 ～ 55℃ / N/E 95 %
(6)	Applicable standard	:	IEC, JIS, JEC, JEMA or equivalent standard
(7)	Model	:	Enclosed type
(8)	Rated voltage	:	DC 220 V +20 % -15 %
(9)	Rated frequency	:	50 Hz
(10)	Attachments	:	connectors etc.

Spare parts

n/a

Consumables

n/a

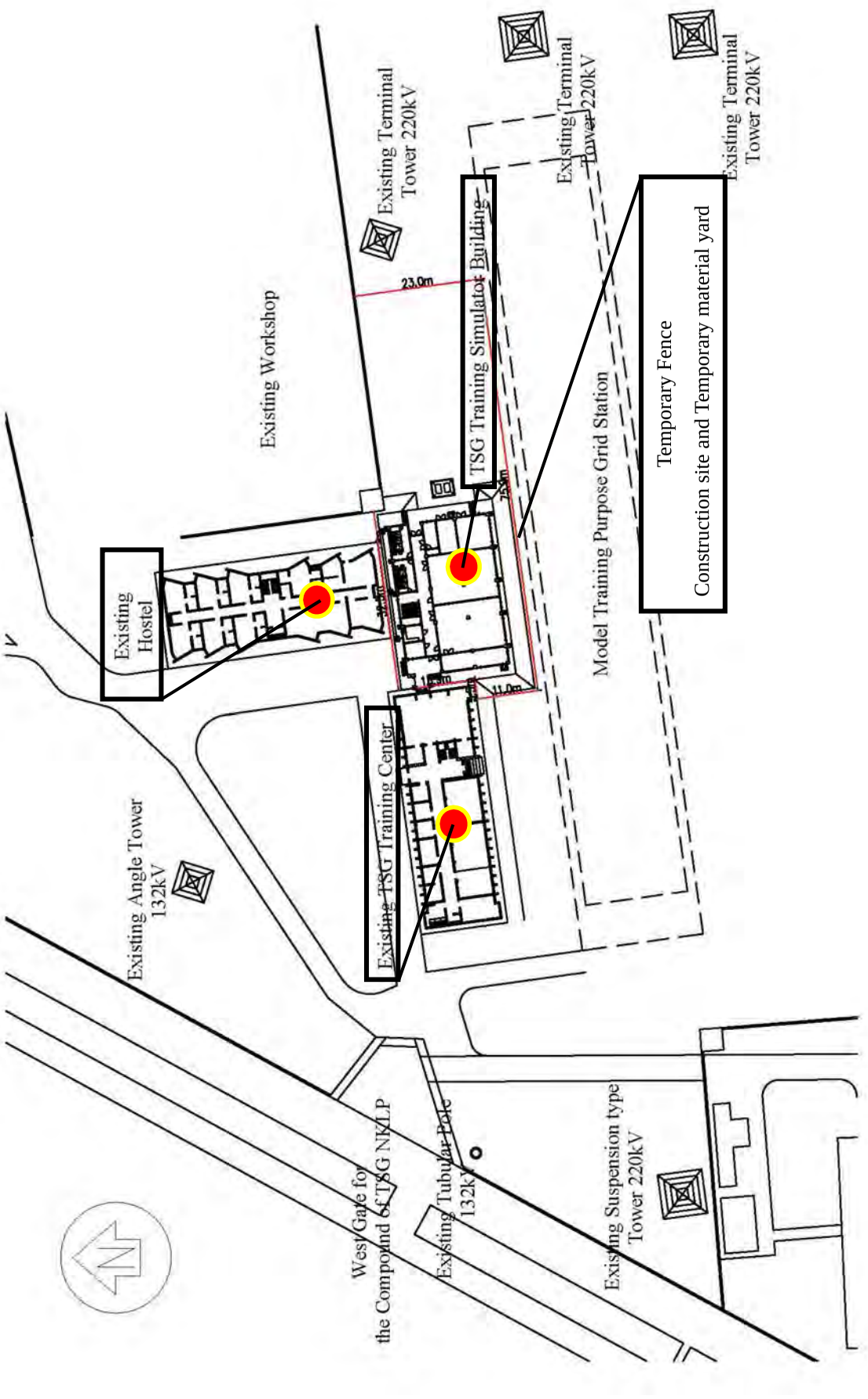
Other special instructions

(1)	Manual	:	1 set
(2)	ODA sticker	:	1 set

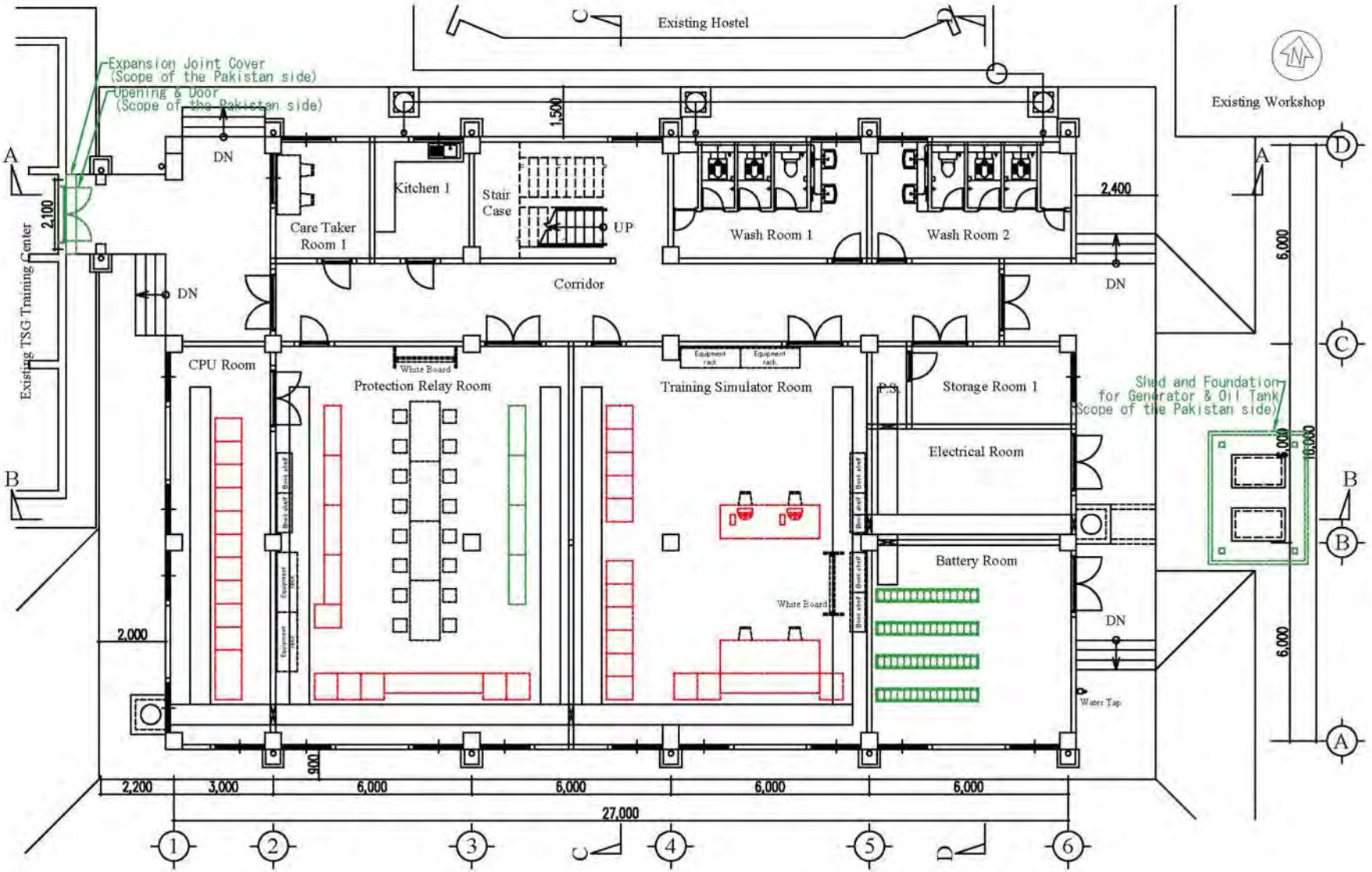
APPENDIX 6
OUTLINE DESIGN DRAWINGS

Appendix 6. Outline Design Drawings

Dwg No.	Dwg Title
1	Site Layout Plan
2	Ground Floor Plan
3	First Floor Plan
4	Roofing Plan
5	South Elevation
6	North Elevation
7	East Elevation
8	West Elevation
9	Section A-A
10	Section B-B
11	Section C-C
12	Section D-D



