Republic of Tajikistan
Ministry of Energy and Water Resources (MoEWR)
Barki Tojik (BT)

Preparatory Survey Report on the Project for Improvement of Substations in Dushanbe in the Republic of Tajikistan

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Summary

Summary

① Country Profile

The Republic of Tajikistan (hereinafter referred to as "Tajikistan") is a mountainous, landlocked country in Central Asia with an area of 143,100 km2 (approximately 40% of the land area of Japan). It is located on the path of the ancient Silk Road and bordered by Afghanistan to the south, the Republic of Uzbekistan to the west, the Kyrgyz Republic to the north, and the People's Republic of China to the east. It is covered by mountains of the Pamir range, and more than fifty percent of the country is over 3,000 meters above sea level.

Tajikistan declared independence in1991 after the collapse of the U.S.S.R. and celebrates the 25th anniversary of independence on 9th September, 2016. Meanwhile, despite the period of sluggish economy due to the civil war, the expansion of economy has been robust with a mean annual economic growth rate of 8.6% since the end of the civil war in 1997. Agriculture, most notably cotton cultivation, is the largest sector of economy and employment, and 65% of the working population is engaged in agriculture. The manufacturing industry sector primarily consists of aluminum refining making use of the inexpensive electric power from abundant hydropower generation. The aluminum thus produced is a main item of export along with cotton.

Although population has increased from 5.30 million in 1990 to 8.67 million in 2015, the improvement of the standard of living has been slow after the devastation from the civil war, and Tajikistan is regarded as having the lowest standard of living among the former U.S.S.R. countries.

Tajikistan is a country with an exceptionally large hydropower potential, which is derived from the abundant snowmelt in mountainous areas and rainfall in watersheds. As much as 94% of the electric power supply capacity is generated at large and medium-sized hydropower stations (11 units in 8 locations) and small hydropower stations (about 300), the rest comes from three cogeneration thermal power stations. The annual output of hydropower generation represents 64% of the primary energy supply in 2012, raising the rate of self-sufficiency in primary energy to 74%.

However, the output of hydropower generation diminishes in winter because of the decrease in snowmelt and the low flow rates resulting from the freezing of rivers in watersheds. Thermal power generation cannot compensate for the decrease in hydro power generation to meet the high demand from space heating in winter, and planned outage needs to be enforced in winter in this situation.

Although the decrease in hydro power generation in winter used to be supplemented with the power from thermal power generation in Uzbekistan using a scheme of regional power interchange, the shortage of power in winter has been aggravating since the termination of power exchange in 2009.

Furthermore, district heating systems depending on the supply of natural gas from Uzbekistan, has been affected by the fact that the pipeline from Uzbekistan has not been

operated since 2013, resulting in the shift of energy sources to electric heating, coal, wood, etc. In particular, the shift to electric heating, considered to be a result of the low pricing of electric power, is a cause of serious electric power shortage, combined with the low power generation in winter.

On the other hand, there is a prospect that a new source of energy can be obtained through the reduction of power loss, which currently is higher than that in Western countries. Various actions have begun, including the effective use of the power grid and the renewal of inefficient superannuated facilities, as well as the promotion of energy-saving and power-saving on the side of users.

② Profile of the Capital Dushanbe and Project Sites

As the capital city serving as the political, economic, and social center of the country, the capital Dushanbe has been undergoing the development and reinforcement of metropolitan functions. At the same time, rapid expansion of urbanization is also taking place as a result of the inflow of population, causing various problems that must be addressed promptly.

The supply of electric power in Dushanbe is delivered to the residents and business buildings in the four main urban blocks, the factories and individual houses in the industrial zone and the suburbs, and some other users. The four main urban blocks feature the accumulation of organizations and facilities that are important for administration, economy, and life in society, such as the government, government agencies, educational and healthcare institutions, and business enterprises. The capital has a population of 0.8 million in 2016 with the annual population growth rate of about 2.5%.

Because of the large number of important users and the high density of electric power demand, Dushanbe is given preferential treatment and is excluded from the target of planned outage in winter. However, as urban becomes more and more dependent on electric power, the unstable power supply inevitably fails to meet the peak demand in winter, which is three times as high as that in summer.

③ Prevailing Circumstances and Issue of the Power Sector

The government department in charge of energy policies of Tajikistan, including electricity services, is the Ministry of Energy and Water Resources, which proposes and develops energy policies and related laws and implements these policies. This Ministry will be the government organization responsible for this project.

Under the control of the Ministry of Energy and Water Resources, the electricity services in Tajikistan are operated almost exclusively by Open Joint Stock Holding Company “Barki Tojik” (hereinafter referred to as “BT”). BT will be the implementing body of this project.

This company is a joint-stock company that owns power generation facilities and power transmission/distribution facilities (transmission, substation, and distribution), seamlessly conducting the operation of facilities and the retailing of electric power. It also provides district heating services using the energy from cogeneration thermal power stations. Shares are owned

100% by the national government. As a holding company, BT is operating in a group of subsidiary companies specializing in power distribution, maintenance services, etc.

Charged with the mission of serving for public interest, an electric power company must strive for the stable supply of inexpensive electric power, the improvement of the quality of electric power, the elimination of the areas without electricity, the improvement of energy use efficiency, and the mitigation of environmental impacts as the indispensable prerequisites for the development of economy and the improvement of life in society. However, BT is faced with many problems in these fields. In addition, there are problems in financial standing, such as the large amount of cumulative loss and the low collection rate of power charges, aggravating the tight financial situation.

While BT is a company clearly separated from the state in financial and legal aspects, the state requested BT to implement management reforms to solve its various problems. The government decided in the fall of 2011 to implement the management reform plan with the assistance of Asian Development Bank generally targeting at completion in 2018. The plan is currently ongoing.

The electric power system of Tajikistan is formed by 500-kV and 220-kV trunk power transmission lines. The 500-kV lines have been installed for the interconnection between the northern system and the southern system, the power transmission from the large hydropower sources in the southeast of Dushanbe to the vicinities of Dushanbe, and for the system interconnection with Kyrgyzstan and Uzbekistan ("Central Asia Power System," the regional interconnection system constructed in the U.S.S.R. era).

The 220-kV power transmission lines are used for the power transmission from hydropower stations and system interconnection (including interconnection with Afghanistan), similarly to the 500-kV lines, and in addition, they form the skeleton of the power network for the purpose of ensuring the reliability of supply.

For succeeding and building on Central Asia Power System, CASA-1000 (Central Asia South Asia Electricity Transmission and Trade Project) was established.

The CASA-1000 Project aims to transmit the abundant hydropower of Kyrgyzstan and Tajikistan to seriously undersupplied Pakistan via Afghanistan. The transmission from Sangtuda in Tajikistan to Peshawar in Pakistan via Kabul in Afghanistan is planned to be realized using 500-kV direct current transmission (HVDC: High Voltage DC Transmission Line) with low transmission loss. This will be one of the largest project in the world with the transmitted power of 1,300 MW.

Started in 2008, the project has been making great progress. It is currently in the stage of bidding for the two AC-DC conversion facilities to be installed in Tajikistan and Pakistan.

In the electric power system of Tajikistan, the local systems supplying to demand areas are composed of 110-kV and 35-kV systems carrying the power stepped down from the 220-kV

trunk network. Voltage is further stepped down at distribution substations for the supply to pole transformers, roadside transformers, etc. at 10 kV and 6 kV.

The 220-kV transmission substations and distribution substations, as well as power transmission lines and distribution lines connecting them, contain components that were constructed in the U.S.S.R. era and have since not been renewed.

With respect to the stable supply of electric power, planned outage in winter to cope with insufficient supply capacity has been enforced continuously in local areas. Even in urban areas, sudden outages occur in winter when protective devices are tripped by facility overloading resulting from the abrupt increase in demand. These outages are making considerable impacts on economy and life in society.

In addition, the occurrence of outages, the maintenance of voltage and frequency, and other aspects of the quality of electric power are strongly affected by the degree of reliability of power transmission, substation, and distribution facilities. Outages, voltage fluctuations, and other events resulting from facility troubles are taking place routinely throughout the year.

Investment in power transmission/distribution facilities has been made in several projects, such as the construction of 220-kV transmission lines and the rehabilitation of transmission substations, including those with the assistance of overseas donors. However, current efforts to augment supply capacity and reliability are insufficient with respect to the improvement in the central part of the capital Dushanbe, where construction of important facilities and redevelopment are accelerating and demand is increasing rapidly. The rehabilitation and capacity expansion of superannuated substations in the central part and the construction of new substations in the areas with high demand density are, therefore, considered an issue requiring urgent attention.

In addition, the enhancement of the supply capacity of distribution substations will also be effective in that the reduction of the load on adjacent substations will facilitate the appropriate planning of the renewal of adjacent facilities in the context of the mid- and long-term facility rehabilitation and expansion of the extensively superannuated power transmission/distribution facilities, which Tajikistan needs to promote in the future. It is also effective in terms of the improvement of the skills in how to implement facility renewal.

④ Background and Overview of the Project

The government of Tajikistan, considering this situation, applied for the Japanese grant aid project "The Project for Improvement of Substations in Dushanbe in the Republic of Tajikistan," which intends to conduct the facility rehabilitation and capacity expansion of a superannuated substation and the construction of a new substation in the capital Dushanbe for the purpose of the stable supply of electric power in the capital and the improvement of energy use efficiency, thereby contributing to sustainable economic and social development.

In response to this request, JICA sent the Preparatory Survey Team to Tajikistan from June 2 to July 7, 2016 (First Field Survey), reconfirmed the details of request and discussed the

details of implementation with relevant government departments and organizations (responsible government department: Ministry of Energy and Water Resources, implementing body: BT), and conducted a project site survey and the acquisition of related materials.

After returning to Japan, the Survey Team examined necessity, socioeconomic effects, and appropriateness of the project based on the materials from the field survey, and compiled the results in the Preparatory Survey Report (Draft). JICA sent the Outline Design Briefing Team to Tajikistan from January 9 to January 20, 2017, conducted the briefing and discussion of the Cooperation Project (Draft), and reached a basic agreement with the relevant persons in the country.

The cooperation project decided according to the result of the survey consists of the total facility replacement and capacity expansion of "Promyshlennaya Substation," owned and operated by BT in the southwestern part of Dushanbe, and the construction of new "Radiostantsiya Substation" in the site obtained by BT in Radiostantsiya district, the eastern part of the city with an accumulation of government agencies.

It should be noted that the original request included a plan for the construction of a new substation (tentatively called Glavpochtampt Substation) in Glavpochtampt district adjoining Radiostantsiya district. However, as a result of evaluation of short-term investment effect, total project cost, and other factors, the cooperation project was decided to include the above-mentioned two substations with higher priority.

In the rehabilitation and capacity expansion of existing Promyshlennaya Substation, two main transformers will be upgraded from present 110/35/10 kV (capacity: 25/25/25 MVA) to 110/35/10 kV (40/20/40 MVA), and the components that directly affect the reliability of power supply, such as switchgears, transformers, lightning arrestors, and protective relays, will be replaced with the newest equipment with proven quality.

Because of the limited availability of empty spaces for renovation work in the substation, new equipment needs to be installed after the removal of the existing equipment. Therefore, procedures need to be developed so that the changeover new equipment can be achieved using the existing bus lines, minimizing the interruption of the operation of existing equipment as much as possible, and the ways to ensure safety and timely completion of work need to be devised in various aspects of work. In this respect, the abundant experience in the renewal and expansion of substations in Japan may be effective.

The location of new Radiostantsiya Substation is close to the Executive Office of the President on the east bank of the Dushanbe River and the area along Rudaki Avenue, the main street, and the site for the substation has been secured by BT in a part of the redevelopment area. The permission to use this land has already been obtained.

In the areas planned to receive power from Radiostantsiya Substation, the supply from the substations in the vicinities is unable to cover the increase in power demand arising from the recent increases in population and the rapid proliferation of business and residential high-rise

buildings in the area. Furthermore, all these substations are considerably superannuated, and the long distance of power distribution is compromising the quality of power supply to the Executive Office of the President, government offices, administrative offices, and other important organizations and facilities.

Therefore, based on the demand projection in this area, two 110/35/10 kV (40/20/20 MVA) transformers will be installed, and other equipment will be configured similarly to that in Promyshlennaya Substation.

⑤ Project Term and Cost

Information will be publicly available after Procurement Contract Award. The project term including Design Stage is approximately 24 months.

⑥ Project Effect

As Available Power Transfer Capability to the Central Area of Dushanbe will be from 50MVA to 160MVA by this Project which is 3.2 times of the Existing Power Transfer Capability, it can be supplied sufficient amount of Electricity which coincide with the growing Power Consumption in this Area.

As the power supply to important areas will be provided by the supply from highly reliable up-to-date facilities, outages due to troubles in superannuated facilities will decrease and the reliability of power supply will be improved. This will contribute to the maintenance and reinforcement of the functions of the capital, and also be advantageous in the evaluation of infrastructure by the foreign companies considering business expansion into the country.

In addition, the project will make the future renewal of adjacent facilities easier, as it will reduce the load on adjacent substations to be considered in the planning of mid- and long-term facility rehabilitation and expansion of power transmission/distribution systems by BT.

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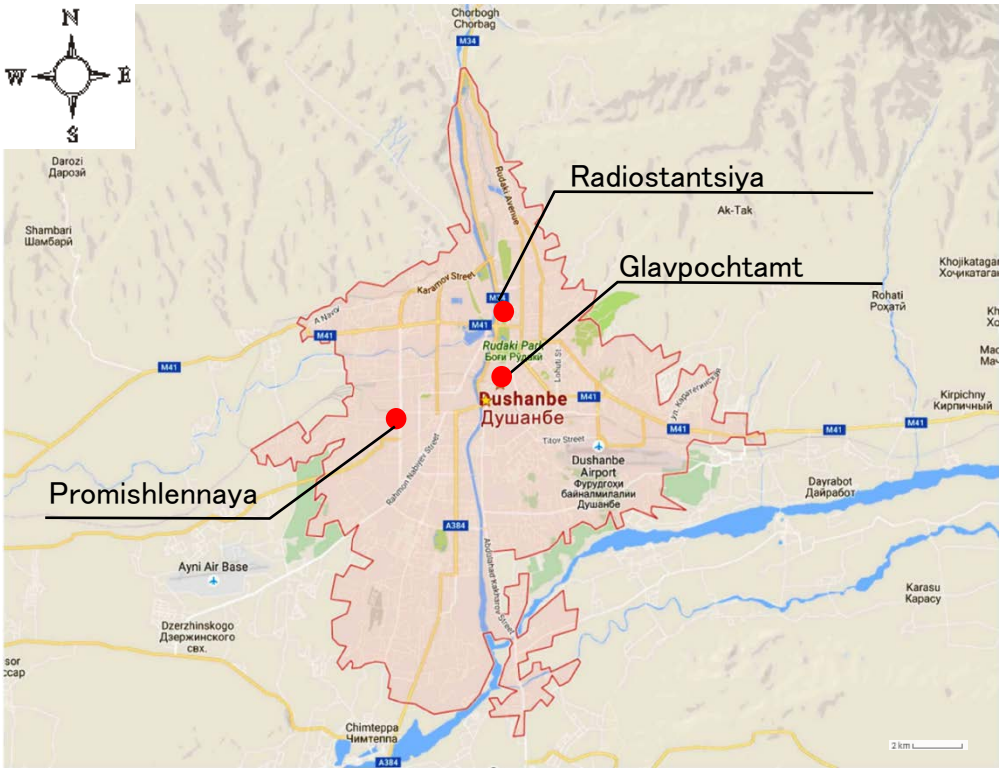

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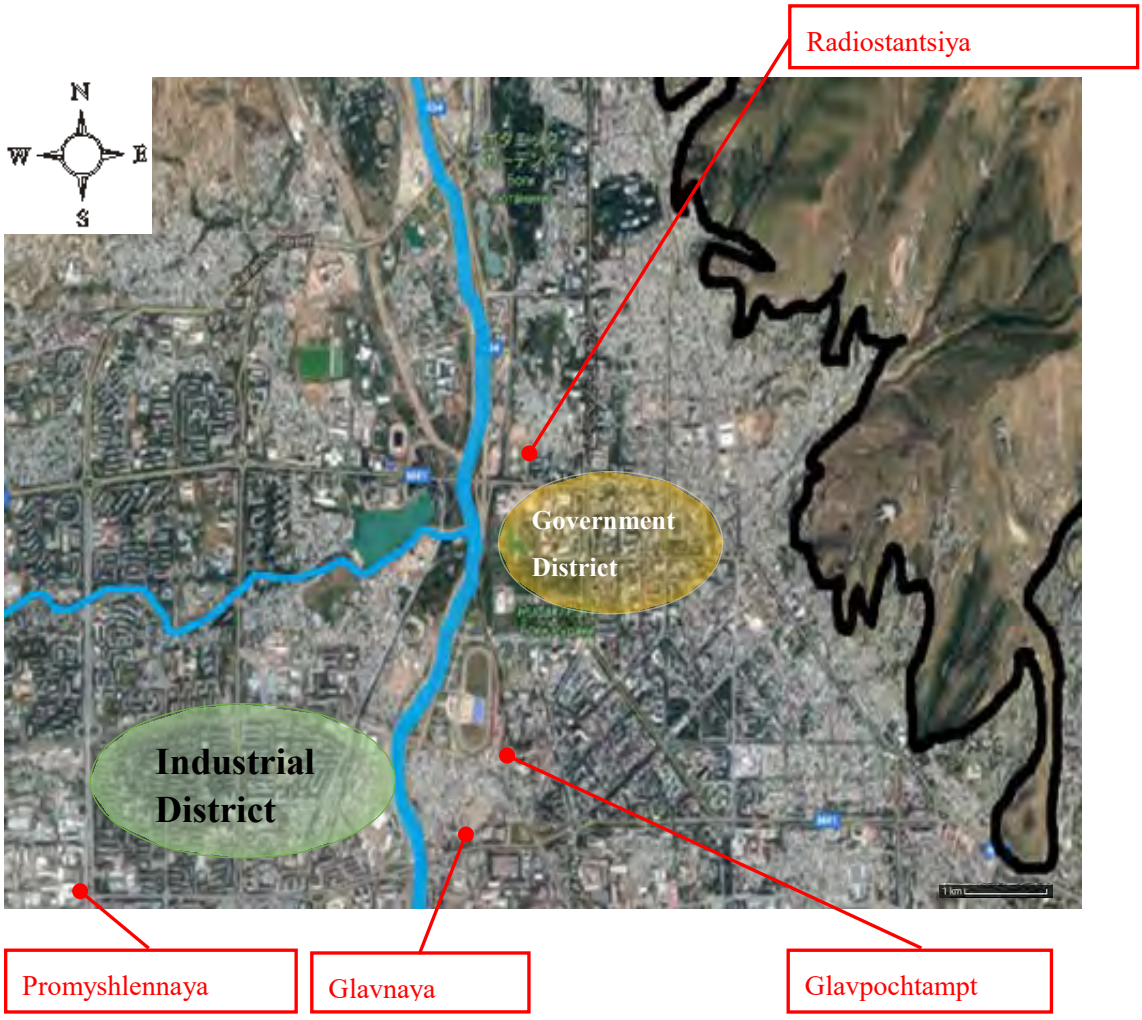

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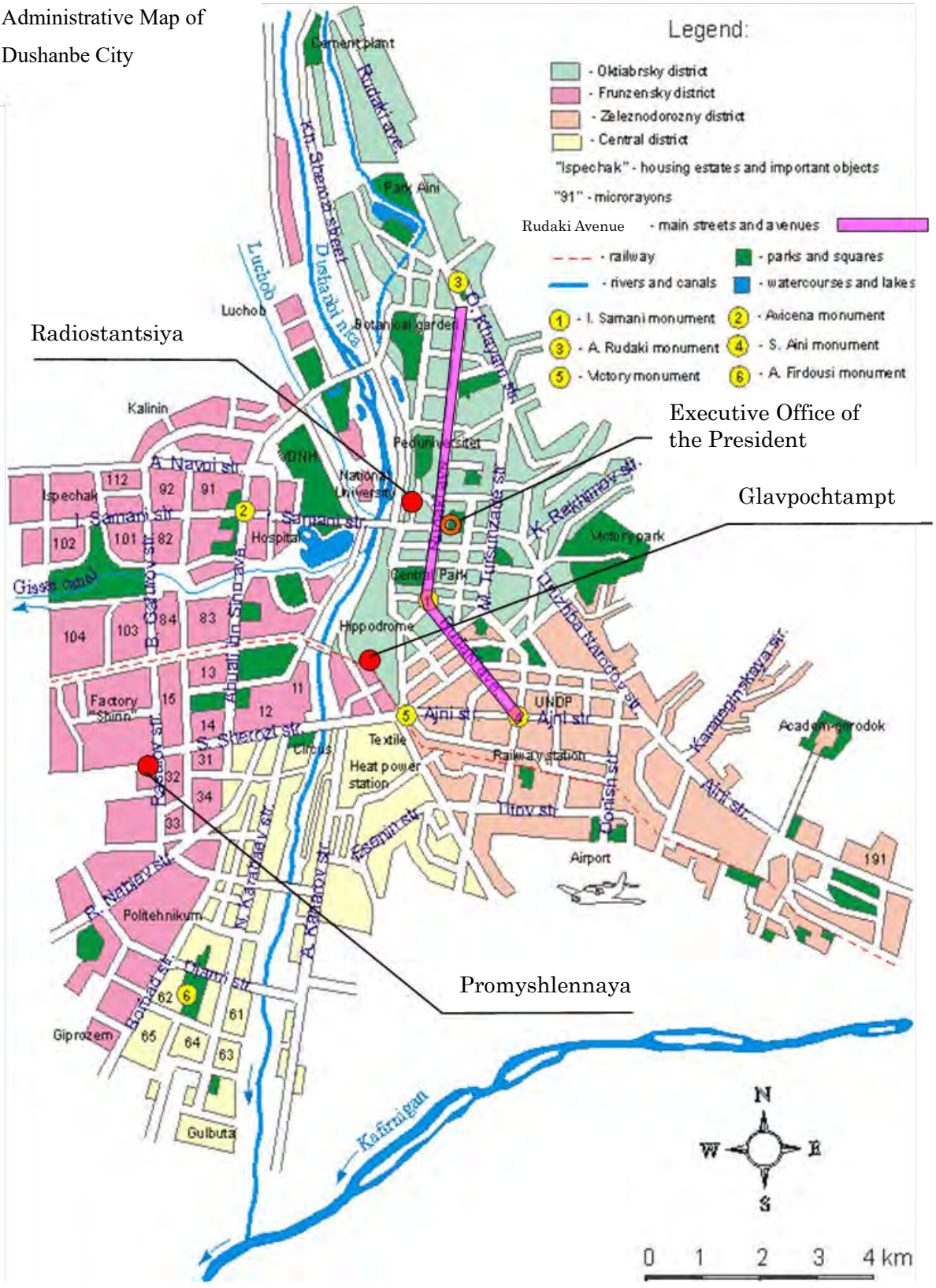

Administrative Divisions

Perspective

Bird’s Eye View of Promyshlennaya Substation

Bird’s Eye View of Radiostantsiya Substation

Abbreviations

Abbreviation	Full Form	Japanese Translation
ACSR	Aluminum Conductor Steel Reinforced	鋼心アルミより線
ADB	Asian Development Bank	アジア開発銀行
AIS	Air Insulated Switchgear	空気絶縁開閉設備
A/P	Authorization to Pay	支払授権書
AusAID	Australia Agency for International Development	オーストラリア国際開発庁
B/A	Banking Arrangement	銀行取り極め
BIG	Border International Working Group	国境管理支援ドナー国際ワーキング グループ
BM	Breakdown Maintenance	事後保全
BT	Barki Tojik	タジキスタン電力公社
CAPS	Central Asia Power System	中央アジア電力システム
CASA-1000	Central Asia South Asia Electricity Transmission and Trade Project	中央アジア・南アジア送電及び 電力輸出入プロジェクト
CB	Circuit Breaker	遮断器
CBM	Condition Based Maintenance	状態基準保全
CEP	Committee for Environmental Protection of the Republic of Tajikistan	タジキスタン共和国環境保全委員会
CG Meeting	Consultative Group Meeting	タジキスタン支援国会合
China Eximbank	Export-Import Bank of China	中国輸出入銀行
CIS	Commonwealth of Independent States	独立国家共同体
CN	Confirmation Note	技術協議録
CT	Current Transformer	電流変成器
CO_2	Carbon Dioxide	二酸化炭素
COP	Conference of the Parties to the UNFCCC	気候変動枠組条約締約国会議
CV Cable	Crosslinked Polyethylene insulated PVC sheathed Cable	架橋ポリエチレン絶縁ビニルシース ケーブル
DAC	Development Assistance Committee	OECD（経済協力開発機構） 開発援助委員会
DCC	Donor Coordination Council	ドナー調整委員会
DFID	Department for International Development	英国国際開発省
DGR	Directional Ground Relay	方向地絡保護継電器
DMS	Distribution Management System	配電系統電圧安定化機能
DS	Disconnector Switch	断路器

EBRD	European Bank for Reconstruction and Development	欧州復興開発銀行
EC	European Community	欧州共同体
EF	Emission Factor	排出係数
EIA	Environmental Impact Assessment	環境影響評価
EIB	European Investment Bank	欧州投資銀行
EMS	Energy Management System	エネルギー管理システム
E/N	Exchange of Notes	交換公文
EP	Environmental Permit	環境許可
G/A	Grant Agreement	贈与契約
GBAO	Gorno-Badakhshan Autonomous Region	ゴルノ・バダフシャン自治州
GDP	Gross Domestic Product	国内総生産
GEF	Global Environment Facility	地球環境ファシリティ
GHG	Greenhouse Gas	温室効果ガス
GIS	Gas Insulated Switchgear	ガス絶縁開閉設備
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit	ドイツ国際協力公社
GOT	Government of Tajikistan	タジキスタン共和国政府
GPS	Global Positioning System	全地球測位システム
GWP	Global Warming Potential	地球温暖化係数
HPP	Hydro Power Plant	水力発電所
HVDC	High Voltage Direct Current	高電圧直流
IAS	International Accounting Standards	国際会計基準
IDB	Inter-American Development Bank	米州開発銀行
IEA	International Energy Agency	国際エネルギー機関
IEC	International Electrotechnical Commission	国際電気標準会議
IED	Intelligent Electronic Device	インテリジェント電子装置
IEE	Initial Environmental Examination	初期環境調査
IMF	International Monetary Fund	国際通貨基金
INDC	Intended Nationally Determine Contributions	約束草案
IOM	International Organization for Migration	国際移住機関
IPCC	Intergovernmental Panel on Climate Change	気候変動に関する政府間パネル
2006 IPCC Guidelines	2006 IPCC Guidelines for National Greenhouse Gas Inventories	気候変動に関する政府間パネルの国別温室効果ガス目録（インベントリ）のための 2006 年版ガイドライン
IPP	Independent Power Producer	独立系発電事業者

IsDB	Islamic Development Bank	イスラム開発銀行
JCSS	Joint Country Support Strategy	共同支援戦略
JEC	Japanese Electrotechnical Committee	電気規格調査会
JICA	Japan International Cooperation Agency	独立行政法人 国際協力機構
JICA ESC Guidelines	JICA Guidelines for Environmental and Social Considerations	JICA 環境社会配慮ガイドライン
KFAED	Kuwait Fund for Arab Economic Development	アラブ経済開発クウェート基金
KfW	Kreditanstalt für Wiederaufbau	ドイツ復興金融公庫
kWh	kilowatt hour	キロワット時（電力量の単位）
LA	Lightning Arrestor	避雷器
LEE	Law on Ecological Expertise	環境保護法
LSIS	Living Standard Improvement Strategy of Tajikistan	タジキスタン生活水準向上戦略
M/D	Minutes of Discussions	協議議事録
MDGs	Millennium Development Goals	ミレニアム開発目標
MoEDT	Ministry of Economic Development and Trade of the Republic of Tajikistan	タジキスタン共和国経済開発・貿易省
MoEWR	Ministry of Energy and Water Resources of the Republic of Tajikistan	タジキスタン共和国 エネルギー水資源省
MoF	Ministry of Finance of the Republic of Tajikistan	タジキスタン共和国財務省
MoFA	Ministry of Foreign Affairs of the Republic of Tajikistan	タジキスタン共和国外務省
MoJ	Ministry of Justice of the Republic of Tajikistan	タジキスタン共和国法務省
Mtoe	Million tonnes of oil equivalent	石油換算百万トン
MVA	Mega Volt Ampare	メガボルトアンペア（皮相電力の単位）
NBT	National Bank of Tajikistan	タジキスタン国立銀行
NCV	Net Calorific Value	低位発熱量
NDS	National Development Strategy	国家開発戦略
NGO	Non-governmental Organization	非政府組織
ODA	Official Development Assistance	政府開発援助
OECD	Organization for Economic Co-operation and Development	経済協力開発機構
OJSHC	Open Joint Stock Holding Company	公開型持株会社
O&M	Operation and Maintenance	運転・保守
OJT	On the Job Training	職場内訓練

ONAF	Oil Natural Air Forced	油入風冷式
ONAN	Oil Natural Air Natural	油入自冷式
OPEC	Organization of the Petroleum Exporting Countries	石油輸出国機構
OPGW	Optical Ground Wire	光ファイバ複合架空地線
OSCE	Organization for Security and Co-operation in Europe	欧州安全保障協力機構
PC	Petersen Coil	消弧リアクトル
PCB	Poly Chlorinated Biphenyl	ポリ塩化ビフェニル
PIC	Project Implementation Consultant	事業実施コンサルタント
PMR	Project Monitoring Report	事業進捗報告
POPs	Persistent Organic Pollutants	残留性有機汚染物質
PPA	Power Purchase Agreement	電力購入契約
PRS	Poverty Reduction Strategy	貧困削減戦略
PVC	Polyvinyl Chloride	ポリ塩化ビニル
RCM	Reliability-Centered Maintenance	信頼性中心保全
REACT	Rapid Emergency Assessment and Coordination Team	即時緊急支援調整チーム
RRS	Region of Republican Subordination	共和国直轄地
SCADA	Supervisory Control and Data Acquisition System	集中監視制御システム
SEA	Strategic Environmental Assessment	戦略的環境影響評価
SECO	State Secretariat for Economic Affairs (Swiss Confederation)	スイス連邦経済省経済事務局
SF_6	Sulfur Hexafluoride	六フッ化硫黄
SMEs	Small and Medium-sized Enterprises	中小企業
SS	Substation	変電所
SVC	Static Var Compensator	静止型無効電力補償装置
TAJSTAT	Agency on Statistics under President of the Republic of Tajikistan	タジキスタン共和国国家統計委員会
TBM	Time Based Maintenance	時間基準保全（定周期保全）
TOR	Terms of Reference	業務指示書
TPP	Thermal Power Plant	火力発電所
UNDP	United Nations Development Programme	国連開発計画
UNESCO	United Nations Educational, Scientific and Cultural Organization	ユネスコ（国連教育科学文化機関）

UNFCCC	United Nations Framework Convention on Climate Change	気候変動枠組条約
UNICEF	United Nations Children's Fund	国連児童基金
UNMOT	UN Mission of Observers in Tajikistan	国連タジキスタン監視団
USAID	United States Agency for International Development	米国国際開発庁
VT	Voltage Transformer	電圧変成器
WB	World Bank	世界銀行
WDA	Welsh Development Agency	ウェールズ開発局（2006 年廃止）
WHO	World Health Organization	世界保健機関
WTO	World Trade Organization	世界貿易機関

Chapter 1 Background of the Project

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1-1 Background and Overview of the Grand Aid Cooperation

1-1-1 Background

Tajikistan is located in a geopolitically important area connecting Asia and Europe to Russia and Middle East, and the stability of this country is important for the stability of Central Asia and by extension the entire Eurasia. It is also crucial to the actions of the international community striving to achieve self-sustenance and stability of Afghanistan, a neighbor country of Tajikistan.

Although the civil war that continued from 1992 to 1997 caused the devastation of socioeconomic infrastructure and the outflow of human resources, socioeconomic situations have been improving since the peace agreement in 1997, and steady economic growth has been achieved.

On the other hand, the country is poor in energy resources like oil and natural gas, and its economy has been exhausted by the protracted civil war. Partly because of these reasons, the country's economic growth has been falling behind, and the income of people is ranked the lowest among the countries of the Commonwealth of Independent States (CIS). Water supply, healthcare, and other basic social services are underdeveloped, and the reduction of poverty in local areas is a serious challenge. Furthermore, economic development is also impeded by the aging and underdevelopment of infrastructure, which is needed as the foundation for economic development. Given this situation, it is meaningful to provide assistance to Tajikistan through ODA from the perspective of the expansion of bilateral relationship and "human security" and also from the perspective of solving the problems in the country while contributing to the stability of not only Tajikistan but also the entire region including its neighbor, Afghanistan.

Japan has been actively participating in the Consultative Group (CG) Meeting for Tajikistan organized by the United Nations since 1994, and sponsored the CG Meetings in 1996 and 2001 in Tokyo. In addition, Japan held the Seminar on Democracy and Good Governance for Tajikistan in Tokyo three times starting from March 1999, as an attempt to contribute to the peace building in post-Civil War Tajikistan with the participation from both the government and antigovernment sides.

In March 2003, Japan sent a Project Formation Study Team to Tajikistan, and based on the result of study, four fields of assistance were selected: healthcare, education, vocational training, and water supply. Following the opening of the JICA Tajikistan Office in August 2006, the priority areas of assistance were expanded to include road improvement and promotion of agriculture, and assistance has been provided using grant aid and technical cooperation schemes.[1]

The basic policy of the assistance to Tajikistan (high-level objective) is "the assistance in nation-building that can support sustainable economic and social development," and "the implementation of assistance in the electric power sector aiming to improve the instable power

[1] Quoted from: Country Data Book on the website of the Ministry of Foreign Affairs.

supply" is listed under the development of economic infrastructure (middle-level objective). "Energy measures in harmony with the environment" was identified as a priority area from 2009 to 2010, and "The Project for Introduction of Clean Energy by Solar Electricity Generation System" was implemented with the purpose of the procurement of solar power generation equipment and the assistance in engineer training. The present grant aid cooperation is also in line with these policies.

1-1-2 Overview

Based on the request from Tajikistan, the present grant aid cooperation aims to implement the facility rehabilitation and capacity expansion at a superannuated substation and the construction of a new substation in the capital city Dushanbe. These works are expected to contribute to the sustainable development of economy and society through the reinforcement of the system for the stable supply of power in the capital city and the improvement of energy use efficiency.

This project will also reduce the loads on adjacent substations, making the renewal of adjacent facilities easier when BT will develop the mid- and long-term plans for the rehabilitation and expansion of power transmission/distribution facilities.

The two substations included in the project are "Promyshlennaya Substation," which is owned and operated by BT in the southwestern part of Dushanbe, and "Radiostantsiya Substation (a tentative name, which is used throughout this report)," which will be constructed in the site obtained by BT in Radiostantsiya district, the eastern part of the city with an accumulation of government agencies.

It should be noted that the original request included a plan for the construction of a new substation (tentatively called Glavpochtampt Substation) in Glavpochtampt district adjoining Radiostantsiya district. However, as a result of evaluation of short-term investment effect, total project cost, and other factors, the cooperation project was decided to include the above-mentioned two substations with higher priority.

(1) Overview of Promyshlennaya Substation Rehabilitation and Capacity Expansion Project

Promyshlennaya Substation was constructed in the 1960s during the U.S.S.R. era. It was originally intended to cover the electric power demand of processing and manufacturing factories dealing in valves, oil seed pressing, milk, confectionery, etc. and residences in some districts of Dushanbe. At the present, the electric demand in winter has increased dramatically as a result of the expansion of residential areas reflecting population growth, as well as the construction of new factories, public service facilities, collective housing units, etc., beyond the capacity of this substation. As transformers and distribution cables have already been overloaded, outages from overloading are taking place, and reinforcement of facilities is needed.

On the other hand, because this substation and planned Radiostantsiya Substation are located at a considerable distance across the river from each other, the construction of Radiostantsiya Substation in itself will not easily take over some of the load on the existing substation and reduce its responsibility as a key regional supply substation. Reinforcement of this substation

itself is needed.

More than 60% of substation facilities are old facilities that have been operated for over 50 years, causing difficulties in operation and maintenance. Sudden outages due to facility troubles are also taking place, indicating the need for the total renewal of superannuated main facilities.

Therefore, two main transformers will be replaced with an increase in capacity from present 110/35/10kV (capacity: 25/25/25 MVA) to 110/35/10 kV (40/20/40 MVA) based on the future demand projection for the supply area of the substation, and the components that directly affect the reliability of power supply, such as switches, transformers, lightning arrestors, and protective relays, will be replaced with the newest equipment with proven quality. These facilities need to comply with international standards.

Because of the limited availability of empty spaces for renovation work in the substation, new equipment needs to be installed after the removal of the existing equipment. Therefore, procedures need to be developed so that the changeover to new equipment can be achieved using the existing bus lines, minimizing the interruption of the operation of existing equipment as much as possible, and the ways to ensure safety and timely completion of work need to be devised in various aspects of work. In this respect, the abundant experience in the renewal and expansion of substations in Japan may be used effectively.

(2) Overview of New Radiostantsiya Substation

The location of new Radiostantsiya Substation is close to the Executive Office of the President on the east bank of the Dushanbe River and the area along Rudaki Avenue, the main road of the city. This area is undergoing rapid redevelopment, in which low-rise buildings form the U.S.S.R. era are demolished to be replaced with government facilities and high-rise building for business and residential use. The site for the substation has been secured by BT in a part of the redevelopment area, and the permission to use this land has already been obtained.

While the areas planned to receive power from Radiostantsiya Substation is currently supplied from Tekstilmash Substation, Vakhdat Substation, Centralnaya Substation, Karamova Substation, etc., these substations have become unable to meet the growing demand for power resulting from the recent rapid increase in population and business and residential buildings in the area. Furthermore, all these substations are considerably superannuated, and the long distance of power distribution is compromising the reliability of power supply to the Executive Office of the President, government offices, administrative offices, and other important organizations and facilities in the city.

Therefore, based on the demand projection in this area, two 110/35/10 kV (40/20/20 MVA) transformers will be installed to cover approximately 30% of the existing substations, and a substation with the specifications similar to those of Promyshlennaya Substation will be constructed.

In addition, the project is considered to make it easier for BT to conduct future renewal of existing superannuated substations, because Radiostantsiya Substation will take over some of the loads on the existing superannuated substations.

1-2 Natural Environment

(1) Topography and Geology

Tajikistan is located in the southwestern part of Central Asia, extending from 36° 40′ N to 41° 5′ N latitude and from 67° 31′ E to 75° 14′ E longitude, and bordering Afghanistan, Uzbekistan, Kyrgyzstan, and China. Being close to India, Pakistan, Turkmenistan, and Iran, it has long been a way station in the transport routes traversing the Eurasian Continent threaded through highlands.

The country has an area of 143,000 km^2, which is approximately 40% of the land area of Japan. About 94% of the country is occupied by mountainous areas, more than half of which exceeding 3,000 m in elevation. In the Pamir region in the eastern part of the country, the capital of Gorno-Badakhshan Autonomous Province, Khorugh, is located at an elevation exceeding 2000 m. The Pamir Mountains extending to the border with China is called the roof of the world, where Ismoil Somoni Peak (7,495 m), Lenin Peak (7,135 m), Peak Korzhenevskaya (7,105 m), and other mountains exceeding 7,000 m stretch over more than 800 km long. These ranges were formed one million years ago by the impact of the collision of the Indian continent into the Eurasian plate.

On the other hand, the southwestern part of Tajikistan containing the capital Dushanbe is called the Tajik Depression, where elevation is relatively low at 700-800 m. Fergana Basin in the northwestern is the lowest part, where elevation is 300-500 m and the country shares intricate border lines with Uzbekistan and Kyrgyzstan.

The geological structure of the country is diverse, consisting of rocks and sediments of various geological ages. Quaternary, Neogene, and Paleogene strata are found in the areas from the southwestern part to the northeastern part. The central part has Cambrian, Ordovician, Jurassic, Cretaceous, and Permian strata. The Pamir Mountains in the western part contains Precambrian, Jurassic, Cretaceous, and Triassic strata. The depression around Dushanbe has widely distributed sedimentary rocks from the late Mesozoic to the Cenozoic.

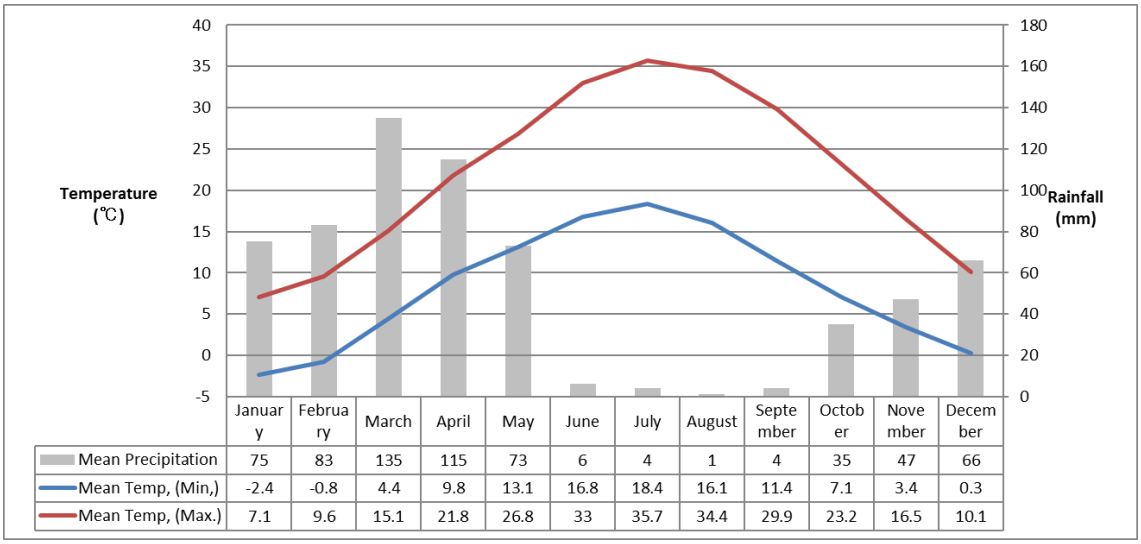
Snowmelt from mountainous areas and rainfall are collected in main rivers, the Amu Darya, Vakhsh River, Panj River, Bartang River and Zeravshan River, and drain to the southern region along the Afghanistan border.

The capital city, Dushanbe, has its central part developed on the heights on the east of the Dushanbe River, which flows from North to South. Elevation increases eastward, eventually connecting to the hills. Roads and parks are covered with green trees, and spraying on roads and trees with fountains and sprinkler trucks is performed routinely, making use of the abundant water resources. The area on the west of the Dushanbe River spreads at the level of the foot of the levee, and an industrial zone is formed there. Construction of apartment houses is also increasing in this area in response to recent population growth.

(2) Climate

The climate of Tajikistan is continental. In the plains, it is hot and dry from June to September with the maximum temperature exceeding 35°C, while the mean temperature drops below 0°C and snow falls from December to February.

Dushanbe has hot summers with temperatures from 27°C to 36°C, while winters are not so harsh with temperatures from -2°C to 10°C and with little snow cover. Annual precipitation is 650 mm. In particular, summer has few rainy days and plenty of sunshine. Figure 1-1 shows the data for temperature and precipitation in Dushanbe.



	January	February	March	April	May	June	July	August	September	October	November	December
Mean Precipitation	75	83	135	115	73	6	4	1	4	35	47	66
Mean Temp, (Min,)	-2.4	-0.8	4.4	9.8	13.1	16.8	18.4	16.1	11.4	7.1	3.4	0.3
Mean Temp, (Max.)	7.1	9.6	15.1	21.8	26.8	33	35.7	34.4	29.9	23.2	16.5	10.1

Note: (Annual means from 2013 to 2015)

Figure 1-1 Trends of Annual Temperature and Precipitation in Dushanbe

Source: Prepared by the Survey Team based on the information from BT

(3) Results of Topographic Surveys and Geologic Surveys

For the purpose of designing, topographic surveys and geologic surveys were conducted for Promyshlennaya Substation, Radiostantsiya Substation, and Glavpochtampt Substation.

The items and outline of the surveys were as follows.

① Topographic surveys: Plane surveying of the sites for new and existing substations

② Geologic surveys: Boring, penetration tests, and laboratory tests in the sites for new and existing substations

The geotechnical composition at Promyshlennaya Substation is 0.5-m thick topsoil (cohesive soil containing gravel), an approximately 2.5-m thick layer of silty fine sand, and a gravel layer underneath.

The silty fine sand layer is relatively firm, showing an N value of approximately 20, a unit weight of 1.8 kN/m^3, and an angle of internal friction of about 25 degrees. The long-term bearing capacity of soil is about 100 kN/m^2, which is sufficient for the purpose of supporting facility foundations and buildings.

The geotechnical composition at Radiostantsiya Substation is 0.3-m thick topsoil, approximately 3-m thick layer of earth fill (firm cohesive soil containing gravel), a 13 m to 14-m thick layer of silty fine sand, and a gravel layer underneath.

The earth fill layer is sand-gravel soil containing cobbles. The test holes produced during the geologic survey, which were generally vertical down to the depth of 2 m, proved the firm quality of soil.

The silty fine sand layer is relatively firm, showing an N value of about 15, a unit weight of 1.8 kN/m^3, and an angle of internal friction of about 25 degrees. The long-term bearing capacity of soil is about 120 kN/m^2, which is sufficient for the purpose of supporting facility foundations and buildings.

The geotechnical composition at Glavpochtampt Substation is 0.3-m thick topsoil, an earth fill layer (firm cohesive soil containing gravel), a 1.4 to 3-m thick layer of hard silt, and a gravel layer underneath.

The earth fill layer and the silty fine sand layer show properties similar to those of Radiostantsiya.

In planer surveying, the locations of land forms and features were measured in the planned sites for substations, and the results were compiled in topographic maps.

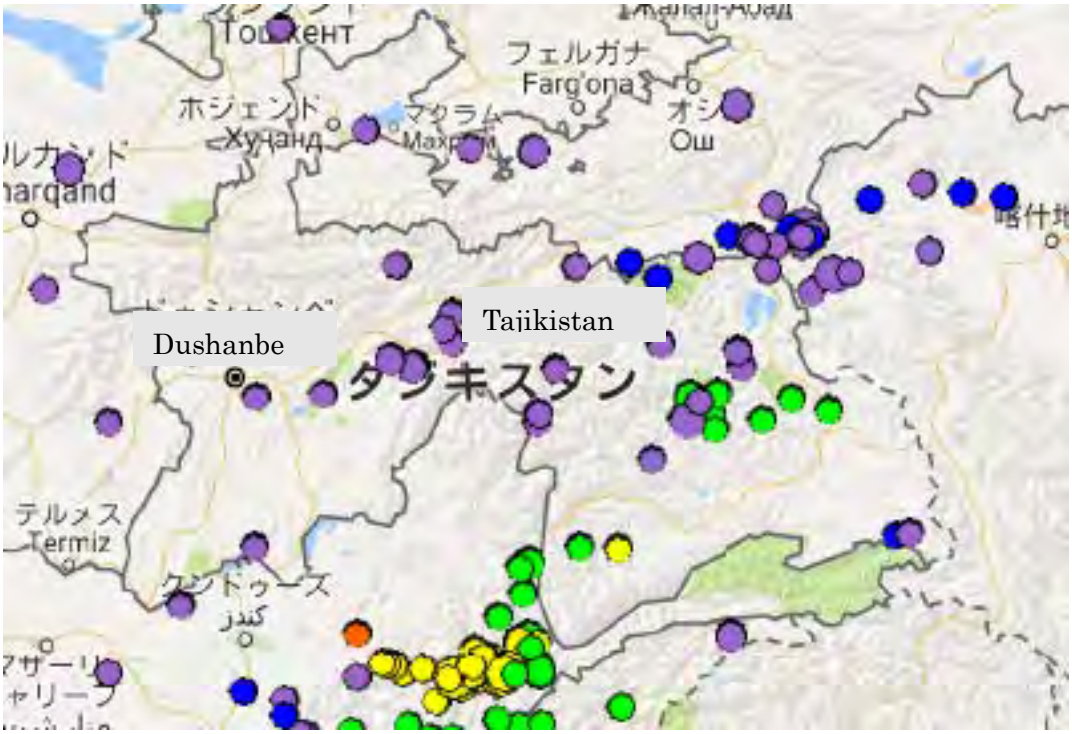
Because Promyshlennaya Substation is an existing substation, the locations and shapes of facilities and buildings were also shown in the map. Elevations were determined using the public datum points of Dushanbe.

