The Islamic Republic of Iran
TPPH
TAVANIR
TREC

Data Collection Survey
on
Electric Power Sector
in the Islamic Republic of Iran

Final Report

February 2017

Japan International Cooperation Agency (JICA)

Tokyo Electric Power Services Co., Ltd.

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Abbreviations

Abbreviation	Words
ACSR	aluminum conductors steel reinforced
AIS	Air insulated switchgear
B/A	Banking Arrangement
BOO	Build Own Operate
BOT	Build Operate Transfer
bp	basis point
BTMU	Bank of Tokyo-Mitsubishi UFJ
CB	Circuit Breaker
CBI	Central Bank of Iran
CPI	Consumer Price Index
DOE	Department of Energy
D/D	Due diligence
EIA	Environmental Impact Assessment
EHC	Environmental High Council
E/A	Evidence of Authority
E/N	Exchange of Notes
ECA	Energy Conversion Agreement
FEF	Front-End Fee
GCB	Gas insulated Circuit Breaker
GDP	Gross Domestic Product
GIS	gas insulated switchgear
GT	Gas turbine
GTC	General Terms and Conditions
HEC	High Economic Council
H-GIS	Hybrid gas insulated switchgear
IAEA	International Atomic Energy Agency
ICA	Islamic Consultative Assembly
IEA	International Energy Agency
IEC	International Electrotechnical Commission
IEM	Iranian Electricity Market
IGMC	Iran Grid Management Company
IMF	International Monetary Fund
INTA	Iranian National Tax Administration
IRGC	Islamic Revolutionary Guard Corps
IPDC	Iran Power Development Company
IPO	Iranian Privatization Organization
IPP	Independent Power Producer
IPPMC	Iran Power Plant Maintenance Company
IREB	Iran Electricity Regulatory Board

Abbreviation	Words
JBIC	Japan Bank for International Cooperation
JCPOA	Joint Comprehensive Plan of Action
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
L/A	Loan Agreement
L/C	Letter of Credit
LIBOR	London Interbank Offered Rate
L/O	Legal Opinion
MEAF	Ministry of Economic Affairs and Finance
MPO	Management and Planning Organization
MOFA	Ministry of Foreign Affairs
MOE	Ministry of Energy
ODA	Official Development Assistance
OECF	Overseas Economic Cooperation Fund
OFAC	Office of Foreign Assets Control
OIETAI	Organization for Investment, Economic and Technical Assistance of Iran
P/A	Power of Attorney
PBO	Planning and Budgetary Organization
P/Q	Prequalification
PPA	Power Purchase Agreement
QBS	Quality-Based Selection
QCBS	Quality- and Cost-Based Selection
RFP	Request for Proposals
SABA	Iran Energy Efficiency Organization
SBD	Standard Bidding Documents
SDN	Specially Designated Nationals
SEA	Strategic Environmental Assessment
STATCOM	Static Synchronous Compensator
SRFP	Standard Request for Proposals
S/S	Specimen Signatures
SSO	Social Security Organization
SUNA	Renewable Energy Organization of Iran
TAVANIR	Iran Power Generation, Transmission & Distribution Management Company
TPPH	Thermal Power Plants Holding Company
TREC	Tehran Regional Electricity Company
UNDP	United Nations Development Program
UNEP	United Nations Environment Program

Chapter 1 Introduction

1.1 Background to Survey

Iran is one of the largest oil and natural gas producers in the world, boasting the world's largest natural gas reserves and fourth largest oil reserves. The demand for energy is increasing every year mainly in the cities based on extremely inexpensive electricity power charges. On the other hand, the impact of economic sanctions and other measures as a result of nuclear development and other suspicions has resulted in continued use of aging electric power related facilities. In addition, the facilities are being operated without implementing adequate environmental measures, and this has become a serious problem that has a large impact on air pollution.
The Government of Iran is taking measures to facilitate the efficient use of electric power, and policies concerning the efficient use of energy, introduction objectives for renewable energy and environmental pollution measures are included in the "5th Five-Year Plan". In addition, policies concerning even more efficient use of energy and so on is included in the "6th Five-Year Plan" which has be drafed in 2016 and is waitiong for approval by Parliament .
A Joint Comprehensive Plan of Action (JCPOA) was concluded between Iran and the EU3+3 (United Kingdom, Germany, France, United States, Russia and China) concerning nuclear development suspicions on July 14, 2015, under which economic sanctions that were implemented by the EU, the United States and the United Nations are being lifted (or ended) in exchange for Iran committing to limit nuclear development to peaceful purposes. On January 16, 2016, the related economic sanctions that were placed by the EU, the United States and the United Nations were lifted (or ended). The Government of Japan also lifted the related economic sanctions on January 22 in accordance with a U.N. resolution.
It is expected that Iran will deepen rebuilding of relations with governments and corporations in the EU and the United States using the lifting of sanctions as an opportunity, and rapidly proceed with renewal and enhancement of aging energy or electric power related facilities and strengthening of environmental measures. In addition, from the standpoint of efficient use of energy and other such perspectives, the Government of Iran has explained to the Government of Japan that there is a high level of need for assistance by Japanese corporations who were involved in the development of electric power related facilities for refurbishing and other work at electric power plants, substations and other such facilities. In consideration of these conditions, from the standpoint of promoting the formation of contractee assistance projects in this field in the future, there is a need to collect and analyze concrete information as soon as possible in order to identify current issues and assistance needs.

1.2 Objective of Project

To strengthen and stabilize the supply of electric power in Iran by refurbishing or newly building power plants and substation facilities, improving operation & maintenance, increasing operation efficiency of facilities and other such measures. Base on this concept, the objective of this survey is to confirm and review the refurbishment or new construction plans for power plant and substation facilities being prepared by the Government of Iran, examine assistance measures by the Government of Japan, grasp intangible issues concerning operation and maintenance, and gather measures and related information for the improvement of operation. In addition, assistance needs concerning refurbishment and enhancement plans for electric power facilities delivered by Japanese corporations in the past will be verified and reviewed, and

assistance measures which will contribute to an improvement in the operation efficiency of these facilities will be reviewed. Furthermore, another objective of this survey is to collect basic information on the decision making mechanism and legal system in Iran (procurement rules and system concerning foreign borrowing) with the expectation that assistance will be provided in the form of loan assistance.

1.3 Work Content

The scope of the survey will be power generation, transformation (substations), transmission and distribution. However, power generation (including environmental measure facilities) will be the primary focus, with specific assistance measures for substations to be reviewed and the general conditions of power transmission and distribution to be investigated.

During the field survey period, information will be gathered with a focus on power plants and other facilities in which Japanese corporations were involved in facility development in the past in order to obtain a grasp and analyze the development status and future plans for power generation, transformation, transmission and distribution in Iran, and a wide range of information will be collected and plan formulation assistance will be provided in order to review assistance needs and assistance measures related to future refurbishment and new development of electric power related facilities. During the period of preliminary preparation work in Japan, existing materials will be checked and analyzed, advance verification and coordination will be performed as appropriate with relevant parties in Iran, and the field survey will be conducted after the survey and consultation policy has been organized.

In addition, the necessity and background of a kick-off event with relevant organizations and electric power related facility development plans in the survey target areas will be verified, and basic information will be gathered on the various systems in Iran (legal system concerning foreign borrowing in Iran, public procurement system, system concerning environmental and social considerations and financial system [remittances, settlement] and other systems) for which assistance can be expected for a loan assistance project.

The target areas and related organizations are described below.

• Target Areas
The entire Iran (in particular, areas with power plants, substations and other electric power related facilities in which Japanese corporations have been involved in the past)

• Related Organizations
Ministry of Energy, Iran Power Generation, Transmission and Distribution Management Company(TAVANIR), Thermal Power Plants Holding Company(TPPH), Tehran Regional Electric Company(TREC), etc.

The scope of the survey is shown below in item format.

1. Organization of survey items in first field survey by verifying and analyzing existing materials
2. Collection of information by interviewing Japanese corporations interested in advancing into electric power field

3. Review of power generation, transformation, transmission & distribution development plans
4. Confirmation of power generation, transformation, transmission & distribution development policy, plans and implementation status in the target areas
5. Current status and future prediction of electric power demand
6. Verification of charge system, charge collection status, subsidies, status of private sector fund introduction and privatization policy
7. Type, scale (power generation capacity etc.), year developed, status of aging, replacement status of power generation facilities
8. Development status, year developed, status of aging, replacement status of substation facilities
9. Current status of operation & maintenance plans, operation track record & experience, existence of organization system & technical expertise of power generation sector
10. Current status of operation & maintenance plans, operation track record & experience, existence of organization system & technical expertise of substation sector
11. Current status of role division between the national government, provincial and municipal governments in the target areas (system, personnel system, etc.)
12. Current financial status and budget status, etc. of entities
13. Confirmation of assistance status by foreign private sector companies and other organizations in other countries concerning power plants and substations in the target areas
14. Collection of basic information on decision making mechanism for investment projects and various systems, and proposals for response measures against issues toward provision of cooperation
15. Prediction of electric power demand in the target areas
16. Development plan of the sector as a whole (including detailed examination and analysis of fund needs)
17. Sector issues for power generation and transformation (charge system, privatization policy, etc.)
18. Policies etc. to strengthen organization system and technical capabilities for facility operation and maintenance
19. Plans for development of facilities required in the future (including detailed examination and analysis of fund needs)
20. M/M schedule and TOR proposal of consulting service required to achieve plans
21. Policy for operation & management of power plants and substations (charge system, charge collection system, etc.), implementation plan
22. Review of environmental impact of power generation facilities that need to be developed in the future
23. Review of technologies viewed as strengths of Japanese corporations
24. Analysis of expected issues when loan assistance is implemented, and formulation of response measures
25. Explanation to and consultation with persons concerned in Government of Iran on direction concerning assistance by JICA taking into consideration results of review of power plant & substation development plan
26. Submission of issue response measures anticipating implementation of loan assistance

27. Explanation of various systems concerning loan assistance and submission of issue response measures for implementation of such systems to relevant organizations in Iran
28. Comparative review & risk analysis and relevance review of alternative proposals as necessary
29. Collection of information to enhance survey accuracy and enhance accuracy of issue organization and response measures
30. Preparation of, explanation and discussion on survey report

1.4 Survey Schedule

The overall survey schedule is as shown in Figure 1.4-1. The total period is 11 months, and the report will be submitted as shown in the table.

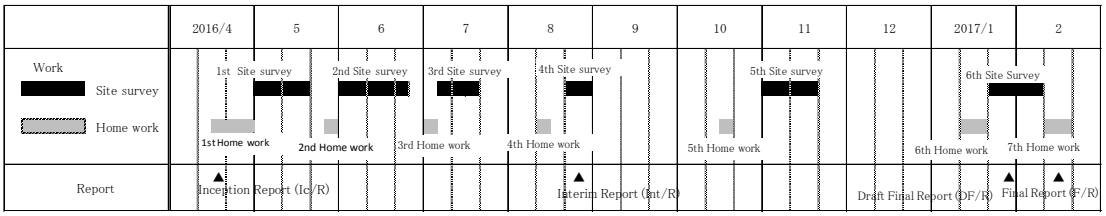


Figure 1.4-1 Overall Survey Schedule

1.5 Structure of Survey

The implementation structure of this survey is as shown in Figure 1.5-1.
Counter organizations are Thermal Power Plants Holding Company (TPPH) and the Iran Power Generation, Transmission & Distribution Managemet Company (TAVANIR), and TREC (Tehran Regional Electricity Company) as one of Regional electric companies controlled under TAVANIR.

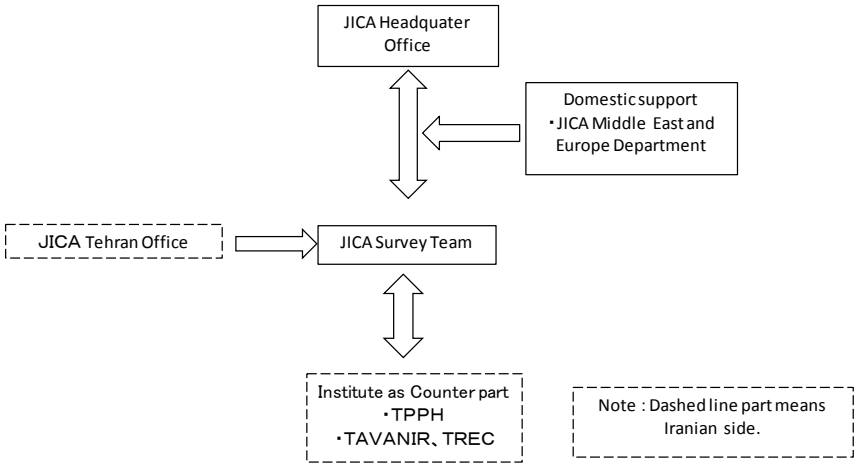


Figure 1.5-1 Implementation Structure of the Survey

Chapter 2 Overview of Electric Power Sector

2.1 System of Electric Power Sector

2.1.1 Ministry of Energy (MOE)

The Ministry of Energy (MOE) is the organization responsible for supply of electrical power and other energy, as well as being responsible for water resources management, water and sewage management (Water and Wastewater Company: ABFA), human resources development and education, etc. TAVANIR and TPPH are organizations affiliated to the MOE.
Figure 2.1-1 shows the organization chart of the Ministry of Energy of Iran. There are 10 organizations that are affiliated to the MOE, including Iran Power Generation, Transmission & Distribution Management Co. (TAVANIR) and Thermal Power Plants Holding Company (TPPH). The other 8 affiliated companies are Water Resources Management, Water & Drainage Company, SATKAP Company, Water & Electricity University, Water and Electricity Institute, Niro Research center, Water Research Institute, and National Water Institute.

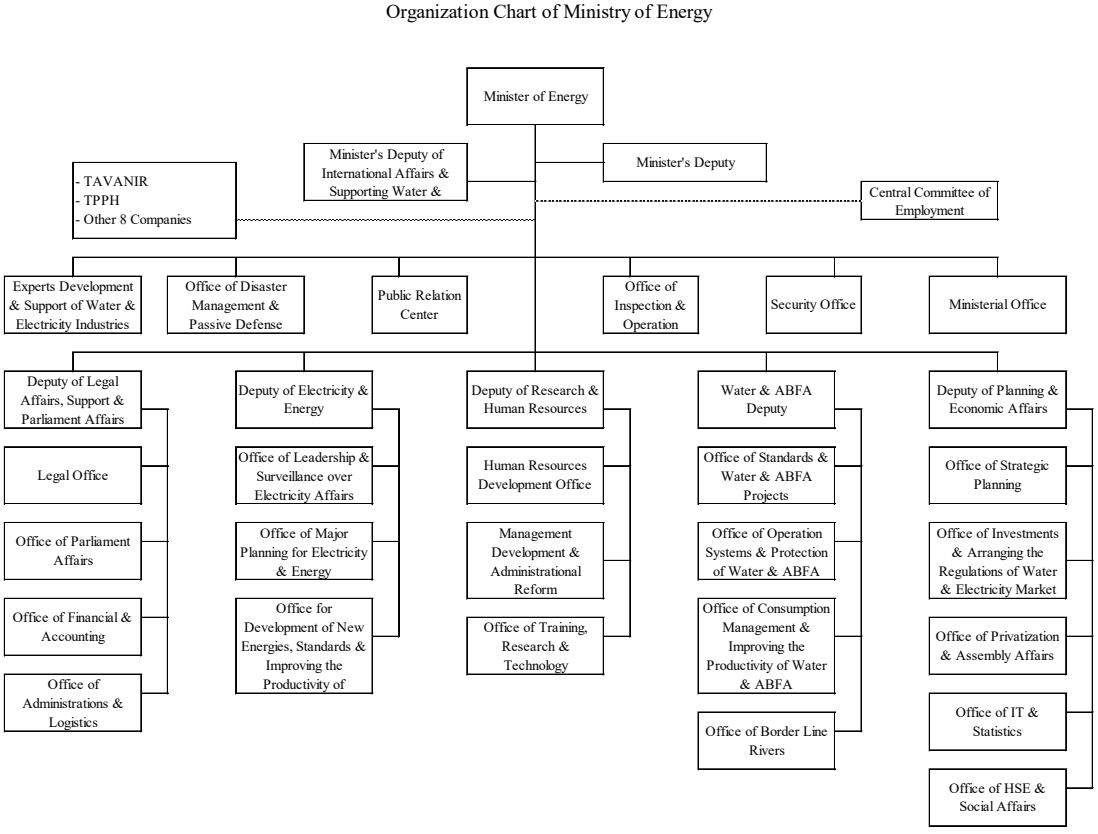
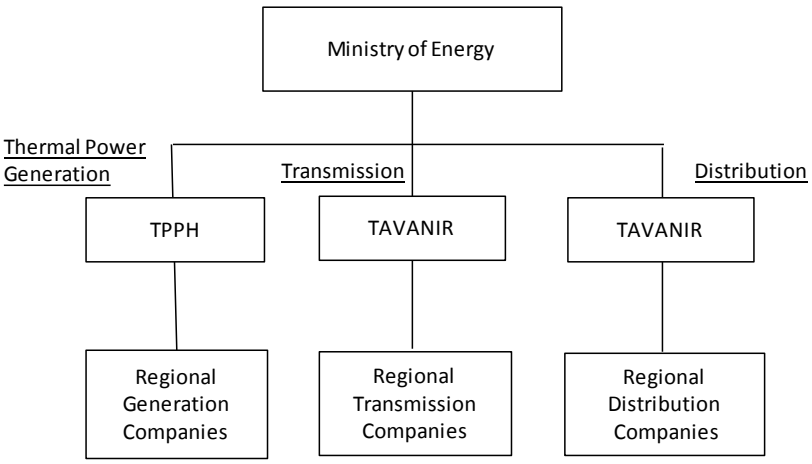


Figure 2.1-1 Organization Chart of Ministry of Energy

The electric power sector was centrally managed by TAVANIR (Iran Power Generation, Transmission & Distribution Management Co.), a state owned enterprise. However, from October 2015, thermal power generation was separated as shown in Figure 2.1-2, with thermal power generation the responsibility of the Thermal Power Plants Holding Company (TPPH), and other power generation, transmission and distribution of the responsibility of TAVANIR.

TPPH was formed by separation of Iran Power Development Co. (IPDC) from TAVANIR, of which it was formerly a subsidiary.



Source: Prepared by the JICA Study team

Figure 2.1-2 Basic Configuration of Electric Power Sector

2.1.2 TPPH

a. Objectives of TPPH

TPPH has started its official activities on September 10 in 2015, TPPH is introduced as follows on its website.

http://www.tpph.ir/en/SitePages/HomePage.aspx

The objectives of the company is defined as follows:

- Planning, management and development of capacities for thermal power generation based on comprehensive programs of the Ministry of Energy and regulations
- Organizing and managing all thermal power producers that belong to the government in whole or in part

The parent organization for the establishment of TPPH is Iran Power Development Company (IPDC), the name was changed from IPDC, the relevant departments were transferred from TAVANIR, and the personnel and their roles were strengthened. IPDC itself was established in 1989 as a subsidiary of TAVANIR, but with its re-organization to TPPH it became an MOE subsidiary.

IPDC was responsible for development and construction of power plants, improvement in generation capacity, and planning of power plants within the country. In addition they undertook planning and implementation of national projects, optimization and extension of transmission lines, and development and construction of dispatching centers and related communication network and optical fiber systems.

b. TPPH organization chart and details of its business

Also, according to the information on the company's website, the details of the company's business are as follows.

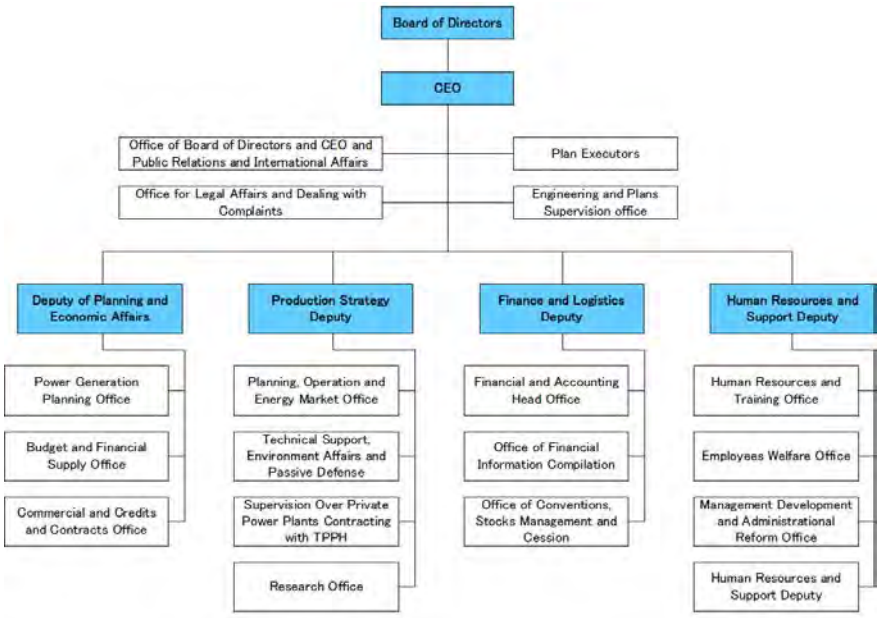
The duties of the company is defined as follows:

1. Planning and management (development and utilization) of capacities of thermal power generation in the framework of comprehensive and macro-scale plans of the Ministry of Energy.
2. Organization and management of thermal power generation companies, their stocks belong to the company partially or entirely.
3. Development of governmental thermal power generation development in the framework of relevant regulations.
4. Cooperation with concerned institutes for transferring public power plants and stocks of the government in the power generation companies to the non-governmental sector and increasing the share of this section in power generation in the framework of the regulations.
5. Performing the necessary measures for attaining the non-governmental sector participation in the establishment of new power plants, development of capacity and optimization of existing power plants for the realization of the programs approved by the Ministry of Energy
6. To execute policies, plans and approvals of the Ministry of Energy
7. Management of stocks and capitals of the company in affiliated companies
8. To take necessary measures and cooperation for assigning a part of the stocks of the company through stock exchange company
9. To show necessary supports for increasing the productivity of production agents in the affiliated companies
10. To receive any financial facilities, to distribute participation bonds and other methods for providing financial sources by observing legal measures
11. Management, development and providing financial sources, and optimized use of those resources through establishing financial facilities and circulating financial sources between the company and affiliated companies
12. Optimized use of the interests earned by the investments and other local sources of the company and subsidiary companies for protecting private sector for the purpose of establishment, development and optimization of installations and supplying facilities and power generation services. The company is authorized to establish, develop and optimization of governmental power generation by using the above-mentioned resources.
13. Promotion of thermal power plant outputs by developing methods such as simulators generation of power, heat and cooling and producing sweet water by using recycled heat.
14. To take necessary actions and supports for lowering pollutants and greenhouse gas caused by thermal electricity generation
15. Supporting risk-taking investments by using financial institutional capacities and local sources of the company
16. Management and coordination between affiliated companies and directing them towards policies determined by the Ministry of Energy
17. Supervision on the management and financial systems of subsidiary companies
18. To perform any executive, engineering, commerce, financial, transactions, and investment operations, participation in other institutes and companies that act in line with the policies of the Ministry of Energy in connection with the object of company by observing the relevant laws and regulations.

19. To support and protect research activities, innovation and technology in the scope of company activities

As above, TPPH bears an important role in technical aspect of thermal power plant. They have a relationship with new thermal power plants constructed by Russian, Chinese and other companies during economic sanctions. As the result, they have been evaluated as it is possible to contract based on the international standard (FIDIC and etc.) in case of a loan assistance between governments in future.

Figure 2.1-3 shows the organization chart of TPPH. The Deputy of Planning and Economic Affairs is responsible for power station planning and management, budgeting, and financial aspects, etc., and the Production Strategy Deputy carries out planning and operation, environmental, privatization, and other work.



Source: TPPH

Figure 2.1-3 TPPH's Organization Chart

Figure 2.1-4 is a photograph of its headquarters building, and currently it has about 600 employees.

Figure 2.1-4 Photograph of Headquarters Building of TPPH

The policies of the company is defined as follows:

- Constructing steam units on combined cycle power stations by absorbing private-investment in the form of buyback contracts.
- Constructing a new generation of combined cycle power stations (with F class technology and above) by advocating to localization of construction technologies, inauguration, exploitation and repairing these power stations.
- Planning and executing rehabilitation, renovation and outcome improvement plans for actual thermal power plants.
- Managing water resource and consumption by a reform in power station's cooling system and a replacement in water providing methods.
- Attracting domestic and foreign private investment in construction and exploitation of thermal power stations.
- Resolving any issues related to remaining contracts to reduce cost and directing THHP's financial resources
- A thorough payment on debts and commitment in previous years
- Share and capital management in affiliate companies and executing appropriate measures to privatizing state-run power stations
- Developing human resource, a structural reform and process revision to increase exploitation and promoting administrative system
- Using new methods to provide finance for projecting either direct investing, foreign financing, buyback contracts, banking facilities, bonds, interior incomes.
- Using legal capacities to remove obstacles on competitive production in order to finance projects
- On-time repairs and improving power stations, fuel consumption managements and other appropriate policies to promote productive elements' exploitation.
- Generating stable electricity suitable for Iran's national electricity network by directional supervision on constructing and exploiting thermal power stations.
- Effective interaction with electricity market from affiliate companies.
- Prioritizing environmental, safety and social issues on exploitation fields and development of thermal power stations.

- Prioritizing effective researches and constructive relations with academic and scientific institutions.

c. Power Stations Associated with TPPH

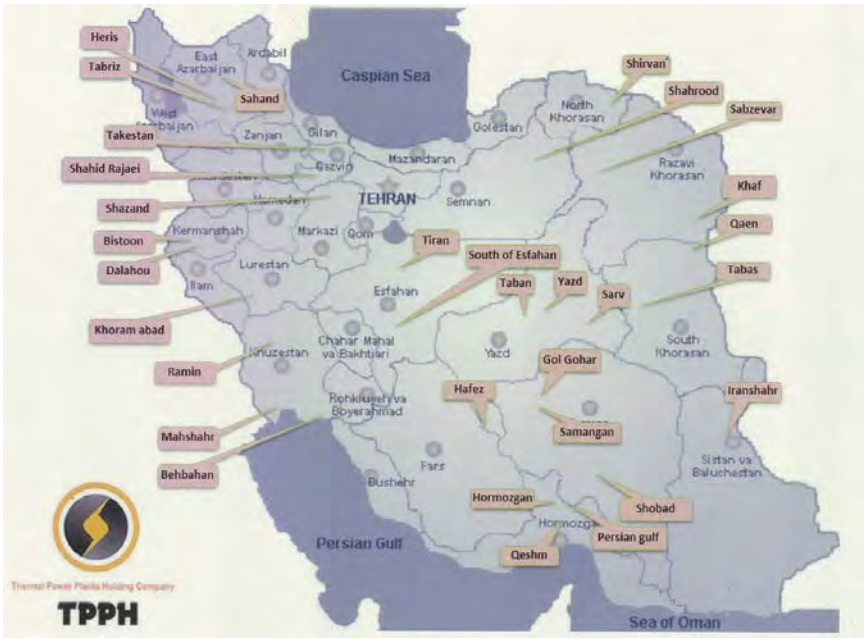
The following table shows the breakdown of the annual results of the power stations managed by TPPH since the era of the former IPDC, according to the generation type. From 1996 until the present a capacity of 37,010 MW has been developed.

Table 2.1-1 Development of Thermal Power Stations by IPDC/TPPH since 1996

Thermal Power Station Development by the Company Since 1996

	Exploited Capacity per Year (Megawatt)																				
Power Station Type	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	**Total**
Combined Cycle Gas Sector	492	1107	123	0	246	795	1041	1041	1938	1755	2754	2649	2388	1443	3078	1944	1296	162	1790	324	656	**27022**
Combined Cycle Steam Sector	296	148	0	107	214	300	496	304	0	0	480	480	480	480	320	160	640	640	320	0	160	**6025**
Steam	64	64	715	715	650	650	64	64	325	325	0	0	0	0	0	0	0	0	0	0	0	**3636**
Other Projects	0	0	0	0	0	0	0	0	0	0	0	82,6	3,5	50	0	8	8	75	75	25	0	**327**
Total	852	1319	838	822	1110	1745	1601	1409	2263	2080	3234	3211,6	2871,5	1973	3398	2112	1944	877	2185	349	816	**37010**

In addition, Figure 2.1-5 shows the locations within Iran of recent projects relating to thermal power stations in which TPPH is involved, and Table 2.1-2 shows the main projects currently being implemented.



Source: Web page of TPPH

Figure 2.1-5 Locations of Thermal Power Generation Projects Covered by TPPH

Table 2.1-2 Main Projects Currently Being Implemented

	Project Name	Unit Number & Capacity (Megawatt)	Total Capacity (Megawatt)	Power Station Name and Number of Units under Execution
Plans on Execution	22 Units Combined Cycle Plan	3*160	480	Shirvan (3 Units)
	6000 Megawatt Gas Power Station Phase 2	2*162	324	Mahshahr (2 Units)
	Private	4*162 5*160	1464	Showbad (Kahnouj) phase 1 (1 Steam Unit), Taban (Sadough) phase 1 (1 Unit), Golgohar (Sirjan 2) (3 Units), Samangan (Sirjan 1) (3 Units), Behbahan (1 Units)
	Total		**2268**	
First Steps	6000 Megawatt Gas Power Station Phase 2	4*162	648	Zarand Kerman (2 Units), Zahedan (2 Units)
	Payback Projects (Public and Private)	46 Units	7512	Iranshahr (1 Unit), Shahroud (1 Unit), Shahid Kaveh (2 Units), Persian Gulf (3 Units), South Isfahan (3 Units), Hafez (3 Units), Mahshahr (2 Units), Hormozgan (2 Units), Roudshour (1 Unit), Chabahar (1 Unit), Kashan (1 Unit), Uremia (3 Units), Semnan (1 Unit), Soltanieh (2 Units), Zagros (2 Units), Sabalan (3 Units), Aliabad (3 Units), Parand (3 Units), Ferdowsi (3 Units), Asalouyeh (3 Units), Jahrom (3 Units
	Construction and Development of Steam Power Stations	4*325	3330	Tosee Ramin Ahvaz (2 Units), Tosee Shazand (2 Units)
		4*350		East Bandar Abbas
		2*315		Tosee Bisotoun (2 Units), under negotiations
	Tabas Coal Power Station	2*325	650	Tabas Coal Power Station (2 Units), under negotiations
	Private power station plans	-	4818	Qeshm Movaled (3 Units), West Mazandaran (3 Units), Khoramabad Phase 1 (3 Units), Dalahou (2 Units), Maku (3 Units), Haris (2 Units), Sabzevar (3 Units), Andimeshk and Dezfoul (3 Units), Miyaneh (2 Units), Zahedan 2 (3 Units), Zanjan 2 (3 Units), South Fars (3 Units)
	Total		**16958**	
	Whole		**19226**	

Source: Web page of TPPH

The capacity of thermal power generation plants whose construction TPPH was involved with since 1996 amounts to 37,010 MW (248 units), of which the capacity of power stations constructed by the private sector based on supervision and guidance of TPPH amounts to 10,961 MW (72 units).

Table 2.1-3 Thermal Power Station Installation Capacity in Iran (actual result)

Thermal Power Station Installation Capacity in Iran According to Statistics

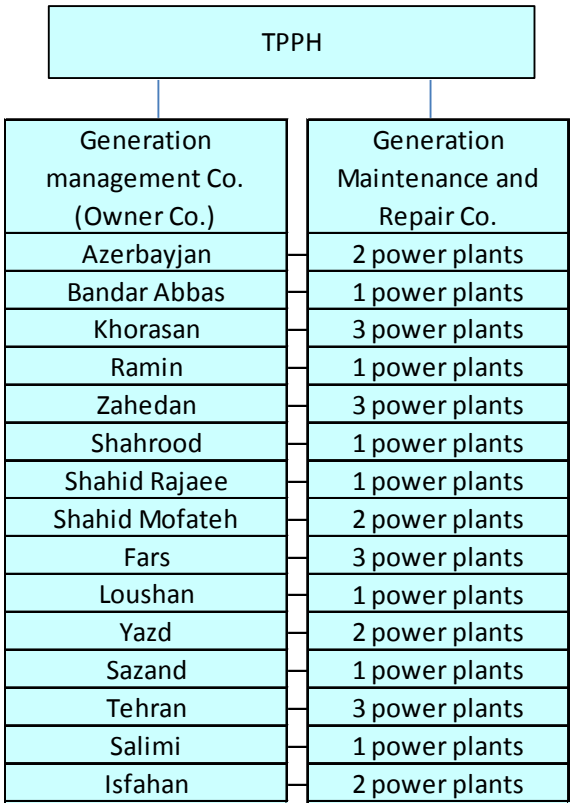
Period	Megawatt
Since the beginning	75011*
Before Islamic Revolution	7024
1979-1995	21914
Since 1996	53106
Installed Capacity Rate by the Company Since 1996 to Present	37010 (248 units)
	National Capacity Rate 69,69%
Installed Capacity Rate by Private Sector under Company's Supervision	10961 (72 units)
	Installed Capacity Rate by the Company 29,61%

*By Counting Boushehr Nuclear Power Station's 1000 Megawatt

Source: Web page of TPPH

d. TPPH's subsidiary company

With the independence of the thermal power generation field, the TAVANIR thermal power generation subsidiary was also transferred to TPPH. As described later, privatization (sale) of publically operating power plants is in progress, but at present publically operated power plants remain. 15 generation management companies (owner companies) and 27power generation maintenance and repair companies have been transferred to TPPH. The roles are divided in the thermal power plants: the generation management companies own, operate, and manage the power plants, and the power generation maintenance and repair companies are responsible for maintenance and repair, etc.



Source: TPPH

Figure 2.1-6 TPPH Organization Chart

2.1.3 TAVANIR

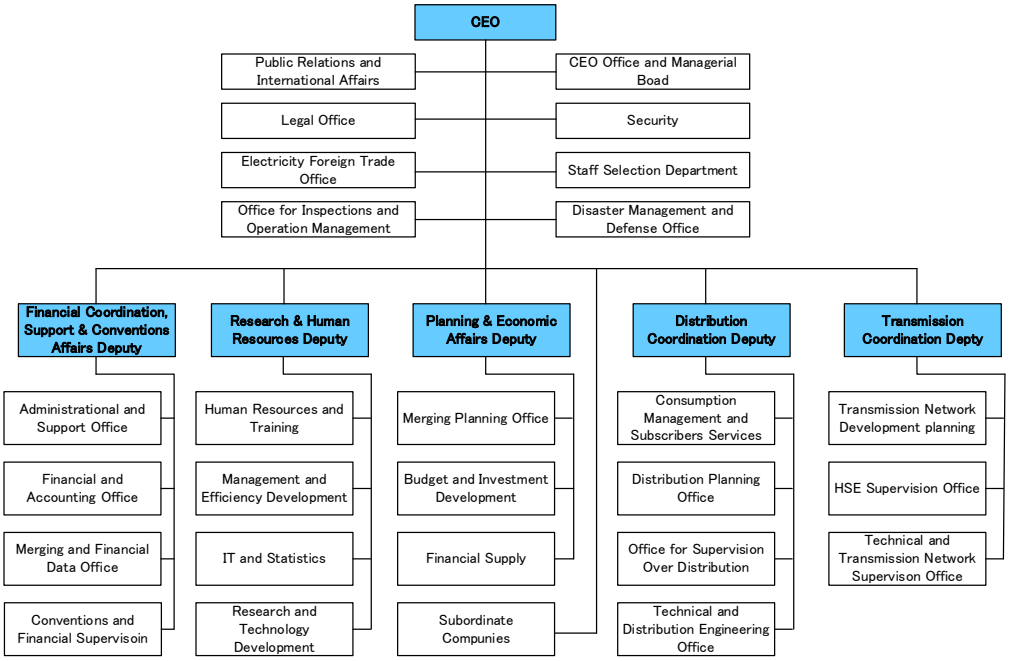
a. Objectives of TAVANIR

TAVANIR is responsible for generation apart from thermal power, and for transmission and distribution. TAVANIR is also a holding company, and they carry out indirect work such as planning and policy making, and the direct work is undertaken by its subsidiaries. Note that TAVANIR is a subsidiary of the MOE and gets its status from the Deputy Minister of Energy for Electricity and Energy Affairs, and can be considered to be one of the departments of MOE.

Originally TAVANIR was established in 1970 under the Ministry of Water and Power (name changed in 1970 to Ministry of Energy), and its initial purpose was to enhance the power generation capacity and the substation capacity, as well as to develop the transmission and distribution network. According to their website, at present the purpose of TAVANIR is “to organize the government’s supervisory activities in the field of operation and development of the electric power industry within the framework of the policy of the Ministry of Energy, to improve the efficiency and productivity of related companies, to manage the optimum utilization of electric power facilities, and to carry out specific important matters in the supervisory and planning fields on behalf of the MOE”.

TAVANIR is a state owned company responsible for transmission and distribution of electric power within Iran. The subsidiaries of TAVANIR include 16 regional electric companies and 39 distribution companies. In addition, it has overall control of the management of Iran Grid Management Company (IGMC), Renewable Energy Organization of Iran (SUNA), Iran Energy Efficiency Organization (SABA), and Iran Power Plant Maintenance Company.

The organization chart of TAVANIR is shown in Figure 2.1-7.

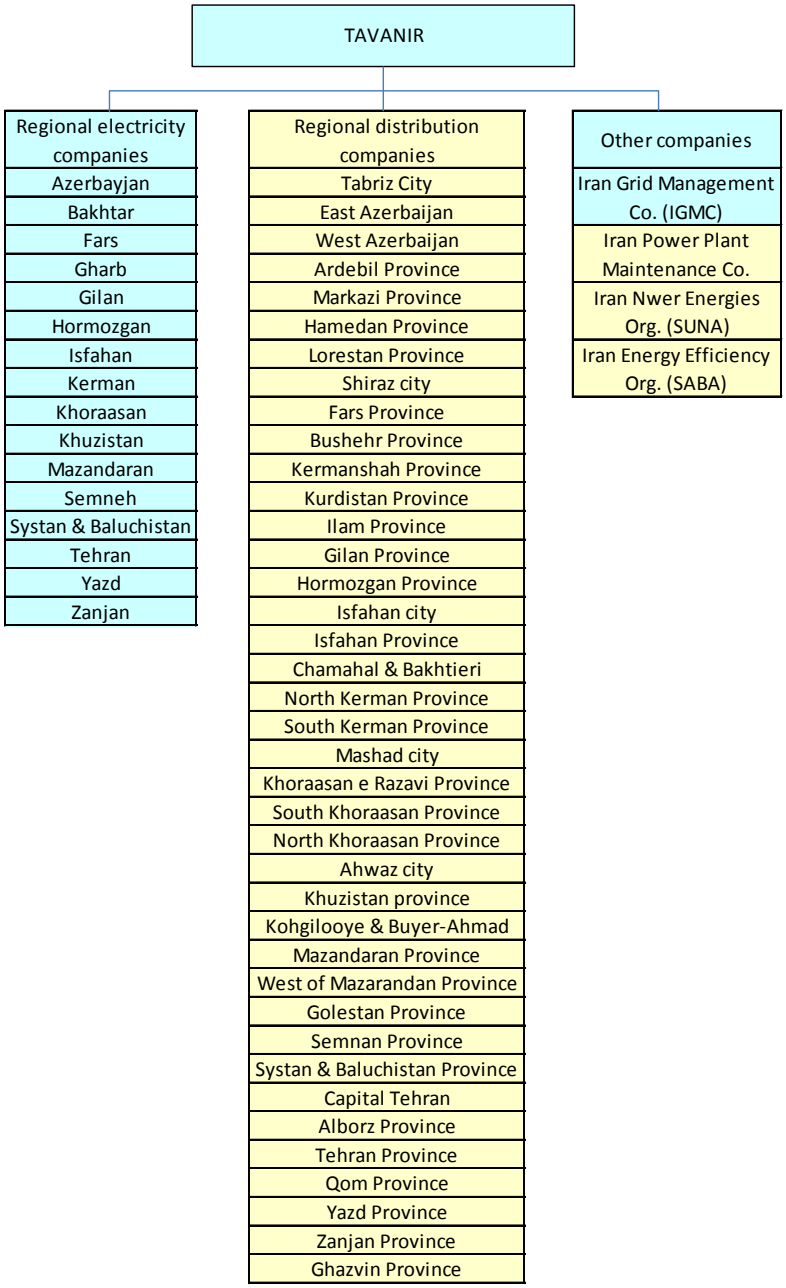


Source: TAVANIR

Figure 2.1-7 Organization Chart of TAVANIR

b. TAVANIR's subsidiaries company

Electric companies and distribution companies are divided into each region, and each company has a monopoly on transmission and distribution in that region. What changes the characteristics of the regional distribution companies is the fact that, unlike the electric companies and their subsidiaries which are subsidiaries of TAVANIR, the regional distribution companies are privatized, with TAVANIR having a 40 – 50% ownership share. Therefore they are not subsidiaries, but affiliated companies.