Dwg No.1: Site Layout Plan

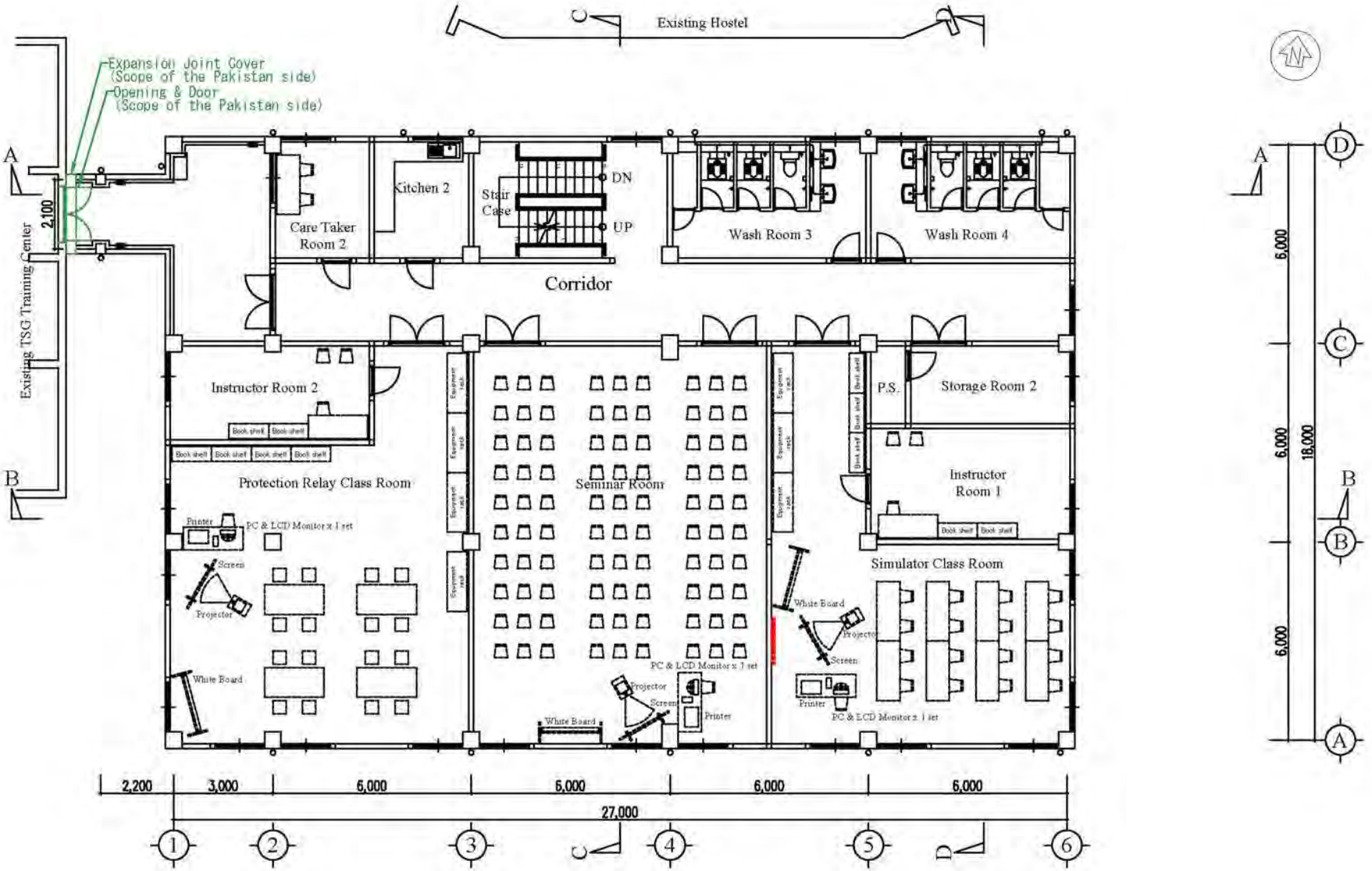


Remarks

Green : Scope of the Equipment and Work by the Pakistan side

Red : Scope of the Equipment by the Japan side

Dwg No.2: Ground Floor Plan

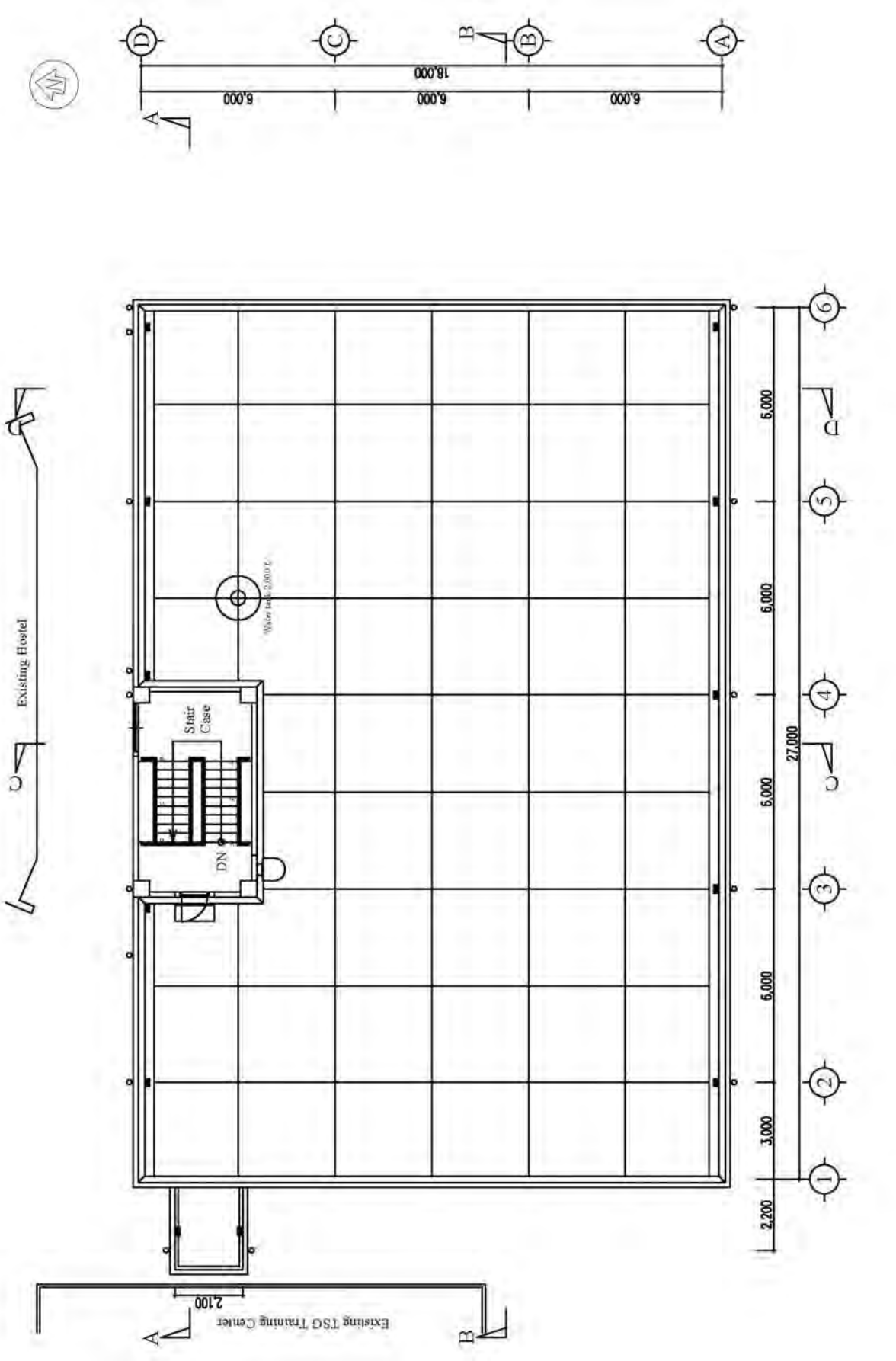


Remarks

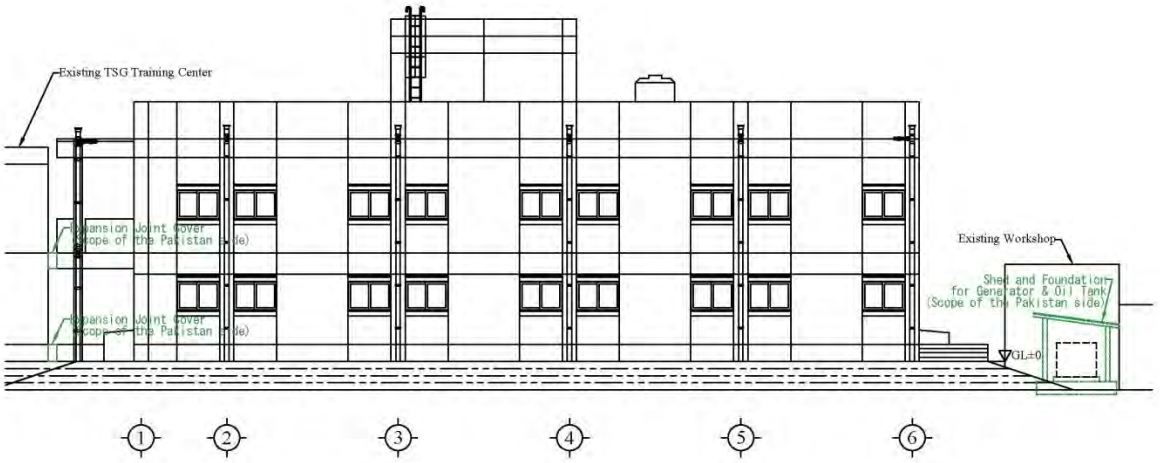
Green : Scope of the Equipment and Work by the Pakistan side

Red : Scope of the Equipment by the Japan side

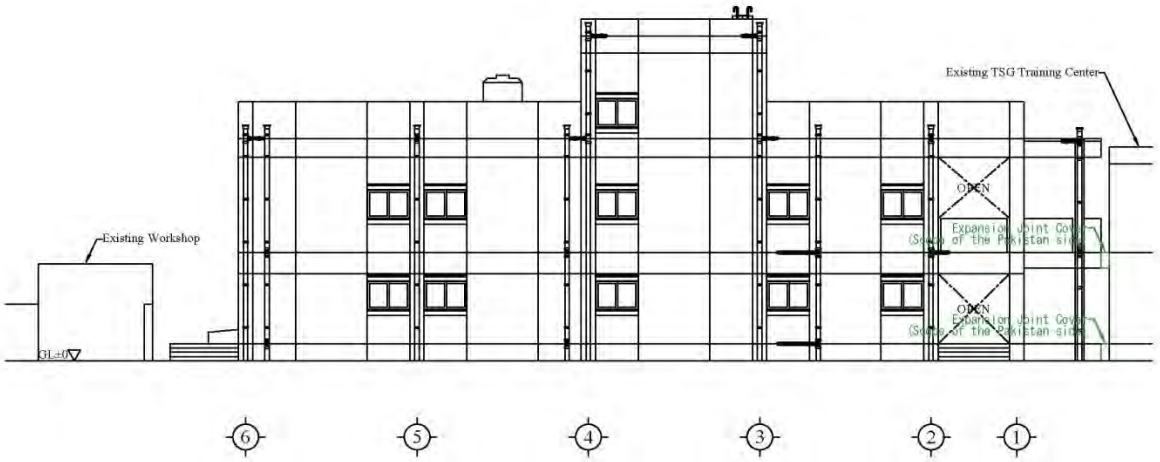
Dwg No.3: First Floor Plan



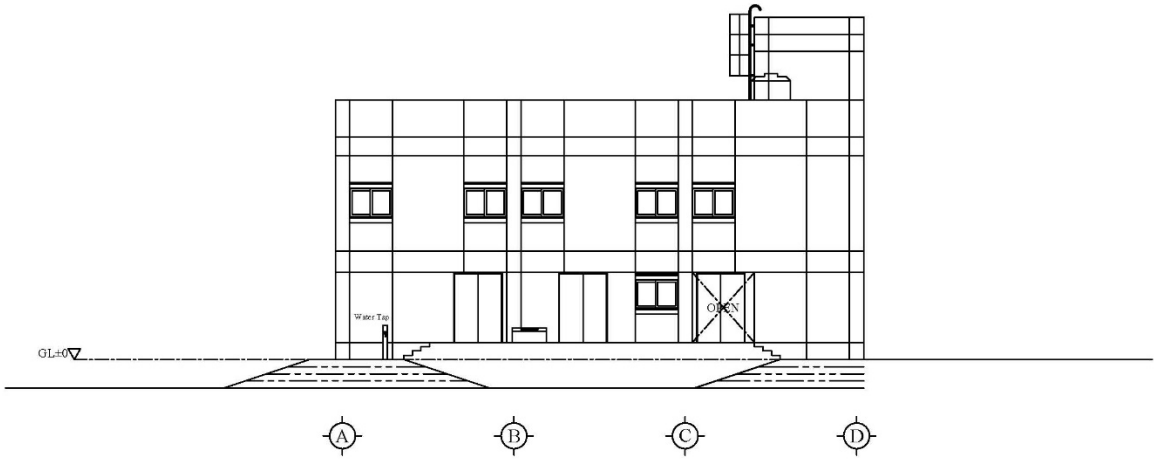
Dwg No.4: Roofing Plan



Dwg No.5: South Elevation



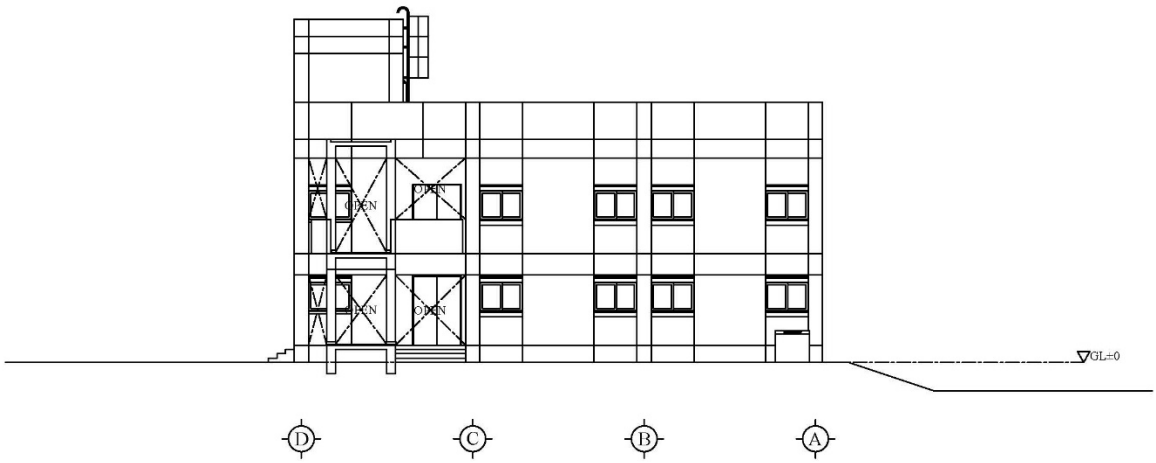
Dwg No.6: North Elevation



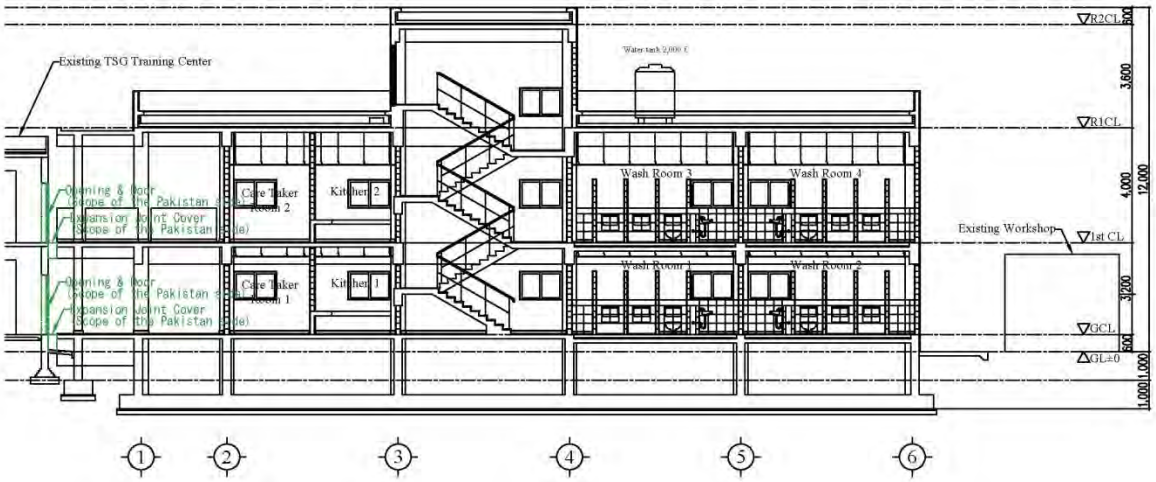
Dwg No.7: East Elevation

Remarks

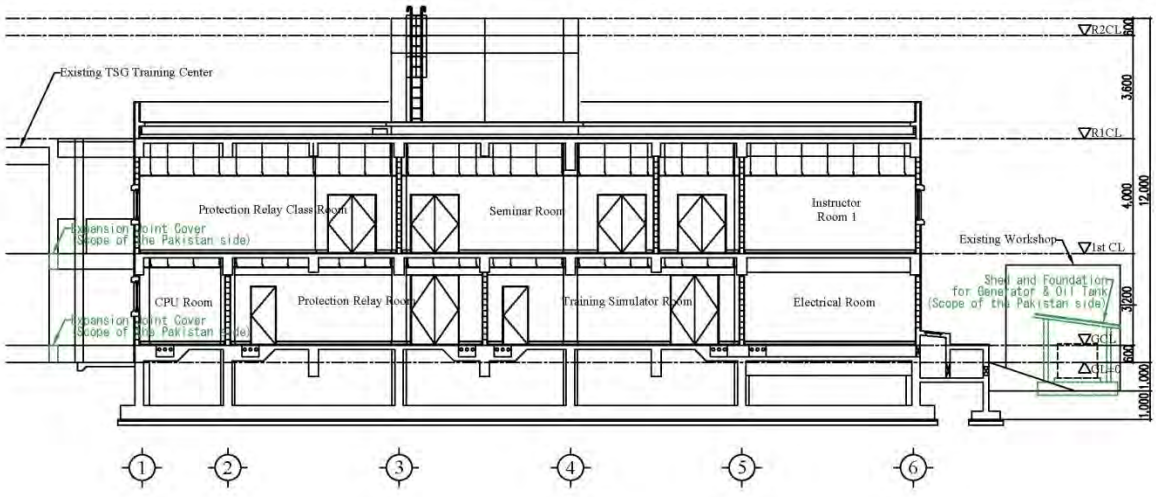
Green : Scope of the Work by the Pakistan side