The results of topographic surveys are shown in Appendix 11, and the results of geologic surveys are shown in Appendix 12.

(4) Earthquakes

Many earthquakes of 5 or greater magnitude occur mainly the central part and the northeastern part of Tajikistan. A 6.8 magnitude earthquake occurred in 1978 near the border between Gorno-Badakhshan Province and Kyrgyzstan, and a 5.7 magnitude earthquake hit Obikhingou in the central part in May 2012, causing damage.

Figure 1-2 shows the locations of magnitude 5 or greater earthquakes occurring in and after 1970. All of these earthquakes were in the range of magnitude from 5.0 to 6.0, indicating that the risk of earthquakes is low in this area.



Note: Circles show earthquake locations, and colors indicate hypocentral depths. Purple represents relatively shallow earthquakes.

Figure 1-2 Occurrence of Magnitude 5 or Greater Earthquakes in and after 1970

Source: IRIS (Incorporated Research Institutions for Seismology) “Seismic Monitor”

1-3 Environmental and Social Considerations

1-3-1 Environmental Impact Assessment

1-3-1-1 Overview of the Project Component that causes Environmental and Social Impacts

(1) Overview

Based on the initial request from the Tajikistan Government, this Initial Environmental Examination was assumed to cover rehabilitation of an existing substation, construction of two new substations and the installation of underground cables for power supply to a new substation. Promyshlennaya Substation, which is planned to be rehabilitated, is located in the industrial area to the west of the Dushanbe River, and the site is surrounded by roads on three sides. The proposed site for the construction of Radiostantsiya Substation is on the heights to the east of the Dushanbe River. The proposed site for the construction of Glavpochtampt Substation is in the lowland to the east of the Dushanbe River and is adjacent to the horse race track. Table 1-1 shows the target construction work of the project scope.

Table 1-1 Project Scope

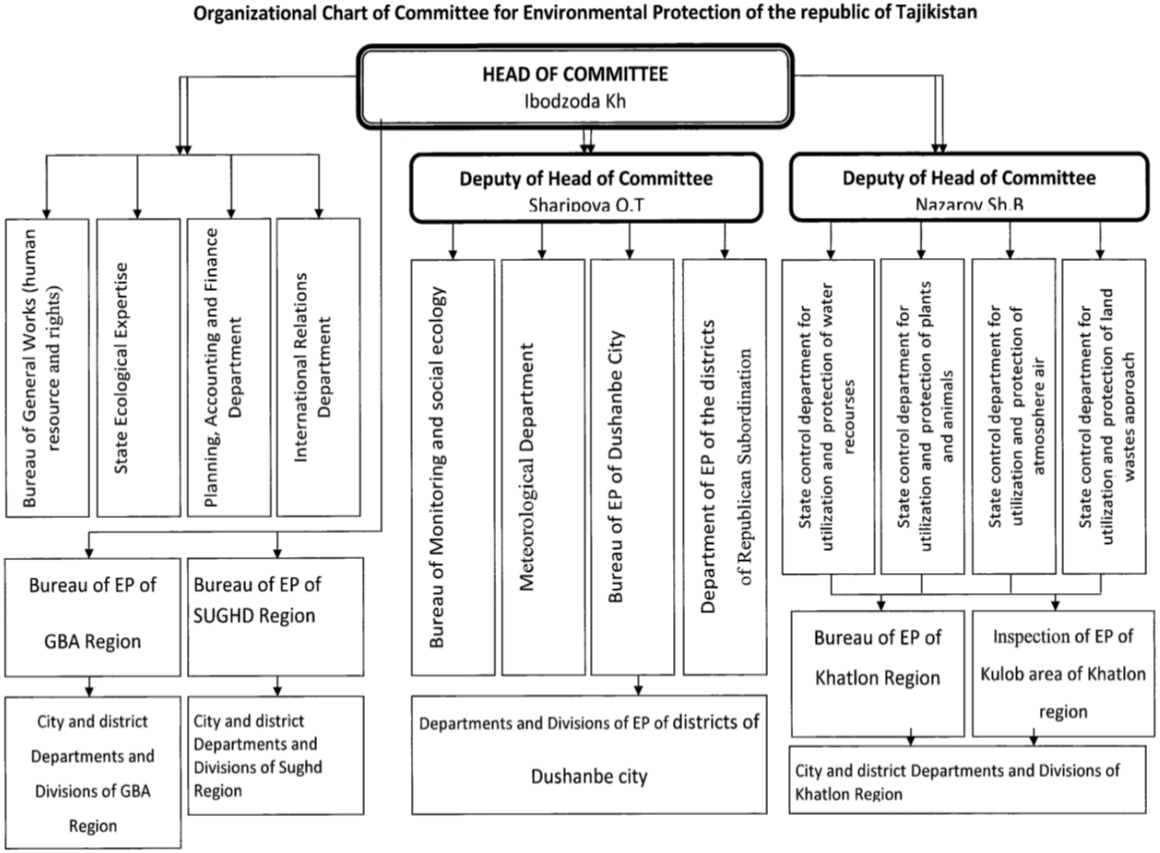
Item	Substation Name	Scope	Location Address
Rehabilitation of substation	Promyshlennaya	Site area: 8,322.20m^2 List of existing equipment: ①Transformers: 110/35/10kV (25/25/25MVA) (manufactured in 1960, to be replaced in this project) and 115/11kV (16/16MVA) (manufactured in 2015) ②110kV circuit breakers (replacement of 2 units) ③35kV and 10kV switchgear ④Switchgear Buildings: 2 buildings (to be newly constructed in this project) Structure: Concrete block structure Plane area: Protective control panel and 10kV switchgear: 230m^2 35kV switchgear: 48m^2	Jabbor Rasulov Avenue, Sino district, Dushanbe
Construction of new substation	Radiostantsiya	Site area: 1,401.0m^2 List of main new equipment: ① Transformers: 110/35/10kV (40/20/20MVA), 2 units ②110kV circuit breakers, 2 units ③35kV and 10kV switchgear ④ Switchgear Building: 1 building (to be constructed newly in this project) Structure: Concrete block structure Building area: 210m^2	Habib Ahrori Street, Somoni district, Dushanbe
Construction of new substation	Glavpochtampt	Site area: 1,582.7m^2 List of main new equipment: ① Transformers: 110/10/6kV (25/12.5/12.5MVA), 2 units ② 110kV circuit breakers, 2 units ③ 10kV and 6kV switchgear ④ Switchgear Building: 1 building Structure: Concrete block structure	Habibullo Nazarov Street, Somoni district, Dushanbe
Installation of underground	Glavnaya ↓ Glavpochtampt	・Installation of transmission line for power supply to newly constructed Glavpochtampt Substation (110kV, 2	—

cables		circuits × 25MVA, 250mm-sq, installation length 1.7km, underground cables)	

(2) System and Organization related to Environmental and Social Considerations

Figure 1-3 shows the organization chart of CEP (Committee for Environmental Protection), which is responsible for environmental management in the Government of Tajikistan.

Figure 1-3 Organization Chart of CEP (Committee for Environmental Protection)



1-3-1-2 Scoping and TOR of Environmental and Social Considerations and Mitigation of Climate Change

(1) Scoping

Classification		Potential Environmental Impact	Evaluation		Rationale for Evaluation
			Before & During work	In Operation	
Pollution Control	1	Air Quality	B-	D	During work: Temporary impact of dust and exhaust gas on air quality is expected from the operation of construction vehicles and equipment. However, the scale of work is small, and the scope of impact is limited. In use: No operations that may deteriorate air quality are expected.
	2	Water Pollution	B-	B-	During work: There is a possibility of water pollution resulting from the leak of insulating oil used in transformers, the discharge of water from work site, heavy machines, vehicles, and lodgings, etc. In use: There is a possibility of water pollution resulting from the leak of insulating oil used in transformers.
	3	Waste Management	B-	D	During work: Generation of construction wastes, earth materials, etc. is expected during work. It is necessary to ensure appropriate disposal according to the standards of the country. It is necessary to confirm whether or not PCB is contained in the transformers, capacitors, ballasts, etc. at the substation to be rehabilitated (Promyshlennaya Substation). → If equipment contains PCB, it is necessary to ensure appropriate storage and disposal after separation into “PCB-containing wastes” and “non-PCB-containing wastes” according to the standards of the country. In use: Generation of wastes that may affect surrounding environment is not expected.

Classification		Potential Environmental Impact	Evaluation		Rationale for Evaluation
			Before & During work	In Operation	
	4	Soil Pollution	B-	B-	During work: There is a possibility of soil pollution resulting from the leak of insulating oil used in transformers, oils used for construction work, etc. In use: There is a possibility of soil pollution resulting from the leak of insulating oil used in transformers.
	5	Noise & Vibration	B-	C	During work: Noise from construction work and noise from construction equipment and vehicles are expected. In use: The impact of the noise from transformers on residents is expected.
	6	Ground Subsidence	D	D	No operations that may cause land subsidence are expected.
	7	Odor	D	D	No operations that may cause foul odor are expected.
	8	Bottom Sediment	D	D	No operations that may affect bottom material are expected.
Natural Environment	9	Protection Area	D	D	There are no national parks, conservation areas, etc. in and around the project sites.
	10	Ecosystems	D	D	Because there are no rare animal or plant species in the project sites, the impact on ecosystems is considered negligible.
	11	Hydrology	D	D	During work: No operations that may alter river flow or cause riverbed changes are expected.
	12	Topography & Geology	B-	D	Foundation work and other operations in the sites of two proposed substations (Radiostantsiya Substation and Glavpochtampt Substation) may cause impact on topography and geology.
	13	Involuntary Resettlement	D	D	Because applications for land use in the sites of two proposed substations (Radiostantsiya Substation and Glavpochtampt Substation) have been filed, nonvoluntary relocation of residents is not expected to occur.
	14	Poverty Group	D	B+	In use: The decrease in the occurrence of outages resulting from this project is expected to have positive impact on poor people.

Classification		Potential Environmental Impact	Evaluation		Rationale for Evaluation
			Before & During work	In Operation	
Social Environment	15	Ethnic Minority & Indigenous People	D	D	There are no ethnic minorities or indigenous people in and around the project sites.
	16	Local Economy (Employment, Livelihood)	D	A+	The decrease in the occurrence of outages resulting from this project is expected to have positive impact on local economy.
	17	Land Use / Use of Regional Resource	D	A+	The decrease in the occurrence of outages resulting from this project is expected to have positive impact on local economy.
	18	Water Use	C	C	During work: If river or other water resources are exploited around the project areas, there may be the impact of water turbidity resulting from work. In use: If river or other water resources are exploited around the project sites, there may be the impact of oil leak during rainfall.
	19	Existing Social Infrastructure and Social Services	B-	A+	During work: Traffic congestion during work is expected. In use: The decrease in the occurrence of outages is expected to have positive impact on existing social infrastructure and social services.
	20	Social Capital / Local Social Organizations for Decision-making	D	A+	The decrease in the occurrence of outages resulting from this project is expected to have positive impact on social organizations such as social capital and local decision-making bodies.
	21	Maldistribution of Benefits and Damage	D	D	The decrease in the occurrence of outages resulting from this project is hardly expected to cause unfair burdens and benefits in the surrounding areas.
	22	Conflict of Interest in the Region	D	D	The decrease in the occurrence of outages resulting from this project is not considered to cause conflict of interest in the area.
	23	Cultural Heritage	D	D	There are no cultural assets in and around the project sites.
	24	Landscape	D	D	Because this project mainly consists of underground cables, the impact on scenery is considered negligible.

Classification		Potential Environmental Impact	Evaluation		Rationale for Evaluation
			Before & During work	In Operation	
	25	Gender	D	D	This project is not expected to have notable negative impact on gender issues.
	26	Children's Rights	D	D	This project is not expected to have notable negative impact on children's rights.
	27	Infections (HIV/AIDS, etc.)	D	D	The possibility of the spread of infections is not expected.
	28	Working Environment (including Occupational Safety and Health)	B-	D	During work: Attention must be paid to the working environment of construction workers. In use: No operations that may cause negative impact on workers in the use stage are planned.
Mitigation of Climate Changes	29	Fossil Fuel Use	B-	B+	The decrease in transformation loss is expected to reduce the usage of fossil fuels at thermal power plants that are operated in winter.
	30	Greenhouse Gas Emission	B-	D	During work: SF_6 with a high global warming potential may be discharged inadvertently from gas insulated switchgear, PT (Potential Transformer), and CT (Current Transformer) into atmosphere as a result of inappropriate handling.
Others	31	Traffic Congestion	B-	D	During work: Measures must be taken to manage traffic congestion.
	32	Accidents	B-	B-	During work: Measures must be taken to manage accidents during work.
	33	Transboundary Impact	D	D	Because project sites in Dushanbe are far from international borders and the scale of work is limited, transboundary impact is considered to be negligible.

A+/-: Significant positive/negative impact is expected.

B+/-: Positive/negative impact is expected to some extent.

C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)

D: No impact is expected.

(2) TOR

Impact Item	Survey Item	Method
Examination of alternatives	① Underground cable routes ② Methods of Laying of Underground Cable	①Project cost, impact on river, impact on social environment, impact on traffic environment, impact on natural environment
Initial Environmental Examination and Obtaining Environmental Permission	① Initial Environmental Examination ②Assistance in application for environmental permission by the Ministry of Energy and Water Resources	①Survey on relevant laws and systems ②Understanding the details of instruction from CEP ② Field exploration
Acquisition of land in the proposed newly construction site for substation	①Situation of the acquisition of land in the proposed newly construction site for Radiostantsiya Substation) ②Requirements for land acquisition	① Ministry of Energy and Water Resources
Air Quality	① Environmental Circumstances	①Field exploration
Water quality	① Measures to prevent and control Water Pollution from the Wheel Wash	①Understanding the details of instruction from CEP
Waste	① Confirmation whether Transformers Contain Polychlorinated Biphenyl (PCB) or not ② Treatment method of PCB-Contaminated Transformers ③ Treatment method of construction waste	①Survey on relevant laws and systems, interviews with related organizations
Soil Pollution	①Prevention measure of oil leakage under construction ②Prevention measure of oil leakage of transformer	①Confirmation of the content and methods of work
Noise / Vibration	① Confirmation of the distance between residential area the source ② Examination of impact under construction	①Field exploration and interviews
Topography & Geology	① Examination of impact under construction	①Topographic and geologic surveys in the premises of one substation to be rehabilitated (Promyshlennaya Substation) and the proposed construction sites for two new

Impact Item	Survey Item	Method
		substations (Radiostantsiya Substation and Glavpochtampt Substation)
Land acquisition and Involuntary Resettlement	① Confirmation whether Land acquisition for Radiostantsiya Substation has been done and Involuntary Resettlement has not been needed. ② GAP Analysis between JICA Guidelines for Environmental and Social Considerations and Legal system of Tajikistan	①Field exploration to confirm how the acquired construction sites and underground cable installation routes are located relative to residents, etc. ②Survey on relevant laws and systems
Working environment (including occupational safety and health)	① Measures for Securing Safety and Health ② reduce emissions from power generation have the greatest impact, bo	③ Interviews with related organizations
Greenhouse Gas Emissions from fossil fuel combustion	① Reduction of fossil fuel consumption for thermal power plants through upgrade of Substation	① Survey on the Transformer Loss Reduction through Upgrade Substations (GWh) ② Survey on the Reduction of fossil fuel consumption for thermal power plants through upgrade of Substation
Stakeholder Consultation	① Collecting opinions from affected people and affected communities	① Organization of the stakeholder consultation (3 Sites: Promyshlennaya, Radiostantsiya and Glavpochtampt) Schedule: October 2016

1-3-2 Results of Surveys on Environmental and Social Considerations (Including Predicted Results)

1-3-2-1 Environmental Impact Survey and Environmental Permission

(1) The Framework Concerning Assessment and Mitigation of Environmental Impact

1) The Framework Concerning Environmental Impact Assessment and Mitigation

The framework concerning environmental impact assessment and mitigation is as shown in Figure 1-4, based on the Law on Environmental Protection, No. 760: August 2, 2011, and the Law on Ecological Expertise (the EE Law), No. 818: April 16, 2012, enacted under the

Constitution of Tajikistan.

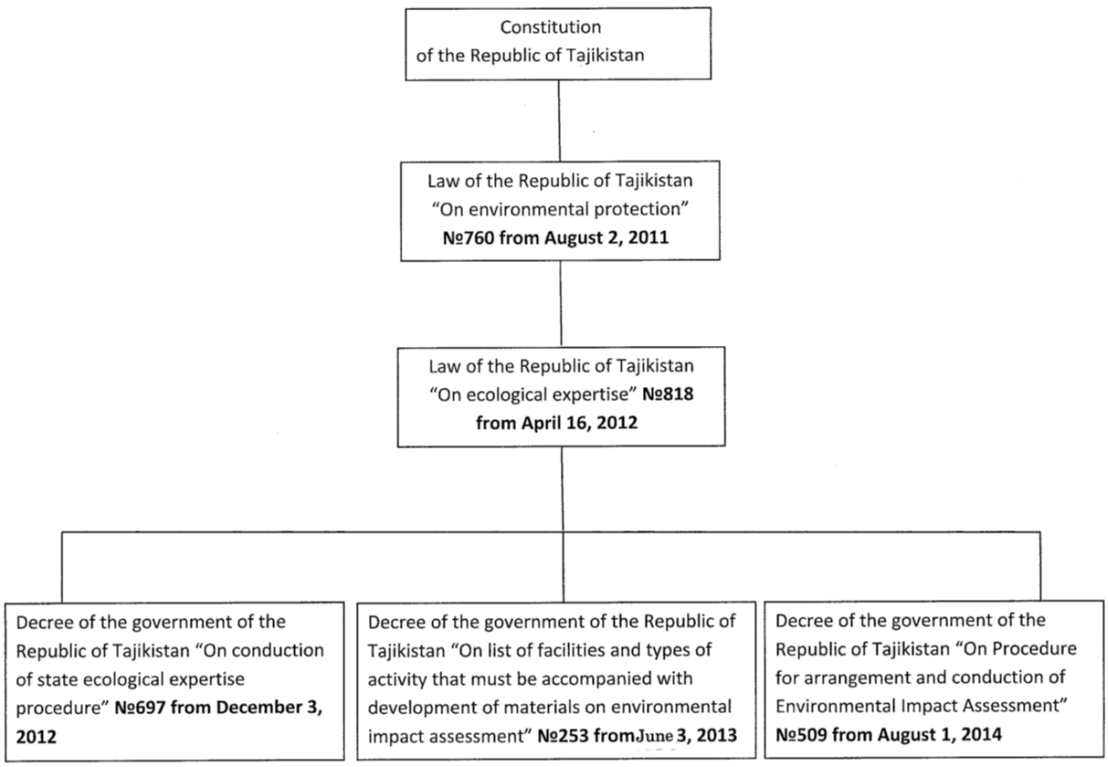


Figure 1-4 The Framework Concerning Environmental Impact Assessment and Mitigation

2) The EE Law and the Rules Concerning Environmental Impact Assessment

The Ecological Expertise (EE) Law (No. 818; enacted on April 16, 2012) is a law covering a wide range of topics including environmental impact assessment (EIA), and the final objective under this law is to obtain environmental permission for the implementation of the project. The organization responsible for the enforcement of the EE Law is CEP.

Enacted under the EE Law, Decision No. 253 (enacted on June 3, 2013) classifies projects into Categories I through IV according to the type of activity and the expected severity of impact on environment. In addition, Decision No. 509 (enacted on August 1, 2014) stipulates the requirements of environmental impact assessment for each category, as shown in Table 1-2.

Table 1-2 Project Classification Based on Decision No. 253 and Requirements of Environmental Impact Assessment Based on Decision No. 509

		EIA Program	Section Environmental Protection		Statement of EIA	Severity of Impact	Example
CATEGORY	I	○	—	—	—	High	・Construction of an express highway
	II	—	○	—	—	Medium	・Construction of a local road
	III	—	—	○	—	Low	・Construction of a grain storage
	IV	—	—	—	○	Local	・Bakery
Environmental Permission		○ For 60 days	○ For 30 days	○ For 30 days	○ For 30 days		
Stakeholder Consultation		◯	—	—	—		
JICA Guidelines for Environmental and Social Considerations		Category A	Category B	Category C			
		EIA	IEE	—			

EIA : Environmental Impact Assessment
IEE : Initial Environmental Examination

3) The Process of Obtaining Environmental Permission

Enacted under the EE Law, Decision No. 697 (enacted on December 3, 2012) stipulates the process of obtaining environmental permission, as shown in Figure 1-5.

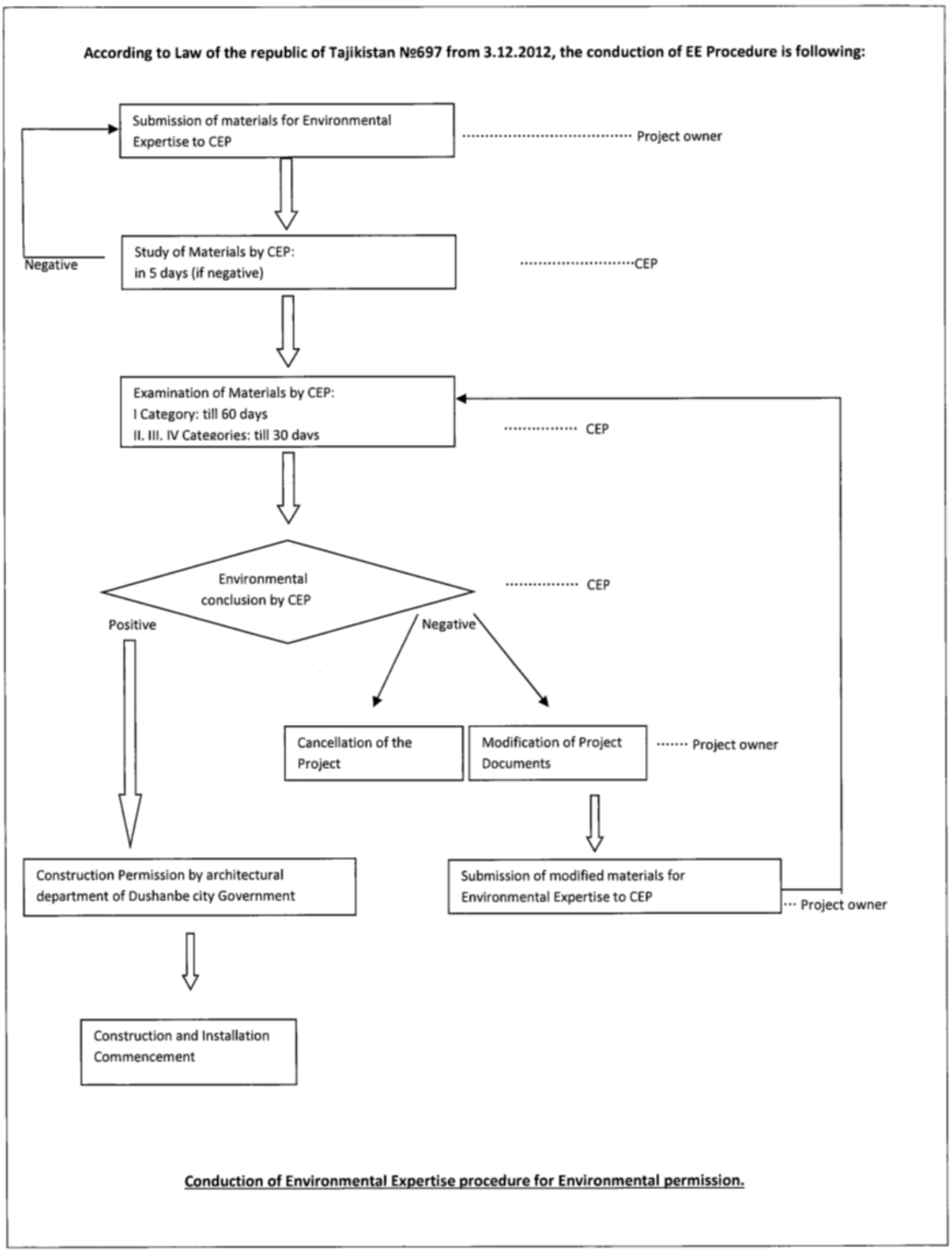


Figure 1-5 The Process of Obtaining Environmental Permission

(2) Project Categories

1) Rehabilitation of a Substation and Construction of a New Substation

Category III (corresponding to JICA Category C)

2) Installation of 110 kV Underground Cables (between Glavnaya and Glavpochtampt, Approximately 1,700m)

Category II (corresponding to JICA Category B)

This project falls under Category III, because the rehabilitation of Glavpochtampt Substation and the installation of 110 kV underground cables are not implemented this time.

(3) Application for Environmental Permission

1) Date of Application for Environmental Permission: Application filed on September 13, 2016: №8-1797

Application was submitted by the Minister of Energy and Water Resources to CEP.

2) Submitted Documents

The submitted documents are shown in Table 1-3.

Table 1-3 List of Submitted Documents

No.	File Name
1.	Overview of the project Version04
2.	Assessment of Underground Electric Cable Laying Route
3.	Assessment of the Construction Work for Substations Version04
4.	Summary of Trees Survey in Underground Cable Route Version03
5.	Photo Trees Survey in Underground Cable Route Version03-1__5
6.	Photo Trees Survey in Underground Cable Route Version03-2__5
7.	Photo Trees Survey in Underground Cable Route Version03-3__5
8.	Photo Trees Survey in Underground Cable Route Version03-4__5
9.	Photo Trees Survey in Underground Cable Route Version03-5__5
10.	Radiostantsiya Substation Site Version06
11.	Promyshlennaya Substation Version06-1_2
12.	Promyshlennaya Substation Version06-2_2
13.	Equipment and Material List to be removed from Promyshlennaya SS
14.	Draft Implementation Schedule
15.	Document List for Environment Permission Version06
16.	Glavpochtampt SS Land Certificate
17.	Glavpochtampt SS Land Plot Layout Drawing
18.	Radiostantsiya SS Land Certificate
19.	Radiostantsiya SS Land Plot Layout Drawing

3) Coverage of the Application for Environmental Permission

・Rehabilitation of existing Promyshlennaya Substation

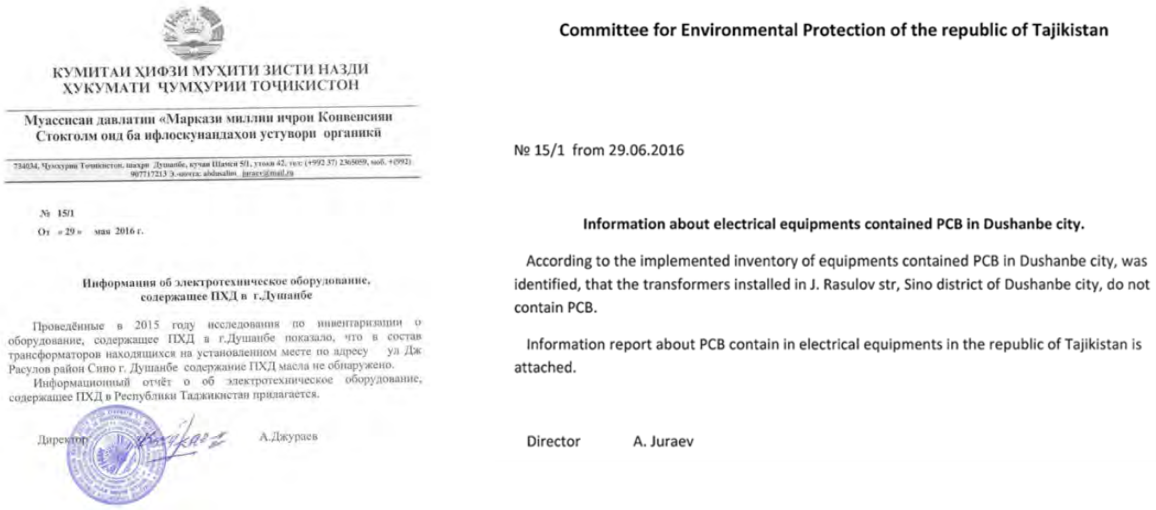
・Construction of new Radiostantsiya Substation

・Construction of new Glavpochtampt Substation

・Installation underground transmission line (between existing Glavnaya Substation and new Glavpochtampt Substation)

4) Confirmation of the presence/absence of PCB-containing Equipment (Existing Promyshlennaya Substation)

In relation to the rehabilitation of existing Promyshlennaya Substation, a survey was made on whether or not there are PCB-containing items. The Republic of Tajikistan ratified the Stockholm Convention on Persistent Organic Pollutants (POPs Convention) on February 8, 2007, and has completed the inventory data survey on PCB (polychlorobiphenyl) and other substances in the country. These inventory data provided a proof that the existing Promyshlennaya Substation has no PCB-containing equipment. The certificate is shown in Figure 1-6.



КУМИТАИ ҲИФЗИ МУҲИТИ ЗИСТИ НАЗДИ
ХУКУМАТИ ҶУМҲУРИИ ТОҶИКИСТОН

Муассисаи давлатии «Маркази миллии ичрои Конвенсияи Стокголм оид ба ифлоскунандаҳои устувори органикӣ

№ 15/1
От «29» мая 2016 г.

Информация об электротехническое оборудование, содержащее ПХД в г.Душанбе

Проведённые в 2015 году исследования по инвентаризации о оборудование, содержащее ПХД в г.Душанбе показало, что в состав трансформаторов находящихся на установленном месте по адресу ул Дж Расулов район Сино г. Душанбе содержание ПХД масла не обнаружено.
Информационный отчёт о об электротехническое оборудование, содержащее ПХД в Республики Таджикистан прилагается.

Директор А.Джураев

Committee for Environmental Protection of the republic of Tajikistan

№ 15/1 from 29.06.2016

Information about electrical equipments contained PCB in Dushanbe city.

According to the implemented inventory of equipments contained PCB in Dushanbe city, was identified, that the transformers installed in J. Rasulov str, Sino district of Dushanbe city, do not contain PCB.

Information report about PCB contain in electrical equipments in the republic of Tajikistan is attached.

Director A. Juraev

Figure 1-6 Certificate of NO PCB Contaminated Equipment

・Stockholm Convention (Stockholm Convention on Persistent Organic Pollutants (POPs))
Coming into effect on May 17, 2004. The Republic of Tajikistan ratified the Convention on February 8, 2007.

・POPs (Persistent Organic Pollutants)
These are the chemical substances characterized by strong toxicity, bioaccumulation, the possibility of long-range transport in environment, and adverse effects on human health or environment (dioxins, PCB (Poly Chlorinated Biphenyl), DDT, etc.)

5） Appropriate Disposal of Wastes

The methods of appropriate disposal of wastes are shown in Table 1-4.

Table 1-4 Methods of Appropriate Disposal of Wastes

Type of waste material	Disposal Method	Waste disposal site
Excavated surplus soil	Carry to the disposal site	Hard Disposal Stockyard (Approx.15km East from the Center of Dushanbe)
Asphalt paving waste material	Carry to the disposal site after crushing process	
Concrete, scrap		
Brick		

6) Land Acquisition

The Land Permission needed for the use of the proposed construction site for new Radiostantsiya Substation was issued by the Mayor of Dushanbe to BT on January 27, 2016. The site for the substation has been secured and there is no need for the relocation of residents.

(1) Land Permission Issue Number: No.19

(2) Condition for Issuance of Land Permission

- Land use is limited to the use for the substation.
- Construction must begin within 3 years (if not, the land must be returned).
- Vehicle tire washing during construction work.

  Action: Each substation will be provided with a tire washing facility during the construction period. Waste water will be passed through an oil-water separator to remove oil, earth materials, etc. before it is discharged to the sewer system.

The action plan concerning vehicle tire washing during construction work is shown in Table 1-5.

Table 1-5 Action Plan Concerning Wheel Wash during Construction Work

No.	Substation	Environmental measures	Person in charge	Period of implementation
1.	Promyshlennaya	Wheel Wash System Oil separating system High-pressure washer (Leased)		18 months
2.	Radiostantsiya	Wheel Wash System Oil separating system High-pressure washer (Leased)		18 months

(2) Issuance of Environmental Permission

1) Date of Issuance: Issued on October 10, 2016

2) Conditions for Permission

- Construction work must be conducted strictly conforming to the environmental and health regulations of Tajikistan.
- An action plan concerning environmental conservation must be formulated according to the format approved by the department in charge of environmental management.
- The action plan concerning environmental conservation must be observed strictly, and environmental conservation must be promoted.
- Construction work must be conducted paying attention to environmental and ecological aspects.
- Measures needed to prevent contamination of surface water and groundwater must be implemented.
- Wastes must be separated and treated appropriately.
- In the event of an emergency, measures must be taken so that waste water may no flow into water supply tanks or soil.
- The tires of construction vehicles must be washed to remove dirt.
- To minimize the environmental impact of noise and vibration during construction work, detailed work plans must be developed and maintained, and standard construction equipment with low environmental loads must be used.
- Necessary measures for hygiene management must be implemented.
- Substations must be operated and managed.
- If planted trees need to be moved for construction work, consult with the environmental department of Dushanbe City.
- Tree planting and transplanting must be performed using appropriate methods.

With respect to the construction of new Radiostantsiya Substation, it is necessary that the Tajikistan side (BT) provides for voltage upgrading from present 35 kV to 110 kV, and lead the upgraded transmission line into the substation. According to the answer of CEP concerning the environmental requirements for this work, the voltage upgrading work will consist of the replacement of the insulators of the existing transmission line, and the work of connecting the upgraded transmission line into the substation will be performed within the width under the transmission line. Because these works are within the scope of routine maintenance, CEP considers that they do not require environmental impact assessment.

1-3-3 Environmental Management Plan and Monitoring Plan

1-3-3-1 System for Implementation of Environmental Management

BT as the Executing Agency bears the overall responsibility for the implementation of the project. BT will produce and implement safety and environmental action plans (included in the work plan). The project implementation consultant (PIC) will confirm these plans, and ask BT to

make appropriate response to any problems occurring in the construction period.

During the construction period, any complaints from the residents of the project areas and any occurrence of environmental and social problems will be handled by BT. The Ministry of Energy and Water Resources as the responsible government agency will cooperate with BT toward the solution of problems. On the other hand, any complaints from citizens received by the Ministry will also be reported to BT, which will work for the solution of the problems.

1-3-3-2 Action Plan Regarding Environmental Management and Monitoring Plan

The action plan regarding environmental management and monitoring plan are shown in Table 1-6.

Table 1-6 Action Plan Regarding Environmental Management and Monitoring Plan

Item	Measures Parameters to be Monitored	Location	Timing and Frequency	Implementing / Responsible Organization
Pre-Construction Stage				
Action plan regarding environmental protection	Submitted to the environmental department of Dushanbe ・ Detailed work plan to reduce environmental impact ・Emergency response plan ・ Measures for hygiene management ・ If applicable, action plan regarding tree planting ・ Substation operation and management system	—	At the time of draft detailed design and at the time of final design	Ministry of Energy and Water Resources / BT
・Wheel Wash System ・Oil Separating System	・Installation ・Connection to sewer pipe ・Test operation	Each substation	At the time of draft detailed design, at the time of final design, and at the time of test operation	Ministry of Energy and Water Resources / BT
Construction Stage				
Air, noise, vibration	Confirmation of dust and noise conditions	Substation work site	Once/day	BT
Water pollution	Visual confirmation of turbid water flow	Surface water in the vicinity of substation	Once/day	BT

		work site		
Waste	Confirmation of the situation of waste separation, quantity, and disposal	Work site, field office, and waste disposal site	Once/day Once/week (waste disposal site)	BT
Emergency response	Confirmation of the awareness of emergency response procedures	Work site and field office	Once/week	BT
・Wheel Wash System ・Oil Separating System	・Visual confirmation of the discharge into sewer pipe ・Appropriate disposal of separated oil and sludge	Work site	Once/day	BT
Vehicle for Construction Work	・Confirmation of driving manners ・On-site confirmation during patrol	Work site and vicinities	Once/day	BT
Public health, working environment, accident	Public health, working environment Confirmation of situation	Work site and field office	Once/day	BT
Actions regarding tree planting	If necessary, confirmation of actions concerning tree planting	Work site and transplanting site	When tree planting takes place	BT
Substation operation and management system	Confirmation of operation and management system	Substation	Before the substation is put into use	BT
Safety management	Confirmation that signs are shown in hazardous places	Substation	Before the substation is put into use	BT
Use Stage				
Soil and water pollution	Confirmation that oil is not leaking from transformers	Substation	Once/day	BT

1-3-4 Stakeholder Consultation

1-3-4-1 Promyshlennaya Substation (Rehabilitation)

1. Date	Friday, November 4, 2016	
2. Place	Office of "District Electricity Power Networks of Sino District：DEPN"	
3. Attendants	Organizer side	
	Mr. Yakhiyoev Parviz Jamolovich (Presenter)	Chief Specialist, Department of Management, Development and Implementation of Investment

		Projects in Energy and Water Resources, Ministry of Energy and Water Resources of RT(MEWR)
	Mr. Rahmatov Bakhtiyor Dodihudoevich	Deputy Director, Department of Distribution Networks, Open Stock Holding Company "Barki Tojik"
	Stakeholder side	
	Mr. Ghiyosov A. M.	Deputy Chief Engineer, Dushanbe City Electricity Power Network：DCEPN"
	Mr. Nurzoda O. A.	Head of "District Electricity Power Networks of Sino district"
	Mr. Dodarov S. S.	Head of DCEPN Left-River Bank SSs
	Other participants	See the List of Participants in Appendix
4.Main opinions	Because Promyshlennaya Substation is considerably superannuated and outages due to overloading are taking place, participants desire prompt implementation of this project, which will renew substation facilities with increased capacity.	
5. Dissemination of the holding of the stakeholder consultation	Mr. Parviz Yahyoev of the Ministry of Energy and Water Resources made a phone call to a staff member of "District Electricity Power Networks of Sino district (Sino DEPN)," which is adjacent to and partly share the premises with Promyshlennaya Substation, 5 days before the stakeholder conference, notifying the holding of the stakeholder conference concerning the rehabilitation of Promyshlennaya Substation and asking to make it known to people.	

1-3-4-2 Radiostantsiya Substation (New Construction)

1. Date	Friday, October 28, 2016	
2. Place	"Radiostantsiya Substation Site：Habib Ahrori Mahalla"	
3. Attendants	Organizer side	
	Mr. Safarov Manuchehr Bahodurovich (Presenter)	Head, Department of Management, Development and Implementation of Investment Projects in Energy and Water Resources, Ministry of Energy and Water Resources of RT(MEWR)
	Mr. Yakhiyoev Parviz Jamolovich	Chief Specialist, Department of Management, Development and Implementation of Investment Projects in Energy and Water Resources, MEWR
	Mr. Sandalov Sh.	Chief Specialist, Department of Management, Development and Implementation of Investment Projects in Energy and Water Resources, MEWR

	Stakeholder side	
	Mr. Yusufov Ikrom Sadulloevich	Head of Habib Ahrori Mahalla
	Residents of Habib Ahrori Mahalla district	See the List of Participants in Appendix
4. Main opinions	Because the construction of Radiostantsiya Substation will improve the response to the growing power demand in the urban areas of Dushanbe and the reliability of power supply, participants desire early implementation of the project.	
	・Mr. Yusufov Ikrom Sadulloevich：Head of Habib Ahrori Mahalla Requested the submission a copy of the Land Permission that was issued to the Ministry of Energy and Water Resources by the Mayor of Dushanbe. →A copy of the Land Permission has already been submitted.	
5. Dissemination of the holding of the stakeholder consultation	Mr. Parviz Yahyoev of the Ministry of Energy and Water Resources made a phone call to Mr. Yusufov Ikrom Sadulloevich, “Head of Habib Ahrori Mahalla,” 5 days before the stakeholder conference, notifying the holding of the stakeholder conference concerning the rehabilitation of Promyshlennaya Substation. On the same day, the “Head of Habib Ahrori Mahalla” visited all residents of Habib Ahrori Mahalla district, ensuring that people know about the holding of the stakeholder conference.	

1-3-5 Environmental Laws and Regulations

Table 1-7 shows related environmental laws and regulations of Tajikistan.

Table 1-7 Related Environmental Laws and Regulations

Title	No.	Enacted Date
Constitution of the Republic of Tajikistan	—	November 6, 1994
"Technical Regulation" Law The law stipulating the change from the standards used in the former U.S.S.R. era to "International Standards"	No.522	May 19, 2009
"Environmental Protection" Law	No.760	August 2, 2011
"Ecological Expertise" Law	No.818	April 16, 2012
"State Ecological Expertise Procedure" Decree	No.697	December 3, 2012
"List of facilities and types of activities on Environmental Impact Assessment" Decree	No.253	June 3, 2013
"Procedure for arrangement and conduction of Environmental Impact Assessment" Decree	No.509	August 1, 2014
"Air Protection" Law	No.915	December 28, 2012
"Air Code of Tajikistan"	No.720	November 13, 1988
"Water Code of Tajikistan"	No.11	November 29, 2000
"Ensuring Sanitary and Epidemiological Safety of Population Law"	No.49	December 8, 2003
"Industrial and Consumer Wastes" Law	No.44	May 10, 2002
"Procedure, Conditions and Methods of Collection, Use, Neutralization, Transportation, Storage and Disposal of Industrial and Consumer Wastes" approved under Decree	No.279	June 2, 2011
"Criteria of Referring Hazardous Wastes to Classes of Danger for Environment" adopted under the Order of the Chairman of Committee on Environmental Protection	No.810	March 7, 2008

1-3-6 Climate Change Mitigation

Although Tajikistan has many glaciers, including the Fedchenko Glacier boasting the largest size in Central Asia, approximately 30% of their mass has been lost in the past 70 years, and the country is committed to taking measures against global warming. The Republic of Tajikistan submitted the Intended Nationally Determined Contribution describing the country's post-2020 climate actions to the UNFCCC (United Nations Framework Convention on Climate Change) on September 30, 2015. Tajikistan intends to achieve a greenhouse gas emissions reduction target of 65-75% of the 1990 level by 2030 subject to new substantial international funding and technology transfer.

1-3-6-1 Thermal Power Plants in Tajikistan and CO_2 Emissions

While there are three thermal power plants in Tajikistan, the only ones operating at the present are TPP-1 (Thermal Power Plant) and TPP-2, which are both cogeneration plants.

TPP-1 (198 MW) has been operated since the 1960s and has become considerably superannuated. This led to the construction of TPP-2, and TPP-2 Phase I (100 MW) started operation in January 2014. In addition, the thermal power plant TPP-2 Phase II (300 MW) is now in the stage of final confirmation test run, aiming at the start of operation in December 2016. After the completion of Phase II, it will become TPP-2 (400 MW) and operated as a cogeneration plant for the purpose of improving the power supply situation in winter. The amount of CO_2 emission is approximately 65,000 ton-CO_2/year for TPP-1 burning Mazut (black oil) and approximately 428,000 ton-CO_2/year for TTP-2 burning domestic coal. Table 1-8 shows the data for TPP-1 and TPP-2.

Table 1-8 Data for TPP-1 and TPP-2

	TPP-1 (1962, operated since 1965)	TTP-2 Phase I (Operated since January 2014)	
Capacity	198MW (4 units)	100MW (2 units)	
Power Generation (MWh/year)	57,456 (Annual average in 2013-2015)	501,65 (2015)	
Fuel Type	Mazut (Black Oil)	FON-YAGNOB COKE-COAL (Domestic coal)	Diesel
Net Calorific Values (NCVs) (GJ/ton)	41.06	28.2	43.0
CO_2 Emission Factors for Combustion (ton-CO_2/GJ)	0.07737	0.0946	0.0741
Emission Factor (ton-CO_2/MWh)	1.140 (Annual average in 2013-2015)	0.853 (2015)	
CO_2 Emissions (ton-CO_2)	65,482 (Annual average in 2013-2015)	427,816 (2015)	

・NCVs, CO_2 Emission Factors
Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2 Energy
http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html
：TÜV SÜD Climate and Energy　https://www.netinform.de/KE/
Landfill gas data table　https://www.netinform.de/KE/files/pdf/Annex3_(Landfill).pdf

(1) Contribution to the Greenhouse Gas Emissions Reduction

1) Because newly constructed Radiostantsiya Substation will take over approximately 30% of the loads on superannuated existing substation, such as Tekstilmash Substation, Vakhdat Substation, Centralnaya Substation, and Karamova Substation, the improved transformation efficiency of Radiostantsiya Substation will result in the improvement of the transformation loss corresponding to the part of electric energy that will be taken over by the new substation (MWh/year).

2) The extent of CO_2 emission reduction resulting from the improvement of transformation loss was calculated assuming that the transformation efficiency of the new substation will be 1% better than that of the existing substations.

3) With respect to the emission factor, TPP-1 (198 MW) has a higher emission factor than TTP-2 Phase I (100 MW) in a comparison between the two thermal power plants operating in Dushanbe. If the improvement of transformation loss translates into the reduction of power generation at TPP-1 (198 MW), the amount of the avoided loss of electric energy will be equivalent to the reduction of CO_2 emission by 2,037 ton-CO_2. The details of this calculation are shown in Table 1-9.

Table 1-9 Reduction of CO_2 Emission Achieved by the Construction of Radiostantsiya Substation

Item	Improvement resulting from reduction of Transformer Loss with upgrade Transformer
Transformer (MVA)	40
Assumed power factor	0.95
Active power (MW)	38
Annual mean load factor (%)	60
Annual electric energy supplied (MWh)	178,704
Load loss at 40MVA (MW)	0.219
Load loss at power factor 0.95 (MW)	0.1976475
No-load loss (MW)	0.0205
Transformer efficiency (%)	99.43

Power loss improvement rate (%)	1
Avoided energy loss (MWh/year)	1,787
Emission factor (ton-CO_2/MWh)	1.14
CO_2 emission reduction (ton-CO_2)	2,037

Power loss improvement rate (%)	1
Avoided energy loss (MWh/year)	1,787
Emission factor (ton-CO_2/MWh)	1.14
CO_2 emission reduction (ton-CO_2)	2,037

Chapter 2 Contents of the Project

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Overarching Goals and Project Goals

(1) Overarching Goals

Tajikistan has set the National Development Strategy (NDS) as its top level national goal, in which the development of the energy sector is considered to be vital to further development of the national economy and a subsequent increase in the level of happiness of the people.

The Government of Tajikistan cites three priority sectors under the NDS, which are a) energy, b) transport and transportation, and c) food security.

Moreover, the Living Standard Improvement Strategy of Tajikistan (LSIS) states that making energy sources usable safely and stably is a prerequisite for poverty reduction.

The Government of Tajikistan has formulated a series of development plans for the energy sector, including refurbishment of the existing facilities and transmission network, and considers the improvement of substations and development of new infrastructures in Dushanbe to be its top priority.

(2) Project Goals

The project objective is to improve the electricity supply to the industrial and other civilian sectors in Dushanbe, thereby contributing to the promotion of economic and social development, and improvement in the living standards.

2-1-2 Overview of the Project

The Project aims to improve the electricity stable supply to the industrial and other civilian sectors in Dushanbe without power outage caused by facility overload or failure throughout the year, by rehabilitating and enhancing the 110kV Promyshlennaya Substation for power distribution, and constructing new substations to achieve the objective mentioned above, thereby contributing to the promotion of economic and social development, and improvement in the living standards.

(1) Requests from the Recipient Country

The Tajikistan side has requested the following three components, which are listed in order of their priority.

(i) (Rehabilitation of) Promyshlennaya Substation

For increasing of the 110/35/10kV transformer capacity, the two existing 25MVA units will be replaced by two 40MVA units.

(ii) (New construction of) Radiostantsiya Substation

For the 110/35/10kV transformer, two 40MVA units will be installed.

(iii) (New construction of) Glavpochtampt Substation

For the 110/10/6kV transformer, two 25MVA units will be installed.

(2) Proposed Project Coverage

The electricity system that supply electricity to Dushanbe has several urgent issues, such as response to a sharp increase in power demand, improvement in the reliability of the electricity supply system essential for maintenance and enhancement of the capital's functions, and systematic rehabilitation of the existing facilities that are fairly aged as a whole. However, taking short-term investment effects, total project cost and other factors into account, we have to select two out of the three components requested by the recipient country.