Source: TPPH

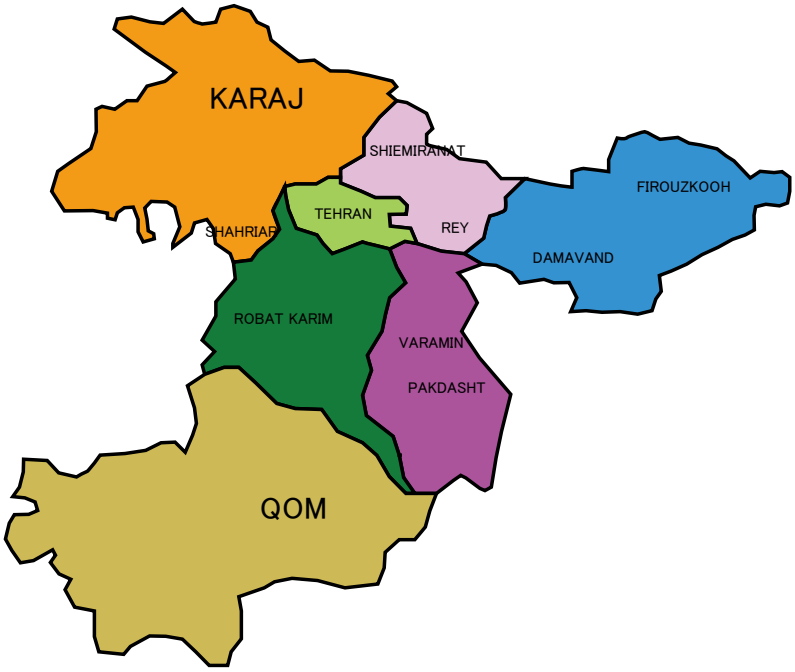
Figure 2.1-8 TAVANIR Organization Chart

c. TREC(Tehran Regional Electric Company)

Operation of the transmission and substation equipment is carried out by 16 regional electric companies, that are subsidiaries of TAVANIR.

The regional electric companies plan their own new and expanded facilities, repairs, etc., but in the case of large-scale repairs or expansion projects, the approval of TAVANIR must be obtained.
Tehran Regional Electric Company (TREC) is the largest of the regional electric companies, and is the regional electric company that supplies the capital, Tehran, and surrounding two states.

The supply area of TREC is as shown in Figure 2.1-9, the area is about 30,000 km², in which 23% of the population of Iran is living.



Source: Obtained from TREC, and prepared by the Study team

Figure 2.1-9 Tehran Regional Electric Company Territory

TREC supplies the capital Tehran from the past, so much of the equipment is old, and about 1/3 of the 400 kV and 230 kV main system substations are more than 30 years old, which requires replacement of transformer equipment. Therefore, rehabilitation is necessary, and a renewal plan has been formulated.

Among TREC's substations, in the case of primary system equipment that is more than 30 years old, there are substations for which reliability is a problem during an accident because of omission of breakers in some cases, and there are some substations where because of the omission of a substation bus, during a transmission cable accident an excessive load is placed on the equipment on the intact side.
The problem points have been determined and plans for modification have been prepared, but due to funding problems, etc., at present they are operated as they are.

The current equipment is well-maintained, and the operators are very knowledgeable, but as stated previously some substations are being operated that have a problem with reliability.

Figure 2.1-10 shows the organization chart for TREC, one of the regional electric companies.

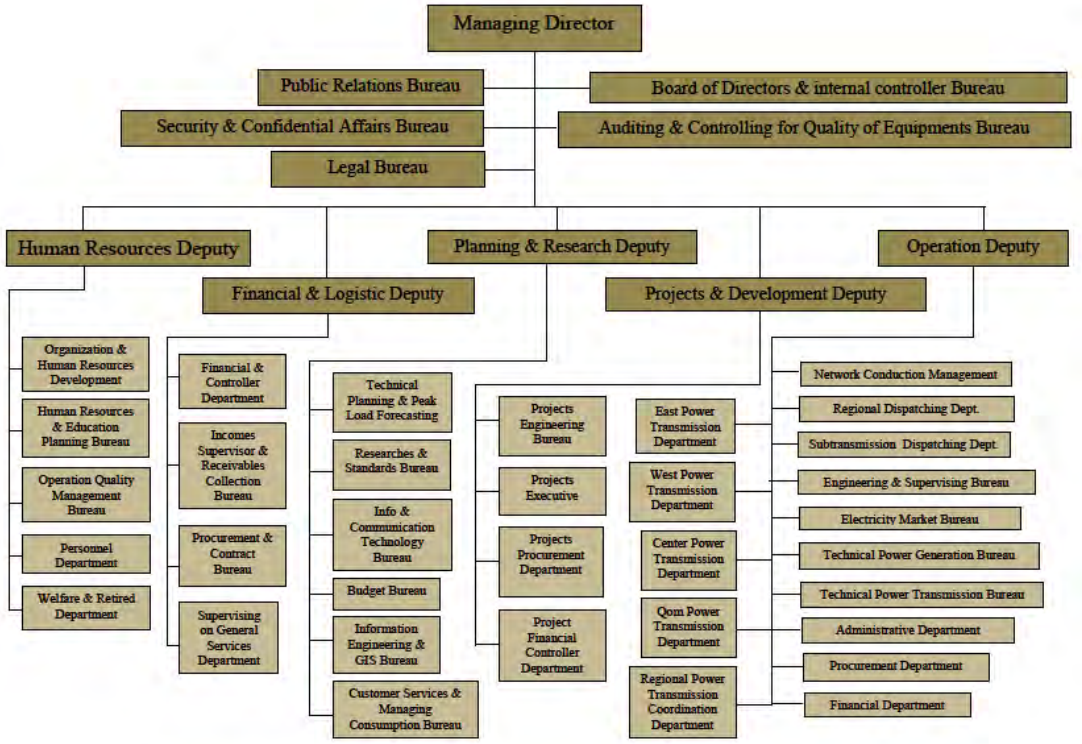


Figure 2.1-10 TREC Organization Chart

TREC owns, operates, and manages the transmission and distribution equipment. The number of substation staff varies depending on the location, but the standard personnel are six operation and management engineers, plus 14 including the plant manager, security staff, drivers, etc., for a total of 20 persons. The operation and management engineers operate on a two person three shift system (one cycle is a 24-hour period from 8:00 to 8:00).
Also, among the old substations, there are substations with a 63 kV control room separate from the 400 kV and 230 kV control room. One operating and management engineer is stationed in these control rooms (one person, three shifts), to operate and manage the 63 kV equipment.
In these substations, it is desirable that the monitoring rooms be integrated, to achieve reductions in personnel and improve efficiency.

When the operation and management engineers detect a problem with the equipment, they contact the dispatching center, and the equipment repairs are carried out by a repair company affiliated with TAVANIR.

d. Other the subsidiaries and affiliated companies of TAVANIR

Regional Distribution Companies

Of the 39 regional distribution companies, several are responsible for major cities. There are three distribution companies in Tehran. The others are responsible for wide area (provinces).

The regional distribution companies were privatized in accordance with the 2007 Act on the Independence of Regional Distribution Companies. All 39 regional distribution companies were privatized. However, TAVANIR retained shares in the companies, and own 40 – 50% of the regional distribution companies. They were not completely privatized, and TAVANIR can exercise some influence as they are affiliated companies of TAVANIR. It is considered that this is a measure to ensure that the distribution companies are managed within the framework of the policies of MOE.

Iran Grid Management Co. (IGMC)

IGMC is a state-owned company, and its work is supervised by TAVANIR. The MOE Market Committee carries out supervision of the performance of the e-marketplace, which is a job related to IGMC.

This company was established in order to provide a sound competitive environment between electric power supply companies in accordance with the national electric power industry policy, to attract private sector investment into electric power generation, to reduce government interference in the electric power industry, to allocate subsidies to electric power, to respect the right of customers to choose, and to establish the market to store electricity[1].

Iran Power Plant Maintenance Company (IPPMC)

IPPMC was established to overhaul and carry out periodic repairs to power plants and high voltage substations, and to manufacture and modify spare parts that are required for domestic power plants. One of their important roles is to enable self-sufficiency in electric power to be realized. At present it is an affiliated company of TAVANIR. The activities of IPPMC include mechanical repairs, power plant repairs, electric repairs, equipment policy matters, joint export matters in association with SANIR, and repair parts policies. TAVANIR owns 49.9% of the shares of the company[1].

Renewable Energy Organization of Iran (SUNA)

The TAVANIR affiliated company SUNA was established in 1996, and carries out the following roles to promote the development and use of renewable energy and new energy resources.

[1] TAVANIR website; http://amar.tavanir.org.ir/pages/report/stat85/sanatlhtml/Structure.htm

- Project research and development, publication of educational and beneficial pamphlets and booklets, design and consultancy for testing plans, and technical and economic support for the development of the capability to efficiently utilize energy and new energy by the private sector.
- Planning and project management related to the organization's mission
- Cooperation and sharing with companies and other organizations in order to achieve the organization's set mission.
- Execution of other tasks defined by TAVANIR within the framework of the fields of activities of the organization.
- When implementing any task, the actions shall be carried out in accordance with the organization's objectives[1].

Iran Energy Efficiency Organization Org. (SABA)

SABA is an affiliated company of TAVANIR that was established in 1996 to carry out the following tasks.

- Implementation of energy and load management in each region of the country.
- Provision of consulting to provide measuring instruments and provision of information services.
- Surveying and regulation of the level of energy consumption by electric equipment and industry within the country.
- Provision of low interest loans to implement energy efficiency projects and assist facilities.
- Publication and cultural activities to expand the cooperation of the people in optimization of energy consumption, jointly with the national broadcasting media[1].

2.2 Policy of Electric Power Sector

2.2.1 Privatization

a. From nationalization to privatization

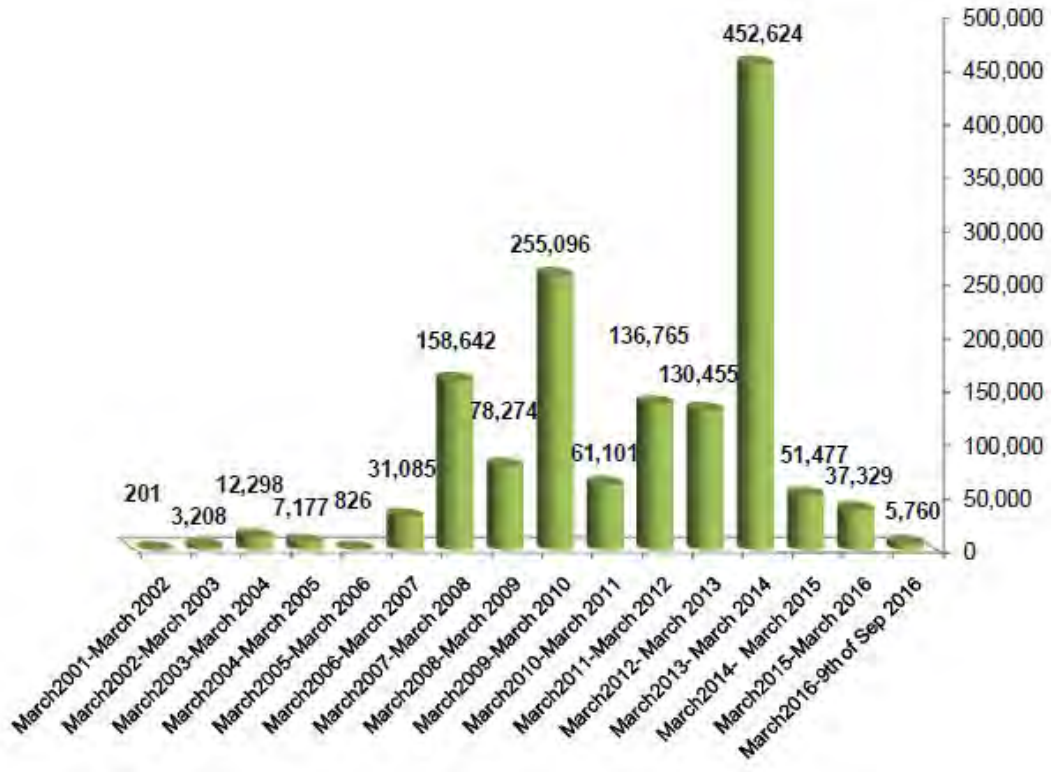
Privatization of nationally and publically operated companies is a policy that is necessary in many countries from the point of view of economic efficiency and financial reform, and Iran is no exception.

After the Islamic Revolution many companies were nationalized. By the Act for Protection and Development of Iranian Industries, companies that had received a certain level of finance from banks, companies associated with the royal family, companies that had carried out illegal transactions, land owned by those that had escaped overseas, etc., was nationalized. As a result

of the economic sanctions and the Iran-Iraq War, it was necessary to adopt closed and centralized economic policies[2].

Following the end of the war, the first movements towards privatization came in the early 1990s in the first Five-year Economic Development Plan (1990 – 1995). Efforts were made to utilize private sector dynamism in the electric power sector as it was necessary to increase generation capacity in response to the rapidly increasing demand for electric power. In this case it was limited to the electric power field, but failed.

Privatization in the electric power sector started in earnest in the 2000s. In 2001 the Iranian Privatization Organization (IPO) was established as the organization to implement privatization under the Ministry of Economic Affairs and Finance. Also, in 2004 Article 44 of the Constitution was amended, to enable privatization to be freely interpreted and enable state companies in important sectors to be efficiently privatized. The Supreme Leader Ayatollah Khamenei indicated that 80% of state-owned companies would be privatized in accordance with the Constitution[1]. Also in the electric power sector in 2004, the organization of TAVANIR was changed by the enacting a law. Power plants were made into separate companies, and authority was granted to sell 65% of the shares on the Tehran Stock Exchange[3]. Also, in the same year IGMC was established, and preparation of the Iranian Electrical Market (IEM) commenced.



Source: IPO website

Figure 2.2-1 Trend in Privatization (Billion IRR)

[2] Privatization of industries in Iran: a case study of Tehran city, Chapter 3, Privatization in Iran trends & issues, Aliasghar Hadizadeh, University of Mysore, 2010

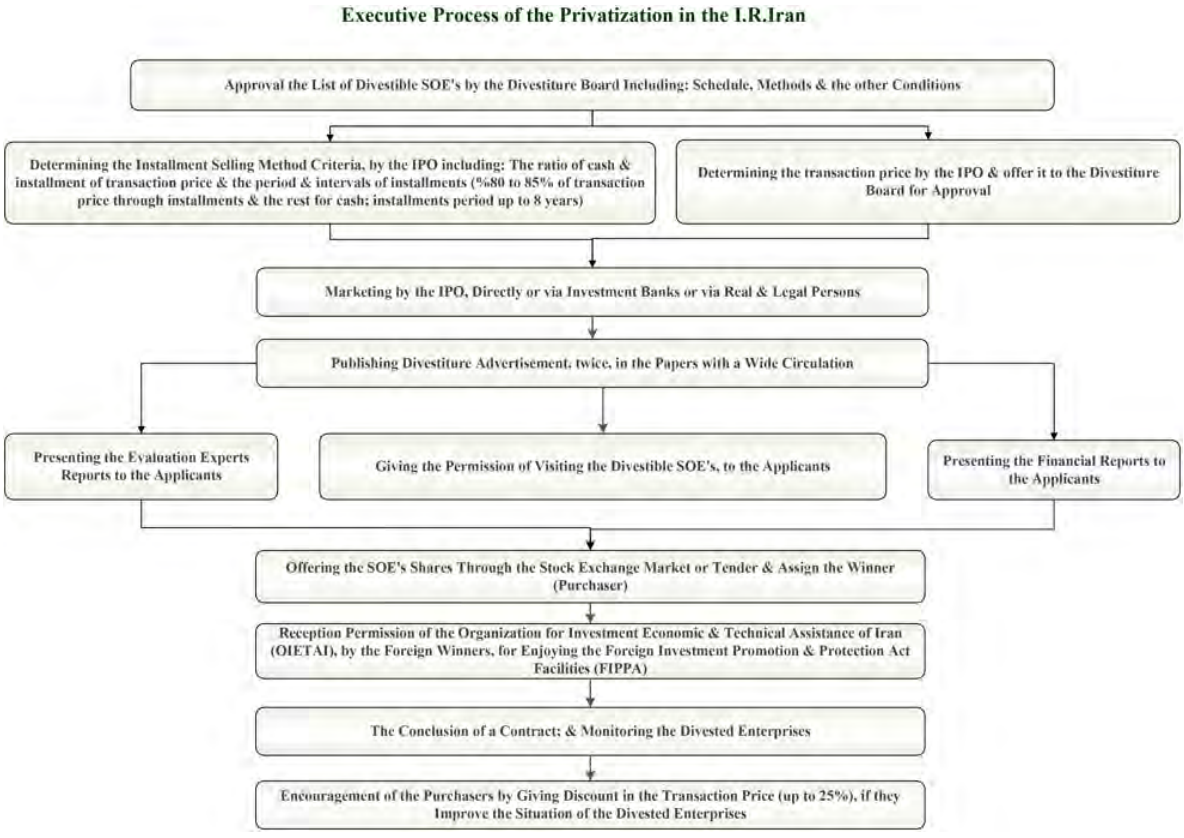
[3] Iran announces new plans for privatization and structural reform in the power sector, Written by Adrian Creed and Dr. Amir Kordvani, May 2014

As shown in the figure above, privatization of state-owned companies was carried out in earnest from the middle of the 2000s onwards, reaching a peak in 2014 with a small hiatus thereafter. The cumulative value of privatization is 1,422,319 billion IRR (108,219 million USD)[4].

b. Method of privatization

When the movement towards privatization started in Iran in the 1990s, there was no central organization responsible for privatization, and this was one reason that privatization was insufficient at that time. IPO is an independent company established in 2001 by the Ministry of Economic Affairs and Finance in order to promote privatization, and as its name suggests, it is an organization to implement privatization by separation from government ministries and agencies. The Deputy Minister of Energy for Electricity and Energy Affairs is the Director of Executive Board and Managing Director.

The procedure of privatization by IPO is as follows.



Source: IPO website

Figure 2.2-2 Privatization Procedure

[4] IPO website

c. Privatization in the electric power sector

Privatization was implemented in the electric power sector from the late 2000s onwards. Privatization was carried out in the generation and distribution fields, but transmission was exempt from privatization in accordance with Article 44 of the Constitution.

Privatization was carried out through IPO. According to the MOE, the companies to be privatized were selected by the MOE, but the method of privatization itself was the best method as determined by IPO. According to TPPH, privatization of power plants was carried out by selling shares on the Tehran Stock Exchange. Privatization was carried out by selling the shares of the Generation Management Co. and the Generation Maintenance & Repair Co. as a set, and the sale was for the highest price by auction. There is one share owner, and although the sale was carried out through the Tehran Stock Exchange, the shares are not listed there. Of course if the shareholder wishes they can list the shares on the stock exchange, but at present the companies are not listed.

The following is a list of the privatized power plants. To date 35 power plants have been privatized. In the electrical power sector, in particular in the power generation sector, many of the power plants in Iran are old, and large scale repairs are necessary at many of them. However, there is a limit to the improvement that can be implemented with the current finances in Iran. This factor is also affecting the privatization in the electrical power generation sector.

Table 2.2-1 Privatized Power Plants

No	Name	Capa (MW)	Type
1	Tabriz	736	Steam
2	Shahid Mohammad Montazeri	1616	Steam
3	Montazerghaem	625	Steam
4	Birch	600	Steam
5	Mashhad	133	Steam
6	Zergan (Shahid Modhej)	290	Steam
7	Tabriz	64	Gas Turbine
8	Orumia	960	Gas Turbine
9	Sabalan	960	Gas Turbine
10	Kashan	324	Gas Turbine
11	Parand	954	Gas Turbine
12	Shariati	150	Gas Turbine
13	Mashhad	196	Gas Turbine
14	Shams fern	50	Gas Turbine
15	Zergan (Shahid Modhej)	128	Gas Turbine
16	Soltanieh	648	Gas Turbine
17	Jerusalem (Semnan)	324	Gas Turbine
18	Chabahar	414	Gas Turbine
19	Zagros	648	Gas Turbine
20	Jahrom	954	Gas Turbine
21	Kahnooj	75	Gas Turbine
22	Noshahr	47	Gas Turbine
23	Yazd Shahid lily	97	Gas Turbine
24	Sarv (Chadermalu)	332	Gas Turbine
25	Khoy	349	Combined cycle
26	Montazerghadem	998	Combined cycle
27	Damavand	2868	Combined cycle
28	Qom	714	Combined cycle
29	Shariati	347	Combined cycle
30	Neyshabur	1040	Combined cycle
31	Abadan	814	Combined cycle
32	Sanandaj	956	Combined cycle
33	Fars	1035	Combined cycle
34	Kazeroon	1372	Combined cycle
35	Gilan	1306	Combined cycle

Source: Obtained from TAVANIR

All the regional distribution companies were privatized. Unlike the generation companies, not all of the company shares were sold, but some were retained as TAVANIR's shareholding. Between 40 to 50% of the shares was retained as TAVANIR's shareholding. Note that the regional distribution companies are not listed on the Tehran Stock Exchange, either.

Another example of privatization in the electric power sector is the MAPNA Group. Originally the main business of the MAPNA Group was construction of power plants, but now they have branched into various directions such as oil and gas, rail transportation, manufacture of equipment, etc. The MAPNA Group is listed on the Tehran Stock Exchange, and in 2010 it was the fourth largest company on the Tehran Stock Exchange. In the past, the MAPNA Group was an affiliated company of TAVANIR, with the main shareholders SABA Investment Company 51%, TAVANIR Holding 39%, and Sazman Gostaresh va No Sazi Sanaye Iran 10%. However, at present 90% of the shares are owned by SABA, Edalat Brokerage, MAPNA Employees Investment Co. and Ayandeh Negar.

2.2.2 Use of private sector vitality

In Iran, it is anticipated that the demand for electrical power will continue to increase in the future, as the population increases and a better standard of living has been achieved, so more sources of electrical power are necessary. However, due to the financial circumstances of the government, it is difficult for the Iranian government to provide all of these new sources of electrical power. Since the year 2000, the Iranian government has been using private-sector investment for the construction of power stations in contracts with the format of Build, Operation, and Transfer (BOT) and Build, Own, and Operate (BOO)[5].
Incentives have been provided for the construction of private sector power stations, and the policy calls for investment from both within Iran and overseas. The following are the incentives provided by the government for operation of combined cycle power stations[6].

- BOO contract
- 5 year Energy Conversion Agreement (ECA)
- Purchase price standard of USC2.6/kWh
- Revision of price in response to rises in commodity prices and fluctuations in exchange rates
- Promotion of acquisition of environmental and other licenses
- Approval of export after the 5 year ECA period
- Payment guarantees from the government

For BOO or BOT, TPPH (TAVANIR until 2015) prepares the project (power station) plan, and calls for public tenders from private operators to receive the BOO or BOT contract. TPPH enters into a contract with an operator selected in the tender, the operator constructs the power station in accordance with the specification prepared by TPPH, and carries out operation throughout the contract period. The difference between BOO and BOT is that upon ownership of the building. That is, with BOO the operator conserves ownership of the building, with BOT on the contrary, ownership of the power station will be transferred to TPPH after completion of the contract period.
Development of social capital by the private sector under a BOO contract has the following merits[5].

1. Increase in national production by the private sector due to the transfer of ownership and management of projects from the government sector to the private sector.

[5] Considering of BOO Contract in project management & its role in developing of rivatization, Nouredin Gandomi & Shiva Rezai, The 4th International Conference on Innovative Research in Management, Economics and Accounting, July 2016
[6] Investment opportunities and incentives in power industry, 2nd business forum Iran Europe, Ministry of Energy Iran, March 2016

2. The effect of privatization on the government budget is to create budget flexibility by reducing financial expenditure.
3. One other effect of privatization is improvement in economic efficiency, so privatization is considered to be one tool for improvement in government operations.

The following shows the evolution of power station development by BOO and BOT, the power stations operating as of 2016, and, the power stations under construction by BOO and BOT schemes.

Table 2.2-2 Evolution of Power Station Development by BOO and BOT

Private Power Station Units under Operation by Yea

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
Capacity (Megawatt)	795	687	1268	1116	698	1134	1458	1294	555	1140	327	492	**10961**

Source: Website of TPPH

Table 2.2-3 Power Stations Developed by BOO and BOT Operating as of 2016

Synchronized Private Power Stations

Power Station Name	Number and Capacity of Synchronized Units (Megawatt)	The Amount of Synchronized Megawatt
Chehelsotoun (South Isfahan) (BOT)	6*159	954
Roudshour (BOO)	3*264	792
Ferdowsi (BOO)	6*159	954
Asalouyeh (Mapna) (BOO)	6*159	954
Khoramshahr (BOO)	6*162	972
Golestan (Aliabad) (BOO)	6*162	972
Zavareh (BOO)	1*160+2*162	484
Fars (Hafez) (BOT)	6*162	972
Pareh-sar (BOT)	2*160+4*162	968
Kahnouj Small Scale Steam (BOO)	3*25	75
Nowshahr Small Scale Steam (BOO)	2*25	50
Kashan	2*162	324
Gonaveh (BOO)	1*160+2*162	484
Shirkouh (BOO)	1*160+2*162	484
Ardakan (Chadormalou) (BOO)	1*160+2*166	492
Showbad (Kahnouj) (BOO)	2*162	324
Shams Sarakhs (BOO)	2*25	50
Taban (Sadough) (BOO)	2*162	324
Behbahan (BOO)	2*166	332
Total Number (19 Power Station)	**72**	**10961**

Source: Website of TPPH

Table 2.2-4 Power Stations under Construction by BOO and BOT Schemes

Private Power Stations under Construction in BOO or BOT		
Power Station Name	**Construction Unit**	**Investor**
Showbad (Kahnouj) 968 Megawatt Combined Cycle Power Station	160 Megawatt Steam Unit (the rest of the first phase 484 Megawatt)	Arian Mah Tab Gostar
Taban (Sadough) 968 Megawatt Combined Cycle Power Station	The first phase with 484 Megawatt capacity	Iran Investment
Behbahan 984 Megawatt Combined Cycle Power Station	160 Megawatt Steam Unit (the rest of the first phase 492 Megawatt)	Mapna
Khoramabad (1) 968 Megawatt Combined Cycle Power Station	The first phase with 484 Megawatt capacity	Sana va Farab
Dalahou (Islamabad) 968 Megawatt Combined Cycle Power Station	The first phase with 484 Megawatt capacity	Farab
Golgohar (Sirjan) 484 Megawatt Combined Cycle Power Station	484 Megawatt combined cycle	Gohar Energy Sirjan, Golgohar Sang-e-Ahan, Omid Investment, Mines and Metals Development Investment and Goharzamin Sang-e-Ahan Cooperan
Sirjan (Samangan) 484 Megawatt Combined Cycle Power Station	484 Megawatt combined cycle	Kanimes, Qods Niro, Kerman Tableau, Mes Business Service, Tosee-Abadani Kerman
Lamard 968 Megawatt Combined Cycle Power Station	The first phase with 484 Megawatt capacity	Ghadir Investment
Maku 100 Megawatt Combined Cycle Power Station	100 Megawatt	Golbargh Uremia
Haris 968 Megawatt Combined Cycle Power Station	The first phase with 484 Megawatt capacity	Omid Tabanhour, Alvand Power Station, Tana Energy, Atiye Karkonan Bank-e-Sepah Cooperation
Total power Stations under Construction	**3808 Megawatt**	

Source: Website of TPPH

Chapter 3 Present Status and Future Plans in Iran

3.1 Present Status of Supply & Demand / Forecast Demand

3.1.1 Present status of electric power demand in Iran

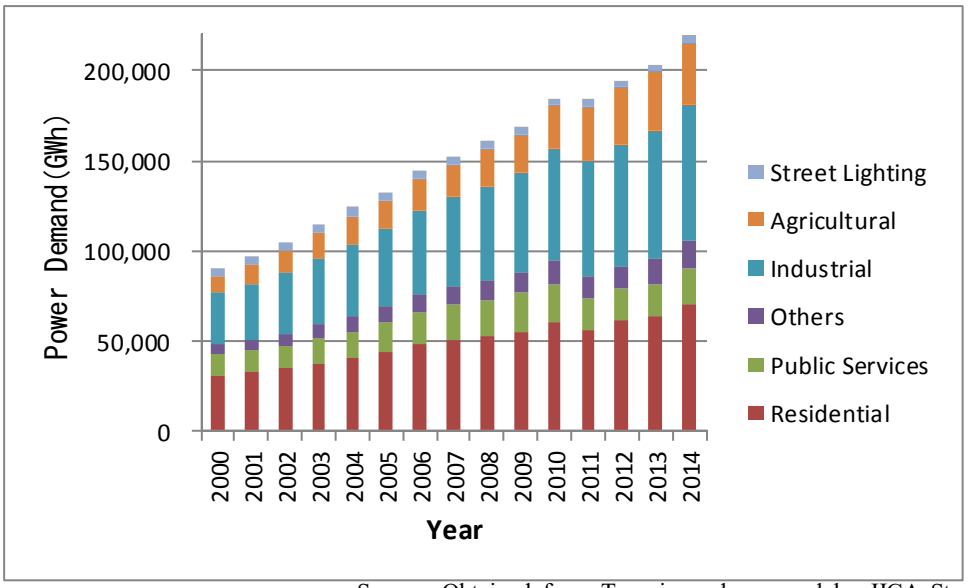
The demand for electric power in Iran in fiscal years 2010 to 2014 is shown in Table 3.1-1.
Although there was a temporary reduction in electric power demand from fiscal 2011 to 2012 due to economic sanctions, the average annual growth rate between fiscal 2010 and 2014 was 5% for peak demand output and 4.5% for electric power demand.
The growth rate in the number of consumers was about 5%.
As shown in Figure 3.1-1, the percentages of demand according to sector in fiscal 2014 were: household use 32.4%, public use 9%, commercial and other 7%, industrial use 33.8%, and agricultural use 16%. Compared with fiscal 2000 the percentages are almost the same, but the electric power demand has increased by a factor of 2.4.
Prior to the economic sanctions the growth rate of electric power demand was between 5 and 9%, the average annual growth rates between fiscal 2000 and 2010 was 6.5% for peak demand and 7.4% for electric power demand.

Over the period 2000 to 2014, the annual average growth rate for the summer maximum demand was 6.1%, and for the peak demand was 6.5%, although there was a temporary reduction in demand under the effect of increases in oil, gas, and electricity prices at the end of 2010 during the economic sanctions.

Table 3.1-1 Trend of Electric Power Demand in Iran (Fiscal 2010 to 2014)

Subject	2010	2011	2012	2013	2014
Peak Demand (MW)	40,239	42,367	43,459	46,474	48,937
Annual Growth Rate(%)	6.2%	5.3%	2.6%	6.9%	5.3%
Power Demand (GWh)	184,183	183,905	194,149	203,214	219,653
Annual Growth Rate(%)	9.3%	-0.2%	5.6%	4.7%	8.1%
Number of Customers (Thousand custormer)	25,693	27,158	28,751	30,288	31,672
Annual Growth Rate(%)	6.2%	5.7%	5.9%	5.3%	4.6%

Source: Obtained from Tavanir, and prepared by JICA Study Team
(Statistical Report on 48 years of Activities of Iran Electric Power Industry (1967-2014) : TAVANIR)



Source: Obtained from Tavanir, and prepared by JICA Study Team
(Statistical Report on 48 years of Activities of Iran Electric Power Industry (1967-2014) : TAVANIR)

Figure 3.1-1 Trend in Electric Power Demand According to Sector (Fiscal 2000 to 2014)

3.1.2 Status of Electrical Power Demand in the Regional Electric Companies

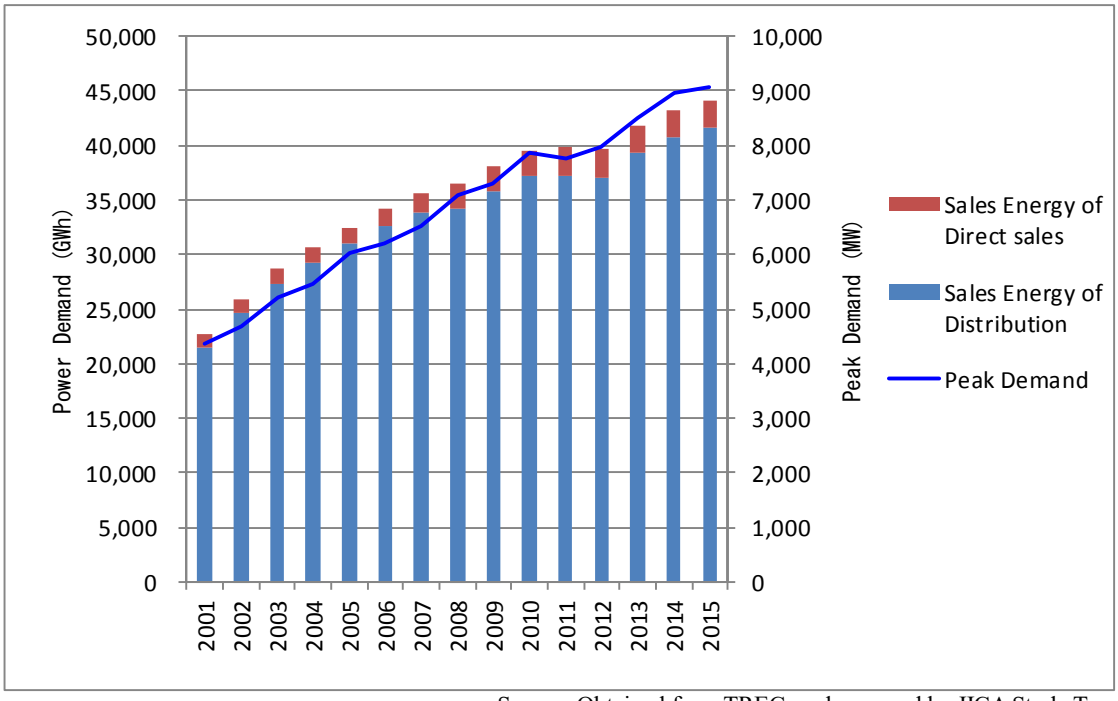
As an example of the demand for electrical power at the regional electric companies, Table 3.1-2 shows the demand at Tehran Regional Electric Company (TREC) from 2010 to 2015. TREC supplies electric power to the capital Tehran, and is the largest of the 6 regional electric companies.

The annual average growth rate over the period 2001 to 2015 was 5.3% for summer maximum demand, and 4.9% for peak demand.
Because the regional electric company TREC supplies the Tehran that consumes the most electricity due to dynamic economic activity, the annual average growth rate of the electrical power demand over the period 2001 to 2009 was steady with 6.4%.
However, the effect of the increase in oil, gas, and electricity prices at the end of 2010 due to the economic sanctions was great, so in 2011 the demand was lower than in the previous year, and in 2012 also the increase in demand was only 2.7%.
Therefore the annual average growth rate over the period 2010 to 2015 was small, being only 2.9% for the maximum summer demand, and 2.2% for the peak demand.

Table 3.1-2 Trend in Demand within the Area Operated by the Regional Electric Company TREC (Fiscal 2010 to 2015)

Subject	2010	2011	2012	2013	2014	2015
Peak demand of Distribution(MW)	7,615	7,518	7,722	8,250	8,691	8,780
Power Demand of Distribution(GWh)	37,174	37,264	37,106	39,274	40,668	41,615
Peak demand of Direct sales(MW)	460	501	523	529	553	559
Power Demand of Direct sales(GWh)	2,376	2,528	2,645	2,448	2,493	2,465
Total Peak demand(MW)	7,851	7,750	7,961	8,505	8,960	9,052
Annual Growth Rate(%)	7.8%	-1.3%	2.7%	6.8%	5.3%	1.0%
Total Power Demand (GWh)	39,550	39,792	39,751	41,722	43,161	44,080
Annual Growth Rate(%)	4.0%	0.6%	-0.1%	5.0%	3.4%	2.1%

Source: Obtained from TREC, and prepared by JICA Study Team



Source: Obtained from TREC, and prepared by JICA Study Team

Figure 3.1-2 Trend in TREC Electrical Power Demand (Fiscal 2000 to 2015)

3.1.3 Forecast of Electrical Power Demand in Iran

Table 3.1-3 shows the forecast electrical power demand in Iran between 2016 and 2020.
It is envisaged that the annual average growth rate between 2016 and 2020 will be high at 6.5%. Due to the stagnation in infrastructure renewal because of the economic sanctions, there is likely to be demand for renewal in the infrastructure field after removal of the sanctions, so it is considered that domestic investment will continue to increase in the future.

Table 3.1-3 Power Demand Forecast and Required Power Generation Forecast

Subject	2016	2017	2018	2019	2020
Power Demand (GWh)	247,173	263,244	280,586	298,251	318,525
Annual Growth Rate(%)		6.5%	6.6%	6.3%	6.8%
Distribution Losses(%)	10.00%	9.45%	9.20%	8.95%	8.70%
Energy with consideration of distribution losses(GWh)	274,637	290,717	309,015	327,568	348,877
Transmission and Sub-transmission Losses(%)	2.96%	2.93%	2.90%	2.87%	2.84%
Energy with consideration of transmission and sub-transmission losses(GWh)	283,014	299,493	318,248	337,254	359,087
Power plants Consumption(%)	3.50%	3.44%	3.42%	3.27%	3.23%
Amount of energy needed for the consumptions(GWh)	293,278	310,162	329,517	348,641	371,086

Source: The Sixth Five Year Development Plan in TAVANIR

In the case of GDP, which is an index of economic growth and which has a close relationship to electrical power demand, the IMF forecasts that the growth rate in GDP after removal of economic sanctions will be about 4%, as shown in Table 3.1-4.

Taking into consideration that the annual average growth rate of electrical power demand over the period 2010 to 2014, which included the temporary reduction due to the economic sanctions, was 4.5%, and in 2014 the actual GDP growth rate was 3.0% and the growth rate in the electrical power demand was 4.6%, if it is considered that in the future the growth rates of GDP will be at the 4% level, then it is considered that the growth rate of electrical power demand in the future will be about 6%.

Table 3.1-4 Actual and Forecast of GDP（Gross Domestic Product）

	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021
Nominal GDP (Trillion of IRR)	9,421	11,034	11,992	14,043	15,935	17,695	19,372	21,150
Real GDP	-1.9%	3.0%	0.0%	4.3%	4.0%	4.1%	4.4%	4.4%

Source：IMF Country Report No.15/349 ISLAMIC REPUBLIC OF IRAN, 2015 ARTICLE IV CONSULTATION – PRESS RELEASE; STAFF REPORT; AND STATEMENT BY THE EXECUTIVE DIRECTOR FOR THE ISLAMIC REPUBLIC OF IRAN, Dec. 2015

3.1.4 Forecast of Electrical Power Demand at Regional Electric Company TREC

Table 3.1-5 shows the forecast electrical power demand in Iran over the period 2016 to 2020 at the regional electric company TREC.
The annual average growth rate of Power demand over the period 2016 to 2020 is 6.2%.
It is envisaged that the electrical power demand of normal electricity consumers will have an annual average growth rate of 6.2% over the period 2016 to 2020, so it is considered that there will be steady domestic investment after removal of economic sanctions.

Table 3.1-5 Power Demand Forecast in TREC

Subject	2016	2017	2018	2019	2020
Peak demand of Distribution(MW)	9,230	9,699	10,217	10,736	11,261
Power Demand of Distribution(GWh)	44,246	46,911	50,072	53,150	56,332
Peak demand of Direct sales(MW)	636	762	918	1,045	1,148
Power Demand of Direct sales(GWh)	2,588	2,744	2,881	2,996	3,146
Total Peak demand(MW)	9,515	9,999	10,533	11,068	11,609
Annual Growth Rate(%)	5.1%	5.1%	5.3%	5.1%	4.9%
Total Power Demand (GWh)	46,834	49,655	52,952	56,146	59,477
Annual Growth Rate(%)	6.2%	6.0%	6.6%	6.0%	5.9%

Source: Obtained from TAVANIR, and prepared by the JICA Study Team

3.2 Present Status and Issues in Electric Power Sector

3.2.1 Power Generation Facilities

As shown in Table 3.2-1, the main electric power generation facilities in Iran are thermal power generation facilities such as steam, gas turbine, combined cycle, etc., which accounts for more than 80% of the total.
Table 3.2-3 to Table 3.2-5 show the main thermal power plants.
Also, in recent years the Government of Iran is undertaking initiatives to improve the efficiency of use of electric power, and is planning to introduce efficient energy use and renewable energy. Renewable energy accounts for 4% of total electric power generation.
In addition, privatization of electric power facilities is proceeding as a national policy in Iran. New plant is being developed by BOO or BOT schemes, and at the same time existing facilities are being sold. As of end fiscal 2014, 52% of the total power generation facilities have been privatized. The percentage of privatization in fiscal 2013 was 48.9%, so 3% has been privatized in one year. At the end of 2015, the percentage of privatization was 45.3% due to closure of some private power stations and the development of new power stations by the MOE, but henceforth it is planned that 60 to 70% of the new power stations will be private facilities.
Of these, the rate of privatization of gas turbine and combined cycle power plants exceeds 70%, but in the case of steam power generation facilities the rate of privatization is about 30% at present, since it is important facilities to supply power as base load.
On the other hand, the electric power generation at privatized power plants is 50% of the total power generated, and trend of increase.
Gas turbine power plants can be constructed in a short period of time, and are also scheduled to be constructed in the future, but it is planned that the power plants to be constructed in the future will be mainly combined cycle power plants in order to improve the efficiency. The plans

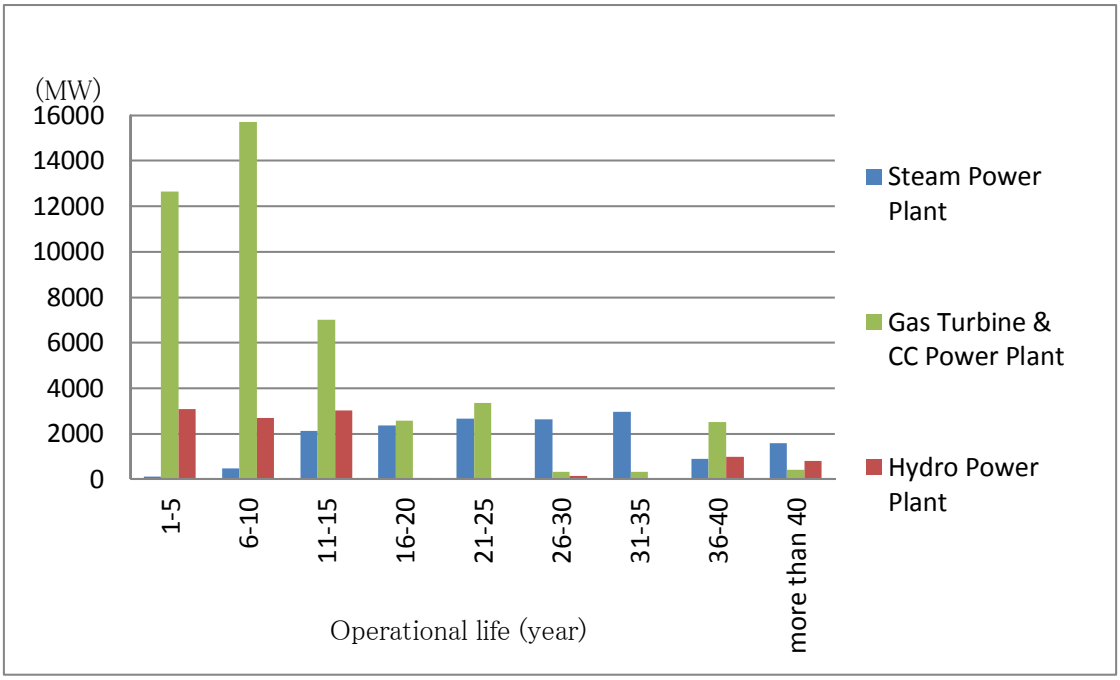
include conversion of existing gas turbine power plants into combined cycle power plants by add on, in order to improve plant efficieny.