Dwg No.8: West Elevation



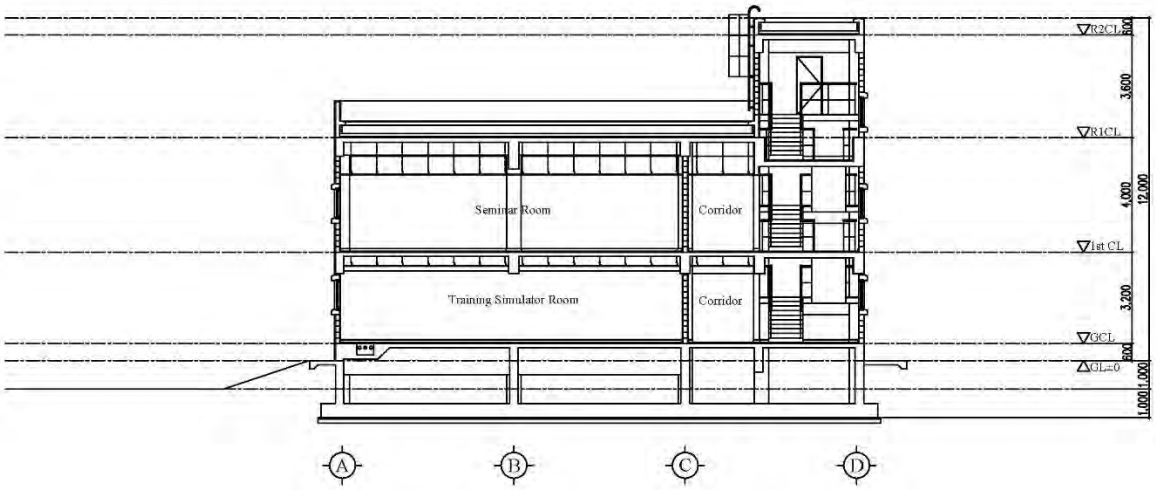
Dwg No.9: Section A-A



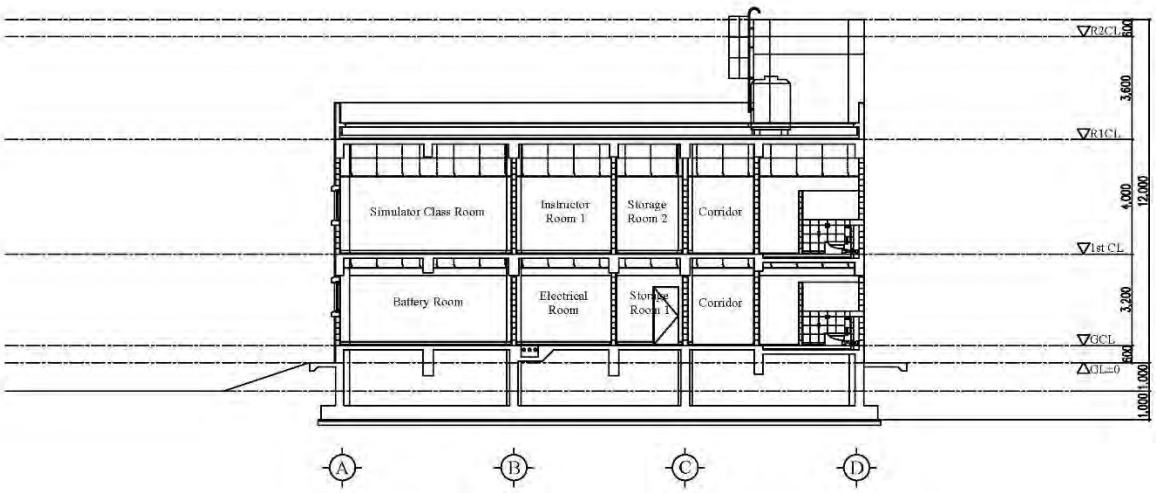
Dwg No.10: Section B-B

Remarks

Green : Scope of the Work by the Pakistan side



Dwg No.11: Section C-C



Dwg No.12: Section D-D

APPENDIX 7
REPORT OF TOPOGRAPHIC SURVEY AND SOIL INVESTIGATION

SUB–SOIL INVESTIGATION REPORT

FOR

PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF TSG TRAINING CENTER ON GRID SYSTEM OPERATIONS AND MAINTENANCE AT LAHORE IN THE ISLAMIC REPUBLIC OF PAKISTAN

Client

YACHIYO ENGINEERING CO., LTD
Tokyo, Japan

APRIL 2015

NOON GEO TECH
Soil & Foundation Engineers
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Tel: (042) 35029651, 0300-4237551, e-mail: noongeotech@hotmail.com

Table of Contents

SUBSURFACE EXPLORATION SURVEY

FOR

PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF TSG TRAINING CENTER ON GRID SYSTEM OPERATIONS AND MAINTENANCE AT LAHORE IN THE ISLAMIC REPUBLIC OF PAKISTAN

A. INTRODUCTION

M/s Yachiyo Engineering Co., Ltd., Tokyo, Japan have desired a Preparatory survey on the project for *Improvement of TSG Training Center on Grid System Operations and Maintenance at Lahore in the Islamic Republic of Pakistan*, to improve the facility of training regarding grid system operations and maintenance.

A balanced and structurally safe building structure needs safe and sound foundation network over the supporting soil, so geotechnical investigation of the site is the foremost requirement. The services of ***M/s Noon Geo Tech***, Lahore have been hired for this task. The subsoil investigation was carried out during April 2015.

B. SITE VISIT

The site was visited on 07.04.2015. The location for test was marked by the client's representative Mr. Hironori Komatsu, Chief Engineer, in the presence of other Engineer/allied staff from M/s Yachiyo Engineering Co., Ltd., Tokyo, Japan. The representative of M/s Noon Geo Tech were also present during site visit and it was decided that the site would be explored on 07.04.2015.

B. SCOPE OF WORK

As per TOR for Subsurface Exploration Survey at site, following scope of work was given by the client:

1. To drill borehole up to 10-meter depth with light percussion drilling method.
2. To perform SPT's at 1-meter interval up to the drilled depth.
3. To collect disturbed & undisturbed soil samples.
4. To log soil strata of borehole as per ASTM D-2488.
5. To locate water table.
6. To carry out necessary field & laboratory tests.
7. To recommend allowable bearing capacity.

C. GEOLOGY

C-1 REGIONAL GEOLOGY

The project site comprises typical deposits of the Punjab plains. The sediments in the project have been deposited rivers Ravi. These deposits are typically a few meters of cohesive silts and plasticity clays underlain by fine to medium silty to fine sands. There are erratic incidents of the presence of thin lenses of cohesive materials, sandwiched within the thick sandy strata.

C-2 SITE AREA GEOLOGY

The project area has the following salient geological characteristics:

- No bedrock outcrops are visible at the site.
- The overburden soils are visible as clayey silts/ silt on the surface.
- Thickness of the overburden soils is more than the investigated depth of 10 meters below NSL.
- The area is generally flat and stable.

- Drainage of the area has to be properly addressed.

C-3 SEISMICITY OF THE SITE

The project site is located in Zone-2A as per the recently revised provisions (2007) of Building Code of Pakistan. Zone-2A indicates slight degree of damage during the seismic loading. This corresponds to an intensity of V to VI on the Modified Mercalli (MM) scale.

Keeping in view the seismotectonic set up of the project site and the degree of importance of the structures of the proposed project, it is recommended that the structures should be designed to withstand minimum average horizontal peak ground acceleration (PGA) of 0.12 g. This PGA has 10% probability of exceedance in 50 years.

D. GEOTECHNICAL INVESTIGATIONS

The subsurface investigation was carried out in accordance ASTM D420-87. The investigation consists of the following:

SECTION-I

Field Investigations

SECTION-II

Laboratory Testing

SECTION-III

Foundation Analysis

SECTION – 1

1.1 FIELD INVESTIGATION

Field investigation comprises the following:

1.1.1 DRILLING

As per recommended practice of ASTM D-420, the site has been explored with percussion method. The hole was advanced by chopping the subsoil and then cleaning it by bailing out the soil with the bailer attached with the percussion string. Subsoil samples were collected from borehole at an interval of 1 meter up to the drilled depth.

1.1.2 STANDARD PENETRATION TEST

The objective of this test is to ascertain the resistance afforded to the penetration apparatus in order to obtain an estimate of the in-situ properties. The test gives valuable information about the degree of compactness of the soil. The test has been performed in

accordance with ASTM D1586-84. As per TOR, this test was performed from a depth of 1-meter to drilled depth at an interval of 1 meter. The N-value of strata varies in borehole from 8 to 19. The N-value of hole is given below as well as on boring log/ summary sheet.

Depth (meter)	SPT N-Value	Consistency
1	3+3+5 = 8	Stiff
2	4+5+8 = 13	Stiff
3	3+3+4 = 8	Stiff
4	3+5+6 = 11	Stiff
5	4+5+7 = 12	Stiff
6	5+7+6 = 13	Stiff
7	5+5+7 = 12	Stiff
8	5+6+7 = 13	Stiff
9	5+7+8 = 15	Stiff
10	5+9+10 = 19	Stiff

1.1.3 DISTURBED & UNDISTURBED SAMPLING

After the boring is advanced to the desired sampling depth, the disturbed & undisturbed samples were collected. These were preserved in the Jars after proper indexing and transported to the laboratory for further testing.

1.1.4 BULK DENSITY, FIELD M.C. & SUBMERGED DENSITY

The samples collected from borehole have been subjected for determination of their bulk density and field moisture content. The values are given below as well at summary sheet.

Depth (meter)	Bulk density (kN/m^3)	Moisture Content (%)
1.5	18.8	6.30
3.5	16.4	5.90
4.5	16.6	5.84
8.5	16.9	7.53

1.1.5 WATER TABLE

The water table was not encountered up to the drilled depth during April, 2015.

SECTION – 2

2.1 LABORATORY TESTING

The samples collected from site after proper treatment, were subjected to the following tests:

1. **Classification Tests.**
   - i) Grain Size Analysis
   - ii) Consistency limits
     - a- Liquid Limit.
     - b- Plastic Limits.
     - c- Plasticity Index.
2. **Strength Test (C Value)**
   - i) Unconfined Compression Test
3. **Chemical Analysis**

2.2 SOIL CLASSIFICATION

To classify the soil as per unified soil classification ASTM D-2487 has been adopted for which grain size analysis and determination of consistency limits is a prerequisite.

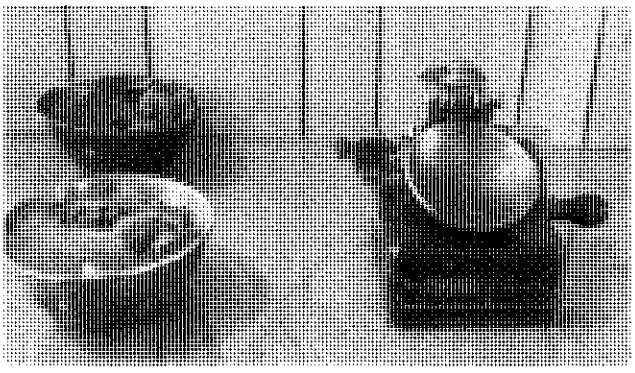
2.2.1 GRAIN SIZE ANALYSIS

Grain size distribution of various fractions of soil samples retrieved from different depths, were subjected to sieve analysis and sedimentation tests.

Soil samples collected from various depths after treating properly have been sieved under wet conditions as per ASTM D421 & D422. The curves have been plotted graphically and are attached with.