To narrow down to two components, the Survey Team has considered the priority order of the recipient country, and thus proposes the (rehabilitation of) Promyshlennaya Substation and the (new construction of) Radiostantsiya Substation.

Even if the number of target substations has been reduced, the total substation capacity has been increased from 144MVA of the initial request to 160MVA of the two components.

1) Promyshlennaya Substation (rehabilitation)

110kV bay unit equipment, transformers, and 35kV and 10kV distribution switchgears, among other things, were manufactured in the 1960s, and thus are fairly aged and have frequent problems. The personnel concerned have difficulty operating and maintaining these facilities, so that main equipment will be replaced by latest equipment, while bus bars that are still usable will continue to be used. While these facilities are replaced, the capacity of transformer will be enlarged from the current 25MVA to 40MVA for a likely increase in the power demand.

As for the sharing between the secondary (35kV) and tertiary (10kV) sides, there is a gap in peak time: a peak at daytime for supply to factory areas on the 35kV side and a peak at night for supply to residential areas on the 10kV side. Thus, their capacities will be made 20MVA and 40MVA, respectively.

2) Radiostantsiya Substation (new construction)

This new substation will cover some 30% of the load of the existing substations, including Tekstilmash, Vakhdat, Centralnaya, and Karamova Substations.

The substation will consist of two 40MVA transformer units with the capacity of 80MVA to be connected to four 35kV transmission cables and 20 10kV distribution cables.

2-2 Outline Design of the Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Policy

The basic matters including the final components, theadequate capacity of the substations, and the number of distribution feeders to be connected have been determined in consideration of the results of the Preliminary Field Survey, subsequent discussions with the counterpart, revisions to the initial requests (additional requests), evaluation of the relevance of the revisions, and technical considerations.

The revisions to the initial requests, evaluation of their relevance, selection of components and other basic matters are described below.

(1) Requests of the Recipient Country

Tables 2-1 to 2-3 list the initial requests and finalized requests in consideration of the additional requests.

Table 2-1 Revisions in relation to Promyshlennaya Substation

Present specifications	Requests	Revisions to the requests
・ 110kV and 35kV outdoor air insulation systems (AIS)	・ 110kV and 35kV outdoor air insulation systems (AIS)	・ 110kV outdoor air insulation system (AIS)
・110/35/10kV 25/25/25MVA Main transformers x 2	・110/35/10kV 40/20/20MVA Main transformers ×2	・110/35/10kV 40/20/40MVA Main transformers x 2
・10kV indoor switchgears	・10kV indoor switchgears	・35kV indoor switchgears ・10kV indoor switchgears

Table 2-2 Revisions in relation to Radiostantsiya Substation

Requests	Revisions to the requests
・110kV gas insulated switchgear (GIS)	・110kV outdoor air insulation systems (AIS)
・110/6kV 16MVA main transformers x 2	・110/35/10kV 40/20/20MVA main transformers x 2
・6kV outdoor switchgears	・35kV and 10kV indoor switchgears

Table 2-3 Revisions in relation to Glavpochtampt and Glavnaya Substations

Requests	Revisions to the requests
・110kV gas insulated switchgear (GIS)	・110kV outdoor air insulation systems (AIS)
・110/6kV 16MVA main transformers x 2	・110/6/10kV 25/12.5/12.5MVA main transformers x 2
・6kV outdoor switchgears	・10kV and 6kV indoor switchgears
	・110kVXLPE underground cable, 2 lines, 120mm2 x 3, 1.7km (GlavnayaSS―Glavpochtampt SS)
	・110kV transmission end switchgear in GlavnayaSS

(2) Consideration of Relevance and Appropriateness of the Transformer Capacity Requested by the Recipient Country

1) Results of Consideration of Relevance and Appropriateness of the Transformer Capacity at Promyshlennaya Substation

With regard to consideration of relevancy, Table 2-4 shows estimated maximum power demand for Promyshlennaya Substation, and Table 2-5 shows changes in the power demand from 2011 to 2013 and estimated demand until 2020 on the assumption that the demand grows from 2013 on at the rate recorded in 2013.

Table 2-4 Estimated Maximum Power Demand for Promyshlennaya Substation

(Unit: MW)

2017		2018		2019		2020		2025	
Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
48.0	54.0	49.2	55.9	50.4	57.9	59.2	59.9	66.3	70.4

Note: The figures are the sum of 2 banks.

Source: prepared by the Survey Team based on materials of BT.

Table 2-5 Changes in Power Demand and Estimated Demand

Customers	2011	2012	2013	2020
	Power Demand	Power Demand	Power Demand	Power Demand
Industrial and business use (kWh)	26,393,039	34,493,669	38,977,845	91,699,856
y/y growth rate (%)		31	13	13
Public facilities and social services (kWh)	3,897,774	8,999,029	10,438,873	12,400,091
y/y growth rate (%)		131	16	16
Pump and other electric power (kWh)	1,521,897	3,521,497	4,049,721	10,772,338
y/y growth rate (%)		131	15	15
General use (kWh)	121,215,041	137,415,617	160,776,335	482.528,708
y/y growth rate (%)		17	17	17

Source: prepared by the Survey Team based on materials of BT.

Currently, two transformers supply electricity to the industrial sector including pulp factories and high-rise condominiums and other residential buildings in Ibn Sina district, but these sectors and district suffer from frequent power outages because of breakdown of aged facilities and, in winter when the power demand is high, tripping of these facilities due to overload.

As for the sharing between the secondary and tertiary sides of the transformer, the recipient country has requested that they will be designed to have an enough capacity of 100% (the capacities of the primary, secondary and third sides to be 40, 20 and 20 MVA, respectively). This is because of different peak times between the 35kV transformer, which has a peak at daytime in factory areas, and the 10kV transformer, which has a peak time at night in

residential areas. The Survey Team has conducted hearings to find out actual supply and demand in detail, and agreed with the counterpart that the project will procure two transformers of the capacity of 110/35/10kV 40/20/40MVA.

2) Results of Consideration of Relevance and Appropriateness of the Transformer Capacity at Radiostantsiya Substation

With regard to consideration of relevancy, Table 2-6 shows estimated maximum power demand for Radiostantsiya Substation, and Table 2-7 shows trends in the number of customers of and the power demand (kWh) to substations to be connected to Radiostantsiya Substation.

Table 2-6 Estimated Maximum Power Demand for Radiostantsiya Substation

(Unit: MW)

2019		2020		2025	
Summer	Winter	Summer	Winter	Summer	Winter
55.2	76.8	56.7	79.5	58.3	82.3

Note: The figures are the sum of 2 banks.

Source: prepared by the Survey Team based on materials of BT.

Table 2-7 Trends in the Number of Customers of and Power Demand to Substations to be Connected to Radiostantsiya Substation

Substations to be connected	2011		2012		2013	
	No. of customers	Power Demand	No. of customers	Power Demand	No. of customers	Power Demand
Tekstilmash (kWh)	8,311	92,420,074	8,978	99,655,558	9,120	101,414,440
y/y growth rate (%)			8	8	2	13
Vakhdat (kWh)	6,345	61,262,751	7,123	68,772,565	7,968	88,604,160
y/y growth rate (%)			12	12	12	29
Centralnaya (kWh)	5,652	76,860,019	6,135	83,428,205	6,865	89,245,031
y/y growth rate (%)			9	9	12	7
Karamova (kWh)	103	1,219,712	189	2,238,112	235	2,667,250
y/y growth rate (%)			83	83	24	19

Source: prepared by the Survey Team based on materials of BT.

Radiostantsiya Substation supplies electricity to the central part of Dushanbe, where many important facilities including the Presidential Palace are located. It covers some 30% of the load of the existing substations, including Tekstilmash, Vakhdat, Centralnaya, and Karamova Substations.

The capacity of transformers to be procured has been calculated in accordance with the estimated demand in the table above. It is relevant to newly built transformers of 80MVA (two 40MVA transformers) to be connected to two 35kV transmission cables and 20 10kV distribution cables.

Meanwhile, an overhead transmission line (35kV) that passes above the project site will be segmented to take in the power source after the voltage is increased to 110kV. This work will be conducted by BT.

3) Results of Consideration of Relevance and Appropriateness of the Transformer Capacity at Glavpochtampt Substation

With regard to consideration of relevancy, Table 2-8 shows estimated maximum power demand for Glavpochtampt Substation, and Table 2-9 shows trends in the number of customers of and the power demand (kWh) to substations to be connected to Glavpochtampt Substation.

Table 2-8 Estimated Maximum Power Demand for Glavpochtampt Substation

2019		2020		2025	
Summer	Winter	Summer	Winter	Summer	Winter
14.4	21.7	14.8	22.5	17.0	26.4

Note: The figures are the sum of 2 banks.

Source: prepared by the Survey Team based on materials of BT.

Table 2-9 Trends in the Number of Customers of and Power Demand to Substations to be Connected to Glavpochtampt Substation

Substations to be connected	2011		2012		2013	
	No. of customers	Power Demand	No. of customers	Power Demand	No. of customers	Power Demand
Glavnaya (kWh)	2,345	22,181,621	3,612	34,166,317	4,720	45,071,280
y/y growth rate (%)			54	54	31	32
Centralnaya (kWh)	5,652	76,860,019	6,135	83,428,205	6,865	89,245,031
y/y growth rate (%)			9	9	12	7
Vakhdat (kWh)	6,345	61,262,751	7,123	68,772,565	7,968	88,604,160
y/y growth rate (%)			12	12	12	29
Tekstilmash (kWh)	8,311	92,420,074	8,978	99,655,558	9,120	101,414,440
y/y growth rate (%)			8	8	2	13

Source: prepared by the Survey Team based on materials of BT.

The substation equipment will be enhanced to increase the electricity supply to the Ismail Somoni district (residential area) in Dushanbe, where the power demand is sharply increasing. The capacity of the facilities is considered to be relevant because the power demand is expected to increase sharply.

(3) The Necessity of the Target Substations and the Priority Order from the Perspective of the Electricity System

The electricity system that supplies electricity to Dushanbe has the following urgent issues.

- Response to a sharp increase in power demand;

・ Improvement in the reliability of the electricity supply system essential for maintaining and enhancement of the capital's functions;

・ Systematic rehabilitation of the existing facilities that are fairly aged as a whole, etc.

It is considered that the plans to build new substations, and rehabilitate and increase the capacity of the existing Promyshlennaya Substation are both effective to solve the issues listed above.

From the viewpoint of investment effects, at the same time, the construction of two substations will have long-term effects as they will alleviate the load of the surrounding aged substations and pave the way to systematic rehabilitation and enhancement of the electricity system as a whole.

However, the candidate construction sites of the two new substations are located across the river from the existing Promyshlennaya Substation, and have difficulty alleviating the burden on the existing substation by serving as important regional substations. Thus, the Promyshlennaya Substation itself needs to be rehabilitated and enhanced, too.

Radiostantsiya Substation, one of the new substations to be constructed, will supply electricity to the Presidential Palace and other important governmental facilities. Enhancement of the stable electricity supply will be of great significance.

Accordingly, the priority order of the counterpart – that is, (1) rehabilitation and capacity expansion of the existing Promyshlennaya Substation; (2) new construction of Radiostantsiya Substation; and (3) new construction of Glavpochtampt Substation – is considered to be relevant, while, from the viewpoint of short-term investment effects, total project costs and other factors, priority should be given to rehabilitation and capacity expansion of the existing Promyshlennaya Substation, and new construction of Radiostantsiya Substation.

2-2-1-2 Policy on Natural Conditions

The following natural conditions should be taken into account in relation to designing of substation facilities.

・ The surrounding temperature is under 40°C, the design condition of ordinary electrical products. Direct sunlight and ultraviolet radiation increase the temperature inside electrical products above 40°C, having negative effects on operations and lifespan of semiconductors and other electronic parts.

Therefore, distribution switchgears, control panels and other electronic parts should not be installed under direct sunlight, but placed indoors to be kept away from direct sunlight.

・ To avoid direct lightning stroke to air insulation parts of busbars and equipment, lightning rods or overhead grounding wires must be installed. In preparation for the intrusion of surges into special high-voltage transmission lines and towers, and overhead distribution lines and towers as a result of lightning stroke, lightning arrestors must be installed at entrances of transmission and distribution lines.

・ Earthquakes in the past have been taken into account, so that the structural design will be made with the seismic coefficient, k=0.2, so that the structures can be resistant to earthquakes of magnitude 6.

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

With regard to rehabilitation of the existing Promyshlennaya Substation, the following matters will be considered in detail so as to avoid negative impacts of outages on society as a result of long-term suspension of the facilities, and secure safety of workers.

・Examining if it is necessary to construct temporary facilities, and securing its construction site
・Establishing the procedure to replace facilities to minimize the outage period
・Securing the safety of construction work
・ Establishing the procedures to transport facilities to be removes, and safety and environmental measures while the facilities are provisionally stored on the premises

2-2-1-4 Policy on Construction Work

The project area is the capital of Tajikistan, where governmental facilities, and many large commercial facilities and office buildings are located. Construction projects of large facilities are also in progress. These projects include electricity work. And there are multiple businesses capable of engaging in electricity work in Dushanbe, which is good for construction work for the Project.

2-2-1-5 Policy on Usage of Local Contractors, Equipment and Materials

According to hearings to local contractors in Tajikistan and records of the implementing agency on project order placement, it is relatively easy to hire construction workers, leasing vehicles, construction equipment and materials in the country. It is also possible to place orders for electrical, civil engineering and construction works involved in the rehabilitation of the substation. Thus, the construction plan will be formulated to take advantage of local contractors hiring local skilled and ordinary workers.

2-2-1-6 Policy on the Operation and Maintenance Capacity of the Implementing Agency

BT, which is in charge of O&M after the implementation of the Project, has a certain technological standard and stably engages in operations, management and maintenance of substation facilities across the country. Thus, it is considered to have the O&M capaility for substation facilities to be procured under the Project.

The Survey Team will make a proposal for the operation and maintenance system after the facilities to be supplied start operations. More specifically, the Survey Team proposes that Japanese engineers will conduct training on operations and maintenance inspections of the facilities during the construction period, and that the Project will also supply maintenance tools

and O&M manuals related to equipment to be procured under the Project.

2-2-1-7 Policy on the Determination of the Coverage and Grades of Facilities and Equipment

In consideration of the conditions described above, the coverage of materials and equipment to be procured and installed under the Project, and the technological level will be determined as basic policy.

(1) Policy on the Coverage of Facilities and Equipment

The Project will rehabilitate and newly construct substation facilities so that they can start to stably supply electricity to governmental facilities, commercial facilities, factories and residential buildings by the target year of 2025.

The Japanese side will procure and install facilities, and local contractors will install and adjust equipment to be procured under the Project in the manner of facilitating the Tajikistan side themselves to operate and manage these electricity facilities. Moreover, for economic efficiency, the Project will use as many standard materials and equipment meeting international standards as possible, and adopt minimum necessary facility components and specifications.

(2) Policy on Setting of Grades

The substation facilities to be constructed and procured under the Project will be designed in conformity with the structure of the existing facilities, technological standards, work manuals and other factors of BT. Any facilities and equipment beyond the technological level of BT, which is in charge of O&M after the delivery, should be avoided.

2-2-1-8 Policy on Work and Procurement Methods, and Work Schedule

The Project will be implemented according to the Japanese Grant Aid Cooperation scheme, and thus the installation needs to be completed within two years after the conclusion of G/A. At the same time, to complete the construction work within a predetermined schedule and generate expected effects, the work processes on the Japanese and Tajikistan sides need to be well coordinated. The entire process must be planned in consideration of inland transportation routes, method, period and procedures.

The Project requires simultaneous construction of two substations. Thus, the work process will be planned so that efficient work can be conducted under an appropriate implementation system. At the same time, work methods familiar to local contractors and engineers will be adopted, and an instruction and supervising system will be established so that the construction work will be carried out safely and swiftly.

Promyshlennaya Substation tends to cause outages due to excessive load particularly in winter. Thus, the process plan will be formulated to avoid winter.

2-2-2 Basic Plan (Facility Plan/Equipment Plan)

2-2-2-1 Prerequisites for the Plan

In any project to construct a substation of this kind, the systematic location of the substation and its distribution coverage must be determined normally after confirmation is made on the relevance of the electricity supply system and amount based on expected power demand and system analysis, and cooperation with other development projects including those for other power generation facilities. In this Project, however, the project sites, voltages and capacities have been determined in accordance with Tajikistan's system enhancement plan.

Therefore, to simply satisfy the requests of the Tajikistan side, it would be enough to provide hard and soft infrastructure in line with thee requests. But it is doubtful if this will guarantee the enhancement of the electricity supply system, which the Tajikistan side actually looks for.

As the basic plan of the Project, the following matters must be considered.

(1) Necessity of Demand Estimation

This survey will collect and analyze the following information, and examine the consistency with the requests of the counterpart, and the relevance of facilities to be procured.

(i) Examining the relevance of estimated demand for the electricity in the distribution area of the substation concerned. Estimated data will be presented by the counterpart, and examined from economic and social perspectives.
(See section 2-2-1-1 "Basic Policy")

(ii) Examining the feasibility of electricity supply from the upper electricity transmission system of the substation concerned, geographical location and transmission system.

(iii) Following the results of the examinations above, discussing the requests of the counterpart and recommendations of the Survey Team.

(iv) Examining whether the requests (including requests to facility manufacturers, etc.) are appropriate in terms of facility operations and maintenance.

(2) Target Year of the Project

The Project aims to fulfill highly urgent requests of the counterpart. In consideration of the consistency with similar Grant Aid Cooperation projects, the target year of the facility plan has been set to 2025.

The target year of the project evaluation including evaluation of beneficiary effects has been set to three years after the commencement of services.

2-2-2-2 Electricity System Analysis

To confirm the relevance and effectiveness of the project components, the Survey Team has

analyzed the electricity system. Appendices 6 and 8 show the result of detailed analysis and data used.

(1) Basic Policy on the Electricity System Analysis in This Survey

Table 2-10 shows the basic policy on the electricity system analysis. The analysis has used the supply system model in Dushanbe taken from the system diagram of the entire country, as well as data on the power demand, which was provided by BT.

Table 2-10 Basic Policy on the Electricity System Analysis

Item	Basic policy
Objective	・ Examining the relevance and necessity of the capacities of major components (circuit breaker and transformer) to be supplied under the Project
Coverage	・ The electricity supply system in Dushanbe
Short circuit current	・ Confirming the breaking capacities of the substations to be rehabilitated and newly constructed
Load flow	・ Confirming the relevance of the capacities of transformers of the substations to be rehabilitated and newly constructed
Voltage	・ Calculating the voltage sensitivity of the present system, and confirming if phase modifying equipment will be needed in future
Transient stability	・ Confirming any disturbance of the generator of the power station due to an accident at one electricity supply cable of the power station, though it is less likely to have an impact on the transient stability of the substations to be rehabilitated and newly constructed
Major cross-section	・ For short circuit current, expected cross-sections before and after the rehabilitation/new construction in FY2018 will be used. ・ For voltage and electricity system analysis, expected cross-sections each fiscal year up to FY2020, and in FY2025 will be used.
Evaluation method	・ Confirming that the rated breaking capacity of the breakers at the substations are within short circuit current values. ・ Confirming that the transformer flow is within the capacity, and that the transformer has a relevant load flow in recent fiscal years ・ Confirming that the present voltage fluctuation range has no particular problem in line with the voltage sensitivity calculated, and confirming if phase modifying equipment will be needed in case the voltage lowers in future.
Prerequisites	・ Conducting system analysis with data provided by BT

(2) Confirmation of the Analysis Results, and Relevance and Effectiveness of the Project

1) Short Circuit Current

Prior to the rehabilitation of Promyshlennaya Substation and new construction of Radiostantsiya Substation, the Survey Team has checked the necessary breaking capacity of their incoming circuit breakers, and confirmed that there will be no problem with the design

specification of 31.5kA. The team has also confirmed that the present short circuit current will not increase at other substations.

Table 2-11 shows the result of calculation of short circuit currents before and after the rehabilitation and new construction.

Table 2-11 Results of Calculations of Short Circuit Currents

Substation	Voltage class (kV)	Before rehabilitation (kA)	After rehabilitation/new construction (kA)
Promyshlennaya	110	24,15	24,05
	35	7,35	5,88
	10	11,99	11.19
Radiostantsiya	110	--	25,50
	35	--	6,10
	10	--	5,33

2) Load Flow

BT's estimated values of load flows before and after the rehabilitation of Promyshlennaya Substation, and at the time of the new construction of Radiostantsiya Substation suggest the necessity of this Project. The Survey Team has confirmed the future situation of the electricity system, including loads on other substations when conducting analytical calculation of load flows.

Table 2-12 shows estimated load flows of Karamova and Sebernaya Substations near Radiostantsiya Substation, both of which have heavy loads but will see considerable decreases in load flows if Radiostantsiya Substation is constructed. Estimated cross-sections for 2025 indicate that the availability factor of Promyshlennaya Substation is 88% and that of Radiostantsiya Substation is 103%. BT estimates, on the other hand, that the load of Promyshlennaya Substation will increase at 3.5% per year after 2020, and that the load of Radiostantsiya Substation will increase at 2.8% per year after 2020. Taking into account the fact that the neighboring Karamova and Sebernaya Substations have spare capacities in their banks, the Survey Team finds it economically effective to enhance the interconnection of distribution lines in the entire areas of the city, average out the availability factors of these substations via redistribution of supply areas, and delay the construction of new substation as much as possible. The two substations to be newly constructed are expected to supply electricity to the central part of the city, and have load flows in preparation for a sharp increase in loads as a result of future re-development of the city, so the actual availability factor will considerably depend on the progress of such re-development. Thus, to avoid a specific substation from having a high availability factor, it is desirable to enhance the interconnection of distribution lines as stated above. If an ideal load distribution is realized,

each substation will see an increase in load flow by 5% per year of the average load flow in the entire city. Table 2-12 indicates that the availability factors of Promyshlennaya and Radiostantsiya Substations will be 88% and 103%, respectively, in 2025 if the average growth rate of the city is set at 5% per year.

Table 2-12 Estimated Load Flows of Promyshlennaya and Radiostantsiya, and Neighboring Substations

Name of substation	Facility capacity	2017				2018						
		Summer (MW)	Availability factor	Winter (MW)	Availability factor	Summer (MW)	Availability factor	Winter Before works (MW)	Availability factor	Change of facility capacity	Winter After works (MW)	Availability factor
PROMYSHLENNAYA	66MVA (25MVA x 2, 16MVA x 1)	48%	96%	54	108%	49.2	58%	55.9	112%	96MVA (40MVA x 2, 16MVA x 1)	55.9	70%
RADIOSTANTSIYA	0MVA									80MVA (40MVA x 2)	63.5	79%
KARAMOVA	50MVA (25MVA x 2)	31.2	62%	54.8	110%	33.6	67%	57.6	115%	50MVA (25MVA x 2)	24.2	48%
SEBERNAYA	50MVA (25MVA x 2)	19	38%	38.8	78%	21	42%	41.2	82%	50MVA (25MVA x 2)	11.4	23%

Name of substation	Facility capacity	2019				2020				2025			
		Summer (MW)	Availability factor	Winter (MW)	Availability factor	Summer (MW)	Availability factor	Winter (MW)	Availability factor	Summer (MW)	Availability factor	Winter (MW)	Availability factor
PROMYSHLENNAYA	96MVA (40MVA x 2, 16MVA x 1)	50.4	63%	57.9	72%	59.2	74%	59.9	75%	66.3	83%	70.4	88%
RADIOSTANTSIYA	80MVA (40MVA x 2)	55.2	69%	76.8	96%	56.7	70%	79.5	99%	58.3	73%	82.3	103%
KARAMOVA	50MVA (25MVA x 2)	18.4	37%	31.2	62%	19.2	38%	32.8	66%	24.6	49%	42	84%
SEBERNAYA	50MVA (25MVA x 2)	2.8	6%	10	20%	3.2	6%	10.8	22%	6.2	12%	16	32%

Note: The numerals in parentheses of 2025 lower line show the case of 5%/year current consumption increase

Source: prepared by the Survey Team based on materials of BT.

3) Voltage

Table 2-13 shows the voltage sensitivity calculation results, that is, changes in voltage when the reactive power of 1Mvar is input in the 35kV bus bar of each substation. It shows that the voltage changes by a mere 0.048% on average in response to an increase in the reactive power by 1Mvar (0.02kV at the 35kV bus). Thus, if the voltage adjustment ranges from -10% to 10% (±3kV at the 35kV bus) due to operation of tap changer, there will be no problem for the time being.

Table 2-13 Calculation Results of Voltage Sensitivity

Sensitivity calculation Result(δV/δQ) at 35kV Bus (%kV/Mvar)

СЕВЕРНАЯ (SEBERNAYA S/S)	0.003%
КАРАМОВА (KARAMOVA S/S)	0.077%
ПРОМЫШЛЕННАЯ (PROMYSHENNAYA S/S)	0.063%
average	0.048%

Result	0.02kV/1MVar(35kVbase)
	0.2kV/10MVar(35kVbase)

Source: prepared by the Survey Team based on materials of BT.

4) Transient Stability

The rehabilitation and new construction under the Project will not involve any change in power sources and transmission cables, so no particular problem will rise in relation to the transient stability of the generators in case of an accident of the transmission lines. But because the Project will cause changes in load flows of these substations, the Survey Team has conducted simulation of disturbance of the generator in case of an accident where lightning or other factor interrupts one of the two transmission lines. The simulation has been addressed to the power plant near the accident site, ГЭС-1 (GES1), and adopted the cross-sections after the rehabilitation and new construction in winter 2018. It has confirmed that the circuit breaker opens in 200ms after the accident (breakdown continues for 200ms), but the disturbance ceased in a short period time, causing no problem at all.

2-2-2-3 Distribution System in Dushanbe

(1) Present Distribution System in Dushanbe

The distribution system in Dushanbe consists of 35kV, 10kV and 6kV transmission lines to supply electricity. The total capacity of the transformer is approximately 910MVA, of which 120MVA is supplied via the 35kV transmission lines to large factories. The 10kV and 6kV lines are chiefly for general households, and the power demand is the highest at night in winter, when they use heating systems. The authorities intend to upgrade the 6kV lines to 10kV lines to respond to the recent increase in the power demand, so the present distribution system has a mixture of different voltages.

(2) Issues of the Distribution System and Recommendations for Improving the Situation

1) Distribution Poles and Electric Wires

The present distribution poles are made of concrete and installed at the depth of about two meters, which are bound with wooden poles by bind wires. Most electric wires of distribution lines are uncovered. Thus, these poles need replacement, and wires need to be covered.

2) Measures against Grounding Fault

Even if a grounding fault occurs to one of the 35kV lines, the line cannot be blocked because the protection relay is an old model, but arc-suppression coil is used to deal with such a problem. Thus, the protection relay needs to be upgraded.

3) Remote Supervisory Control of Distribution lines Using the Supervisory Control and Data Acquisition System (SCADA)

The section switch of distribution lines cannot be remotely controlled, so it takes time to recover the system once an accident occurs. Currently, SCADA has been systematically applied to the upper system, but it is necessary to apply it also to the distribution system for swift operations and energy-saving.

4) Introduction of Automatic Voltage Adjustment

Currently, the voltage of the upper system is not systematically controlled, so if the voltage of the 110/35/10kV transformer is adjusted automatically, the tapping becomes frequent. To avoid this, voltage adjustment is made manually, which causes the voltage fluctuation to be large. An automatic voltage adjustment system needs to be introduced.

2-2-2-4 Situation of the Project Sites

(1) Promyshlennaya Substation (existing facility)

Promyshlennaya Substation is an air insulated substation and there is relatively room to spare around the equipment. However, it will be difficult to install the replacing equipment at a different location in the substation, and shift the operations from the existing to the new substation. Thus, one of the two systems will be gradually halted, while the substation itself continues to be operated. Then, the existing equipment will be removed, and the new facility will be installed at the same place. It is possible to secure a space for temporary storage of the equipment to be removed and new equipment.

The distribution switchgears are cubicle-type, combined facilities. Because they cannot be replaced by new ones at the same location, and also because both the switchgear control and protection units and DC supply system are located indoors to avoid high temperature and sunlight in summer, an indoor space of housing will be needed to store these facilities. In order to construct building, the transformer secondary and tertiary busbar conductor to distribution switchgears and support steel structures are all obstacles, these will be removed by the use of temporary installed power cables instead of busbars. Figure 2-1 shows the state of the facilities at Promyshlennaya Substation.

25MVA transformer

25MVA transformer and busbar conductor to 10kV distribution switchgear building

10kV distribution switchgears

10kV indoor distribution switchgear

10kV busbar conductor

35kV switchgears and support structure

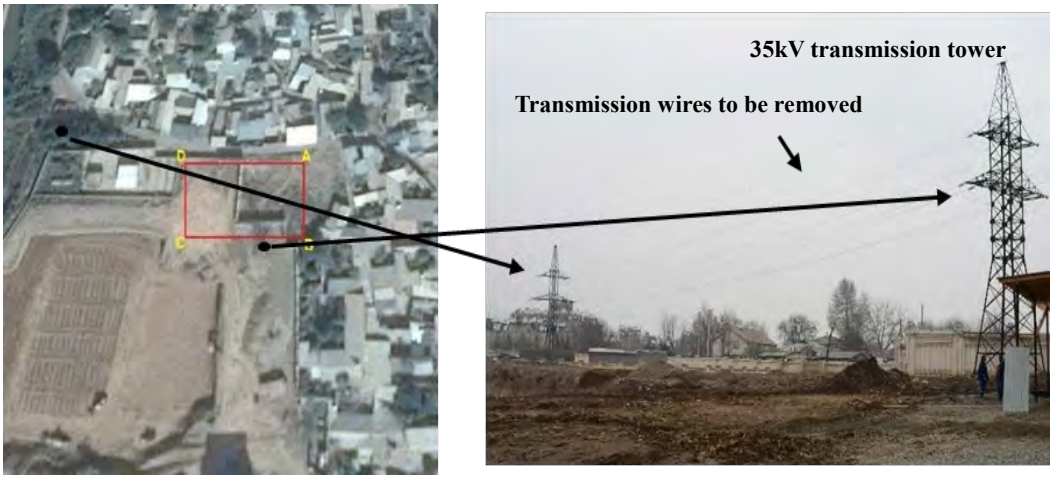
Temporary storage for removed equipment

Figure 2-1 The State of Facilities at Promyshlennaya Substation

(2) Radiostantsiya Substation

BT has already secured almost flat land in a re-development area, for which a land use permit was issued as of January 27, 2016.

Some walls that no longer exist are left in the project site and need to be removed, and the site also needs land preparation before the commencement of the construction work at the expenses of the Tajikistan side. At the same time, road work for the delivery of the transformers, and securing and preparation of land for the lead-in line tower of 110kV transmission lines are needed. Figure 2-2 shows the state of the project site and surrounding areas of Radiostantsiya Substation.



Relation between the site for Radiostantsiya Substation (in red box) and transmission tower for which the voltage is raised to 110kV

Project site | **Neighboring area**

Figure 2-2 The State of Construction Site for Radiostantsiya Substation and Neighboring Area

2-2-2-5 Project Overview in line with the Design Policy

(1) Position of Substations in the Network

The power network in Dushanbe, electricity first transmits from the 220kV overhead transmission lines near the city and then, via 110kV overhead transmission lines, to the distribution substation located in the central part of the Dushanbe. Electricity is then distributed via 35kV, 10kV and 6kV distribution network. The 35kV distribution network are for the electricity supply to large customers and distribution substations to lower the voltage to 10kV and 6kV for smaller beneficiaries.

Promyshlennaya and Radiostantsiya Substations are located in areas where the demand density is high, and distribute electricity to 35kV and 10kV distribution network.

(2) Type of Substations

Both substations are outdoor air insulated type, which receive electricity from two 110kV transmission lines and lower voltage with two three-winding transformers (each can steps down the voltage to two different levels). The total capacity is 80MVA (40MVA x 2).

The 35kV and 10kV distribution switchgears are an indoor cubicle type.

(3) Substation Arrangement and Protection Methods

The circuit arrangement of the substation is typical of BT's distribution substations, which are economically efficient with no circuit breaker in the side of 110kV bay unit and in the transfer bus between two bay units. The connecting operation of facilities consisting of two systems will be made with disconnectors in the transfer bus. The combination of two systems 35kV and 10kV distribution switchgears will be made with a circuit breaker in the transfer bus.

As for the system grounding, direct grounding will be adopted for the primary, and non-grounding for the secondary and tertiary systems.

With regard to the protection system for equipment (incoming facilities, transformers and distribution switchgears) and distribution lines, the current-limiting reactor of the arc-suppressing method, which has been used for the secondary non-grounding winding (and needs retuning when the system is changed), will be replaced by a simple but high-performance system. Power receiving transmission lines will be protected on the side of transmission substations.

(4) Design Conditions

1) Climatic and Other Service Conditions

Table 2-14 shows the climatic conditions of Dushanbe, which will apply to the designing of equipment, steel structures, foundations and other components, and which need to be confirmed if they are applicable for the Project. As the conditions are above the ordinary service range of the standards of equipment (under the elevation of 1,000m within the ambient temperature range of -20 and +40°C), care must be taken.

Table 2-14 Climate and Other Usage Conditions

Elevation		800m
Ambient temperature	Max	+45.0℃
	Min	-27℃
	Ave	15.0℃
Maximum wind speed		34m/sec
Precipitation		644mm/y
Seismic coefficient		0.2G
Soil bearing capacity		100kN/m2

Source: prepared by the Survey Team based on materials of BT.

2) Applicable Standards and Units

Standards applicable to equipment will be basically the International Electrotechnical Commission (IEC) Standards, the Japanese Electrotechnical Committee (JEC) Standards, and others designed in accordance with these standards (IEC Standards, etc.).

(5) Facility Plan

1) Approach to Selection of Equipment Specifications

Technical considerations have been made for specifications of equipment, and equipment conforming to IEC Standards, etc. have been selected.

a) Voltage Rating

The nominal voltages of the system are 100kV, 35kV and 19kV. The rated voltage of equipment has been selected from among IEC standard values.

b) Rated Current

The rated continuous and temporally over loading current of equipment has been determined in accordance with the calculation of the maximum current requirement on the assumptions that a transfer bus is used for while one of two transmission lines or bay units is stopped, and that a transformer allows 120% over loading for a short period time.

The power flow analysis has been conducted, and the rated short circuit withstand current has been determined in accordance with BT's data on the system and operation plans.

c) Insulation Level

The insulation level against the withstand overvoltage, such as short-time AC overvoltage, lightning surge and switching surge, has been determined in accordance with the insulation coordination philosophy that lighting arrestors are installed at the incoming of transmission lines and transformer terminals.

Moreover, as conditions for electrical insulation design, the insulation level in the air insulated bus structure, external creepage distance of porcelain against contamination adhesion, spacing clearance between live parts and construction machines, required and other factors have been taken into account.

d) Voltage Control

On-load tap changer will be installed on the primary side of the transformer, for remote electrical operation and for automatic control, so that the voltage can be controlled within the range of 115kV±9x1.78%. On the secondary side, the off–load tap changer will be installed, the secondary voltage can controlled within the range of 38.5kV±2x2.5%.

e) Earthing System

The earthing system of the substations will be earthing mat or mesh of bare copper wire buried 75cm deep. The bare copper wire and grounding rods will be buried so that the earth resistance value is 1Ω or below.

f) Monitoring and Control System

The monitoring and control system will be designed so that monitoring and controlling operations can be conducted directly from the control panels for the 110kV bay units and distribution switchgears of the substations. The system will be considered so that these operations can be remotely in future. Optical ground wire (OPGW) will also be installed to transmit the data and voice for control and monitoring.

g) LV(AC and DC) Supply System

The AC supply system for control of equipment, auxiliary facilities and lighting systems comprise two auxiliary transformers of the 10kV distribution switchgears, where the voltage step down to 220V and 110V. The 110VDC supply system for the switchgear control and protection units comprise battery and battery charger unit.

h) Disaster Resistance

As for disaster resistance measures, other than those against lightning and damage described in Section “Current Overload and Electrical Insulation Capacities”, there is no need to set any special load conditions in the course of designing steel structure and equipment against strong winds because of the expected maximum wind speed. As for aseismic resistance, no particular measure needs to be incorporated in the specification of equipment, any of which satisfies the aseismic design standards of the country.

2) Specifications of Main Equipment

Table 2-15 lists the specifications and components of main equipment. This section outlines the characteristics of main equipment.

The quantities of power cables and other materials necessary for the installation work have been calculated based on the physical layout drawings of equipment and steel structural drawings.

a) 110kV Switchyard

In the 110kV switchyard, a gas (SF_6) circuit breaker, disconnector switches (with earthing switches), a current transformer, a voltage transformer, and lightning arrestors are installed as for the 110kV bay unit, that is the one of the BT’s air insulated distribution substation

standard.

b) 110kV Transformer

Three-winding transformers have been selected, which have been little used other than in former Soviet Union countries, but are still standard at BT. Three-winding transformers becomes less efficient if the load sharing among the secondary and third windings is not systematic enough, but is flexible to changes in future plans when it is difficult to estimate the future power demand.

For the capacity expansion of Promyshlennaya Substation, 40MVA will be allocated to the primary winding, 20MVA to the secondary and 40MVA to the third in consideration of the gap in peak times between customers of the 35kV distribution system (large consumers such as factories) and those of the 10kV distribution system (chiefly general households), and for the purpose of maximizing the supply to the 10kV distribution system .

Equipment related to Transformer No.3 (110/10kV,16MVA) of Promyshlennaya Substation, which supplies electricity to the leased customer, will not be included in the Project.

c) 110kV Busbars and Structures

The busbars and support structures currently in use will continue to be used for Promyshlennaya Substation.

Radiostantsiya Substation, on the other hand, consists of transfer bus between bay unit Nos.1 and 2, in which two disconnector switches are installed. The overhead transmission lines entry into the switchyard through the terminal point in the gate-type steel structures. The transfer busbar will be supported by another gate-type steel structures. To protect the busbars from direct lightning strokes, overhead grounding wires will be installed to cover the upper part of equipment, by using the steel structures and poles installed on the transformer sides.

d) 35kV and 10kV Distribution Switchgears

Indoor, layered cubicle type switchgears have been selected because they can be efficiently installed in a limited space of the substations, and save the construction cost of substation building.

The 35kV and 10kV distribution switchgears are the complex facility of cubicles, in which circuit breaker, current transformer, lightning arrestor and other facilities are installed. It has a disconnecting function of circuit, for which movable parts, like drawers, can be pulled out of the fixed part.

The fixed part consists of bus bar and the reception side of disconnector, having two-layered movable parts. Promyshlennaya Substation uses as many as 40 feeders, which will be divided into two portions, laid on a plane, and connected with cables.

e) Protection Relay and Control Panels

Protection relays detect all faults occurred in the 110kV bay units, transformers and distribution switchgears.

Control panels are provided for control, displaying measuring, indication and annunciation data.

These data will be able to transmit to the remote monitoring system of the substations.

f) 35kV and 10kV Cables

As for power cable system, connecting the transformers and distribution switchgears, XLPE insulated cables will be use. The conductor size has been determined in consideration of the rated current and cable layer configuration,

With regard to cable terminations on the side of the distribution switchgears, slip on termination will be used, which is easily installed and handled in case of accident. Cable heads will be provided at the termination of air distribution cables on the 35kV steel structures and towers.

g) DC Service Equipment

The DC service equipment, battery and battery charger are installed to provide high availability, reliable supply to control, protection, alarm and indication devices, tripping and closing circuit, emergency power and emergency lighting. The capacity of batteries are designed as a minimum necessary backup power source in case of substation operation temporary suspension.

Table 2-15 List of Main Equipment

P: Promyshlennaya Substation
R: Radiostantsiya Substation

Equipment name	Country of origin	Major specifications or components	Quantity	
			P	R
110kv transformer	Japan	Rated voltage: 110/35/10kV Rated capacity: 40/20/40MVA Rated frequency: 50Hz Connection configuration: Star, direct neutral grounding / star, neutral ungrounded / delta, ungrounded Cooling method: Oil-immersed self-cooled / oil-immersed forced air-cooled Tap location: primary and secondary side	2 units	—
110kV transformer	Japan	Rated voltage: 110/35/10kV Rated capacity: 40/20/20MVA Rated frequency: 50Hz Connection configuration: Star, direct neutral grounding / star, neutral ungrounded / delta, ungrounded Cooling method: Oil-immersed self-cooled / oil-immersed forced air-cooled Tap location: primary side	—	2 units
110kV circuit breaker	Japan	Type: SF_6 gas live tank type, 3-pole, outdoor use Rated voltage: 126kV Rated current: 1250A Rated braking current: 31.5kA Control voltage: DC110V	2 units	2 units
110kV Disconnector Switch with Grounding Switch	Japan	Type: 3-phase, outdoor Rated voltage: 126kV Rated current: 1250A Rated short circuit withstand current: 31.5kA (1sec.) Lightning impulse withstand voltage: 550kV Power frequency withstand voltage: 230kV Type: 3-phase, outdoor Rated voltage: 110kV	6 units	6 units
110kV voltage transformer	Japan	Type: 3-phase, outdoor Rated voltage: 110kV/220V Rated frequency: 50Hz	2 units	2 units

110kV current transformer	Japan	Type: single-phase, outdoor Rated voltage: 126kV Rated primary current: 400A Rated secondary current: 1A Rated short circuit withstand current: 31.5kA (1sec.) Rated burden: 30VA or each or higher	12 units (single phase)	12 units (single phase)
110kV lightning arrestor	Japan	Type: outdoor Use, zinc oxide gapless type, single phase Rated voltage: 144kV Nominal discharge current: 10kA	6 units (single phase)	12 units (single phase)
35kV distribution switchgear	Japan	Type: indoor cubicle type Components: circuit breaker, disconnector switch, grounding switchgear, lightning arrestor, current transformer, voltage transformer (VT), and switchgear control and protection unit Rated voltage: 38.5kV Rated current: 600A Rated Interrupting Current: 25kA	1 set Incoming: 2 bus bar communication: 1 Distribution cable: 4 VT: 2	1 set Incoming: 2 bus bar communication: 1 Distribution cable: 4 VT: 2
10kV distribution switchgear	Japan	Type: indoor cubicle type Components: circuit breaker, disconnector switch, grounding switchgear, lightning arrestor, current transformer, voltage transformer (VT), transmitter for SCADA, and switchgear control and protection unit Rated voltage: 12kV Rated current: 2000A Rated Interrupting Current: 12.5kA Current transformer: 2000/1A	1 set Incoming: 2 bus bar communication: 1 Distribution cable: 40 Station service: 2 VT: 2	1 set Incoming: 2 bus bar communication: 1 Distribution cable: 16 Station service: 2 VT: 2
Protection & Control Device	Japan	Type: digital with protection relay Components: incoming control panel and transformer protection panel	1 set Incoming protection and transformer protection	1 set Incoming protection and transformer protection
DC Facilities (battery charger and battery)	Japan	Rate (charger): AC440V/DC220V Rate (battery): 200Ah/5hrs	1 set	1 set
35kv power cable	Japan	Type: CV and CVT Rate: 36kV	300m	170mm
10kv power cable	Japan	Type: CV and CVT Rate: 12kV	3,750m	300

3) Housing

a) Housing Design for Distribution Switchgears and Control and Protection Panels etc.

The distribution switchgears, control and protection panels and DC supply unit are vulnerable to high temperatures and intense strong sunlight in summer, these shall be stored in a housing under condition of air-conditioning and partitioned by walls. At the same time, cable channels are installed at the semi-basement level for easier cable handling.
Radiostantsiya Substation will have a space for sanitary facilities in a housing.

b) Attached Facilities of Substation

Radiostantsiya Substation will be equipped with annex facilities necessary for securing the public safety, maintenance work and facility maintenance itself. These facilities will include gate doors, walls, paths on the premises, fire extinguishers.

4) Equipment/Facility Layout Design

a) Promyshlennaya Substation

Since the 110kV bay units use the existing busbars and support structures, the equipment layout will be designed more or less the same as the layout prior to the replacement. The 35kV and 10kV distribution switchgears will be place in two housing, respectively, to be constructed in a vacant space.

The housing to store the 35kV distribution switchgears will be built in a vacant space near the existing 35kV air insulated switchgear yard, which will avoid the existing No.2. 35kV busbar conductor and support structure, which will be used while the construction is in progress.

The housing for the 10kV distribution switchgears will be built near the existing 10kV switchgears housing. However, the obstacle air insulated busbar conductor and support structure are in the way, and thus will be removed before the construction of the housing but after temporary installed power cables are laid in a place that does not interfere with the construction work.

b) Radiostantsiya Substation

The 110kv transmission lines will be led in from the supporting steel structure via a lead-in transmission steel tower to be built near the substation in accordance with the segmentation of the 35kV overhead transmission line adjacent to the substation construction site and the sharing of the work to raise the voltage to 110kV with C/P.

The basic layout of the 110kV bay units and transformers has been designed in consideration of the easiness of the construction work, necessary electric insulation distance, separation distance necessary for operations after the commencement of services, carrying in and out of equipment at the time of any facility accident, and other factors. The physical layout will be standard and more or less the same as that of Promyshlennaya Substation. However, the project site is smaller and unable to secure a path to carry in the transformers and carry out equipment at the time of any failures. Thus, the substation will be designed so

that equipment and materials have to be carried in or out directly from the roads on the both side of the premises.

The distribution switchgear, switchgear control and protection unit and other equipment will be placed in one housing, where the equipment will be placed on two-layered racks to make maximum use of limited space.

A lead-in pit for the 30kV and 10kV distribution cables from the housing to the road, and another two-line lead-in pit for distribution cables to the existing 35kV transmission tower will be installed.

5) Boundary with the Existing Facilities

a) Promyshlennaya Substation

The boundary of the Project with the existing 110kV bay units (demarcation point of facilities subject to the construction work) is the air insulated busbar clamps and connectors of equipment. Any equipment relating to the Transformer No.3, including the transformer itself and disconnector switch will be outside the scope of the Project.

The Project will cover equipment from the cable head at the outlet steel tower up to the connecting point of the insulator unit for the 35kV distribution transmission lines, and up to the intermediate cable joint with the existing distribution cables for the 10kV distribution cables.

b) Radiostantsiya Substation

At the 110kV bay units, the Project will cover facilities up to the connecting point (insulator unit) with the transmission steel tower adjacent to the lead-in steel tower to lead in the transmission lines to the substation. For the 35kV distribution cables, the Project will cover facilities from the cable head to connect with the existing transmission steel tower to the connection of cables to the insulator unit. However, the outlet work of the 10kV distribution cables will be borne by C/P.

6) Considerations with Regard to the Rehabilitation and Capacity Expansion Work of Promyshlennaya Substation

a) Considerations in terms of Construction Method, Process and Period

The availability factor of the facilities is high throughout the year at this substation, so it is impossible to suspend the entire operations to upgrade the facilities. It is also impossible to newly build facilities somewhere else to replace the aged facilities because there is neither space nor cost for such an idea. Thus, the Project has to stop one of the two bay units and transformers at a time, and replace the system suspended with a new one.

Because the construction is carried out while one of the two facilities is in operation, it is necessary to continue using a part of the existing bus and undergo the process of removing equipment to be upgraded, control cables, and equipment racks and foundations; leveling ground; laying grounding wires; installing equipment racks and foundations; moving and installing new equipment; and assembling, adjusting and testing the equipment.

A problem is that the construction site of the housing for distribution switchgear, switchgear control and protection unit, and DC accessories overlaps the existing facilities, so it is necessary to construct a temporary structure to move the existing facilities provisionally before the construction of the housing. Thus, the contractor, once selected, will have to start the temporary work forthwith.