Table 3.2-1 Generation Capacity According to Type (End fiscal 2015)

Type of Power Plants	Nominal Capacity (MW)	Rasio of power station		Privatization rate	Operational Capacity (MW)
Steam	15,829	21.4%	83.6% (Thermal Power Plants)	25.3%	15,209
Gas Turbine	26,870	36.3%		57.0%	21,631
Combined Cycle	18,493	25.0%		76.9%	15,112
Diesel	439	0.6%			284
Hydro	11,278	15.2%			11,278
Nuclear & Renewable Energy	1,193	1.6%		4.4%	1,193
Total	74,103	100.0%		0.0%	64,708

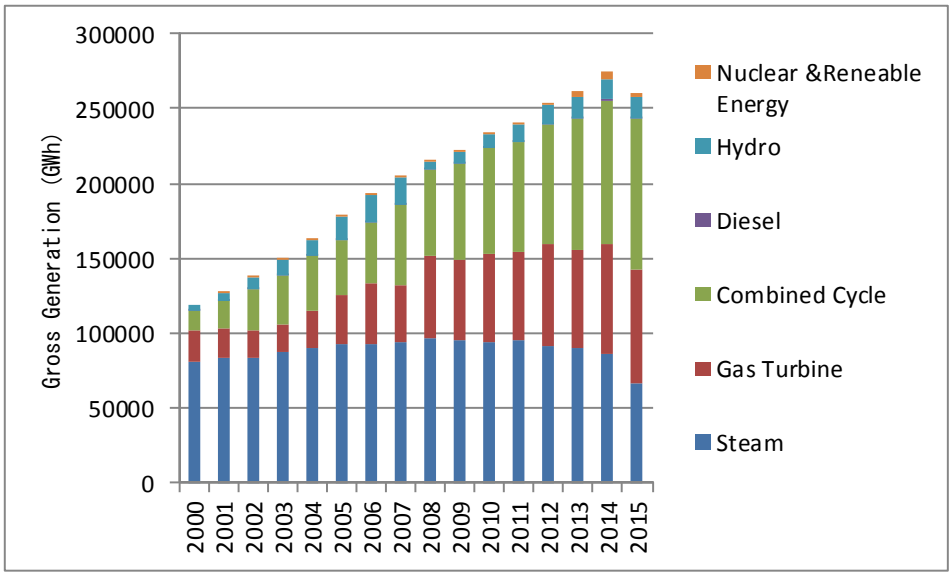
Source: Obtained from TAVANIR, and prepared by the JICA Study Team

Of the thermal power generation facilities, gas turbine and combined cycle generation account for about 80% of the generation capacity, as they are affected by the external air temperature and pressure. On the other hand, steam power plants producing stable output are important facilities for base load supply etc..
However, as shown in Figure 3.2-1, 67% of the capacity of steam power plants is from plants that have been in operation for more than 20 years. Therefore, plant output is decreasing year by year, and there is a necessity for rehabilitation.



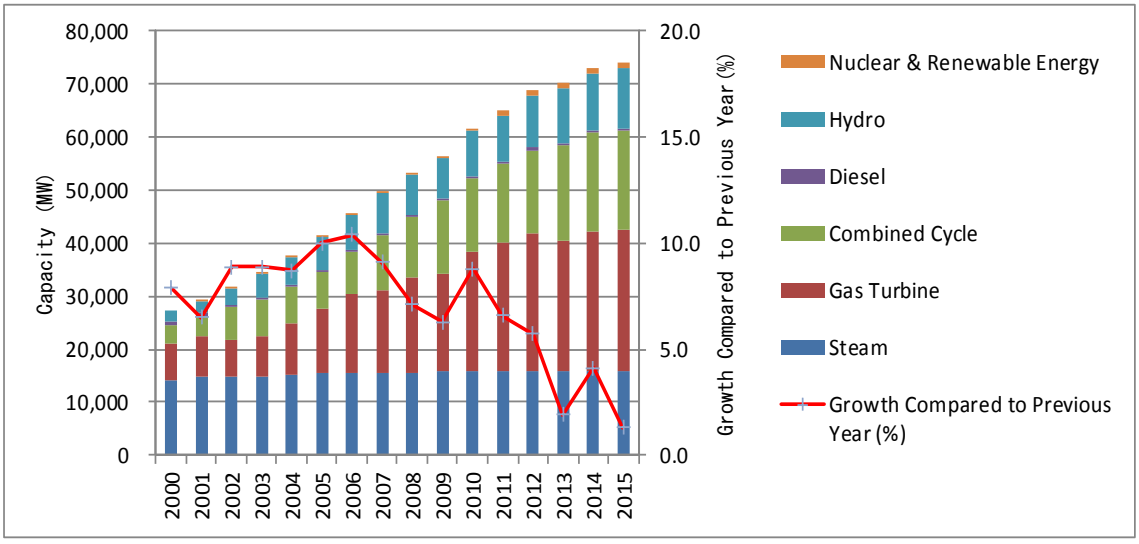
Source: Obtained from TAVANIR, and prepared by the JICA Study Team
(electric Power Industry in Iran (2014-2015), TAVANIR)

Figure 3.2-1 Number of Years of Operation of Power Plant



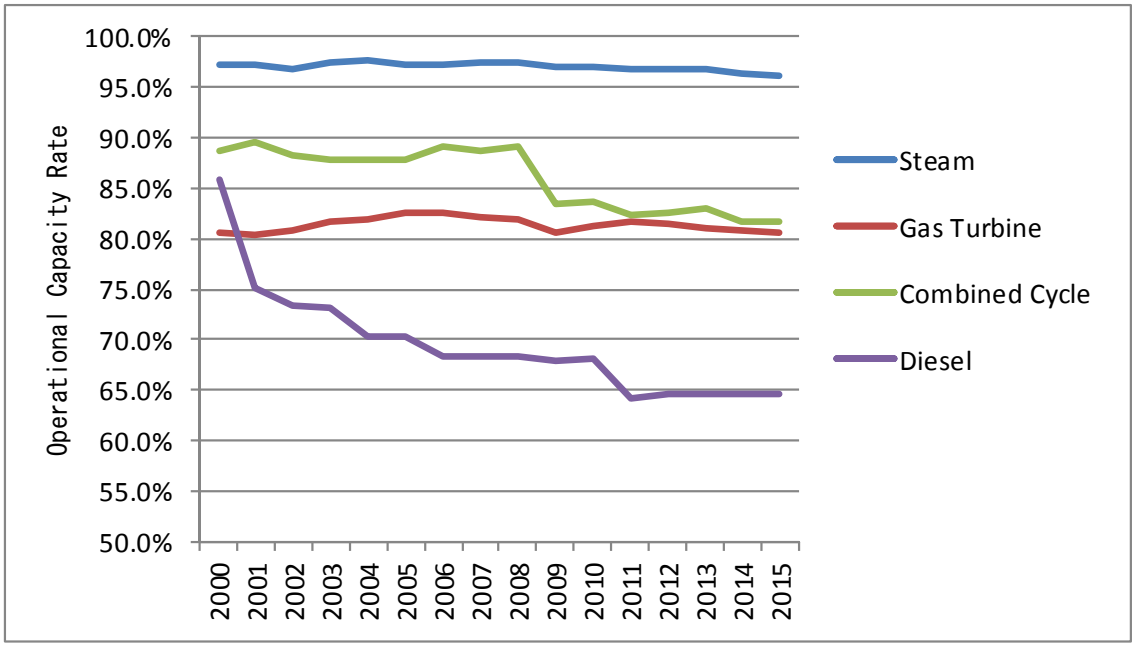
Source: Obtained from TAVANIR, and prepared by the JICA Study Team

Figure 3.2-2 Trend in Annual Power Generation According to Type



Source: Obtained from TAVANIR, and prepared by the JICA Study Team

Figure 3.2-3 Trend in Power Plant



Source: Obtained from TAVANIR, and prepared by the JICA Study Team

Figure 3.2-4 Trend in Operational Capacity According to Type

And, another important item from technicalpont is environmental issue

Air contaminant emissions by the respective types of power generation facilities are shown in Table 3.2-2. Emissions from steam power generation facilities are high, with a particularly high volume of SO_2 emissions, which is presumed to be caused by the use of oil or light diesel oil as an alternative fuel for gas in areas that do not have a gas pipeline. Meanwhile, it appears that NOx emissions are considerably higher compared to oil fired facilities in Japan, making it necessary to consider appropriate measures according to the fuel(s) that can be used when rehabilitating the facilities supplied from Japan.

Table 3.2-2 Contaminant Emissions by Type of Power Plant (Fiscal 2014) [10^3kg]

Type of Power Plant	NOx	SO_2	CO_2
Steam Power	92,217.2	4,846,441.1	58,425,643
Combined Cycle	76,075	63,276.9	48,414,498
Gas Turbine	85,613.8	76,278.2	54,196,585
Diesel	124.8	382.6	63,552
Total	254,030.8	4,986,378.8	161,100,278

Source: ELECTRIC POWER INDUSTRY IN IRAN (2014-2015), TAVANIR

Table 3.2-3 Thermal Power Plants in 2015

Name of Power Station	Installed Capacity(MW)			Available Capacity(MW)				Primary/secondary Voltage (kV)	Location	Completion Year	Company
				Summer period		Winter period					
	Number of Units	Unit Capacity	Total Capacity	Output capacity	Outpot Rate	Output capacity	Outpot Rate				
Tarasht (Shahid firoozi)	4	12.5	50.0	40.0	80.0%	40.0	80.0%	11.5/63	Tehran	1959	Teheran
Beasat	3	82.5	247.5	225.0	90.9%	225.0	90.9%	13.2/63	Tehran	1967-1968	Teheran
Islam Abad (Isfahan)	2	37.5	75.0	70.0	93.3%	70.0	93.3%	13.8/63	Isfahan	1969	Isfahan
	1	120.0	120.0	120.0	100.0%	120.0	100.0%	13.8/63		1974	
	2	320.0	640.0	640.0	100.0%	640.0	100.0%	20/230		1980-1988	
	Total		835.0	830.0	99.4%	830.0	99.4%				
Shahid Montazere Ghaem	4	156.3	625.0	560.0	89.6%	560.0	89.6%	15/230	Karaj	1971-1973	Teheran
Loushan (Shahid beheshti)	2	120.0	240.0	240.0	100.0%	240.0	100.0%	10.5/230	Loushan	1973	Gilan
Zarand	2	30.0	60.0	45.0	75.0%	48.0	80.0%	11.5/132	Zarand	1973	Keman
Mashhad	2	60.0	120.0	120.0	100.0%	120.0	100.0%	13.8/63	Mashhad	1973-1974	Khorasan
	1	12.5	12.5	12.5	100.0%	12.5	100.0%			1968-2007	
	Total		132.5	132.5	100.0%	132.5	100.0%				
Zargan	2	145.0	290.0	200.0	69.0%	200.0	69.0%	15/230	Ahwaz	1975-1992	Khozestan
Neka (Shahid salimi)	4	440.0	1760.0	1700.0	96.6%	1720.0	97.7%	20/400	Neka	1979-1981	Mazandaran
	2	9.8	19.6	19.6	100.0%	19.6	100.0%	Turbine extension		2007	
	Total		1779.6	1719.6	96.6%	1739.6	97.8%				
Ahwaz (Ramin)	6	315.0	1890.0	1810.0	95.8%	1810.0	95.8%	20/230	Ahwaz	1979-1999	Khozestan
	2	6.5	13.0	13.0	100.0%	13.0	100.0%	Turbine extension		2007	
	Total		1903.0	1823.0	95.8%	1823.0	95.8%				
Bandar Abbas	4	320.0	1280.0	1280.0	100.0%	1280.0	100.0%	20/230	Bandar Abba	1980-1986	Hormozgan
Shahid M. Montazeri	8	200.0	1600.0	1568.0	98.0%	1600.0	100.0%	15.75/230/400	Isfahan	1984-1999	Isfahan
	2	8.0	16.0	8.0	50.0%	8.0	50.0%			2011-2012	
	Total		1616.0	1576.0	97.5%	1608.0	99.5%				
Toos	4	150.0	600.0	600.0	100.0%	600.0	100.0%	11.5/132	Mashhad	1985-1987	Khozestan
Tabriz	2	368.0	736.0	650.0	88.3%	650.0	88.3%	20/230	Tabriz	1986-1989	Azarbayjan
Shahid Rajaee	4	250.0	1000.0	1000.0	100.0%	1000.0	100.0%	19/400	Ghazvin	1992	Teheren
Bistoon	2	320.0	640.0	640.0	100.0%	640.0	100.0%	20/230	Kaemanshah	1994	Gharb
Shahid Mofateh	4	250.0	1000.0	1000.0	100.0%	1000.0	100.0%	19/230	Hamedan	1994	Bakhtar
Iranshahr	4	64.0	256.0	240.0	93.8%	248.0	96.9%	21/230	Iran shahr	1995-97-2002-03	Sistan & Baluchestan
Shazand	4	325.0	1300.0	1260.0	96.9%	1280.0	98.5%	20/230	Arak	2000-2001	Bakhtar
Sahand	2	325.0	650.0	650.0	100.0%	650.0	100.0%	20/230	Tabriz	2004-2005	Azarbayjan
Sarbandar-Mahshahr	4	162.0	648.0	488.0	75.3%	584.0	90.1%	15.75/230	Khozestan	2016	TPPH
Shirvan	3	160.0	480.0	426.0	88.8%	480.0	100.0%	15.75/230	Khorasan	2017-2018	TPPH
Total	79		15240.6	14511.1		14594.1					

Source: Obtained from TAVANIR and TREC, and prepared by the JICA Study Team

Table 3.2-4 Gas Power Plants in 2015

Name of Power Station	Installed Capacity(MW)			Available Capacity(MW)				Primary/secondary Voltage (kV)	Location	Completion Date	Company
				Summer period		Winter period					
	Number of Units	Unit Capacity	Total Capacity	Output capacity	Outpot Rate	Output capacity	Outpot Rate				
Shiraz	1	11.8	11.8	9.0	76.3%	11.0	93.2%	11/66	Shiraz	1965	Fars
	3	15.0	45.0	30.0	66.7%	36.0	80.0%	11/66		1967	
	1	28.6	28.6	18.0	62.9%	20.0	69.9%	11/66		1973	
	1	25.6	25.6	18.0	70.3%	20.0	78.1%	11/66		1974	
	1	24.2	24.2	17.0	70.2%	18.0	74.4%	11/66		1975	
	1	60.8	60.8	38.0	62.5%	44.0	72.4%	10.5/66		1981	
Mashhad	2	18.8	37.6	36.0	95.7%	38.0	101.1%	5.5/63	Mashhad	1971-1989	Khorasan
	2	79.0	158.0	124.0	78.5%	142.0	89.9%	10.5/63		1977-1978	
Bushehr	3	25.0	75.0	51.0	68.0%	57.0	76.0%	10.5/66	Bushehr	1975-1993	Fars
Loshan (Shahid beheshti)	2	60.0	120.0	100.0	83.3%	110.0	91.7%	10.5/230	Loushan	1977	Gitan
Doroud	2	30.0	60.0	30.0	50.0%	36.0	60.0%	11.5/20	Doroud	1977	Bakhtar
Shahid Zanbagh (Yazd)	4	24.3	97.0	68.0	70.1%	80.0	82.5%	11/63	Yazd	1977-1979	Yazd
Rey	4	32.0	128.0	92.0	71.9%	104.0	81.3%	11/230	Ray	1977-1978	Tehran
	10	23.7	237.0	192.0	81.0%	240.0	101.3%	11.5/230		1977-1987-2007	
	9	32.0	288.0	207.0	71.9%	232.0	80.6%	11/230		1978	
	3	85.0	255.0	183.0	71.8%	217.0	85.1%	11/230		1978	
	1	24.0	24.0	16.0	66.7%	20.0	83.3%	10.5/230		1978	
Zargan	4	32.0	128.0	80.0	62.5%	80.0	62.5%	11/230	Ahvaz	1978-1980	Khozestan(Ahvaz)
Tabriz (New)	2	32.0	64.0	46.0	71.9%	54.0	84.4%	10.5/230	Tabriz	1978	Azarbayjan
Chahbahar (Konarak)	6	23.8	142.5	102.0	71.6%	108.0	75.8%	11/63	Chabahar	1978	Sistan & Baloochestan
Orumia	2	30.0	60.0	38.0	63.3%	44.0	73.3%	11.5/20	Orumia	1981	Azarbayjan
Shariati	6	25.0	150.0	108.0	72.0%	132.0	88.0%	11.5/132	Mashhad	1984-1986	Khorasan
Sufian	4	25.0	100.0	68.0	68.0%	80.0	80.0%	10.5/132	Tabriz	1984-1985	Azarbayjan
Zahedan	3	24.5	73.4	51.0	69.5%	54.0	73.6%	11/63	Zahedan	1986	Sistan & Baluchestan
	1	30.0	30.0	17.0	56.7%	18.0	60.0%	6.6/63		1995	
	1	24.8	24.8	17.0	68.5%	18.0	72.6%	11/63		1997	
	4	24.5	98.0	68.0	69.4%	72.0	73.5%	11/63		2007	
Ghaen	3	25.0	75.0	51.0	68.0%	60.0	80.0%	11.5/132	Ghaen	1987-1994	Khorasan
Hasa	3	29.2	87.6	60.0	68.5%	69.0	78.8%	11.5/63	Shahin Shah	1989	Esfahan
Kangan	6	25.0	150.0	102.0	68.0%	114.0	76.0%	10.5/66, 11.5/66	Kangan	1995-96-97-2002	Fars
	1	14.0	14.0	11.0	78.6%	13.0	92.9%	11/66		1995	
Yazd	2	60.0	120.0	82.0	68.3%	92.0	76.7%	10.5/63	Yazd	1998	Yazd
Farg Darab	3	1.4	4.2	2.7	64.3%	3.0	71.4%	6/66	Darab	2002	Fars
Bandar Abbas	2	25.0	50.0	32.0	64.0%	36.0	72.0%	20/132	Bandar Abba	2002	Hormozgan
Hormozgan (Khalije Gars) C.C	6	165.0	990.0	834.0	84.2%	918.0	92.7%	15.75/230	Bandar Abba	2004-2005	Hormozgan
Shirvan C.C	6	159.0	954.0	756.0	79.2%	864.0	90.6%	15.75/400	Shirvan	2005-2006-2007	Khorasan
Cheisotoon	6	159.0	954.0	648.0	67.9%	792.0	83.0%	15.75/230	Isfahan	2005-2006	Isfahan
Parand	6	159.0	954.0	702.0	73.6%	804.0	84.3%	15.75/230	Tehran	2005	Tehran
Roud Shour	3	263.0	789.0	687.0	87.1%	567.0	71.9%	15.75/230	Tehran	2005-2006	Tehran(Parand)
Orumia C.C	4	159.0	636.0	488.0	76.7%	560.0	88.1%	15.75/230	Orumia	2006-2007	Azarbayjan
	2	162.0	324.0	244.0	75.3%	280.0	86.4%	15.75/230		2009	
Sabaian C.C	4	159.0	636.0	492.0	77.4%	552.0	86.8%	15.75/230	Ardebil	2006-2007	Azarbayjan
	2	162.0	324.0	246.0	75.9%	276.0	85.2%	15.75/230		2009	
Kahnodj	3	25.0	75.0	45.0	60.0%	54.0	72.0%	10.5/230	Kahnodj	2009-2012	Kerman
Asaloye	6	159.0	954.0	810.0	84.9%	906.0	95.0%	15.75/230	Asaloye	2006-2007	Booshehr
Ferdosi C.C	6	159.0	954.0	705.0	73.9%	837.0	87.7%	15.75/230	Khorasan	2006-2007	Khorasan(Mashad)
Jahrom C.C	6	159.0	954.0	654.0	68.6%	780.0	81.8%	15.75/230	Jahrom	2006-2007	Fars
Chabahar	4	24.0	96.0	64.0	66.7%	72.0	75.0%	15.75/230	Chabahar	2007	Sistan & Baluchestan
	2	159.0	318.0	254.0	79.9%	284.0	89.3%	15.75/230		2007-2008	
Shahid Kaveh C.C(Ghaenat)	4	159.0	636.0	444.0	69.8%	516.0	81.1%	15.75/400	Ghaen	2007-2008	Khorasan
Khorramshahr	4	243.0	972.0	768.0	79.0%	900.0	92.6%	15.75/230	Khorramshah	2007-08-09-13	Khozestan
Noshahr	2	23.7	47.4	34.0	71.7%	38.0	80.2%	10.5/230	Noshahr	2008	Mazandaran
Kashan	2	162.0	324.0	234.0	72.2%	272.0	84.0%	15.75/230	Kashan	2008	Isfahan
Golestan	6	162.0	972.0	840.0	86.4%	918.0	94.4%	15.75/230	Golestan	2009	Ali-Abad
Zagros	4	162.0	648.0	472.0	72.8%	536.0	82.7%	15.75/400	Kermanshah	2009-2010	Gharb
Soltanie	4	162.0	648.0	472.0	72.8%	536.0	82.7%	15.27/230	Zanjan	2009-10-11	Zanjan
Semnan C.C	2	162.0	324.0	234.0	72.2%	282.0	87.0%	15.27/230	Semnan	2009	Semnan
Bastami (Shahrood)	2	162.0	324.0	238.0	73.5%	272.0	84.0%	15.27/230	Shahrood	2010	Semnan
Hafez (Fars)	6	162.0	972.0	672.0	69.1%	798.0	82.1%	15.75/230	Fars	2010-11	Fars
Bam Pour	2	162.0	324.0	242.0	74.7%	288.0	88.9%	15.75/230	Iranshahr	2012-14	Sistan & Baloochestan
Esin	4	162.0	648.0	516.0	79.6%	580.0	89.5%	15.75/230	Hormozogan	2013	Hormozogan
Shobsd (kahnodj)	2	162.0	324.0	232.0	71.6%	282.0	87.0%	15.75/230	kahnodj	2013	Kerman
Sarv (Chadormaloo)	2	162.0	324.0	232.0	71.6%	282.0	87.0%	15.75/230	Chadormaloo	2013	Yazd
Eslamabad Ghard	4	25.0	100.0	96.0	96.0%	116.0	116.0%	10.5/230	Eslamabad	2013	Gharb
Shams Sarakhs	2	25.0	50.0	31.0	62.0%	38.0	76.0%	10.5/132	Sarakhs	2013	Gharb
DG & CHP	80		665.0	-	-	-	-	-	Country	2010-11-12	Gharb
Total Gas Power Plants in NG	301		21261.5	15550.7	73.1%	17672.0	83.1%				
Kish (Gas)	3	37.5	112.5	81.0	72.0%	90.0	80.0%	10.5/20	Kish	1922-99-2003	Kish
	1	24.3	24.3	14.0	57.6%	14.0	57.6%			2006-2007	
	2	23.5	47.0	28.0	59.6%	28.0	59.6%			2006-2007	
Khark (Gas)	1	25.0	25.0	16.0	64.0%	20.0	80.0%	10.5/20	Khark	2014	Fars
Total Gas Power Plants out of NG	7		208.8								
Total	308.0		21470.3								

Source: Obtained from TAVANIR and TREC, and prepared by the JICA Study Team

Table 3.2-5 Combined-Cycle Power Plants in 2015

Name of Power Station	Installed Capacity(MW)			Available Capacity(MW)				Primary / secondary Voltage (kV)	Location	Completion Date	Company
				Summer period		Winter period					
	Number of Units	Unit Capacity	Total Capacity	Output capacity	Outpot Rate	Output capacity	Outpot Rate				
Gilan Combined-Cycle	6	143.2	859.2	726.0	84.5%	822.0	95.7%	10.5/230		1992	Gilan
	3	148.8	446.4	405.0	90.7%	414.0	92.7%	15.75/230	Rashy	1997	
Montazare Ghaem	6	116.3	697.5	480.0	68.8%	576.0	82.6%	13.8/230	Karaj	1992	Tehran
	3	100.0	300.0	240.0	80.0%	288.0	96.0%	10.5/230		1999-2000	
Qom Combined-Cycle	4	128.5	514.0	368.0	71.6%	432.0	84.0%	13.8/230	Qom	1993	Tehran
	2	100.0	200.0	184.0	92.0%	200.0	100.0%	11.5/230		1997-1998	
Shahid Rajai Combined-Cycle	6	123.8	742.8	504.0	67.9%	600.0	80.8%	13.8/400	Ghazvin	1994	Tehran
	3	100.0	300.0	252.0	84.0%	297.0	99.0%	10.5/400		2001	
Neishabour Combined-Cycle	6	123.4	740.4	546.0	73.7%	606.0	81.8%	13.8/400	Neishabour	1994-1998	Khorasan
	3	100.0	300.0	273.0	91.0%	300.0	100.0%	10.5/400		2002-2003	
Shariati Combined-Cycle	2	123.4	246.8	180.0	72.9%	210.0	85.1%	13.8/132	Mashad	1994	Khorasan
	1	100.0	100.0	95.0	95.0%	100.0	100.0%	10.5/132		2003	
Fars Combined-Cycle	6	123.4	740.4	498.0	67.3%	576.0	77.8%	13.8/230	Shiraz	1995-1998	Fars
	3	98.3	294.9	249.0	84.4%	288.0	97.7%	10.5/230		2002	
Khuy Combined-Cycle	2	123.4	246.8	180.0	72.9%	202.0	81.8%	13.8/230	Khuy	1997	Azarbayjan
	1	102.5	102.5	90.0	87.8%	100.0	97.6%	10.5/132		2002	
Shahid Salimi Combined-Cycle	1	160.0	160.0	154.0	96.3%	160.0	100.0%		Neka	2006	Mazandaran
	2	137.5	275.0	232.0	84.4%	258.0	93.8%	10.5/230		1990	
Yazd Combined-Cycle	2	160.0	320.0	272.0	85.0%	297.0	92.8%	15/230	Yazd	2006-2010	Yazd
	2	123.4	246.8	184.0	74.6%	206.0	83.5%	15/230		2000	
	2	159.0	318.0	228.0	71.7%	262.0	82.4%	15/230		2008-2009	
Kazeroon Combined-Cycle	2	128.0	256.0	190.0	74.2%	220.0	85.9%	13.8/230	Kazeroon	1994	Fars
	4	159.0	636.0	468.0	73.6%	544.0	85.5%	15.75/230		2002-2003	
	3	160.0	480.0	401.0	83.5%	452.0	94.2%	15.75/230		2006-2007	
Kerman Combined-Cycle	8	159.0	1272.0	880.0	69.2%	1000.0	78.6%	15.75/230	Kerman	2001-2002	Kerman
	4	160.0	640.0	528.0	82.5%	588.0	91.9%	15.75/230		2007-2009	
Damavand Combined-Cycle	12	159.0	1908.0	1404.0	73.6%	1608.0	84.3%	15.75/400	Garmsar	2003-2004-2005	Tehran
	6	160.0	960.0	552.0	57.5%	620.0	64.6%	15.75/400		2009-2010-2011	
Sanandaj Combined-Cycle	4	159.0	636.0	456.0	71.7%	528.0	83.0%	15.75/230	Sanandaj	2005-2006	Gharb
	2	160.0	320.0	134.0	41.9%	152.0	47.5%	15.75/230		2011-2012	
Abadan Combined-Cycle	4	123.4	493.6	364.0	73.7%	452.0	91.6%	13.8/230	Abadan	2002-2003	Khozestan
	2	160.0	320.0	272.0	85.0%	262.0	81.9%	10.5/230		2013-2014	
Zavare Combined-Cycle	2	162.0	324.0	220.0	67.9%	262.0	80.9%	15.7/230	Esfahan	2011	Esfahan
	1	160.0	160.0	130.0	81.3%	151.0	94.4%	15.75/230		2012	
Pare Sar Combined-Cycle	4	162.0	648.0	536.0	82.7%	452.0	69.8%	15.75/230	Gilan	2011-2012	Gilan
	2	160.0	320.0	308.0	96.3%	320.0	100.0%	15.75/230		2013	
Shir Kooh Combined-Cycle	2	162.0	324.0	230.0	71.0%	272.0	84.0%	15.75/230	Yazd	2012	Yazd
	1	160.0	160.0	135.0	84.4%	156.0	97.5%	15.75/230		2013	
Genaveh Combined-Cycle	2	162.0	324.0	244.0	75.3%	292.0	90.1%	15.75/230	Boushehr	2011	Genaveh
	1	160.0	160.0	142.0	88.8%	160.0	100.0%	15.75/230		2014	
Total	132		18493.1	11353.0		12906.0					

Source: Obtained from TAVANIR and TREC, and prepared by the JICA Study Team

3.2.2 Transmission and Distribution Facilities

TAVANIR is responsible for planning and strategy formulation of transmission and distribution facilities in all Iran, and implementation is the responsibility of its subsidiaries, the regional electric companies. In addition, IGMC, a subsidiary of TAVANIR is the entity responsible for monitoring and control of the electrical power system, standardization of protective control relays, determination of specifications, etc., and the regional electric companies take charge of practical affairs in accordance with the guidelines and instructions of IGMC.

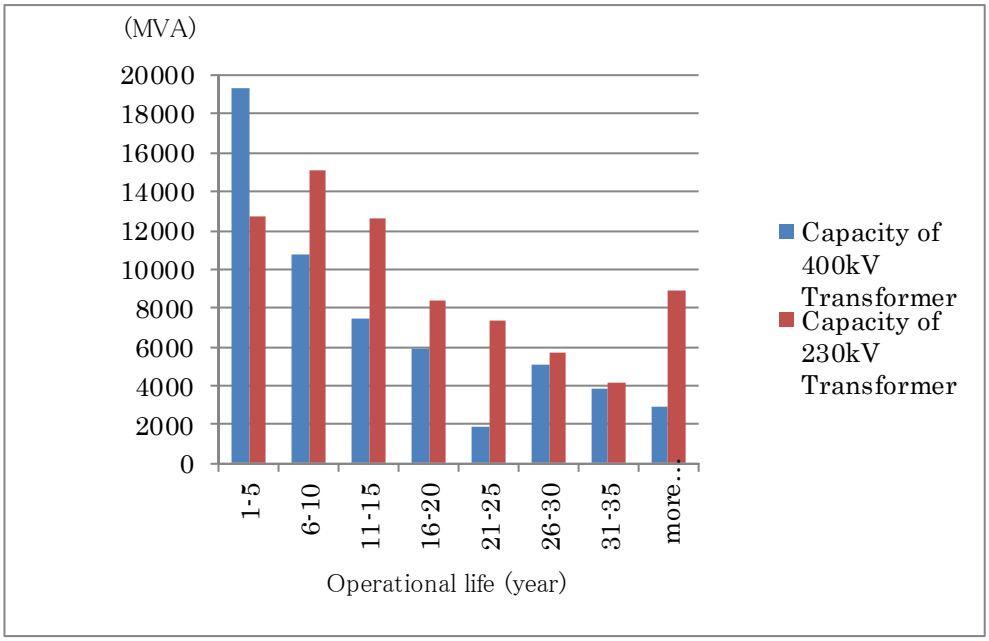
The Iranian electric power system consists of a 400 kV and 230 kV primary transmission system, a 132 kV, 66 kV, and 63 kV secondary transmission system, and a 20 kV, and in part 33 kV and 11 kV distribution system.
Also, they have started to investigate a 765 kV ultra high voltage system as the next generation primary system voltage.
The following dispatching centers have been provided in Iran for monitoring and control of the electric power system. Under the direction of IGMC,

- Central Region and Backup Dispatching Center
- Tehran Dispatching Center
- Northwest Region Dispatching Center
- Northeast Region Dispatching Center
- Southwest Region Dispatching Center
- Southeast Region Dispatching Center
- South Region Dispatching Center
- North Region Dispatching Center
- West Region Dispatching Center

RTU（Remote Terminal Unit）s or optical communication equipment is installed at each substation in order to transmit information to these dispatching centers.

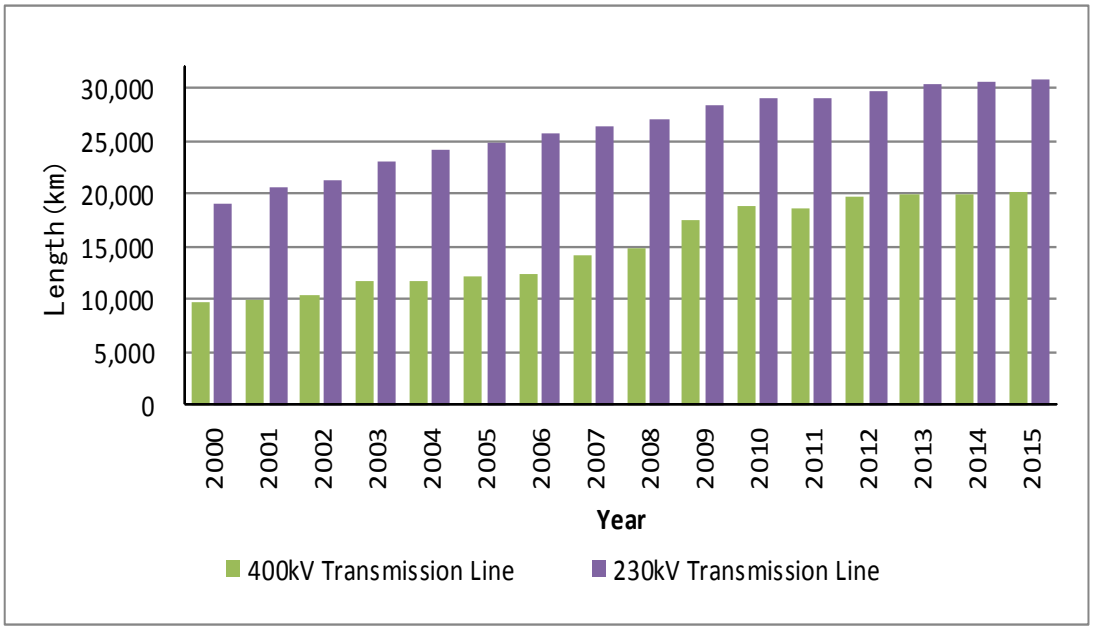
The primary system transmission cables as of the end of fiscal 2015 included 20,205 km of 400 kV transmission cable, and 30,869 km of 230 kV transmission cables, covering the whole country of Iran.
Figure 3.2-6 and Figure 3.2-7 shows the trend in the total length of the primary system transmission cables and the total capacity of transformers over the period fiscal 2000 to 2015.
The average growth rates of the total length of transmission cable over the period fiscal 2000 to 2015 was 5.0% for 400 kV transmission cables and 3.3% for 230 kV transmission cables, but in recent years the growth rate has been less than 2%.
The total installed capacity of 400 kV transformers is 59.3 GVA, and for 230 kV transformers is 76.5 GVA.
The average annual growth rate of transformer capacity over the period 2000 to 2015 was 6.9% for 400 kV transformers, and 5.2% for 230 kV transformers, so transformer capacity is increasing in accordance with the demand.
However, as shown in Figure 3.2-5, 30% of the transmission exceeds 20 years age, and, 15% exceeds 30 years of age, which is a rule of thumb for replacement of normal transformers.

Table 3.2-6 shows a list of the 400 kV and 230 kV substations and switching stations of the regional electric company TREC, which supplies the capital Tehran.
Because the TREC has supplied the capital Tehran from the past, most of the substations are old, and in 1967, the first primary substation was constructed. Thereafter the construction of similar substations was developed, and 400 V and 230 kV substations and switching stations were constructed at 50 locations. More than 20 years has passed since start of operation at 25 of these facilities, and 13 substations, or 1/3 of the total number, are more than 30 years old, whose transformers need to be replaced.
The number of transformers that are more than 30 years old is double that compared with the rest of the Iran.



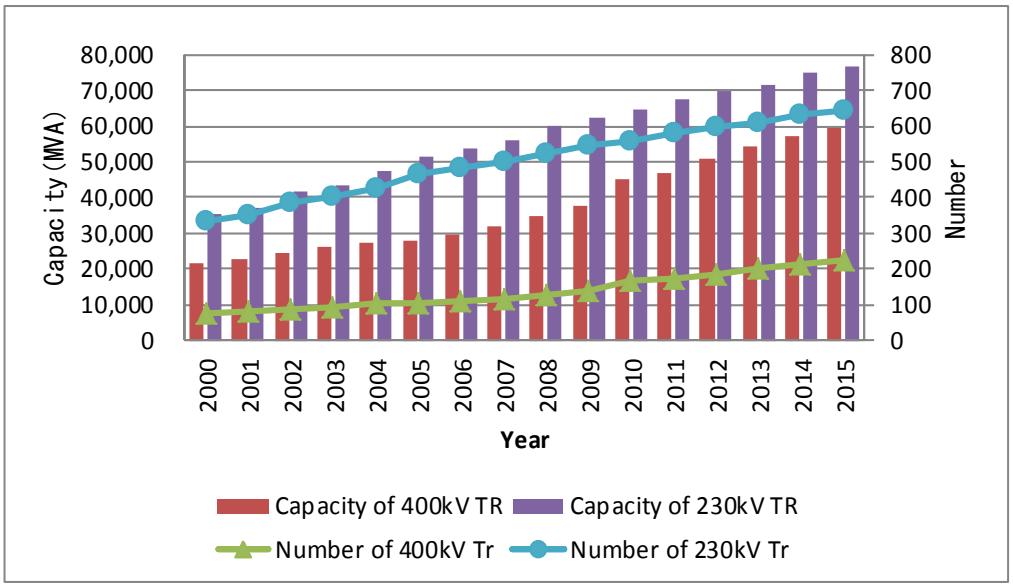
Source: Obtained from TAVANIR, and prepared by the JICA Study Team
(Statistical Report on 48 years of Activities of Iran Electric Power Industry (1967-2014), TAVANIR)

Figure 3.2-5 Number of Years of Operation of Primary System Transformers



Source: Obtained from TAVANIR, and prepared by the JICA Study Team
(Statistical Report on 48 years of Activities of Iran Electric Power Industry (1967-2015), TAVANIR)

Figure 3.2-6 Trend in Total Length of Primary Transmission Cable



Source: Obtained from TAVANIR, and prepared by the JICA Study Team
(Statistical Report on 48 years of Activities of Iran Electric Power Industry (1967-2015), TAVANIR)

Figure 3.2-7 Trends in Number of Primary System Substations and Total Capacity of Transformers

Table 3.2-6 List of 400 kV and 230 kV Substations and Switching Stations within the TREC Area

No	Substation Name	Voltage (kV)	Capacity (MVA)	Year of Operation	Operating Year
1	Besat	230/63	360	1967	49
2	Firouzbahram	400/230	2000	1969	47
3	ShahidFirouzi	230/63	340	1970	46
4	MontazerQaem	230/63	540	1971	45
5	MontazerQaem-CHP Switch station	200	-	1971	45
6	Ozgol	230/63	350	1974	42
7	Namayeshgah	230/63	540	1974	42
8	Kan	400/230	1000	1976	40
		230/63	320	1976	40
9	DoshanTappeh	230/63	540	1976	40
10	Manavi	230/63	540	1976	40
11	Qom1	230/63	360	1978	38
12	Ziyaran	400/230	1000	1979	37
		230/63	250	1979	37
13	Tehran Pars	400/230	1000	1981	35
		230/63	360	1981	35
14	Jalal Switch station	400	-	1981	35
15	Rey Gas Turbine	230/63	360	1983	33
16	Rey Shomali	400/230	1500	1987	29
		230/63	680	1987	29
17	Kalan-Switch station	200	-	1989	27
18	Mosalla	230/63	720	1990	26
19	Azadegan	230/63	540	1991	25
		230/20	180	1991	25
20	ShahidRajaeiPower Plant's Switch station (Gas Turbine)	400	-	1993	23
21	ShahidRajaeiPower Plant's Switch station (CHP)	400	-	1995	21
22	Eslamshahr	230/63	480	1995	21
23	Qom Cycle (Qom 2)	230/63	320	1995	21
24	Qourkhaneh	230/63	540	1995	21
		230/20	180	1995	21
25	ZarrinKouh Mobile	230/63	40	1996	20
26	Moshiriyeh	230/63	320	1998	18
27	Alghadir	230/63	500	1999	17
28	BonyadRang	230/25	126	1999	17
29	Shoush	230/63	360	1999	17
30	Firouzkouh Mobile	230/63	40	2000	16
31	Hashtgerd	230/63	320	2002	14
32	Vardavard	400/230	1000	2003	13
		230/63	320	2003	13
33	Parand	230/63	320	2003	13
34	Parand-Power Plant Switch station	200	-	2003	13
35	Qeytariyeh	230/63	320	2003	13
36	Karaj	230/63	320	2003	13
37	Imam Khomeini airport	230/20	80	2004	12
38	Damavand Power Plant's Switch station	400	-	2005	11
39	Pardis	400/230	1000	2008	8
		230/63	320	2005	11
40	Kamalabad	230/63	500	2006	10
41	RoudshourGas Turbine Switch station	400	-	2007	9
42	RoudshourSwitch station	400	-	2007	9
43	Jamkaran	230/63	320	2007	9
44	SaeidabadSemi Mobile	230/20	90	2008	8
45	Neyzar Mobile	230/63	80	2009	7
46	Varamin	400/63	400	2010	6
47	Sheikh Bahaei	400/230	1000	2011	5
		230/63	360	2010	6
48	Shahriyar	230/63	360	2011	5
49	SiahbishePower Plant Switch station	400	-	2014	2
50	Firouzkouh	400/230	200	2015	1

Source: Prepared by the JICA Study Team, based on TREC documents (2016.7.12)

Among the Iranian facility planning standards, the following are the standards for maintenance of voltage.