2.2.2 CONSISTENCY LIMITS

3 Nos. Soils samples selected for the determination of consistency limits (Liquid limits, Plastic limits and Plastic Index). One of them falls in cohesive soil which were determined as 26% liquid limit and 5% plastic index. The remaining ones are non-cohesive soil.



2.2.3 SOIL CLASSIFICATION

Grain size analysis and consistency limits were used to classify the soil column in accordance with ASTM D-2487 which shows group symbol and group name.

The soil column from Existing Ground Level (EGL) to 2.5 meter comprises of clayey silt (CL-ML). It was underlain by sandy silt (ML). The detailed soil classification has been given at summary sheets.

2.3 STRENGTH TESTS

2.3.1 Unconfined Compression Test

3 Nos. Soils samples retrieved with the help of Shelby tubes were subjected to unconfined compression test. One of them was determined as 1.1 TSF and strain 4.5% and others were collapse because of non-cohesive stratum.

SECTION – 3

3.1 FOUNDATION ANALYSIS

3.1.1 INTRODUCTION

Consultant requires knowledge about the magnitude of loading, type of structure and subsoil characteristics for foundation design. Soil beneath foundation should be capable of with standing the stresses produced by the service load of the structure, otherwise there may be a shear failure. The second condition implies, that excessive consolidation is harmful for the structure. This can be achieved by spreading the load of the structure by designing suitable foundation. Safety factor 3 has been adopted for normal loading conditions.

3.1.2 SITE CHARACTERIZATION AND DEPTH

The soil column from Existing Ground Level (EGL) to about 2.5 meter comprises of clayey silt (CL-ML). It was underlain by sandy silt (ML). The SPT value showed that the underlying strata are medium packed which is suggestive that it is quite competent to support the vertically imposed load. The consultant has desired to calculate allowable bearing capacity for Isolated column footing for building structure foundation.

3.2 BEARING CAPACITY ANALYSIS

3.2.1 ALLOWABLE BEARING CAPACITY (SHEAR FAILURE CRITERIA)

The general equation of bearing capacity based on shear failure criteria was developed by Terzaghi (1943) and adopted by ASCE (1993) has been used to calculate the allowable bearing capacity. Since entire soil profile below proposed foundation depth comprises non-cohesive strata, so following reduced relation has been opted for the calculation of allowable load for strip & square footing.

$$qu = qN_q + 0.5\,\gamma b\, B\, N_\gamma\, \delta_\gamma$$

Where

qu = Ultimate bearing capacity (TSF)

γ_b = Bulk density

Z = Depth of footing

B = Assumed minimum width = 2.44 meter

= Angle of shear = 29°

δ = Effective angle of shear = 0.75 δ = 21.75°

N_q & N_γ = Base on local shear failure 7.66 & 3.76

S_γ = Shape factor = 1.0 for column

Factory of Safety = 3

Depth of footing *meter / reduce level*	Width of footing *(meter)*	Allowable bearing load Isolated (qa)	
		TSF	Kpa
1.0 / 208	2.44	0.929	99.636
2.0 / 207	2.44	1.010	108.323
3.0 / 206	2.44	1.020	109.396
4.0 / 205	2.44	1.020	109.396
5.0 / 204	2.44	1.020	109.396

6.0 / 203	2.44	1.020	109.396
7.0 / 202	2.44	1.020	109.396
8.0 / 201	2.44	1.020	109.396
9.0 / 200	2.44	1.020	109.396
10.0 / 199	2.44	1.020	109.396

3.3 RECOMMENDATION

After an intensive and thorough exercise, following recommendations for Allowable bearing capacity adopted for Isolated footing at recommended depth.

Depth of footing *(meter)*	Width of footing *(meter)*	Allowable bearing load Isolated (qa)	
		TSF	kPa
2.0-meter (reduce level 207)	1.22	0.894	95.882
	1.83	0.952	102.103
	2.44	1.010	108.323
	3.05	1.069	114.652
	3.66	1.127	120.872

3.4 GENERAL PRECAUTIONS

1. The compaction of foundation trenches must be ensured to a minimum level of 95% modified proctor in accordance with ASTM/AASHTO Standards prior to the placement of foundation.
2. The sides of the trenches should be filled in with 6" well compacted layers.
3. The area around the building should be suitably drained. Ingress of moisture from any source will be harmful to the foundation. There should be no leakage water and sewerage lines. These lines should be sufficiently away from the foundations.
4. The foundations should not be laid on any loose packet or filling.
5. No deep-rooted trees be allowed to grow near the foundations.

DIRECTOR
for **NOON GEO TECH**

SUMMARY SHEET

SUMMARY OF LABORATORY TEST RESULTS

Preparatory Survey on the Project for Improvement of TSG Training Center on Grid System Operations and Maintenance at Lahore in the Islamic Republic of Pakistan

Borehole/ sample No.	Depth (meter)	SPT N-value (per foot)	Specific Gravity	Grain Size Analysis				Atterberg Limits		Bulk Density		Unconfined compression		Direct Shear		Sulphate content in soil %	Soil Classification Group Symbol
				Gravel	Sand	Silt	Clay% (0.002)	LL	PI	γb	N.M.C	qu	Strain	C	ϕ		
				%	%	%		%	%	KN/m^3	%	TSF	%	KN/m^2	degree		
BH 1																	
SPT-1	1.0	8		7	12	73	8	Non-Plastic			8.70					0.012	CL-ML
UDS-1	1.5									18.8	6.30	1.1	4.5				
SPT-2	2.0	13	2.68	5	10	75	10	26	5		6.80						CL-ML
SPT-3	3.0	8		0	30	70	0	Non-Plastic			6.90						ML
UDS-2	3.5									16.4	5.90						
SPT-4	4.0	11		0	32	68	0	Non-Plastic			5.50			0.0	29.0		ML
UDS-3	4.5									16.6	5.84						
SPT-5	5.0	12		0	38	62	0	Non-Plastic			6.30						ML
SPT-6	6.0	13		0	36	64	0	Non-Plastic			5.00			0.0	29.3		ML
SPT-7	7.0	12		0	41	59	0	Non-Plastic			4.70						ML
SPT-8	8.0	13		0	34	66	0	Non-Plastic			7.32						ML
UDS-4	8.5									16.9	7.53						
SPT-9	9.0	15	2.630	0	37	63	0	Non-Plastic			6.48						ML
SPT-10	10.0	19		0	38	62	0	Non-Plastic			6.30						ML

Lab Incharge / Engineer

BORE LOG

BORING LOG

JOB DESCRIPTION

PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF TSG TRAINING CENTER ON GRID SYSTEM OPERATIONS AND MAINTENANCE AT LAHORE IN THE ISLAMIC REPUBLIC OF PAKISTAN

BH NO.: *1*

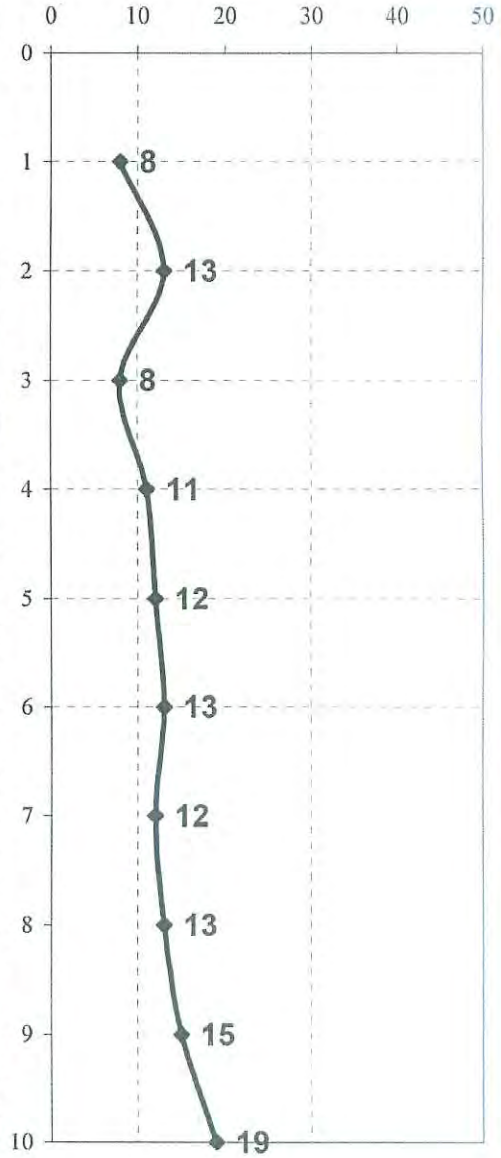
SHEET NO. : *1 of 1*

WATER TABLE : *Nil*

LOGGED BY : *Salamat*

Depth (meter)	Reduce level	Sample	Thick-ness	Strata Encountered	Legend
	208.53			Brown, stiff, clayey silt (CL-ML)	
1	208.03				
2	207.03		2.5		
3	206.03			Light brown / grey, stiff, sandy silt (ML)	
4	205.03				
5	204.03				
6	203.03				
7	202.03				
8	201.03				
9	200.03				
10	199.03		7.5		
				Bore hole closed	

SPT CURVE



LEGEND

- Disturbed sample (DS)
- Undisturbed sample (UDS)
- Water table (W.T.)
- SPT

Hafiz

Lab: Incharge / Engineer

NOON GEO TECH

PARTICLE SIZE DISTRIBUTION GRAPH

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PARTICLES SIZE & ATTERBERG LIMITS ANALYSIS

Project: TSG Training Center on Grid System Operations and Maintenance at Lahore.

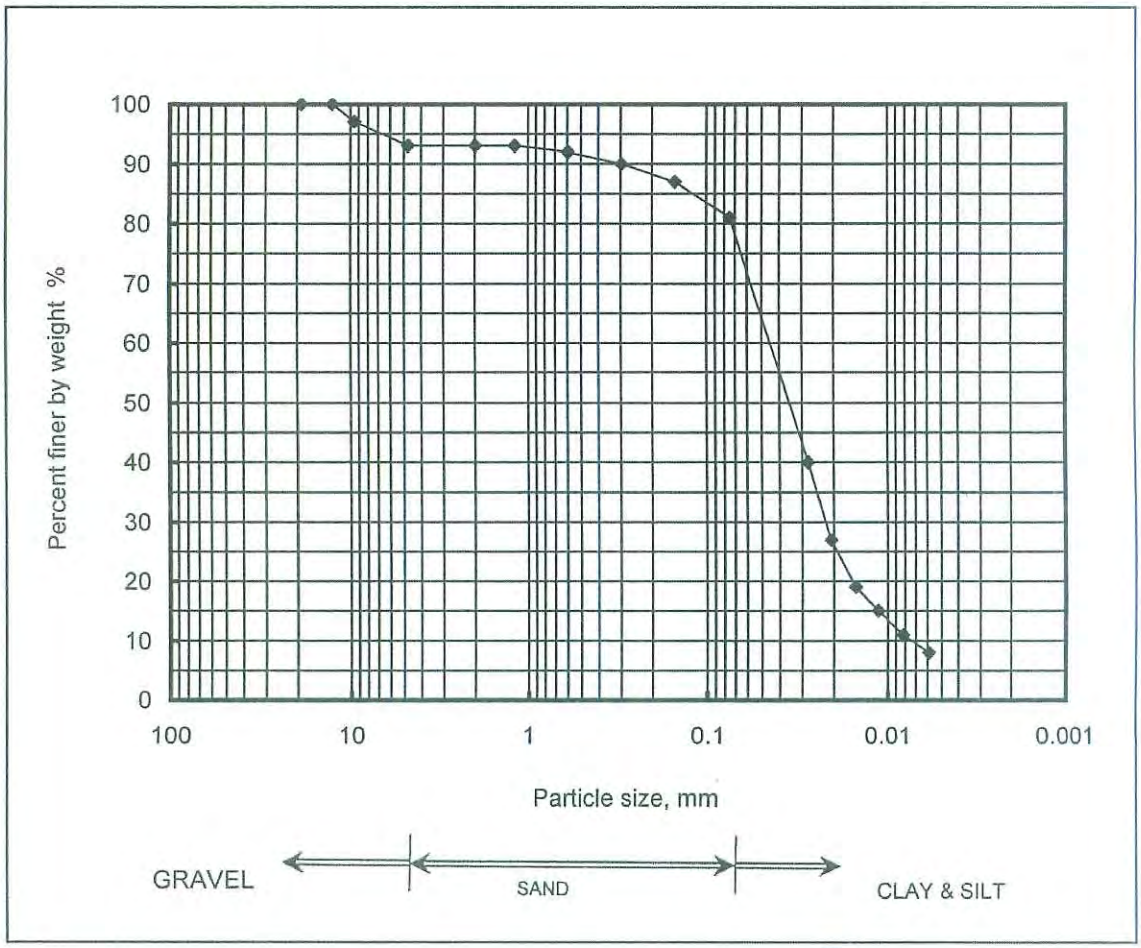
Material Type:	**Fine**	Bore Hole #	**1**
Test Method:	**ASTM D422**	Sample No.	**SPT-1**
Dated:	**10-Apr-15**	Depth: (m)	**1**