Promyshlennaya Substation is short of the capacity in its facilities to meet a surge in the power demand in winter, having planned, and unplanned and abrupt outages because of overload. Thus, it is desirable to suspend the operations of one transformer in April or afterwards when the demand drops. However, because the two systems need to be suspended in series within the Grant Aid Cooperation project period (24 months after the contract agreement), the schedule will be fairly tight and the operations of one transformer will have to be suspended in February or so in winter. Thus, it is necessary (for C/P) to shift a part of the load to other substations by using the 10kV interconnected distribution lines until the power demand drops. Once the first transformer is upgraded, the capacity will increase and thus the restriction on the replacement work will be eased.

b) Considerations in terms of the Sharing and Cooperation of Facility Operation and Management

To minimize the suspension period of the distribution lines and Transformer No.3 for specific beneficiaries, it is necessary to conduct temporary works, consider the scope of facility suspension, ensure the changeover procedure, and simultaneously use the existing and new distribution switchgears. All this increases and makes complicated the operations of the switchgears and safety measures. Thus, a close liaison and supervision must be established among the contractor, personnel responsible for the O&M of the facilities, and resident operators and maintenance staff at the substations, who are also required to constantly commit themselves to the operations throughout the construction work. It is also necessary to determine the sharing of obligations among the operators and those in charge of the construction work in accordance with operational procedures and rules, and operations (locking of operation, attaching earthing devices, setting of safety zones, etc.).

Promyshlennaya Substation has frequent outages in winter, and abrupt outages due to failures with its facilities throughout the year. In preparation for possible facility problems or outages during the construction work, it is necessary to consider and make adjustment, revisions and confirmation of the work in accordance with its progress.

The existing facilities include many aged facilities manufactured in the Soviet era, and their repair records are unlikely to be kept, so surveys, confirmation and adjustment of these facilities may be friendly required at the time of their removal and upgrading.

c) Considerations in terms of Safety Measures during Construction

The existing facilities are the air insulated type, in which there are many energized parts such as busbar conductors and terminal of equipment. Some energized parts of the facilities

are close to the construction work area. Thus, particularly careful attention must be paid to safety of personnel electric shock.

The construction work involves operations using high elevation work vehicles or scaffolding because the busbars and steel structures are high. When the equipment to be removed is transferred from the site to the temporary storage area and new equipment is transferred from the temporary storage area to the installation site, there are quite a few heavy facilities, including the transformers and circuit breakers, on their way. (C/P requests the existing equipment to be transferred to the storage as it is, because it intends to use some units.) In addition, because the existing busbars continue to be used, the operation of cranes is limited. In relation to all these high elevation work, transfer of heavy equipment on the premises, and restriction on the use of heavy machines, safety must be particularly secured.

7) Approach to Equipment Procurement

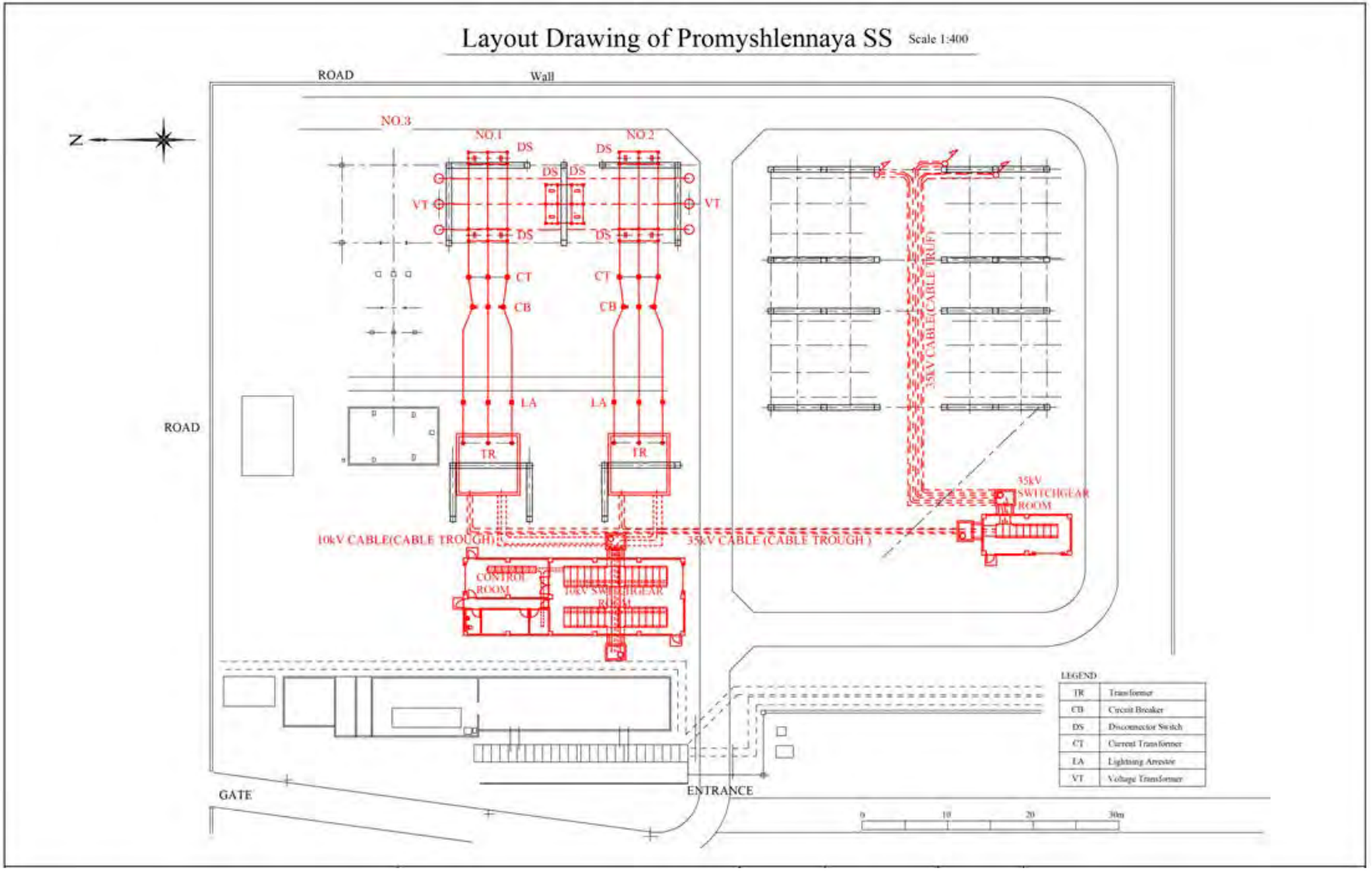
Equipment to be procured under the Project has specifications complying with the IEC standards, and can be manufactured in Japan. Thus, all items will be procured in Japan, except aggregates, reinforcing steels, cement, and other construction materials for housing and foundations of equipment, which will be procured in Tajikistan. On the other hand, three-winding transformers are hardly used by Japanese power companies, and it would cost to design and transport them from Japan. Thus, they may be procured in a third country, where high quality products of overseas factories of Japanese manufacturers are available. In addition, IEC standard 110kV circuit breakers, disconnector switches, and voltage transformers are produced in many countries, so they may be procured in third countries, where high quality and cost effectiveness can be gained.

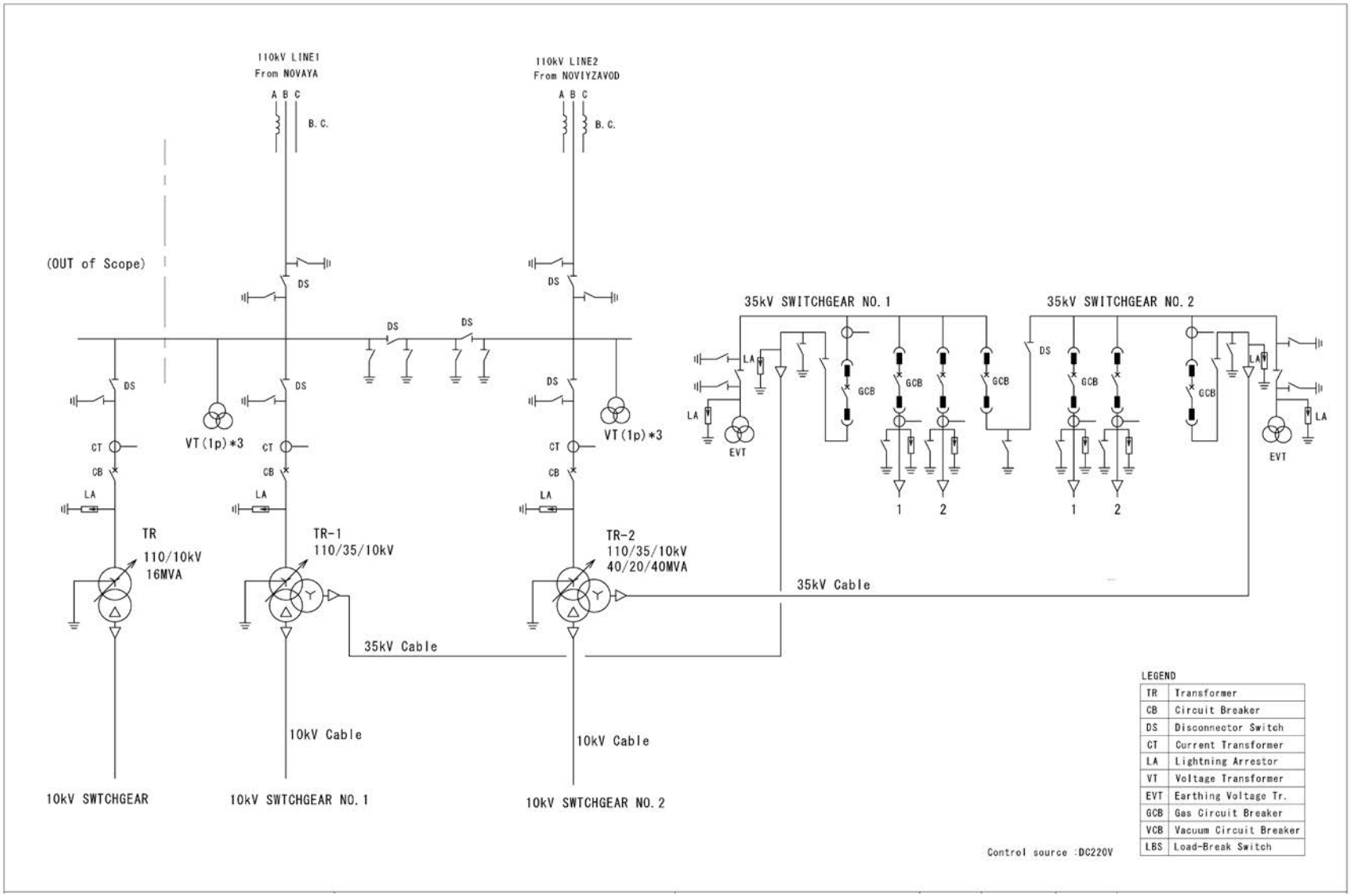
2-2-3 Outline Design Drawings

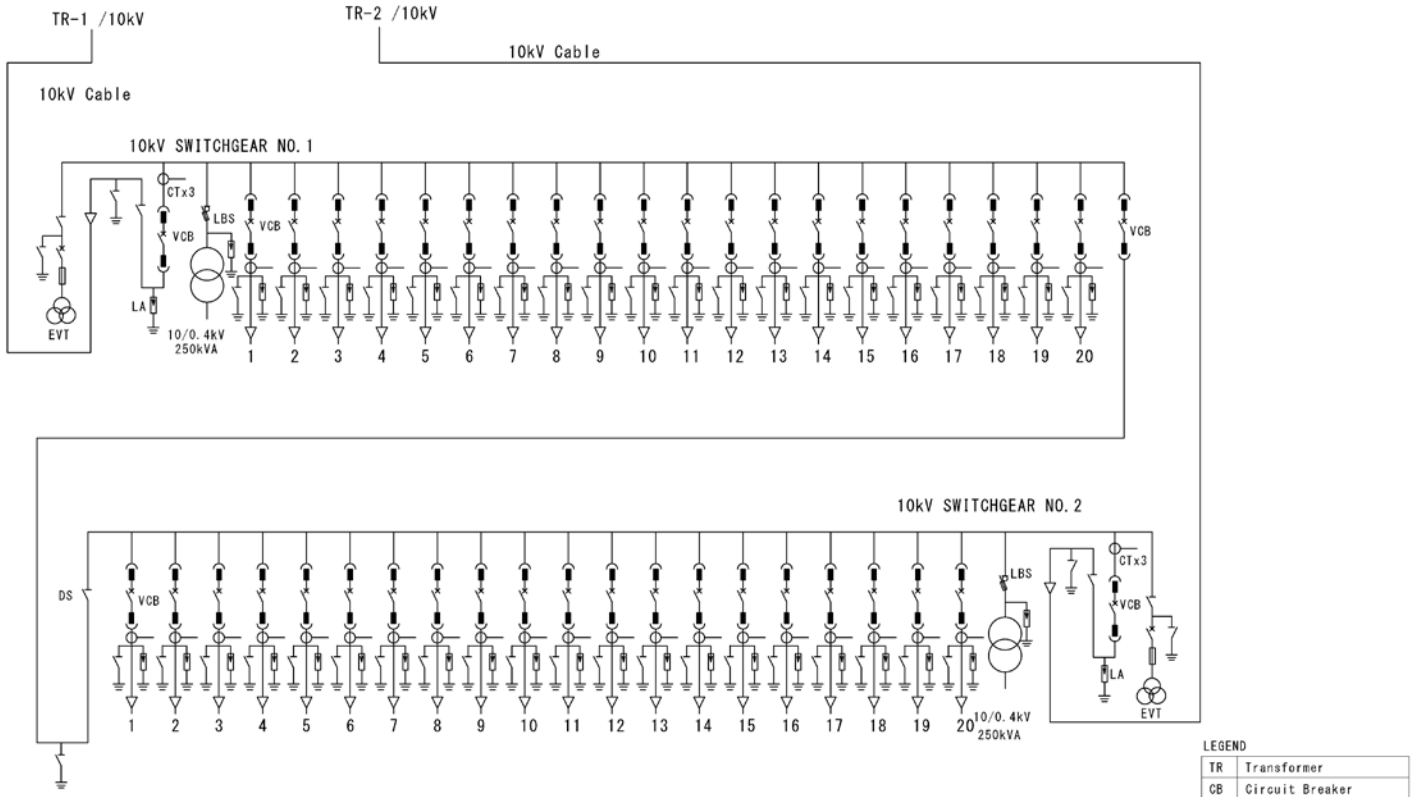
Outline design drawings of the Project are presented below. The list of drawings is given in Table 2-16.

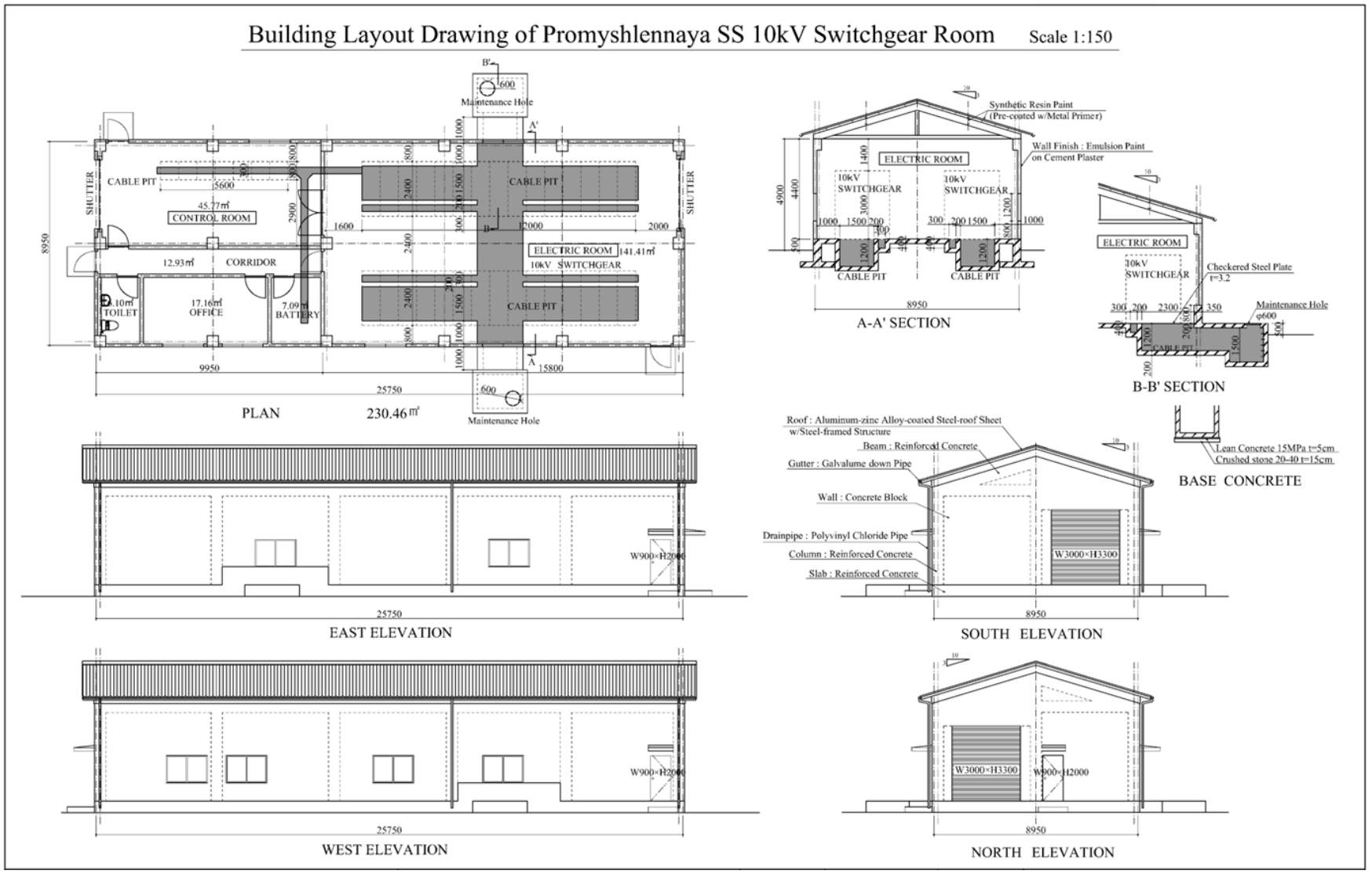
Table 2-16 List of Outline Design Drawings

No.	Title	Scale
1	Layout Drawing of Promyshlennaya SS	1 : 400
2	Singleline Diagram of Promyshlennaya SS (1)	-
3	Singleline Diagram of Promyshlennaya SS (2)	-
4	Building Layout Drawing of Promyshlennaya SS 10kV Switchgear Room	1 : 150
5	Building Layout Drawing of Promyshlennaya SS 35kV Switchgear Room	1 : 150
6	Layout Drawing of Radiostantsiya SS	1 : 400
7	Singleline Diagram of Promyshlennaya SS	-
8	Building Layout Drawing of Radiostantsiya SS Switchgear Room	1 : 150


Layout Drawing of Promyshlennaya SS
Scale 1:400
ROAD
Wall
N
NO.3
NO.1
NO.2
DS
VT
CT
CB
LA
TR
ROAD
35kV CABLE(CABLE TROUGH)
35kV SWITCHGEAR ROOM
10kV CABLE(CABLE TROUGH)
35kV CABLE (CABLE TROUGH)
CONTROL ROOM
10kV SWITCHGEAR ROOM
GATE
ENTRANCE
LEGEND
TR Transformer
CB Circuit Breaker
DS Disconnector Switch
CT Current Transformer
LA Lightning Arrester
VT Voltage Transformer
0
10
20
30m

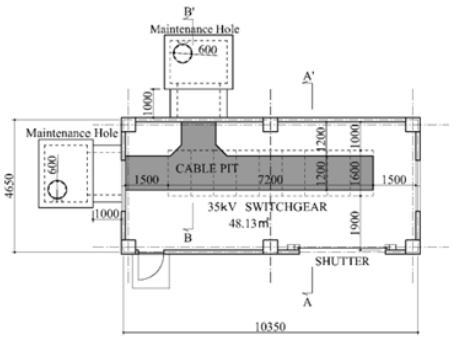

110kV LINE1
From NOVAYA
110kV LINE2
From NOVIYZAVOD
A B C
B. C.
(OUT of Scope)
DS
CT
CB
LA
VT(1p)*3
TR
110/10kV
16MVA
TR-1
110/35/10kV
TR-2
110/35/10kV
40/20/40MVA
35kV SWITCHGEAR NO. 1
35kV SWITCHGEAR NO. 2
GCB
EVT
1
2
35kV Cable
10kV Cable
10kV SWTCHGEAR
10kV SWTCHGEAR NO. 1
10kV SWTCHGEAR NO. 2
Control source :DC220V
LEGEND
TR Transformer
CB Circuit Breaker
DS Disconnector Switch
CT Current Transformer
LA Lightning Arrestor
VT Voltage Transformer
EVT Earthing Voltage Tr.
GCB Gas Circuit Breaker
VCB Vacuum Circuit Breaker
LBS Load-Break Switch


TR-1 /10kV
TR-2 /10kV
10kV Cable
10kV Cable
10kV SWITCHGEAR NO.1
CTx3
VCB
LBS
VCB
VCB
LA
EVT
10/0.4kV
250kVA
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
10kV SWITCHGEAR NO.2
DS
VCB
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
LBS
10/0.4kV
250kVA
CTx3
VCB
LA
EVT
LEGEND
TR Transformer
CB Circuit Breaker
DS Disconnector Switch
CT Current Transformer
LA Lightning Arrestor
EVT Earthing Voltage Tr.
GCB Gas Circuit Breaker
VCB Vacuum Circuit Breaker
LBS Load-Break Switch
Control powersource :DC220V

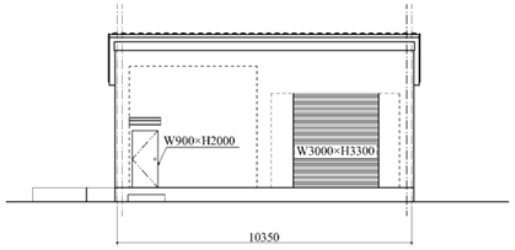

Building Layout Drawing of Promyshlennaya SS 10kV Switchgear Room
Scale 1:150
Maintenance Hole
CABLE PIT
SHUTTER
45.77㎡
CONTROL ROOM
12.93㎡
CORRIDOR
2.10㎡
TOILET
17.16㎡
OFFICE
7.09㎡
BATTERY
ELECTRIC ROOM
141.41㎡
10kV SWITCHGEAR
8950
9950
25750
15800
PLAN
230.46㎡
EAST ELEVATION
WEST ELEVATION
SOUTH ELEVATION
NORTH ELEVATION
A-A' SECTION
B-B' SECTION
BASE CONCRETE
Synthetic Resin Paint
(Pre-coated w/Metal Primer)
Wall Finish : Emulsion Paint
on Cement Plaster
Checkered Steel Plate
t=3.2
Roof : Aluminum-zinc Alloy-coated Steel-roof Sheet
w/Steel-framed Structure
Beam : Reinforced Concrete
Gutter : Galvalume down Pipe
Wall : Concrete Block
Drainpipe : Polyvinyl Chloride Pipe
Column : Reinforced Concrete
Slab : Reinforced Concrete
Lean Concrete 15MPa t=5cm
Crushed stone 20-40 t=15cm
W900×H2000
W3000×H3300

Building Layout Drawing of Promyshlennaya SS 35kV Switchgear Room

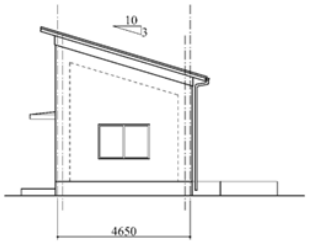
Scale 1:150



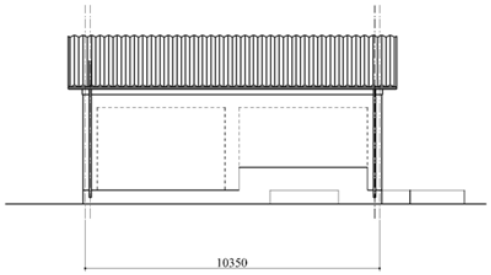
PLAN
48.13㎡



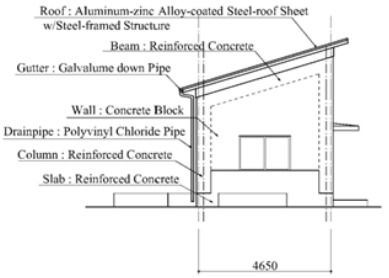
WEST ELEVATION



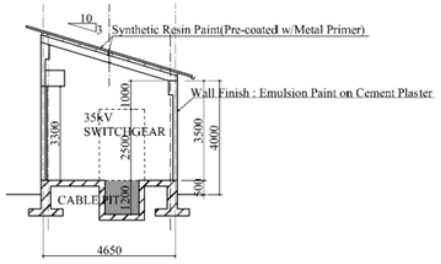
SOUTH ELEVATION



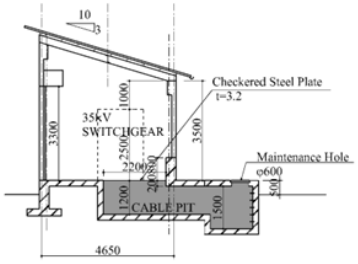
EAST ELEVATION



NORTH ELEVATION



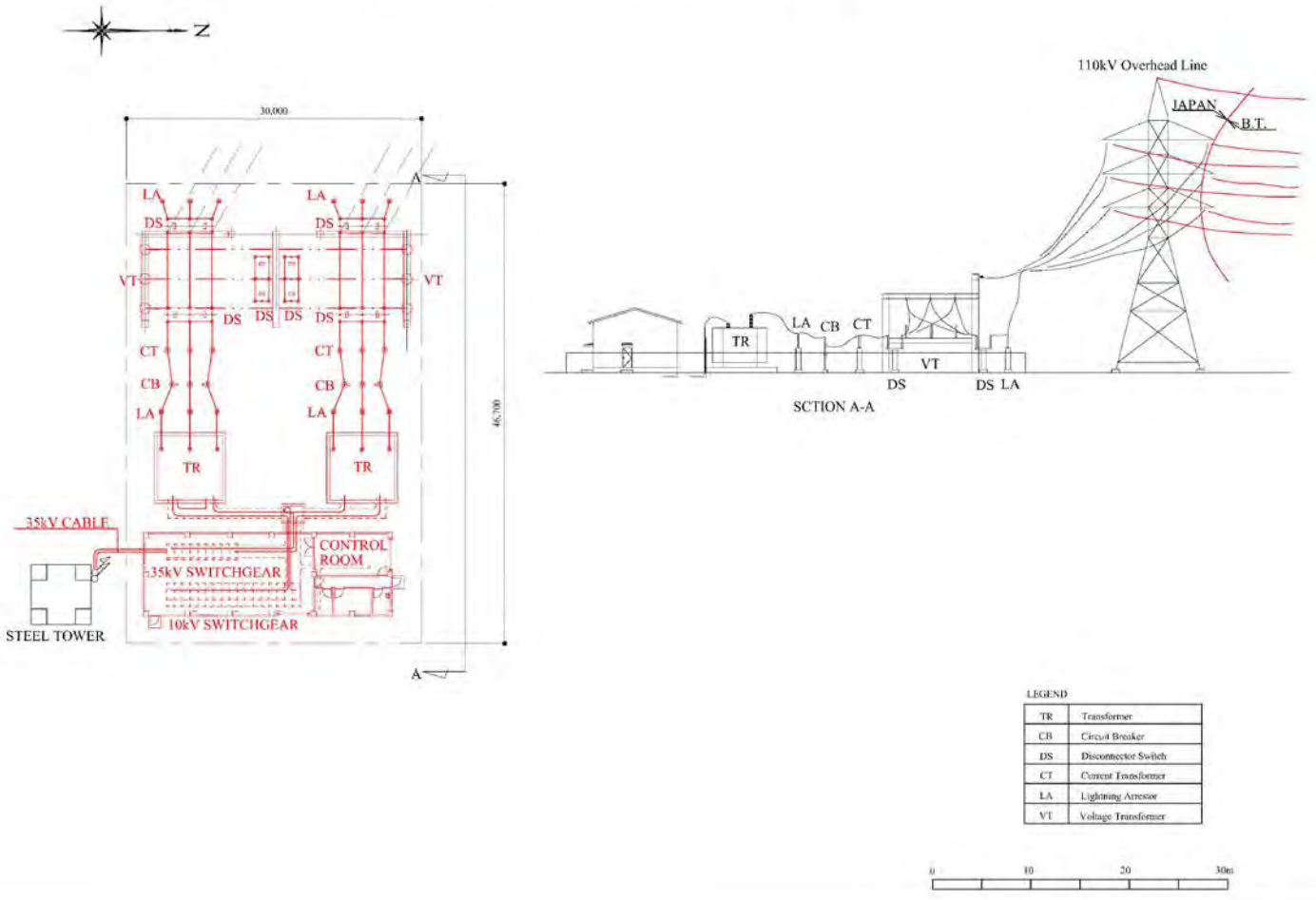
A-A' SECTION



B-B' SECTION

BASE CONCRETE

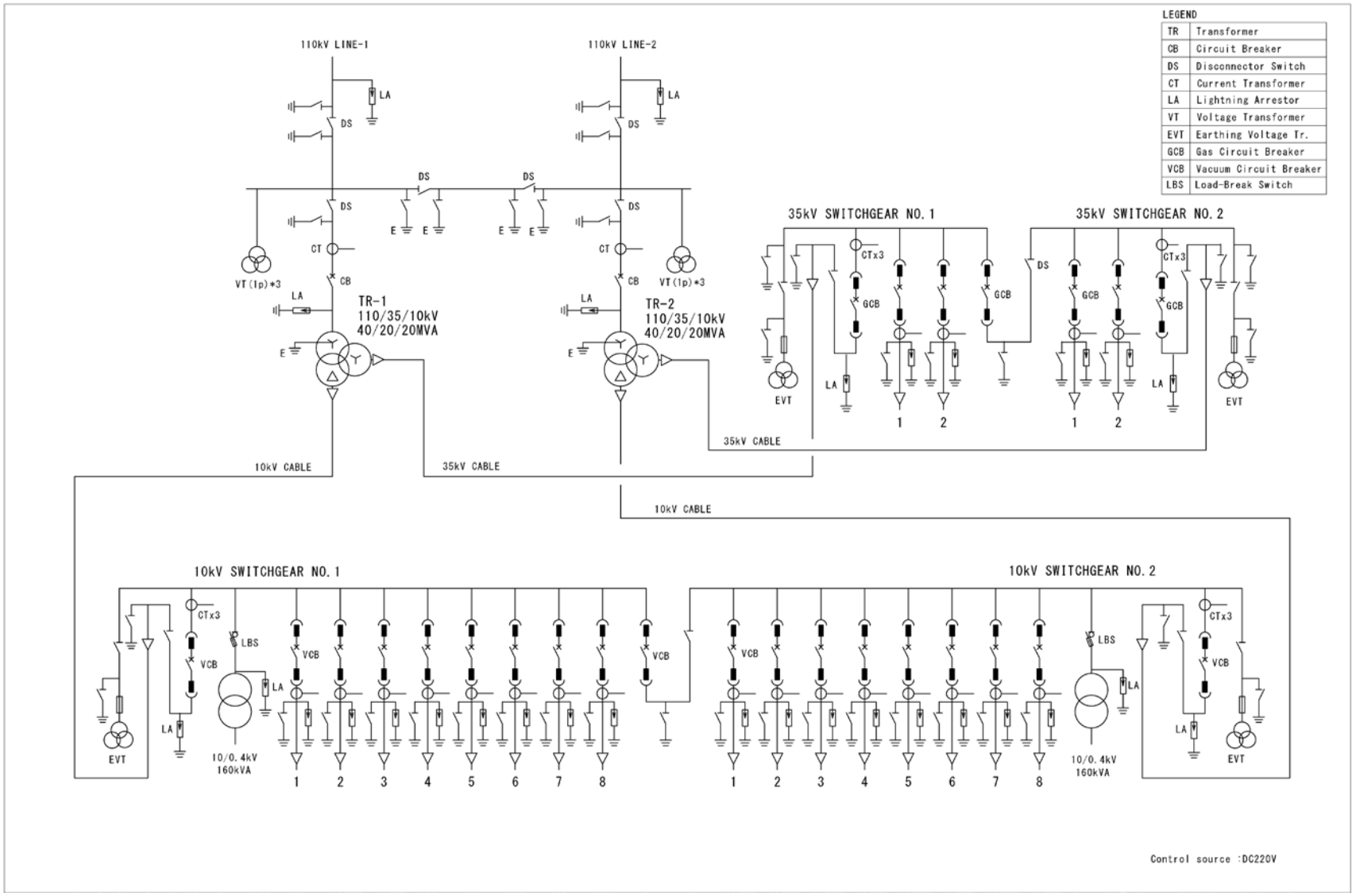
Layout Drawing of Radiostantsiya SS Scale 1:400



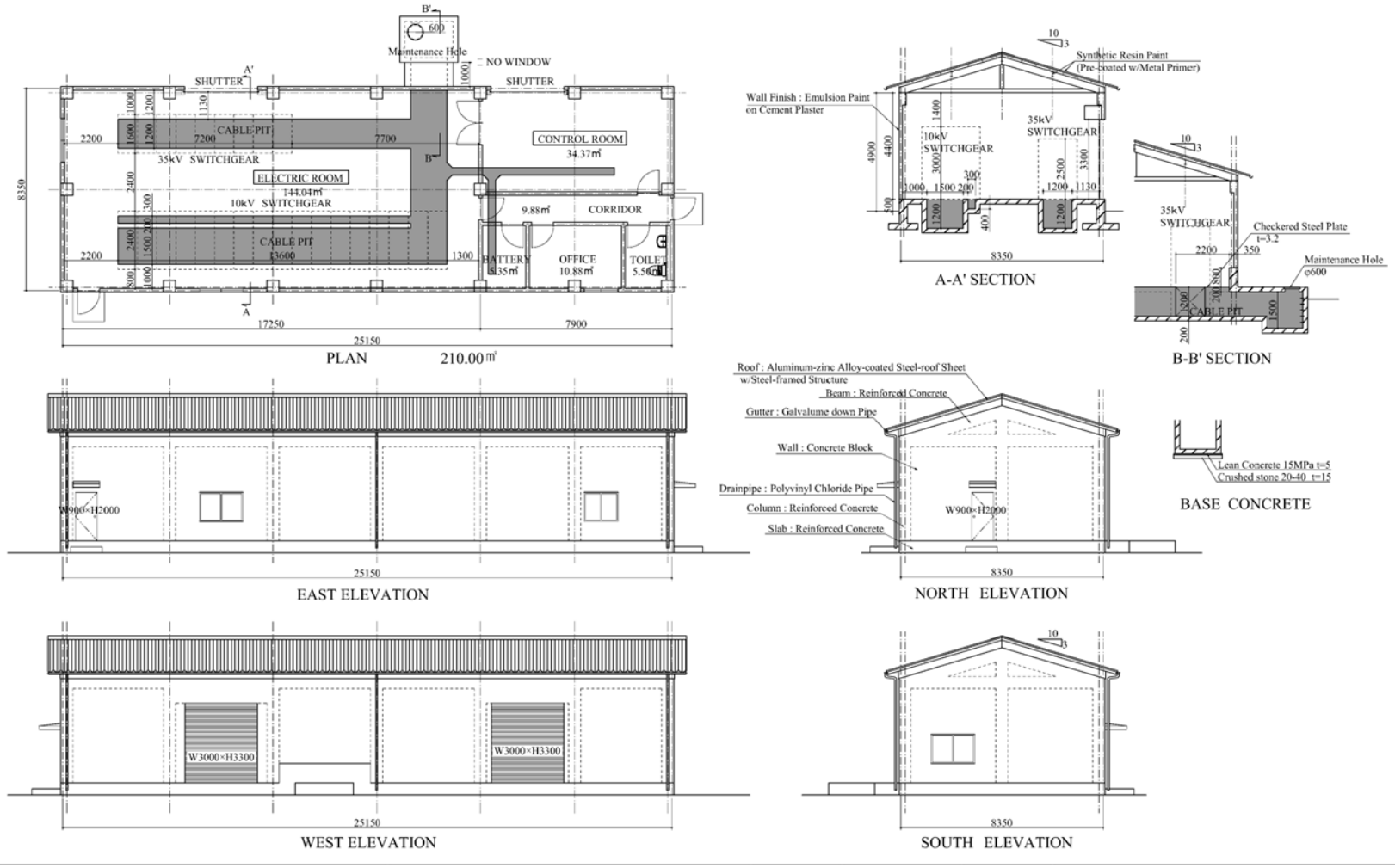
LEGEND

TR	Transformer
CB	Circuit Breaker
DS	Disconnector Switch
CT	Current Transformer
LA	Lightning Arrestor
VT	Voltage Transformer

0 10 20 30m


LEGEND
TR Transformer
CB Circuit Breaker
DS Disconnector Switch
CT Current Transformer
LA Lightning Arrestor
VT Voltage Transformer
EVT Earthing Voltage Tr.
GCB Gas Circuit Breaker
VCB Vacuum Circuit Breaker
LBS Load-Break Switch
110kV LINE-1
110kV LINE-2
TR-1
110/35/10kV
40/20/20MVA
TR-2
110/35/10kV
40/20/20MVA
35kV SWITCHGEAR NO.1
35kV SWITCHGEAR NO.2
10kV CABLE
35kV CABLE
10kV SWITCHGEAR NO.1
10kV SWITCHGEAR NO.2
10/0.4kV
160kVA
Control source :DC220V

Building Layout Drawing of Radiostantsiya SS Switchgear Room Scale 1:150



2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

As the Project will be implemented based on the Japanese Grant Aid framework, it will be approved by the Japanese Government and commence after an Exchange of Notes (E/N) between the two countries and a Grant Agreement (G/A) between JICA and Tajikistan are exchanged. Basic policy and special conditions needed if the Project is implemented are given below.

(1) Project Implementing Body

The organization responsible for supervising the project implementation is the Ministry of Energy and Water Resources (MoEWR). The Project implementing body responsible for O&M after the facilities go into service is Barki Tojik (BT). For the smooth implementation, MoEWR and BT must appoint project representatives to stay in close contact and negotiate with the Japanese consultant and contractor.

The appointed BT project representatives must explain the project details sufficiently to MoEWR and BT project staff and project area residents so that they will cooperate with Project implementation.

(2) Consultant

Japanese consultants will enter a design and supervision agreement with BT to procure and install equipment for the Project, and produce detailed design and supervise construction work related to the Project. Along with drafting tender documents, consultants will handle bidding on behalf of BT, the Project implementing body.

The Project requires particular considerations in terms of safety and quality assurance as it includes the rehabilitation work of equipment while the existing facilities of the substation is in operation. Thus, the Consultant is required to play a positive role in the supervision so that BT project representatives, facility operators, and contractor can closely cooperate with each other.

(3) Contractor

In accordance with Japanese Grant Aid framework, independent Japanese contractors selected by Tajikistan through open bidding will build, procure and install equipment for the Project.

Contractors will need to continue supplying spare parts, support for failures, and other services after the Project is completed, and as such must give due consideration to a post-delivery communication and coordination for equipment and facilities.

(4) Necessity of Dispatching Engineers

The Project is a combination of the rehabilitation and capacity expansion work for one substation, and the new construction work for the other substation. The former includes the removal of aged facilities of the existing substation, and the civil engineering and construction works in ration to the installation of substation facilities. The latter includes the installation work for substation facilities and lead-in steel towers on a new project site, together with the related civil engineering and construction works. Thus, the two sides of the Project must be implemented in a well-coordinated manner. Moreover, most of the works involved are carried out in parallel. For the management of the process, quality, volume completed and safety, it is essential for the Japanese side to dispatch Japanese engineers including foremen, who are familiar with the Japanese Grant Aid Cooperation scheme and capable of managing and supervising the entire course of the works.

2-2-4-2 Implementation Conditions

(1) Construction Situation in Tajikistan and Technological Transfer

There are several of general contractors and electric contractors in Dushanbe. It is possible to employ workers and procure transportation vehicles, construction heavy duty machines, and construction materials in Tajikistan. It is also possible to order to local contractors the construction work for new building the Project. Japanese engineers need to supervise in Tajikistan for process plan, quality, and safety.

(2) Use of Local Materials and Equipment

Aggregates, cement, reinforcing bars and other materials for the equipment foundation and building construction are available in Tajikistan. In fact, projects in the past took advantage of locally procured materials, though it is necessary to manage the quality and delivery period. Thus, the construction plan will be formulated in the manner that local materials and equipment will be adopted as possible while the promotion of local industries is taken into account.

(3) Safety

Security concern is relatively low in Tajikistan. The project area is located at the center of Dushanbe, accessible from anywhere, and it is easy to conduct monitoring the project. It is still necessary to avoid operations after sunset and pay careful attention to prevent theft material and security of workers and involved project..

(4) Tax Exemption

Local contractor involved the project will be exempt tax without income and pension tax.

When this contractor exempt tax, firstly this project shall be listed in Project of national Investment and authorized by National Assembly, secondly the list of subcontractor involved the project shall be submitted. Table 2-17 shows taxes in Tajikistan by type.

Table 2-17 Taxation in Tajikistan

Item	Name
National	Income tax
	Corporate income tax
	Value added tax
	Consumption tax
	Social tax
	Natural resources tax
	Automobile road user tax
Local	Automobile tax
	Property tax

Source: MoEWR

2-2-4-3 Scope of Works in Construction/Procurement and Installation

Table 2-18 shows the scope of works between the Japanese and Tajikistan sides, respectively.

Table 2-18 Scope of Works to be Borne by the Japanese and Tajikistan Sides

No.	Items	Borne by		Remarks
		Japan	Tajikistan	
1	New Substation Radiostantsiya			
	(1) Securing of the land to build the substation		○	
	(2) Ground leveling on the site		○	
	(3) Securing of the path to carry in equipment and access road		○	
2	110kV lead-in transmission tower for the new substation			
	(1) Securing of the site for the steel tower		○	
	(2) Construction of the lead-in steel tower	○		
3	Auxiliary facilities of the new substation			
	(1) Construction of building including sanitary facilities	○		
	(2) Exterior work/ gate doors, walls, parking	○		
	(3) Water supply and drainage work	○		
	(4) Water supply and drainage works		○	
	(5) Road and rainwater drainage work	○		

	(6) Installation of OPGW for information telecommunications and telephones		○	
4	Facilities of the existing substation /Promyshlennaya			
	(1) Construction of building	○		excluded sanitary facility (the existing one to be used)
	(2) Telephone work connecting to the existing control room	○		
5	For materials and equipment, transportation, import customs, and tax handling			
	(1) Transportation from origin to Tajikistan	○		
	(2) Procedures for tax exemption and import customs		○	
	(3) Transportation in Tajikistan	○		Temporary yard for materials and equipment will be installed in substation.
6	Exemption from value added tax on materials and equipment procured in third countries		○	
7	Measures necessary to obtain entry permits to Tajikistan		○	
8	Appropriate operation and maintenance of facilities		○	
9	Payment not included by grant aid cooperation		○	
10	Payment of the following fees based on B/A:			
	(1) Authorized commission for A/P		○	
	(2) Commission for remit		○	
11	Proposal for Monitoring, Securing budget for authorization and enforcement Monitoring		○	
12	Measures necessary to obtain the following permits ・ Permit for installation work ・ Permit for entry to restricted areas		○	Permits to be obtained, if necessary, prior to the Project
13	Construction of temporary fences and gates for storage yard	○		
14	Securing of parking during the construction		○	
15	Office for the construction work	○		For businesses to procure materials and equipment, and the Consultant
16	Appropriate storage of materials and equipment, and safety management	○		The construction work for temporary storage is in

				preparation.
17	Provision of disposal site of surplus soil and miscellaneous wastewater		○	
18	Production and procurement of equipment	○		
19	Installation work of equipment and commissioning	○		
20	Temporary offline work during the construction		○	
21	Guidance for operation and maintenance on equipment	○		
22	Safety management of workers involved Project		○	
23	Response to and compensation for customers with respect to necessary shutdown during the construction		○	
24	Communication to customers about offline work plan and Safety method during construction		○	

Note: The party in charge is indicated by symbol "○".

B/A denotes "Banking Arrangement", and A/P denotes "Authorization to Pay".

2-2-4-4 Construction Supervision Plan/Procurement Supervision Plan

The Consultant comprehend outline design, organize project team for detailed design and supervision, and proceed the project smoothly according to Japan Grant aid scheme policy. Because the project includes rehabilitation, constructing substation, also modification. Consultant shall supervise on the site while closely communicating with MoEWR and BT.

Especially, rehabilitation in Promyshlennaya substation, the Consultant shall dispatch more than two engineers which work for residential supervisor and construction management, and checking overall progress of work, quality control, volume of construction and safety.

Consultant shall dispatch specialists who supervise installation, commissioning and test according to progress of work. In addition, Consultant shall inspect equipment procured by Contractor in factory and pre-shipment to prevent trouble after transportation.

(1) Basic Policy on Procurement Supervision

The Consultant will supervise the progress of the construction work so that it will be completed in the scheduled period; ensure the quality, volume completed and delivery of materials and equipment as specified in the contract agreement; and supervise and give guidance to the Contractor so that the construction work is implemented safely. Major points to consider with regard to the supervision are as follows.

(2) Process Management

The Consultant will compare the implementation process planned at the time of the contract agreement with the actual process on a monthly or weekly basis. If any delay is

expected, the Consultant give guidance to the Contractor by promoting awareness of the delay and requesting remedies and execution so that the construction work and delivery of materials and equipment will be completed within the contract period. The comparison between the planned process and actual progress will be made chiefly by confirming the following items.

- The construction volume completed (volume of equipment manufactured at factories, and volume of construction works completed)
- The actual volume of materials and equipment delivered to the site (materials and equipment, and those for the construction work)
- The progress of the temporary work and preparation of construction machinery
- Check for Unit man-hours and actual man hours of engineers and workers

(3) Safety Management

The Consultant will engage in safety management in collaboration with the Contractor to prevent accidents involving third parties on the project site during the construction. Major points to consider with regard to the on-site safety management are as follows.

- Establishing safety management rules, and selecting personnel in charge
- Preventing disasters through regular inspections of construction machinery
- Selecting operation routes of construction vehicles and transportation machinery, and ensuring safety driving
- Providing workers with a welfare program, and facilitating them to take days-off

(4) Overall Relations of the Parties Concerned in the Project Implementation

Figure 2-3 shows the relations of the parties concerned with the Project including the project supervision stage

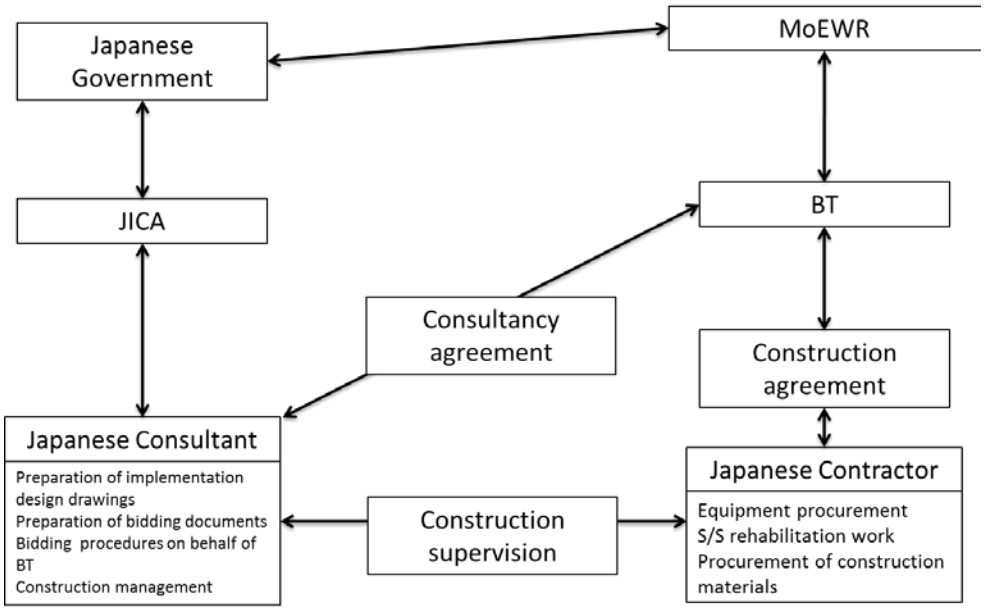


Figure 2-3 Relationship for Project Implementation

(5) Construction Supervisor

The Contractor procure and deliver materials and equipment for the existing substation and the substation to be newly constructed, and implement the electrical, civil and construction works. To this end, the Contractor subcontract these works to local contractors in Tajikistan.

To make them thoroughly comply with the process, quality volume completed set forth in the construction agreement, as well as safety measures, the Contractor dispatch Japanese engineers having experience of any similar overseas projects. These engineers supervise and advice to local contractors on site.