During normal operations: plus or minus 5% of nominal voltage

During accidents (N-1 conditions): plus or minus 10%

In addition, for transformers, capacity increase is planned assuming operation at demand factor of 80%, to allow for accidents. However, in regions where demand is high, such as Tehran, the expansion of transformer capacity is delayed relative to the increase in demand, so some transformers exceed 80% demand factor, so there is concern over reduced reliability due to excessive load during an accident.

Control of voltage is carried out using transformer taps and VAR compansation equipment installed at each sub-station.

Phase adjustment equipment automatically controls sub-stations, but in regions with high electrical power demand, the phase adjustment equipment is insufficient, and during peak times, there is a significant problem of voltage reduction.

The sub-station peak load and minimum voltage for the main system in the Tehran region is shown in Table 3.2-7, and the system diagram is shown in Figure 3.2-8.

Among the primary system 230 kV substations, there are some substations where the breaker was omitted due to limitations on construction costs at the time of being newly installed, so they have a problem with reliability during accidents. In the 400 kV substations, the substation bus has been omitted, and there are some substations where the transmission cable and the transformer are directly connected, so during a transmission cable accident the transformers stop, and an excessive load is placed on the transformers on the intact site.

Many of these substations are more than 30 years old, so rehabilitation of the substations is necessary by improving reliability such as by installing a bus, installing a breaker on the primary side, etc., as well as replacement of the old substation equipment.

In addition, the protective relays at these substations are analog types and transistor types, so it is necessary to modify them to the latest digital type relays, to strengthen the reliability of the primary system substations.

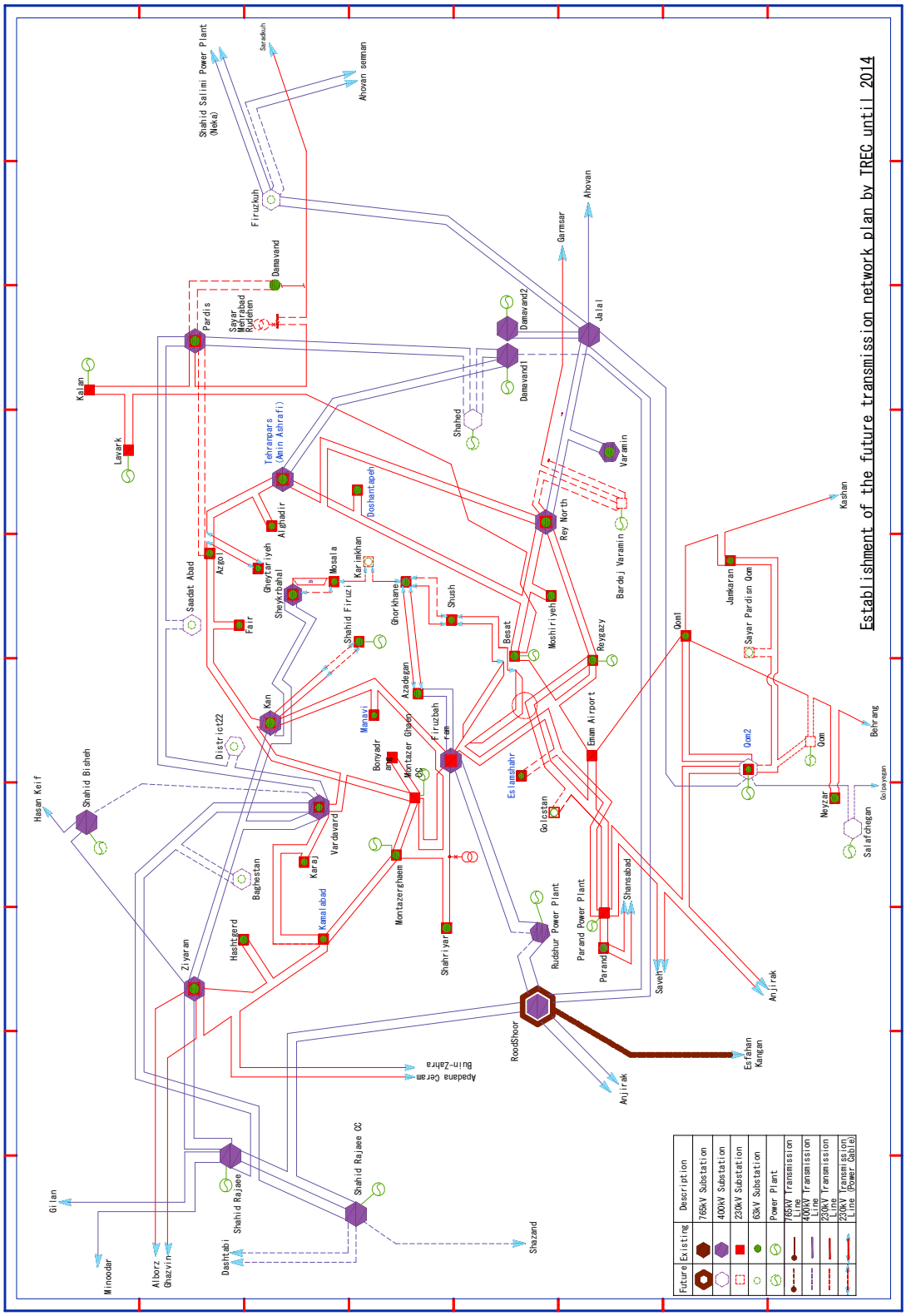
The distribution system is mainly 20 kV, but in some areas 33 kV and 11 kV distribution cables are used. The total capacity of the transformers for distribution is 80 GVA by ending of 2014, of which 24% are installed underground in cities.

The low-voltage distribution voltage to normal consumers is three-phase 380V, and single phase 200 V.

Table 3.2-7 Maximum Load and Minimum Voltage of TREC 400kV, 200kV Substations

Name of Substation	Ratio	Capacity (MVA)	Year of Operation	2012				2013				2014				2015				2016			
				Peak Load		Demand Factor (%)	Minimum Voltage	Peak Load		Demand Factor (%)	Minimum Voltage (kV)	Peak Load		Demand Factor (%)	Minimum Voltage (kV)	Peak Load		Demand Factor (%)	Minimum Voltage (kV)	Peak Load		Demand Factor (%)	Minimum Voltage (kV)
				MW	MVAR			MW	MVAR			MW	MVAR			MW	MVAR			MW	MVAR		
Besat	230/63	180x2	1967	86	64	29.8%	222 (kV) 96.5 (%)	86	64	29.8%	222 (kV) 96.5 (%)	46	77	24.9%	220 (kV) 95.7 (%)	89	147	47.7%	214 (kV) 93(%)	80	100	35.6%	213 (kV) 92.6 (%)
Karaj	230/63	160x2	2003	213	109	74.8%	223 (kV) 97 (%)	213	109	74.8%	223 (kV) 97 (%)	195	101	68.6%	222 (kV) 96.5 (%)	271	149	96.6%	210 (kV) 91.3 (%)	340	143	73.8%	212 (kV) 92.2 (%)
Parand combined cycle	230/63	160x2	2003	221	124	79.2%	225 (kV) 97.8 (%)	221	124	79.2%	225 (kV) 97.8 (%)	217	110	76.0%	224 (kV) 97.4 (%)	255	136	90.3%	217 (kV) 94.3 (%)	266	125	91.8%	215 (kV) 93.5 (%)
Ozgol	230/63	90x3+80	1974	211	54	62.2%	218 (kV) 94.8 (%)	211	54	62.2%	218 (kV) 94.8 (%)	203	60	60.5%	220 (kV) 95.7 (%)	238	75	71.3%	211 (kV) 91.7 (%)	229	55	67.3%	211 (kV) 91.7 (%)
DoshanTappeh	230/63	180x3	1976	339	140	67.9%	220 (kV) 95.7 (%)	339	140	67.9%	220 (kV) 95.7 (%)	307	120	61.0%	219 (kV) 95.2 (%)	370	136	73.0%	211 (kV) 91.7 (%)	389	140	76.6%	209 (kV) 90.9 (%)
Qeytariyeh	230/63	160x2	2003	168	52	55.0%	221 (kV) 96.1 (%)	168	52	55.0%	221 (kV) 96.1 (%)	152	52	50.2%	222 (kV) 96.5 (%)	197	74	65.8%	213 (kV) 92.6 (%)	234	53	75.0%	214 (kV) 93 (%)
Amin Ashrafi (Tehranpars)	400/230	500x2	1981	713	459	84.8%	383 (kV) 95.8 (%)	713	459	84.8%	383 (kV) 95.8 (%)	713	324	78.3%	382 (kV) 95.5 (%)	820	391	90.8%	372 (kV) 93(%)	819	391	90.8%	379 (kV) 94.8 (%)
	230/63	180x2	1981	119	37	34.6%	224 (kV) 97.4 (%)	119	37	34.6%	224 (kV) 97.4 (%)	153	51	44.8%	223 (kV) 97 (%)	182	73	54.5%	215 (kV) 93.5 (%)	136	52	40.4%	214 (kV) 93 (%)
Rey Shomali	400/230	500x3	1987	725	495	58.5%	384 (kV) 96 (%)	725	495	58.5%	384 (kV) 96 (%)	736	493	59.1%	381 (kV) 95.3 (%)	735	702	67.8%	370 (kV) 92.5 (%)	867	550	68.4%	379 (kV) 94.8 (%)
	230/63	250x2+180	1987	487	296	83.8%	223 (kV) 97 (%)	487	296	83.8%	223 (kV) 97 (%)	473	273	80.3%	222 (kV) 96.5 (%)	543	332	93.6%	215 (kV) 93.5 (%)	515	297	87.4%	213 (kV) 92.6 (%)
Imam Khomeini airport	230/20	40x2	2004	3	3	5.3%	223 (kV) 97 (%)	3	3	5.3%	223 (kV) 97 (%)	5	2	6.7%	223 (kV) 97 (%)	1	6	7.6%	216 (kV) 93.9 (%)	11	1	13.8%	214 (kV) 93 (%)
Pardis	400/230	500x1(Add TF in 2015, Stop TR in 2016)	2008	129	122	35.5%	386 (kV) 96.5 (%)	129	122	35.5%	386 (kV) 96.5 (%)	184	122	44.2%	385 (kV) 96.3 (%)	236	152	28.1%	376 (kV) 94(%)	100	74	24.9%	383 (kV) 95.8 (%)
	230/63	160x2	2005	110	50	37.8%	225 (kV) 97.8 (%)	110	50	37.8%	225 (kV) 97.8 (%)	156	96	57.2%	222 (kV) 96.5 (%)	141	71	49.3%	221 (kV) 96.1 (%)	141	67	48.8%	224 (kV) 97.4 (%)
Jamkaran	230/63	160x2	2007	244	83	80.5%	227 (kV) 98.7 (%)	244	83	80.5%	227 (kV) 98.7 (%)	208	65	68.1%	225 (kV) 97.8 (%)	234	75	76.8%	221 (kV) 96.1 (%)	280	101	93.0%	215 (kV) 93.5 (%)
Firouzkouh (mobile)	230/63	Discontinue in 2016	2000	49	16	64.4%	220 (kV) 95.7 (%)	49	16	64.4%	220 (kV) 95.7 (%)	32	10	83.8%	218 (kV) 94.8 (%)	23	7	60.1%	221 (kV) 96.1 (%)	–	–	–	–
Hashtgerd	230/63	160x2	2002	148	59	49.8%	223 (kV) 97 (%)	148	59	49.8%	223 (kV) 97 (%)	164	70	55.7%	221 (kV) 96.1 (%)	153	121	61.0%	213 (kV) 92.6 (%)	193	79	65.2%	213 (kV) 92.6 (%)
Shoush	230/63	180x2	1999	195	107	61.8%	225 (kV) 97.8 (%)	195	107	61.8%	225 (kV) 97.8 (%)	204	109	64.2%	228 (kV) 99.1 (%)	188	182	72.7%	215 (kV) 93.5 (%)	222	106	68.3%	213 (kV) 92.6 (%)
Moshiriyeh	230/63	160x2	1998	126	78	46.3%	223 (kV) 97 (%)	126	78	46.3%	223 (kV) 97 (%)	151	85	54.2%	221 (kV) 96.1 (%)	151	85	54.2%	214 (kV) 93 (%)	184	65	61.0%	209 (kV) 90.9 (%)
Alghadir	230/63	250x2+180	1999	168	74	57.4%	227 (kV) 98.7 (%)	168	74	57.4%	227 (kV) 98.7 (%)	172	87	60.2%	222 (kV) 96.5 (%)	158	76	35.1%	213 (kV) 92.6 (%)	253	79	53.0%	212 (kV) 92.2 (%)
Shahriyar	230/63	180x2	2011	131	68	41.0%	222 (kV) 96.5 (%)	131	68	41.0%	222 (kV) 96.5 (%)	143	72	44.5%	221 (kV) 96.1 (%)	177	71	53.0%	211 (kV) 91.7 (%)	182	55	52.8%	213 (kV) 92.6 (%)
Vardavard	400/230	500x2	2003	554	308	63.4%	385 (kV) 96.3 (%)	554	308	63.4%	385 (kV) 96.3 (%)	551	263	61.1%	385 (kV) 96.3 (%)	697	316	76.5%	372 (kV) 93(%)	709	411	82.0%	382 (kV) 95.5 (%)
	230/63	160x2	2003	156	72	53.7%	226 (kV) 98.3 (%)	156	72	53.7%	226 (kV) 98.3 (%)	197	79	66.3%	224 (kV) 97.4 (%)	240	108	82.2%	214 (kV) 93 (%)	250	104	84.6%	216 (kV) 93.9 (%)
Sheikh Bahaei	400/230	500x2	2011	541	195	57.5%	382 (kV) 95.5 (%)	541	195	57.5%	382 (kV) 95.5 (%)	499	122	51.4%	383 (kV) 95.8 (%)	619	196	64.9%	366 (kV) 91.5 (%)	639	212	67.3%	377 (kV) 94.3 (%)
	230/63	180x2	2010	109	32	35.5%	222 (kV) 96.5 (%)	109	32	35.5%	222 (kV) 96.5 (%)	111	32	32.1%	222 (kV) 96.5 (%)	193	66	56.7%	209 (kV) 90.9 (%)	175	62	51.6%	211 (kV) 91.7 (%)
SaeidabadSemi Mobile	230/20	90x2	2008	32	20	41.9%	229 (kV) 99.6 (%)	32	20	41.9%	229 (kV) 99.6 (%)	33	18	41.8%	223 (kV) 97(%)	28	14	34.8%	212 (kV) 92.2 (%)	33	19	42.3%	–
Bonyadrang	230/25	Discontinue in 2014	1999	10	0	15.9%	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
MontazerQaem	230/63	180x3	1971	366	129	71.9%	225 (kV) 97.8 (%)	366	129	71.9%	225 (kV) 97.8 (%)	381	143	75.4%	224 (kV) 97.4 (%)	432	172	86.1%	214 (kV) 93(%)	458	165	90.2%	216 (kV) 93.9 (%)
Shahid Firuzi	230/63	180+80x2	1970	224	56	67.9%	219 (kV) 95.2 (%)	224	56	67.9%	219 (kV) 95.2 (%)	203	59	62.2%	219 (kV) 95.2 (%)	204	61	62.6%	209 (kV) 90.9 (%)	189	57	58.1%	210 (kV) 91.3 (%)
Kan	400/230	500x2	1976	475	216	52.2%	382 (kV) 95.5 (%)	475	216	52.2%	382 (kV) 95.5 (%)	462	166	49.1%	384 (kV) 96(%)	532	184	56.3%	367 (kV) 91.8 (%)	582	215	62.0%	379 (kV) 94.8 (%)
	230/63	160x2	1976	237	77	77.9%	223 (kV) 97 (%)	237	77	77.9%	223 (kV) 97 (%)	231	82	76.6%	223 (kV) 97 (%)	284	89	93.0%	213 (kV) 92.6 (%)	271	92	89.4%	214 (kV) 93 (%)
Namayeshgah	230/63	180x3	1974	324	95	62.5%	220 (kV) 95.7 (%)	324	95	62.5%	220 (kV) 95.7 (%)	294	77	56.3%	222 (kV) 96.5 (%)	296	70	56.3%	210 (kV) 91.3 (%)	331	90	63.5%	211 (kV) 91.7 (%)
Manavi	230/63	180x3	1976	295	105	58.0%	226 (kV) 98.3 (%)	295	105	58.0%	226 (kV) 98.3 (%)	245	78	47.6%	222 (kV) 96.5 (%)	308	106	60.3%	208 (kV) 90.4 (%)	347	120	68.0%	209 (kV) 90.9 (%)
Firouz Bahram	400/230	500x4	1969	1,016	319	53.2%	389 (kV) 97.3 (%)	1,016	319	53.2%	389 (kV) 97.3 (%)	964	280	50.2%	394 (kV) 98.5 (%)	1,311	373	68.2%	378 (kV) 94.5 (%)	1,195	456	64.0%	396 (kV) 99 (%)
Rey Gas	230/63	180x2	1983	285	146	89.0%	222 (kV) 96.5 (%)	285	146	89.0%	222 (kV) 96.5 (%)	240	108	73.1%	220 (kV) 95.7 (%)	278	135	85.8%	214 (kV) 93(%)	294	152	91.9%	210 (kV) 91.3 (%)
Ziyaran	230/63	125x2	1979	87	45	39.2%	227 (kV) 98.7 (%)	87	45	39.2%	227 (kV) 98.7 (%)	101	54	45.8%	225 (kV) 97.8 (%)	150	72	66.6%	221 (kV) 96.1 (%)	110	52	48.7%	221 (kV) 96.1 (%)
	400/230	500x2	1979	405	237	46.9%	395 (kV) 98.8 (%)	405	237	46.9%	395 (kV) 98.8 (%)	471	202	51.2%	393 (kV) 98.3 (%)	443	306	53.8%	381 (kV) 95.3 (%)	425	231	48.4%	392 (kV) 98 (%)
Kamalabad	230/63	250x2+180	2006	273	123	59.9%	221 (kV) 96.1 (%)	273	123	59.9%	221 (kV) 96.1 (%)	312	79	64.4%	221 (kV) 96.1 (%)	366	109	76.4%	211 (kV) 91.7 (%)	342	86	70.5%	213 (kV) 92.6 (%)
Eslamshahr	230/63	160x3	1995	354	155	80.5%	223 (kV) 97 (%)	354	155	80.5%	223 (kV) 97 (%)	342	123	75.7%	223 (kV) 97 (%)	376	154	84.7%	215 (kV) 93.5 (%)	393	158	88.2%	212 (kV) 92.2 (%)
Azadegan	230/63	180x3	1991	291	117	58.1%	222 (kV) 96.5 (%)	291	117	58.1%	222 (kV) 96.5 (%)	280	108	55.6%	222 (kV) 96.5 (%)	298	98	58.1%	212 (kV) 92.2 (%)	424	138	82.6%	214 (kV) 93 (%)
	230/20	90x2	1991	82	45	52.0%	222 (kV) 96.5 (%)	82	45	52.0%	222 (kV) 96.5 (%)	60	32	37.8%	222 (kV) 96.5 (%)	88	49	56.0%	212 (kV) 92.2 (%)	85	47	54.0%	214 (kV) 93 (%)
Mosalla	230/63	180x4	1990	508	128	72.8%	223 (kV) 97 (%)	508	128	72.8%	223 (kV) 97 (%)	419	134	61.1%	224 (kV) 97.4 (%)	571	145	81.8%	211 (kV) 91.7 (%)	589	164	84.9%	214 (kV) 93 (%)
Qourkhaneh	230/63	180x3	1995	381	151	75.9%	223 (kV) 97 (%)	381	151	75.9%	223 (kV) 97 (%)	340	110	66.2%	225 (kV) 97.8 (%)	405	145	79.7%	212 (kV) 92.2 (%)	446	160	87.7%	214 (kV) 93 (%)
	230/20	90x2	1995	100	100	78.6%	223 (kV) 97 (%)	100	100	78.6%	223 (kV) 97 (%)	62	51	44.6%	225 (kV) 97.8 (%)	77	59	53.9%	212 (kV) 92.2 (%)	80	47	51.5%	214 (kV) 93 (%)
Qom 1	230/63	180x2	1978	147	53	86.8%	225 (kV) 97.8 (%)	147	53	86.8%	225 (kV) 97.8 (%)	147	45	42.7%	222 (kV) 96.5 (%)	181	75	54.4%	218 (kV) 94.8 (%)	237	103	71.8%	213 (kV) 92.6 (%)
Qom Combined cycle (Qom2)	230/63	160x2	1995	210	21	66.0%	230 (kV) 100 (%)	210	21	66.0%	230 (kV) 100 (%)	241	136	86.5%	228 (kV) 99.1 (%)	261	147	93.6%	224 (kV) 97.4 (%)	212	86	71.5%	219 (kV) 95.2 (%)
ZarrinKouh Mobile	230/63	40x1	1996	39	0	97.5%	220 (kV) 95.7 (%)	39	0	97.5%	220 (kV) 95.7 (%)	13	3	33.4%	226 (kV) 98.3 (%)	18	3	45.6%	214 (kV) 93(%)	–	–	–	–
Varamin	400/63	200x1(Add Tr in 2014)	2010	89	37	48.2%	387 (kV) 96.8 (%)	89	37	48.2%	387 (kV) 96.8 (%)	115	63	32.8%	385 (kV) 96.3 (%)	100	46	27.5%	377 (kV) 94.3 (%)	164	90	46.8%	384 (kV) 96 (%)
Neyzar Mobile	230/63	40x2	2009	36	14	48.3%	226 (kV) 98.3 (%)	36	14	48.3%	226 (kV) 98.3 (%)	40	15	53.4%	228 (kV) 99.1 (%)	26	10	34.8%	228 (kV) 99.1 (%)	25	7	32.5%	–

Source: Obtained from TAVANIR, and prepared by the JICA Study Team



Source: Obtained from TAVANIR, and prepared by the JICA Study Team

Figure 3.2-8 Power Network Diagram in TREC

In addition, it is reported that in Iran, the loss in the distribution system is 12.93% and the loss in the transmission system is 3.02%, as shown in Table 3.2-8.
The loss in the distribution system is a high value due to the long distance of distribution lines in the regional areas, but the improvements are being made year by year, by reducing these losses.

Table 3.2-8 Transmission and Distribution Loss（Fiscal 2010 to 2014）

Year	Distribution Loss	Sub-Transmission and Transmission Loss
2010	14.80 %	3.60 %
2011	14.74 %	3.43 %
2012	15.03 %	3.53 %
2013	14.83 %	3.35 %
2014	12.93 %	3.02 %

Source: Obtained from TAVANIR, and prepared by the JICA Study Team
(Electric Power Industry in Iran (2014-2015))

In addition, the transmission and distribution losses in the sixth five-year plan of TAVANIR are expected to be as follows, so further action will be taken to reduce the losses in the future.

Table 3.2-9 Forecast of Transmission and Distribution Loss

Subject	2016	2017	2018	2019	2020
Transmission and Sub-transmission Losses(%)	2.96%	2.93%	2.90%	2.87%	2.84%
Distribution Losses(%)	10.00%	9.45%	9.20%	8.95%	8.70%

Source: The Sixth Five Year Development Plan in TAVANIR

3.3 Electric Power Facility Plans for Future

The development of the power plants shown in Table 3.3-1 is planned in conjunction with the increase in the electric power system and demand in Iran, by the development of new power plants as sources of electric power, completion of hydroelectric power plants under construction, conversion of existing gas turbine power plants to combined cycle power plants in order to improve efficiency, and development of new power plants by BOO and BOT, etc.
In this way, the reserve capacity will be increased and the electric power supply stabilized.
In addition, in the plans for new power stations, 60 to 70% will be private power stations. From these plans, it can be seen that privatization of power generation facilities is a national policy in Iran.

Table 3.3-1 Time Schedule for Completion of Various New Power Plants

No	Regional electricity power	Name of Power Plant	Kind of Power Plant	Capacity(MW)			
				2016	2017	2018	2019
1	Ministry of energy	Shirwan	Combined Cycle	0	480	0	0
2		SarBandar-Mahshahr		648	0	0	0
3		Zahedan		0	0	0	324
4		Zarand		0	0	162	162
5		F Class Units	Gas Turbine	0	301	1,210	1,952
6	Private	Sarv (Chadormaloo)	Combined Cycle	160	0	0	0
7		Pasargad Qeshm		0	0	0	324
8		West Mazandaran		0	0	0	310
9		Khorramabad		0	0	324	160
10		Sadough (Yazd 2)		0	160	0	0
11		Dalahoo (Kermanshah)		0	0	0	304
12		Gol Gohar Sirjan		332	160	0	0
13		Samangan		332	160	0	0
14		Shobad (Kahnooj)		160	0	0	0
15		Heris		0	0	0	304
16		Makoo		0	110	0	0
17		Sabzevar		0	0	0	324
18		Behbahan		332	160	0	0
19		Andimeshk & Dezfoul		0	0	0	304
20		Rood-e Shoor		0	0	317	0
21		Chabahar		0	0	0	160
22		Jahrom		0	0	320	160
23		Kashan		0	0	0	160
24		Oroumiyeh		0	0	477	0
25		Semnan		0	0	0	159
26		Sabalan		0	0	0	480
27		Parand		160	320	0	0
28		Foreign Investment		0	0	0	3,124
29		Renewable Energies	Renewable	350	600	960	960
30		Dispersed Generation, Heat and Power Production	DG, CHP	480	480	480	480
31	Ministry of Energy (special projects)	Wind Power plants	Wind	140	90	100	100
32	Ministry of Energy	Darian	Hydro	0	140	70	0
33		Roodbar in Lorestan		225	225	0	0
34		Sardasht		0	50	100	0
35		Chamshir		0	0	55	121
36		Small, Medium and Flowing Water Powerplants		0	4	0	20
Total of MOE				1,013	1,290	1,697	2,679
Total of Private Sector				2,306	2,150	2,878	7,713
Total of the Country				3,319	3,440	4,575	10,392
Privatization rate				69.5%	62.5%	62.9%	74.2%

Source: Electric Power Industry in Iran (2014-2015), TAVANIR

Also in conjunction with the development of new power plants, it is intended to steadily implement the following construction plans, in order to improve the efficiency of existing power plants.

(1) Rehabilitation of existing facilities
(2) Repowering
(3) Improving the efficiency of combined cycle power generation
(4) Improving the performance of steam power generation

It is planned to increase and strengthen the transmission lines and substations as shown in Table 3.3-2 and Table 3.3-3, to enable the electric power generated from the new power plants to be stably supplied to the electric power system to satisfy the increase in demand.

Table 3.3-2 Forecast of Extensions in Sub-Transmission and Transmission Installation

Description	Voltage (kV)	End of 2015	End of 2016	End of 2017	End of 2018	Annual Growth (%)
Transmission Substation Capacity (MVA)	400 & 230	132,167	137,834	145,048	152,846	5.0
Sub-Transmission Substation Capacity (MVA)	66,63& 132	94,330	98,108	104,087	110,549	5.4
Transmission Lines Length (km-Circuit)	400 & 230	50,726	51,364	54,170	57,202	4.1
Sub-Transmission Lines Length (km-Circuit)	66,63& 132	70,024	70,980	75,021	79,389	4.3

Source: Electric Power Industry in Iran (2014-2015), TAVANIR

Table 3.3-3 Forecast of Extensions in Distribution Installation

Description	Unit	End of 2015	End of 2016	End of 2017	End of 2018	Annual Growth (%)
Number of Customers	10^3 Customers	31,672	33,061	34,356	35,669	4.0
Eenergy Sales	10^6 Kwh	219,653	230,448	242,183	254,502	5.0
Distribution Lines Length	km	734,489	751,644	768,641	784,854	2.2
Sub-Transmission Substation Capacit	MVA	105,356	109,104	112,794	116,284	3.3

Source: Electric Power Industry in Iran (2014-2015), TAVANIR

Table 3.3-4 and Table 3.3-5 show the total capacity and the component ratio for each power plant type in the Sixth Five-year Development Plan of TAVANIR, as well as their annual generating capacity.
Among the power plant types, there is a trend towards the combined cycle generation whose capacity exceeds 50 % of total generating capacity, and which allows to increase the thermal efficiency including existing gas turbine generation as an add-on. Also, the capacity of renewable energy such as wind power generation, etc., that utilize natural energy without relying on fossil fuel, exceeds 5% of the total generating capacity and its percentage of the total capacity is tending to increase.
On the other hand, in the annual power generation, the generation by renewable power plants that use unstable natural energy is only about 1%, and it is about 6% of all power generation systems including hydroelectric power generation but excluding thermal power generation. Therefore, there is no change to the trend of dependence on thermal power generation for more than 90% of the total. Among thermal power generation, steam generation is capable of

generating a stable output throughout the year, so it is planned to rely on it for 20% or more of power generation output.
In order to obtain stable output, an increase in new combined cycle plant and rehabilitation of aging steam generating plants for function-permitting maintenance seem to be necessary

Table 3.3-4 Nominal Capacity by Power Plants Type within the Sixth Development Plan (MW)

Type of Power Plants	2016		2017		2018		2019		2020	
	Capacity (MW)	Ratio of Power Station	Capacity (MW)	Ratio of Power Station	Capacity (MW)	Ratio of Power Station	Capacity (MW)	Ratio of Power Station	Capacity (MW)	Ratio of Power Station
Steam	15,830	20.3%	15,830	19.3%	15,830	18.2%	16,155	17.3%	17,455	17.3%
Gas Turbine	26,761	34.4%	23,481	28.7%	19,269	22.1%	15,057	16.1%	10,845	10.8%
Combined Cycle	20,914	26.9%	26,945	32.9%	35,117	40.3%	43,619	46.6%	51,487	51.1%
Diesel	439	0.6%	439	0.5%	439	0.5%	439	0.5%	439	0.4%
Thermal Total	63,944	82.1%	66,694	81.4%	70,654	81.0%	75,269	80.4%	80,225	79.6%
Hydroelectric	11,819	15.2%	12,236	14.9%	12,236	14.0%	12,236	13.1%	12,236	12.1%
Nuclear	1,020	1.3%	1,020	1.2%	1,020	1.2%	1,020	1.1%	1,020	1.0%
Renewable	578	0.7%	1,168	1.4%	2,068	2.4%	3,366	3.6%	4,966	4.9%
Renewable Total	13,417	17.2%	14,424	17.6%	15,324	17.6%	16,622	17.8%	18,222	18.1%
Distributed Generation	500	0.6%	800	1.0%	1,200	1.4%	1,700	1.8%	2,350	2.3%
Total	77,861	100.0%	81,918	100.0%	87,178	100.0%	93,591	100.0%	100,797	100.0%
Annual Growth Rate(%)	5.1%	-	5.2%	-	6.4%	-	7.4%	-	7.7%	-

Source: The Sixth Five Year Development Plan in Tavanir

Table 3.3-5 Power Generation by Power Plants Type within the Sixth Development Plan

Type of Power Plants	2016		2017		2018		2019		2020	
	Power Generation (GWh)	Ratio of Power Station	Power Generation (GWh)	Ratio of Power Station	Power Generation (GWh)	Ratio of Power Station	Power Generation (GWh)	Ratio of Power Station	Power Generation (GWh)	Ratio of Power Station
Steam	86,130	28.6%	86,130	27.0%	86,130	25.3%	87,625	24.2%	91,964	23.7%
Gas Turbine	88,462	29.3%	66,097	20.7%	50,660	14.9%	36,203	10.0%	22,576	5.8%
Combined Cycle	104,912	34.8%	142,998	44.9%	177,433	52.2%	210,878	58.3%	241,430	62.3%
Diesel	71	0.0%	71	0.0%	71	0.0%	71	0.0%	71	0.0%
Thermal Total	279,575	92.7%	295,297	92.7%	314,294	92.5%	334,776	92.5%	356,041	91.8%
Hydroelectric	15,531	5.2%	15,006	4.7%	16,077	4.7%	15,006	4.1%	16,077	4.1%
Nuclear	4,914	1.6%	5,004	1.6%	5,004	1.5%	5,004	1.4%	5,004	1.3%
Renewable	456	0.2%	972	0.3%	1,658	0.5%	2,654	0.7%	3,915	1.0%
Renewable Total	20,901	6.9%	20,981	6.6%	22,739	6.7%	22,663	6.3%	24,996	6.4%
Distributed Generation	986	0.3%	2,334	0.7%	2,839	0.8%	4,424	1.2%	6,764	1.7%
Total	301,462	100.0%	318,612	100.0%	339,872	100.0%	361,863	100.0%	387,802	100.0%

Source: The Sixth Five Year Development Plan in Tavanir

3.4 Overview of Other Related Organizations

3.4.1 Consulting Companies

In Iran, there are consulting companies that are independent of the Ministry of Energy, that obtain contracts from TAVANIR and TPPH for the design and supervision of power plants and construction supervision.
Since these companies are delegated authority of project implementation from TAVANIR and TPPH, they bear managing responsibility in technical and financial aspects of EPC project.
They have fulfilled their responsibility and role for the EPC project related with Russian and Chinese companies. In case of contract with them as a local consultant, it is important to aware of the due diligence.
The main consulting companies are as follows.

- **GHODS NIROO ENGINEERING COMPANY (GNEC)**

According to information on their website, GNEC was established in 1975, they currently have about 1,000 employees, and are engaged in the electric power generation, transmission, and distribution fields. They have provided consulting services for the design, construction, and commissioning of a total of 23,000 MW power plants, 270 substations, and more than 25,000 km of high voltage lines. Recently also TPPH is providing consulting services for several projects with Russian, German, and Chinese companies.

http://www.ghods-niroo.com/

- **MOSHANIR**

According to information on their website, Moshanir was authorized by the Iranian Parliament in 1964 as Water and Power Engineering Services (Manab). They officially commenced business in 1969, and in 1980 the water and electric power departments of Manab were separated, and Moshanir was started as a consulting company in the electric power field. They have provided consulting services for the design, construction, and commissioning of a total of 26,800 MW of power plants, and more than 39,350 km of high voltage lines.

http://www.moshanir.co.ir/en/home.aspx

- **Monenco Iran**

Monenco Iran was founded in 1973 as joint venture company between private sector of Iran and Montreal Engineering Co. of Canada.
In 1997 Mapna Co. and AMEC Co. of England became main shareholders of Menenco Iran by buying respectively shares of government of Iran and since then Monenco Iran has been the engineering wing of Mapna.
Between 1996 and 2012 Monenco Iran had fulfilled the consulting services for 35 gas power stations, 49 combined cycle power stations and 124 substations in range of 63kV to 400kV.
Monenco Iran has obtained ISO 9001:2008、ISO 14001:2004.

http:// www.monenco.com

3.4.2 Companies Engaged in Manufacture, Construction of Equipment for Thermal Power Plants

- **MAPNA GROUP**

The Mapna Group organization includes a Manufacturing Division and a Power Division, that undertake the construction of thermal power plants and the manufacture of equipment. Also,

they have more than 170 cooperating companies within Iran, including oil, gas, railways, and other businesses.

http://mapnagroup.com/en/

MAPNA have a lot of experience for construction of thermal power plants in Iran. At the same time, they have also business experience in neighboring countries. Recently, they reported on their home page in web site that they contract license of manufacturing F type gas turbine with Siemens, Germany.

- **FARAB**

This company established in 1992 initially played the role of EPC contractor in charge of managing hydroelectric power station construction projects within Iran. However subsequently they also became involved in thermal power station projects. In recent years there are also participating in overseas projects.

WWW.farab.com

- **SHAHRIAR TURBINE COMPONENTS Co.**

This is a company specialized in maintenance of gas turbine parts, for example they have experience of repairing 4300 sets of hot parts for different gas turbines.

www.sh-turbine.com

3.4.3 Manufacturers and construction companies for substation

- **IRAN TRANSFO COMPANY**

Iran Transfo Company was established in 1967 under the license of Siemens Germany and has been a major transformer manufacturer in Iran. The products are air-cooling and water-cooling auto transformer and 3-phase transformer, mobile transformer and shunt reactor. Iran Transfo has currently designed and manufactured transformers more than 5MVA conforming to international standards such as IEC, BS, ANSI,...

The maximum manufacturing capacity is 420kV, 600MVA as for transformer, 400kV, 50MVAr as for shunt reactor and 230kV, 55MVA as for mobile transformer. Iran Transfo manufactures yearly 30,000MVA and has provided a lot of transformers to Tehran Reginal Electric Company (TREC).

Iran Transfo obtains ISO 9001:2008, ISO 14001:2004 and ISO/IEC 17025:2005.

Website: www.iran-transfo.com

- **Toos Cut Industries**

Toos Cut Industries is a switchgear manufacturer in Iran. The products are gas insulated switchgears (GIS) and substation units. The specification of GIS conforming to IEC 62271 is 145kV/2500A and 72.5kV/2500A and the specification of substation unit is 63/20KV.

Website: www.kti-co.ir

- **IRAN SWITCH COMPANY**

Iran Switch Company is an Iranian switchgear manufacturer that was established under technical cooperation of Brown Boveri of Switzerland. Iran Switch has currently taken technical cooperation with ABB Switzerland, Siemens Germany and so. The products are circuit breakers upto 550kV and 4000A and etc.

Website: www.iranswitch.org

- **FULMEN**

Fulmen is an Iranian switchgear manufacturer and substation constructor that was established in 1973. Fulmen has taken license with Alstom France in 1996. The products are disconnecting switch upto 420kV and 3150A, metal-clad switchgears upto 36kV and mobile substation upto 245kV.
Fulmen has fulfilled engineering, procurement and construction (EPC) works as turn-key base for AIS and GIS substations in range of 63kV to 400kV.

Website: www.fulmen.com

- **PARSIAN GROUP**

Parsian Group is an Iranian energy facilities constructor that is constituted in four divisions, e.g. plant division and substation division established in 1993. Turnover in 2014 was 38 million USD for substation division and 53 million USD for Parsian Group. The employee is 197 (70% of staff are engineers and technicians) for substation division and 329 for Parsian Group. The substation division has fulfilled engineering, procurement and construction (EPC) works as turn-key base for AIS and GIS substations in range of 63kV to 400kV. The substation division is currently engaging in international projects of 23% and in domestic projects of 77%.
Parsian Group obtains ISO 9001:2008 and ISO 14001:2004.

Website: www.parsian.com

3.5 Considerations after economic sanctions released

It is reported that many companies have a relationship with construction and repairing work of a thermal power plant in Iran. In case of loan assistance in future, it is important to research in advance that a related company is not in the economic sanctions target list

Considerations on business after economic sanctions released were uploaded on Internet in June 2016 by Japan External Trade Organization (JETRO).

JETRO mentions as follows:
Economic sanctions release allows a trade with Iranian party without passing through U. S. person and companies (e.g. financial settlement through currency other than US dollar). However, it is necessary to list up considerations when starting a business in Iran, i.e. technical issues for financial transactions resume, selection of an Iranian business partner not listed on SDN list, complete execution of due diligence, snap-back provision and etc.

Furthermore, JETRO explains as follows concerning with confirmation of SDN list and execution of due diligence:

1) Confirmation of SDN list
The United States Treasury Department of Foreign Assets Control stations make a SDN list on which the subject of asset freeze, i.e. person or organization, is described in a lump on basis of various sanctions regulations related with diverse business. The SDN list is the most essential information to select a business partner in Iran.

2) Execution of due diligence
In case of a public company, the management information ought to be obtained from the public information from the stock exchange. In case of a non-public company, the common information ought to be obtained at least from internet.

When a large-scale trading is made, it is effective to utilize the report edited by a private credit research firm, which is recognized and trusted in the U. S.
A compliance certification written by an Iranian business partner itself (Iranian party is independent from the subject on the SDN list) is occasionally judged as insufficient.
When a due diligence is executed, an effective utilization of a credit research firm is not requirements, but it is one of risk management measures to secure safety of trading.
The due diligence is actually decided based on scale of trading, nature of trading, continuity of trading and etc.

ref: “Iran Business Guidebook ・Points of economic sanctions release and attractiveness of business” June 2016 JETRO

Chapter 4 Competitive Advantage Business Areas

4.1 Power Generation Facilities

The main electric power generation equipment in Iran is thermal power generation facilities such as steam, gas turbines, combined cycle, etc., which accounts for more than 80% of the total. Of the thermal power generation facilities, gas turbines and combined cycle generation are affected by the external air temperature and pressure, so the generation capacity remains at about 80% of the generation capacity, and the dependence on steam power plants which can produce a stable output is largely for base load supply and other important facilities. However, 67% of the steam power generation capacity is from equipment that commenced service more than 20 years ago, so rehabilitation is necessary.