Gravel= **7%**	Sand= **12%**	Clay & Silt= **81%**

Liquid Limit= %

Plastic Limit= %

Plasticity Index= %



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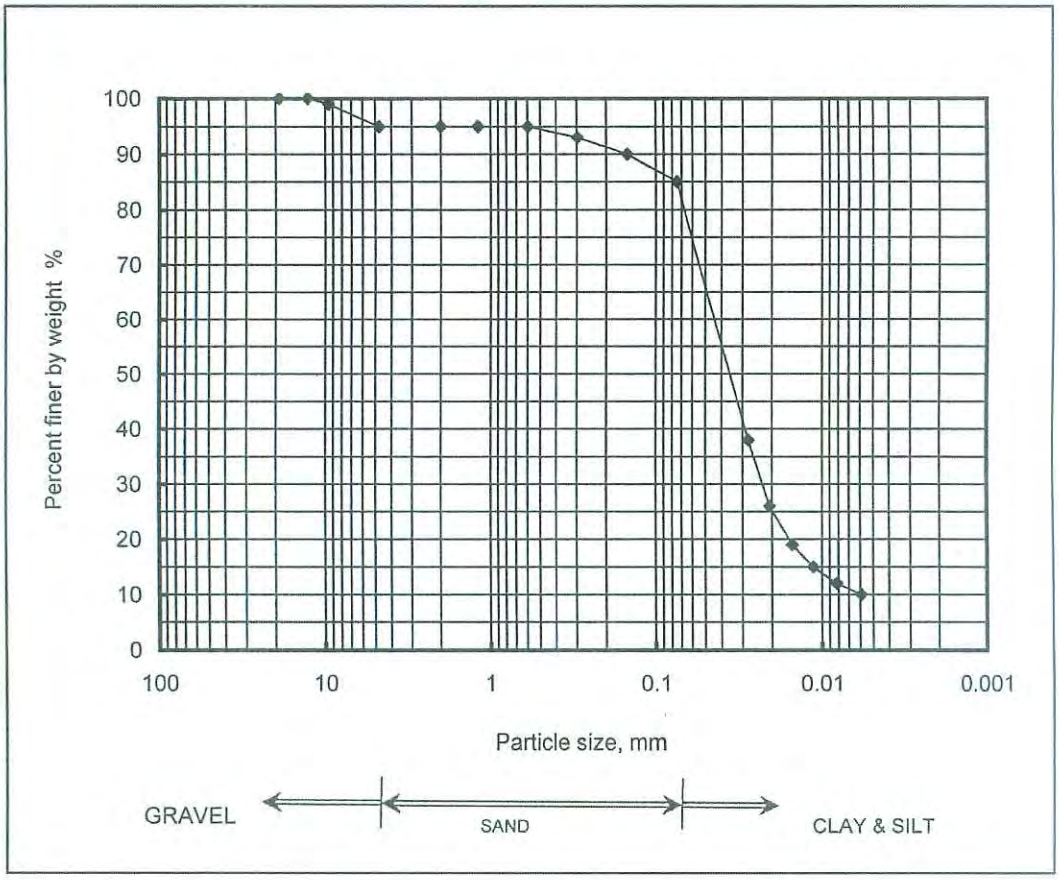
PARTICLES SIZE & ATTERBERG LIMITS ANALYSIS

Project: TSG Training Center on Grid System Operations and Maintenance at Lahore.

Material Type:	**Fine**	Bore Hole #	**1**
Test Method:	**ASTM D422**	Sample No.	**SPT-2**
Dated:	**10-Apr-15**	Depth: (m)	**2**

Gravel= **5%**	Sand= **10%**	Clay & Silt= **85%**

Liquid Limit= %
Plastic Limit= %
Plasticity Index= %



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PARTICLES SIZE & ATTERBERG LIMITS ANALYSIS

Project: TSG Training Center on Grid System Operations and Maintenance at Lahore.

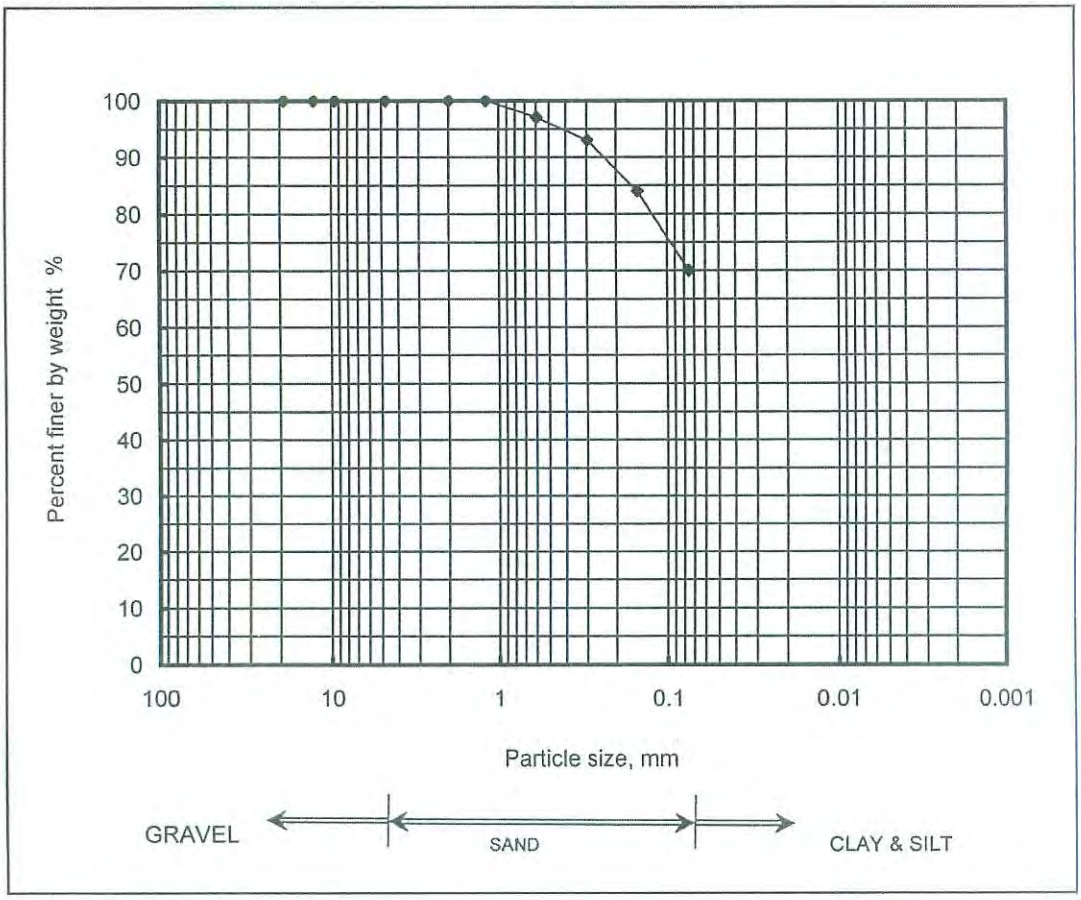
Material Type:	**Fine**	Bore Hole #	**1**
Test Method:	**ASTM D422**	Sample No.	**SPT-3**
Dated:	**10-Apr-15**	Depth: (m)	**3**

Gravel=	**0%**	Sand=	**30%**	Clay & Silt=	**70%**

Liquid Limit= %

Plastic Limit= N.P. %

Plasticity Index= %



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PARTICLES SIZE & ATTERBERG LIMITS ANALYSIS

Project: TSG Training Center on Grid System Operations and Maintenance at Lahore.

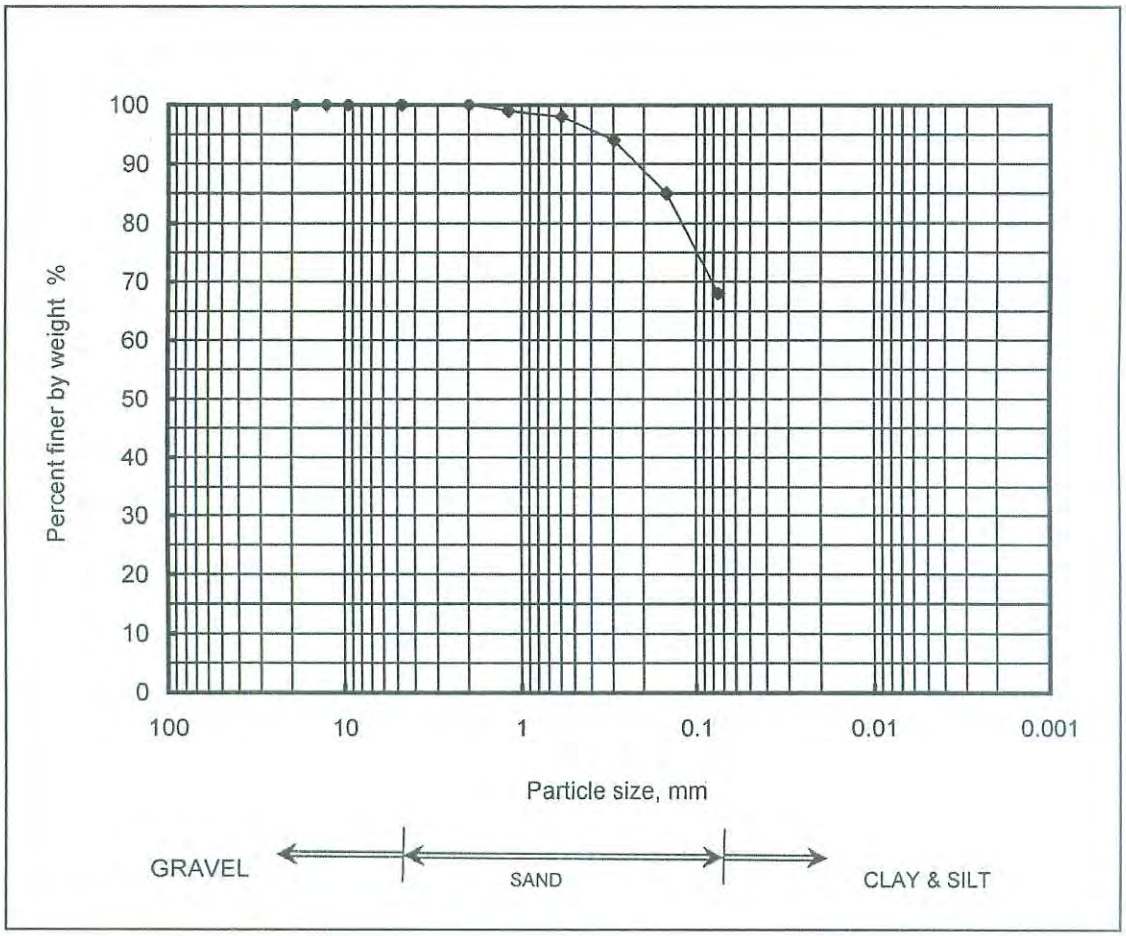
Material Type:	**Fine**	Bore Hole #	**1**
Test Method:	**ASTM D422**	Sample No.	**SPT-4**
Dated:	**10-Apr-15**	Depth: (m)	**4**

Gravel=	**0%**	Sand=	**32%**	Clay & Silt=	**68%**

Liquid Limit= %

Plastic Limit= N.P. %

Plasticity Index= %



Lab: Incharge / Engineer

NOON GEO TECH

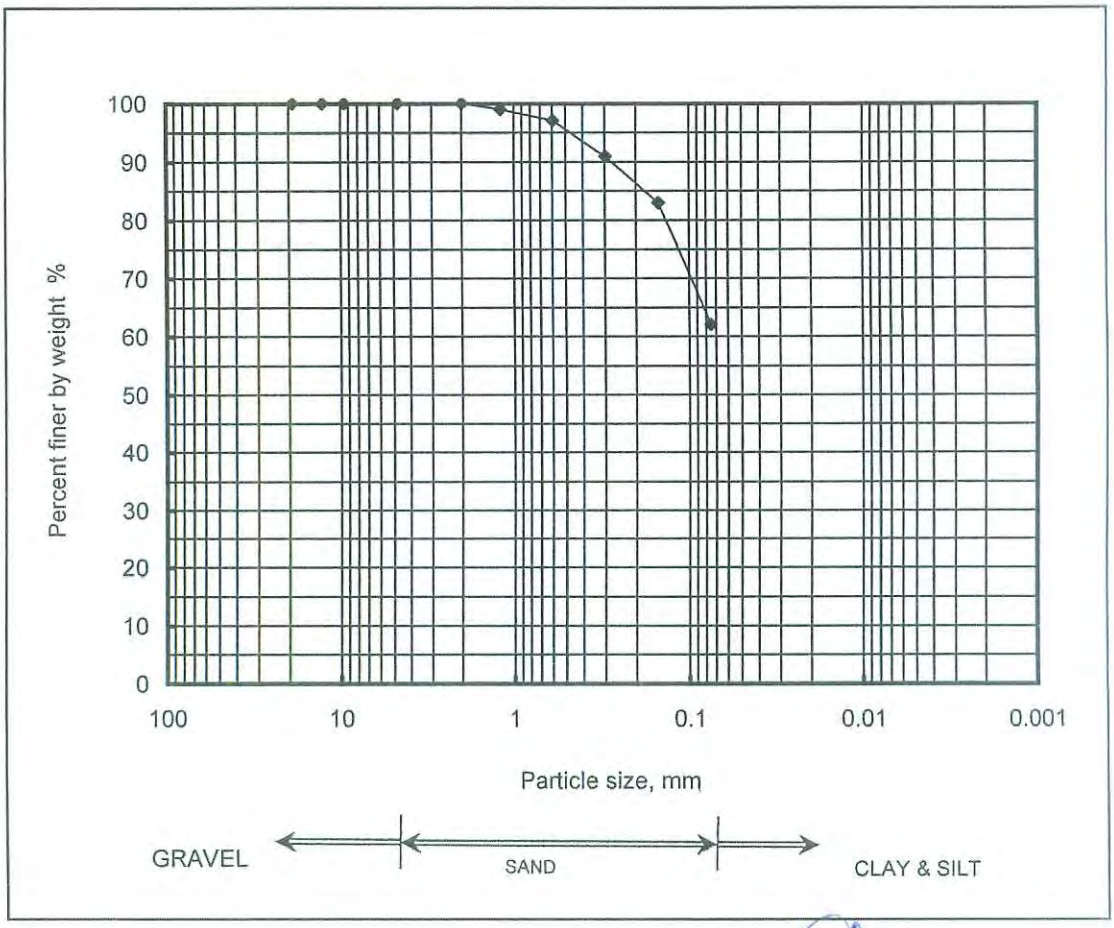
PARTICLES SIZE & ATTERBERG LIMITS ANALYSIS

Project: TSG Training Center on Grid System Operations and Maintenance at Lahore.