In light of the scale and nature of the substation works under the Project, the Contractor is required to station desirably at least the engineers in Table 2-19 on a full time basis.

Contractor shall arrange engineers who supervise residentially on site according to content of project. Table 2-19 shows part of engineers, number, description and period.

Table 2-19 Detail of Residential Engineers

Duty	Number	Work descriptions	Period
Personnel in charge of local procurement management (equipment)	1	Management of entire work Discussion and coordination with the parties concerned Supervision of procurement of materials and equipment Customs clearance Labor and accounting affairs Overall supervision of safety management	During equipment work period
Personnel responsible for electrical work	1	Electrical work management Supervision of equipment procurement	During equipment work period
Engineers in charge of electrical work management	9	Electrical work management at SUBSTATION	During equipment work period
Personnel in charge of safety management	2	Overall safety management	During equipment work period
Personnel in charge of construction work management	1	Construction work management Steel structure construction management	During construction work period
Facility engineer	1	Supervision of facility work for steel structures	During facility work period

2-2-4-5 Quality Control Plan

Supervisors of Consultant check actual quality and volume of work which are procured equipment and constructed building and foundation, contract included technical specification and shop drawing by the Contractor. Detail check points are following below.

- Checking shop drawings and specifications of materials and equipment
- Witnessing factory inspections, or checking the results of factory inspections
- Checking the methods of packing, transportation and on-site temporary storage
- Checking shop drawings and installation method
- Checking method on commissioning and inspection of materials and equipment
- Supervising the on-site installation work of equipment, and commissioning and inspection
- Cross-checking the volume completed against equipment installation and manufacture drawings
- Cross-checking the volume completed against civil , building work shop drawings

2-2-4-6 Procurement Plan

Materials and equipment to be procured and installed under the Project are not manufactured in Tajikistan. BT's transformation facilities have been introducing main equipment such as transformers and switchgears chiefly from Russia and other former CIS countries, and also in recent years from Turkey, Germany and other countries. But there are not so many manufacturers in these countries, which provide after-delivery services of response to accidents, repair and supply of spare parts for special high voltage transformation equipment. Thus, in the selection of suppliers of materials and equipment for the substations, it is necessary to consider the local situation, and the easiness of operation and maintenance for local engineers and the

availability of spare parts, response to breakdown and other after-delivery services.

2-2-4-7 Operational Guidance Plan

As for Operational Guidance Plan, hereinafter O&M, instructors of manufactures shall provide on the job training, hereinafter OJT, with manuals compiled by manufacture before the completion of the project. For the smooth implementation of the guidance plans, BT shall select engineers participating OJT, and closely communicate consultant and Contractor to progress guidance smoothly. This Engineers shall report the knowledge and skills learned to other who do not participate in the guidance, and devote themselves to the enhancement of O&M capacity of BT.

Because operation for equipment and commissioning shall be assigned engineers who have specific skills, it is difficult to subcontract local contractor. Therefore Contractor need to dispatch engineers who supervise quality, advice skill and progress to local worker.

2-2-4-8 Implementation Schedule

In accordance with Japan's Grant Aid Cooperation scheme, Figure 2-4 shows the project implementation process.

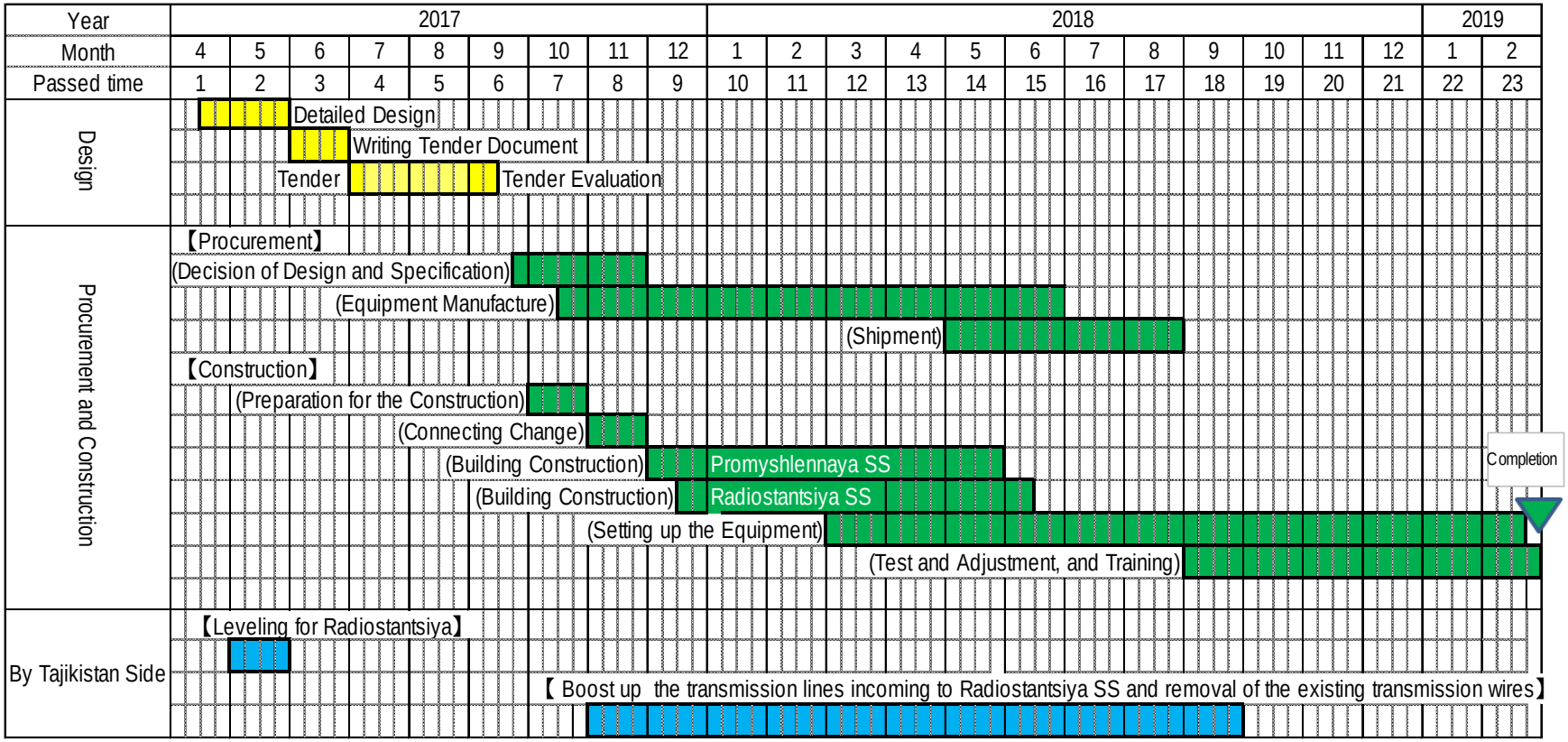


Figure 2-4 Project Implementation Process

2-3 Obligations of Tajikistan

Table 2-20 outlines obligations of the Tajikistan side.

Table 2-20 Obligations of Tajikistan

(P: Promyshlennaya Substation)

(R: Radiostantsiya Substation)

No.	Obligations
1 (P)	Removal of the existing transformers outside the site
2 (P)	Communications to consumers about planned outages and safety measures during the construction , and related compensation
3 (R)	(1) Securing of the project site (2) Ground leveling and removal of obstacles on the project site
4 (R)	The step-up voltage work for the 110kV transmission line to be conducted by BT
5 (R)	For the new substation construction work: (1) Ground leveling (2) Access roads to the project site (3) Replacement of, if any, drainage on the project site
6 (R)	For the auxiliary facility work in the new substation: (1) Water supply work: to lead in the main pipe to the site (2) Drainage work: to drain wastewater to the outside
7 (P and R)	Customs clearance and taxation procedures for materials and equipment (1) At Dushanbe Station 2 (2) Provision of storage for materials and equipment, and payment of the cost incurred, if the tax exemption and customs clearance procedures take time at the station due to reasons on the Tajikistan side
8 (P and R)	Exemption from value added tax on locally procured materials and equipment
9 (P and R)	Measures necessary to obtain entry permits to Tajikistan
10 (P and R)	Electricity and water supply for the construction work, and payment of the cost incurred

No.	Obligations
11 (P and R)	Payment of the following fees based on Bank Arrangement B/A: (1) Fee for Authorization to Pay (2) Commission to remit
12 (P and R)	Securing and implementation of budget of application for and acquisition of approval for environmental and social considerations for the Project
13 (P and R)	Measures necessary to obtain the following permits ・ Permit for installation work ・ Permit for entry to restricted areas
14 (P and R)	Temporary yard for materials and equipment in SUBSTATION will be secured on the site of Promyshlennaya Substation
15 (P and R)	Securing of parking during the construction work
16 (P and R)	Transfer of the existing overhead/underground cables and pipes, and acquisition of necessary permits (electricity, telephone, water supply and drainage, etc.)
17 (P and R)	Provision of disposal site of surplus soil and miscellaneous wastewater
18 (P and R)	The Contractor and BT agree with off-line work plan and BT will conduct necessary actions for the off-line work.
19 (P and R)	All member involved the Project share with safety information around project site
20 (P and R)	Provision of office room for the Consultant

2-4. Project Operation and Maintenance Plans

2-4-1 Basic Policy

In order to improve the reliability of the electricity supply among consumers in the project area, and stably operate the electricity supply system, the transmission and transformation facilities must be appropriately operated and maintained. The surroundings must be preserved, too. To this end, C/P is desirably required to reduce the accident rates of the facilities, and conduct appropriate accident prevention and maintenance measures with an eye to the higher reliability, safety and efficiency. Figure 2-5 shows the concept of O&M for transmission and transformation facilities. Accordingly, the O&M of the equipment to be procured and installed, and facilities to be constructed under the Project will focus on preventive maintenance for accident and fault.

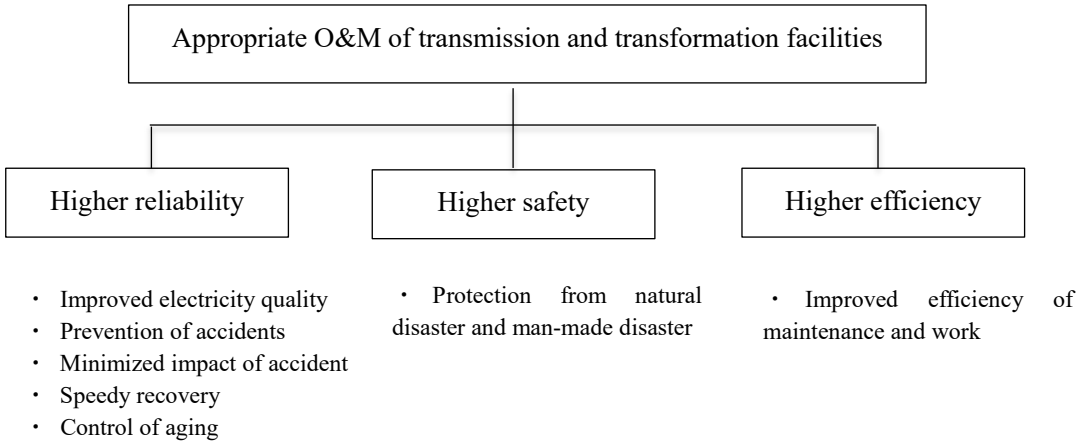


Figure 2-5 O&M of Transmission and Transformation Facilities

The engineers of the Contractor will implement OJT about O&M for transformation and transformation facilities during installation work and commissioning. In addition the Japan side will provide maintenance tools and manuals for O&M, and propose O&M system after hand over. These actions will expect fully promising.

2-4-2 Daily and Regular Inspection Items

Table 2-21 lists regular inspection items for transformation facilities to be procured and installed in the Project.

As the table indicates, these items are classified into three categories:

(i) “daily inspection” is daily inspections that relies on the five senses of humans to detect abnormal high temperature and noise of equipment.

(ii) “Normal inspection” includes checking whether bolts are fastened, insulation is clean, and charging parts not checked in daily.

(iii) “Detailed inspection” includes checking mechanical and control function of equipment interlock between equipment and accuracy of gauges and instruments.

Actually Normal inspection is conducted once a year or every two years. Detailed inspection is conducted once every several years.

In nominal or detailed inspection, it is recommended that Parts of distribution panel included fuses, gauges, instruments and parts deteriorated over time included relay and insulation when performance of parts is deteriorated by checking characteristic and frequency in use.

Table 2-21 Standard Inspection Items of Equipment for Transformation Facilities

Item	Contents	Daily	Normal	Detailed
Appearance	Indicator of equipment	○	○	
	Abnormal noise and odor	○	○	
	Discolor terminal by heating	○	○	
	Crack, damage and stain on bushings	○	○	
	Rust on stage and frame	○	○	
	Abnormal rise in temperatures	○	○	
	Whether bushing terminals are fastened by mechanical check with torque wrench	○	○	
Control unit Operation device and control panel	Gas pressure of circuit breaker	○	○	
	Display units of gauges and instruments	○	○	○
	Checking humidity, rust and stain in control unit and panels		○	○
	Checking whether fuel is fully refueling and panels is kept clean		○	○
	Whether cable terminals are securely fastened	○	○	○
	Confirmation of display units of switchgears		○	○
	Leakage of air and oil		○	○
	Checking pressures ,such as SF_6 gas, before/after operations		○	○
	Checking operation of gauges and instruments		○	○
	Rust, deformation damage of springs	○	○	○
	Checking operation of auxiliary switchgears and relays		○	○
	Checking operation of DC control supply		○	○
Measuring and test	Measuring of insulation resistance		○	○
	Measuring of contact resistance			○
	Checking breaking of Heater wire		○	○
	Checking operation of relays		○	○

2-4-3 Procurement of Spare Parts

2-4-3-1 Scope of Spare Parts

The spare parts define that parts are deteriorated in daily operation and running and need to be replaced at fixed intervals. The survey team suppose that spare parts of procured equipment not need to be prepared because it is not necessary to replace parts from handover for a year. Plan of Spare Parts

2-4-3-2 Procurement Plan of Spare Parts

As a general rule of Japan Grant Aid Cooperation, the recipient country is required to have the capacity of operating and managing provided facilities. The Preparatory Survey has concluded that BT has the capability. As previous section, the Project will not provide any spare parts that need to be replaced by new ones within one year after the commencement of services. From the second year on, however, the Tajikistan side shall basically procure any spare parts as part of its O&M, except packings, grease and other items, which are attached to equipment and need to be replaced at the time of the initial regular inspection.

2-5 Project Cost Estimation

2-5-1 Estimated Cost of the Project

The total project costs required for the implementation of the Project are estimated at _____. Tables 2-22 and 23 show the breakdown of the costs to be borne by the Japanese and Tajikistan sides, respectively, based on the scope of works, according to section (3) "Estimation Conditions" below. However, the figure does not show the Amount of Grant in the E/N.

(1) Cost to be Borne by the Japanese Side

Estimated Total Project Cost

Table 2-22 Costs to be Borne by the Japanese Side

Item		Estimated project cost
Equipment	Buildings for Switchgears and control rooms	
	110kV Main Transformer 35kV distribution switchgear 10kV distribution switchgear Other Transformation facilities, including Protection Panel and Control panel Power Cables Construction work for towers for the lead-in of electricity to Radiostantsiya Substation	
Detailed design and supervision of procurement		

(2) Cost to be Borne by the Tajikistan Side

Table 2-23 Costs to be Borne by the Tajikistan Side

No.	Item	Estimated amount	Estimated amount
1	At Radiostantsiya Substation Ground leveling on the site Construction of access road for transportation equipment		
2	At Radiostantsiya Substation The voltage stepped up work from the 35kV to 110kV transmission line to secure power supply		
3	At Radiostantsiya Substation Connection to water supply and drainage with main system		
4	Concessions for Bank Arrangement		
	Total		

(3) Estimation Conditions

(i) Time of estimation: July 2016

(ii) Exchange rate:

The exchange rate has been used average from April to June 2016.

- American Dollar, hereinafter USD, and Euro, hereinafter EUR are adopted Telegraphic Transfer Selling, hereinafter T.T.S rate, of the Bank of Tokyo-Mitsubishi UFJ .
- Tajikistan Somoni, hereinafter TJS, is adopted the rate of the National Bank of Tajikistan.

Adopted exchange rate are following below

1USD = JPY 109.04

1EUR = JPY 123.38

1TJS = JPY 13.74

(iii) Procurement period: Detailed design and procurement period are as shown in Figure 3-4 “Project Implementation Process”.

(iv) Others: The cost estimation are carried out in accordance with the Japanese Grant Aid scheme.

2-5-2 Operation and Maintenance Costs

BT operates and maintain at existing substation near project site. Also New substation is operated and maintain by BT after handover. In contrast, no addition worker is employed because BT has assigned existing staff and operator in Promyshlennaya Substation.

New facility procured by the project enables to reduce once every four years than semiannually owing to old facility, and significantly maintenance and total cost.

Chapter 3 Project Evaluation

3-1 Preconditions for the Project Implementation

Acquisition of land, environmental permit, and other necessary permits and approvals are prerequisites for the project implementation.

The counterpart in Tajikistan has already started necessary procedures, formulated a task team consisting of persons responsible and experts at MoEWR and BT, and established a project promotion system including persons concerned such as members of the CEP. Thus, there is no particular concern about the Tajikistan side.

(1) Land Acquisition

Land acquisition is required (no resettlement is required) for Radiostantsiya Substation, and BT already has land permission dated January 27, 2016. The secondary Field Survey in January 2017 has confirmed that boundary stakes have been installed on the site, and that a cadastral map based on survey work is available.

The counterpart is required to conduct site preparation and consider consistency with other re-development projects nearby in line with the schedule of the Project.

(2) Environmental Permit

CEP has already issued environmental permits for the target two substations to MoEWR.

3-2 Necessary Inputs by Tajikistan to Realize the Project

(1) Prior to the Construction Work

- BT will remove walls left behind and completed land preparation on the site for Radiostantsiya Substation, and obtain specific information about re-development projects that may affect the Project until the meeting on bidding documents so that it can incorporate the information in the bidding documents.
- BT will lead in a power source for construction work to the site for Radiostantsiya Substation.

(2) During Construction

- If any planned disconnection of distribution cables is unavoidable for construction of Promyshlennaya Substation, the interconnection with distribution cables of other substations will be utilized to avoid outages for the benefit of consumers. If an outage is still inevitable, notification will be made in advance to local citizens.
- Similarly, if one of the two transformers is suspended, the interconnection with distribution cables of other substations will be utilized to avoid outages due to excess load and disperse the loads as much as possible.
- After the work to replace one of the two bay units and distribution switchgears of

Promyshlennaya Substation, interim completion test & inspection and necessary procedures for facility management so that the replaced equipment can operate.

- The 35kV transmission lines will be upgraded to 110kV ones so that a on site withstand voltage test can be conducted on the commercial electricity supply from upgraded transmission lines promptly after completion of the installation work at Radiostantsiya substation.
- The 10kV distribution cable lead-in work will be conducted so that transformer load (heat run) test can be conducted.
- Water supply and drainage works will be conducted on the road side so that the water supply and drainage system can be led in to the premises of the Radiostantsiya Substation.
- Telephone lines for security and maintenance purposes and telecommunication lines for monitoring information will be led in to the premises of the Radiostantsiya Substation.

(3) After Construction and Commencement of Services

- After commencement of services at Radiostantsiya Substation, a 10kV distribution cable lead-in work will be conducted.

3-3 Important Assumptions

External conditions that are prerequisites for development and maintenance of the project effects are as follows.

(1) In relation to Higher Goal

- The governmental policy on electricity development is not changed.
- The political and economic situations are stable.

(2) In relation to Project Objective

- O&M is sustainably conducted.
- Toll collection and financial support continue.
- Security of the facilities is secured.

(3) In relation to expected output

- The upper transformer and lower distribution facilities sufficiently operate.
- O&M plans for the facilities are put into operation.

3-4 Project Evaluation

As described below, the Project contributes to the fulfillment of energy and electricity policies of Tajikistan, and benefits residents including those in poverty and public facilities in the target areas, and thus the relevance as a cooperation project is considered to be high.

3-4-1 Relevance

(1) Urgency and Relevance of the Facility Capacity

The facility plan for the electricity distribution network is put into operation chiefly from the following perspectives:

(i) Securing the supply capacity in response to the power demand
(ii) Enhancing the reliability of the electricity supply (reducing the outage period, etc.) by securing the supply backup capacity
(iii) Improving the electricity quality by enhancing the electricity distribution facilities

In particular, perspective (i) of securing the supply capacity in response to the power demand is the top priority and highly urgent for stable supply of electricity that supports the social and economic systems as basic infrastructure.

Dushanbe, the capital city of Tajikistan, plays the central role of the country's political, economic and social activities. The functions as the capital have been developed and enhanced, and the city has been rapidly expanding as more and more people flow in. The central part of the city, in particular, has seen quite a lot of projects to construct public facilities, business buildings, commercial facilities and high-rise condominiums at a fast pace as a part of regional re-development policy. Substations supplying electricity to this area are obliged to operate beyond their capacities, not chronically, but in winter when the power demand is high. In addition, the demand is beyond the supply capacity in some distribution cables, causing the suspension to protect these facilities.

Thus, it is considered to be highly urgent to increase the supply capacity in the central area by conducting the rehabilitation of the existing Promyshlennaya Substation and newly constructing Radiostantsiya Substation at the heart of the area where the load density is high.

Based on estimated maximum power demand (at the annual growth rate of about 5%), the facilities are capable of supplying electricity until 2025, and seem to be able to meet the demand if the interconnection of distribution cables of neighboring substations that still have enough capacities is conducted, even if the power demand grows more than estimated.

Alleviating the burden on the neighboring substations will make certain of the upgrading of these neighboring facilities under mid- and long-term facility rehabilitation and enhancement plans, which the country has to press ahead with for aged electricity distribution facilities.

As the electricity distribution facilities are aged, abrupt outages are frequent. This reduces the reliability of the electricity supply and causes direct economic losses. Thus, it is highly urgently needed to recover the credibility of the electricity supply by upgrading the aged facilities as a whole at Promyshlennaya Substation and installing latest facilities at a new substation.

If latest facilities with low loss replace the aged facilities with high electricity loss, and if

Radiostantsiya Substation is constructed in the area where the load density is high, the total length of distribution cables will be shortened, alleviating the electricity transmission loss that has occurred because of the long-distance transmission from the neighboring substations to the area where the demand is high.

As described in the assessment of demand estimation, it has been confirmed that the facilities to be provided under the Project will satisfy the power demand even in the target year (2025). In other words, the timing of project implementation and project size are considered to be relevant from the mid- and long-term perspectives of the Project.

(2) Benefit

Electricity is a form of energy essential to self-reliant, sustainable social and economic development. Projects contributing to establishment of a reliable and efficient electricity distribution network in the capital, which plays a core role in political, economic and social activities, are considered to be of paramount importance for infrastructure development.

The central part of Dushanbe has many challenges related to electricity, including supply shortage, and frequent outages and unstable voltage due to accidents of the aged facilities. All this lowers the reliability and quality of electricity, leading to a rise in opportunity cost in economic and social activities for higher living standards.

The Project will be a fundamental solution to these issues, contribute to maintenance and enhancement of the functions of the capital, and make the city favorable in infrastructure assessments by businesses intending to do overseas business operations. Thus, the Project is highly beneficial.

(3) O&M Capacity

BT has long engaged in O&M of many electricity facilities, and its O&M capacity is considered to be highly relevant.

The models of protection relays and switchgears for the distribution system to be procured under the Project have been little used in Tajikistan. But they are not considerably beyond the country's technological standards.

Therefore, there will be no particular problem with BT's O&M capacity for equipment to be procured, so long as technological transfer is made through initial operation guidance and operation guidance in line with the characteristics, features and specifications of the equipment.

Moreover, the rehabilitation work of Promyshlennaya Substation will be based on work methods and procedures that incorporate Japan's rich experience. In other words, the existing substation will be rehabilitated safely while it is in operation and the necessary outage is minimized. Thus, the Project will contribute to an improvement in technologies of Tajikistan, which will have to upgrade more and more distribution substations in future.

(4) Project Contributing to Higher Plan.

The highest ranked plan in relation to the Project is NDS, which states that the development of the energy sector is considered to be vital to further development of the national economy and a subsequent increase in the level of happiness of the people. The term "development of the energy sector" includes enhancement of the transmission and transforming facilities and upgrading of aged facilities.

The project objective is to improve the electricity supply to the industrial sector and citizens in Dushanbe, thereby contributing to the promotion of economic and social development, and improvement in the living standards. To this end, the Project will rehabilitate and increase the capacity of the existing Promyshlennaya Substation, and newly construct Radiostantsiya Substation. This is consistent with the development plan in the energy sector in Tajikistan, and is considered to be essential to realization of the higher plan.

(5) Consistency with Japan's Assistance Policy

The Japan`s Assistance Policy for Tajikistan cites "assistance to nation building that enables sustainable economic and social development" as the basic principles of the assistance (major objective). In line with this, Japan will assist Tajikistan to strive for development of regions with many people in poverty and sustainable development focusing on economic infrastructures.

As for priority areas (medium objectives), the Japan`s Assistance Policy cites "development of economic infrastructure". Accordingly, Japan will provide assistance to the electricity sector for the purpose of improving the unstable electricity supply.

The Project literally assists the electricity sector to improve the unstable supply. The assistance through procurement of high quality equipment that is utilized for Japan's highly reliable electricity supply system, and system design technologies, is considered to be highly relevant as a grant aid cooperation project on the grounds that the Project facilitates technology assistance to infrastructure and non-infrastructure aspects, where Japan has superiority, and that it helps Tajikistan to enhance electricity facilities that are important infrastructures.

3-4-2 Effectiveness

3-4-2-1 Quantitative Effects

(1) Reduction in Electricity Loss

Rehabilitation and expansion of the capacity of Promyshlennaya Substation, and construction of Radiostantsiya Substation are expected to increase the electricity amount that can be transmitted, and reduce electricity loss due to overload outages. Table 3-1 shows the quantitative effects.

Table 3-1 Quantitative Effects

Indicator	Benchmark (2016)	Target (2020)
An increase in the electricity amount that can be transmitted as a result of rehabilitation of Promyshlennaya Substation (MWh/year) (Increase in the capacity of the transforming facilities)	332,880 (25MVA× 2 units)	520,125 (40MVA×2 units)
An increase in the electricity amount that can be transmitted as a result of construction of Radiostantsiya Substation (MWh/year) (Increase in the capacity of the transforming facilities)	--	432,744 (40MVA×2 units)
Electricity loss due to overload outages (MWh)	4,081	0

(2) Reduction in Greenhouse Gas Emissions

Radiostantsiya Substation to be newly constructed will shoulder some 30% of the load of aged substations, including Tekstilmash, Vakhdat, Centralnaya, and Karamova Substations. This will improve the efficiency of Radiostantsiya Substation and thus reduce the electricity loss out of the electricity amount to be shouldered (MWh/year).

The amount of CO_2 emissions reductions as a result of the improvement in electricity loss in the course of transformation has been calculated on the assumption that the transforming efficiency will rise by 1% in comparison with the existing aged substations.

As for the coefficient of emissions, the reduction in the electricity loss in the transforming facilities is equal to the amount of electricity generated by TPP-1 (198MW) with a higher coefficient of emissions, compared to another thermal power plant in Dushanbe, TPP-2 Phase I (100MW). The amount of electricity loss corresponds to the amount of CO_2 emissions reductions, 2,037 ton-CO_2. Table 3-2 shows the details.

Table 3-2 CO_2 Emissions Reductions due to Construction of Radiostantsiya Substation

	Effects of improvement in electricity transforming efficiency
Transformer (MVA)	40
Estimated power factor	0.95
Effective power (MW)	38
Annual average load factor (%)	60
Annual electricity supply amount (MWh)	178,704
Load loss at 40MVA (MW)	0.219
Load loss at power factor of 0.95 (MW)	0.1976475
No-load loss (MW)	0.0205
Transformer efficiency (%)	99.43
Improvement rate of electricity loss (%)	1
Electricity loss avoided (MWh/year)	1,787
Coefficient of emissions (ton-CO_2/MWh)	1.14
CO_2 Emissions reductions (ton-CO_2)	2,037

3-4-2-2 Qualitative Effects (Entire Project)

Table 3-3 shows qualitative effects of the Project.

Table 3-3 Qualitative Effects of the Project

Present state and issues	Effects of the Project
(1) Poor quality of electricity Because the voltage control is not automatic, the fluctuation of voltage is big. This shortens the service lives of electrical products. Small PV systems are not interconnected, and stop frequently.	The automatic tap control of transformers enables fine adjustment of voltage, reducing the fluctuation of voltage.
(2) Outages due to overload occur about 200 times each year. This causes heaters, elevators and other electrical devices to stop, affecting people's daily lives. Outages also lower the productivity of factories and service lives of electrical products.	No outage due to overload occurs. This contributes to improvements in daily lives and security, and a rise in the productivity of factories.
(3) Supervisory Control and Data Acquisition System (SCADA) is not adopted. Basic data necessary for the stable electricity supply is hardly collected.	Digital protection relays satisfying the new international standards are installed, making it easier to collect data on operations and control of the substations, and build a SCADA.
(4) Increased inspections and maintenance cost because of aged facilities The following units are inspected once in every six months. 1. Transformer: 5 persons 2. Breaker: 5 persons 3. Disconnector switch: 5 persons 4. Protection relay unit: 4 persons 5. Measuring units (PT and CT): 5 persons Repair of oil leakage from transformer is conducted about three times each year: 5 persons	The reliability of equipment is improved, reducing the frequency of inspections to once in every six years or so. This also considerably reduces the maintenance cost. As new equipment is provided, repair of oil leakage is no longer needed.

Appendices

Appendices

Appendix 1: Member List of the Survey Team

Appendix-2

Appendix 1: Member List of the Survey Team

(1) The 1st Field Survey
- **Main survey: June 2 – July 7, 2016**
- **Supplementary survey: July 28 – September 16, 2016 and October 17 – 21, 2016**

Name	Duty	Affiliation
Kazunari Oshima	Team Leader	JICA Expert
Takeshi Naito	Planning Management	Energy Team I, Industrial Development and Public Policy Department, JICA
Kazuyoshi Mori	Chief Consultant/Electricity Planning	Asia Engineering Consultant Co., Ltd
Hideo Fukui	Substation Planning	Asia Engineering Consultant Co., Ltd
Mineo Motoyama	Facility Planning, Natural Conditions, Cost Estimation	Asia Engineering Consultant Co., Ltd
Kazuyoshi Yoshida	Power System Analysis	Asia Engineering Consultant Co., Ltd
Tetsuo Okumura	Transmission Planning	Asia Engineering Consultant Co., Ltd
Noboru Nakamura	Distribution Planning	Asia Engineering Consultant Co., Ltd
Shigenari Yamamoto	Environmental and Social Considerations/Natural Conditions	Asia Engineering Consultant Co., Ltd
Makoto Hanamura	Procurement Planning, Cost Estimation	Asia Engineering Consultant Co., Ltd
Satoru Suzuki	Procurement planning, Cost Estimation	Asia Engineering Consultant Co., Ltd
Kazuaki Nemoto	Civil Engineering	Asia Engineering Consultant Co., Ltd
Takumi Mito	Project Coordinator	Asia Engineering Consultant Co., Ltd

(2) The 2nd Field Survey (January 9 – 20, 2017)

Name	Duty	Affiliation
Kazunari Oshima	Team Leader	JICA Expert
Takeshi Naito	Planning Management	Energy Team I, Industrial Development and Public Policy Department, JICA
Makoto Hanamura	Chief Consultant	Asia Engineering Consultant Co., Ltd
Kazuyoshi Yoshida	Power System Analysis	Asia Engineering Consultant Co., Ltd
Shigenari Yamamoto	Environment and Social Considerations	Asia Engineering Consultant Co., Ltd
Takumi Mito	Project Coordinator	Asia Engineering Consultant Co., Ltd

Appendix-4

Appendix 2: Study Schedule

Appendix-6

Appendix 2: Study Schedule

(1) The 1st Field Survey (Main survey: June 2 – July 7, 2016)

Date	Activity	Location	Major interviewee
2016/5/31 (Tue)	Departing Japan	Narita/Kansai Airport	
6/1(Wed)	Traveling		
6/2(Thu)	JICA Tajikistan: briefing on the survey BT&MoEWR. Project C/P determined	JICA Tajikistan MoEWR	JICA Tajikistan: Mr. Ishii (Office Head), Mr. Konohara (coordinator) MoEWR: Mr. Jamshed Shoimzoda (Deputy Minister) MoEWR: Mr. Parviz Atoev (Head of Int'l Dept) MoEWR: Mr. Parviz Yakhyoev (Chief Specialist) BT: Mr. Sharipov Rezvon (Planning Manager) BT: Mr. Giosov Abduvarob (Dushanbe City Electric Deputy Chief Engineer)
6/3(Fri)	Site visits with BT & MoEWR	Glavpochtamt, Glavnaya, Radiostantsiya, Promyshlennaya	MoEWR: Mr. Parviz Atoev (Head of Int'l Dept) MoEWR: Mr. Parviz Yakhyoev (Chief Specialist) BT: Mr. Sharipov Rezvon (Planning Manager) BT: Mr. Giosov (Dushanbe City Electric Deputy Chief Engineer)
6/4(Sat)	Team meeting, sorting materials and documents		
6/5(Sun)			
6/6(Mon)	JICA Tajikistan: briefing on the survey BT&MoEWR Briefing on the project and grant aid cooperation scheme	AM: JICA PM: MoEWR	JICA Tajikistan: Mr. Ishii (Director), Mr. Konohara (coordinator) JICA: Mr. Oshima (general manager), Mr. Naito MoEWR: Mr. Manuecher Safasov (Head of Investment Dept) MoEWR: Mr. Parviz Atoev (Head of Int'l Dept) MoEWR: Mr. Parviz Yakhyoev (Chief Specialist) BT: Mr. Sharipov Rezvon (Planning Manager) BT: Mr. Giosov (Dushanbe City Electric Deputy Chief Engineer)
6/7(Tue)	Site visits Information gathering from local contractors	Glavpochtamt S/S (existing) Glavpochtamt and Radiostantsiya S/S (new construction) MoEWR BT Avtostrada Services	Mr. Tojiddin JICA: Mr. Oshima (general manager), Mr. Naito MoEWR: Mr. Parviz Atoev (Head of Int'l Dept) MoEWR: Mr. Parviz Yakhyoev (Chief Specialist) BT: Mr. Sharipov Rezvon (Planning Manager) Mr. Giosov (Deputy Chief Engineer) Avtostrada: Mr. Usmon Sidiko (Director) Eurasian Consulting & Engineering Services Mr. Abdurashid Shukurov(Director), Mr. Akhlidin Davlatbekov (Project Manager)
6/8(Wed)	AM: team meeting PM: sorting materials and documents		
6/9(Thu)	PM: Japanese Embassy in Tajikistan Drafting (proposed) M/D	Japanese Embassy in Tajikistan, MoEWR	EoJ: Ms. Chie Tamura, second secretary MoEWR: Mr. Parviz Atoev (Head of Int'l Dept) MoEWR: Mr. Parviz Yakhyoev (Chief Specialist)

			BT: Mr. Sharipov Rezvon (Planning Manager) BT: Mr. Giosov (Dushanbe City Electric Network, Deputy Chief Engineer)
6/10(Fri)	AM: information gathering from other donor organizations BT&MoEWR: discussion on and signing M/D	ADB MoEWR	ADB: Mr. Bouadokpheng Chansavat (Portfolio Management Specialist) MoEWR: Mr. Parviz Atoev (Head of Int'l Dept) MoEWR: Mr. Parviz Yakhyoev (Chief Specialist) BT: Mr. Sharipov Rezvon (Planning Manager) Dushanbe City Electric Network: Mr.Ghiyosov Abduvarob (Deputy Chief Engineer)
6/11(Sat)	AM: field survey PM: sorting materials and documents	Transmission route between Glavnaya and Glavpochtamt	Integral LLC Mr. Shamsudino Shambe (General Director) Mr. Aliev Mahmadvazir (Chief Engineer) Mr. Sabzov Rasul (Group Leader)
6/12(Sun)	Sorting materials and documents		
6/13(Mon)	Information gathering from C/P	MoEWR BT	MoEWR: Mr. Parviz Yakhyoev (Chief Specialist) BT: Mr. Behruz Misbohov (Duty Manager)
6/14(Tue)	Information gathering from C/P Information gathering from engineering consultant	MoEWR Dushanbe City Electric Network	MoEWR: Mr. Parviz Yakhyoev (Chief Specialist) Dushanbe City Electric Network: Mr.Ghiyosov Abduvarob (Deputy Chief Engineer) Bark Sokhtmon Loihakash: Mr. Ibragimov Komiljon Holmurodov (General Director)
6/15(Wed)	Information gathering from C/P Information gathering from engineering consultant Information gathering from carriers	Committee for Environmental Protection	Committee for Environmental Protection: Mr. Sudurov Saidismon (Head of Ecological Expertise Department) ARAL-NERU: Muzaffari Mukhriddin (Director) Globalink: Mr. Masrur Kasimov (Fright Forwarding Manager) ABM: Mr. Abdulloev Bakhtyot (Commercial Director)
6/16(Thu)	Information gathering from C/P Information gathering from engineering consultant Information gathering from carriers Information gathering from sales distributers of transformers	Committee for Environmental Protection Integral LLC M&M TLM	Mr. Sudurov Saidismon (Head of Ecological Expertise Department) Mr. Shamsudino Shambe (General Director) Mr. Aziz Sharipov (Managing Director) Mr. Sheraliev Tohir (Director) Mr. Cao Yadong (Director)
6/17(Fri)	Information gathering from C/P Information gathering from	MoEWR Committee for Environmental	Mr. Parviz Yakhyoev (Chief Specialist) Mr.Sudurov Saidismon(Head of Atmosphere)

	sales distributers of transformers	Protection Tol Sokhtmon	Mr. Darlatov Azam (Director)
6/18(Sat)	Information gathering from C/P	Committee for Environmental Protection	Mr. Sudurov Saidismon (Head of Ecological Expertise Department)
6/19(Sun)	Sorting materials and documents		
6/20(Mon)	Information gathering from C/P Information gathering from engineering consultant	MoEWR ENERGOSETPROEKT	Mr. Parviz Yakhyoev (Chief Specialist) Mr.Makhamdamin Aminov (Director)
6/21(Tue)	Information gathering from C/P	Committee for Environmental Protection MoEWR	Mr. Sudurov Saidismon (Head of Ecological Expertise Department) Mr. Parviz Yakhyoev (Chief Specialist)
6/22(Wed)	Obtaining quotation from consultant on environmental and social considerations	COLIBRILAW	
6/23(Thu)	Information gathering from C/P	MoEWR Dushanbe Thermal Power Plant-2	Mr. Parviz Yakhyoev (Chief Specialist) Mr. Murod:Dushanbe Thermal Power Plant-2 Deputy Head
6/24(Fri)	1. Information gathering from C/P 2. Visiting Dushanbe Thermal Power Plant 3. Visiting Nurek Hydropower Plant 4. Contacting an electric engineering company, NERGOSETPROEKT	1.BT 2.Dushanbe Thermal Plant 3.Nurek Power Plant	1.B.T. Mr.Kharimov Mirovich (First Executive Director) 2.D.P.P.2 Mr.Sayfulloev Kiyomidir(Chief Engineer) 3.B.T. Abduvahob Ghiyosov 4.Mr.Makhmandamin Aminov
6/25(Sat)	Sorting materials and documents		
6/26(Sun)	Sorting materials and documents, creating outline of the report on the field survey		
6/27(Mon)	TV team meeting ① Confirming the contents of M/D ② Checking on quotations from 3 companies ③ Technical meeting	Atlas Hotel	
6/28(Tue)	Information gathering from C/P	MoEW CEP	Mr. Parrviz Yakhiev (Chief Specialist) Mr. Sudurov Saidismon(Head of Atmosphere)
6/29(Wed)	Information gathering from C/P	MoEW CEP	Mr. Parrviz Yakhiev (Chief Specialist) Mr.Sudurov Saidismon(Head of Atmosphere)
6/30(Thu)	Information gathering from C/P	1.MoEW CEP 2.B.T.	1.Mr.Sudurov Saidismon (Head of Atmosphere) 2.Mr.Ghiyosov Abduvarob (Deputy Chief Engineer) Mr.Sharipov
7/1(Fri)	Joint survey with BT on Promyshlennaya S/S	PromyshlennayaSS	Mr.Kharimov Mirovich (First Executive Director) Mr.Ghiyosov Abduvarob (Deputy Chief Engineer)
7/2(Sat)	Agreement on enironmental and social considerations survey	Atlas Hotel	Colibri Law Firm LLC：Mr. Khujanazar Aslamshoev

7/3(Sun)	Sorting materials and documents, preparing for reporting after returning to Japan		
7/4(Mon)	Information gathering from C/P	MoEW CEP Colibri Law	Mr.Parviz Yakoev (Chief Specialist) Mr.Sudurov Saidismon(Head of Atmosphere) Mr. Alisher Khosimov
7/5(Tue)	1. Information gathering from C/P 2. Report after returning to Japan (TV meeting)	BT JICA	Mr.Kharimov Mirovich (First Executive Director) Mr. Sharipov、
7/6(Wed)	Sorting materials and documents		
7/7(Thu)	Obtaining signatures from C/N	BT	Mr.Kharimov Mirovich (First Executive Director) Mr. Sharipov Rezvon (Planning Manager)
7/7(Fri)	Sorting materials and documents		
7/7(Sat)	Departing to Japan		

(2) The 1st Field Survey (Supplementary survey-1: July 28 – September 16, 2016)

Date	Activity	Location	Major interviewee
7/27(Wed)	Departing Japan	Narita	
7/28(Thu)	Information gathering from C/P Visiting JICA Tajikistan Office	Colibri Law Firm LLC MoEWR CEP JICA Tajikistan Office	Mr. Alisher Khoshimov (Senior Associate) Mr. Shirinbek Milibekov (Senior Associate) Mr. Parviz Yakhiev (Chief Specialist) Mr. Shukurov Isfandiyor (Head of Ecological Expertise Department) Mr. Sudurov Saidismon(Head of Atmosphere) Mr. Konohara
7/29(Fri)	Visiting Colibri Law Firm LLC	Colibri Law Firm LLC	Mr. Shirinbek Milibekov、 Senior Associate
7/30(Sat)	Sorting materials and documents		
7/31(Sun)	Sorting materials and documents		
8/1(Mon)	Information gathering from C/P	MoEWR CEP	Mr. Parviz Yakhiev (Chief Specialist) Mr. Shukurov Isfandiyor
8/2(Tue)	Visiting Colibri Law Firm LLC Information gathering from C/P Survey on impact of underground cable route on the environment	Colibri Law Firm LLC MoEWR Underground cable route (Route I: along River Dushanbe)	Mr. Shirinbek Milibekov(Senior Associate) Mr. Parviz Yakhiev (Chief Specialist)
8/3(Wed)	Meeting on the 110kV power source underground cable route from the existing Glavnaya S/S to Glavpochtampt S/S	Hotel ATLAS	Mr. Farohob Nurkhahob (interpreter)
8/4(Thu)	Creating picture map of the 110kV power source underground cable route from	Hotel ATLAS	

	the existing Glavnaya S/S to Glavpochtampt S/S		
8/5(Fri)	Information gathering from C/P	MoEWR CEP	Mr. Parviz Yakhiev (Chief Specialist) Mr. Shukurov Isfandiyor (Head of Ecological Expertise Department) Mr. Sudurov Saidismon(Head of Atmosphere)
8/6(Sat)	Sorting materials and documents		
8/7(Sun)	Sorting materials and documents		
8/8(Mon)	・Survey on impact of underground cable route on the environment ・ Visiting Colibri Law Firm LLC	Underground cable routes (Route I: along River Dushanbe, Route II: route through green belt) Colibri Law Firm LLC	Mr Khujanazar Aslamshoev (General Director) Mr. Alisher Khoshimov (Senior Associate) Mr. Shirinbek Milibekov
8/9(Tue)	Information gathering from C/P	CEP	Mr. Shukurov Isfandiyor
8/10(Wed)	Information gathering from C/P	MoEWR	Mr. Parviz Yakhiev (Chief Specialist)
8/11(Thu)	Visiting Colibri Law Firm LLC	Colibri Law Firm LLC	Mr Khujanazar Aslamshoev:(General Director) Mr. Alisher Khoshimov (Senior Associate) Mr. Shirinbek Milibekov
8/12(Fri)	Visiting JICA Tajikistan Office	JICA Tajikistan Office	Mr. Ishii (Director), Mr. Inoue, Mr. Konohara
8/13(Sat)	Sorting materials and documents		
8/14(Sun)	Sorting materials and documents		
8/15(Mon)	Information gathering from C/P	MoEWR	Mr. Parviz Yakhiev (Chief Specialist)
8/16(Tue)	Visiting Colibri Law Firm LLC Information gathering from C/P	Colibri Law Firm LLC CEP	Mr. Khujanazar Aslamshoev (General Director) Mr. Alisher Khoshimov (Senior Associate) Mr. Shirinbek Milibekov (Senior Associate) Mr. Shukurov Isfandiyor (Head of Ecological Expertise Department)
8/17(Wed)	Information gathering from C/P	MoEWR	Mr. Parviz Yakhiev (Chief Specialist)
8/18(Thu)	Liaison meeting on safety measures	EoJ	Mr. Kitaoka (Ambassador), Mr. Minesaki (Second Secretary, Consul), Ms. Tamura (Second secretary), Mr. Kashiwazaki (in charge of risk management) JICA: Mr. Ishii (Director), Mr. Inoue
8/19(Fri)	Visiting GIINTIZ Visiting Colibri Law Firm LLC	GIINTIZ Colibri Law Firm LLC	Mr. Saidov R Sfarovich (Director) Mr. Khujanazar Aslamshoev (General Director) Mr. Alisher Khoshimov (Senior Associate) Mr. Shirinbek Milibekov (Senior Associate)
8/20(Sat)	Sorting materials and		

	documents		
8/21(Sun)	Sorting materials and documents		
8/22(Mon)	Information gathering from C/P	BT	Mr. Sharipov Rezvon (Planning Manager) Mr. Rahmatov
8/23(Tue)	Site survey	Glavnaya Glavpochtampt Radiostantsiya Promyshlennaya	Mr.Ghiyosov Abduvarob (Deputy Chief Engineer)
8/24(Wed)	Information gathering from C/P	MoEWR	Mr. Parviz Yakhiev (Chief Specialist)
8/25(Thu)	Visiting Colibri Law Firm LLC		Mr. Khujanazar Aslamshoev (General Director) Mr. Alisher Khoshimov (Senior Associate) Mr. Shirinbek Milibekov (Senior Associate)
8/26(Fri)	Discussion on priority and basic design	BT	Mr.Kharimov Mirovich (First Executive Director) Mr. Sharipov Rezvon (Planning Manager)
8/27(Sat)	Sorting materials and documents		
8/28 (Sun)	Sorting materials and documents		
8/29 (Mon)	Obtaining quotation and related information	Giintiz	
8/30 (Tue)	Obtaining quotation and related information Site survey Hearing to C/P	Giintiz Cable Route BT MoEWR DCEN	Mr. Sharipov Rezvon (Planning Manager) Mr. Manuecher Safasov (Head of Investment Department) Mr. Parviz Atoev (Head of International Department) Mr. Parviz Yakhyoev (Chief Specialist of International Department Mr.Ghiyosov Abduvarob (Deputy Chief Engineer)
8/31 (Wed)	Obtaining quotation and related information	PMK-14	
9/1 (Thu)	Obtaining quotation and related information	Global Group	
9/2 (Fri)	Obtaining quotation and related information Site survey Hearing to C/P	Barksoftmon Cable Route BT MoEWR DCEN	Mr. Sharipov Rezvon (Planning Manager) Mr.Ghiyosov Abduvarob (Deputy Chief Engineer)
9/3 (Sat)	Sorting materials and documents		
9/4 (Sun)	Sorting materials and documents		
9/5 (Mon)	Obtaining quotation and related information	Asfalt Betcon	
9/6 (Tue)	Obtaining quotation and related information Site survey Hearing to C/P	Integral Cable Route BT MoEWR DCEN	Mr. Sharipov Rezvon (Planning Manager) Mr.Ghiyosov Abduvarob (Deputy Chief Engineer)
9/7 (Wed)	Obtaining quotation and related information	Poyanda	