Although the electric power demand in Iran is rapidly increasing, environmental pollution is a problem. Insufficient environmental countermeasures and old energy facilities are one cause of atmospheric pollution. The Government of Iran is tackling this problem, and in April 2016 new regulations on gaseous emissions from power plants were enacted by the Cabinet. Existing thermal Power Plant cannot comply with the new regulations with the existing equipment, so additional environmental countermeasure is required.

Also, insufficient water resources is an important issue in Iran. According to a JICA Study team on the water sector, the maximum quantity of water resources that can be used per person annually is estimated to be about 1,600 m^3. On the other hand, the demand for water is increasing with the economic development of companies and the increase in population. Therefore, as power plant with wet type cooling tower needs a large quantity of water, there is an urgent need to replace the wet-type cooling tower with a dry-type cooling tower.

In this way, it is necessary to carry out rehabilitation that will improve the efficiency of the equipment at the existing power plants, in order to extend the plant life.

4.2 Transmission and Distribution Equipment

Since the facilities deteriorated in the influence of economic sanctions have been utilized in the Iranian power sectors, 8.9 percent (capacity ratio) of super high voltage substations (400 or 230kV) have passed more than thirty five years at 2014.[1)]
An expected life of transformer is generally thirty years at the time of manufacturing and an expected life of circuit breaker which incorporates movable portions will be shorter than a transformer, therefore update of the deteriorated facilities shall be an urgent issue in order to hold the reliability of power supply.
In this survey, Iran side proposed six substations as candidate sites for rehabilitation, and three out of six have been built approximately forty years ago by a Japanese company.
It is observed that a super high voltage overhead transmission line is directly connected to a transformer in several main substations, some of which are included in the candidate sites. It is necessary to install a bus bar in the substation and to connect a transmission line and a transformer via a circuit breaker to a bus bar in order to prevent the spread of the electric accident and increase the freedom of the grid configuration. To achieve the above purpose, the current substation configuration shall be modified.

In addition, the upgrading or the expansion of the substations is to be carried out at the same time of the rehabilitation in order to meet the power demand increase foreseen.
On the other hand, the reduction of power loss at the power grid network is also an urgent issue. The loss has been reduced every year since 2006, however it has recorded still 13.13% at 2014[7]. Most of the power loss is a transmission loss and a distribution loss. Although on the Table 3.2-8 and Table 3.2-9, yearly transmission loss and distribution loss are described, which are published including above power loss by TAVANIR, the value of each is different due to different denominator (i.e. receiving energy, sending energy) in loss calculation on the TAVANIR's book. Therefore, each number does not match.
In the Fifth Economic, Social and Cultural Development Plan formulated by the Iranian government, and targeting March 2011 to March 2016, POWER LOSS REDUCTION, IMPROVEMENT OF GENERATING EFFICIENCY and MANAGEMENT OF LOAD are forcused.

1) Rehabilitation of substations
Six candidate substations were 400kV or 230kV substations of Teheran city-suburbs.
As the result of site survey, it has been confirmed in all substations to be able to renovate or extend the existing facilities by using current technology while operating the existing facilities at the same site.
In order to reinforce a protective function, protective relays and control circuits are to be digitalized for faster protection and control at the same time of facilities renovation or extension.
In order to let the grid network gain a margin and to improve the stabilization of the grid network, a transformer capacity is to be expanded or a feeder bay is to be extended in the substation where an overload is foreseen in the near future.

2) Proposals for emergency recovery and disaster preparedness
It is necessary to early renew or repair the deteriorated electrical apparatus to supply stable electricity.
Iran is one of the countries in which the earthquake occurs frequently and has several huge faults which cover 90% of whole land. Once the big earthquake occurs, electrical facilities would suffer destructive damage.
It is proposed to improve the stability of the social infrastructure with the introduction of the facility aiming early recovery and strong equipment against disasters applied Japanese technology.

4.3 Fields in Which Japanese Technology Has an Advantage

4.3.1 Power Generation Equipment

The following are suggestions for the potential of application of the technologies in which Japanese companies are strong in plans for the development of new power generation facilities, for which the necessity is high in the future, and the renovation of existing facilities.

< Direction for Development of Existing Power Generation Facilities >
When a single unit gas turbine has been installed, converting the facility into a combined cycle plant by adding an exhaust heat recovery boiler and steam turbine enables the plant output to be boosted without increasing the amount of fuel used. However, in addition to the necessity of the

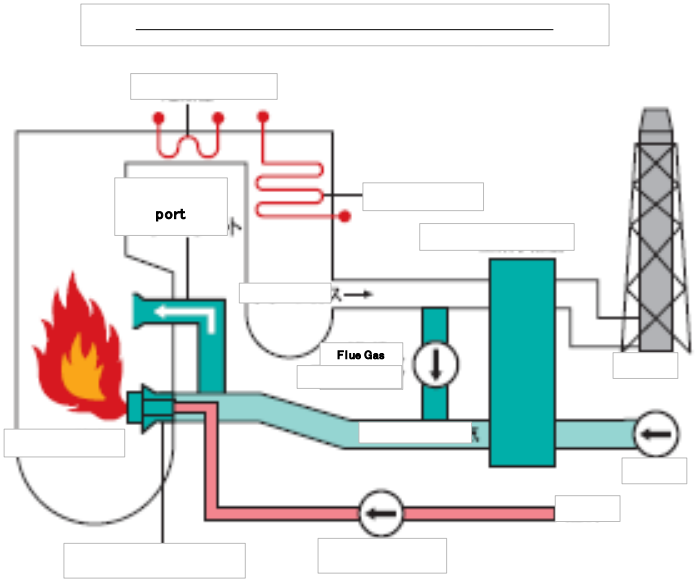
[7] Source : Electric power industry in Iran (2014-2015),TAVANIR

required site area for the addition of facilities, selection of the gas turbine that satisfies these conditions will be the key issue, since a high level of effect cannot be expected for enhancing efficiency and recovering the investment if the gas turbine is comparatively large and new.
When space for the addition of an exhaust heat recovery boiler and steam turbine cannot be secured, there are other methods that can be adopted, such as boosting thermal efficiency/output by replacing gas turbine parts or reducing output during the summer and other periods when temperature is high by installing an intake cooling unit, but a relatively large and new gas turbine needs to be selected in this situation also in order to obtain a certain level of effects.

A major increase in output and efficiency cannot be expected for steam power generation facilities, but rehabilitation of the boiler equipment and steam turbine equipment will enable the output and efficiency to be restored to a certain extent.

For coal or oil fired boilers, deterioration in heat exchange performance due to buildup of ash on the tubes in the boiler, leakage caused by corrosion of the tubes and other such problems tend to occur, but natural gas fired boilers are comparatively resistant to this type of deterioration.
Turbine blades in steam turbines may suffer wear after years of usage depending upon the status of maintenance, which has the potential to have a large impact on output and efficiency. In plants in which these conditions are visible, replacement of the main parts including the turbine blades or upgrading to newly designed turbine blades can be expected to restore output and efficiency.

Furthermore, review of environmental measures for steam power generation facilities needs to be performed. In the document entitled Electric Power Industry in Iran (2014 – 2015) (prepared by TAVANIR), total NOx emissions by conventional steam power facilities in fiscal 2014 amounted to approximately 92,220 tons, and when this is divided by the annual power generation volume of these steam power generation facilities, it is estimated that the NOx emissions per GWh are approximately 1 ton. The main fuel used for thermal power generation facilities in Iran is gas (partly oil). The assumed value of 1 ton/GWh is about twice by standard emissions of “oil” fired boilers in Japan. Therefore, it is presumed that the low NOx combustion technology adopted as a standard measure in Japan (Refer to Figure 4.3-1) is not adopted by steam power generation facilities in Iran.
Regarding the selection of environmental measure implementation target facilities, adequate confirmation of the environmental specifications of current facilities needs to be performed



Source: Federation of Electric Power Companies of Japan website

Figure 4.3-1 Low NOx Combustion Technology Adopted in Boilers within Japan

< Direction for development of new power generation facilities >

In Iran the main fuel for power generation is natural gas, so if new power generation equipment is to be installed, provided natural gas can be supplied to that area by pipeline, combined cycle plant can be installed using high-efficiency gas turbines, which is considered to be both necessary and effective for improvement in thermal efficiency and environmental protection.

However, the enhancement of electric power facilities by domestic industry is being pursued within Iran as a national policy. According to the website of Mapna, who carry out construction and maintenance of infrastructure such as electric power, oil, gas, railways, etc., has recently concluded a technology transfer contract with Siemens to manufacture their F-class gas turbine.

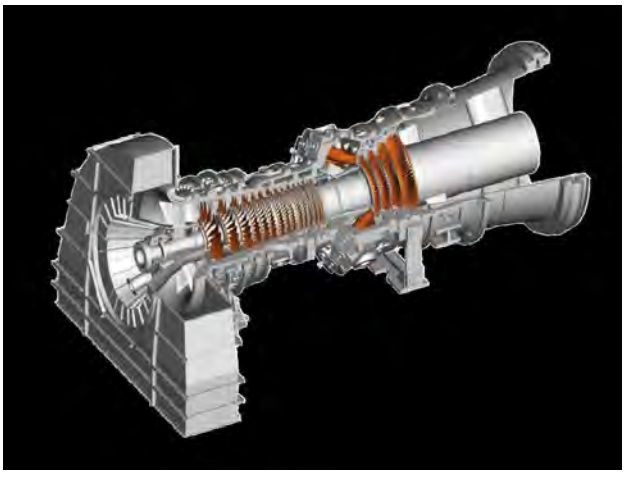
The Siemens F-class gas turbine (SGT5-4000F: Refer to Figure 4.3-2) is a high-efficiency gas turbine with a single engine output of 307 MW and efficiency of 40%. Unless there is a scheme to introduce a Japanese company's product with a higher performance than this, there is a high possibility that it will not be accepted on the Iranian side.

Although limited, there are gas turbines manufactured by Japanese companies with such a high performance (Refer to Figure 4.3-3).

In examination of assistance of Japan, it is necessary to confirm the introduction possibility of Japanese company's product with such a technique.

Source: Siemens website

Figure 4.3-2Siemens F-class Gas Turbine (SGT5-4000F)



Source: MHPS website

Figure 4.3-3 Example of High Performance Gas Turbine Manufactured by Japanese Company (M701J by MHPS)

4.3.2 Transmission and Distribution Facilities

Iranian needs are as follows, based on Iranian survey results.
Following 6 Japan's technologies and equipment may be applied to substation facilities:

(1) Energy Storage System

TAVANIR is investigating about setting up an Energy Storage System at Tehran as an important capital city, in preparation for unforeseen circumstances.
Energy storage system strores energy at night time and discharges energy in day time. The system would levelize power demand by shifting power demand and enable effective operation of electric facilities. Furthermore, it would be expected to improve power quality due to function against an instantaneous voltage drop and function as emergency power source.
Sodium sulphur (NAS) battery and/or redox-flow battery as Japanese products which are large capacity, high energy density and less harmful to the global environment seems to be fit their requirement,.

(2) STATCOM

Installation of a lot of reactive power compensation facilities (Reactor/Condenser) has been planned. Japanese STATCOM that can suppress voltage fluctuation by hi-speed control of reactive power is possessing hi-reliability in long term.

(3) GIS、H-GIS

TREC's intention to adopt Japanese GIS and H-GIS was confirmed in a part of the transformer substation targeted for rehabilitation.
At the transformer substation where plottage is wide enough, GIS is inferior to AIS in terms of price at other sites.
Japanese GIS/H-GIS is possessing excellent quality, long-term reliability and a low gas leak rate of 1/5 or less of IEC standards in order to reduce maintenance costs and protect the global environment.

(4) Mobile Substation

Adoption of mobile substation is under survey by TREC to avoid outage due to substation construction Mobile substation shall be compactly needed to meet Iran's road regulations and to satisfy TAVANIR's criteria.

(5) Transformer

TREC's 400kV main transformers are auto-transformer. In future, in case that it is difficult to transport into the substation site in urban area or in the mountains, specially divided three phase transformer/detachable and transportable transformer is usefull.
At present,seismic designed and very slightly partial discharged transformer is securing long term quality of transformer.

(6) Automatic High-speed Multi Phase Reclosing Function

TAVANIR and TREC are interested in the product which can reduce outage on the grid.

On condition that transmission line is a parallel circuit and two or more of phases are non-tripped and the linkage of the grid is kept, the multi-phase reclosing method is a method to cut off and to reclose only failure phases even in the simultaneous failure of both circuits.
For example, high-speed reclosing is performed even in a three-phase failure of one line in two lines, high-speed reclosing is performed even in the case of a one-phase ground fault in two lines and six phases.
Therefore, as long as the reclosing is a success, the influence on the grid is extremely small. Double circuit transmission lines are especially effective because same phase of the lines is often attacked by lightning strike.

Following Japan's technologies and equipment may be applied to transmission line facilities:

(1) Low Loss Conductor (LLC)

LLC is considered to be introduced in southern Iran. LLC can be constructed to overhead transmission line by same construction method as conventional ACSR conductor because LLC are almost same shape and weight as ACSR and transmission loss can be reduced by 10 to 25%.
LLC can be applied to both newly installation and replacement, and the initial investment cost can be collected in approximately 10 years.
LLC can be applied to both newly installation and replacement, and the initial investment cost can be collected in approximately 10 years.

Chapter 5 Results of Field Survey

5.1 Operation and Maintenance of Power Generation Facilities, and Performance and Organization System

A field survey was carried out at Shahid Rajaee Power Plant and Shahid Mofatteh Power Plant on the outskirts of Tehran, at which it was judged that there was a strong need by TPPH for repairs of electrical power equipment delivered in the past by Japanese companies.

Shahid Rajaee Power Plant is located about 2 hours by car west of Tehran. Also, Shahid Mofatteh Power Plant is located about 4 hours by car southwest of Tehran. (Refer to Figure 5.1-1)

Source: Prepared by the Study team using Google Earth

Figure 5.1-1 Map for Shahid Rajaee and Shahid Mofatteh Power Plants

Shahid Rajaee Power Plant and Shahid Mofatteh Power Plant are the main power plants in Iran, and are important base load power plants. These power plants play an important role in the electric power policy of the Government of Iran.
The generation capacity of Shahid Rajaee Power Plant is 1,000 MW for the steam generation plant (250 MW × 4 Units) and 1,042 MW for the combined cycle generation plant, and the generation capacity of the Shahid Mofatteh Power Plant is 1,000 MW for the steam generation plant (250 MW × 4 Units).

For both Shahid Rajaee Power Plant and Shahid Mofatteh Power Plant, more than 20 years has passed since the start of operation. On the other hand, both power plants are considered to be thermal power plant for base load operation, so the life of the power plants has been assumed to be 50 years from start of operation. Against this background, the plants are reaching about half of their assumed service life of 50 years, and the equipment is approaching the design life of 200,000 hours. Therefore, in order to avoid as much as possible major unplanned stoppages caused by problems associated with aging in the remaining 20+ years of operation, it is considered that it will be appropriate to implement equipment renewal in a planned matter, and that the timing of this renewal is very important.

The following effects can be expected from rehabilitation of each of these power plants.

(1) Improvement in thermal efficiency
An improvement of 3 to 5% in the thermal efficiency of the steam turbine in relative values can be expected by upgrading the steam turbine.

(2) Environmental values (reduction in NOx)
It is expected that Shahid Rajaee Power Plant can satisfy the new NOx emissions standard value of less than 300mg/Nm^3 (O_2 5%) agreed with Qazvin Province and the DOE by adopting low NOx burner advanced technology.

(3) Improvement in water shortages
Shahid Mofatteh Power Plant can reduce the quantity of water used by 87% by replacing the wet-type cooling tower with a dry-type cooling tower.

(4) Simplification of maintenance, reduction in unit stoppage time, improvement of safety, and extension of life
It is expected that each power plant can extend its equipment life by 20 years or more, simplify maintenance, reduce the unit stoppage time, and improved safety by implementing rehabilitation.

5.1.1 Shahid Rajaee Power Plant

The generation capacity of Shahid Rajaee Power Plant is 1,000 MW (250 MW × 4 Units) for the steam power plant, and 1,042 MW for the combined cycle generation plant. The layout of the power plant is shown in Figure 5.1-2.

Source: Obtained from Shahid Rajaee Power Plant, and prepared by the Study team

Figure 5.1-2 Layout of Shahid Rajaee Power Plant

Figure 5.1-3 Shahid Rajaee Power Plant 1,000 MW (250 MW × 4 Units)

Figure 5.1-4 Shahid Rajaee Power Plant (Dry Cooling Tower)

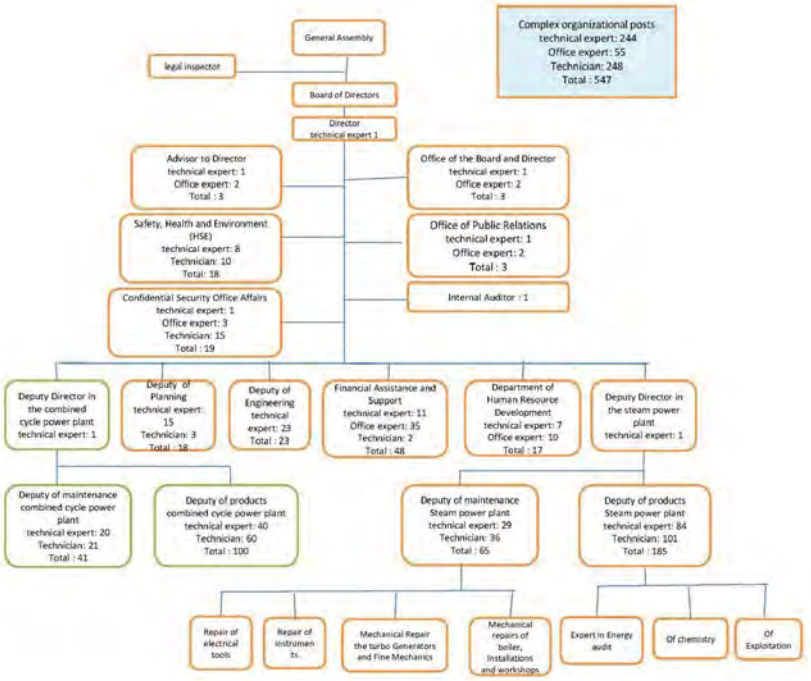
(1) Operation and maintenance, and results

Inspection and maintenance of each unit of the power plant is carried out every year, avoiding the summer period (from May to September). Unit inspection is carried out in a planned manner in 12 days/year, 20 days/2 years, and 90 days/4 years.
More than 20 years have passed since the commencement of operation of Shahid Rajaee Power Plant, so some small strains have occurred in the steam turbine chamber, and as a result, there are steam leaks and it cannot be operated at its rated output. Therefore, its usage rate has reduced slightly. In addition, the thermal efficiency at generator terminal has reduced, so fuel consumption has increased.

Also, during operation the NOx level is 400 ppm (O_2 5%), so the new NOx emissions standard value of 300mg/Nm^3 (O_2 5%) cannot be satisfied. Therefore as a five-year provisional arrangement, it has been agreed between Qazvin Province and the DOE that the plant can continue operation under the condition that it pays to the DOE a penalty of maximum 10% of its profit.
This arrangement has been approved by the DOE based on the fact that the power plant is studying rehabilitation.
However, if no improvement is seen in five years, there is a high possibility that closure of the power plant will be considered.
More than 20 years have passed since the commencement of operation of the generation equipment, so every year about 123 hours of outages are caused by equipment problems.

(2) Organization system

The power plant organization chart is shown in Figure 5.1-5. There is a total of about 550 employees in the power plant.



Source: Obtained from TPPH, and prepared by the Study team

Figure 5.1-5 Shahid Rajaee – Organization Chart

Operation Department:

The system consists of one manager that supervises engineers, technicians, and operators. The power plant operates on a three shift system, in which engineers, technicians, and operators are deployed on each shift.

Maintenance Department:

The system consists of one manager that supervises electric, instrumentation and control, and mechanical departments. Electric engineers and technicians are deployed in the electric department, electric control engineers and technicians are deployed in the instrumentation and control department, and mechanical engineers and technicians are deployed in the mechanical department.

Management department:

Executive directors, general affairs personnel, security personnel, and drivers are deployed in this department.

5.1.2 Shahid Mofatteh Power Plant

The generation capacity of Shahid Mofatteh Power Plant is 1,000 MW (250 MW × 4 Units) for the steam power plant. The layout of the power plant is shown in Figure 5.1-6.

Source: Prepared by the Study team using Google Earth

Figure 5.1-6 Layout of Shahid Mofatteh Power Plant

Figure 5.1-7 Shahid Mofatteh Power Plant (Dry Cooling Tower & 250 MW × 4 Units)

Figure 5.1-8 Shahid Mofatteh Power Plant (Wet Cooling Tower & Dry Cooling Tower)

(1) Operation and maintenance, and performance

Inspection and maintenance of each unit of the power plant is carried out every year, avoiding the summer period (from May to September). Unit inspection is carried out in a planned manner in 12 days/year, 20 days/2 years, and 90 days/4 years.

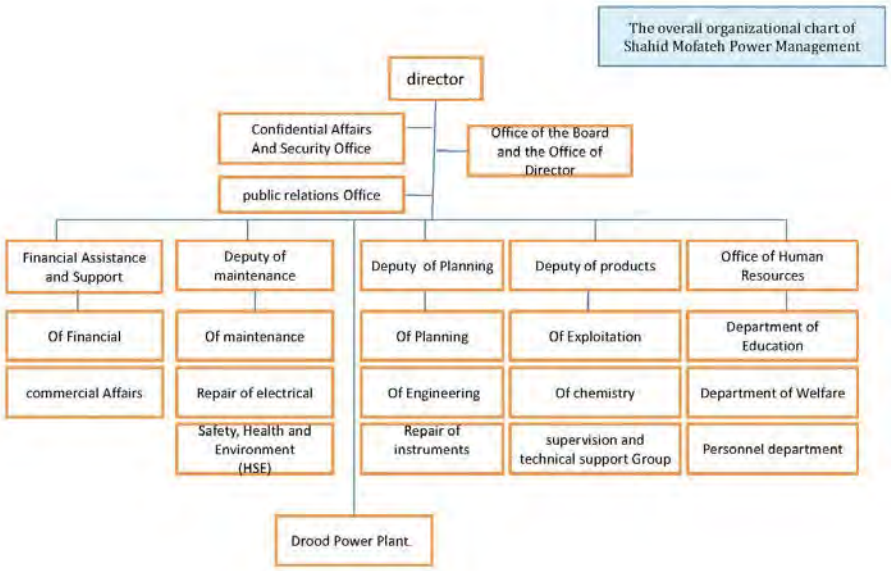
Shahid Mofatteh Power Plant uses a wet-type cooling tower. This wet-type cooling tower uses groundwater as the cooling water, so at the rated output it consumes a large quantity of 14,892,000 m^3 annually (*1). As a result, there have been complaints from around the power plant, which have been dealt with by partial stoppages of power plant operation. According to TPPH, in 2015 the power plant was permitted to consume 5,777,000 m^3 per annum, and as a result of the partial stoppages of power plant operation, there was an annual loss of 4.12 million MW of electric power generation. Therefore, there is an urgent necessity to replace the wet-type cooling tower with a dry-type cooling tower. If no improvement is seen, there is a high possibility that closure of the power plant will be considered.

(*1) 14,892,000 m^3 = 2 m^3/MWh x 24 (hrs) x 365 (days) x 0.85 x 250 (MWe) x 4 (Units)

More than 20 years have passed since the commencement of commercial operation of the power generation facilities, so there has been about 1,088 hours of outages annually due to equipment problems.

(2) Organization system

The organization chart of the power plant is shown in Figure 5.1-9. The power plant employs a total of about 400 people.



Source: Obtained from TPPH, and prepared by the Study team

Figure 5.1-9 Shahid Mofatteh – Organization Chart (1)

Table 5.1-1 Shahid Mofatteh – Organization Chart (2)

		Engineer	Engineer Expert	Technitian	Technician Expert	Other	Total
1	Manager	1	5	0	1	0	7
2	Dupty of Engineer	26	0	21	0	1	48
3	Finance	0	12	0	16	1	29
4	Service Control	0	3	0	9	2	14
5	Operation	19	0	118	0	3	140
6	Chemical control	7	0	43	0	2	52
7	Mechanic Repair	9	0	22	0	4	35
8	Electric Maintenance	5	0	13	0	0	18
9	I&C Maintenance	9	0	17	0	0	26
10	Security	1	8	0	0	17	26
11	Adminstration	0	11	0	3	0	14
	Total	77	39	234	29	30	409

Source: Obtained from Shahid Mofatteh Power Plant, and prepared by the Study team

Operation Department:

The system consists of one manager that supervises engineers, technicians, and operators. The power plant operates on a three shift system, in which engineers, technicians, and operators are deployed on each shift.

Maintenance Department:

The system consists of one manager that supervises electric, instrumentation and control, and mechanical departments. Electric engineers and technicians are deployed in the electric department, electric control engineers and technicians are deployed in the instrumentation and control department, and mechanical engineers and technicians are deployed in the mechanical department.

Management department:

Executive directors, general affairs personnel, security personnel, and drivers are deployed in this department.

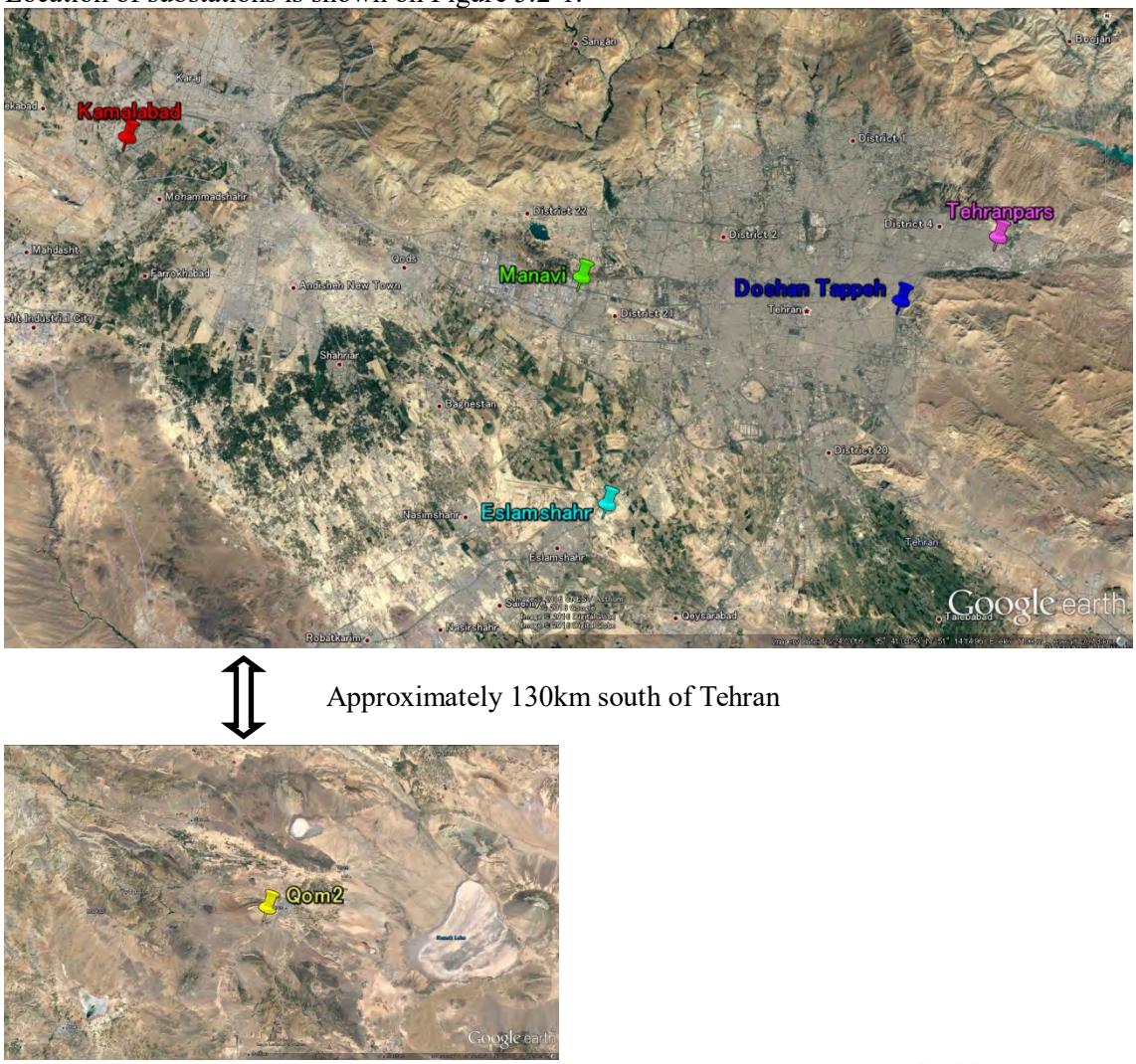
5.2 Transmission and Distribution Related Equipment

Site survey has been fulfilled on six substations at Tehran city and outskirt. The name of substations, and the current nominal voltage and the capacity of main transformers are as follows:

・Tehranpars	400/230/63/20kV	500MVA×2+180MVA×2
・Qom2	230/63kV	160MVA×2
・Eslamshahr	230/63kV	160MVA×3
・Kamalabad	230/63kV	250MVA×2
・Manavi	230/63kV	180MVA×3
・Doshan Tappeh	230/63kV	180MVA×3

5.2.1 Location of Substations

Location of substations is shown on Figure 5.2-1.



Source: edited by Survey team

Figure 5.2-1 Location of Substations

5.2.2 Site Survey

(1) Tehranpars

a. 400kVFeeder Bay

Existing 400kV feeder bays are not equipped with a busbar and two 400kV transmission lines are directly connected to main transformers via conventional air insulated switchgear (AIS). The bay is consisted in circuit breaker (CB), line trap, instrumental transformers, lightning arrester earthing switch and disconnecting switch. The CB is 3-phase gas insulated circuit breaker (GCB) and Mitsubishi-make. The 400kV transmission lines are connected to Damavand combined cycle power plant.
Existing 400kV AIS are dismantled and a 400kV gas insulated switchgear (GIS) with double busbars and one and half CB configuration is alternatively installed. GIS is equipped with three diameters, i.e. three feeder bays and three transformer bays.

Source: edited by Survey team

Figure 5.2-2 400kV Feeder Bay

b. 400/230/20kV Transformer

Two sets of 400/230/20kV 500MVA auto transformers with a spare have been installed. Both primary and secondary of transformer including a spare are connected with changeable overhead wires. New transformer #3 and a spare will be installed besides existing transformer. 20/0.38kV 500kVA stational transformer and two sets of 20kV 25MVAr reactors are connected to the tertiary of transformer. Two sets of 230/63kV 180MVA transformer are also installed in same switchyard. 400kV transformers are Mitsubishi-make and 230kV transformers are ASEA-make.

Source: edited by Survey team

Figure 5.2-3 400/230/20kV 500MVA Transformer

c. 230kVSwitchgear

Existing 230kV switchgear is AIS type with four diameters configuration, double busbars and one and half CB, and is connected to two sets of 400/230/20kV 500MVA auto transformers, two sets of 230/63kV power transformers and four 230kV feeder bays. A span of busbar is extended and a diameter which is connected to 400/230/20kV 500MVA auto transformer is added to the buabar. Existing CBs are Mitsubishi-make in 1978 and 3-phase GCB.

Source: edited by Survey team

Figure 5.2-4 230kV Switchgear

d. 63kV Overhead Transmission Lines

Three circuits of 63kV overhead transmission line are passing above the candidate site for planned 400kV GIS. Since it is difficult to secure safety distance from the overhead lines during construction works for 400kV GIS, the transmission lines would be changed to the underground cables prior to the installation of GIS to avoid hindrance during the construction.

Source: edited by Survey team

Figure 5.2-5 63kV Overhead Transmission Lines

e. Control and Protective Units

TREC consider to digitalize Control and protective units for 400kV feeder and busbar provided by Mitsubishi in 1978=and to study the application of hi-speed multi-phase reclosing function to the protective unit in order to reinforce the protective function. In case that new function is added to the protective function, TREC requires following procedure to the contractor:

- Documentation
- Requirements at intended Substation & Remote End Substation
- Communication Link
- Advantages and Disadvantages
- References
- Typical scheme
- Trial Examination (e.g. Damavand – Tehranpars 400kV Transmission line)

After the procedure will be fulfilled, Joint Study (Iran Grid Management Company (IGMC) – TREC) will be done. IGMC's approval for a new protective scheme will be issued.

Source: edited by Survey team

Figure 5.2-6 400kV Damavand 1L, 2L Protective Relay Panel

(2) Qom2

a. 400kV Switchgear

400kV overhead transmission lines are currently passing with a bypass circuit next to the switchyard at Qom.2. 400kV Switchgear is installed besides dead end tower of 400kV transmission lines. A bypass circuit is disconnected and both ends are connected to the 400kV Switchgear.
A 400kV H-GIS or AIS with double busbars and one and half CB configuration is installed. Switchgear is equipped with two diameters. Accommodation for future extension shall be secured, and in case of H-GIS the construction shall be able to be extended.

Source: edited by Survey team

Figure 5.2-7 Candidate Site for 400kV Switchgear

The rating and specification of busbars and connections should be checked and verified.

b. 400/230/20kV 500MVA Transformer

Figure 5.2-8 shows the candidate site for two sets of 400/230/20kV 500MVA auto transformer and a spare. 20/0.38kV 500kVA station transformer and two sets of 20kV 25MVAr reactors are connected to the tertiary of the transformers. Two 230/63KV 160MVA power transformers have been installed in the switchyard and one more power transformer is installed. Existing 230kV transformers is TRO-make.

Source: edited by Survey team

Figure 5.2-8 Candidate Site for 400kV Switchgear and 400/230/20kV 500MVA Transformer

c. 230kVSwitchgear

Existing 230kV switchgear is AIS type with eight diameters configuration, double busbars and one and half CB, and is connected to six sets of generators in range of 100 to 126MW, two sets of 230/63kV 160MVA power transformers and six 230kV feeder bays. A span of busbar is extended. A diameter which is connected to 230/63kV 160MVA power transformer and two CBs which are connected to 400/230/20kV 500MVA auto transformer are added to the buabar. Existing CBs are Mitsubishi-make in 1987 and 3-phase GCB.

Source: edited by Survey team

Figure 5.2-9 230kV Switchgear

d. 230/63KV 160MVA Transformer

A 230/63kV 160MVA power transformer is installed besides extended 230kVSwitchgear.

e. 63kVSwitchgear

Existing 63kV switchgear is two units of AIS type with single busbar configuration, and is connected to fifteen 63kV feeder bays. In accordance with the expansion of a 230/63kV 160MVA power transformer, a unit of 63kV switchgear and two CBs are added. The new unit of 63kV switchgear is connected to the other unit of 63kV switchgear via a bus-coupling CB. A new 63kV 25MVAr capacitor is connected to each unit of 63kV switchgear.
In accordance with the extension of 63kV switchgear, two 63kV transmission lines are removed from existing to new switchgear. In order to remove transmission lines, some towers and wires are removed.

Source: edited by Survey team

Figure 5.2-10 63kV Switchgear

f. Control and Protective Units

TREC is investigating digitalization of the 230 kV transmission line and bus bar protective and control unit delivered by Mitsubishi in 1991. In addition, they are investigating adding a high-speed multi-phase reclosing line function and strengthening the protective function. To add a new protective function, it is necessary to obtain the approval of Iran Grid Management Company (IGMC) and TREC.
Care is required over the compatibility, interlock, etc. between the new 400 kV transmission line and bus bar protective and control device, and the existing transmission line and bus bar protective and control device.

Source: edited by Survey team

Figure 5.2-11 230kV Busbar Protective Relay Panel

(3) Eslamshahr

a. 230kVSwitchgear

The existing 230 kV switchgear is AIS type, double bus bar 1 breaker configuration, with 8 No. of 230kV bays, i.e. 3 No. of 230/63 kV 160 MVA 3-phase transformers, 4 No. of 230 kV transmission lines, and 1 No. of bus coupler connected. Four new bays will be installed, with 1 No. of 230/63 kV 160 MVA 3-phase ransformer, 2 No. of 230 kV transmission lines, and 1 No. bus coupler connected. However, the existing bus coupler will be removed, and a new transformer circuit installed in the space. The breaker is a 3-phase gas insulated circuit breaker (GCB) manufactured by Mitsubishi in 1992.

Source: edited by Survey team

Figure 5.2-12 Proposed Installation Location for 230kV Switchgear

The rating and specification of busbars and connections should be checked and verified.

b. 230/63kV 160MVA transformer

Installation of 1 No. 230/63 kV 160 MVA 3-phase transformer beside the existing T3 transformer.

Source: edited by Survey team

Figure 5.2-13 Proposed Installation Location for 230/63kV Transformer

c. 63kVSwitchgear

The existing 63 kV switchgear is AIS type, single bus bar type, in 3 groups and 21 lines. With the addition of 1 No. 230/63 kV 160MVA 3-phase transformer, the 63 kV switchgear has been expanded to 1 group 8 No. lines + 2 No. lines, connected with a bus coupler breaker. In addition, a 63 kV 25 MVAr condenser will be newly installed to each group of the existing 2 groups (#1, #2).
The breaker is a 3-phase gas insulated circuit breaker (GCB) manufactured by Mitsubishi Electric.

Source: edited by Survey team

Figure 5.2-14 63kV Switchgear

d. Control and Protective Units

TREC is investigating digitalization of the 230 kV transmission line and bus bar protective and control unit delivered by Mitsubishi in 1992. In addition, they are investigating adding a high-speed multi-phase reclosing line function and strengthening the protective function. To add a new protective function, it is necessary to obtain the approval of Iran Grid Management Company (IGMC) and TREC.
Care is required over the compatibility, interlock, etc. between the new 230 kV transmission line and transformer control and protective unit, and the existing transmission line and bus bar control and protective unit.

Source: edited by Survey team

Figure 5.2-15 230kV Transmission Line Protective Relay Panel

(4) Kamalabad

a. 400kVSwitchgear

The 400 kV overhead transmission line passes at a position 8 km from the Kamalabad sub-station, so it will be extended to the sub-station and connected with 400 kV switchgear
The 400 kV switchgear is scheduled to be a double bus bar 1½ breaker system, in a 2 diameter configuration, AIS or H-GIS. In addition, a site for future expansion will be secured; in the case of H-GIS the structure enables future expansion.
The 400 kV switchgear is scheduled to be installed on the space showing up on right side in Figure 5.2-16.

Source: edited by Survey team

Figure 5.2-16 Proposed Installation Location for 400 kV Switchgear and 400/230/20 kV Transformer

b. 400/230/20kV transformer

Two 400/230/20 kV 500 MVA autotransformers + a spare device are scheduled to be installed on the space showing up on the left side in Figure 5.2-16. The tertiary side of each transformer is connected to a 20/0.38 kV 500 kVA transformer within the station and 2 No. 20 kV 25 MVAr reactors.

c. 230kVSwitchgear

The existing 230 kV switchgear is an AIS type, double bus bar 1½ breaker system, in a 4 diameter configuration, connected to 2 No. 230/63 kV 250 MVA 3-phase transformers, and 6 No. 230 kV transmission lines. A new bus line will be installed for 2 diameters, and connected to 2 No. 400/230/20 kV 500 MVA autotransformers and 1 No. 230/63 kV 250 MVA 3-phase transformer. However, the number of breakers for 1 diameter will be 2. The existing breaker is a 3-phase gas insulated circuit breaker (GCB) manufactured by Mitsubishi in 1992.

Source: edited by Survey team

Figure 5.2-17 230 kV New Bus Bar Installation Location

d. 230/63kV 250MVA transformer

One 230/63 kV 250 MVA 3-phase transformer is scheduled to be installed beside a new 400/230/20 kV 500 MVA autotransformer as shown in Figure 5.2-16.

An alternative proposal is beside the existing 230 kV transformer. It is necessary to compare the connection costs of both proposals.

Source: edited by Survey team

Figure 5.2-18 Proposed Installation Location for 230/63kV Transformer (alternative proposal)

e. 63kVSwitchgear

The existing 63 kV switchgear is AIS type, single bus bar type, in 2 group, 17 line system. With addition of 1 No. 230/63 kV 250 MVA 3-phase transformer, a new 63 kV switchgear 1 group 9 circuits + 2 circuits will be installed, connected with a bus coupler breaker. In addition a total of 3 No. 63 kV 25 MVAr condensers will be newly installed, one to each of the existing 2 groups (#1, #2) and the new group (#3).

The breaker is a 3-phase gas insulated circuit breaker (GCB) manufactured by Mitsubishi.

Source: edited by Survey team

Figure 5.2-19 63kV Switchgear

f. Control and Protective Units

TREC is investigating digitalization of the 230 kV transmission line and bus bar control and protective unit delivered by Mitsubishi in 1992. In addition, they are investigating adding a high-speed multi-phase reclosing line function and strengthening the protective function. To add a new protective function, it is necessary to obtain the approval of Iran Grid Management Company (IGMC) and TREC.
Care is required over the compatibility, interlock, etc. between the new 230 kV transmission line and transformer control and protective unit, and the existing transmission line and bus control and protective unit.

Source: edited by Survey team

Figure 5.2-20 230kV Transmission Line Protective Relay Panel

(5) Manavi

a. 230 kV Feeder Bays

Two 230 kV transformers are directly connected to 2 No. 230 kV overhead transmission lines. The feeder bays are composed of a line trap, transformer for instrumentation, lightning arrester, earthing switch, disconnecting switch, etc.
The existing 230 kV switchgear will be removed, and a 230 kV double bus bar 1½ breaker system GIS will be installed. The GIS will be a 3 diameter, 3 No. transmission line (of which 1 No. is spare), with 3 No. transformer lines. In addition, a site for future expansion will be secured, the structure adopted enables future expansion in the case of H-GIS. The equipment specification is compatible with a transformer capacity of 250 MVA to take into consideration future replacement.