Material Type:	**Fine**	Bore Hole #	**1**
Test Method:	**ASTM D422**	Sample No.	**SPT-5**
Dated:	**10-Apr-15**	Depth: (m)	**5**

Gravel=	0%	Sand=	38%	Clay & Silt=	62%

Liquid Limit=	29.0	%
Plastic Limit=	20.0	%
Plasticity Index=	9.0	%



Lab: Incharge / Engineer

NOON GEO TECH

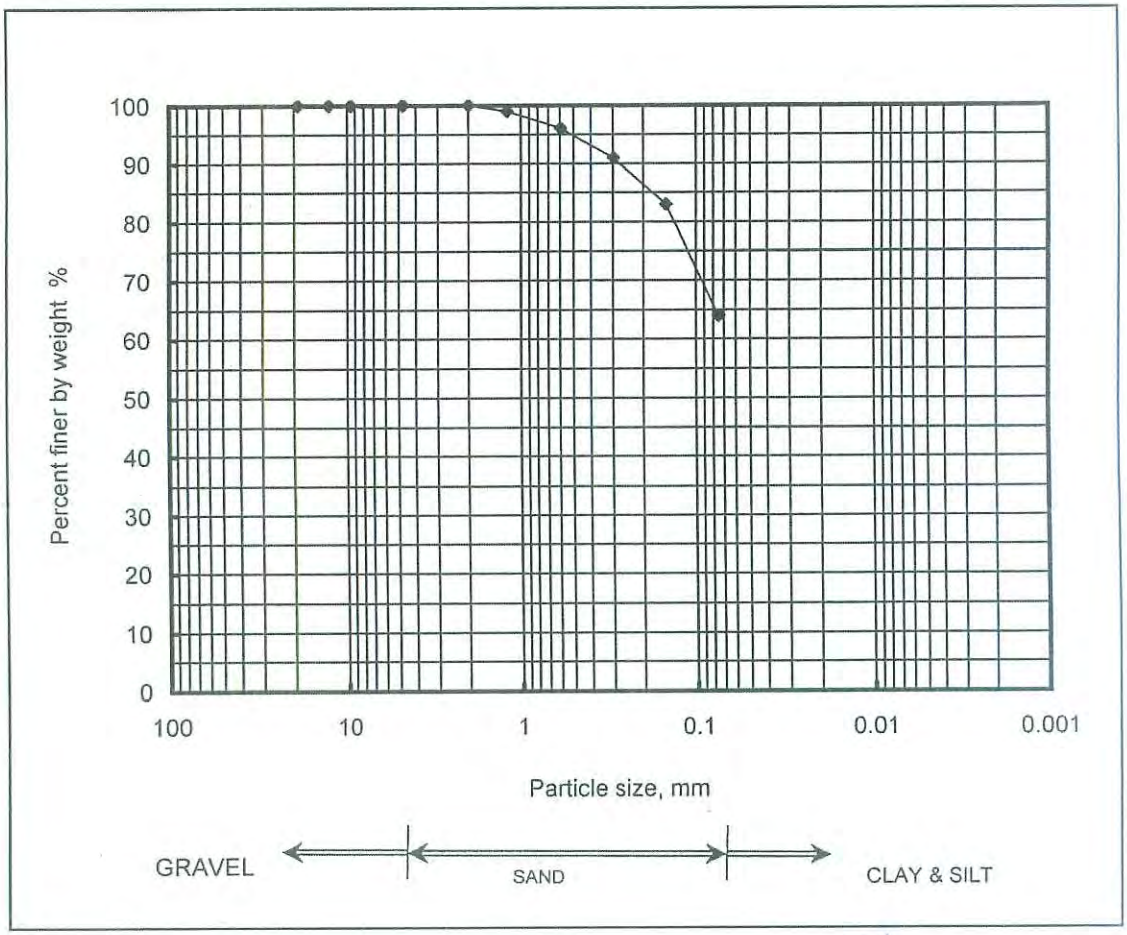
PARTICLES SIZE & ATTERBERG LIMITS ANALYSIS

Project: TSG Training Center on Grid System Operations and Maintenance at Lahore.

Material Type:	**Fine**	Bore Hole #	**1**
Test Method:	**ASTM D422**	Sample No.	**SPT-6**
Dated:	**10-Apr-15**	Depth: (m)	**6**

Gravel= **0%**	Sand= **36%**	Clay & Silt= **64%**

Liquid Limit= %
Plastic Limit= **NP** %
Plasticity Index= %



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NOON GEO TECH

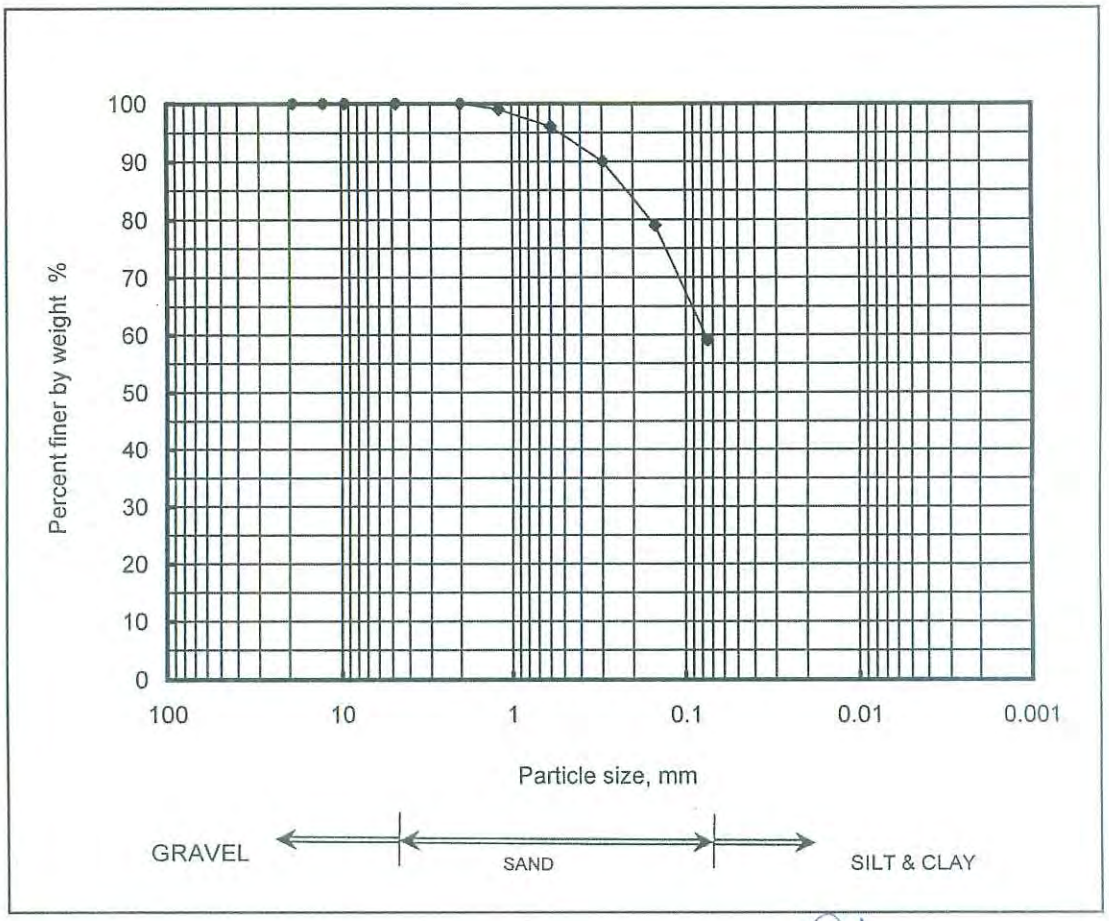
PARTICLES SIZE & ATTERBERG LIMITS ANALYSIS

Project: TSG Training Center on Grid System Operations and Maintenance at Lahore.

Material Type:	**Fine**	Bore Hole #	**1**
Test Method:	**ASTM D422**	Sample No.	**SPT-7**
Dated:	**10-Apr-15**	Depth: (m)	**7**

Gravel= **0%**	Sand= **41%**	Silt & Clay= **59%**

Liquid Limit= %
Plastic Limit= **N.P.** %
Plasticity Index= %



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NOON GEO TECH

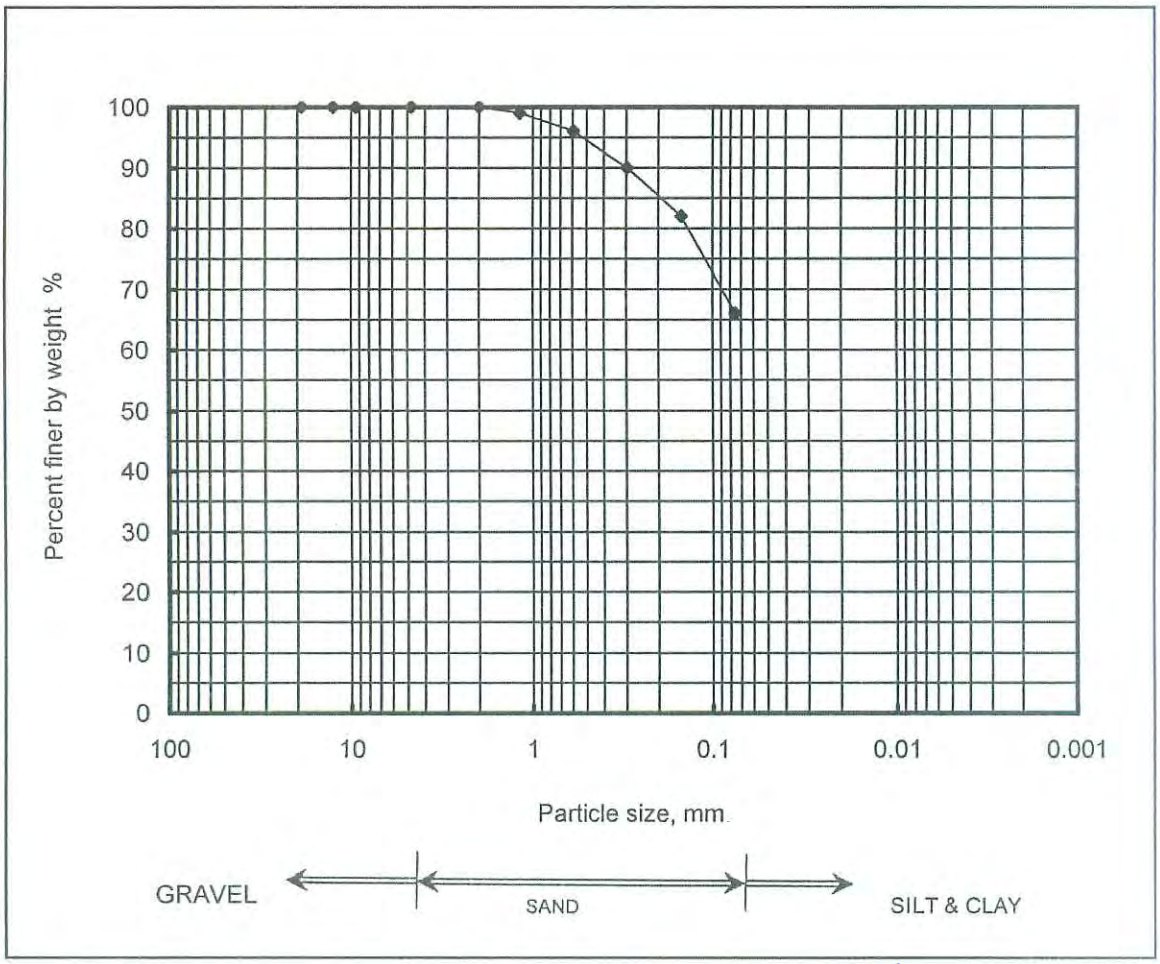
PARTICLES SIZE & ATTERBERG LIMITS ANALYSIS

Project: TSG Training Center on Grid System Operations and Maintenance at Lahore.