9/8 (Thu)	Obtaining quotation and related information	Romsar	
9/9 (Fri)	Obtaining quotation and related information	Dilshod-N	
9/10 (Sat)	Sorting materials and documents		
9/11 (Sun)	Sorting materials and documents		
9/12 (Mon)	Obtaining quotation and related information	Anushico	
9/13 (Tue)	Obtaining quotation and related information	Tajikgidroelectro montaj	
9/14 (Wed)	Obtaining quotation and related information	Integral	
9/15 (Thu)	Obtaining quotation and related information	Barksoftmon	
9/16 (Fri)	Obtaining quotation and related information		
9/17 (Sat)	Departing to Japan		

(2) The 1st Field Survey (Supplementary survey-2: October 17 – 21, 2016)

Date	Activity	Location	Major interviewee
10/15 (Sat)	Departing Japan		
10/16 (Sun)	Sorting materials and documents		
10/17 (Mon)	Briefing on purpose of visit	MoEWR CEP BT DCEN	Mr. Sharipov Rezvon (Planning Manager) Mr.Ghiyosov Abduvarob (Deputy Chief Engineer)
10/18 (Tue)	Discussion Briefing on purpose of visit	MoEWR BT DCEN JICA Tajikistan Office	Mr. Sharipov Rezvon (Planning Manager) Mr.Ghiyosov Abduvarob (Deputy Chief Engineer)
10/19 (Wed)	Site discussion	3 S/S	
10/20 (Thu)	Discussion on CN	BT MoEWR	Mr. Sharipov Rezvon (Planning Manager)
10/21 (Fri)	Signing CN	BT MoEWR	Mr. Sharipov Rezvon (Planning Manager)
10/22 (Sat)	Sorting materials and documents Departing to Japan		

(2) The 2nd Field Survey

Date	Activity	Location	Major interviewee
2017/1/6 (Fri.)	Departing Japan		
2017/1/7 (Sat.)			
2017/1/8 (Sun.)	* Team meeting		
1/9(Mon)	Explaining the Project	MoEWR BT CEP	Mr. Manuecher Safasov (Head of Investment Department) Mr. Parviz Atoev (Head of International Department) Mr. Parviz Yakhyoev (Chief Specialist of International Department) Mr. Sharipov Rezvon (Planning Manager) Mr. Shukurov Isfandiyor (Head of Ecological Expertise Department) Mr. Sudurov Saidismon (Head of Atmosphere)
1/10(Tue)	Discussion on M/D	MoEWR JICA Tajikistan Offfice	Mr. Usmonali Usmonzoda (Minister) Mr. Jamshed Shoimzoda (Deputy Minister) Mr.Asozoda Mahmadumar (First Deputy Chairman) Mr. Manuecher Safasov (Head of Investment Department) Mr. Parviz Atoev (Head of International Department) Mr. Parviz Yakhyoev (Chief Specialist of International Department) Mr.Kazunari Oshima Mr.Takeshi Naito
1/11(Wed)	Discussion on M/D	MoEWR	Mr. Usmonali Usmonzoda (Minister) Mr. Jamshed Shoimzoda (Deputy Minister) Mr.Asozoda Mahmadumar (First Deputy Chairman) Mr. Manuecher Safasov (Head of Investment Department) Mr. Parviz Atoev (Head of International Department) Mr. Parviz Yakhyoev (Chief Specialist of International Department) Mr.Kazunari Oshima Mr.Takeshi Naito
1/12(Thu)	Items subject to tax exemption, and procedures Discussion on (proposed) report	Ministry of Finance BT	Mr. Latifov Umed Barotovich Mr. Sharipov Rezvon (Planning Manager)
1/13(Fri)	Confirming company information	Tajikgidroelectromantaji	Mr. Muhammadiev Tulkin Rahmatjonovich
1/14(Sat)	Confirming (proposed) report Final confirmation of the contents of M/D Signing M/D	BT MoEWR MoEWR	Mr. Sharipov Rezvon (Planning Manager) Mr. Usmonali Usmonzoda (Minister) Mr. Jamshed Shoimzoda (Deputy Minister) Mr.Mirzo Ismoilzoda (Chairman) Mr.Asozoda Mahmadumar (First Deputy Chairman) Mr. Manuecher Safasov (Head of Investment Department) Mr. Parviz Atoev (Head of International Department) Mr. Parviz Yakhyoev (Chief Specialist of International Department) Mr. Ken Inoue Mr.Kazunari Oshima Mr.Takeshi Naito
1/15(Sun)	Team meeting		
1/16(Mon)	Field survey	BT	Mr. Giosov Abduvahob
1/17(Tue)	Final confirmation on	BT	Mr. Sharipov Rezvon (Planning Manager)

	(proposed) report Confirming matters to be borne by the recipient country	MoEWR	Mr. Manuecher Safasov (Head of Investment Department)
1/18(Wed)	Technical meeting Signing (proposed) report	MoEWR BT	Mr. Manuecher Safasov (Head of Investment Department) Mr. Sharipov Rezvon (Planning Manager)
1/19(Thu)	Hearings to contractor Report on the survey results	Barksoftmon JICA Tajikistan Office	Mr. Ibragimov Komiljon Holmurodov (General Director) Mr. Ken Inoue
1/20(Fri)	Survey on transformer transportation route		
1/21(Sat)	Departing to Japan		

Appendix 3: List of Parties Concerned in Tajikistan

Appendix 3: List of Parties Concerned in Tajikistan

Ministry of Energy and Water Resources of the Republic of Tajikistan (MoEWR)

Mr. Usmonali Usmonzoda	Minister
Mr. Jamshed Shoimzoda	Deputy Minister
Mr. Manuecher Safasov	Head of Investment Department
Mr. Parviz Atoev	Head of International Department
Mr. Parviz Yakhyoev	Chief Specialist of International Department

Barki Tojik

Mr.Mirzo Ismoilzoda	Chair man
Mr.Asozoda Mahmadumar	First Duputy Chairman
Mr. Kharimov Mirovich	First Executive Director
Mr. Sharipov Rezvon	Planning Manager

Dushanbe City Electric Network

Mr. Ghiyosov Abduvahob	Deputy Chief Engineer

Committee for Environmental Protection

Mr. Sudurov Saidismon	Head of Ecological Expertise Department

Mnistry of Finance

Mr. Latifov Umed Barotovich	Deputy Minister

Asian Development Bank

Mr. Bouadokpheng Chansavat	Portfolio Management Specialist

Embassy of Japan in the Republic of Tajikistan

Mr.Hazime Kitaoka	Ambassador Extraordinary and Plenipotentiary
Mr.Futoshi Minezaki	Second Secretary Consul
Ms.Chie Tamura	Second Secretary
Mr.Takashi Okimoto	Third Secretary

JICA Tajikistan Office

Mr. Kiyoshi Ishii	Resident Representative
Mr. Ken Inoue	Representative

Ms. Makiko Konohara	Project Formulation Advisor

Private companies

・Engineering

Integral LLC

Mr. Shamsudino Shambe	General Director
Mr. Aliev Mahmadvazir	Chief Engineer
Mr. Sabzov Rasul	Group Leader

Bark Sokhtmon Loihakash

Mr. Ibragimov Komiljon Holmurodov	General Director

Aral-Neru

Muzaffari Mukhriddin	Director

Energosetproekt

Mr.Makhamdamin Aminov	Director

Tol Sokhtmon

Mr. Darlatov Azam	Director

PMK-14

Mr. Halimov Murodbeg	Director

Global Group

Mr.Saylona Saidmuradova	Commercial Director

Tojikhidroelektromontaj

Mr. Muhammadiev Tulkin Rahmatjonovich	Deputy General Director

・Environmental consultant

COLIBRILAW

Mr.Khujanazar Aslamshoev	General Director
Mr.Alisher Khoshimov	Senior Associate

・Construction consultant

Giintiz

Mr.Rahmatull Saidov	General Director
Mr.Kamolov Ravshan	Technical Director

・Carriers

Globalink

Mr. Masrur Kasimov	Fright Forwarding Manager

ABM Trans Service

Mr. Abdulloev Bakhtyot	Commercial Director

M&M Tajikistan LLC

Mr. Aziz Sharipov	Managing Director

・Sales distributors

TLM

Mr. Sheraliev Tohir	Director
Mr. Cao Yadong	Director

Poyanda

Mr. Bekir Bayoglu	Director

Romsar

Mr. Umed	Administrator

Dilshod-N

Mr. Zokirov Narzullo	General Director

Anushico

Mr. Murodov Shodi Kuvatovich	General Director

Appendix 4: Minutes of Discussions (M/D)

Appendix 4: Minutes of Discussions (M/D)

4-1. Minutes of Discussions (M/D1)

Minutes of Discussions
on the Preparatory Survey for the Project for
Rehabilitation of Substations in Dushanbe in the Republic of Tajikistan

In response to the request from the Government of the Republic of Tajikistan(hereinafter referred to as "Tajikistan"), the Government of Japan decided to conduct a Preparatory Survey for the Project for Rehabilitation of Substations in Dushanbe (hereinafter referred to as "the Project"), and entrusted the Preparatory Survey to Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent the Preparatory Survey Team for the Outline Design (hereinafter referred to as "the Team") to Tajikistan, headed by Mr. Kazunari Oshima, Senior Advisor, JICA, and is scheduled to stay in the country from 6 to 10 June, 2016.

The Team held a series of discussions with the officials concerned of the Government of Tajikistan and conducted a field survey in the Project area. In the course of the discussions, both sides have confirmed the main items described in the attached sheets. The Team will proceed to further works and prepare the Preparatory Survey Report.

Dushanbe, June 30, 2016

Kiyoshi Ishii
Resident Representative
Japan International Cooperation Agency
Tajikistan Office

Jamshed Shoimzoda
Deputy Minister
Ministry of Energy and Water Resources of the Republic of Tajikistan

Asozoda Mahmadumar
First Deputy Chairman
Open Joint Stock Holding Company "Barki Tojik"

1

ATTACHEMENT

1. Objective of the Project
The objective of the Project is to improve sustainability of stable and efficient power supply in Dushanbe city by construction and rehabilitation of substations, thereby contributing to social and economic development of Tajikistan.

2. Title of the Preparatory Survey
Both sides confirmed the title of the Preparatory Survey as "the Preparatory Survey for the Project for Rehabilitation of Substations in Dushanbe".

3. Project Site
Both sides confirmed that the sites of the Project are in Dushanbe, which is shown in Annex 1.

4. Line Agency and Executing Agency
Both sides confirmed the line agency and executing agency as follows:

4-1. The line agency is Ministry of Energy and Water Resources, which would be the agency to supervise the executing agency.

4-2. The executing agency is Barki Tojik. 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 2.

5. Items requested by the Government of Tajikistan

5-1. As a result of discussions, both sides confirmed that the items requested by the Government of Tajikistan are as follows:

- Rehabilitation of Promishlennaya substation (Replacement of all the equipment and connecting works between existing transmission line and distribution line and equipment in Promishlennaya substation).
- Construction of Substations in Radiostansiya and Glavpochtamt and connecting works between existing transmission line and distribution line and equipment in each new substation.

5-2. JICA will assess the appropriateness of the above requested items through the survey and will report findings to the Government of Japan. The final components of the Project would be decided by the Government of Japan.

6. Japanese Grant Scheme

6-1. The Tajikistan 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 Tajikistan.

6-2. The Tajikistan side understands to take the necessary measures, as described in Annex 6, for smooth implementation of the Project, as a condition for the Japanese Grant to be implemented. The detailed contents of the Annex 6 will be worked out during the survey and shall be agreed no later than by the Explanation of the Draft Preparatory Survey Report.
The contents of Annex 6 will be used to determine the following:
(1) The scope of the Project.
(2) The timing of the Project implementation.
(3) Timing and possibility of budget allocation.

Contents of Annex 6 will be updated as the Preparatory Survey progresses, and will finally be the Attachment to the Grant Agreement.

7. Schedule of the Survey

7-1. The Team will proceed with further survey in Tajikistan until 8 July, 2016.

7-2. JICA will prepare a draft Preparatory Survey Report in English and dispatch a mission to Tajikistan in order to explain its contents around December 2016.

7-3. If the contents of the draft Preparatory Survey Report is accepted in principle and the Undertakings are fully agreed by the Tajikistan side, JICA will complete the final report in English and send it to Tajikistan around April 2017.

7-4. The above schedule is tentative and subject to change.

8. Environmental and Social Considerations

8-1. The Tajikistan side confirmed to give due environmental and social considerations during implementation of the Project, and after completion of the Project, in accordance with the JICA Guidelines for Environmental and Social Considerations (April, 2010).

8-2. The Project is categorized as "B" because the Project is not located in a sensitive area, nor has sensitive characteristics, nor falls into sensitive sectors under the JICA guidelines for environmental and social considerations April 2010 , and its potential adverse impacts on the environment are not likely to be significant. The Tajikistan side confirmed to conduct the necessary procedures concerning the environmental assessment (including stakeholder meetings, Environmental Impact Assessment (EIA) /Initial Environmental Examination (IEE) and information disclosure,etc.) and make EIA/IEE report of the Project. The EIA/IEE approval shall be received from the responsible authorities and submitted to JICA by the end of October 2016. The first stakeholder meeting will be held by the end of June and informed the result JICA.

9. Other Relevant Issues

9-1. Transmission line connecting Glavnaya Substation (existing substation) and Glavpochtamt Substation (new substation)

The team and Tajikistan side confirmed that necessity of construction of 110kV transmission line cum necessary equipment from the existing Glavnaya Substation to Glavpochtamt Substation. JICA will discuss GOJ to add this component to the scope of study. After getting confirmation by GOJ, JICA will discuss with Tajikistan side the type of line (Underground or Overhead) and route.

9-2. Upgrade of transmission line to Radiostansiya Substation (new substation)

Tajikistan side will consider availability of upgrading (voltage up from 35kV to 110kV) transmission line to Radiostansiya Substation and inform the result JICA by the end of June.

9-3. Specifications of equipment in substations

The team suggests that both candidate sites for Glavapochtamt Substation and Radiostansiya Substation have enough space to install AIS type switchgear. The final selection on switchgear type will be made based on the result of geographical survey. Tajikistan side proposed that capacity of transformers in Glavapochtamt Substation is 2 X 25MVA and Radiostansiya Substation is 2 X 40MVA. Voltage class of Glavapochtamt Substation is 110/10/6 kV and Radiostansiya Substation is 110/35/10 kV. Further, Tajikistan side proposed to mount communication systems in Glavpochtamt and Radiostantsiya substations for connecting with SCADA system, which will be operational in spring 2017. As for the specifications of transformers, it will be finalized based on the result of study of demand forecast and power flow analysis.

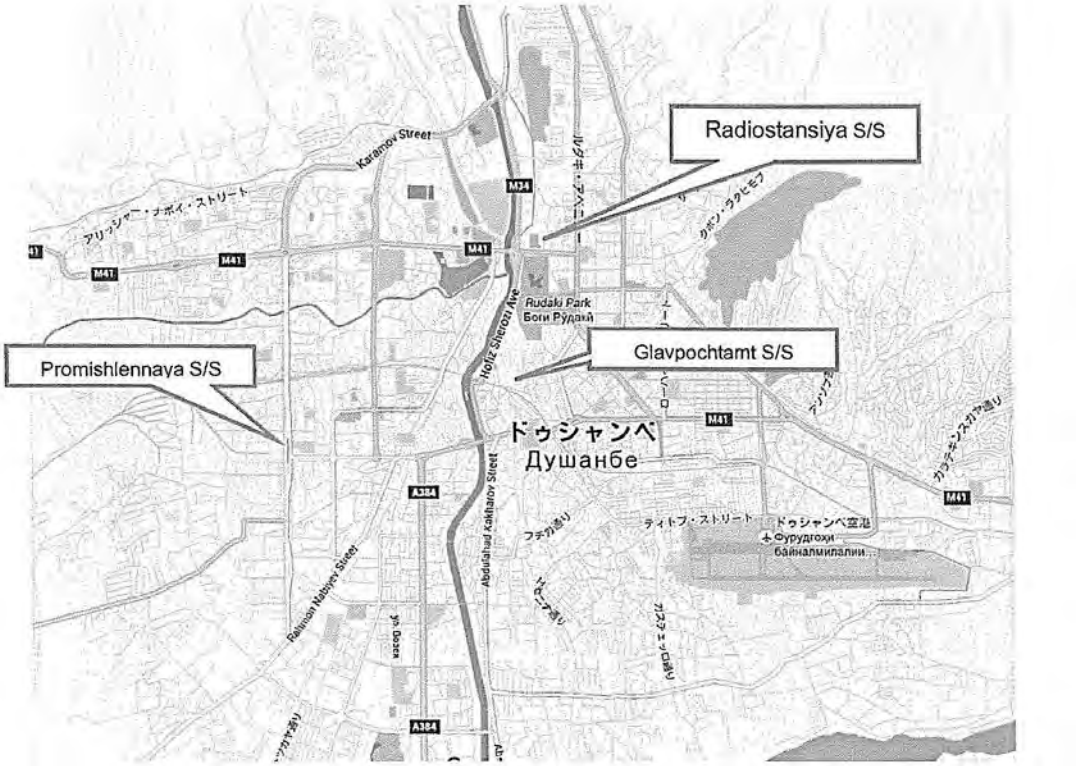
9-4. Prioritizing contents of the project

The team explained that items that requested from Tajikistan, mentioned in 5-1, will be studied and made prioritizing from the viewpoints of its urgency and effectiveness contribution to stable power supply in Dushanbe city.

Annex 1 Project Site
Annex 2 Organization Chart
Annex 3 Japanese Grant
Annex 4 Flow Chart of Japanese Grant Procedures
Annex 5 Financial Flow of Japanese Grant
Annex 6 Major Undertakings to be taken by Each Government (Tentative)
Annex 7 Sample of Project Monitoring Report

Annex 1

Project Site



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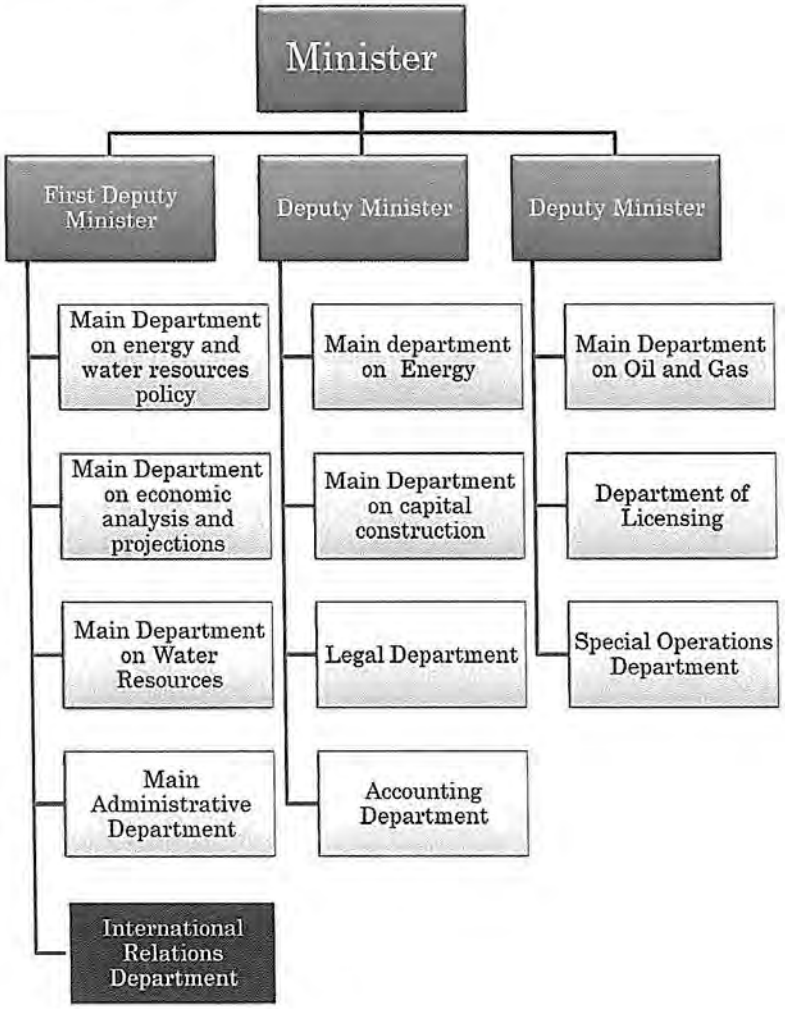
Annex 2
Organization Chart of Ministry of Energy and Water Resources



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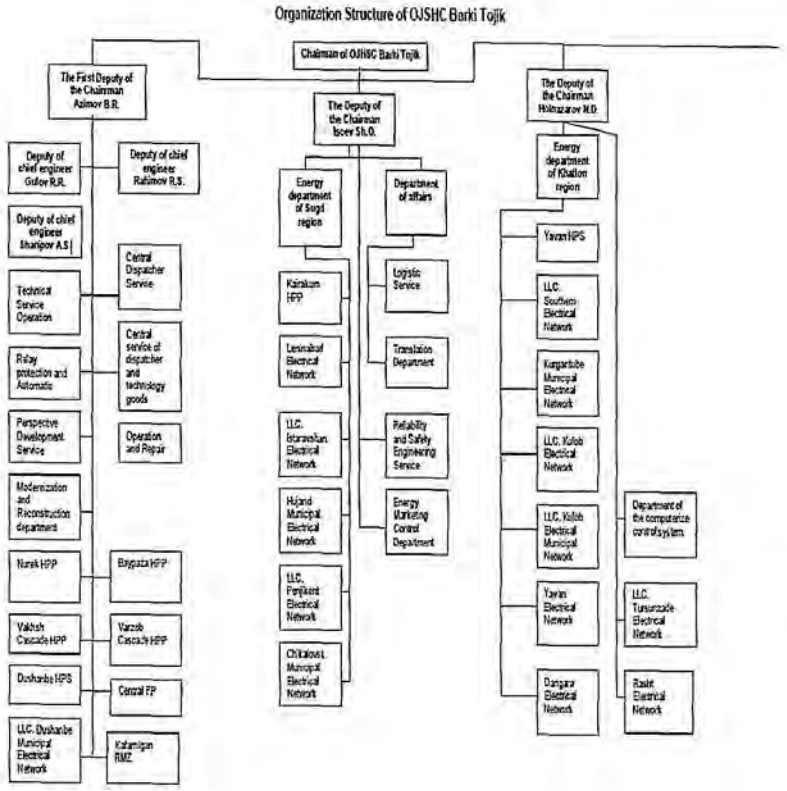
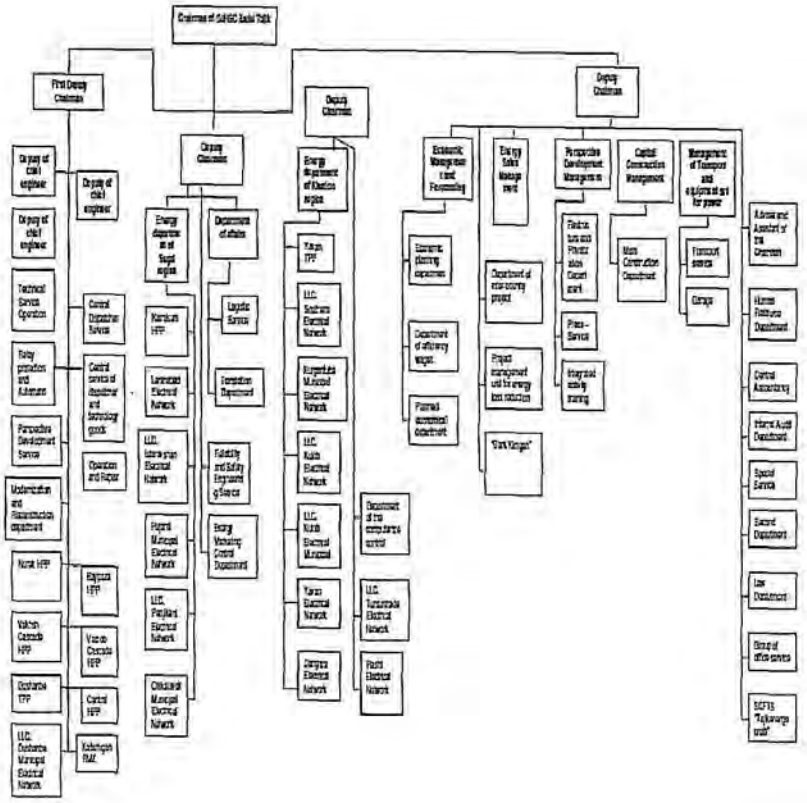
Organization Chart of Barki Tojik



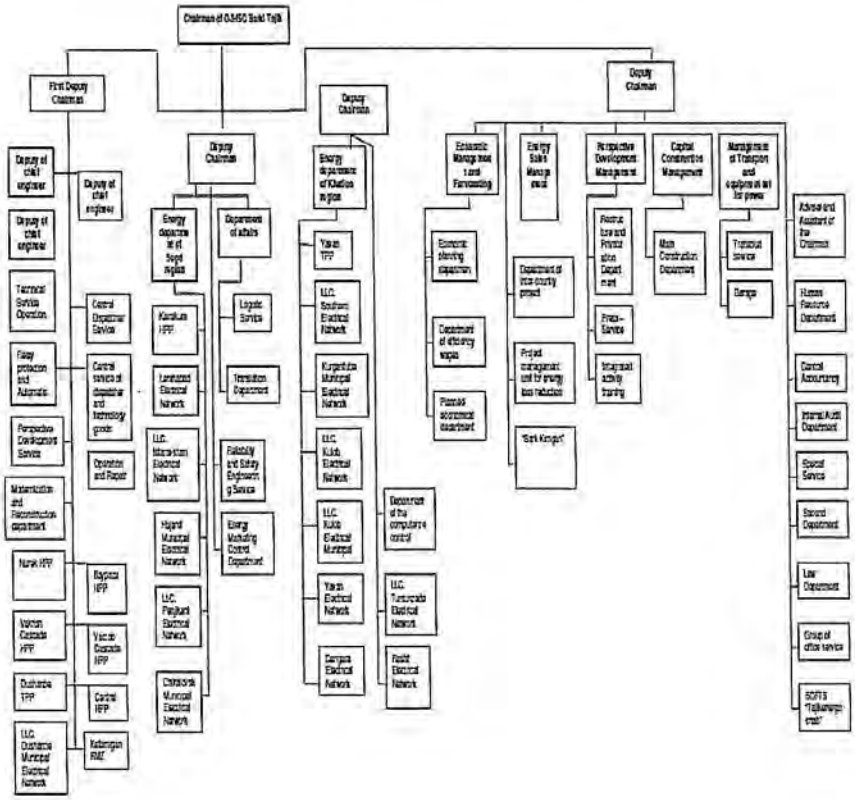
Annex A-2

Organization Structure of OJSHC Barki Tojik



Annex A-2

Organization Structure of OJSHC Barki Tojik



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).

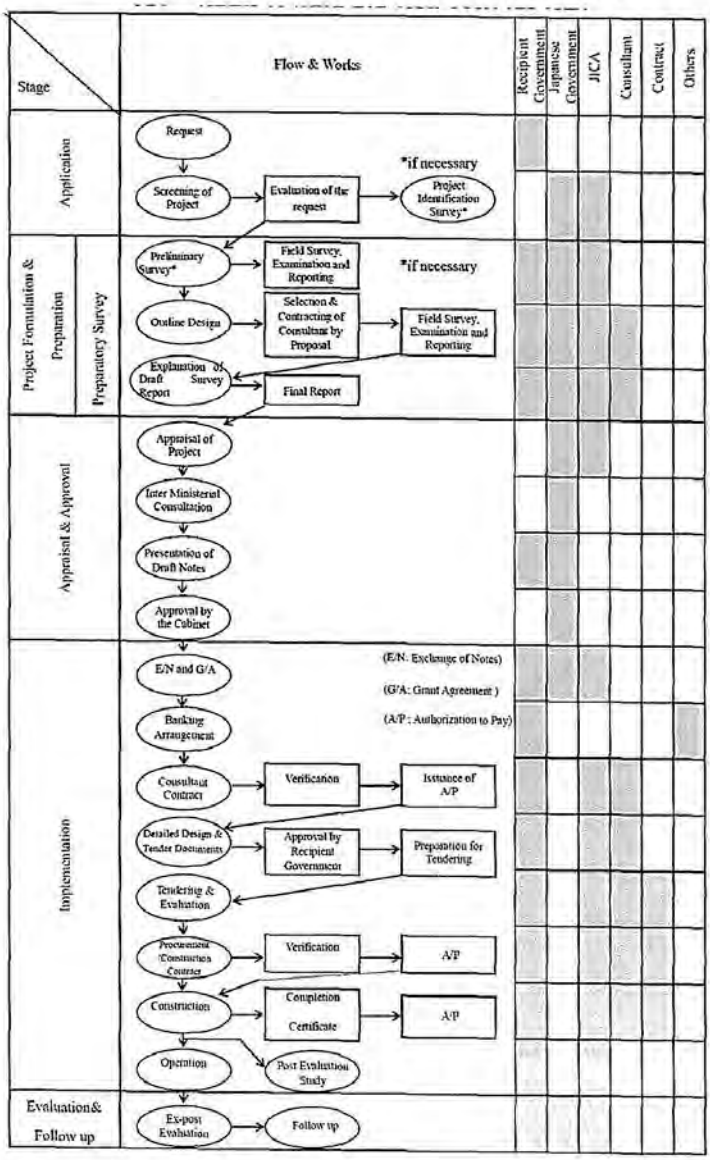
(12) Safety Measures

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

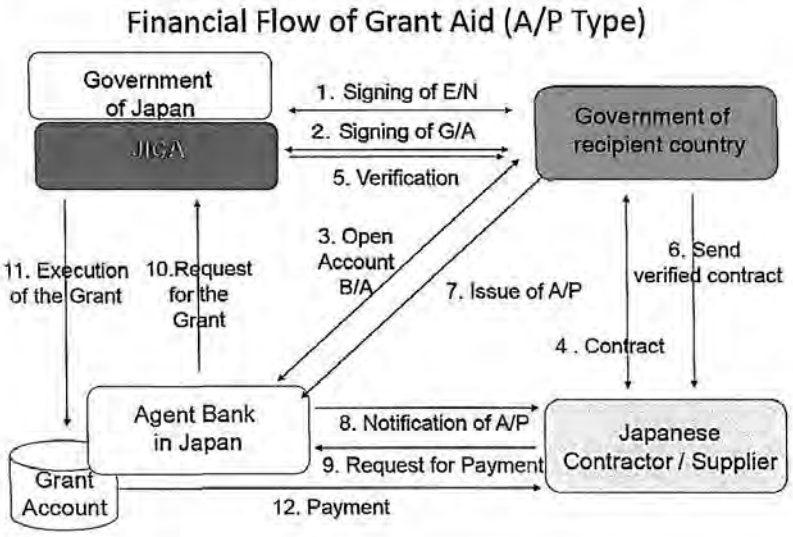
end

Annex 4

FLOW CHART OF JAPANESE GRANT PROCEDURES



Annex 5


Financial Flow of Grant Aid (A/P Type)
Government of Japan
JICA
1. Signing of E/N
2. Signing of G/A
5. Verification
Government of recipient country
11. Execution of the Grant
10.Request for the Grant
3. Open Account B/A
7. Issue of A/P
6. Send verified contract
4 . Contract
Agent Bank in Japan
8. Notification of A/P
9. Request for Payment
Japanese Contractor / Supplier
Grant Account
12. Payment

Annex 6

Major Undertakings to be taken by Recipient Government
(Tentative)

1. Before the Tender

NO	Items	Deadline	In charge	Cost	Ref.
1	To open Bank Account (Banking Arrangement (B/A))	within 1 month after G/A			
2	To approve IEE/EIA	within 1 month after G/A			
3	To implement EIA	before start of the construction			
4	To secure the following lands	before notice of the tender document			
5	To obtain the planning, zoning, building permit	before notice of the tender document			
6	To clear, level and reclaim the following sites	before notice of the tender document			
7	To submit the result of DD	end of DD			

2. During the Project Implementation

NO	Items	Deadline	In charge	Cost	Ref.
1	To bear the following commissions to a bank of Japan for the banking services based upon the B/A				
	1) Advising commission of A/P	within 1 month after the singing of the contract			
	2) Payment commission for A/P	every payment			
2	To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country				
	1) Tax exemption and customs clearance of the products at the port of disembarkation	during the Project			
	2) Internal transportation from the port of disembarkation to the project site	during the Project			

3	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			
4	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. 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 respect to the supply of the products and services under the verified contract	during the Project			
5	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			
6	To submit Project Monitoring Report	during the Project			
7	To implement EMP and EMoP	during the construction			
	To submit results of environmental monitoring to JICA, by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report	during the construction			
	To implement RAP (livelihood restoration program, if needed)	for a period based on livelihood restoration program			
	To implement social monitoring, and to submit the monitoring results to JICA, by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report - Period of the monitoring may be extended if affected persons' livelihoods are not sufficiently restored. Extension of the monitoring will be decided based on agreement between implementation organization of Tajikistan and JICA.	- until the end of livelihood restoration program (In case that livelihood restoration program is provided) - *for two years after land acquisition and resettlement complete (In case that livelihood restoration program is not provided)*			

3. After the Project

NO	Items	Deadline	In charge	Cost	Ref.
1	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid 1) Allocation of maintenance cost 2) Operation and maintenance structure 3) Routine check/Periodic inspection	After completion of the construction			
2	To implement EMP and EMoP	for a period based on EMP and EMoP			
	To submit results of environmental monitoring to JICA, by using the monitoring form, semiannually - The period of environmental monitoring may be extended if any significant negative impacts on the environment are found. The extension of environmental monitoring will be decided based on the agreement between implementation organization of Tajikistan and JICA.	for three years after the Project			

(B/A: Banking Arrangement, A/P: Authorization to pay, N/A: Not Applicable)

Major Undertakings to be Covered by the Japanese Grant

No	Items	Deadline	Cost Estimated (Million Japanese Yen)*	
1	To construct xx facility and provide equipment			
	1) To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country			
	a) Marine(Air) transportation of the products from Japan to the recipient country		XX.XX	
	b) Internal transportation from the port of disembarkation to the project site			
	2) To construct facilities			
	3) To provide equipment with installation and commissioning			
2	To implement detailed design, tender support and construction supervision (Consultant)		YY.YY	
3	Contingencies		ww.ww	
	Total		ZZ.ZZ	

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

Annex 7

SAMPLE of Project Monitoring Report

Project Monitoring Report

on

Project Name

Grant Agreement No. XXXXXXX 20XX, Month

Organization Information

1) 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

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.

1-3 Effectiveness and the indicators

- Effectiveness by the project

Quantitative Effect (Operation and Effect indicators)		
Indicators	Original (Yr)	Target (Yr)
Qualitative Effect		

2: Project Implementation

2-1 Project Scope

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

Location	**Original:** *(M/D)* **Attachment(s):Map**	**Actual:** *(PMR)* **Attachment(s):Map**

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

Items	Original	Actual
(M/D)	*(M/D)*	*(PMR)*

'Soft component' shall be included in 'Items'.		Please state not only the most updated sc hedule but also other past revisions chron ologically. All change of design shal l be recorded regardless of its degree.

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

Items	Original	Actual
1. Primary and Secondary Surveillance Radars at Chittagong Int'l Airport	i) OSR/SSR 1 set ii) RDP 1 set iii) VHF Transmitters 2 sets	Ditto
2. Access Control System for Dhaka Int'l Airport	1 set	Ditto
3. Doppler VOR/DME at Saidpur Airport	1 set	Ditto
4. Aerodrome Simulator for Civil Aviation Training Center	1 set	Ditto
5. Baggage Inspection System for Dhaka Int'l Airport	i) Hold Baggage Xray Inspectin system 7sets ii) Hold Baggage Explosive Trace Detecting System 7sets iii) Cabin Baggage Xray Inspection System 2sets	Ditto
6. Airport Fire Fighting Vehicles for Dhaka Int'l Airport	2 sets	3 sets

2-1-2 Reason(s) for the modification if there have been any.

(PMR)

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	
[M/D]	*(M/D)*		*(PMR)* As of (Date of Revision)
'Soft component' shall be stated in the column of 'Items'.			Please state not only the most updated schedule but also other past revisions chronologically.
Project Completion Date*			

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

(Sample)Table 2-2-1: Comparison of Original and Actual Schedule

Items	Original		Actual
	DOD	G/A	
Cabinet Approval	11/2015	-	-
E/N	12/2015	1/2016	24/1/2016
G/A	12/2015	1/2016	24/1/2016 Amended 13/3/2017
Detailed Design	12/2015-4/2016	1/2016-5/2016	1/2016-5/2016
Tender Notice	5/2016	5/2016	1/6/2016
Tender	6/2016	6/2016	15/7/2016
(Lot1) Construction Period	7/2016-11/2018	7/2016-11/2018	8/8/2016-30/11/2018
(Lot2) Installarion of Equipement	7/2016-6/2018	7/2016-6/2018	6/8/2016-30/60/2017
Project Completion Date	11/2018	11/2018	30/11/2018
Defect Liability Period	11/2019	11/2019	30/11/2019

*Project Completion was defined as Check-out of Construction work 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.

2-3-3 Report on RD

See Attachment 4.

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 (or Equipment)	'Soft component' shall be included in 'Items'.			Please state not only the most updated schedule but also other past revisions chronologically.
Consulting Services	- Detailed design -Procurement Management -Construction Supervision			
Total				

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 XX

Items	Cost (Million USD)

	Original	Actual	Original	Actual
				Please state not only the most updated schedule but also other past revisions chronologically.
Total				

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

(Sample)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[1),2)]	Actual
Construction Facilities	1. Outpatient Department 2. Operation Theatre, Casualty Unit, Maternity Ward	Ditto Ditto	[redacted]	[redacted]
Equipment	1) Primary and Secondary Surveillance Radars at Chittagong Int'l Airport 2) Access Control System for Dhaka Int'l Airport 3) Doppler VOR/DME at Saidpur Airport 4) Aerodrome Simulator for	Ditto	[redacted]	[redacted]

別添-47

	Civil Aviation Training Center 5) Baggage Inspection System for Dhaka Int'l Airport 6) Airport Fire Fighting Vehicles for Dhaka Int'l Airport			
Consulting Services	- Detailed design -Procurement Management -Construction Supervision -Soft Component	Ditto	[redacted]	[redacted]
Total			[redacted]	[redacted]

Note: 1) Date of estimation: October, 2014
2) Exchange rate: 1 US Dollar = 99.93 Yen

(Sample)Table 2-4-1b Comparison of Original and Actual Cost by the Government of Bangladesh

Items			Cost (1,000 Taka)	
	Original	Actual	Original[1)-2)]	Actual
Dhaka International Airport	Modification of software of existing Rader Data Processing System	Ditto	[redacted]	[redacted]
	Provision of a partition, lighting, air conditioning and electric power supply at transfer hold baggage check point	Ditto	[redacted]	[redacted]
	Replacement of five doors in the international passenger terminal building	Ditto	[redacted]	[redacted]
Chittagong Int'l Airport	Preparation of the radar site including felling of trees, clearing and grabbing	Ditto	[redacted]	[redacted]
Total			[redacted]	[redacted]

Note: 1) Date of estimation: October, 2014

2) Exchange rate: 1 US Dollar = 0.887 Bangladesh Taka (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)*
Actual, if changed: *(PMR)*

2-6 Environmental and Social Impacts

- The results of environmental monitoring as attached in Attachment 5 in accordance with Schedule 4 of the Grant Agreement.
- The results of social monitoring as attached in Attachment 5 in accordance with Schedule 4 of the Grant Agreement.
- Information on the disclosed results of environmental and social monitoring to local stakeholders, whenever applicable.

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)*
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%)	

4-2. Minutes of Discussions (M/D2)

Minutes of Discussions
on the Preparatory Survey for
the Project for Improvement of Substation Facilities in Dushanbe
in the Republic of Tajikistan

(Explanation on Draft Preparatory Survey Report)

With reference to the minutes of discussions signed between Ministry of Energy and Water Resources (hereinafter referred to as "MoEWR") and Barki Tojik (hereinafter referred to as "BT") and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on 30 June, 2016 and in response to the request from the Government of Tajikistan (hereinafter referred to as "GOT") dated August, 2014, JICA dispatched the Preparatory Survey Team (hereinafter referred to as "the Team") for the explanation of Draft Preparatory Survey Report (hereinafter referred to as "the Draft Report") for the Project for Improvement of substation facilities in Dushanbe in the Republic of Tajikistan (hereinafter referred to as "the Project"), headed by Mr. Kazunari OSHIMA,Senior Advisor, Industrial Development and Public Policy Department, JICA from 9 to14,January, 2017.

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

Dushanbe, 14 January, 2017

Kazunari OSHIMA
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Usmonali USMONZODA
Minister
Ministry of Energy and Water Resources
Republic of Tajikistan

Mirzo ISMOILZODA
Chairman
Open Joint Stock Holding Company
Barki Tojik
Republic of Tajikistan

ATTACHEMENT

1. Objective of the Project
The objective of the Project is to improve sustainability of stable and efficient power supply in Dushanbe city by rehabilitation of Promishlennaya substation and construction of new Radiostansiya substation, thereby contributing to social and economic development of the Republic of Tajikistan.

2. Title of the Preparatory Survey
Both sides confirmed the title of the Preparatory Survey as "the Preparatory Survey for the Project for "Improvement of substation facilities in Dushanbe in the Republic of Tajikistan".

3. Project site
Both sides confirmed that the sites of the Project are in Dushanbe city, which is shown in Annex 1.

4. Contents of the Draft Report
After the explanation of the contents of the Draft Report by the Team, the Tajikistan side agreed to its contents.

5. Cost estimate
Both sides confirmed that the cost estimate including the contingency described in the Draft Report is provisional and will be examined further by the Government of Japan for its approval. The contingency would cover the additional cost against natural disaster, unexpected natural conditions, etc.

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

7. Timeline for the project implementation
The expected timeline for the project implementation is as attached in Annex 3.

8. Expected outcomes and indicators
Both sides agreed that key indicators for expected outcomes are as follows. The Tajikistan side will be responsible for the achievement of agreed key indicators targeted in year 2022 and shall monitor the progress based on those indicators.
[Quantitative indicators]
- Promishlennaya substation: Increace the capacity of transformer (MVA) and the amout of capable power supply (MWh/year)
- Radiostantsiya substation: Increace the capacity of transformer (MVA) and the amout of capable power supply (MWh/year)
- Reduce the number of power outages which are caused by over load of transformers in the area where Promishlennaya substation and Radiostansiya substation supply electricity.

[Qualitative indicators]
- The quality (Frequency and Voltage level) of power supply in Dushanbe is improved.
- The economic and social development in Dushabe is promoted.

9. Undertakings of the Project

Both sides confirmed the undertakings of the Project as described in Annex 4. With regard to exemption of customs duties, internal taxes and other fiscal levies as stipulated in 4 of Annex 4, both sides confirmed that such customs duties, internal taxes and other fiscal levies include VAT, and income tax, which shall be clarified in the bid documents by BT during the implementation stage of the Project.

The Tajikistan side assured to take the necessary measures and coordination including allocation of the necessary budget by BT 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.

Both sides also confirmed that the Annex 5 will be used as an attachment of G/A.

10. Monitoring during the implementation

The Project will be monitored by the Executing Agency (BT) under the leadership and surpervison of MoEWR and reported to JICA by using the form of Project Monitoring Report (PMR) attached as Annex 5. The timing of submission of the PMR is described in Annex 4.

11. Project completion

Both sides confirmed that the project completes when all the facilities constructed and equipment procured by the grant are in operation. The completion of the Project will be reported to JICA promptly, but in any event not later than six months after completion of the Project.

12. Ex-Post Evaluation

JICA will conduct ex-post evaluation after three (3) years from the project completion, in principle, with respect to five evaluation criteria (Relevance, Effectiveness, Efficiency, Impact, Sustainability). The result of the evaluation will be publicized. The Tajikistan side is required to provide necessary support for the data collection.

13. Schedule of the Study

JICA will finalize the Preparatory Survey Report based on the confirmed items. The report will be sent to the Tajikistan side around April 2017.

14. Environmental and Social Considerations

14-1. Environmental Guidelines and Environmental Category

The Team explained that 'JICA Guidelines for Environmental and Social Considerations (April 2010)' (hereinafter referred to as "the Guidelines") is applicable for the Project. The Project is categorized as C because the Project is likely to have minimal adverse impact on the environment under the Guidelines.

15. Other Relevant Issues

15-1. Project compornent

The Tajikistan side understand that the Project will cover two out of three compornents which the Tajikistan side requested in "Application Form for Grant Aid". The Tajikistan side requested the team to conduct continuously the study to formulate new cooperation project to overcome vulnerability of stable power supply in Dushanbe city as soon as possible. The team took note of this request and report JICA Head Quarters.

15-2. Tax exemption

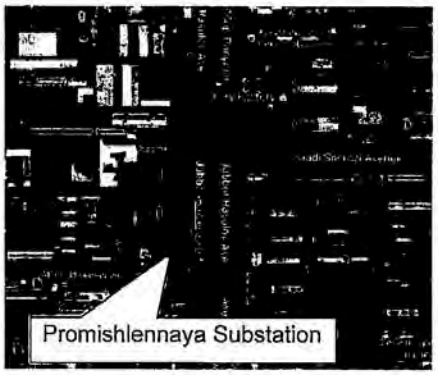
The Tajikistan side suggested that the Grant Agreement should mention tax exemption again.

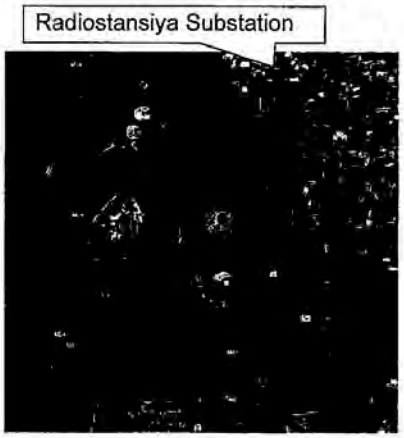
15-3 Disclosure of Information

Both sides confirmed that the Preparatory Survey Report from which project cost is excluded will be disclosed to the public after completion of the Preparatory Survey. The comprehensive report including the project cost will be disclosed to the public after all the contracts under the Project are concluded.