Source: edited by Survey team

Figure 5.2-21 230kV Feeder Bay

b. 63kVSwitchgear

The existing 63 kV switchgear is an AIS type, single bus bar system. One group of 63 kV 20 MVAr condensers will be added to 1 group (#1) of bus bars of the existing 63 KV switchgear or to the secondary side of transformer T1 (alternative). For this purpose, a new 63 kV breaker will be installed.

Source: edited by Survey team

Figure 5.2-22 63kV Switchgear

c. Control and Protective Units

The existing 230 kV switchgear will be removed and the 230 kV transmission line and bus bar control and protective unit will be replaced. In addition, TREC is investigating adding a high-speed multi-phase reclosing function and strengthening the protective function. To add a new protective function, it is necessary to obtain the approval of Iran Grid Management Company (IGMC) and TREC.
Care is required over the compatibility, interlock, etc. between the new 230 kV transmission line and busbar protection and control unit, and the existing transformer protection and control unit.

Source: edited by Survey team

Figure 5.2-23 Transformer Protective Relay Panel

(6) Doshan Tappeh

a. 230kV Feeder Bay

The existing 2 No. overhead transmission lines are directly connected to 2 No. transformers. The feeder bay is composed of a line trap, a transformer for instrumentation, lightning arrester, aearthing switch, disconnecting switch, etc.

The existing 230 kV switchgear will be removed, and a 230 kV double bus bar with 1½ breaker GIS will be installed. The GIS will be a 3 diameter, 3 No. transmission line (of which 1 No. is spare), and 3 No. transformer circuit system. Also a site for future expansion will be secured, and the structure will enable future expansion in the case of H-GIS. The instrumentation specification will be compatible with a 250 MVA transformer capacity to take into consideration future replacement.

Source: edited by Survey team

Figure 5.2-24 230kV Feeder Bay

b. 63kVSwitchgear

The existing 63 kV switchgear is an AIS type, single bus bar system. The 3 groups (#1, #2, #3) of bus bars of the existing switchgear will be expanded with a 63 kV 25 MVAr condenser for each group. For this purpose 3 No. 63 kV breakers will be installed, 1 No. for each group of 63 kV switchgear.

Source: edited by Survey team

Figure 5.2-25 63kV Switchgear

c. Control and Protective Units

The existing 230 kV switchgear will be removed and the 230 kV transmission line and bus bar control and protective unit will be replaced. In addition, TREC is investigating adding a high-speed multi-phase reclosing function and strengthening the protective function. To add a new protective function, it is necessary to obtain the approval of Iran Grid Management Company (IGMC) and TREC.
Care is required over the compatibility, interlock, etc. between the new 230 kV transmission line and bus bar protective and control unit, and the existing transformer protective and control unit.

Source: edited by Survey team

Figure 5.2-26 Transformer Protective Relay Panel

5.2.3 Rehabilitation of Substations

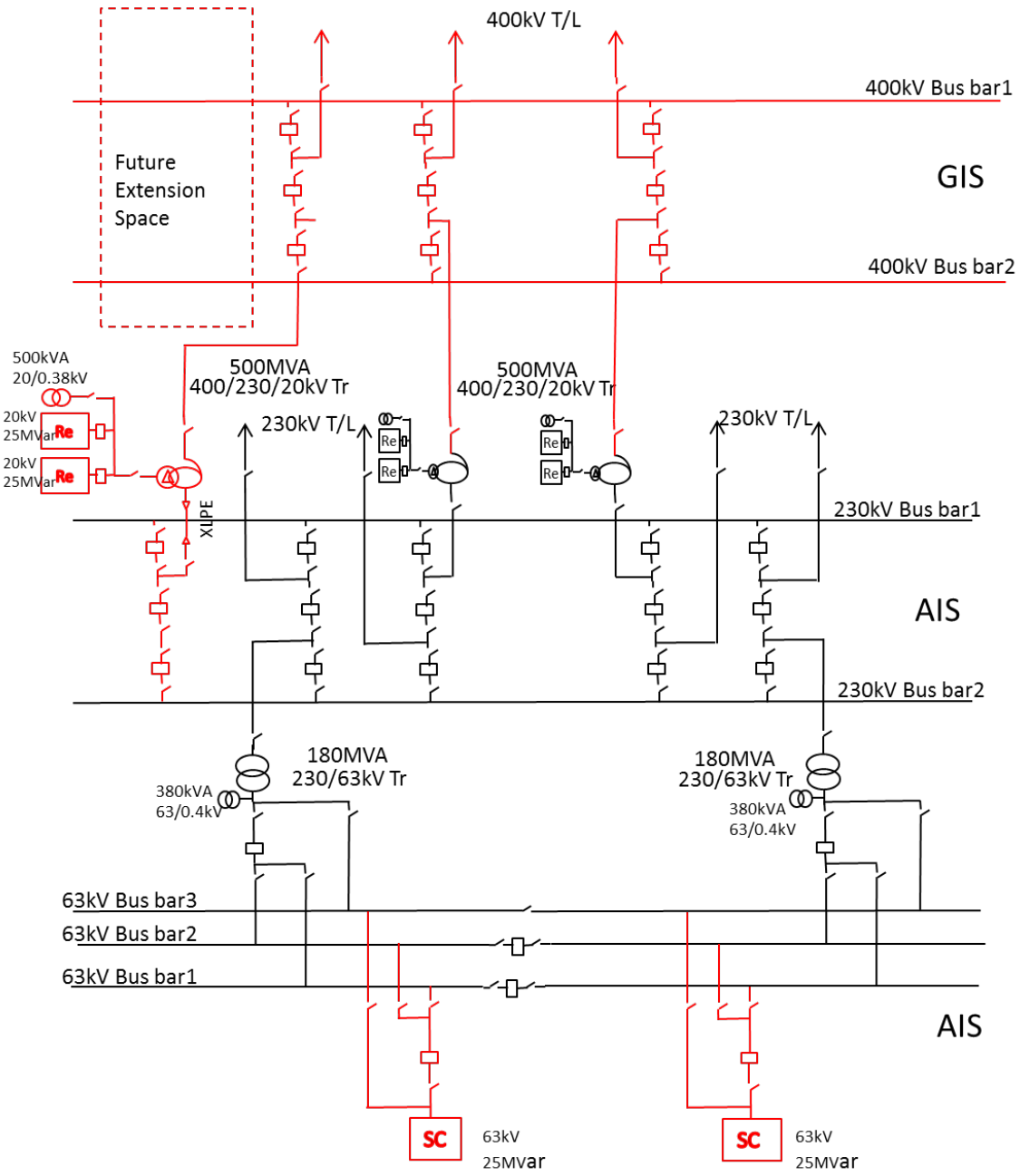
As the results of meeting between TREC and Survey Team based on the site survey, it is confirmed that rehabilitation plan for substations that TREC considered is shown in the Table 5.2-1. However, the plan might be changeable according to further consideration or other cause. The suevey team reviewed the plan and described the results of review as issue in the table.
Single Line Diagram of each substation rehabilitated is shown in Figure 5.2-27 to Figure 5.2-32.

Table 5.2-1 Implementation Contents for Substation Rehabilitation

Substation name	Purpose	Implementation	Issue
Tehranpars	Enhancement of Reliability	➢400kV 1½ CB & Double Bus bars Configuration GIS 6bays (3 diameters) to be Installed ➢230kV 1½ CB & Double Bus bars Configuration AIS 1bay (1 diameter) to be Extended ➢63kV XLPE Cable to be Installed ➢400kV Existing Switchgear to be Dismantled	➢63kV Existing T/L 3bays to be Undergrounded ➢400kV Incoming Feeder 2bays to be Transferred
	Bank Capacity Expansion	➢400/230/20kV 500MVA Auto-transformer 1set to be Installed ➢230kV XLPE Cable to be Installed (if required)	−
	Improvement & Modernization of Protection	➢Control & Protection System to be Digitalized ➢Multi Phase Hi-speed Auto-reclosing System shall be Studied and might be Installed after Approval	➢To be Integrated with Existing System ➢At Opposite Substation, CB to be Replaced (if necessary) & Multi Phase Auto-reclosing System to be Installed**
	Improvement of Facility	➢20/0.38kV 500kVA Auxiary Transformer 1set to be Installed	−
	Voltage Control & Var Compensation	➢63kV 25MVar Capacitor Bank 2sets to be Installed ➢20kV 25MVar Reactor Bank 2sets to be Installed	−
Qom 2	Enhancement of Reliability	➢400kV 1½ CB & Double Bus bar Configuration AIS/H-GIS 4bays (2 diameters) to be Installed ➢230kV 1½ CB & Double Bus bar Configuration AIS 3bays to be Extended	➢400kV Existing T/L 2bays to be Modified (if required)
	Bank Capacity Expansion	➢400/230/20kV 500MVA Auto-transformer 2sets to be Installed ➢230/63kV 160MVA Transformer 1set to be Installed	−
	Improvement & Modernization of Protection	➢Control & Protection System to be Digitalized ➢Multi Phase Hi-speed Auto-reclosing System shall be Studied and might be Installed after Approval	➢To be Integrated with Existing System ➢At Opposite Substation, CB to be Replaced (if necessary) & Multi Phase Auto-reclosing System to
	Improvement of Facility	➢63kV AIS(11bays) to be Extended ➢20/0.38kV 500kVA Auxiary Transformer 2sets to be Installed ➢63/0.4kV 400kVA Grounding Transformer 1set to be Installed	➢63kV Existing T/L 2bays to be Displaced
	Voltage Control & Var Compensation	➢63kV 25MVar Capacitor Bank 3sets to be Installed ➢20kV 25MVar Reactor Bank 4sets to be Installed	−
Eslamshahr	Bank Capacity Expansion	➢230/63kV 160MVA Transformer 1set to be Installed	−
	Improvement & Modernization of Protection	➢Control & Protection System to be Digitalized ➢Multi Phase Hi-speed Auto-reclosing System shall be Studied and might be Installed after Approval	➢To be Integrated with Existing System ➢At Opposite Substation, CB to be Replaced (if necessary) & Multi Phase Auto-reclosing System to be Installed**
	Improvement of Facility	➢230kV AIS Feeder 4bays to be Extended as per attached drawing ➢63kV AIS(8bays) to be Extended ➢63kV AIS (2bays) to be Replaced ➢63/0.4kV 400kVA Grounding Transformer 1set to be Installed	➢230kV Bus-coupler 1bay to be Displaced
	Voltage Control & Var Compensation	➢63kV 25MVar Capacitor Bank 2sets to be Installed	−
Kamalabad	Enhancement of Reliability	➢400kV 1½ CB & Double Bus bars Configuration AIS/H-GIS 4bays (2 diameters) to be Installed ➢230kV 1½ CB & Double Bus bars Configuration AIS 3bays to be Extended	➢230kV Existing T/L 1bay to be Lifted
	Bank Capacity Expansion	➢400/230/20kV 500MVA Auto-transformer 2sets to be Installed ➢230/63kV 250MVA Transformer 1set to be Installed ➢230kV XLPE Cable to be Installed (if required)	−
	Improvement & Modernization of Protection	➢Control & Protection System to be Digitalized ➢Multi Phase Hi-speed Auto-reclosing System shall be Studied and might be Installed after Approval	➢To be Integrated with Existing System ➢At Opposite Substation, CB to be Replaced (if necessary) & Multi Phase Auto-reclosing System to be Installed**
	Improvement of Facility	➢63kV AIS(9bays) to be Extended ➢63kV AIS(2bays) to be Replaced ➢20/0.38kV 500kVA Auxiary Transformer 2sets to be Installed ➢63/0.4kV 400kVA Grounding Transformer 1set to be Installed	−
	Voltage Control & Var Compensation	➢63kV 25MVar Capacitor Bank 3sets to be Installed ➢20kV 25MVar Reactor Bank 4sets to be Installed	−
	Transmission Line Extension	➢400kV O/H Line, Double Circuits, 3 bundles, 8km	➢Resettlement Action Plan
Manavi	Enhancement of Reliability	➢230kV 1½ CB & Double Bus bars Configuration GIS 6bays (3 diameters) to be Installed (1bay for future line) ➢230kV XLPE Cable to be Installed (if required) ➢63kV XLPE Cable to be Installed (if required for displacing the 63kV T/L) ➢230kV Switchgear to be Dismantled	➢230kV Existing T/L 2bays to be Transferred ➢63kV Existing T/L to be Undergrounded (if required)
	Improvement & Modernization of Protection	➢Control & Protection System to be Digitalized ➢Multi Phase Hi-speed Auto-reclosing System shall be Studied and might be Installed after Approval	➢To be Integrated with Existing System ➢At Opposite Substation, CB to be Replaced (if necessary) & Multi Phase Auto-reclosing System to be Installed**
	Voltage Control & Var Compensation	➢63kV 20MVar Capacitor Bank 1set to be Installed	−
Doshan Tappeh	Enhancement of Reliability	➢230kV 1½ CB & Double Bus bars Configuration GIS 5bays (3 diameters) to be Installed ➢230kV XLPE Cable to be Installed (if required) ➢230kV Switchgear to be Dismantled	➢230kV Existing T/L 2bays to be Transferred
	Improvement & Modernization of Protection	➢Control & Protection System to be Digitalized ➢Multi Phase Hi-speed Auto-reclosing System shall be Studied and might be Installed after Approval	➢To be Integrated with Existing System ➢At Opposite Substation, CB to be Replaced (if necessary) & Multi Phase Auto-reclosing System to be Installed**
	Voltage Control & Var Compensation	➢63kV 25MVar Capacitor Bank 3sets to be Installed	−

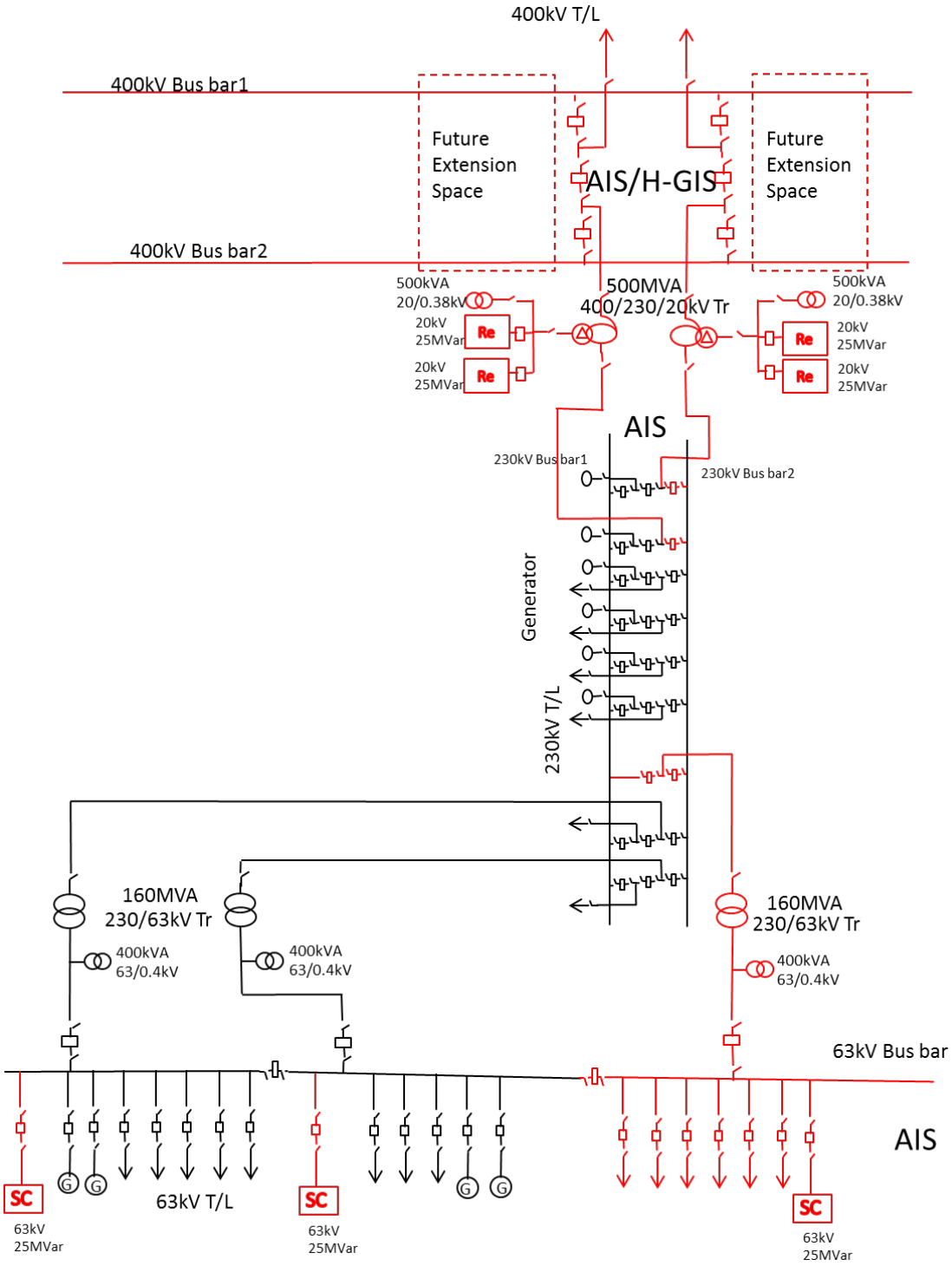
** At design stage, the requirement will be clarified

Source: edited by Survey team



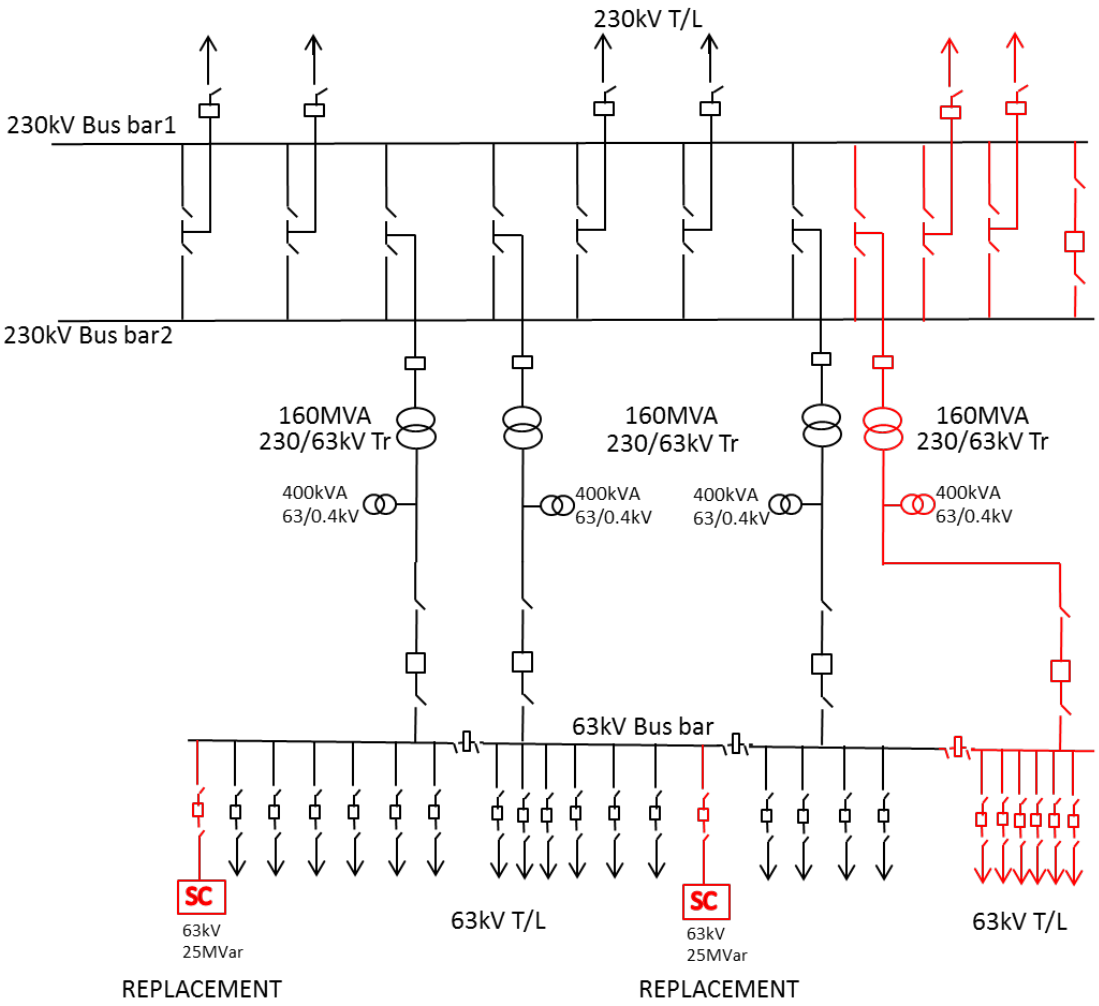
Source: edited by Survey team

Figure 5.2-27 Tehranpars: Single Line Diagram



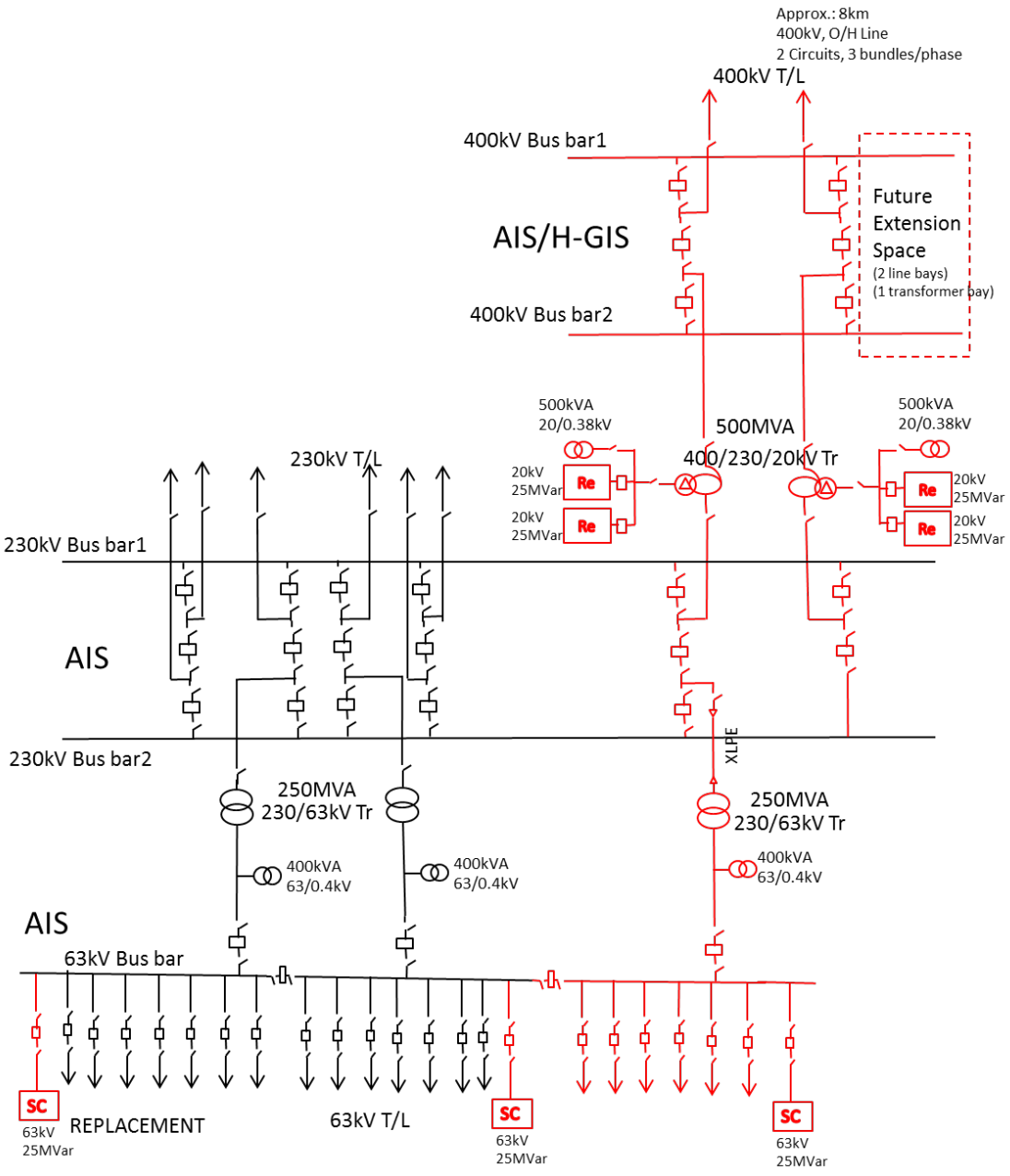
Source: edited by Survey team

Figure 5.2-28 Qom2: Single Line Diagram



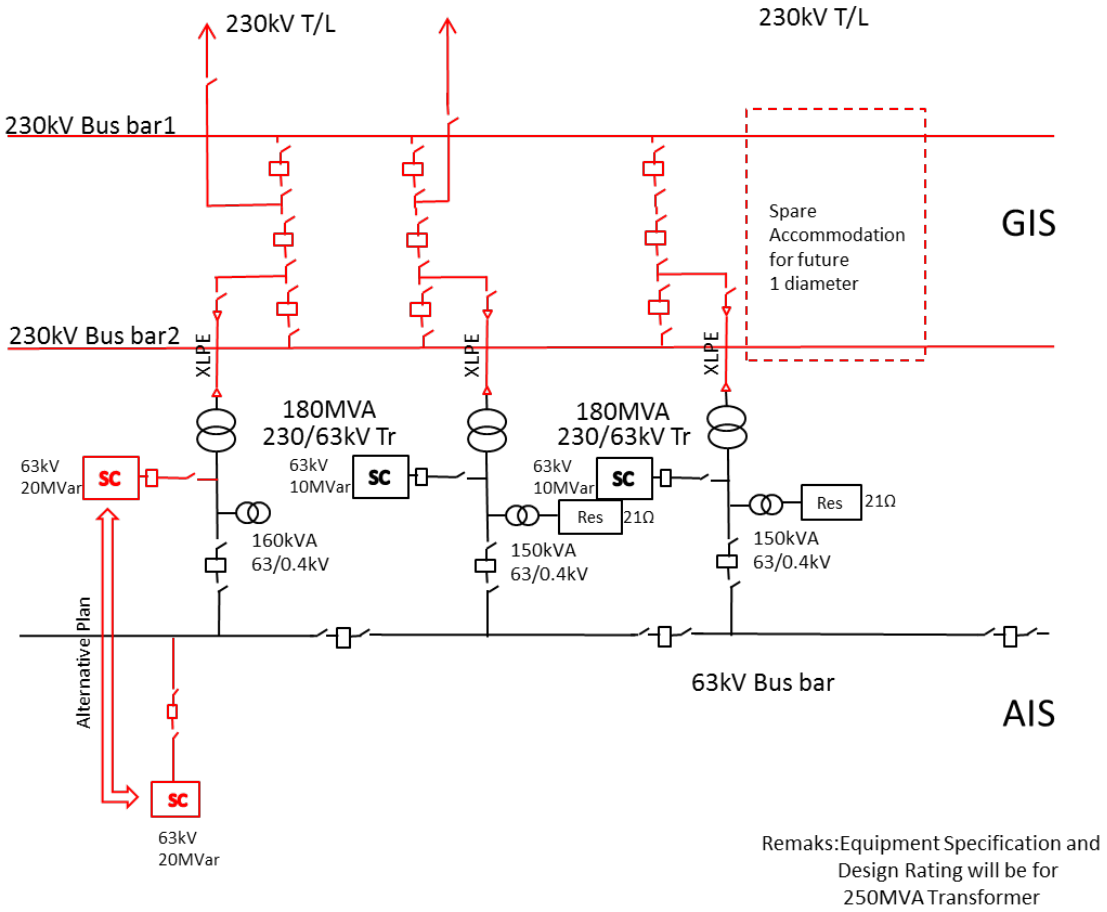
Source: edited by Survey team

Figure 5.2-29 Eslamshahr: Single Line Diagram



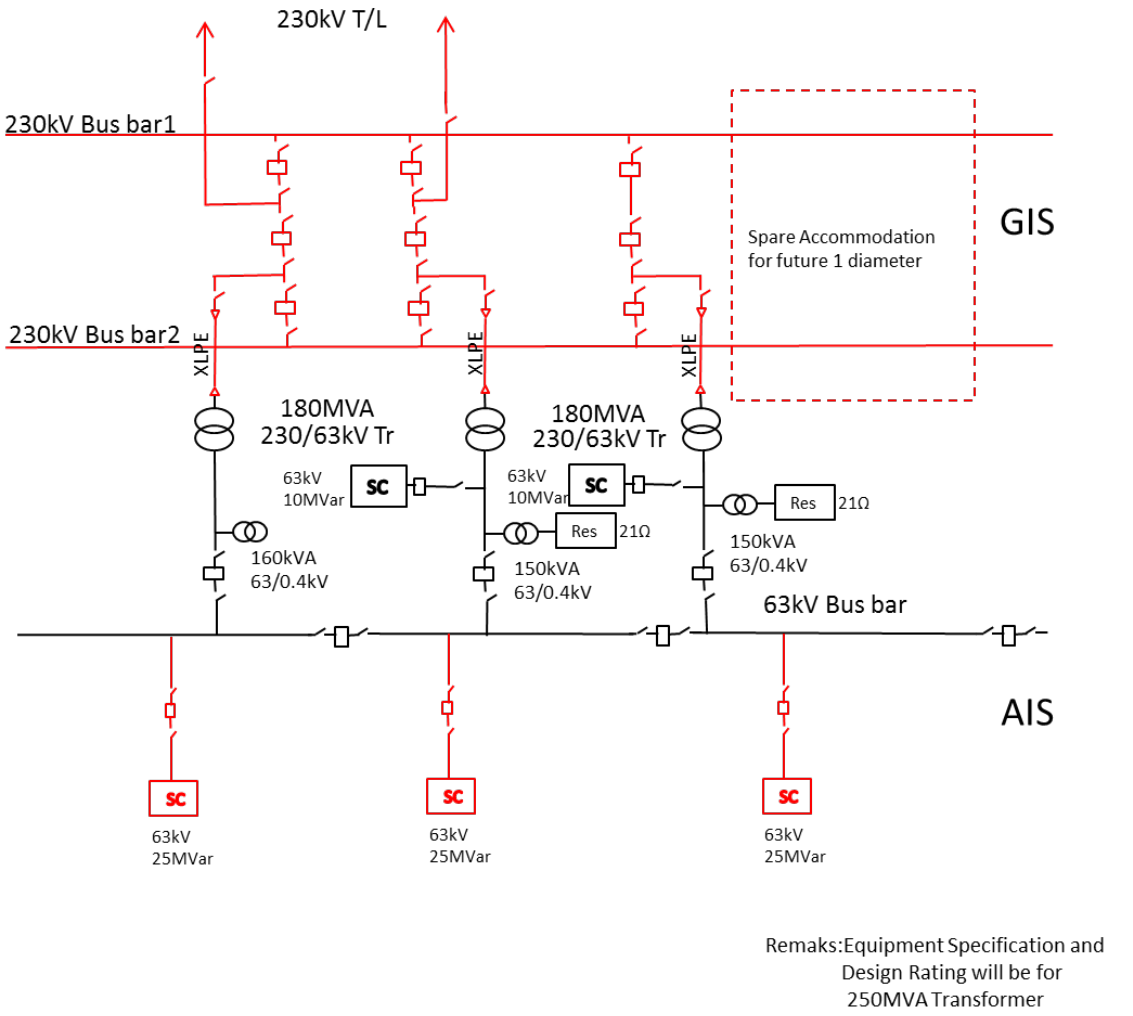
Source: edited by Survey team

Figure 5.2-30 Kamalabad: Single Line Diagram



Source: edited by Survey team

Figure 5.2-31 Manavi: Single Line Diagram



Source: edited by Survey team

Figure 5.2-32 Doshan Tappeh: Single Line Diagram

5.2.4 Issues on Rehabilitation for Substations

(1) Reduction of yearly Outage time

Outage situation of recent eight months (Apr. 2016 – Nov. 2016) for six substations subjected to the rehabilitation is shown in Table 5.2-2. Outage time is widely distributed in the range from a few minutes to above twenty four hours. The most outage facility is feeder bay (frequency ratio 77% and time ratio 73%) and the most cause of outage is protective relay operation (frequency ratio 53% and time ratio 56%).
Iranian transmission line is mostly overhead transmission line. Since transmission line mostly fails due to flush-over, insulation can be recovered by shutting power supply to the failure point. Success rate of reclosing is more than 90%.

Table 5.2-2 List of Outage Time for Six Substations

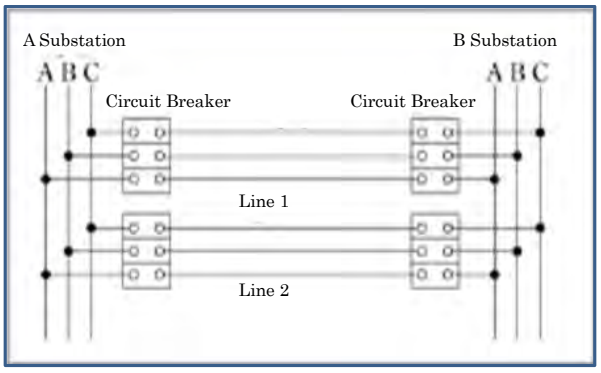
Measuring Period : Apr. 2016 ～ Nov. 2016.(8 months)

Serial No.	Substation name	Operated Equipment/Feeder	Outage		Duration	Cause	Total Time
			Start	End			
1-1	Tehranpars	400/230/20kV T2	9/23/2016 0:45	9/23/2016 4:37	3:52	Protective Relay Operated	
1-2	Damavand Combined Cycle	400kV Tehranpars Feeder MP916	4/21/2016 19:29	4/21/2016 20:06	0:37	Instrument Pollution	
1-3	Damavand Combined Cycle	400kV Tehranpars Feeder MP917	4/21/2016 14:35	4/22/2016 14:58	24:23	Fire	28:52
2-1	Qom2	230kV Arak Feeder AM816	4/23/2016 3:46	4/23/2016 7:15	3:29	Protective Relay Operated	
2-2	Qom2	63kV Bus Section CB M6812	3/22/2016 15:36	3/22/2016 15:59	0:23	No report	
2-3	Qom2	230kV Arak Feeder AM816	11/6/2016 14:09	11/6/2016 14:59	0:50	Problem in PLC System	
2-4	Qom2	230kV Jamkaran Feeder HM815 CB M8152	6/15/2016 11:22	6/15/2016 16:35	5:13	Solving Leakage from related Instruments	
2-5	Parand Combined Cycle	230kV Qom2 Feeder MP809	4/13/2016 3:24	4/13/2016 3:47	0:23	Protective Relay Operated	10:18
3-1	Eslamshahr	63kV Capacitor Sc11	8/27/2016 11:22	8/28/2016 11:43	24:21	Protective Relay Operated	
3-2	Eslamshahr	230kV Rey Gas PP Feeder VY837	6/10/2016 13:25	6/10/2016 14:27	1:02	Protective Relay Operated	
3-3	Rey Gas PP	230kV Eslamshahr Feeder VY838	9/13/2016 13:39	9/14/2016 16:35	26:56	Protective Relay Operated	
3-4	Rey Gas PP	230kV Eslamshahr Feeder VY837	4/30/2016 13:50	4/30/2016 14:13	0:23	Protective Relay Operated	
3-5	Rey Gas PP	230kV Eslamshahr Feeder VY837	4/30/2016 13:33	4/30/2016 13:50	0:17	No report	52:59
4-1	Kamalabad	230kV Montazer Ghaem Feeder DR825	7/16/2016 15:19	7/16/2016 15:35	0:16	Protective Relay Operated	
4-2	Kamalabad	230kV Montazer Ghaem Feeder DR825	7/30/2016 13:39	7/30/2016 19:44	6:05	Protective Relay Operated	
4-3	Kamalabad	230kV Montazer Ghaem Feeder DR825	6/30/2016 12:39	6/30/2016 13:22	0:43	Protective Relay Operated	
4-4	Kamalabad	230kV Montazer Ghaem Feeder DR825	6/30/2016 12:05	6/30/2016 12:20	0:15	Protective Relay Operated	
4-5	Kamalabad	230kV Montazer Ghaem Feeder DR825	6/29/2016 15:36	6/29/2016 15:44	0:08	Protective Relay Operated	
4-6	Kamalabad	230kV Montazer Ghaem Feeder DR825	4/15/2016 17:13	4/15/2016 17:34	0:21	Protective Relay Operated	
4-7	Kamalabad	230/63kV T2	8/7/2016 9:36	8/7/2016 10:57	1:21	corect faults	
4-8	Kamalabad	63kV Capacitor Sc12	5/7/2016 10:00	5/7/2016 15:16	5:16	Unusual Sound	
4-9	Kamalabad	230kV Vardavard Feeder DV806	11/10/2016 9:30	11/10/2016 17:05	7:35	Optical Fiber Wiring	
4-10	Montazer Ghaem	230kV Kamalabad feeder DR828	11/15/2016 11:29	11/15/2016 12:52	1:23	Protective Instrument Operated	
4-11	Montazer Ghaem	230kV Kamalabad feeder DR825	7/21/2016 15:42	7/21/2016 22:40	6:58	Protective Relay Operated	
4-12	Montazer Ghaem	230kV Kamalabad feeder DR825	11/8/2016 0:38	11/8/2016 3:30	2:52	Clamp Meter (& Connection) Operated	
4-13	Montazer Ghaem	230kV Kamalabad feeder DR825	11/2/2016 1:05	11/2/2016 4:45	3:40	Solving Thermography Errors	
4-14	Montazer Ghaem	230kV Kamalabad feeder DR825	5/23/2016 22:30	5/24/2016 2:09	3:39	Clamp Meter (& Connection) Operated	40:32
5-1	Manavi	230kV Montazer Qaem C.C. Feeder AM818	10/8/2016 17:50	10/8/2016 18:20	0:30	Protective Relay Operated	
5-2	Manavi	230/63kV T2	5/1/2016 5:50	5/1/2016 6:06	0:16	Protective Relay Operated	0:46
6-1	Doshan Tappeh	230/63kV T3	5/25/2016 1:37	5/25/2016 3:13	1:36	Sectionner Error	1:36

Source: edited by Survey team based on TREC's data

The introduction of automatic hi-speed multi-phase reclosing system is recommended to TREC in order to reduce yearly outage time and to improve reliability of power grid.

On condition that transmission line is a parallel circuit and two or more of phases are non-tripped and the linkage of the grid is kept, the multi-phase reclosing system is a method to cut off and to reclose only failure phases even in the simultaneous failure of both circuits.
For example, in case that A and B phase on line #1 and B and C phase on line #2 in Figure 5.2-33 are failed at same time, power supply to the failure points shall be shut and afterwards reclosed at the both ends.



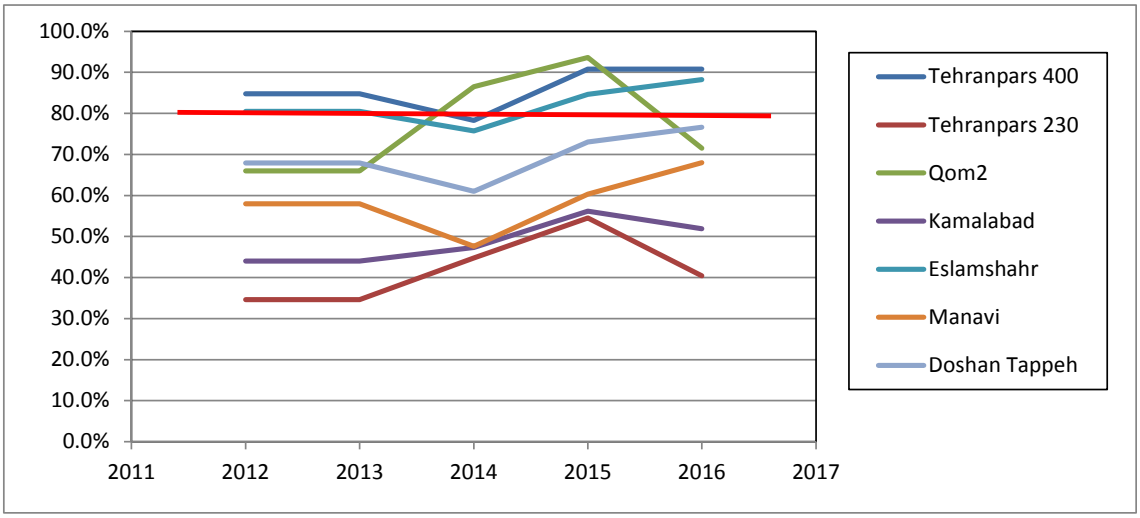
Source：Japan Electric Engineers' Association, Electric Technology Course

Figure 5.2-33 Explanation Drawing for Hi-speed Reclosing System

In case that the linkage of the grid is kept at C phase of line #1 and A phase of line #2, hi-speed reclosing is possible. Since multi-phase reclosing system shuts power supply to only the failure point and recloses, for example, high-speed reclosing is performed even in a three-phase failure of one line in two lines, high-speed reclosing is performed even in the case of a one-phase ground fault in two lines and six phases.
Therefore, as long as the reclosing is a success, the influence on the grid is extremely small. Double circuit transmission lines are especially effective because same phase of the lines is often attacked by lightning strike.
The condition for realizing the function of high-speed multi-phase reclosing is that 2 transmission lines are provided in parallel between sub-stations and a multi-phase reclosing function is installed at the sub-station of destination, and single phase breakers are installed that can close each phase. In the case of Iran, 2 ultra-high voltage transmission lines of 230 kV or higher are frequently installed in parallel, so this is no problem. However, a multi-phase reclosing function must also be installed at the sub-station of destination that is subject to rehabilitation, and depending on the circumstances, the 3-phase breakers must be replaced with single-phase breakers. This means the protective method and function must be changed, so it is necessary to obtain the approval of TREC and IGMC. The approval procedures are described in Section "5.2.2- (1)-e Control and Protective Units". It is expected that about 40% of power outages can be eliminated by introducing this system.