Material Type:	**Fine**	Bore Hole #	**1**
Test Method:	**ASTM D422**	Sample No.	**SPT-8**
Dated:	**10-Apr-15**	Depth: (m)	**8**

Gravel= **0%**	Sand= **34%**	Silt & Clay= **66%**

Liquid Limit= %
Plastic Limit= **N.P.** %
Plasticity Index= %



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NOON GEO TECH

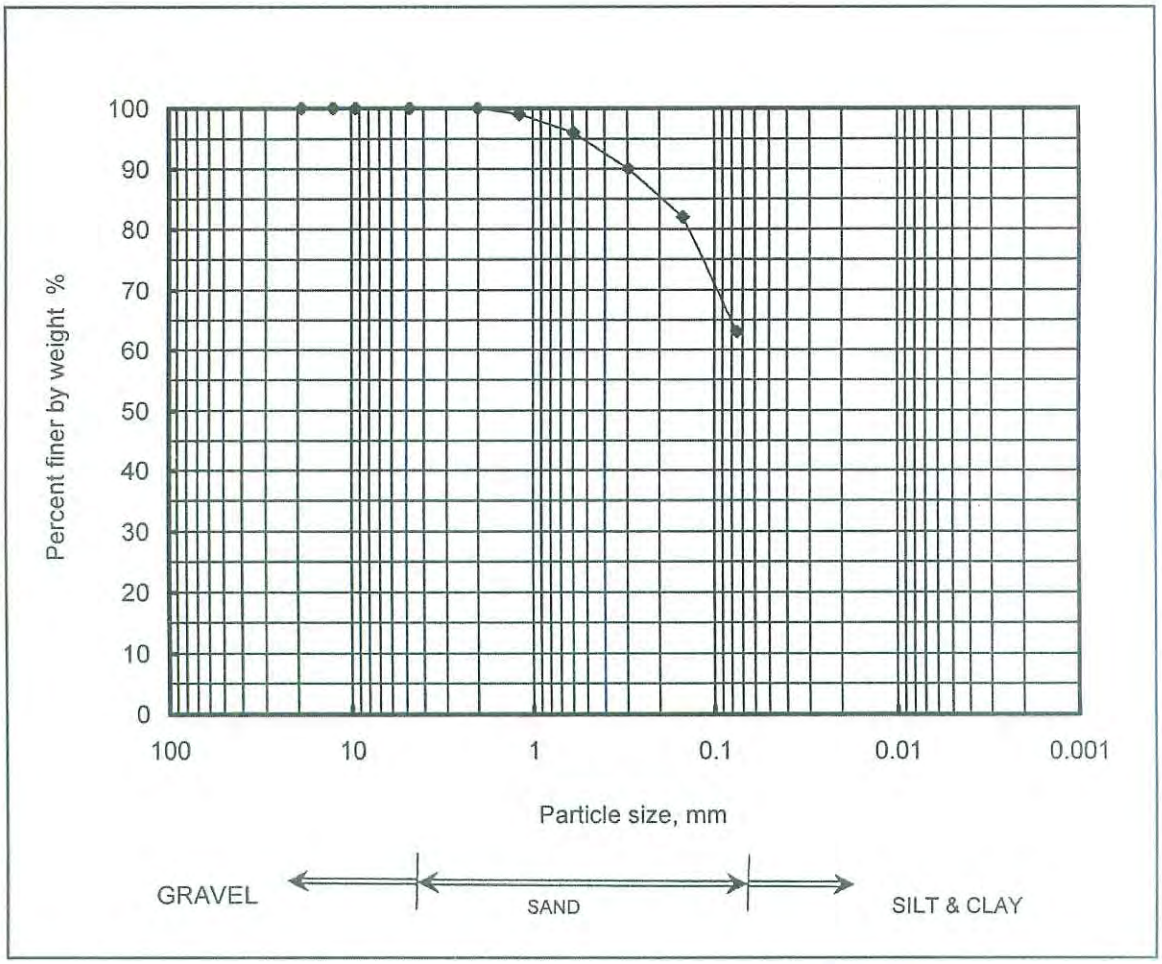
PARTICLES SIZE & ATTERBERG LIMITS ANALYSIS

Project: TSG Training Center on Grid System Operations and Maintenance at Lahore.

Material Type:	**Fine**	Bore Hole #	**1**
Test Method:	**ASTM D422**	Sample No.	**SPT-9**
Dated:	**10-Apr-15**	Depth: (m)	**9**

Gravel= **0%**	Sand= **37%**	Silt & Clay= **63%**

Liquid Limit= %
Plastic Limit= **N.P.** %
Plasticity Index= %



Lab: Incharge / Engineer

NOON GEO TECH

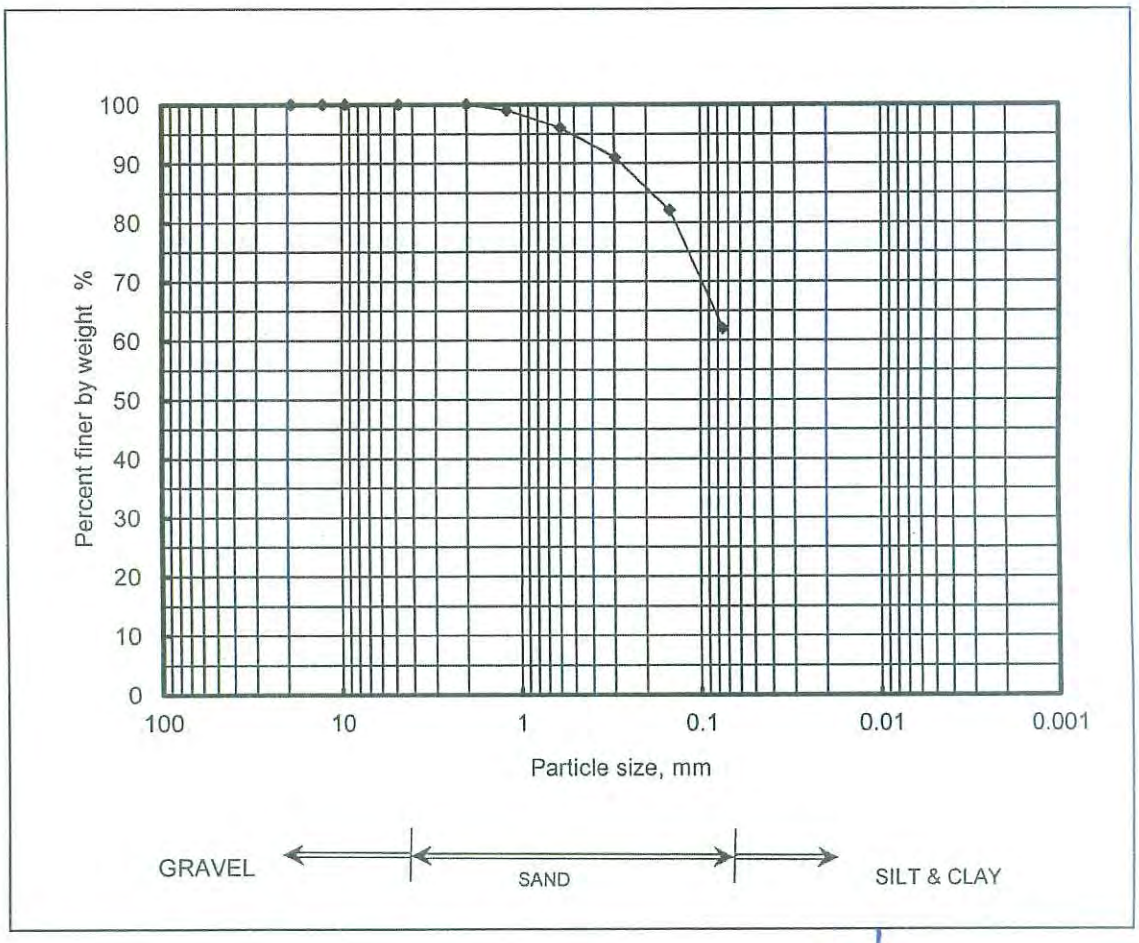
PARTICLES SIZE & ATTERBERG LIMITS ANALYSIS

Project: TSG Training Center on Grid System Operations and Maintenance at Lahore.

Material Type:	**Fine**	Bore Hole #	**1**
Test Method:	**ASTM D422**	Sample No.	**SPT-10**
Dated:	**10-Apr-15**	Depth: (m)	**10**

Gravel= **0%**	Sand= **38%**	Silt & Clay= **62%**

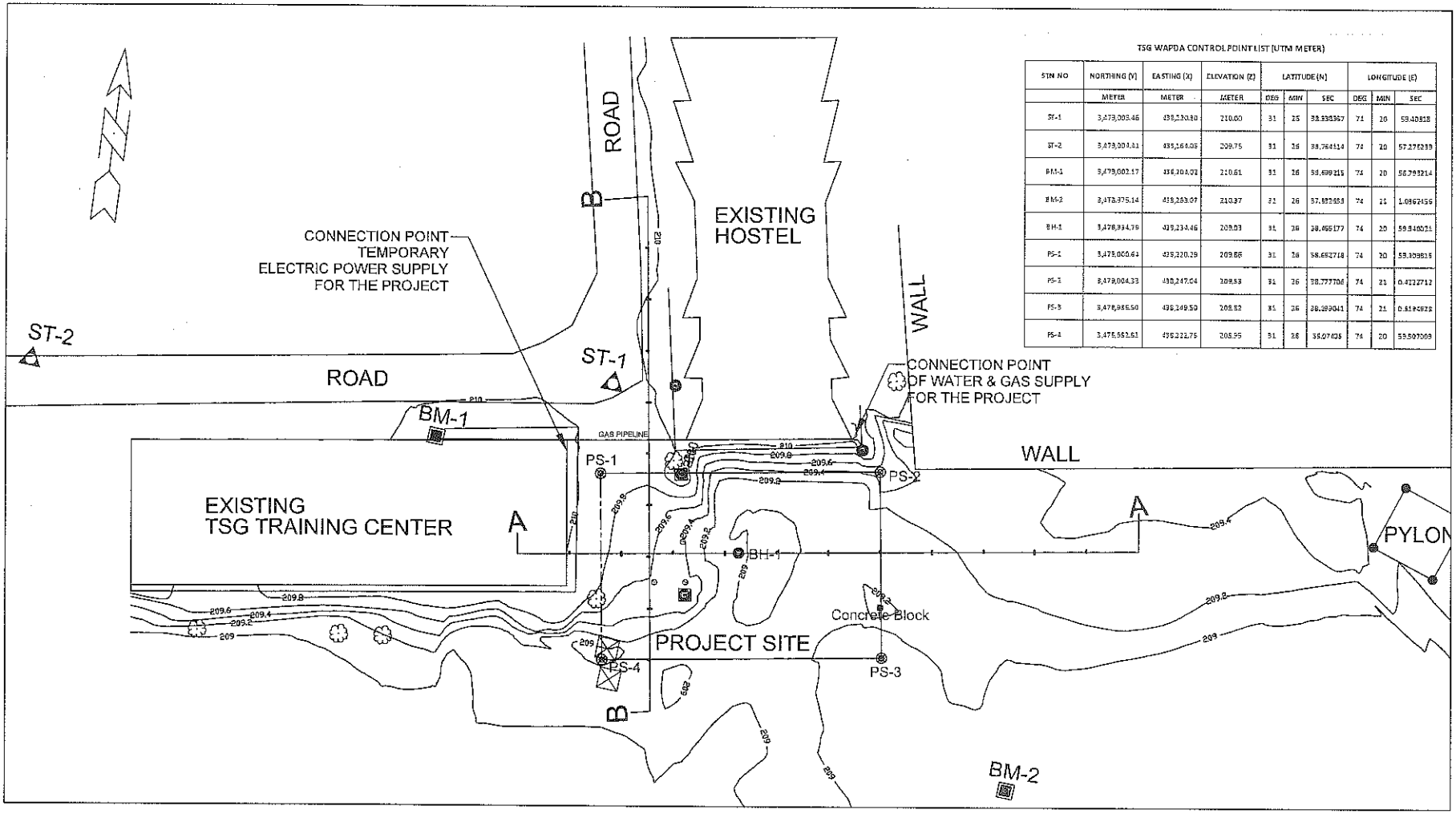
Liquid Limit= %
Plastic Limit= **N.P.** %
Plasticity Index= %