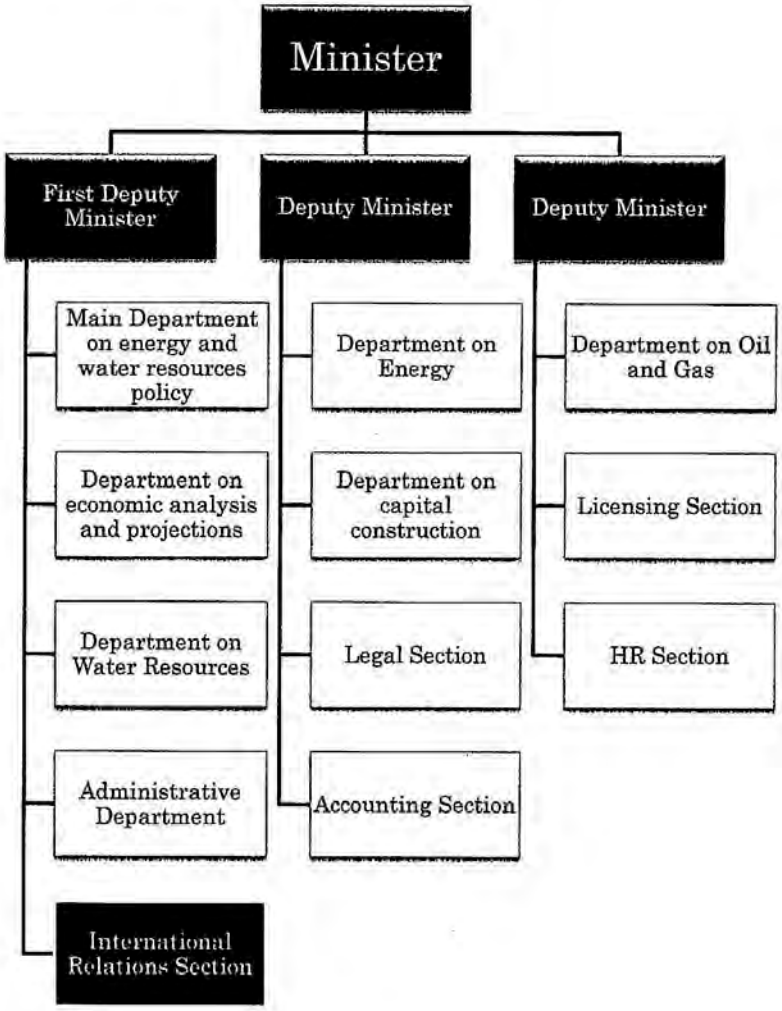
Annex 1 Project Site
Annex 2 Organization Chart
Annex 3 Project Implementation Schedule
Annex 4 Major Undertakings to be taken by the Government of Tajikistan
Annex 5 Sample of Project Monitoring Report

Annex 1 Project Site

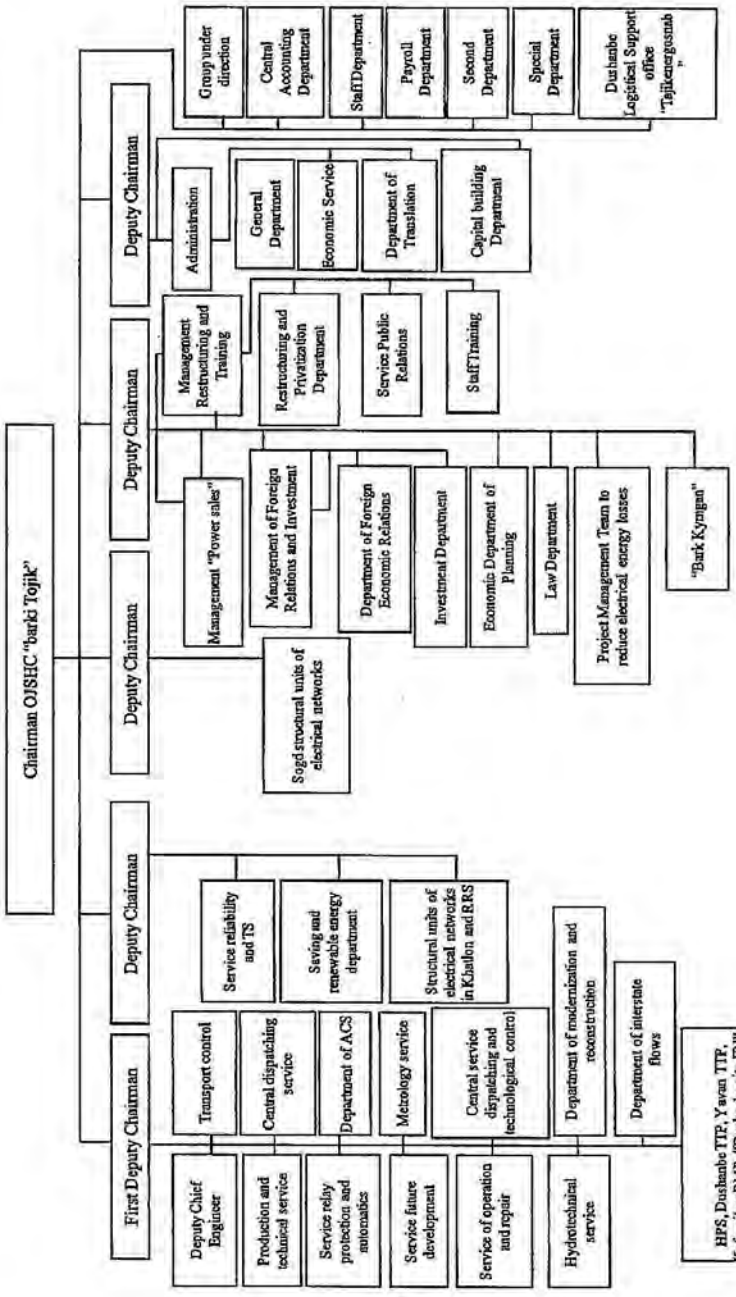




Annex 2
Organization Chart of Ministry of Energy and Water Resources



Organization Chart of Barki Tojik



Annex 3. Timeline for the project implementation

Year	2017	2018	2019	2020
① Detail Design	May — Oct			
② Procurement Supervision	Oct —	—	— March	
③ One Year Inspection				— March

Annex 4

Major Undertakings to be taken by Government of Tajikistan

1. Specific obligations of the Government of Tajikistan which will not be funded with the Grant
(1) Before the Tender

NO	Items	Deadline	In charge	Cost (Thousand TJS)	Ref.
1	To open Bank Account (Banking Arrangement (B/A))	within 1 month after G/A	MOF		
2	To issue Authorization to Pay (A/P) to a bank in Japan (the Agent Bank) for the payment to the consultant	within 1 month after the signing of the contract	MEWR BT		
3	To secure and clear the following project sites				
	1) Promishlennaya Substation To secure the space for equipments that the Project will install and the temporary storage space for existing equipments that the Project will remove in Promishlennaya Substation	before notice of the bidding document	BT		
	2) Radiostansiya Substation To clear, level and reclaim the Radiostantsiya substation site	within 3 months after the signing of G/A	BT	[redacted]	
4	To obtain the planning, zoning, building, electricity, telephone, water supply, sewage permit	before notice of the tender document	BT		
5	To construct access roads to Radiostantsiya substation	before notice of the tender document	BT		
6	To draw electrical power supply cable to Radiostantsiya substation for the construction	before the start of construction	BT		
7	To submit Project Monitoring Report (with the result of Detail Design)	before preparation of bidding documents	BT		

(2) During the Project Implementation

No.	Items	Deadline	In charge	Cost (Thousand TJS)	Ref.
1	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the Supplier(s)	within 1 month after the signing of the contract(s)	MEWR BT		
2	To bear the following commissions to a bank of Japan for the banking services based upon the B/A		BT	[redacted]	
	1) Advising commission of A/P	within 1 month after the singing of the contract	BT		
	2) Payment commission for A/P	every payment	MoF	* equivalent to 0.1% of total payment	
3	To ensure prompt customs clearance and to assist the Supplier(s) with internal transportation in recipient country	during the Project	BT		
4	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	BT		
5	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. 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 respect to the supply of the products and services under the verified contract	during the Project	BT		
6	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	BT	[redacted]	
	1) To boost up 35kV existing transmission lines to 110kV at Radiostansiya	By the end of August, 2018			
	2) To connect the 110kV transmission lines to the small tower set up by the Project side at Radiostansiya	By the end of August, 2018			
	3) To remove the transmission lines between 35kV tower and the 110kV tower boosted up at Radiostansiya	By the end of August, 2018			
	4) To connect water supply and sewage system to Radiostansiya and Promishlennaya	By completion of building construction			
	5) To connect telephone line for electricity power security to Radiostansiya and Promishlennaya	By completion of building construction			
7	To submit Project Monitoring Report	during the Project	BT		
8	1) To submit Project Monitoring Report after each work under the contract(s) such as shipping, hand over, installation and operational training	within one month after completion of each work	BT		
	2) To submit Project Monitoring Report (final)	within one month after signing of Certificate of Completion for the works under the contract(s)	BT		
9	To submit a report concerning completion of the Project	within six months after completion of the Project	BT		

(3) After the Project

NO	Items	Deadline	In charge	Cost (Thousand TJS)	Ref.

1	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid 1) Allocation of maintenance cost 2) Setting up operation and maintenance structure 3) Routine check/Periodic inspection	After completion of the construction	BT		

(B/A: Banking Arrangement, A/P: Authorization to pay, N/A: Not Applicable)

2. Other obligations of the Government of Tajikistan funded with the Grant

NO	Items	Deadline	Amount (Million Japanese Yen)*
1	To rehabilitate deteriorated Promishlennaya substation and construct Radiostansiya substation and provide equipment i) To conduct the following transportation a) Marin (Air) transportation of the products from Japan to Tajikistan b) Internal transportation from the port of disembarkation to the project site	March, 2019	
	2) To provide equipment with installation and commissioning		
2	To implement detailed design, bidding support and procurement supervision (Consulting Service)		
	Total		[redacted]

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

Annex 5

SAMPLE of Project Monitoring Report

Project Monitoring Report

on

The Project for Improvement of Substation Facilities in Dushanbe

Grant Agreement No. XXXXXXX 20XX, Month

Organization Information

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

Outline of Grant Agreement:

Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of Tajikistan: _____
Project Title	The Project for Improvement of Substation Facilities in Dushanbe
E/N	Signed date: Duration:
G/A	Signed date: Duration:

1: Project Description

1-1 Project Objective

The objective of the Project is to improve sustainability of stable and efficient power supply in Dushanbe city by rehabilitation of Promishlennaya substation and construction of Radiostansiya substations, thereby contributing to social and economic development of Tajikistan.

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.

1-3 Effectiveness and the indicators

- Effectiveness by the project

Quantitative Effect (Operation and Effect indicators)			
Indicators		Original (Yr)	Target (Yr)
Promishlennaya substation	Increace the capacity of transformer (MVA)		
	Increace the amout of capable power supply (MWh/year)		
Radiostantsiya substation	Increace the capacity of transformer (MVA)		
	Increace the amout of capable power supply (MWh/year)		
Reduce the number of power outages which are caused by over load of transformers in the area where Promishlennaya substation and Radiostantsiya substation supply electricity			
Qualitative Effect			
The quality (Frequency and Voltage level) of power supply in Dushanbe is improved. The economic and social development in Dushabe is promoted.			

2: Project Implementation

2-1 Project Scope

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

Location	**Original:** *(M/D)* **Attachment(s):Map**	**Actual:** *(PMR)* **Attachment(s):Map**

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

Items	Original	Actual
1.Promishlennaya	· Transformer (110/35/10kV 40/20/40MVA) · Circuit Breaker (110kV Gas(SF6) Circuit Breaker Type: 3-pole,Outdoor use,) · Disconnector Switch (Type: 3-Pole, Outdoor use) · 35kV Switchgear Indoor Cubicle type · 10kV Switchgear Indoor Cubicle type · Protection and control equipment · DC power supply system AC440V/DC220V, 200Ah	
2. Radiostantsiya	· Transformer (110/35/10kV 40/20/20MVA) · Circuit Breaker (110kV Gas(SF6) Circuit Breaker Type: 3-pole,Outdoor use,) · Disconnector Switch (Type: 3-Pole, Outdoor use) · 35kV Switchgear Indoor Cubicle type · 10kV Switchgear Indoor Cubicle type · Protection and control equipment · DC power supply system AC440V/DC220V 200Ah · One one-story building 210m2 · Two one-story buildings 230m2 for 10kV switchgear and 48m2 for 35kV switchgear	

2-1-2 Reason(s) for the modification if there have been any.

(PMR)

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	
Cabinet Approval	3/2017		-
E/N	4/2017		
G/A	4/2017		
Detailed Design	5/2017-10/2017		
Tender Notice	10/2017		
Tender	10/2017		
Installarion of Equipement	10/2017-4/2019		
Project Completion Date	4/2019		
Defect Liability Period	4/2020		

*Project Completion was defined as Check-out of Construction work 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.

2-3-3 Report on RD
See Attachment 4.

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
Equipment	1.Promishlennaya Transformer			

	(110/35/10kV 40/20/40MVA) ・Circuit Breaker (110kV Gas(SF6) Circuit Breaker Type: 3-pole,Outdoor use,) ・Disconnector Switch (Type: 3-Pole, Outdoor use) ・35kV Switchgear Indoor Cubicle type ・10kV Switchgear Indoor Cubicle type ・Protection and control equipment ・DC power supply system AC440V/DC220V 200Ah ・Two one-story buildings 230m2 for 10kV switchgear and 48m2 for 35kV switchgear 2.Radiostantsiya ・Transformer (110/35/10kV 40/20/20MVA) ・Circuit Breaker (110kV Gas(SF6) Circuit Breaker Type: 3-pole,Outdoor use,) ・Disconnector Switch (Type: 3-Pole, Outdoor use) ・35kV Switchgear Indoor Cubicle type ・10kV Switchgear Indoor Cubicle type ・Protection and control equipment ・DC power supply system AC440V/DC220V 200Ah ・One one-story building 210m2			
Consulting Services				
Total				

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

Items			Cost (Million USD)	
	Original	Actual	Original	Actual
Total				

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)*

Actual, if changed: *(PMR)*

2-6 Environmental and Social Impacts

- The results of environmental monitoring as attached in Attachment 5 in accordance with Schedule 4 of the Grant Agreement.

- The results of social monitoring as attached in Attachment 5 in accordance with Schedule 4 of the Grant Agreement.
- Information on the disclosed results of environmental and social monitoring to local stakeholders, whenever applicable.

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)*
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 Record of Discussions
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)

Attachment 6

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
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: Confirmation Note (C/N)

Appendix 5: Confirmation Note (C/N)

5-1 Confirmation Note (C/N1)

Confirmation Note

on the Preparatory Survey

for the Project for Rehabilitation of Substations in Dushanbe

in Republic of Tajikistan

(First Field Survey)

In response to the request from the Government of the Republic of Tajikistan for Japanese Technical Cooperation on the Project for Rehabilitation of substations in Dushanbe (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 June, 2016 to survey the Project feasibility in Barki Tojik (hereinafter refer to as "BT") under relevant agencies surrounding BT such as Dushanbe Power Grid and Committee for Environmental Protection (hereinafter refer to as "CEP"), and the line agency i.e. Ministry of Energy and Water Resources (hereinafter refer to as "MoEWR")

The first field survey was mainly implemented to discuss the Project feasibility, and confirm the request of general specification of the substations from June 2nd to July 6th, 2016. As a result of the discussions, the contents of agreed and confirmed topics are described in the Confirmation Note hereby. If any discrepancy occurs between English and Russian versions, then English version shall prevail.

Dushanbe, July 6, 2016

Sharipov Rezvon
Planning & Technology Manager
Barki Tojik

Kazuyoshi Mori
Team Leader
JICA Expert

Khalimov Rajabali Mirovich
First Executive Director
Barki Tojik

1. Items requested by the Government of Tajikistan

Both sides confirmed the request from Tajikistan side for specifications of the substations as follows

1-1. Rehabilitation of Promishlenaya SS

The requested items are as follows. Please refer to the annex 1. "Layout Drawing (hereinafter refer to as "DWG") Promishlenaya", the annex 2. "Single Line DWG Promishlenaya A", and the annex 3. "Single Line DWG Promishlenaya B" for details.

- 110kV AIS
- 110/35/10kV transformer
- 35kV GIS (SF6) and 10kV indoor switch gears (changed)
- Control room

1-2.Construction of Glavpochtamt SS

The requested items are as follows. Please refer to the annex 4. "Layout DWG Glavpochtamt" and the annex 5. "Single Line DWG Glavpochtamt" for details.

- 110kV AIS
- Two 110/10/6kV (three-winding) 25MVA transformers Although two 110/6kv 16MVA transformers were requested in the request letter from the government of Tajikistan. (Changed)
- 10kV and 6kV outdoor switch gears IN PREMISES
- Control room
- Transmission line from Glavnaya to Glavpochtamt

(110kV (two-lines about 1.7km /underground cable) (Changed)

Please refer to the annex 6. "Layout DWG Glavnaya" and the annex 7. "Single Line DWG Glavnaya" for details.

1-3.Construction of Radiostansiya SS

The requested items are as follows. Please refer to the annex 8. "Layout DWG Radiostansiya" and the annex 9. "Single Line DWG Radiostansiya" for details.

- 110kV AIS
- Two 110/35/10kV (three-winding) 40MVA transformers Although two *110/6kv 16MVA** transformers were requested in the request letter from the government of Tajikistan. (Changed)
- 35kV and 10kV outdoor switch gears IN PREMISES
- Control room

・Barki Tojik is in charge of implementing voltage boost to 110kV (Changed)

**Note: Recommendation – Since the connection of "Radiostansiya" SS is going to be made from the transmission line 35kV "L-2G-1 and L-2G-2" [DTES-2 (Dushanbe Heat Power Plant) – "Glavnaya" SS], taking into account the voltage boost of PTL 35kV to 110kV, 35/6kV "Centralnaya" SS will be left without power supply. At the present time, 35/6kV "Centralnaya" SS is supplied through these lines, and it has two transformers, 2 x 16 MVA, which operate at 80÷85% of the load level. Hereby, the construction of 110/6kV SS in this area, with two transformers, each with capacity of 16 MVA, is considered to be not effective. Taking into account the existing loads of 35/6kV "Centralnaya" SS, and the rapid increase in the power demand in this area, the following option is offered for consideration and implementation.*

1-4.Environmental and Social consideration

・Decision No. 253 categorizes a project into category Ⅰ, Ⅱ, Ⅲ or Ⅳ in relation to damage to the environment. Decision No. 509 shows an environmental damage assessment procedure as below

Decision No. 509

		・EIA Program ・EIA Report ・Stakeholder Meeting	Section Environmental Protection	Statement of EIA	Impact	Example (Construction of)
CATEGORY	Ⅰ	○	—	—	Much ↑ Less	・Express way
	Ⅱ	—	○	—		・Local Roads
	Ⅲ	—	○	—		・Grain Storage Plant
	Ⅳ	—	—	○		・Bread Making Factory
Days to assess		○ 60days	○ 30days	○ 30days		
JICA		Category A	Category B	Category C		
		EIA	IEE	—		

EIA : Environmental Impact Assessment

IEE : Initial Environmental Examination

・Construction of substation is categorized into the category Ⅱ and rehabilitation of substation is categorized into the category Ⅲ.

2. Data requested to be submitted

Both sides confirmed data requested and time limit as below

No.	Item	Questioner	Respondent	Time Limit
1	1)SCADA System Diagram 2)Kind of Signal for SCADA Remote Terminal Unit (Ex : Current, Power, Voltage and so forth)	Mori and Yoshida	Khalimov Rajabali Mirovich	7/15
2	Financial report of BT and information of budget for management and maintenance of the substations	Mori and Suzuki	Yakhyoev Parviz	7/15
3	Demand prediction for the substations after 2013	Mori and Fukui	Ghiyosov Abduvahob	7/15
4	1)Department which is in charge of tax exemption for imports and local items 2) The procedure of tax exemption	Mori and Suzuki	Yakhyoev Parviz	7/15

3. Survey Schedule

Both sides confirmed Survey Schedule as below

3-1 Survey Plan for the substations and, environmental and social consideration

Promishlenaya substation
・The team discusses method of rehabilitation, duration and work schedule with the minimum duration of power failure.
Glavpochtamt substation site
・The team will implement geological survey to ensure that foundations to support heavy facilities such as transformer can be safely constructed in July. ・The team will discuss method and cost of laying underground type cable. ・The team will discuss necessity and validity of installing two 110/10/6kV(three-winding) 25MVA transformers instead of two 110/6kV 16MVA transformers by considering power demand prediction and lineage system analysis.
Radiostansiya substation site
・The team will implement geological survey to ensure that foundations to support heavy facilities such as transformer can be safely constructed in July. ・The team will discuss method, duration and work schedule of constructing foundation.

・The team will discuss necessity and validity of installing two 110/35/10kV(three-winding) 40MVA transformers instead of two 110/6kV 16MVA transformers by considering power demand prediction and system analysis. ・Barki Tojik is going to implement voltage boost for overhead power line 35kV from "Karamova" SS to the connection point of "Radiostansiya" SS to 110kV.
Environment and social consideration
・The team will inform some recommended project designs to MoEWR by the end of August at the latest.[1] ・The CEP is going to assess some recommended project designs, including zero option. ・The team will prepare the environment and social consideration report which includes environment impact assessment. ・The team will discuss and prepare necessary information and project impact (reduced loss electricity: GWh) for the three substations by the end of July in order for the CEP to assess some recommended project designs in terms of environmental damage during construction and after the substations start to operate. ・A project in the category I needs to hold Stakeholder Meeting[2], whereas the project does not need to hold Stakeholder Meeting according to Decision No. 509. However, M/D between JICA and MoEWR requires MoEWR to start preparing Stakeholder Meeting in June. ・The team will inform some recommended project designs to MoEWR with consent of people concerned by the end of August at the latest to ensure that MoEWR holds Stakeholder Meeting in October 2016 because Stakeholder Meeting is going to be held at the same period of obtaining environmental approval and MoEWR needs to advertise it in television and newspaper.

[1] Because MoEWR needs 30 days to prepare documents for applying environment approval.
[2] Advertising Stakeholder Meeting needs much time and effort to let people concerned to know schedule and a result of Stakeholder meeting through TV and newspapers.

3-2 Survey Schedule afterward

Month	Place	Item
Jul.	Tajikistan	・Obtaining data and answers to the questionnaires from MoEWR and Barki Tojik by visiting and phone call. ・Implementing geological survey (Boring investigation). ・Confirming the items on environmental and social consideration by signing a contract with local environmental consultant. ・Proposing and explaining some recommended project designs , including zero option and necessary information for environmental impact assessment such as outlines of the project, drawing of construction area including residents around, diagram of construct implementation, construction method, carry method of materials, material list, facility list and waste list. ・Proposing explanations and reasons of project impact (reduced loss electricity: GWh) for the three substations
	Japan	・Supporting MoEWR to hold Stakeholder meeting which should take place in October. ・Obtaining data from MoEWR and Barki Tojik by E-mail and phone call. ・Obtaining quotation from local civil engineering and electric construction company
Aug.	Tajikistan	・Obtaining data, if left unanswered in July, from MoEWR and Barki Tojik by visiting and phone call. ・Revisiting the substations.
	Japan	・Setting the specification for main facility, obtaining quotation from Japanese manufacturer for it, and estimating costs. ・The first design verification ・Estimating outline costs, including local equipment.
Sep.	Tajikistan	
	Japan	・Estimating outline costs and holding verification council. ・Making preparatory survey report in Japanese and discussing it.
Oct.	Tajikistan	
	Japan	・Making draft final report of preparatory survey in Japanese and English and examining it.
Nov.	Tajikistan	
	Japan	・Sending draft final report of preparatory survey and outline costs of the project to Tajikistan. ・The second design verification.
Dec.	Tajikistan	・Explaining draft final report of preparatory survey to Tajikistan and discussing modifications and additional information.
	Japan	
Jan.~ Feb.	Tajikistan	
	Japan	・Making equipment specification and detailed statement of outline costs ・Competing final report of preparatory survey and submitting it to JICA

Annex List

Annex 1. Layout DWG Promishlenaya
Annex 2. Single Line DWG Promishlenaya A
Annex 3. Single Line DWG Promishlenaya B
Annex 4. Layout DWG Glavpochtamt
Annex 5. Single Line DWG Glavpochtamt
Annex 6. Layout DWG Glavnaya
Annex 7. "Single Line DWG Glavnaya
Annex 8. Layout DWG Radiostansiya
Annex 9. Single Line DWG Radiostansiya

5-2 Confirmation Note (C/N2)

Confirmation Note

on the Preparatory Survey

for the Project for Rehabilitation of Substations in Dushanbe

in Republic of Tajikistan

(Second Field Survey)

In response to the request from the Government of the Republic of Tajikistan for Japanese Grant Cooperation on the Project for Rehabilitation of substations in Dushanbe (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") to Second field survey in August, 2016 to survey the Project feasibility with Barki Tojik (hereinafter refer to as "BT") under relevant agencies surrounding BT such as Dushanbe Power Grid and Committee for Environmental Protection (hereinafter refer to as "CEP"), and the line agency i.e. Ministry of Energy and Water Resources (hereinafter refer to as "MoEWR")

The second field survey was conducted from August 21st to 27th, 2016.As a result of the discussions, the contents of agreed and confirmed topics are described in the Confirmation Note hereby.
If any discrepancy occurs between English and Russian versions, then English version shall prevail.

Dushanbe, October 20th, 2016

山本重成

Shigenari Yamamoto
Survey Team Leader
JICA Expert

Sharipov Rezvon
Planning & Technology Manager
Barki Tojik

Tajikistan side and Japanese side discussed mainly the five significant points as written below.

1. 110kV Cable

   Cable laying route options in question (Appendix 1) are Route I – through the so-called "Green Belt" that is strip of lawn, trees and bushes, along the automobile road in Khafiz Sherozi Street, down to cross-section with the main railway, and Route II – through the populated area. The parties concluded that in order to make final decision, as to cable laying route, it would be necessary to jointly discuss technical feasibility of the options for further operation, and make their economic comparison. To define the cable laying type, both parties have agreed on embedded method, vertically arranged, and inserting every single cable into flexible and protective PE pipes one by one. Manholes are to be installed in cable joint boxes.

2. The Number of Cubicles for Outgoing in Promishlennaya

   Japanese side is not going to supply 56 cubicles for outgoing in Promishlennaya, the number of which shall depend on the number of actually functioning cubicles at this substation. The Tajikistan side requested that in order to make final decision on the selection of the number of 10kV cubicles at Promishlennaya SS, BT and representatives of Dushanbe Power Grid would clarify the number of functioning 10kV cubicles taking into account two backup cubicles (two cubicles per each bus section). Besides, the Tajikistan side, having based on actual loads of power transformer windings at 10kV and 35kV side, requested the alteration of the rated capacity of power transformers specified in the project as below, in terms of the project budget. Both parties have agreed to continue discussing on this matter.

kV	110kV	35Kv	10kV
Previous Request	40MVA	16MVA	24MVA
Present Request	40MVA	20MVA	40MVA

   It means that the rated capacity of power transformer windings, Sн = 40000/20000/40000 kVA (100/50/100%).

3. Petersen Coil in Promishlennaya

   The Japanese side suggested that BT would use ground-fault protection relays instead of Petersen Coils. Both parties agreed that the Japanese side would send a document on details of Japanese digital type ground-fault protection relay operation, and the Tajikistan side would consider the necessity of Petersen Coil.

山本重成

с текстом Протокола переговоров

4. The Lightning/Surge Arresters between 110kV Underground Cable for switching surge protection

   The Japanese side explained unnecessary status of Lightning/Surge Arresters to the Tajikistan side from technical point of view. The Tajikistan side, keeping in mind the serious accident happened at new 500kV indoor gas-insulated switchgear at Nurek Hydropower Plant, because of absence of Lightning/Surge Arresters in cable lines, and in accordance with the Electric Installation Code (7th Edition), deemed that it would be obligatory to install Lightning/Surge Arresters in cable line connection terminals.

5. Priority for the Substations

   The Japanese side suggested starting, first, the construction of two new substations, 110/6-10kV Glavpochtamt and 110/35/10kV Radiostansiyat, and finally rehabilitate the existing substation Promishlennaya. On the contrary, the Tajikistan side proposed that we would rehabilitate, first, the existing substation Promishlennaya, and then build Radiostansiya considered to be crucially important facility to overcome the issue of overloading the existing power networks around it and significantly improving the power supply security in the city, and then get down to construction of Glavpochtamt SS. Taking this into consideration, both parties agreed to make maximum effort to start all the three substations at the same time by reducing project cost.

6. Power System Analysis Data

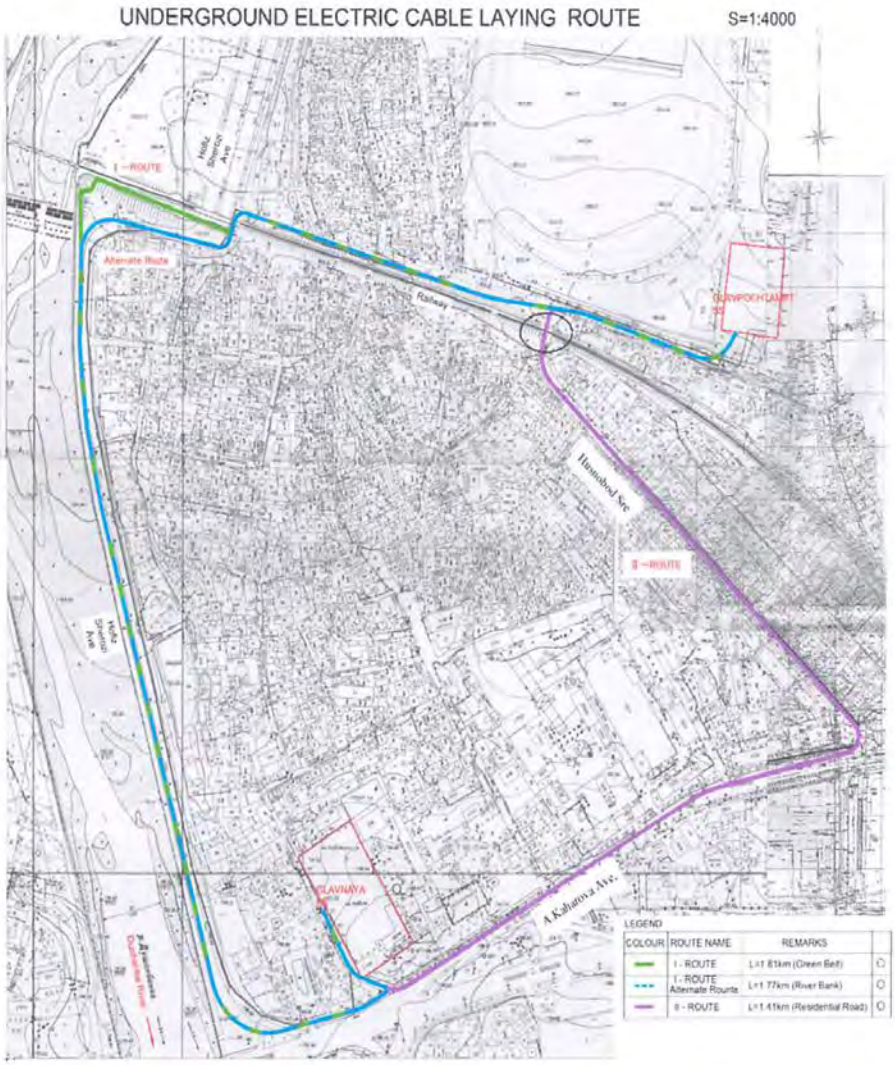
   The Tajikistan side is going to offer data on Circuit Breaker Operation Condition, Transformer, Power Load, and Generator Data.

山本重成

Appendix List

Appendix 1: 110kV UNDER GROUND ELECTRIC CABLE ROUTE

Appendix 1: UNDERGROUND ELECTRIC CABLE ROUTE


UNDERGROUND ELECTRIC CABLE LAYING ROUTE
S=1:4000
I -ROUTE
Alternate Route
Railway
II -ROUTE
Humboldt Ave
A.Kalinina Ave.
LEGEND
COLOUR
ROUTE NAME
REMARKS
I - ROUTE
L=1.81km (Green Belt)
I - ROUTE Alternate Rounte
L=1.77km (River Bank)
II - ROUTE
L=1.41km (Residential Road)

5-3 Confirmation Note (C/N3)

Confirmation Note

on the Preparatory Survey

for the Project for Rehabilitation of Substations in Dushanbe

in Republic of Tajikistan

(Third Field Survey)

In response to the request from the Government of the Republic of Tajikistan for Japanese Grant Cooperation on the Project for Rehabilitation of substations in Dushanbe (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") to Third field survey in October, 2016 to survey the Project feasibility with Barki Tojik (hereinafter refer to as "BT") under relevant agencies surrounding BT such as Dushanbe Power Grid and Committee for Environmental Protection (hereinafter refer to as "CEP"), and the line agency i.e. Ministry of Energy and Water Resources (hereinafter refer to as "MoEWR")

The Third field survey was conducted from October 17st to 21st, 2016.As a result of the discussions, the contents of agreed and confirmed topics are described in the Confirmation Note hereby.
If any discrepancy occurs between English and Russian versions, then English version shall prevail.

Dushanbe, October 20th, 2016

山本重成

Shigenari Yamamoto
Survey Team Leader
JICA Expert

Manuchekhr Safarov
Head of Department of Management Development & implementation investment projects in energy & water resources

Asozoda Mahmadumar
First Deputy Chairman of
Barki Tojik

Tajikistan side and Japanese side discussed mainly the five significant points as written below.

1. Both sides agreed to the Tajikistan side proposal which is the first, Rehabilitation of Promishlenaya substation, the second, newly construction of Radiostansiya substation and the third, newly construction of Glavpochtamt substation.

2. Both sides have agreed on transformer specifications in Promishlennaya and Radiostansiya as below.

Substation		Promishlennaya	Radiostansiya
Voltage		110kV/35kV/10kV	110kV/35kV/10kV
Capacity		40MVA/20MVA/40MVA	40MVA/20MVA/20MVA
Winding		Y-Y-Δ Y₀/Y/Δ	Y-Y-Δ Y₀/Y/Δ
Tap	110kV-19tap	115kV±~~9kV×1.28%~~ ±9×1.78%	
	35kV-5tap	38.5kV±2×2.5%	

3. Both sides have confirmed that both sides can complete all processes of rehabilitation for Promishlennaya by the end of the project period as shown in Appendix1 that Tajikistan side made.

4. Both sides have agreed on major undertakings to be implemented by BT as shown in Appendix2.

5. Both sides have agreed that both sides would set Japanese digital ground- fault protection relay operation instead of PC(Petersen Coil).

Confirmed by Yamamoto 21st October, 2016

山本重成

Steps of works implementation to change the transformers T-1 and T-2 at the 110/35/10kV Promishlennaya.

1. With the energy organization prepare a plan-scedule for dismantling works on the present equipment and installation of the new equipment;
2. Move the part of loading from the transformer No. 2 to the nearest electric substations and the part of loading to the transformer No.1. (these works shall be done in the lowest loading period – from April to September);
   Shut down the feeding of equipment, which is working on transformer No. 2 from the low (10kV), middle (35kV) and high (110kV) sides of loading with disconnected switch, shut down the feeding of the second circuit as well. Dismantling the power transformer T-2, 110kV equipment, 10kV bridge bus bar from the transformer`s input to the indoor switchgear-10kV building and 35kV bus bar cable to the input cubicle of the transformer No.1 at the outdoor switchgear-35kV;
3. Move the transformer No.2 and the equipment, which was dismantled, and materials to the place, inducted by the Customer;
4. Set of the new 110kV equipment, construct the new building indoor switchgear -10kV and 35kV, taking into the consideration the equipment complect, mounting and equipment regulation, taking into the consideration the second circuit;
5. Set up the new transformer No.2;
6. Mounting and the regulation of the power transformer, mechanic and electric checks of the equipment of high loud and equipment on the second circuit;
7. Start up the new transformer No.2;
8. Connect the 35kV and 10kV switchgears to the new transformer No 2;
9. Move the 10kV and 35kV loud to the new switchgears;
10. Works on dismountling of the other part of substation and mountling of the new equipment shall be done by the same scheme.

山本重成

Подтверждение договорённостей

О подготовительном исследовании по

Проекту восстановления электрических подстанций

в городе Душанбе в Республике Таджикистан

(Третье исследование на местах)

В ответ на запрос Правительства Республики Таджикистан о японской грантовой помощи по Проекту восстановления электрических подстанций в городе Душанбе (здесь и далее в тексте именуемого как «Проект»), в октябре 2016 года Японское агентство по международному сотрудничеству (здесь и далее в тексте именуемое как «JICA») направило в Таджикистан экспертную группу JICA (здесь и далее в тексте именуемая как «Группа») для проведения третьего исследования на месте с целью оценки осуществимости Проекта вместе с Барки Точик (здесь и далее в тексте именуемое как «БТ»), с привлечением таких заинтересованных организаций как Душанбинские городские электрические сети, Комитет по защите окружающей среды (здесь и далее в тексте именуемый как "КЗС»), и отраслевое министерство, то есть Министерство энергетики и водных ресурсов Республики Таджикистан (здесь и далее в тексте именуемое как «МЭВР»).

Третье исследование на месте было проведено с 17 октября по 21 октября 2016 года. В результате обсуждений, в настоящем документе о подтверждении договорённостей описывается содержание согласованных и подтверждённых вопросов.

В случае расхождений между английской и русской версиями документа, преимущественную силу имеет английская версия.

Душанбе, 20 октября 2016 года

山本重成

Ямамото Сигенари
Лидер исследовательской группы
Эксперт JICA

Сафаров Манучехр Баходурович
Начальник Департамента по управлению инвестиционными проектами в области энергетики и водных ресурсов

Асозода Махмадумар
Первый заместитель Председателя
ОАХК «Барки Точик»

Таджикская и японская стороны обсудили, в основном, нижеследующие пять пунктов.

1. Обе стороны согласились с предложенем Таджикской стороны, что первым этапом будет реализация реконструкции подстанции «Промышленная», вторым этапом – строительство подстанции «Радиостанция» и третьим – строительство подстанции «Главпочтамт».

2. Обе стороны пришли к соглашению по стоявшему ранее вопросу касательно технической характеристики трансформаторов ПС «Промышленная» и ПС «Радиостанция», как указано ниже.

Параметр		Промышленная	Радиостанция
Электронапряжение		110кВ/35кВ/10кВ	110кВ/35кВ/10кВ
Мощность		40MBA/20MBA/40MBA	40MBA/20MBA/20MBA
Соединение обмоток		Звезда/ звезда/ треугольник	Звезда/ звезда/ треугольник
Количество ответвлений	110кВ-19	115кВ ± 9кВ×1,28%±9 ×1,74%	
	35кВ-5	38.5кВ ± 2×2.5%	

3. Порядок проведения работ по реконструкционным работам на ПС «Промышленная» был составлен Таджикской стороной и указан в Приложении 1, было также проверено, что работы могут быть завершены в пределах сроках Проекта.

4. Были согласованы пункты обязанностей Таджикской стороны по настоящему Проекту, как указано в Приложении 2.

5. Было согласовано применение японского цифрового реле защиты от замыканий на землю на ПС «Промышленная» вместе с тем, что в рамках данного Проекта ЗРОМ устанавливаться не будет.

Confirmed by Yamamoto 21st, October 2016

山本重成

Порядок выполнения работ по замене трансформаторов: Т-1 и Т-2 на ПС 110/35/10 кВ «Промышленная»

1. Совместно с энергоснабжающей организации разработать график выполения демонтажных работ по действующему оборудованию и мантаж новых оборудовании;
2. Перевод нагрузки с трансформатора №1 на других ближайших электрических Подстанции и часть нагрузки на трансформатор №2 (данная работа должна выполняться в период минимальной нагрузки подстанции, т.е с апреля по сентябрь);
3. Отключения питания оборудований работающих на трансформаторе Т-1 со стороны низкого (10 кВ), среднего (35 кВ) и высокого (110 кВ) напряжения с видимым разрывом, а также отключение питания вторичных цепей. Демонтаж силового трансформатора Т-1 оборудования 110 кВ, шинного моста 10 кВ от ввода трансформатора то здании ЗРУ-10 кВ и шинопровода 35 кВ до ячейка ввода трансформаторов Т-2 на ОРУ-35 кВ;
4. Перенос трансформатора №1, 110 кВ демонтируемых оборудовании и материалов до место назначения Заказчиком;
5. Установка новых оборудований 110 кВ, строительство новой здании ЗРУ-10кВ и 35 кВ с учетом комплектации оборудовании, монтаж и наладки оборудовании с учетом вторичных цепей
6. -
7. Установка нового трансформатора №1
8. Мантах и наладка силового трансформатора, механическое и электрическое испытания оборудования высокого напряжения и оборудования на вторичных цепях;
9. Пуск нового трансформатора №1
10. Подсоединение распределителей 35кВ и 10кВ к новому трансформатору №1
11. Перевод нагрузки 10кВ и 35кВ на новые распределительные устройства
12. Работа по демонтажу второй части подстанции и монтаж новых оборудовании выполняется по аналогичной схеме

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番号 No **№ п/п**	負 担 事 項 Major undertaking to be implemented by BT **Обязательства стороны ОАХК «БТ»**	備 考 Notes **Примечания**
1 (Promishlenaya)	(1) 変圧器の敷地外への撤去 Removal of the transformers from the Project site **Перемещение трансформаторов за пределы площадки Проекта** Демонтаж оборудования вне площадки	
2 (P)	工事中の需要家に対する停電計画や安全対策実施時の連絡及び停電の補償 Notification of the plan for temporary electricity outage and security commitment during the constructions and compensation for customers **Уведомление о плановых отключениях электроэнергии и принимаемых мерах по безопасности в ходе строительства, и компенсации для потребителей электроэнергии**	
3 (Radiostansiya)	(1)プロジェクトサイト用地の確保 Securing of the land for Project sites **Обеспечение земельных участков для строительства** (2)プロジェクトサイト内の整地及び障害物の撤去 Land leveling and clearing the obstacles **Выравнивание участков и удаление препятствующих объектов**	

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4 (R)	(1) 110kV 既設送電線昇圧工事は BT 側で実施する。なお、110kV 送電線引き込みのための引留め小型鉄塔はコンサルタントが JICA 側に要請することとした。 BT implements boost up to existing 110kV transmitting line, and the consultant requests JICA to construct a small size 110kV ending transmission tower for the transmission line to the substation **Работы по увеличению напряжения существующих линий передач до 110кВ выполняет сторона Барки Точик. Однако Консультант обратится с заявкой в адрес JICA по поводу небольшой концевой опоры для подсоединения ЛЭП 110кВ**	Обеспечение бюджета На что распространяется бюджет Какая сумма бюджета Какой период работ
5 (R)	新設変電所建設工事のうち Construction for new substation for: **В рамках строительства новой подстанции:** (1) 敷地整地工事 Land leveling **Выравнивание земельных участков** (2) プロジェクトサイトへのアクセス道路 Access road to Project sites **Подъездная дорога к строительным площадкам** (3) プロジェクトサイト内に排水路がある場合、その付け替え Shifting channel of drainage path, if it is on the project site **Замена дренажного канала на проектной площадке, если таковой имеется**	

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6 (R)	新設変電所用附帯設備工事 Communication works at the new substation **Коммуникационные работы на новой подстанции** (1)　水道工事　水道本管からサイトへの引込工事 Water supply works: leading in from water main to the site **Работы по водоснабжению: подсоединение от магистрального трубопровода к площадке** (2)　排水工事　サイト外排水 Drain work: from Project site to outside **Работы по отводу сточных вод: за пределы объекта**	
7 (P and R)	資機材の輸送に係る通関手続き及び諸税の取扱い Customs clearance and tax exemption pertaining to transportation **Таможенное оформление и освобождение от уплаты налогов при транспортировке оборудования** (1)　ドゥシャンベ第２駅での免税措置及び通関手続き Tax exemption and customs clearance at Dushanbe II railway station **Освобождение от уплаты налогов и таможенное оформление на ж/д станции «Душанбе II»** (2)　タジキスタン側の原因によりドゥシャンベ第２駅での免税措置及び通関手続きに時間がかかる場合、資機材輸送保管庫の提供、費用負担 Provision of storage house and payment for the storage fee in case that tax exemption and transportation	

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	procedures take a time, in case if it happened by fault of Customer. **Предоставление складских помещений и расходы по хранению грузов на ж/д станции Душанбе II в случае задержки процедур по освобождению от налогов и процедур по транспортировке, если это произошло по вине Заказчика.**	
8 (P and R)	現地調達資機材に係る付加価値税の免除 VAT exemption **Освобождение от уплаты НДС**	
9 (P and R)	「タ」国内への入国許可に必要な措置 Measures of entry permit for Contractor's staff **Меры по выдаче въездных виз в Таджикистан сотрудникам подрядчика**	
10 (P and R)	工事用電気、水道の設置、費用負担 Electricity and water works for constructions and payment for the utility **Электроснабжение и водоснабжение, необходимые для проведения строительных работ и связанные с этим расходы**	
11 (P and R)	銀行取極（B/A）に基づく以下の手数料の支払い Payment for the Banking Arrangement as below: **Расходы по Соглашению на банковскоеобслуживание, как указано ниже:** (1)A/P 授権手数料 Authorization to Pay **Расходы на платежное поручение** (2)支払手数料 Commission to remit **Комиссия за денежный перевод**	
12 (P and R)	プロジェクト実施に必要な環境社会配慮の申請と承認取得の予算確保及び実施 Application for Environment and Society attention and	

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	Budgeting for the approve and implementation **Заявка на учет социально-экологических факторов, необходимого для реализации Проекта и обеспечение бюджета для получения утверждения и реализации**	
13 (P and R)	以下に示す許可取得のための必要な措置： Measures of authorization as below: **Меры по получению разрешительных документов, как указано ниже:** (1)据付工事に必要な許可 Approval for Installation of the Equipment **Разрешение на монтаж оборудования** (2)プロジェクト対象変電所の制限地区への進入許可 - Access permit for restricted area of project substations **Разрешение на доступ в закрытую зону проектных подстанций**	
14 (P and R)	プロジェクト対象変電所の仮設資機材置場用地は、プロミシレネヤ変電所に確保 Securing of the land for the makeshift equipment storage at Promishlennaya **Обеспечение площадей для временного хранения оборудования на проектной площадке ПС «Промышленная»**	
15 (P and R)	工事期間中の駐車場の確保 Securing of the parking lot during construction **Обеспечение мест парковки строительной техники и транспортных средств в ходе строительства**	

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16 (P and R)	既設架空線/地中ケーブルまたはパイプの移設及び許可取得（電力、電話、水道、下水等） Transferal of overhead wire/underground cable and piping and obtaining the necessary permissions (e.g. Electricity, Telephone, Water Supply, Sewage) **Перемещение существующих проводов воздушных линий /подземных кабелей и трубопроводов и получение необходимых для этого разрешений (например, электрические кабели, телефонные линии, трубопроводы системы водоснабжения и канализации)**	
17 (P and R)	残土及び工事雑水の廃棄場所の提供 Provision of the land for discarding the surplus soil and gray water of construction **Обеспечение мест для утилизации излишнего разработанного грунта и бытовых сточных вод**	
18 (P and R)	日本側工事実施者と BT 側が協議の上停電作業計画を作成し、BT が停電のための必要な操作を行う Japanese construction company and BT discuss and make a plan for temporary electricity outage operation. BT operates for temporary electricity outage operation in accordance with the plan. **Временные отключения электроэнергии, необходимые для строительства, осуществляемые по графику, составленному совместно специалистом японской стороны и стороной Барки Точик в результате обсуждений**	
19 (P and R)	プロジェクト工事サイトにおけるプロジェクト関係者への安全情報の共有。 Security commitment for all concerned parties on project	

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	construction sites, such as sharing security information **Предоставление информации о безопасности всем связанным с проектом лицам на строительных площадках Проекта**	
20 (P and R)	コンサルタント用事務所の部屋提供 Provision of the office for Consultant **Предоставление офисного помещения для консультанта**	

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Appendix 6: Analytical Data on Electric Power Systems

Appendix 6: Analytical Data on Electric Power Systems

6-1 Data on Power Generating Plants

Technical Parameters of Generating Units №1 and №2 of Hydropower Plant-2 (GES-2)

Технические параметры гидроагрегатов №1 и №2 ГЭС-2

№ № п/п	**Parameter** Параметр	**Value** Значение
1	**Installed Capacity of Generating Unit, MW** Установленная мощность агрегата, МВт	7.2
2	**Available Capacity of Generating Unit, MW** Располагаемая мощность агрегата, МВт	3
3	**Maximum Permissible Active Power of Generating Unit, MW** Максимально-допустимая активная мощность, МВт	7.2
4	**Minimum Permissible Active Power of Generating Unit, MW** Минимально-допустимая активная мощность, МВт	
5	**Maximum Reactive Power, MVAr** Максимальная реактивная мощность, МВт	
6	**Minimum Reactive Power, MVAr** Минимальная реактивная мощность, МВт	
7	**MWs/MVA Inertia Constant** p.u. постоянной инерции МВт сек/МВА	
8	**rap.u. MW/ Rate of Attenuation per unit. Attenuation Parameter Typical Range, 0.8-1.0, for Steam-Generating Unit. Measure of Inaccuracy = 1.** Коэффициент частоты затухания агрегата. Типовые диапазоны параметров затухания 0.8-1.0 для парогенераторной установки. Погрешность – 1.	
9	**Connection of Generating Unit to Automatic Load-Frequency Control (ALFC), Yes – No** Подключение агрегата к автоматическому регулированию частоты и мощности (Да – Нет)	