(2) Resolution of Overload

TREC operates transformers at or below 80% plant operating rate, in order to prevent transformer overload at sub-stations. However, in recent years, sub-stations are operating constantly in excess of 80% plant operating rate, and some sub-stations are operating near their upper limit of capacity. Figure 5.2-34 shows the plant-operating rate in the most recent 5 years for the sub-stations that are subject to rehabilitation.
In order to improve this situation, TREC is planning to increase the capacity of the transformers at Tehranpars, Qom2, Kamalabad, and Eslamshahr, and the number of feeder bays of transmission line. It is expected that the sub-station plant operating rates will be brought down to 80% or less by this increase of capacity and feeder bays.

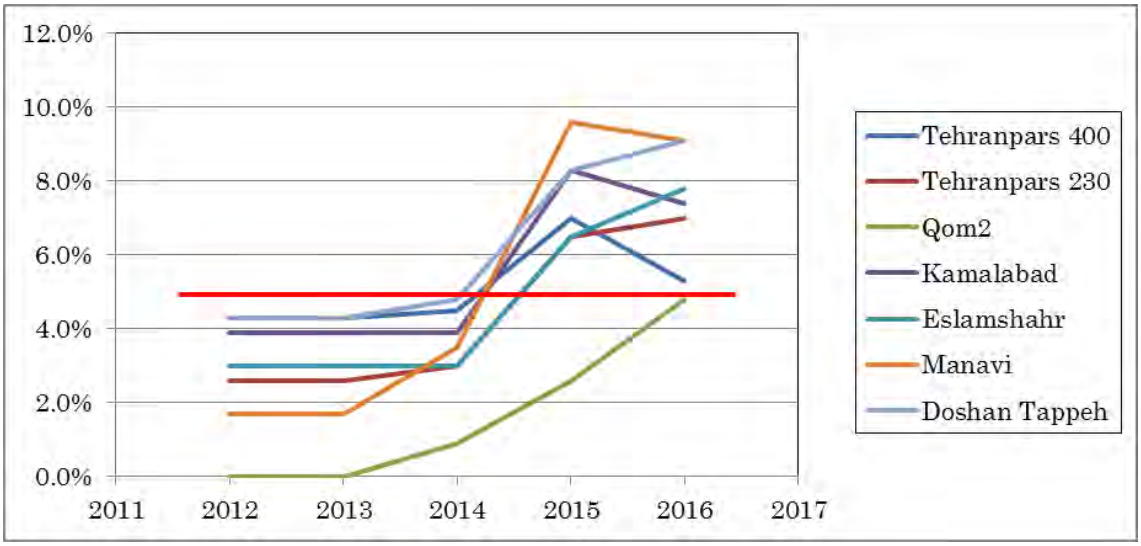


Source: Prepared by the Study Team based on TREC documents

Figure 5.2-34 Sub-station Plant Operating Rates

(3) Voltage Control

TREC controls the voltage so that the line voltage is within ±5% of the rated value. However, with the increase in demand in recent years, it has been found that there are many sub-stations whose output voltage is greatly lower than the standard value. Therefore, TREC is planning to install a VAR compensator (condenser or condenser and reactor) at the 6 sub-stations that are subject to rehabilitation. It is expected that the voltage drop will be kept within the standard values as a result of installation of this system. Figure 5.2-35 shows the percentage voltage drop in the line voltage in the most recent 5 years at the sub-stations that are subject to rehabilitation.



Source: Prepared by the Study Team based on TREC documents

Figure 5.2-35 Sub-station Percentage Voltage Drop

(4) Relocation of Residents

TREC is planning to connect Kamalabad 400kV substation to existing 400 kV overhead transmission lines through newly constructed 2 circuits overhead lines approx. 8 km in length. Since, design is not final at this stage, the exact routing is not specified and impacts due to right of way is not clear. However, according to the JICA survey team's interview to the TREC environmental department, resettlement of residents due to the extension of 400kV transmission lines is considered not to occurred, because of TREC's general method making the route to avoid populated areas.
According to the TREC environmental department too, TREC will prepare to purchase air use right and to compensate farmland, etc. as soon as a transmission line route will be decided. TRAVANIR and TREC's idea on this matter was the same.

5.3 Results of Survey of Needs for Construction of New Power Plants, etc.

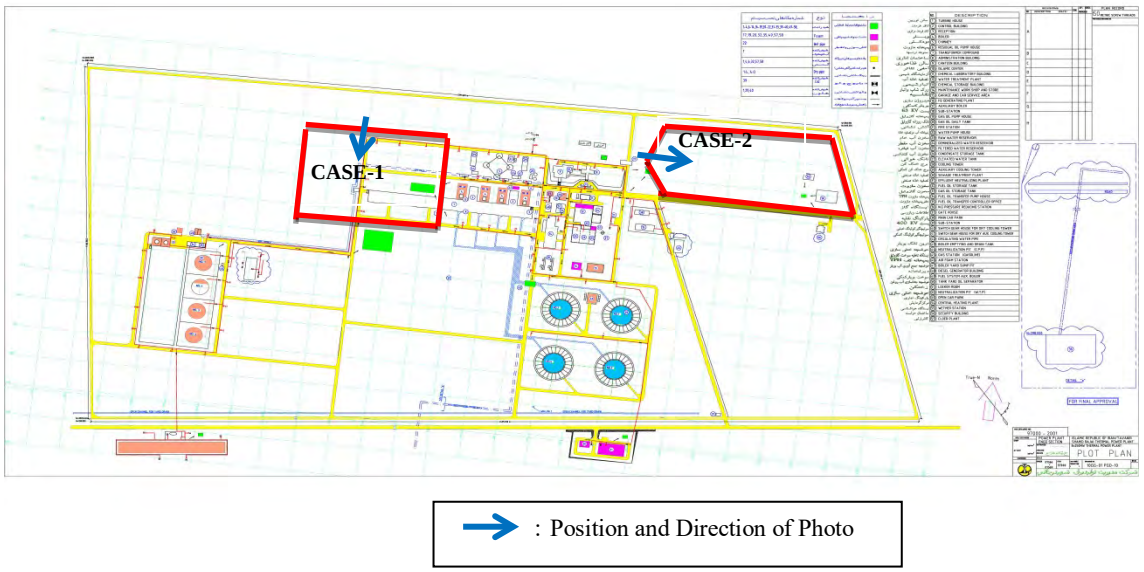
In this survey, a study was carried out of the needs at Rajaee Thermal Power Plant, located on the outskirts of Tehran, where there is a comparatively large electric power demand.
The oil fired steam power plant 1,000 MW (= 250 MW × 4) of Rajaee power plant commenced operation in 1992 to 1994. In addition to have a combined cycle power plant of 1,042 MW (6GT + 3 ST).
The existing combined cycle power plant has six GT installed in 1994 to 1995, the ST started to be added in 1999, and operation commenced in 2001.

As the electric power demand expands within Iran, there is a big expectation for the installation of a new combined cycle power plant at Rajaee Thermal Power Plant.
It has been confirmed that sufficient site remains at this power plant, and that the needs from the power plant side are high. Also, it has been confirmed that there is a high need for installation of a combined cycle power plant with an output of the same scale as the existing power plant.

On the other hand, there tends to be water shortages around the power plant, so a dry-type system is envisaged for the condenser cooling system, and it is a precondition for the layout space. As a result, the studies have shown that about 20 ha is required as space for installation of the new power plant.

Figure 5.3-1 and Figure 5.3-2 show the two scenarios, CASE-1 and CASE-2, for the location of the construction of the new combined cycle power plant at Rajaee Thermal Power Plant. Also, photographs taken at the plant are shown in Figure 5.3-3 and Figure 5.3-4. It has been evaluated that there is sufficient space in either case.

Figure 5.3-1 Draft Layout of New Combined Cycle Power Plant



: Position and Direction of Photo

Figure 5.3-2 Layout of New Combined Cycle Power Plant (draft)

Figure 5.3-3 CASE-1 West Side Installation Space Photograph

Figure 5.3-4 CASE-2 East Side Installation Space Photograp

Chapter 6 Analysis of Financial Cooperation and Overseas Borrowing System

This chapter discusses the issues mainly at an operational level in considering the extension of Japanese ODA loan for the Islamic Republic of Iran. More specifically, the following tries to sort out the points of attention related to the current Iranian legal framework pertaining to foreign finance, Loan Agreement (L/A), loan terms and conditions, disbursement, procurement and so forth. Mostly, the following focuses attention on the issue directly relates to JICA's ODA loan operation.

The term "overseas borrowing" or "foreign finance" below refer only to official/public overseas borrowing from the foreign government or international organization such as multilateral development bank.

6.1 Key Iranian Actors Involving in Japanese ODA Loan

It would have to say that, in present day Iran, the integrated legal framework and robust system for managing overseas borrowing is still in the middle way of establishment. Other than the prospective Executing Agency of the individual Japanese ODA loan project, the following Iranian public organizations are currently involving in borrowing operations of Japanese ODA loan as key actors.

6.1.1 Planning and Budgetary Organization (PBO)

PBO, one of the largest government organizations, was previously known as Management and Planning Organization (MPO) for a considerable period of time (from 1948 until 2007 and again since 2013), but, in the autumn of 2016, MPO was renamed to PBO. Some PBO officials said that it was just a cosmetic name change and the government kept the purpose and role of the organization unchanged.

PBO wields great power since they are the sole government organization in charge of formulation of national budget and development plan and associated instructions. In addition, PBO plays its role as the strategist group serving as the backbone of High Economic Council (HEC) of the Islamic Consultative Assembly (ICA, synonymous with the Parliament) which is a decision-making body of national economic and investment policies and economic relations with foreign entities. In the "Instruction on Requesting for Utilizing Foreign Finance" (to be described later in 6.2.2), PBO insists on positioning itself as "the Secretariat of HEC".

As one of key actors involving in Japanese ODA loan operation, PBO plays a coordinator role for the Iranian organizations concerned from an early stage of preparation of official loan request. As to the individual ODA loan project, PBO's technical unit for specific sector makes a technical review of the project, and the result of its review is delivered to HEC.

6.1.2 Organization for Investment, Economic and Technical Assistance of Iran (OIETAI)

OIETAI, a Ministry of Economic Affairs and Finance-affiliated organization, is responsible for agreement concerning economic and investment relationship with foreign country. Besides, OIETAI plays a role in the coordination of the acceptance and implementation of grant and loan assistances as well as technical assistance associated with those financial assistances.

Under Japanese ODA loan operation, OIETAI has the responsibility to manage official loan requests in an integrated fashion and takes the central role in a series of L/A preparation

procedures from the stage of negotiation on loan terms and conditions with JICA to effectuation stage.

6.1.3 Ministry of Economic Affairs and Finance (MEAF)

At the stages up to the signing of L/A, MEAF's involvement in Japanese ODA loan seems to be implicit and limited since, as described above, OIETAI is assigned to cope with almost all the L/A preparation procedures.

At a level of the effectuation of L/A, a legal advisor to the Minister of Economic Affairs and Finance will be a preparer and signer of Legal Opinion on L/A and on Guarantee. When the disbursement, payment and repayment start, it is expected that MEAF will, at least, be a gateway for the payment of interest and repayment of principal of loan in collaboration with the Executing Agency and other organizations concerned.

6.1.4 Ministry of Foreign Affairs (MOFA)

MOFA, as a specialized professional organization for formulating and pursuing the Iranian foreign policy, plays a number of roles in negotiation and coordination with donors. MOFA is appointed as an official loan request submitter to the donors and, regarding Japanese ODA loan, MOFA will be the representative organization in charge of handling the matter pertaining to the Exchange of Notes (E/N) with the Government of Japan.

6.1.5 Central Bank of Iran (CBI)

According to the Iranian government order titled "Instruction on Requesting for Utilizing Foreign Finance" (this is discussed further in 6.2.2 below), CBI plays a diverse role in the stages of both preparation and implementation of foreign finance project. In the stage of the preparation of request for foreign finance, CBI is obliged to respond to the inquiry of organizations which are planning to obtain finance (Note 1, Article 9), and to take necessary measures to minimize interest rate, overdue and other charges of the projects in the framework of international regulations as much as possible (Article 10). During the project implementation, Article 11 urges CBI to present the performance report of the project under foreign finance to the Secretariat of HEC (in other words, PBO) every six months.

6.2 Laws and Legal Framework for Overseas Borrowing

In the words of OIETAI and PBO, currently no integrated law of overseas borrowing exists and the relevant Articles of the Iran's Constitution of 1979 with Amendments of 1989 (among others, Article 44, Article 77, Article 80 and Article 125) are the fundamental sources of interpretation and decision-making for how to deal with overseas borrowing operation as sovereign country and its government. The related laws and government order under the Constitution, such as Instruction on Requesting for Utilizing Foreign Finance, Budget and Planning Law, are invocating to put flesh on the bones of the said interpretation and decision-making, when necessary.

6.2.1 Iran's Constitution of 1979 with Amendments of 1989

Article 44, Article 77, Article 80 and Article 125 of the Constitution stipulate the followings, respectively[8].

[8] The Worldwide Intellectual Property Organization (WIPO), 1989, [pdf] *Constitution of the Islamic Republic of Iran 1979 (as last amended on July 28, 1989)*. Available at:

[Article 44]

The economic system of the Islamic Republic of Iran is based on three sectors: state, cooperative, and private, and will be based on disciplined and correct planning.
The state sector includes all the national industries, foreign trade, major mines, banking, insurance, energy sources, dams and large water irrigation networks, radio and television, post, telegraph and telephone, aviation, navigation, roads, railroads, and others which are publicly owned and under the state's control.
The cooperative sector will include corporations and cooperative institutions of production and distribution that are established in accordance with Islamic criteria in cities and villages.
The private sector is comprised of that sector of agriculture, animal husbandry, industry, trade, and services that complement the state and cooperative economic activities.
The law of the Islamic Republic protects ownership in these three sectors as long as it agrees with the other principles described in this chapter; and it must not surpass the limits set by Islamic law. Such ownership must induce development and growth in the country's economy; and not cause any social harm. The details of the regulations, areas, and boundaries of the three sectors will be determined by law.

[Article 77]

Treaties, transactions, contracts, and all international agreements must be ratified by the Islamic Consultative Assembly.

[Article 80]

Receiving and issuing national or international loans or grants by the government must be ratified by the Islamic Consultative Assembly.

[Article 125]

All the treaties, transactions, agreements, and contracts between the government of Iran and other governments as well as all the pacts related to the international unions, after they are approved by the Islamic Consultative Assembly, must be signed by the President of the Republic or his legal representative.

Article 44 defines the scope and ownership of each economic sector in Iran and Article 3 of "Instruction on Requesting for Utilizing Foreign Finance" (to be described in the forthcoming section) states that organization which requests for obtaining foreign finance to HEC is obliged to meet the overall principles specified in this Article. Article 77 and Article 80 give interpretations that overseas borrowing by the Iranian government shall be ratified by ICA, and Article 125 stipulates the necessity of ICA's prior ratification of agreement for the government's overseas borrowing and designates the signer of such agreement.

6.2.2 Instruction on Requesting for Utilizing Foreign Finance

This Instruction has been issued in the joint names of the Vice President and the Head of PBO on 27 September 2016 (No. 145018)[9]. This is to harmonize the procedures and forms of request for applying for foreign finance from the Iranian public organization to PBO[10]. PBO will examine the request attached with technical, economic and financial justifications (Article 2) and prepare "Proposal to High Economic Council", and then submit it to HEC if PBO satisfies the request. Article 2 also states that the repayment of principal of loan and subordinate costs

<http://www.wipo.int/edocs/lexdocs/laws/en/ir/ir001en.pdf> [Accessed 3 November 2016].

[9] Provided by TAVANIR. The tentative translation into English was prepared by the JICA Study team.

[10] According to Article 1, this Instruction is applied to line ministry, state-owned company and other organization applying the Public Audit Law (Article 62).

including interest, overdue and commitment charges, management and insurance shall be done by using the revenue of the project[11] and the total implementation cost shall not exceed the determined ceiling.

Moreover, Instruction asks organization to present the initial acceptance of one of Iranian banks to be acting as agent bank for the project (Article 5) and to observe the environmental considerations and submit the permission from the Department of Environment (Article 7), when sending the request to PBO. Interestingly, Instruction says PBO shall submit the said Proposal to HEC within 45 days after receipt of the request documents, and the process from the request review to the opening of letter of credit (L/C) for the project can be completed within 2 months (Article 12).

6.2.3 Budget and Planning Law

When the JICA Study team discussed the legal backdrops of overseas borrowing with the officials of Iran, they commonly cited this Budget and Planning Law together with the Constitution. This law was originally approved by ICA in 1974, and consists of 53 articles and 15 notes. Application range of this law is line ministry, army and organizations affiliated to the army, local government, municipality, government organization, institution affiliated to the government, state-owned company, public institution and specialized credit institution which may be in charge of implementing a part of the annual budget plan (Article 1).

In the context of oversea borrowing, the following Articles are the important references in interpreting legal background[12].

[Article 25]

The amount of foreign loans or credits that are acquired whether in cash or by issuance of security bonds and purchasing goods or services from abroad in order to cover part or all of the costs of developmental projects, or the guarantee of the aforesaid loans or credits, is determined based on the rules and regulations of the then developmental plans. Thus, the amount of the loans and credits and their guarantees for which agreements or contracts is concluded based on the rules and regulations of the then developmental plan shall not be more than the determined amount in the developmental plan at that time. Matters related to foreign loans and credits are managed by the Ministry of Economic Affairs and Finance; following paragraph 9 of Article 3 of this Law[13], the said ministry is authorized to sign the agreements related to acquisition of credits and loans with the determined amount. In addition, the Ministry of Economic Affairs and Finance is duty-bound to submit the report of each contract to the Parliament within one month after being concluded.

Note 1: Those contracts which are concluded with foreign governments for loan acquisition shall be applicable after being approved by Finance Commission of the Parliament.

Note 2: The negotiations related to the acquisition of loan or credit is jointly carried out by the executing organization (recipient) and Ministry of Economic Affairs and Finance.

[11] Article 4 mentions the adequacy of the proposed project's revenues in comparison to the investment costs shall be ensured and officially informed to PBO by submitting the designated form (Worksheet No. 1) with the signature of the highest official of organization.

[12] Islamic Parliament Research Center of the Islamic Republic of Iran, posting year is not described. Available only in Persian at: <http://rc.majlis.ir/fa/law/show/96903> [Accessed November 2016]. The tentative translation into English was prepared by JICA Iran Office.

[13] The JICA Study team could not get information about Article 3.

Note 3: The amount of using foreign financial resources shall not be more than the total amount foreseen in the budget law of that year.

[Article 26]

When the implementation of profit development projects are assigned to state-owned enterprises or government-affiliated institutions, the government shall allow the said enterprise or institution to benefit from foreign loans or credits provided that they obtain the ministry's consent on the contract's terms and conditions. The said contracts can be signed, exchanged and enforced under the names of the said enterprise or companies after being approved by the Cabinet. The enterprise or the institution shall be required to consider all the installments of principal, interest and other relevant costs of the said loans and credits in their budgets and pay them all at due maturities.

Note: If necessary and according to the recommendation by the Ministry of Economic Affairs and Finance, the government shall accredit the host ministry to guarantee the borrowing in this article on behalf of the government. If the enterprise or the institution does not fulfill their obligations, the Ministry of Economic Affairs and Finance can directly or through the Central Bank collect the debt from their current or cash assets (including their deposit accounts) or their other properties.

[Article 27]

All the state-owned bodies and companies and government's affiliated institutions may need to utilize foreign borrowings when part of the costs in their investment projects are not covered by the government's developmental funds. In that case, they shall be required to obtain the written consent of the Ministry of Economic Affairs and Finance regarding the amount of the borrowing as well as all the terms and conditions of its contract.

[Article 30]

All the current and developmental credits, which are approved in the public budget of the country, shall be allocated by a committee composed of the representatives from Ministry of Economic Affairs and Finance and Management and Planning Organization according to the executive reports of budget and regular operational progress reports. The aforesaid credits are allocated according to the guidelines proposed by the Ministry of Economic Affairs and Finance and approved by the Cabinet.

[Article 31]

The Ministry of Economic Affairs and Finance shall be responsible for reimbursement of the installments of the principal loans and its interests as well as commissions or any other banking or non-banking costs related to the foreign loans or credits which are or will be acquired for the costs of developmental plans based on the rules and regulations. To do all these payments, no new permission or license is required. Management and Planning Organization shall foresee the funds required to pay the aforesaid reimbursements in the country's total budget.

The above-mentioned Articles clearly define the outlines of procedure of overseas borrowing and, especially, which activities are acceptable and which are not. More importantly, the right and obligation of state-owned company for obtaining foreign finance are put in the statutory form (Article 26 and Article 27).

6.2.4 Future Prospects of Integrated Law of Overseas Borrowing

Concerning the future possibility of establishment of integrated law of overseas borrowing or similar government or cabinet order, some OIETAI officials express that there is no such plan by considering prospective lengthy complicated process of negotiation and coordination among

numerous government organizations concerned and a bunch of amendments and abolishment of the present laws and regulations and even consuetudes.

6.3 Debate on Applicable Sectors for Japanese ODA Loan

So far, it is not likely that it will not lead to the Iranian government policy or instruction in very near future, but debate among the some Iranian government organizations has recently begun on selection of applicable sectors for Japanese ODA loan. Debate says that the lucrative sectors like electricity sector which can expect to obtain the consistent profit through revenues should be developed by non- or low-concessional foreign finance having relatively high commercial nature, and highly concessional finance like Japanese ODA loan should go to development for sectors with low or without profitability.

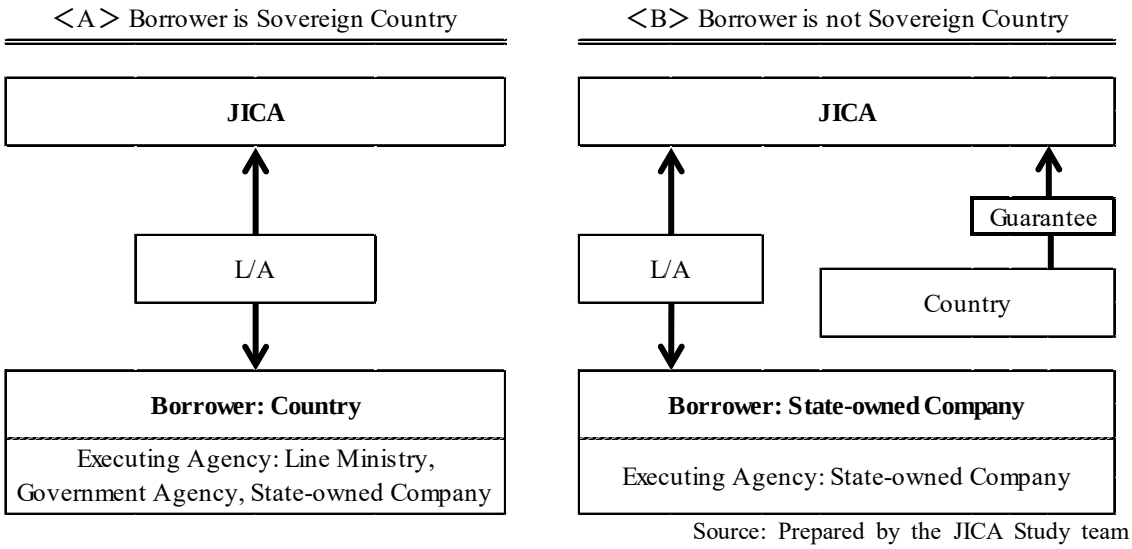
According to some officials of OIETAI and PBO, agriculture sector, health and medical sector, scientific research and higher education sector, environmental sector and general road sector could typically be considered as sectors which cannot expect to get enough self-profit.

While it looks this debate is still at infancy, there is a greater than zero possibility that combinatorial judgment integrating concessional level of foreign finance and level of sector profitability becomes a single criterion for selecting the source of finance for individual development project. Therefore, it is necessary to continue to pay close attention to changes of this debate in the Iranian government.

6.4 Issues before Implementation of Japanese ODA Loan Project

6.4.1 Signing of L/A

Under Japanese ODA loan, if the Borrower is not sovereign country itself, <B> below will be applied as loan scheme for the project. In another words, <B> below is the scheme that legal entity other than sovereign country itself (namely, state-owned company) becomes the Borrower of Japanese ODA loan and a guarantee for administration of loan will be submitted by the Iranian government to JICA.



Source: Prepared by the JICA Study team

Figure 6.4-1 Japanese ODA Loan Schemes Based on the Differences of the Borrower

According to OIETAI and PBO, under <B> scheme in Iran, a signer of L/A is the Managing Director (usually, equivalent to CEO) of the state-owned company and the Minister of Economic Affairs and Finance is an issuer of guarantee. This comes from Article 26 of the said Budget and Planning Law, but the legal background pertaining to guarantor remains unclear. At any rate, if the Iranian side's answers to the JICA's legal questionnaires for drafting L/A in the light of legal framework of the recipient country clearly confirm the legitimacy of application of this scheme, the questions will not be appeared for applying <B> scheme.

As stated by OIETAI and PBO, OIETAI will take care of the following actions toward the signing of L/A:
1) Preparing and providing the answers to legal questionnaires to JICA,
2) Examination of the terms and conditions of L/A and
3) Negotiating the terms and conditions of L/A with JICA.

When <A> scheme above applies to Japanese ODA loan project sometime in the future, the Minister of Economic Affairs and Finance is a signer of L/A. As seen in Article 25 of Budget and Planning Law above, while it stipulates the Ministry of Economic Affairs and Finance is authorized to sign the loan agreement, this authority is subject to prior approval of Finance Commission of ICA (no words as to whether Finance Commission is identical to Special Committee for Economic Affairs below).

For <A> scheme project, L/A must be ratified by ICA. In the opinion of OIETAI and PBO, this ratification will be dealt by the Special Committee for Economic Affairs under ICA as adhocracy, not by the ordinary parliamentary session. Special Committee for Economic Affairs can be convoked and held whenever required. According to OIETAI, by contrast, it is unnecessary for <B> scheme project to undergo a process of the said ratification.

Since the restriction rule on the signing place of L/A is not exist, L/A can be signed in Tehran or Tokyo or even in the third country. If Tokyo is the place of L/A singing, the power of L/A signing will be transferred to the Iranian Ambassador to Tokyo certifying by the Power of Attorney issued by the person who has an authority to sign. Considering the Constitution, in that case, it could be understood that the provision of reauthorization (from the Minister of Economic Affairs and Finance, as the first authorized officer, to the Ambassador to Tokyo, as the second authorizes officer, because, in accordance with Article 125, the Minister of Economic Affairs and Finance is due to receive the power of signing from the President or his legal proxy) should have been inserted into the Power of Attorney.

6.4.2 Effectuation of L/A

In order for the signed L/A to come into effect, original copies of Legal Opinion (L/O), Evidence of Authority (E/A) and Specimen Signatures (S/S) shall be submitted to and accepted by JICA. L/A shall become effective when JICA declares its satisfaction with all the original copies of L/O, E/A and S/S.

Although, initially, the Iranian organizations concerned had its opinion that the preparer and signer of L/O on L/A would be a registered lawyer of private law firm, they switched their opinion in the present day that the Legal Advisor to the Minister of Economic Affairs and Finance would be a preparer and submitter of L/O. In both cases of <A> scheme and <B> scheme, a signer of L/A must be a preparer and signer of E/A and S/S. L/O on guarantee under <B> scheme will also be prepared and signed by the said Legal Advisor.

6.4.3 Government Guarantee as Joint and Several Guarantee

As discussed above, submission of guarantee by the Iranian government must require for <B> scheme.

In accordance with Section 2.01. and Section 7.02. of the General Terms and Conditions under Japanese ODA Loans, dated November 2014 (hereinafter called as the "GTC"), as an integral part of L/A, "guarantee" means a written promise to JICA, made by an entity in the country of the Borrower other than the Borrower constituting a guarantee for any and all liabilities arising from or in connection with the obligations of the Borrower under the Loan Agreement. In addition, the form of guarantee as one of attachments of GTC inserts the statement that "the Guarantor has accepted all the provisions of the Loan Agreement and agrees to guarantee jointly and severally with the Borrower any and all liabilities arising from or in connection with the obligations of the Borrower under the Loan Agreement". Therefore, the guarantor under Japanese ODA loan is thought to refer to the "joint and several guarantor".

In general interpretation, when the guarantor receives the creditor's notice of demand, reference or execution, if the guarantor is not the joint and several guarantor, such simple guarantor has a right of defense by making a plea against the creditor that such creditor's notice or action shall be sent or asserted first to the principal debtor, not to the guarantor. On the other hand, if the guarantor is the joint and several guarantor, since the joint and several guarantor does not have such right of defense, the creditor may immediately assert its demand, reference or compulsory execution directly to the joint and several guarantor regardless of whether or not the principal debtor has the means. To put it plainly, the guarantor under Japanese ODA loan shall be jointly and severally liable to the Borrower for the repayment of the loan set forth in the Loan Agreement.

Nevertheless, there are slightly worrisome symptoms. OIETAI once said to the JICA Study team that a controversy at HEC has arisen over "who shall repay the principal and interest of Japanese ODA loan to JICA in case that the state-owned company as the Borrower is privatized some years later after commencement of borrowing". Meanwhile, as a condition of issuance of government guarantee, a state-owned company has an instruction OIETAI to conclude an agreement with a commercial bank that can undertake the payment of interest for arrears.

To make assurance double sure, it is deemed necessary to carefully confirm whether the scope and legal implication of guarantee to be prepared and furnished by the Iranian government under <B> scheme is exactly matched with a requirement of guarantee under Japanese ODA loan.

6.4.4 Rate of Interest

On both the fixed interest and variable interest are selectable to decide the interest rate for Japanese ODA loan for Upper-Middle-Income Countries including Iran[14]. As of January 2017, the latest terms and conditions for Upper-Middle-Income Countries are as table below.

[14] For consulting services portion, the interest rate will be 0.01% and the repayment period, grace period and conditions for procurement will be the same as those for non-consulting services portions.

Table 6.4-1 Terms and Conditions of Japanese ODA Loan[15][16]

Type	Standard/ Option	Interest Rate (%)	Repayment Period (yrs)	Grace Period (yrs)
Variable	Standard	JPY LIBOR + 20bp	30	10
	Option 1	JPY LIBOR + 15bp	25	7
	Option 2	JPY LIBOR + 10bp	20	6
	Option 3	JPY LIBOR + 5bp	15	5
Fixed	Standard	1.7	25	7
	Option 1	1.6	20	6
	Option 2	1.5	15	5

Source: JICA's homepage "Terms and Conditions of Japanese ODA Loan (Effective from 1 October 2015)"[17]

According to the said Instruction on Requesting for Utilizing Foreign Finance and information from the Iranian organizations concerned, determination of the terms and conditions of foreign finance is under the jurisdiction of CBI. In theory, it is desirable that the borrowing terms and conditions are selected on the basis of better national investment decision grounded in economic and financial analysis. Fluctuation of the 6-Month Japanese Yen (JPY) LIBOR in the past several years seems a little and it hovers at low rates. Consequently, there is a high possibility that the Iranian government shows a marked preference for applying variable interest for Japanese ODA loan.

Let us assume that we are formulating the Japanese ODA loan project as a candidate loan project with 6 years planning for construction period. In case of application of variable interest for that candidate project, "Standard" or "Option 1" may be adopted since the construction period for this project is expecting to be at least 6 years and it is equivalent to or more than the grace period of "Option 2" and "Option 3". The Iranian government may be anxious to avert possible risk of expiration of grace period during the construction work period because not only the payment of interest but also the repayment of principal shall be proceeded soon after the grace period even before the completion of disbursement during the project. Since unforeseeable project implementation delay is not unusual, application of "Standard (grace period: 10 years)" or "Option 1 (grace period: 7 years)" may be looked as preferable decision for the Iranian government if they want to be on the safer side. In fact, when the JICA Study team explained the concept of grace and repayment periods under Japanese ODA loan to the officials of OIETAI and CBI, both they declared unofficially that they might prefer such safer side decision.

To the contrary, however, there is potential that the Iranian government, by intent, will not select the borrowing condition drawn solely from analysis from the aspect of economic and financial rationalities. Japanese ODA loan as long-term foreign finance with the soft condition of more than 20-30 years repayment with low interest rate may cause the Iranian government to take a different path. To put manageability of debt and annual budget before all else, there is still potential that fixed interest may be preferred by the Iranian government.

[15] LIBOR and bp are the abbreviations of "London Interbank Offered Rate" and "basis point" (1bp = 0.01%), respectively.
[16] The base rate of variable loan is the value of the 6-month JPY LIBOR and the spread shall be fixed. If the actual value of interest rate is lower than 0.1%, the interest shall be 0.1%.
[17] JICA, posting year is not described. Available at: <https://www.jica.go.jp/english/our_work/types_of_assistance/oda_loans/standard/index.html> [Accessed 29 January 2017].

In case of application of fixed interest, "Standard (grace period: 7 years)" may only be an option for the Iranian government by considering expected construction period (6 years) under the said candidate project. In this case, the highest interest rate (1.7% per annum) must be applied for the project, but still it could be considered as highly concessional long-term finance when compared to loan terms and conditions of other donors like International Bank for Reconstruction and Development (IBRD) of World Bank Group[18]. Additionally, for the Iranian government, there is potential that the long-term stability of fixed interest may have much greater appeal than potential long-term instability of variable interest.

In fact, OIETAI once showed their opinion to the JICA Study team that the manageability of long-term foreign finance taking into account annual budget control within the government might be one of the standards of judgment with regard to selection of borrowing conditions. At that time, OIETAI official gave a historical instance of debt management troubles concerning Japanese ODA loan projects, which was extended by then Overseas Economic Cooperation Fund (OECF)[19] in 1980's and 1990's, actually occurred inside the government, and stated "during performing long-term repayment obligation, changes of organization in charge of long-term debt and personnel changes in the organization will be repeated again and again over a long period. To fulfil the long-term obligation in stable fashion is always serious challenge for the government borrows foreign finance. To keep borrowing and repayment conditions as simple as possible and to keep ways of debt management as easy as possible could be considered desirable for the Borrower like us".

6.4.5 Banking Arrangement with the Iranian Agent Bank

The Agent Bank (A/B) of the Iranian side should be nominated by the Iranian government as quickly as possible. According to CBI, since they do not have remittance functions for the bank account of private company, it is confirmed that CBI cannot be fully serving its role as A/B.

In light of confirmation with CBI above, CBI and OIETAI explained to the JICA Study team that one of commercial bank should be assigned as A/B, and lined up the candidates from (Semi-) State Bank (Melli, Bank of Industry and Mine, Reffah, Toseeh Taavan, Export Bank, Saderat) to Private Bank (Tejarat, Mellat). In addition, according to CBI and ISDB, while the reason is unknown, the German government recently approaches the Bank of Industry and Mine as the candidate of A/B.

One of the basic setup for commencing loan disbursement is the conclusion of Banking Arrangement (B/A) between BTMU and the Iranian A/B. Considering this, B/A should be concluded immediacy after L/A signing or, at the latest, L/A effectuation. However, as far as the JICA Study team knows, the Iranian government has yet to start dialogue with the commercial banks.

[18] As of 5 November 2016, ranges of applicable interest rate for IBRD loan (flexible loans with a fixed spread) vary widely from the 6-month JPY LIBOR+40bp (for 8 years and below maturity) to the 6-month JPY LIBOR+130bp (for greater than 18-20 years maturity).
(Source: World Bank, 2017, *IBRD Lending Rates and Loan Charges*. Available at: <http://treasury.worldbank.org/bdm/htm/ibrd.html> [Accessed 6 February 2017].)

[19] OECF was Japanese government agency in charge of Japanese ODA loan from 1961 to 1999 and one of predecessor agencies of the current JICA.

6.5 Issues during/after Implementation of Japanese ODA Loan Project

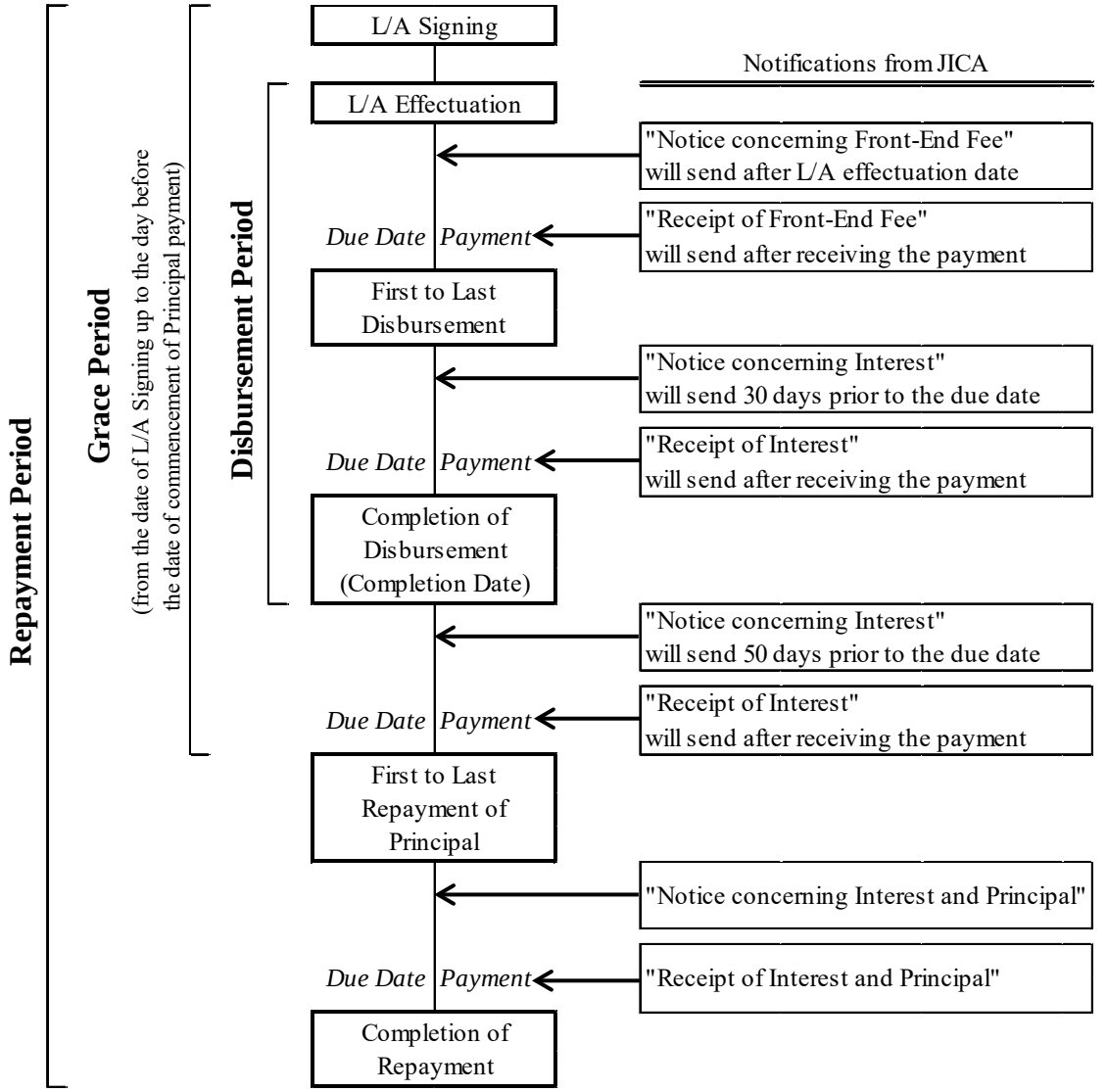
6.5.1 Payment of Interest, Repayment of Principal, Frond-End Fee

When the JICA Study team provided explanations on Japanese ODA loan mechanism to the Iranian organizations concerned, sometimes it was not easy to achieve an understanding of payment obligation of Interest during Construction (IDC). Especially, explanations on the following points always placed the Iranian side in a quandary:

i) Interest shall accrue from the respective dates on which the loan proceeds are disbursed and
ii) The amount of interest notified periodically by JICA's "Notice concerning Interest" shall be paid to JICA prior to the due date specified in the said Notice even during the period of project implementation and even before the completion date of disbursement stipulated in L/A.

The Iranian government receives development finance from the Islamic Development Bank (ISDB), and it has well known that ISDB's lending for social infrastructure development project carries no interest based on *Shari'a* and recovers all costs associated with its lending by charges. Since the Iranian government is limited in recent overseas borrowing experience only from IDB, there is possibility that misunderstanding or incomprehension of IDC obligation is gradually penetrated among the government.

The JICA Study team has tried to explain definitions of disbursement period, grace period and repayment period and obligations of payment and repayment to be shouldered by use of Figure below:



Prepared by the JICA Study team

Figure 6.5-1 Definitions of Disbursement, Grace and Repayment Periods

Under the system of Japanese ODA loan, the Borrower has a right to select IDC payment method between “loan-covered type” and “not loan-covered (cash payment) type”, and the Iranian government continues internal discussion on which type should be applied for Japanese ODA loan project to be implemented by state-owned company. In recent JICA’s ODA loan experiences, Iraq and Myanmar are countries which JICA resumes the provision of Japanese ODA loan after more than two decades hiatus. The former, by considering instable national budget result from heavy oil revenue dependence, consistently chooses “loan-covered type” since the first Japanese ODA loan project formulated after recommencement of Japanese ODA loan provision and the latter, having big concern about grasping the actual situation of government’s annual income and expenditure, prefers “not loan-covered (cash payment) type”.