Lab: Incharge / Engineer

A-7-28

DRAWINGS



TSG WAPDA CONTROL POINT LIST (UTM METER)

STN NO	NORTHING (Y)	EASTING (X)	ELEVATION (Z)	LATITUDE (N)			LONGITUDE (E)		
	METER	METER	METER	DEG	MIN	SEC	DEG	MIN	SEC
ST-1	3,478,003.46	498,120.80	210.00	31	25	38.836357	74	20	59.40818
ST-2	3,478,004.11	498,164.05	209.75	31	25	38.764114	74	20	57.276239
BM-1	3,478,002.17	498,204.92	210.61	31	25	38.699215	74	20	56.793214
BM-2	3,478,375.14	498,253.07	210.87	31	26	57.822453	74	21	1.0867456
BH-1	3,478,334.79	498,234.46	209.03	31	26	38.695177	74	20	59.846021
PS-1	3,478,000.61	498,220.29	209.66	31	25	38.652718	74	20	59.309815
PS-2	3,478,004.33	498,247.04	208.58	31	25	38.777706	74	21	0.4222712
PS-3	3,478,355.50	498,249.50	208.52	31	26	38.199041	74	21	0.5194928
PS-4	3,478,362.61	498,222.75	208.95	31	26	38.07435	74	20	59.507009

A-7-30

PROJECT NAME :-

The Project for Improvement of TSG Training Center on Grid System Operations and Maintenance in the Islamic Republic of Pakistan

NOON GEO TECH

Drawn : by Abd Rauf

Surveyed by M Yamin

LEGEND:-

CONTROL POINT

BUILDING

TELEPHONE POLE (TP)

GAS PIPELINE

ROAD

BENCH MARK

ELECTRIC POLE

WALL

TREE

PYLON

CONTOUR 209.20

CONTOUR INDEX 209.00

MAIN HOLE

SITE NOTE:-

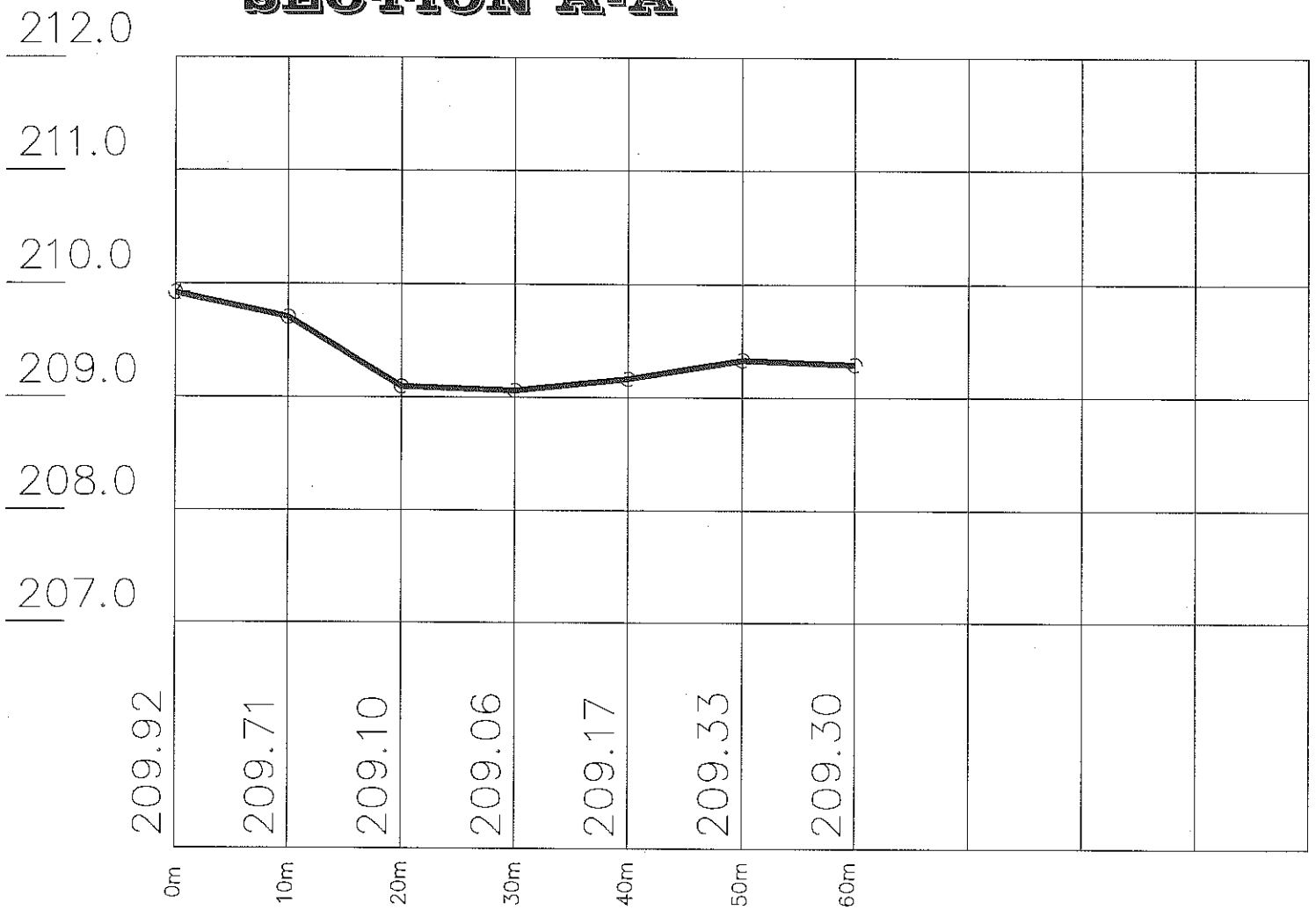
1) ALL DIMENSIONS ARE IN METER

2) COMPUTER GENERATED DRAWING

SCALE:- 1:400 SHEET= A3

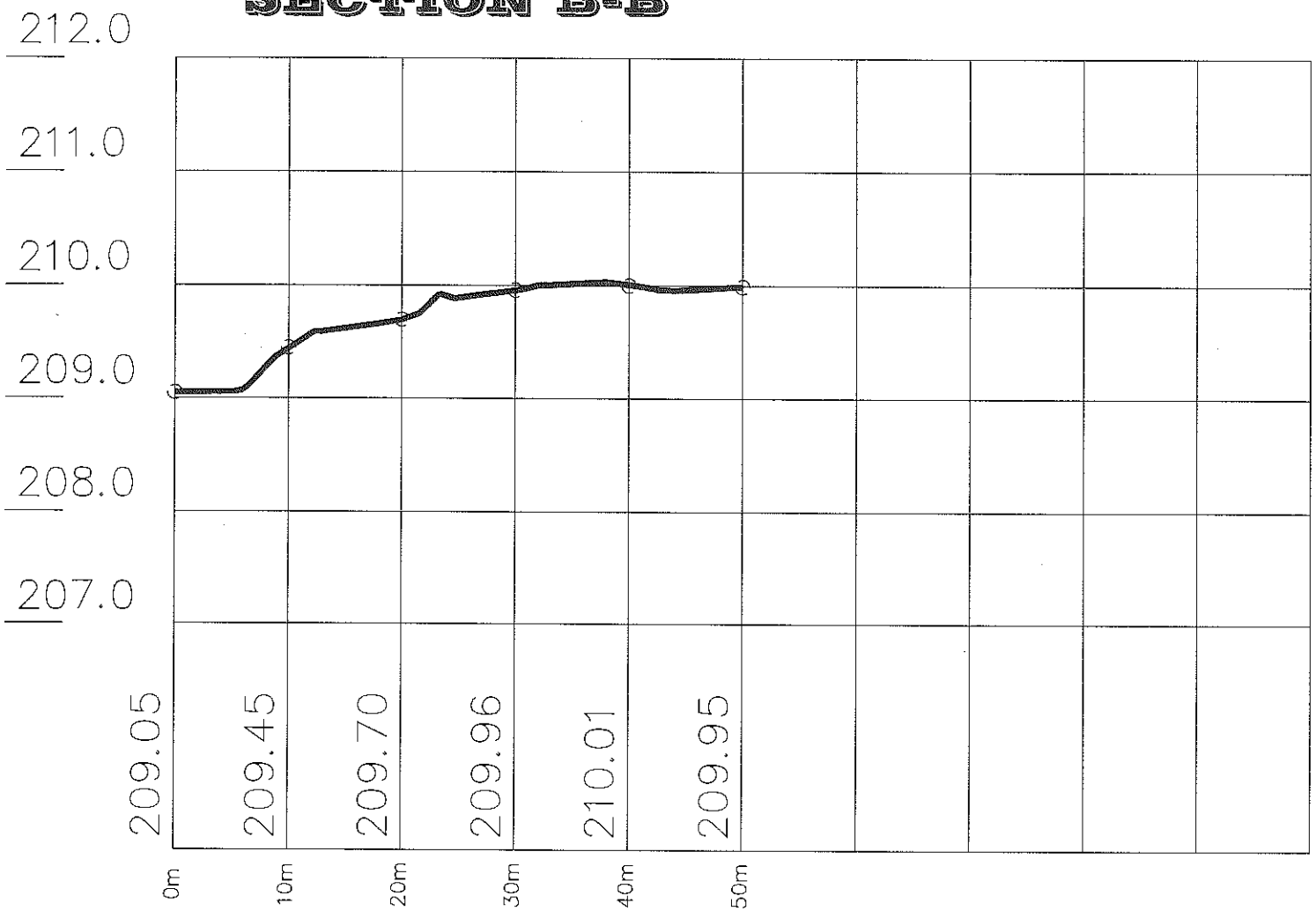
DATE :- 07-04-2015

SECTION A-A



PROJECT NAME :- The Project for Improvement of TSG Training Center on Grid System Operations and Maintenance in the Islamic Republic of Pakistan		LEGEND:-	SITE NOTE:-	SCALE:- 1:400 SHEET= A3
NOON GEO TECH	Drawn by Abd Rauf Surveyed by M Yamin			DATE :- 07-04-2015

SECTION B-B



PROJECT NAME :- The Project for Improvement of TSG Training Center on Grid System Operations and Maintenance in the Islamic Republic of Pakistan		LEGEND:-	SITE NOTE:-	SCALE:- 1:400 SHEET= A3
NOON GEO TECH	Drawn by Abd Rauf Surveyed by M Yamin			DATE :- 07-04-2015

CERTIFICATE

Pakistan Engineering Council

(Constituted under Pakistan Engineering Council Act, 1976 enacted by the Parliament)

Ataturk Avenue (East),
G-5/2, Islamabad.

No.PEC/C6/42036

October 10, 2014

M/s. NOON GEO TECH
563-II-A-2 TOWNSHIP
LAHORE

Subject: **REGISTRATION/RENEWAL OF CONSTRUCTORS LICENCE**

Dear Sir:

We are enclosing Registration/Renewal Licence no. **C6/42036** valid upto December 31, **2014** in category **C6** for undertaking projects upto **15** Million rupees.

Please ensure that payments to all Engineers are made in the form of crossed cheque in favour of individual Engineers after deducting the Income Tax from the salary. Your licence for the next year may not be renewed if you fail to produce proof of payment of salary to Engineers in the manner mentioned above.

This Registration/Licence is being issued to you on the basis of information in your application and related documents furnished by you. If subsequently any of such information is discovered to be false, it shall be considered as misconduct and such Registration/Licence can be cancelled and the person or firm concerned shall be liable to be punished accordingly.

This registration certificate shall remain valid upto 31 December **2014**

Application for change in category or fields of specialization shall not be entertained during the currency of above registration certificate.

The Licencee shall inform PEC of any events taking place after grant of a licence to him or renewal thereof which render him ineligible for continuation of licence in accordance with the PEC Construction & Operation of Engineering Works By Laws 1987.

Please quote Licence no. **C6/42036** for future correspondence with the Council.
Kindly acknowledge Receipt.

Note:
Subsequent renewal of your license will be only carried out on the basics of your performance for last three years and PCP requirements.

Yours Faithfully,

Hussain

(Deputy Registrar)

APPENDIX 8
LANDHOLDING CERTIFICATE

Appendix 8. Landholding Certificate

NATIONAL TRANSMISSION AND DESPATCH CO. LTD.

Chief Engineer (TSG) NTDCL

No: 1902 /CE/TSG/NTDCL/GS-138 Dated. 13 04/2015

Subject: **SIMUILATOR PROJECT SITE OWNERSHIP CERTIFICATE**

It is certified that the Simulator Project Site at TSG Training Center, New Kot Lakhpat, Lahore, is in the ownership of Chief Engineer (TSG) on behalf of NTDCL

Chief Engineer, TSG,
NTDC, Lahore

TSG Training Centre, 220kV G/Station, New Kot Lakhpat, Lahore Tel: 042 35821418 Fax: 042 35821498