10	**Connection of Generating Unit to Automatic Voltage Control (AVC), Yes – No** Подключение агрегата к автоматическому регулированию напряжения (Да – Нет)	
11	**Automatic Load-Frequency Control (ALFC) Range, MAX & MIN** Пределы регулирования АРЧМ (максимальный и минимальный)	
12	**Permissible Active Load Rate of Increase in Normal Operation, MW/min** Допустимая скорость увеличения активной нагрузки в нормальном режиме, МВт/мин	
13	**Permissible Active Load Rate of Decrease in Normal Operation, MW/min** Допустимая скорость уменьшения активной нагрузки в нормальном режиме, МВт/мин	
14	**Permissible Active Load Rate of Increase in Emergency Operation, MW/min** Допустимая скорость увеличения активной нагрузки в аварийных режимах, МВт/мин	
15	**Permissible Active Load Rate of Decrease in Emergency Operation, MW/min** Допустимая скорость уменьшения активной нагрузки в аварийных режимах, МВт/мин	
16	**Prohibited Ranges of Generating Unit Operation (MW $_{min}$ – MW $_{max}$)** Запретные зоны работы генераторов (МВт min – МВт max)	
17	**Transient Reactance used to calculate the Short-Circuit Current** Переходное реактивное сопротивление, используемое для расчёта тока к. з.	
18	**Sub-Transient Reactance used to calculate the Short-Circuit Current** Сверхпереходное реактивное сопротивление, используемое для расчёта тока к. з.	
19	**Zero Phase Sequence of Reactance** Нулевая последовательность реактивного сопротивления	
20	**Economic Operation Mode Range (MAX & MIN) – only for Turbo-Generating Units** Диапазон экономичного режима работы (макс. и мин.) – только для	

	турбогенераторов	

HYDROPOWER PLANT-2 (GES-2)

GENERATING UNIT №1

Type Тип	**Vertically Suspended** Вертикальный подвесной
Manufacturer's Plant Завод изготовителя	**England** Англия
Capacity Мощность	**9000 kVA** 9000 кВА
Power Factor Коэффициент мощности	**0.8** 0.8
Voltage Напряжение	**6300 V** 6300 В
Stator Current Ток статора	**825 A** 825 А
Number of Revolutions Число оборотов	**428 rev./min.** 428 об/мин
Rotor Current Ток ротора	**450 A** 450 А
Type of Exciter Тип возбудителя	**EG-342/8 Shunt Exciter** EG-342/8 Шунтовый
Capacity Мощность	**87.7 kW** 87.7 кВт
Voltage Напряжение	**156 V** 156 В

Sub-Exciter Подвозбудитель	**EG-192** EG-192
Capacity Мощность	**3.8 kW** 3.8 кВт
Voltage Напряжение	**230 V** 230 В
Type of Regulator Тип регулятора	**VS-4** VS-4
Cooling System Система охлаждения	**Closed Cooling System** Замкнутая

Hydropower Plant-1 (GES-1)

Generators 1 and 2				**Hydro Turbines 1 and 2**		
1	**Type** Тип	BB-654		1	**Type** Тип	Francis Turbine, Vertical
2	**Capacity** Мощность	4.65 MVA	$X''_d = 0.274$ $X'_d = 0.3$	2	**Wheel Diameter** Диаметр колеса	1.034/1.256 m
3	**Power Factor** Коэффициент мощности	0.8	$X_d = 1.25$ $X_2 = 0.436$	3	**Wheel Height** Высота колеса	0.586 m
4	**Voltage** Напряжение	6.3 kV		4	**Number of Blades** Число лопаток	15
5	**Stator Current, I** **c** Ток статора	426 A		5	**Design Head** Расчётный напор	H = 49 m
6	**Rotor Current, I** **p** Ток ротора	250 A		6	**Design Flow Rate**	Q = 9.5 m^3

					Расчётный расход	/sec
7	**Number of Revolutions** Число оборотов	375 rev/min		7	**Rated Capacity** Номинальная мощность	3.9 MW
8	**Efficiency** К.п.д.	95.8%		8	**Available Capacity** Фактическая мощность	3.6 MW
				9	**Number of Revolutions** Число оборотов	375 rev/min
				10	**Efficiency** К.п.д.	87.6%
	EXCITER Возбудитель					
1	**Type** Тип	6-300				
2	**Capacity** Мощность	29 kW				
3	**Voltage** Напряжение	115 V				
4	**Excitation Control** Регулирование возбуждения	Compound Exciter				

Hydropower Plant-3 (GES-3)

Generators 1 and 2				**Hydro Turbines 1 and 2**		
1	**Type** Тип	ВСГ-325/29-24		1	**Type** Тип	РО-123-ВБ-140, Francis Turbine
2	**Capacity** Мощность	2.2 MVA	$X''_d = 0.36$ $X'_d = 0.3$	2	**Wheel Diameter** Диаметр колеса	1.4 m
3	**Power Factor** Коэффициент мощности	0.8	$X_d = 1.2$ $X_2 = 0.45$	3	**Number of Blades** Число лопаток	14
4	**Voltage** Напряжение	6.3 kV		4	**Design Head** Расчётный напор	H = 19.7 m
5	**Stator Current, I_c** Ток статора	202 A		5	**Max. Flow Rate** Макс. расход	Q = 12.6 m^3 /sec
6	**Rotor Current, I_p** Ток ротора	385 A		6	**Capacity** Мощность	2.02 MW
7	**Number of Revolutions** Число оборотов	250 rev/min		7	**Number of Revolutions** Число оборотов	250 rev/min
	EXCITER Возбудитель					
1	**Type** Тип	ВВС-74/19-6				
2	**Capacity** Мощность	47 kW				
3	**Voltage**	115 V				

	Напряжение					
4	**Excitation Control** Регулирование возбуждения	Compound Exciter				

Dushanbe Thermal Power Plant (DTEC) – Phase 1

Generators 1, 2 and 3				**Turbines 1, 2 and 3**		
1	**Type** Тип	4H-5466/2		1	**Type** Тип	P-6-90, П-6-35.5; P-4,5-35/6
2	**Capacity** Мощность	7.5 MVA	$X''_d = 0.122$ $X'_d = 0.235$ – for G1 & G2 $X_d = 2.38$ $X_2 = 0.15$	2	**Capacity** Мощность	6 MW
3	**Power Factor** Коэффициент мощности	0.8		3	**Effective Pressure before Stop Valve** Рабочее давление перед стопорным клапаном	35 at
4	**Voltage** Напряжение	6.3 kV		4	**Condenser Backpressure** Давление в конденсаторе	0.05 at
5	**Stator Current, I c** Ток статора	688 A	$X''_d = 0.12$ $X'_d = 0.17$ $X_d = 1.65$ – for G3 $X_2 = 0.147$	5	**Operating T°C before Stop Valve** Рабочая T°C перед стопорным клапаном	435°C
6	**Rotor Current, I p** Ток ротора	158 A		6	**Specific Steam Consumption in Condensing Mode** Уд. расход пара в конденсационном режиме	4.28 kg/kW x hour

7	**Number of Revolutions** Число оборотов	3000 rev/min		7	**The same, with Max. Take-Off & Rated Capacity** То же, при макс. отборе и номинальной мощности	8.85 kg/kW x hour
				8	**Max. Steam Rate** Макс. расход пара	98 tons/hour
	EXCITER Возбудитель					
1	**Type** Тип	E-3031/4				
2	**Capacity** Мощность	50 kW				
3	**Voltage** Напряжение	220 V				
4	**Current** Ток	227 A				

Dushanbe Thermal Power Plant (DTEC) – Phase 2

Generators 4 and 5				**Turbines 4 and 5**		
1	**Type** Тип	ТВС-30		1	**Type** Тип	ПТ-35-90/10
2	**Capacity** Мощность	37.5 MVA	$X''_d = 0.152$ $X'_d = 0.257$	2	**Capacity** Мощность	35 MW
3	**Power Factor** Коэффициент мощности	0.8	$X_d = 2.453$ $X_2 = 0.185$	3	**Overload Capacitance** Перегрузочная способность	20%

4	**Voltage** Напряжение	6.3 kV		4	**Number of Revolutions** Число оборотов	3000 rev/min
5	**Stator Current, I c** Ток статора	3440 A		6	**Effective Pressure before Stop Valve** Рабочее давление перед стопорным клапаном	95 at
6	**Rotor Current, I p** Ток ротора	460 A		7	**Operating T°C before Stop Valve** Рабочая T°C перед стопорным клапаном	535°C
7	**Number of Revolutions** Число оборотов	3000 rev/min		8	**Condenser Backpressure** Давление в конденсаторе	0.05 at
8	**Efficiency** К.п.д.	98.2%		9	**Number of Turbine Stages** Число ступеней турбины	24
				10	**Number of Governed rev/min** Число регулируемых оборотов	2/8/13; 0,7/2,5
	EXCITER Возбудитель			11	**Critical Speed** Критическое число оборотов	1750 rev/min
1	**Type** Тип	BT-170-3000		12	**Number of Turbine Disks (integrally with shaft)** Число дисков (заодно с валом)	16

2	**Capacity** Мощность	150 kW		13	**Number of Capped Turbine Disks** Число насадных дисков	8
3	**Voltage** Напряжение	250 V		14	**Specific Steam Consumption in Condensing Mode** Уд. расход пара в конденсационном режиме	3.96 kg/kW x hour
4	**Current** Ток	600 A		15	**Max. Steam Rate** Макс. расход пара	240 tons/hour
5	**Excitation** Возбуждение	Shunted Excitation				
6	**Excitation Control** Регулирование возбуждения	Compound Exciter				

Dushanbe Thermal Power Plant (DTEC) – Phase 2

Generator 6				**Turbine 6**		
1	**Type** Тип	TB-60-2		1	**Type** Тип	K-50-90
2	**Capacity** Мощность	60 MVA	$X''_d = 0.157$ $X'_d = 0.242$	2	**Capacity** Мощность	50 MW
3	**Power Factor** Коэффициент мощности	0.8	$X_d = 2.0$ $X_2 = 0.191$	3	**Overload Capacitance** Перегрузочная способность	10%
4	**Voltage** Напряжение	10.5 kV		4	**Number of Revolutions** Число оборотов	3000 rev/min

5	**Stator Current, I c** Ток статора	4125 A		5	**Effective Pressure before Stop Valve** Рабочее давление перед стопорным клапаном	90 at
6	**Rotor Current, I p** Ток ротора	700 A		6	**Operating T°C before Stop Valve** Рабочая T°C перед стопорным клапаном	535°C
7	**Cooling System** Система охлаждения	Hydrogen Cooling, 2 kg/cm^2		7	**Condenser Backpressure** Давление в конденсаторе	0.035 at
8	**Number of Revolutions** Число оборотов	3000 rev/min		8	**Critical Speed** Критическое число оборотов	1755 rev/min
				9	**Max. Steam Rate** Макс. расход пара	205 tons/hour
	EXCITER Возбудитель					
1	**Type** Тип	BT-170				
2	**Capacity** Мощность	190 kW				
3	**Voltage** Напряжение	250 V				
4	**Current** Ток	760 A				

Dushanbe Thermal Power Plant (DTEC) – Phase 2

Generator 7				**Turbine 7**		
1	**Type** Тип	TBF-100-2		1	**Type** Тип	K-100-90-6M
2	**Capacity** Мощность	100 MVA	$X''_d = 0.18$ $X'_d = 0.28$	2	**Capacity** Мощность	100 MW
3	**Power Factor** Коэффициент мощности	0.85	$X_d = 1.81$ $X_2 = 0.22$	3	**Overload Capacitance** Перегрузочная способность	10%
4	**Voltage** Напряжение	10.5 kV		4	**Number of Revolutions** Число оборотов	3000 rev/min
5	**Stator Current, I c** Ток статора	6880 A, T=20°C 6480 A, T=33°C		5	**Effective Pressure before Stop Valve** Рабочее давление перед стопорным клапаном	90 at
6	**Rotor Current, I p** Ток ротора	1680 A		6	**Operating T°C before Stop Valve** Рабочая T°C перед стопорным клапаном	535°C
7	**Number of Revolutions** Число оборотов	3000 rev/min		7	**Condenser Backpressure** Давление в конденсаторе	0.035 at
8	**Cooling System** Система охлаждения	Hydrogen Cooling		8	**Max. Steam Rate** Макс. расход пара	408 tons/hour

	EXCITER Возбудитель					
1	**Type** Тип	BT-450				
2	**Capacity** Мощность	470 kW				
3	**Voltage** Напряжение	280 V				
4	**Current** Ток	-				

6-2 Data on Substations

Document 2: Transformers Data

Please check Transformers Data as below

No.	Substation	Voltage (kV)	Cap (MVA)	Impedance	Tap	Winding Connection Scheme
①	ОРДЖ-АБАД-2	#1 220/110/10	125	10,00%	17	Y△
		#2 220/10	125	10,00%	13	Y△
②	ШУРСАЙ	#1 110/10	10	10,00%	13	Y△
③	ВАХДАТ	#1 110/6	32	10,00%	13	Y△
		#2 110/6	25	10,00%	13	Y△
		#3 110/6	25	10,00%	13	Y△
④	АНЗОБ	#1 110/6	16	10,00%	13	Y△
		#2 110/6	16	10,00%	13	Y△
⑤	АКАДЕМГОРОДОК	#1 110/35/10	25	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y△
		#2 110/35/10	25	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y△
⑥	ВОСТОЧНАЯ	#1 110/35/10?	25	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y△
		#2 110/35/10?	25	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y△
⑦	РОХАТИ	#1 35/10	1,6	10,00%	13	Y△
		#2 35/10	6,3	10,00%	13	Y△
⑧	ВИНЗАВОД	#1 35/6	10	10,00%	13	Y△
		#2 35/6	10	10,00%	13	Y△
⑨	ПУГУС	#1 110/35/10	10	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y△
⑩	ХОДЖА ОБИ ГАРМ	#1 35/6	6,3	10,00%		Y△

		#2 35/6	1,6	10,00%		Y △
		#3 6/10	1,6	10,00%		△△
⑪	ТАКОБ	#1 35/10	2,5	10,00%		Y △
		#2 35/6	2,5	10,00%		Y △
⑫	САФЕДОРАК	#1 35/10	2,5	10,00%	13	Y △
		#2 35/10	4	10,00%	13	Y △
⑬	КВЗ	#1 110/35/6	16	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y △
		#1 110/35/6	16	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y △
⑭	СЕВЕРНЫЙ ПОРТАЛ	#1 110/6	6,3	10,00%	13	Y △
⑮	ЮЖНЫЙ ПОРТАЛ	#1 110/6	6,3	10,00%	13	Y △
⑯	ВАРЗОБ	#1 110/10	2,5	10,00%		Y △
⑰	КОНДАРА	#1 10/6	1	10,00%		Y △
⑱	МАЙХУРА	#1 110/10	2,5	10,00%	13	Y △
⑲	УГЛОВАЯ	#1 35/0.4	0,56	10,00%		Y △
⑳	КОМИНТЕРН	#1 35/6	2,5	10,00%		Y △
㉑	ПРОХОДНАЯ	#1 35/0.4	0,56	10,00%		Y △
㉒	ГЭС-1 (РП-6)	#1 35/6	2.5?	10,00%		Y △
㉓	ТОЧИКИСТОН	#1 35/6	2.5?	10,00%		Y △
㉔	ПОГРУЗКА	#1 35/6	2,5	10,00%		Y △
		#2 35/6	1,6	10,00%		Y △
㉕	КАХОРОВ	#1 110/10	20	10,00%	13	Y △
㉖	ФИРДАВСИ	#1 110/10	16	10,00%	13	Y △
		#2 110/10	6,3	10,00%	13	Y △
㉗	СООРУЖЕНИЯ ОЧИСТНЫЕ	#1 35/6	10	10,00%	13	Y △
		#2 110/6/6	25	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y △△
㉘	ДЖАНГАЛ	#1 220/110/10	200	P-S 10.71% S-T 44.25%	13	YY△

				P-T 28.14%		
		#2 220/110/10	200	P-S 10.88% S-T 44.28% P-T 24.11%	13	YY△
㉙	ЖУКОВА	#1 110/35/10	6,3	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y △
		#2 110/35/10	16	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y △
㉚	НАВБАХОР	#1 110/10	16	10,00%	13	Y △
		#2 110/10	16	10,00%	13	Y △
㉛	ЮГО-ЗАПАДНЫЙ ВОДОЗАБОР	#1 110/6	10	10,00%	13	Y △
		#2 110/6	10	10,00%	13	Y △
㉜	ЗАВОДСКАЯ	#1 110/35/10	25	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y △
		#2 110/35/10	25	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y △
㉝	ПАМИР	#1 35/10	5,6	10,00%	13	Y △
		#2 35/10	5,6	10,00%		Y △
㉞	РЭЗ	#1 35/6	6,3	10,00%		Y △
㉟	ЗАПАДНАЯ КОТЕЛЬНАЯ	#1 35/10	10	10,00%	13	Y △
		#2 35/10	10	10,00%	13	Y △
㊱	ПРОМЫШЛЕННАЯ	T1 - 110/35/10	25	VN/SN RPN/PBV – see **Footnote**		Y/Y/ [0]-11
		T2 - 110/35/10	25	VN/SN RPN/RPBV – see **Footnote**		Y/Y/ [0]-11
		T3 - 110/10	16	VN RPN – see **Footnote**		Y_N/ [1]
㊲	БУСТОН	#1 110/35?/10	16	10,00%	13	Y Y △
		#2 110/10	16	10,00%	13	Y △
㊳	БАХОР	#1 110/10?/10	25	P-S 10.00% S-T 44.00%	13	Y Y △

				P-T 28.00%		
		#2 110/10	16	10,00%	13	Y △
㊴	БОТАНИЧЕСКАЯ	#1 110/10	10	10,00%	13	Y △
		#2 110/10	6,3	10,00%	13	Y △
㊵	ШАХРИ	#1 110/10/10	25	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y △△
		#2 110/10	16	10,00%	13	Y △
㊶	НОВАЯ	#1 220/110/10	200	P-S 10.62% S-T 44.34% P-T 28.18%	13	YY△
		#2 220/110/10	200	P-S 10.66% S-T 44.17% P-T 28.02%	13	YY△
		110/6		P-S %	13	Y △
㊷	ДУШАНБИНСКАЯ ТЭЦ-2	#1 220/110/10?	200	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y △
		#2 220/110/10?	200	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y △
㊸	СЕВЕРНАЯ	#1 110/35/10	25	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y △
		#2 110/35/10	25	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y △
㊹	КОСАТАРОШ	#1 35/10	2,5	10,00%		Y △
㊺	ЗИРАКИ	#1 35/10	4	10,00%		Y △
		#2 35/10	4	10,00%		Y △
㊻	ВОДОНАСОСНАЯ	#1 35/10	10	10,00%		Y △
㊼	ЛУЧОБ	#1 110/10/10	40	P-S 10.00% S-T 30.00%? P-T 30.00%?	13	Y △△

		#2 110/10/10	40	P-S 10.00% S-T 30.00%? P-T 30.00%?	13	Y △△
㊽	КАРАМОВА	#1 110/35/10	25	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y △
		#2 110/35/6	25	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y △
㊾	ИСТИКЛОЛ	#1 35/6	10	10,00%		Y △
		#2 35/6	10	10,00%		Y △
㊿	АКВА	#1 35/0.4	2,5	10,00%		Y △
		#2 35/0.4	2,5	10,00%		Y △
51	ЦЕМЗАВОД	#1 35/6	15	10,00%	13	Y △
		#2 35/6	15	10,00%	13	Y △
52	СИМ-СИМ	#1 35/6?	2,5	10,00%		Y △
53	ЦЕНТРАЛЬНАЯ	#1 35/6	16	10,00%	13	Y △
		#2 35/6	16	10,00%	13	Y △
54	СПОРТИВНАЯ	#1 110/10/10	25	10,00%		Y △
		#2 110/10/10	25	10,00%		Y △
55	ГЛАВНАЯ	#1 110/35/6	25	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y △
		#2 110/35/6	40	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y △
56	КАРАМОВА	#2 35/6	10	10,00%		Y △
		#5 35/6	10	10,00%		Y △
57	ДТЭЦ	#1 110/35?/6	31,5	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y △
		#2 110/35?/6	40,5	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y △
58	ТТМ	#1 110/6/6	25	P-S 10.00%	13	Y △△

				S-T 44.00% P-T 28.00%		
		#2 110/6/6	25	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y △△
59	АВИАТОР	#1 110/6	16	10,00%	13	Y △
60	ХБК-110	#1 110/35/10	40	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y △
		#2 110/35/10	20	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y △
61	ТОРГМАШ	#1 35/6	6,3	10,00%		Y △
		#2 35/6	6,3	10,00%		Y △
62	КАСРИ МИЛЛАТ	#1 110/10/10	25	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y △△
		#2 110/10/10	25	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y △△
63	ХБК-35	#1 35/6	16	10,00%		Y △
		#2 35/6	16	10,00%		Y △
64	СОХИЛИ	#1 110/10/10	25	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y △△
		#2 110/10/10	25	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y △△
65	СОВЕТСКАЯ	#1 110/10	20	10,00%	13	Y △
		#2 110/35?/10	40	P-S 10.00% S-T 44.00% P-T 28.00%	13	Y Y △
			3054,22			

Footnote:

VN/SN RPN/PBV	High-Voltage/Medium-Voltage On-Load Tap-Changer/Off-Circuit Tap-Changer
VN/SN RPN/RPBV	High-Voltage/Medium-Voltage On-Load Tap-Changer/? Off-Circuit Tap-Changer
VN RPN	High-Voltage On-Load Tap-Changer

6-3 Load Prediction for the Substations

Document 3: Load Prediction for the Substations

Please show us Power Load at each Substation (with peak load 1800MW in winter period of 2017 in Dushanbe)

LOAD	SUBSTATION	P （MW）	Q （Mvar）	SC Capacity (MVA）
English	Substation	Active Power	Reactive Power	Shunt Capacitor
		Активная мощность МВт	Реактивная мощность Мвар	Shunt Capacitor (SC) (There are no devices for compensation of Reactive Power at these substations)
Japan	Substation	Effective power	Reactive power	Shunt Capacitor
①	ОРДЖ-АБАД-2	156	40	
②	ШУРСАЙ	10,5	4,5	
③	ВАХДАТ	38,6	12	
④	АНЗОБ	18,8	4	
⑤	АКАДЕМГОРОДОК	22	7	
⑥	ВОСТОЧНАЯ	36	10	
⑦	РОХАТИ	2,6	1,1	Does not belong to substation of Dushanbe City
⑧	ВИНЗАВОД	19	5	
⑨	ПУГУС	4,2	2,2	Does not belong to substation of Dushanbe City
⑩	ХОДЖА ОБИ ГАРМ	4,6	1,2	Does not belong to substation of Dushanbe City
⑪	ТАКОБ	2,5	1,1	Does not belong to substation of Dushanbe City
⑫	САФЕДОРАК	2,2	1	Does not belong to substation of Dushanbe City
⑬	КВЗ	14	5	
⑭	СЕВЕРНЫЙ ПОРТАЛ	2,1	1	Does not belong to substation of Dushanbe City
⑮	ЮЖНЫЙ ПОРТАЛ	2,0	1	Does not belong to substation of Dushanbe City

⑯	ВАРЗОБ	6,5	2	Does not belong to substation of Dushanbe City
⑰	КОНДАРА	0,8	0,2	Does not belong to substation of Dushanbe City
⑱	МАЙХУРА	1,2	0,5	Does not belong to substation of Dushanbe City
⑲	УГЛОВАЯ	0,3	0,1	Does not belong to substation of Dushanbe City
⑳	КОМИНТЕРН	4	2	
㉑	ПРОХОДНАЯ	0,5	0,1	Does not belong to substation of Dushanbe City
㉒	ГЭС-1 (РП-6)	5	2	
㉓	ТОЧИКИСТОН	2	1	
㉔	ПОГРУЗКА	3	1	
㉕	КАХОРОВ	6	2	
㉖	ФИРДАВСИ	21	5,5	
㉗	СООРУЖЕНИЯ ОЧИСТНЫЕ	21	7,4	
㉘	ДЖАНГАЛ	320	80	
㉙	ЖУКОВА	18	5	
㉚	НАВБАХОР	24,5	6,8	
㉛	ЮГО-ЗАПАДНЫЙ ВОДОЗАБОР	2	1	
㉜	ЗАВОДСКАЯ	42	11,5	
㉝	ПАМИР	2,5	1,2	
㉞	РЭЗ	5,2	1,6	
㉟	ЗАПАДНАЯ КОТЕЛЬНАЯ	12,2	3,2	
㊱	ПРОМЫШЛЕННАЯ	52,9	18,5	
㊲	БУСТОН	21,4	6,5	
㊳	БАХОР	29,5	7,4	
㊴	БОТАНИЧЕСКАЯ	18,2	3,6	
㊵	ШАХРИ	29,5	6,2	
㊶	НОВАЯ	336	85	
㊷	ДУШАНБИНСКАЯ	-	-	

	ТЭЦ-2			
㊸	СЕВЕРНАЯ	38,4	8,1	
㊹	КОСАТАРОШ	2,1	1,0	Does not belong to substation of Dushanbe City
㊺	ЗИРАКИ	5,2	2,2	Does not belong to substation of Dushanbe City
㊻	ВОДОНАСОСНАЯ	5,4	2,1	
㊼	ЛУЧОБ	43,5	10,5	
㊽	КАРАМОВА	28,5	7,5	
㊾	ИСТИКЛОЛ	18,4	7,2	
㊿	АКВА	4,5	1,7	
51	ЦЕМЗАВОД	24,2	11,4	
52	СИМ-СИМ	1,6	0,2	
53	ЦЕНТРАЛЬНАЯ	26,5	7,2	
54	СПОРТИВНАЯ	36,1	10,9	
55	ГЛАВНАЯ	28,4	5,7	
56	КАРАМОВА	See above		
57	ДТЭЦ	15,2	6,1	
58	ТТМ	43,4	11,2	
59	АВИАТОР	12,5	6,4	
60	ХБК-110	26,5	9,4	
61	ТОРГМАШ	8,6	3,5	
62	КАСРИ МИЛЛАТ	32,5	7,2	
63	ХБК-35	20,1	7,6	
64	СОХИЛИ	38,8	10,1	
65	СОВЕТСКАЯ	36,9	12,7	

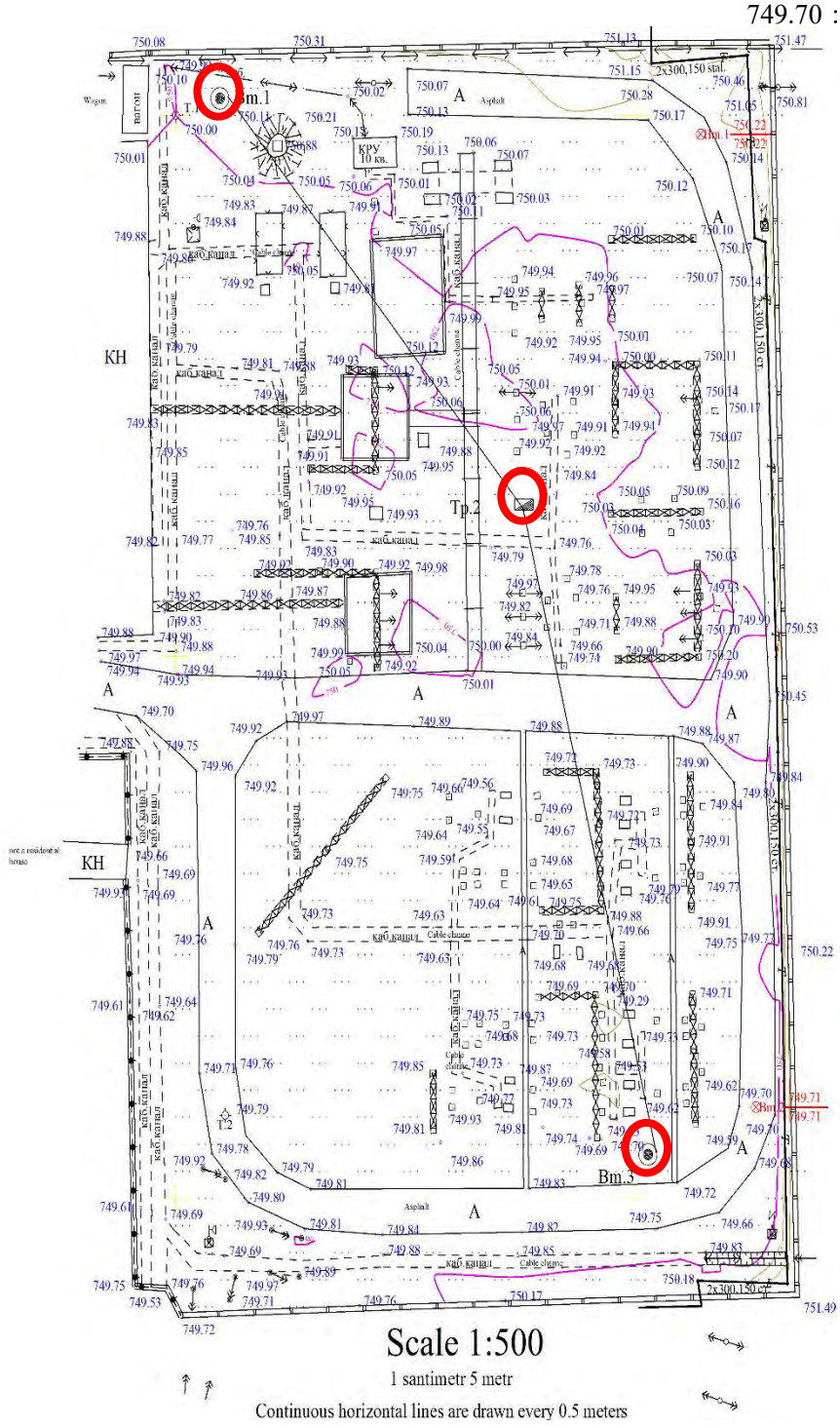
Appendix 7: Report on Topographical Survey Results

Appendix 7: Report on Topographical Survey Results

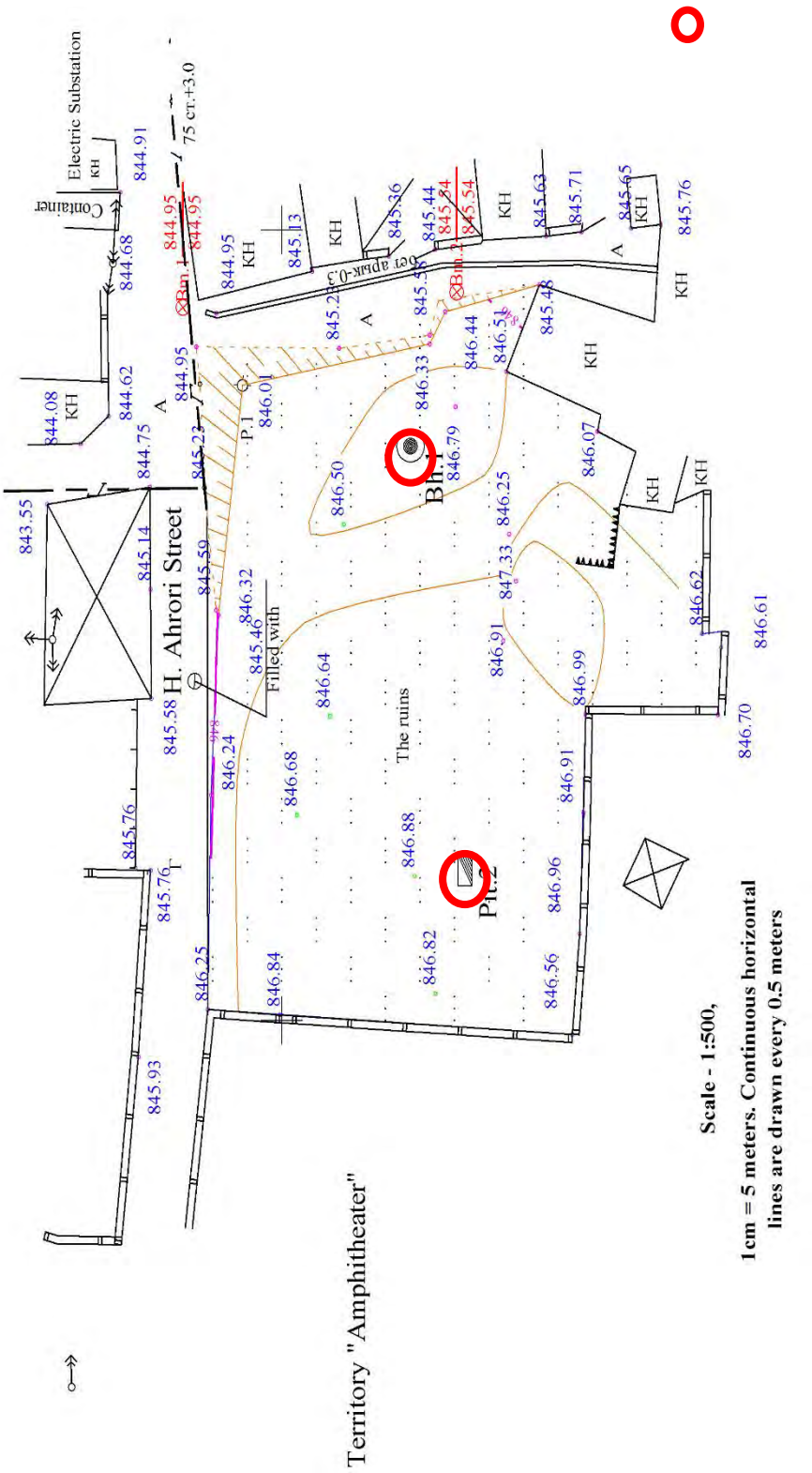
7-1 Topographical Survey Results for Promyshlennaya S/S

O : boring location

749.70 : Elevation



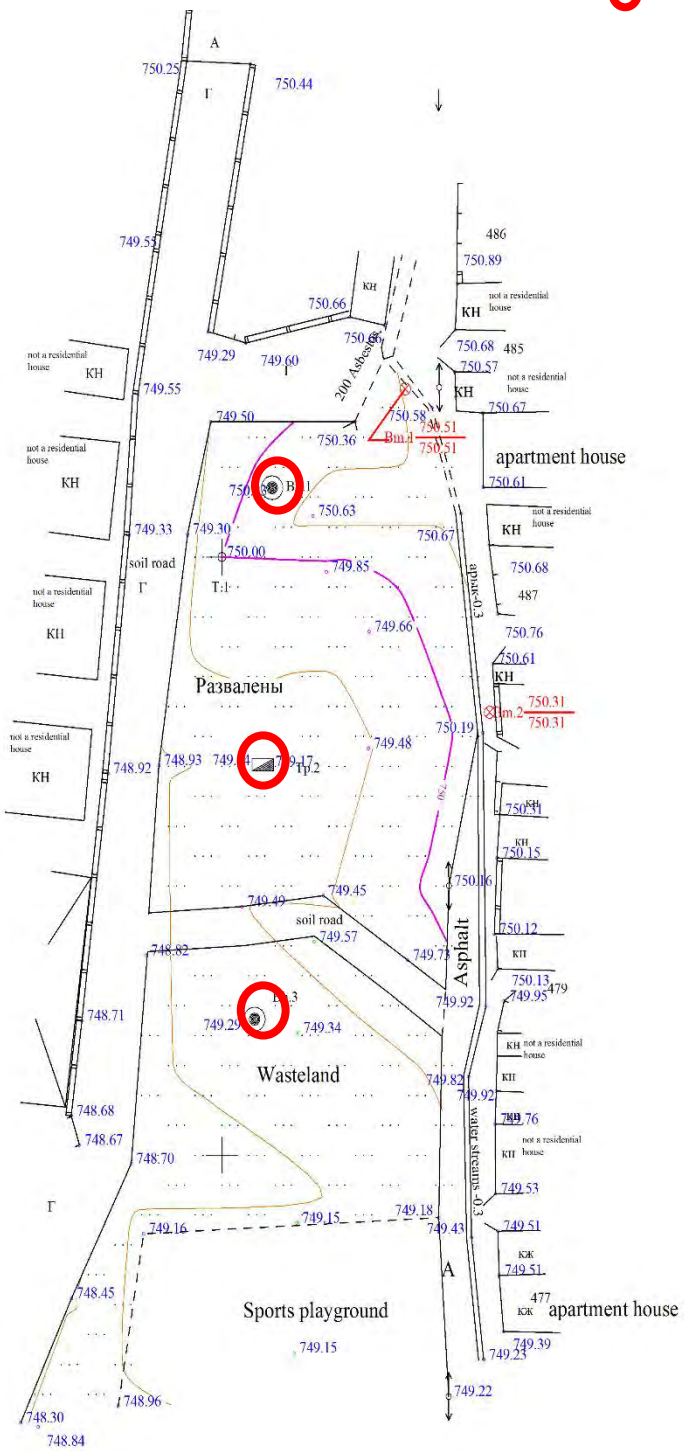
7-2 Topographical Survey Results for Radiostantsiya S/S



7-3 Topographical Survey Results for Glavpochtampt S/S

: boring location

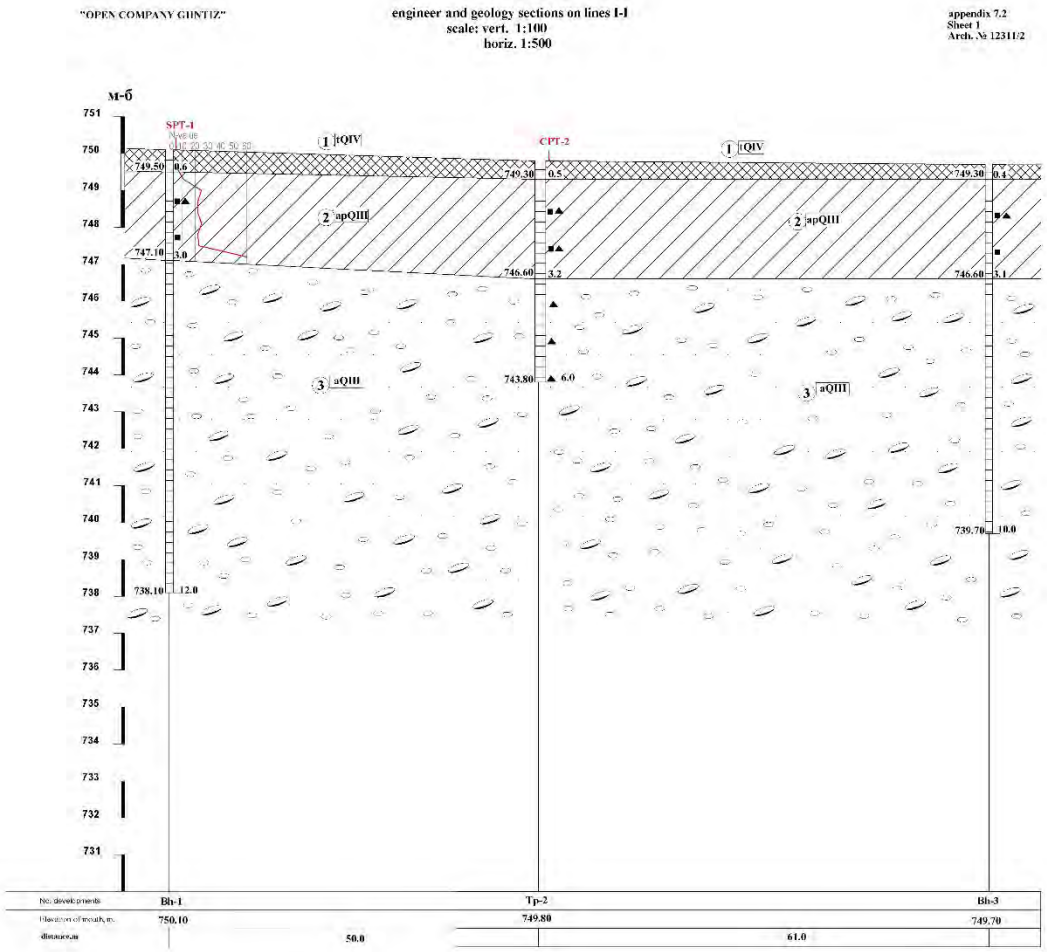
750.60 : elevation

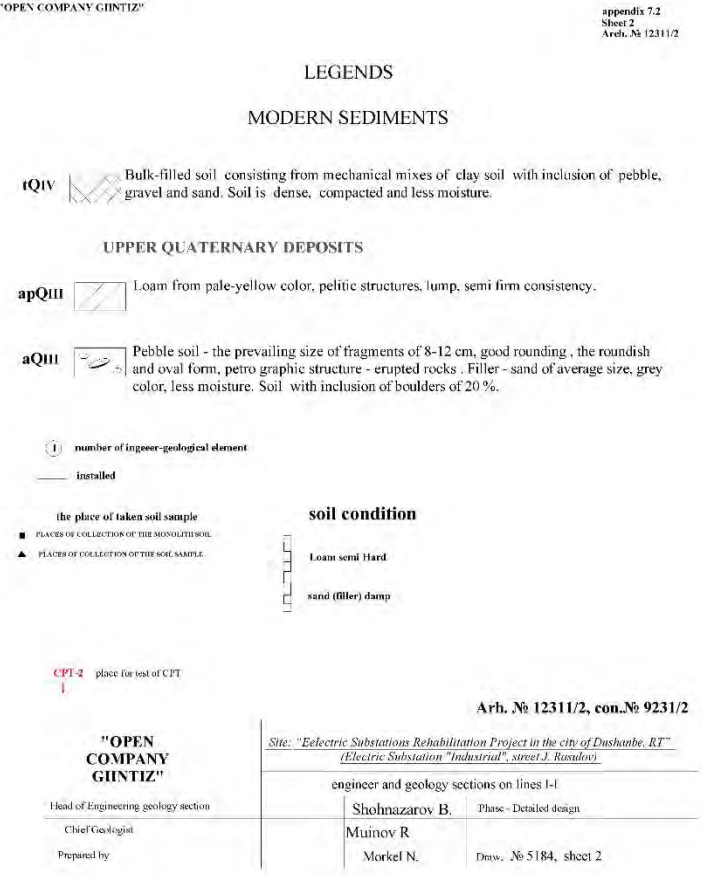


Appendix 8: Report on Geological Survey Results

Appendix 8: Report on Geological Survey Results

8-1 Geological Survey Results for Promyshlennaya S/S



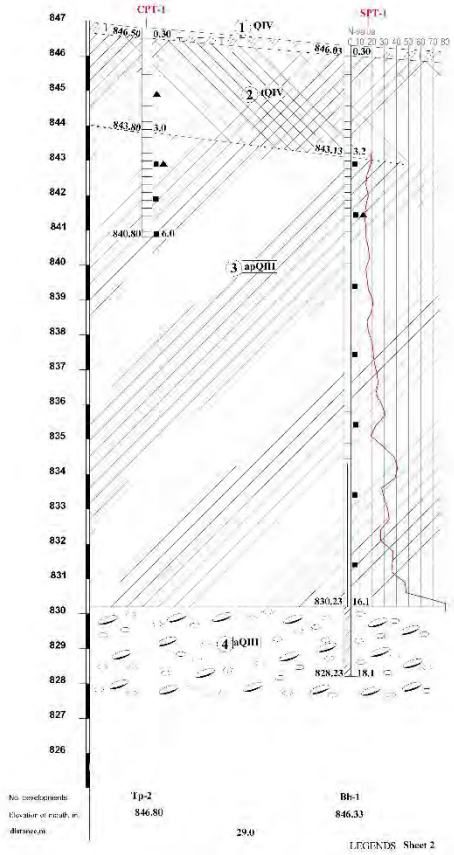


8-2 Geological Survey Results for Radiostantsiya S/S

"OPEN COMPANY GIINTIZ"

appendix 7.2
Sheet 1
Arch. № 12311

engineer and geology sections on lines I-1
scale: vert. 1:100
horiz. 1:500



"OPEN COMPANY GIINTIZ"

appendix 7.2
Sheet 2
Arch. № 12311

LEGENDS

MODERN SEDIMENTS

QIV — Soil-vegetative layer of loam structure with roots of plants

tQIV — Bulk-filled soil consisting from mechanical mixes of clay soil with inclusion of pebble, gravel, sand and construction garbage. Soil is dense, compacted and less moisture.

UPPER QUATERNARY DEPOSITS

apQIII — Loam from pale-yellow to brown color, pelitic structures, lump and massive structure, from semi firm to firm plastic consistences.

aQIII — Pebble soil - the prevailing size of fragments of 6-12 sm, good rounding , the roundish and oval form, petro graphic structure - erupted rocks , Filler - sand of average size, grayish-grey color, damp. Soil with inclusion of boulders of 20-25 %.

1 — number of ingeeer-geological element border:
installed
expected

the place of taken soil sample
■ PLACES OF COLLECTION OF THE MONOLITH SOIL
▲ PLACES OF COLLECTION OF THE SOIL SAMPLE

soil condition
Loam semi Hard
Loam firm plastic
sand (filler) damp

CPT-1 — place for test of CPT

Arh. № 12311, con.№ 9231

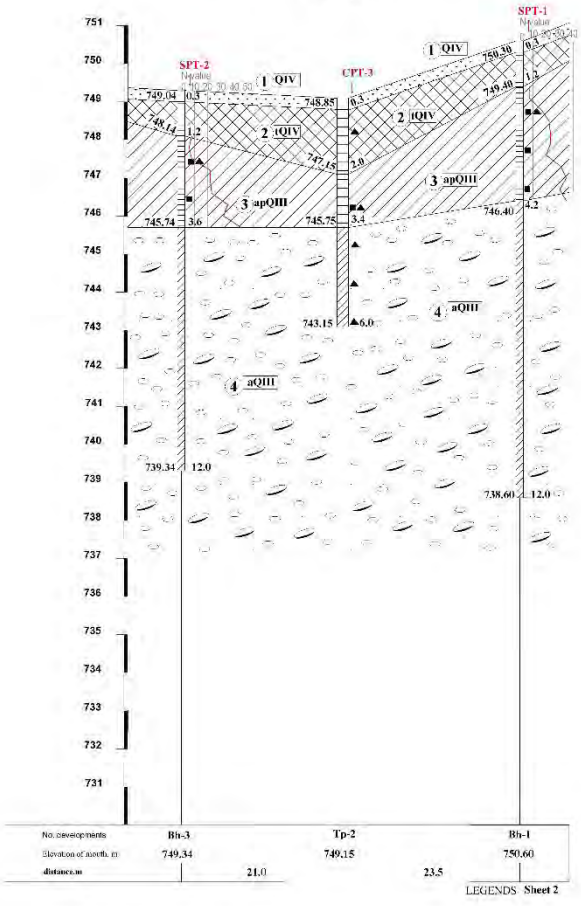
"OPEN COMPANY GIINTIZ"	**"Eelectric Substations Rehabilitation Project in the city of Dushanbe, RT"» (Electric Substation "Radio station", street IL Ahrori)**
	engineer and geology sections on lines I-I
Head of Engineering geology section	Shohnazarov B. — Phase - Detailed design
Chief Geologist	Muinov R
Prepared by	Morkel N. — Draw. № 5180, sheet 2

8-3 Geological Survey Results for Glavpochtampt S/S

"OPEN COMPANY GHNTIZ"

appendix 7.2
Sheet 1
Arch. № 12311/1

engineer and geology sections on lines I-1
scale: vert. 1:100
horiz. 1:500



"OPEN COMPANY GHNTIZ"

appendix 7.2
Sheet 2
Arch. № 12311/1

LEGENDS

MODERN SEDIMENTS

QIV Soil-vegetative layer of loam structure with roots of plants

tQIV Bulk-filled soil consisting from mechanical mixes of clay soil with inclusion of pebble, gravel, sand and construction garbage. Soil is dense, compacted and less moisture.

UPPER QUATERNARY DEPOSITS

apQIII Loam from pale-yellow color, pelitic structures, lump and massive structure, semi firm consistency.

aQIII Pebble soil - the prevailing size of fragments of 6-12 cm, good rounding , the roundish and oval form, petro graphic structure - erupted rocks . Filler - sand of average size, grayish-grey color, damp. Soil with inclusion of boulders of 20 %.

(1) number of ingeeer-geological element

installed

the place of taken soil sample

soil condition

Loam semi Hard

sand (filler) damp

SPT-1 the graphic chart of change of Rd on depth of immersing of a probe N

CPT-2 place for test of CPT

Arch. № 12311, con.№ 9231/1

"OPEN COMPANY GHNTIZ"	*"Eelectric Substations Rehabilitation Project in the city of Dushanbe. RT" (Electric Substation "Main Post Office", street H. Nazarov*
	engineer and geology sections on lines I-I
Head of Engineering geology section	Shohnazarov B. Phase - Detailed design
Chief Geologist	Muinov R.
Prepared by	Morkel N. Draw. № 5180, sheet 2