Though specific procedures for IDC payment and principal repayment are not decided yet, it should be determined by the time of L/A effectuation at the latest because the first JICA’s “Notice concerning Interest” (i.e., notice of due amount and date of IDC) will normally be sent to the Borrower after 6 months from the date of L/A signing.

Front-End Fee (FEF) is applicable to Japanese ODA loan project pledged after 1 April 2013. The amount equivalent to 0.2% of the total loan amount shall be paid within 60 days from the day following the date of L/A effectuation. At present, since "loan-covered type" cannot be selected for FEF payment, the Iranian government shall secure the budget for the purpose of FEF payment.

6.5.2 Treatment of Taxes and Duties

As far as the JICA Study team is aware, preparatory discussion on E/N for any Japanese ODA loan project has not yet launched between the Government of Japan and the Government of Iran. Hence, the treatments of taxes and duties under the resumed Japanese ODA loan are nowhere in sight. Tax treaty or a convention for the avoidance of double taxation between Japan and Iran have not concluded. In this regard, however, the past E/N for the completed Japanese ODA loan for Iran may be able to be a good reference for predicting the possible treatment of taxes and duties under the resumed new Japanese ODA loan project. E/N for Godar-e-Landar Hydroelectric Power Project (Singing date: May 1993, E/N amount: JPY 38,614 million) can be downloaded from Japan's Ministry of Foreign Affairs' official website[20].

In E/N for Godar-e-Landar Hydroelectric Power Project, tax exemption for Japanese ODA loan is stipulated as follow:

[Tax Exemption for Japanese ODA Loan]

The Fund[21] *is exempted from all fiscal levies or taxes imposed in the Islamic Republic of Iran on and/or in connection with the Loan as well as interest accruing therefrom.* (7. (1))

As to Japanese consultant and contractor, E/N provides preferential treatments of Japan as below:

[Japanese Corporation Incomes]

All the charge of fiscal levies or taxes imposed in the Islamic Republic of Iran with respect to the income accruing from the supply of products and/or services to be provided under the Loan by the Japanese companies operating as suppliers, contractors and/or consultants will be met or borne by the Iranian Executing Agency. (7. (2))

[Export and Import by Japanese Corporation]

All the charge of duties and related fiscal charges imposed in the Islamic Republic of Iran with respect to the import and re-export of the materials and equipment needed for the implementation of the Project by the Japanese companies operating as contractors and/or consultants will be met or borne by the Iranian Executing Agency. (7. (3))

[Japanese Personal Incomes]

All the charge of fiscal levies or taxes imposed in the Islamic Republic of Iran with respect to personal income of Japanese employees engaged in the implementation of the Project derived from Japanese companies operating as suppliers, contractors and/or consultants will be met or borne by the Iranian Executing Agency. (7. (4))

[20] Ministry of Foreign Affairs, posting year is not described. Available at: <http://www.mofa.go.jp/mofaj/gaiko/treaty/pdfs/A-H05-1161.pdf> [Accessed 1 July 2016].

[21] "The Fund" refers to OECF.

As seen from the above, in the form of E/N for Godar-e-Landar Hydroelectric Power Project, the Japanese government and the Iranian government agreed that taxes and duties for Japanese corporations and individuals engaging in the project should be shouldered by the Executing Agency, and it could be deemed as substantive tax exemption. At the same time, "met and borne by the Iranian Executing Agency" contains risk for leading directly to delay in the implementation of the project if insufficient budget appropriation or use come up to the surface.

Copies of this E/N have been shared with OIETAI, PBO and Iranian National Tax Administration (INTA). Considering that this E/N for Godar-e-Landar Hydroelectric Power Project was once ratified by ICA at the time, it remains possible that the similar tax treatment for Japanese corporation and individual may be taken also for the resumed Japanese ODA loan project. At the same moment, however, it is expected that the possibility of similar tax treatment implies that the Iranian and the third country's corporation and individual who are joint venture partner or employee will be object of taxation.

During the meeting with INTA, OIETAI and PBO in January 2017, the official of INTA stated that while they found it feasible to apply the same treatment of tax and duty agreed in the said E/N to the Japanese real and legal persons under the resumed Japanese ODA loan, the approval of ICA or authorized authority is deemed necessary to the conduct of such special treatment. He then presented a viewpoint that if the relevant clauses of Direct Taxes Act (approved in February 1988 with amendments in July 2015) apply with no special interpretations, for instance, for the taxable income of foreign natural and legal person, the taxable profit shall consist of 10-40% of the total annual receipts with due regard to the type of activity and the level of profitability (Article 107).

6.5.3 Social Security Charge

During the Study, the JICA Study team has found out information that Social Security Cost (SSC) shall be imposed on the amount of the individual contract and it is highly possible that the consultant and contractor to be procured under Japanese ODA loan project for Iran incur considerable expenses for SCC.

In order to assemble a picture of SCC, the JICA Study team attempted an interview with a certified public accountant working temporary for JICA Iran Office. According to that certified public accountant, the big-picture view of SCC is as follows:

i) Depending on the purpose of contract, type of contract shall be categorized by:
   a) Development (contract under public national development project approved by HEC)
   b) Non-development (contract under private commercial development project)
ii) Along of the type of contract, assignment type of contract shall be categorized by:
   a) Service contract (including consulting services)
   b) Construction contract (such as construction work, equipment supply, etc.)
iii) SCC rates to be applied for each type of the individual contract can be summed up below:

Table 6.5-1 SCC Categories and Payments

	Development	Non-development
Service Contract	15.6% (Client = 12%, Contractor = 3.6%)	16.67% (Contractor must pay all)
Construction Contract	6.6% (Client = 5%, Contractor = 1.6%)	7.8% (Contractor must pay all)

Source: Prepared by the JICA Study team

iv) SSC will be exempted for the amount allotted to import of equipment through L/C transaction, among the total contract amount of the individual contract. If the full component of the contract is only for supply of equipment from foreign country and all payment transactions will be made through L/C, SSC will not be charged.

v) Payment procedures of SSC for the contract categorized as "Development" are as follows:
   a) Right after signing of the contract with the consultant/contractor, the client shall notify Social Security Organization (SSO) of the facts of the contract. Then SSO shall provide Contract Identification Number to the individual contract.
   b) When the client makes a payment to the contractor, the client shall deduct SSC to be shouldered by the contractor from the first payment, and pay the deducted amount to SSO together with the amount to be shouldered by the client itself.
   c) The contractor shall furnish SSO with the list of employees who are the Iranian nationals, or foreigners who shall be insured based on Social Security Law and related regulations in Iran, every month during the period of contract.
   d) At the end of the contract, SSO shall calculate the social security contribution based on the list of employees, and if that amount exceeds the already paid amount of the contractual social security cost, the contractor shall pay the surplus.

Taking into consideration of the above-mentioned i) to v), the contract concluded under Japanese ODA loan project will be treated as "Development" and the consultant and contractor shall contribute comparatively low ratio of SSC.

In this regard, however, the official of SSO explained, during the meeting with SSO, OIETAI and PBO in January 2017, the possibility of full-ratio contribution from the consultant and contractor procured even under Japanese ODA loan project as "Development" category. In either case, discussions or negotiations with the Iranian side including SSO should be continued on this matter.

6.5.4 Disbursement Procedures

For Japanese ODA loan project in Iran to be resumed after the last several decade hiatus, Transfer Procedure (TP) can be considered as most applicable disbursement procedure. Sometimes some say TP is heavy workload disbursement procedure since the Borrower must prepare a bunch of disbursement request documents by itself and JICA shall review all the request documents, but TP is the simplest disbursement procedure easy to understand all the steps and to prepare all the contents of required documents. Thus, the JICA Study team believes TP is the most suitable disbursement procedure for the Borrower without long years of experience of Japanese ODA loans.

TP Type A (for payment in foreign currency including Japanese Yen) shall be considered as a main procedure for disbursement. In case of TP Type B (for payment in local currency, i.e., Iranian Rial), the Agent Bank (A/B) of the Iranian side must receive Japanese Yen from JICA through JICA's Paying Bank (The Bank of Tokyo-Mitsubishi UFJ (BTMU)) and transfer the amount to the contractor's bank account in Iran after exchanging Japanese Yen to Iranian Rial. Nevertheless, so far, we have to say the function and liability of money transfer of the Iranian A/B remains unproved. Hence, at least for the meantime, it may as well use only Type A and Iranian Rial should not be designated as bid currency in the bidding documents.

According to a few state-owned companies, payment under the L/C transaction is familiar for them, but application of Commitment Procedure (CP) of Japanese ODA loan should be carefully studied by considering time required for the opening L/C and L/C transaction capability of the Iranian Agent Bank. If CP is applicable for the project, it is recommended that disbursement for advance payment handles by TP and, in tandem with that, start preparing the opening of L/C. It is anticipated that the consultant or contractor can cover its demand for money for proceeding the works by using the amount received as advance payment for about 2 months. If all the transactions for L/C opening completes within such period, CP will be able to use from the first progress payment request. Whatsoever, if A/B's capability for L/C transaction seems to be low or unclear, dealing with the advance payment request by using CP should be avoidable.

Reimbursement Procedure (RP) and Advance Procedure (AP) seem to be incommensurate with the convenience. Under RP, the Executing Agency requests JICA to make reimbursement after making payments to the consultant or contractor and, after receiving the disbursement request, JICA will make reimbursement to the Executing Agency's loan account. Thus, the Executing Agency is responsible for allocating sufficient budget and executing payments to the consultant or contractor in a timely manner, since if the Executing Agency has had cash-flow problems, the works will also be suspended immediately after depletion of consultant's or contractor's fund. Additionally, volume of necessary procedures and documents need to be prepared for disbursement request are almost same with TP or more than that (e.g., checking a bunch of receipts every few months).

Particularly for Advance Procedure (AP), it is unfavorable for large-scale infrastructure project like the power plant rehabilitation project since disbursement management framework of AP is formulated for meeting a number of small-scale financial demands or contracts.

In conclusion, it is recommended that, in the L/A, TP, CP and RP are stipulated as available disbursement procedures. TP should be considered as a main disbursement procedure and, particularly for disbursement for advance payment, it should be used for realizing prompt disbursement. In order for reducing the potential of delay in payment, the use of CP and TP is recommendable only when the needs of application are obvious and the possibility of proper management is clearly verified.

6.5.5 Procurement

This final section of this chapter tries to deal with some striking difference points between Japanese ODA loan and the current Iranian practice concerning ideas and practices of procurement. The following procurement information of the Iranian side is provided by parol from the officials of Thermal Power Plant Holding Company (TPPH) during a series of discussions with the JICA Study team.

[Method of Selection of Consultant]
Section 3.02(2) of JICA's "Guidelines for the Employment of Consultants under Japanese ODA Loans", dated April 2012 (hereinafter called as JICA's "Consultant Guidelines"), stated that Quality- and Cost-Based Selection (QCBS) is the commonly recommended method for selecting the consultant. TPPH stated that QCBS method is generally adopted for selecting the consultant in Iran, too.

Regarding the quality-cost ratio for combining technical proposal evaluated point with financial proposal evaluated point into total evaluated proposal point, JICA's Standard Request for Proposals (SRFP), in principle, requests 80% weight for quality and 20% weight for cost, and less than 80% weight for quality is not allowed. On this point, TPPH normally assigns 30% to 40% weight for cost. Suffice it to say that, in many developing countries, it is a frequent practice to apply around 30% or 40% weight for cost, and, even when the central government or local government bodies of Japan select the construction consultant for their public works project, the minimum weight for cost is usually 25%. Thus, it is not that TPPH exercises strange ingenuity.

Section 3.02(3) of JICA's Consultant Guidelines mentions that Quality-Based Selection (QBS) method should be applied only for several specific types of assignments. According to TPPH, QBS method is not normally adopted for selecting the consultant. And, TPPH is usually not using price negotiation method (focusing on the proposed prices and negotiate a discount on the proposed prices, and then the lowest price proposal as the result of negotiation is evaluated as the highest ranked proposal) and open counter method (lowest price proposal is automatically evaluated as the highest ranked proposal).

[Request for Proposals, Bidding Documents]
Request for Proposals (RFP) is the bidding documents for selecting the consultant and Bidding Documents is for selecting the contractor/supplier. JICA prepares SRFP and various types of Standard Bidding Documents (SBD) such as for prequalification, goods supply, civil work, plant construction and so on. Section 3.05(2) of Consultant Guidelines and Section 4.01(2) of "Guidelines for Procurement under Japanese ODA Loans", dated April 2012 (hereinafter called as JICA's "Procurement Guidelines"), express that the Executing Agency shall use the applicable SRFP/SBD of the latest version issued by JICA.

According to TPPH, though, of course, they prepare the bidding documents but draft form of contract is not a part of the bidding documents. Standard form of contract is available but it does not attach to the bidding documents. Contract should be tailored in light of specific nature, requirement, condition, limitation and so on under the particular project. Draft form of contract prepared by the client is rich information source for prospective bidders to prepare their financial bid or proposal in more accurate and realistic by considering those specific conditions written in draft form of contract such as a set of applicable International Commercial Terms (INCOTERMS), payment terms, insurance obligation and so on.

[Power and Authority of Consultant]
The comments of TPPH officials are summed up that the Iranian consultant employed by TPPH under self-financing project has been granted the power and authority equivalent to (or more than) FIDIC type's "the Engineer". Almost same with supposition of FIDIC's the Engineer, consultant, as a proxy of TPPH, receives almost full power and authority to manage and supervise the contractor's work.

While amendment of the contract between TPPH and the contractor and material changes of design are beyond the consultant's power, the consultant is able to intervene numerous aspects of project management, including interpretation of the contractor's contract, instruction to the

contractor, certification of payment etc., without TPPH's prior approval. Even in JICA's SBD, matters which the Engineer shall require prior approval of the Client are limited to only material ones, such as determination of cost and schedule of additional work, changes of scope of works and work volume, etc.

[Time-Based Contract]
SRFP provides two types of standard form of contract; one is for Time-Based Contract form and other is for Lump-Sum Contract form. At the stage of consultant selection, the project itself is full of uncertainly and time of completion of construction is not yet certain. Because of those uncertainties, it is hard for the consultant to estimate lump-sum price at the time of proposal submission. Considering such circumstances, that is why Time-Based Contract is reasonable and suitable.

According to TPPH, since Time-Based Contract has not yet been introduced, payment terms are defined in line with several milestones, such as completion of detailed design, completion of bid evaluation, milestones on the progress of construction work.

[Governing Law, Contract Language]
In the usual case, law of the Islamic Republic of Iran is set forth in the contract as governing law. At the time of concluding the contract with foreign contractor, there was case that the law of the third country was selected as governing law. In any case, sole law is selected and stipulated as governing law for the purpose of interpretation of the contract.

TPPH has an experience that when TPPH concluded the contract with European company X, both Persian and common language of company X's registered address were stipulated as contract languages. Indeed, for example, General Conditions of FIDIC's Model Services Agreement describes "The Particular Conditions state the language or languages of the Agreement (snip)" and, in case that multiple languages are selected, ruling language shall be stipulated[22].

In the case of the said TPPH's contract with company X, it sounds ruling language is not stipulated. Since all the communications with the consultant/contractor shall be exchanged in writing, the use of multiple languages as contract languages without ruling language may bring troubles for implementing the contract. JICA's standard form of contract as well as standard form of contract prepared by the multilateral development banks, such as World Bank and Asian Development Bank (ADB), requests the contractual parties to select and stipulate single language as contract language.

[Price Adjustment Clauses]
Note 2. of Section 4.07 of Consultant Guidelines and Section 4.12 of Procurement Guidelines request the Executing Agency to stipulate Price Adjustment Clauses in the contract if the contract period is 18 months or more. In almost all cases and almost all the Executing Agencies around the world show, at least once, disapproval of application of Price Adjustment Clauses. As to TPPH's contract with the consultant or contractor, fixed price contract without any opportunity of price adjustment is commonly used.

Under the application of Price Adjustment Clauses, not only upward revision of contract amount but also downward revision of contract amount is expected. Although there is not small potential of downward revision, why does the Executing Agency normally feel unhappy to put Price Adjustment Clauses in the contract? The reasons behind are:

[22] International Federation of Consulting Engineers (FIDIC), 2006, *Client/Consultant Model Services Agreement*, Fourth Edition, Geneva: FIDIC.

i) Especially for the higher authorities and government organization in charge of budget management, annual revision of the amount of contract causes uncertainty for ministry/government budget management,
ii) Contract management and annual budget request will be becoming complicated, and
iii) Upward revision hit directly the balance of budget for the project and may cause shortage of loan during construction period.

From the standpoint of the consultant and contractor, by considering the case that upward revision of contract amount is necessary for keeping the quality of services in accordance with the contract, Price Adjustment Clauses is vital for them to complete the contractual obligations as originally agreed.

[Performance Security]
According to TPPH, performance security is normally furnished in the form of bank guarantee and that guarantee will be returned in exchange for TPPH's issuance of final acceptance certificate. There are no contradictions with Section 4.14(1) of Procurement Guidelines.

However, TPPH explains that they are requesting not only the contractor but also the consultant to submit performance security. They show their opinion that the consultant to be employed under Japanese ODA loan shall furnish with their performance security. This opinion clearly conflicts with Note 3. of Section 4.09 of Consultant Guidelines.

Submission of performance security is too much huge obligations for the consultant. To secure TPPH from the risk of non-performing, it seems retention is enough for achieving this purpose. Moreover, to force the consultant to keep the quality of services, it looks liability and insurance clauses of the contract will be able to work for that purpose.

Chapter 7 Economic and Financial Analysis

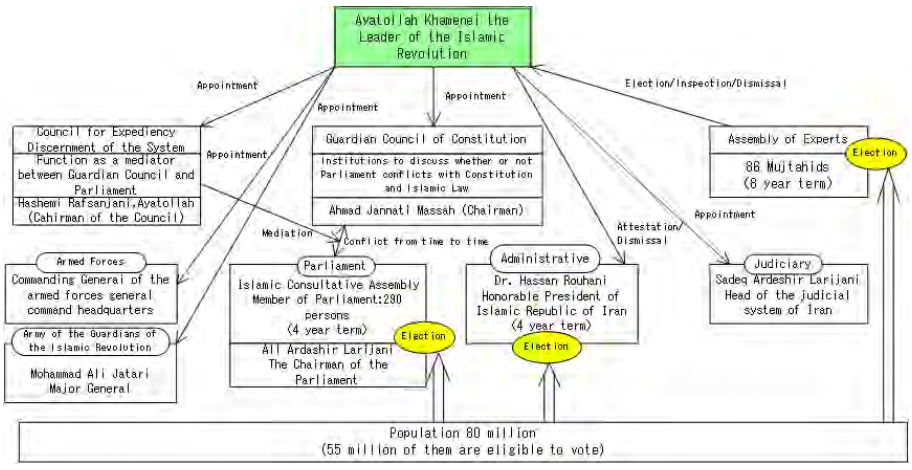
This survey is a basic survey of the electric power sector, “Data Collection Survey on Electric Power Sector in the Islamic Republic of Iran”. TPPH and TREC were designated as implementing agencies in relation to the priority project, but the scope of the survey was the whole electric power sector including generation, transmission, and distribution.

Generally ODA projects, in particular projects that include infrastructure, require several years for introduction and construction, and their results extend over a long period of time, so it is important to evaluate them from a long-term point of view.

In considering the medium and long-term financial effects, the effects of society as a whole on the electric power sector cannot be ignored. The operation of companies and public organizations are greatly affected by the political and economic circumstances. Therefore, the analysis is divided into the external environment and the internal environment, and the external environment is analyzed divided into the political, economic, and financial factors that are considered to have a major effect directly or indirectly on operation of companies and public organizations. The electric power sector as a whole is evaluated as the evaluation of the internal environment. Electric power prices and the financial situation of the electric power sector, which can have a major effect on the composition of the electric power sector and the finances of each of the related companies, are analyzed. The objects of the analysis are TPPH and TAVANIR in the electric power generation field, and the TAVANIR Group in the transmission and distribution fields. It is difficult to obtain financial information, so private sector power generation companies are not included in the analysis of the financial situation.

7.1 Political Situation (External environment analysis 1)

7.1.1 Iran’s Political System



Source: Rouhani Administration Increases its Support in the Iran Elections, Ito Mashino, Japan Oil, Gas and Metals National Corporation (JOGMEC), March 28, 2016

Figure 7.1-1 Iran’s Political System

Political stability is important for implementation of the project and its operation after completion, and instability is a risk factor for execution of the project, whether direct or indirect.

Iran has a unique political system as shown in the diagram above. It is based on the Western European political system, into which the teachings of Islam and Iran's unique history have been intertwined. The bureaucratic organization is based on the Western European bureaucratic organization of the Pahlavi era, but the political system incorporates the teachings of Islam, so it is unique. It is probably difficult to explain this concept in Western European political terminology, but there are no other words for explaining it. Also, the translations of each organization and the titles of positions vary depending on the person, but basically the terminology of the above figure are used, and where different an explanation is provided.

(1) Supreme Leader

The Supreme Leader(the leader of the islamic revolution) is the Head of State of Iran. The political office corresponding to the Head of State was newly established in the 1979 Islamic Revolution. There is no fixed term of office and virtually it is a lifetime appointment. It is the highest position in the five branches of government, namely the executive branch, the judiciary, the legislative branch, the Armed Forces of the Islamic Republic of Iran (Army), and the Islamic Revolutionary Guard Corps, and has the right of final decision throughout the whole government in the following matters.

- Appointment of six of the Assembly of Experts to the Guardian Council
- Appointment of the Chief Justice (the Head of the Judicial System in the figure above)
- Commandership of the Armed Forces
- Commandership of the Islamic Revolutionary Guard Corps
- Dismissal of the President

Note that there is also a president in Iran, but in contrast to other countries where the president is the head of state, the President of Iran is the head of the executive branch, and not the head of state.

(2) Guardian Council

According to the provisions of the Constitution, the Guardian Council is composed of six members from the Assembly of Experts, and six jurists. The six members from the Assembly of Experts are nominated by the Supreme Leader, and the other six members are selected by the Islamic Consultative Assembly (Parliament) from among those nominated by the Chief Justice.

The Guardian Council has wide-ranging power, judging the suitability of the election of the President, the members of the Islamic Consultative Assembly (Parliament), and members of Assembly of Experts, and judging the suitability of laws, but depending on the scope of the matter under consideration, the matters are discussed by those members of the Assembly of Experts (for example, the compatibility of a law with Sharia), or the matters are discussed by all members (for example, the constitutionality of a law)[23].

[23] The Legal and Judiciary Systems of the Countries of the Middle East from a Historical Perspective (No.6 Iran), Attorney Tamiyuki Tanaka, Integral Law Office, Japan Cooperation Center for the Middle East News, 2013

(3) Expediency Discernment Council (the Council for Expediency Discernment of the System in the figure above)

This organization was established by the amendment to the Constitution in 1989, and is composed of members selected by the Supreme Leader from among the leaders of each of the legislative, executive, and judiciary branches of government, and religious leaders. The objective of the Expediency Discernment Council is to resolve differences and inconsistencies between the Parliament and the Guardian Council, and is also functions as advisory body to the Supreme Leader.

(4) Assembly of Experts

The Assembly of Experts is an organization that selects, supervises, and dismisses the Supreme Leader, and the next Supreme Leader is selected from among the Assembly of Experts. The Constitution just defines the Assembly of Experts as the organization that appoints the Supreme Leader, and entrusts its composition, etc., to the law. According to the current law, the Assembly of Experts is composed of 86 Islamic legal scholars selected by the people in a general election dividing the whole country into 36 electoral districts. The term of office is eight years[24].

(5) Islamic Consultative Assembly (Majlis)

The Islamic Consultative Assembly is a one-chamber assembly equivalent to Parliament. Members are appointed for a term of four years, and elected by general election. Of the 290 members, five are allocated to religious minorities. Their role is to enact laws, ratify treaties, approve budgets, examine governmental affairs, as well as having the right to approve or reject the cabinet. However, the laws adopted are subject to examination for compatibility with Sharia and the Constitution by the Guardian Council.

(6) President

The President is the head of the executive branch of government. The term of office is four years, and the President may be re-elected and serve for up to two consecutive terms. The President is elected in a general election. Unlike in a normal republic, the President is not the Head of State, but has some of the functions of Head of State such as receiving foreign diplomats, signing the credentials of ambassadors being dispatched overseas, concluding treaties, conferring honors, etc., and normally is treated as the equivalent of Head of State by other countries.

(7) Armed Forces and Islamic Revolutionary Guard Corps

The Armed Forces of Iran has been the military since the Pahlavi era. Ayatollah Khomeini who came into power in the Islamic Revolution mistrusted the loyalty of the Armed Forces. The Islamic Revolutionary Guard Corps was established by order of Ayatollah Khomeini in May 1979 to resist a coup d'état of the official military and armed attacks from left-wing guerillas. In 1982, the Islamic Revolutionary Guard Corps Aerospace Force was established, and in 1983 its Navy was established, and their capabilities and numbers were expanded as a core force in the

[24] The Legal and Judiciary Systems of the Countries of the Middle East from a Historical Perspective (No.6 Iran), Attorney Tamiyuki Tanaka, Integral Law Office, Japan Cooperation Center for the Middle East News, 2013

Iran-Iraq war. The number of the Islamic Revolutionary Guard Corps was 170,000 in 1983, the following year it increased to 250,000, and in 1986 to 350,000, but at present its size is between 120,000 to 150,000.

The Basij was originally an organization of volunteer soldiers for young people below the age for active service, middle-aged men, and women. The Basij Force was dispatched to the frontline of the Iran-Iraq war after mobilization at Mosques in all parts of the country and receiving training. They were incorporated under the Islamic Revolutionary Guard Corps, and were a pillar of the human wave tactics in attacks on Iraq over minefields[25].

7.1.2 Political Transitions

(1) From the Islamic Revolution to the death of Ayatollah Khomeini

The Islamic Republic of Iran was established by the Islamic Revolution in February 1979, with Ayatollah Khomeini as the Supreme Leader. The 1979 Islamic Revolution was realized by the combination of groups with various secular ideologies such as Marxists and liberal groups, as well as religious forces. However, immediately after the Revolution conflict emerged due to the differences in ideals of government.

On February 18, 1979, the Islamic Republican Party that was formed by the followers of Ayatollah Khomeini expelled from power various organizations that had fought together during the Revolution through a series of events, and by June 1981 succeeded in securing the legislature, judiciary, and executive powers under the prestige of Ayatollah Khomeini. From 1983 during the Iran-Iraq War, there was a split in the Islamic Republican Party between the left wing and the right wing regarding economic policy against the background of the reduction in oil revenue and the worsening economic situation.

With the death of Ayatollah Khomeini in 1989, Ayatollah Khamenei was appointed Supreme Leader, and in the same year Ali Akbar Hashemi Rafsanjani was victorious in the presidential election, which started the “diarchy” system based on the Islamic Republican Party, while eliminating the left wing power.

(2) The rise of Khamenei and the hard-line conservatives

From the 1990s to the early 2000s, Supreme Leader Ayatollah Khamenei used his authority as prescribed by the Constitution to the maximum extent to confront his rival President Rafsanjani and the pragmatists (that split from the right wing of the Islamic Republican Party). From 1997 onwards, Ayatollah Khamenei concentrated on eliminating from politics Khatami, who became President with the support of the pragmatists, and his reformist followers. In the national elections from 2004 onwards he succeeded in forming a parliament based on conservatives, by disqualifying the reformist candidates at the stage of qualification.

From 2000 onwards Ayatollah Khamenei strengthened the Revolutionary Guard and Basij Force. It is considered that Ayatollah Khamenei wished to increase his own importance as balancer of the various political powers, by using the discontent of the revolution second

[25] The Middle East as a Global Strategic Issue – Perspective to 2030 and Response – March 2014, The Japan Institute of International Affairs, Chapter 1 Analysis of Internal Affairs in Iran and Issues Arising – Focusing on the New Rouhani Administration – Mari NUKII, Member of the Japan Institute of International Affairs

generation towards the established interests, and their desire for improvement. From the 1990s Supreme Leader Ayatollah Khamenei appointed members of the Revolutionary Guard to important posts. In the 2003 local elections, the conservative "Alliance of Builders of Islamic Iran", whose main base was the Revolutionary Guard and the Basij, won a landslide victory.

In the ninth presidential election in 2005, the candidate Ahmadinejad was elected as president. President Ahmadinejad developed a policy within Iran of expanding the interests of those associated with the Revolutionary Guard and their near relatives, squeezing the urban middle class that supported the reformists, and providing handouts to the rural and urban poor. On the other hand, the economic sanctions against Iran brought on by its hardline measures such as nuclear weapons development, anti-Israel pronouncements, etc., impoverished many of the people, but for the Islamic Revolutionary Guard Corps it was a chance to expand its power and business interests.

During the time of Khomenei, who opposed the involvement of the Revolutionary Guard in politics, the activities of the Revolutionary Guard were concentrated in the military field, such as national defense, defeating counter-revolutionary forces, etc. At present companies associated with the Revolutionary Guard have grown into a conglomerate in fields such as defense production, construction, pharmaceutical companies, investment companies, banking, real estate, communication businesses, food industry, oil companies, etc. This economic advancement of the Revolutionary Guard has hurt the economic interests of the traditional conservative establishment that dominated the economic sphere.

In the 10th presidential election in 2009, there were protests against the re-election of President Ahmadinejad, and gatherings and demonstrations of several million supporters of the reformist candidate were held. A protest movement referred to as the "Green Movement" spread throughout the whole country, and despite suppression by the police on behalf of the government, the movement continued intermittently for two years afterwards.

(3) Establishment of the Rouhani administration

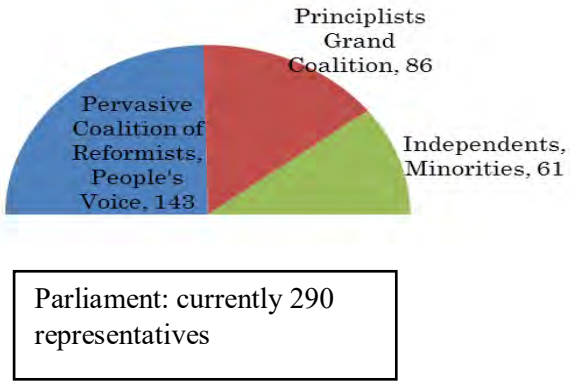
The 11th presidential election held in 2013 was won by Hassan Rouhani. The background to this victory is the possibility that Ayatollah Khamenei, who was regarded as having deviated from the allowable range, returned to the traditional conservatives and also the pragmatists, in contrast to President Ahmadinejad, who from his second term onwards had strengthened his characteristic features, surrounded himself with close associates, and had worked to strengthen his own power base.

From 2000 onwards, prior examination was strengthened, reformist candidates were disqualified in every case, and the better elections were dominated by the conservatives. In addition, a feeling of mistrust, dissatisfaction, and abandonment passed among the people due to the frustration of the "Green Movement" in 2009 and the worsening economic situation caused by sanctions. The fact that Rouhani was not screened out in the prior qualification examination and won the election can be seen to be due to the sense of crisis of Supreme Leader Khamenei as a result of the dissatisfaction of the people increasing to the point of internal collapse of the system[26].

[26] The Middle East as a Global Strategic Issue – Perspective to 2030 and Response – March 2014, The Japan Institute of International Affairs, Chapter 1 Analysis of Internal Affairs in Iran and Issues Arising – Focusing on the New Rouhani Administration – Mari NUKII, Member of the Japan Institute of International Affairs

The Rouhani Administration insisted on constructive cooperation with the international community, and furthermore demonstrated the intention of advancing transparency and fostering trust. Negotiations started on the question of eliminating economic sanctions. A nuclear deal was reached in 2015, and in January 2016 financial sanctions were successfully lifted.

Although the Rouhani Administration produced results by diplomatic negotiation, in internal affairs the Islamic Consultative Assembly (Majlis) was dominated by a majority of hardline conservatives, so they were unable to proceed with economic reforms and political reforms that were promised in the elections.



Source: Sankei News http://www.sankei.com/world/news/160502/wor1605020026-n1.html

Figure 7.1-2 Composition of Power in Iran Islamic Consultative Assembly (Majlis)

In February 2016, the Islamic Consultative Assembly (Majlis) and Assembly of Experts elections were held. Based on the results of a final ballot on April 29, in the Islamic Consultative Assembly (Majlis), the moderate conservatives and reformists that supported the Rouhani Administration obtained 143 seats of the total of 290[27]. This was not a majority, but considering the majority controlled by the hardline conservatives to date, it is considered that it has made the operation of his administration easier.

In the Assembly of Experts election also the supporters of the current administration increased greatly. The number of moderates is 52 out of a total of 88 members. In the Tehran electoral districts the reformists, pragmatists, and moderate conservatives that support the president won 15 out of 16 seats. However, the hardline conservative Jannati was elected as the Chairman of the Assembly of Experts. Ayatollah Khamenei is now 76 years old and is said to have health problems, so there is a high possibility that the next Supreme Leader will be selected from among the present Assembly of Experts (and there is also a possibility that it will be not the Supreme Leader, but the Consultative Assembly).

In the Iranian system of governance, the head is the Supreme Leader who has the ultimate decision making power, below whom are many lower organizations in accordance with function. This election is just a part of this system. Even after the election there is no change in the fact that the hardline conservatives form a part of the power base of the Supreme Leader through the Guardian Council and the Armed Forces (Revolutionary Guard). For the Rouhani

[27] The classification of the political factions of each candidate varies slightly by the media organizations.

Administration that has been entrusted with guiding Iran after the lifting of sanctions, the issue is how to coordinate and compromise with the critics of the government.

However, with the success of the moderates, an environment has been provided to the Rouhani Administration that makes it easier to proceed with political and economic reforms. It is likely that in the future there will be further relaxation on foreign capital and reforms in subsidies, which have proceeded in stages[28].

7.1.3 Economic Sanctions and Nuclear Deal

The poor relationship between Iran and the USA goes back to the time of the Iran Islamic Revolution in 1979. The USA, which supported the Pahlavi dynasty before the Revolution, broke diplomatic relations with Iran in 1980, in 1984 they designated Iran as a country that supports terrorism, and banned the export of weapons to them. In 1995 the USA prohibited US companies from transactions with Iran, and in 1996 enacted the Iran and Libya Sanctions Act, which included foreign companies that invested more than a certain amount in the oil industry of Iran and Libya within the scope of the sanctions. In 2002 the US President Bush (at the time) criticized Iran, Iraq, and North Korea as the "axis of evil". Around that time the suspicions had been increasing that Iran was developing nuclear weapons, and after the Paris Agreement in 2004 in which it was agreed that Iran would stop uranium enrichment, it seemed that there would be a temporary pause in the nuclear development problem. However, Iran restarted uranium enrichment under President Ahmadinejad who was appointed in 2005, so from 2006 onwards the United Nations Security Council progressively adopted sanctions against Iran. In addition, from about 2010 when Iran's uranium enrichment activities gained momentum, the economic sanctions by the international community starting with the USA were significantly strengthened. In the USA the Comprehensive Iran Sanctions, Accountability and Divestment Act was adopted in 2010, and in 2011 the National Defense Authorization Act was adopted which included additional sanctions against Iran. The former prohibited organizations (including foreign companies) that invested in the Iranian oil industry from having transactions with US financial institutions, and the latter prohibited foreign financial institutions that had transactions with Iranian financial institutions (including the Central Bank of Iran) from having transactions with US financial institutions. In 2012 the European Union (EU) instituted measures to strengthen its own sanctions, such as prohibiting the importation of Iranian oil, etc.[29]

The economy of Iran was greatly affected by these sanctions, and the prices of commodities soared. In order to relieve this situation, the Rouhani Administration that was established in 2013 transferred the authority for nuclear negotiations from the Supreme National Security Council to the Ministry of Foreign Affairs, and a nuclear negotiation team was formed headed by the Dr. Zarif, the Minister of Foreign Affairs[30].

[28] Rouhani Administration Increases its Support in the Iran Elections, Ito Mashino, Research & Analysis Department, JOGMEC

[29] The Effect of Reintegration of Iran to the International Community – Focus on Promising Markets as Newly Developing Countries Slow Down, December 22, 2015, Yasuo Yamamoto, Chief Representative of London Office, Research Department – Europe and the Americas, Mizuho Research Institute, Ltd.

[30] Status of the Islamic Republic of Iran as of July 2015, Second Middle East Division, Ministry of Foreign Affairs

As a result of the negotiations, on July 14, 2015 a "Joint Comprehensive Plan of Action (JCPOA)" was concluded between Iran and the permanent members of the United Nations Security Council and Germany (P5+1). In addition, on January 16, 2016 the International Atomic Energy Agency (IAEA) announced that it had confirmed that Iran had taken the nuclear-related measures stipulated in the "Joint Comprehensive Plan of Action (JCPOA)". The same day the P5+1 side and Iran issued the joint statement "Lifting of Multilateral and National Economic and Financial Sanctions Related to Iran's Nuclear Program".

However, the USA did not lift all its sanctions, they only lifted the secondary sanctions on non-Americans, and the primary sanctions aimed at Americans remained. Also, sanctions related to the nuclear problem were lifted, but more than 200 individuals and groups associated with problems such as terror activities, missiles, human rights problems, problems related to Syria and Yemen, etc., such as the Islamic Revolutionary Guard Corps (IRGC) and associated organizations, remained on America's lists of such organizations[31].

The nuclear deal is changing the existing order in the Middle East. After the 1979 Islamic Revolution the regional order in the Middle East was formed revolving around the guarantee of security of a pro-American alliance by the USA, and anti-American exclusionism that included Iran. With the arrival of the Rouhani Administration in 2015 advocating the path of reconciliation with Europe and America, there was a boost in public opinion even in the USA, and the Obama Administration made a major change of policy from regime change to a policy of engagement, which led to the Iran nuclear deal on July 14, 2015.

The sudden change in the regional order brought about by the Iran nuclear deal provoked strong reaction from pro-American countries, such as Israel, Saudi Arabia, etc., which favored the existing regional order, who obstructed the implementation of JCPOA and successively developed anti-Iran policies. However, the international community largely chose to recognize the participation of Iran in the international problem-solving framework. Although Israel is exploring policies to adapt to the arrival of this new regional order, Saudi Arabia has not defined its own stand point regarding the new order, and seems to be uncertain at present[32].

7.1.4 Political Stability

Politics in Iran after the Islamic Revolution were not very stable, in particular regarding relationships with the USA. Basically there was no change in its anti-American stance, but it oscillated between compromise with the reality and standing firm on its anti-American stance. The most adverse scenario for the future is a snap back to its old attitude. It should be noted that Iran's relationship with America and in particular sanctions against Iran will have a major effect on the implementation of ODA projects in the future.

The confrontation in the present-day politics is the confrontation between hardline Islamic conservatives and an alliance of moderate conservatives, pragmatists, and reformists. This is a confrontation within the framework of governance by Islamic legal scholars, and is not a

[31] Prospects for Oil and Natural Gas Resource Development in Iran Post Sanctions – Energy Outlook in Iran Viewed through Political, Economic, and Social Trends – Oil and Natural Gas Review, Vol.50 No.3, May 2016, Ito Mashino, Research & Analysis Department, JOGMEC

[32] "Middle East Security Report" Vol.5, The Effect of the Nuclear Deal on Iranian Internal Affairs and International Relations – Trends in Iran, America, Israel, and Saudi Arabia in the Post Nuclear Deal Period – January 17, 2016 Mari NUKII, Member of the Japan Institute of International Affairs

confrontation of a diversity of opinions and principles in the true meaning of term. Basically candidates that do not pass the framework of governance by Islamic legal scholars cannot stand for election. In addition the political confrontation is intertwined with the allocation of rights and vested interests. Each of the past administrations in Iran had problems of struggles for interests and corruption, not just that of Ahmadinejad. Therefore their reputation and popularity drops, and an opposing political faction gains power. The struggle for interests and corruption are not the only explanations, but they are among the reasons for political events.

The number one key person in Iranian politics is the Supreme Leader. Ayatollah Khamenei has been involved in the recent change in administration. It is considered that the attitude of Ayatollah Khamenei is involved in the background to the changes from reformists to hardline conservatives, and the change from hardline conservatives to pragmatists. At present Ayatollah Khamenei is 76 years old, and it is said that in 2014 he underwent an operation for cancer. Who the next Supreme Leader will be is an important question for political stability in Iran in the future. Also a collective executive is a possibility depending on the form of the Consultative Assembly. In any case, the composition of the current Assembly of Experts is important. It is considered that the moderate conservatives, the pragmatists, and the reformists have a majority, so it is considered that the selection of a person that will result in a sudden worsening in relationships with the USA is unlikely.

7.2 Economic Situation (External environment analysis 2)

7.2.1 Economic Situation in Iran

(1) Basic information

Iran is a country with high potential for economic growth. It is located at a strategic position geopolitically in the Middle East, it has a population of 78 million with many young people, it has plentiful resources, it has a diversified industrial structure, and has the potential for economic growth in many directions.

Iran is located at an important position geopolitically surrounded by the Middle East, Central Asia, Russia, and the Indian Ocean. Historically it was an important route for east-west traffic, and was a complex crossroads of cultures, civilizations, and religions. One feature of Iran is that it occupies a strategic position from the Caspian Sea in the north with its plentiful energy resources, to the Persian Gulf in the south[33]. It is perhaps as a result of its geographical characteristics that over the long term Iran has adopted the business model of exporting to the surrounding countries as a base of manufacturing[34].

With a population of 78 million Iran has the second largest population in the Middle East after Egypt, and its growth rate in the past five years has been an annual average of 1.3%. This population is the 18th largest in the world. Also, the population that is 30 years old or younger who did not see the Islamic Revolution accounts for more than 60% of the population, and by 2035 it will have one of the highest populations of productive age among the main

[33] Iran: Crossroads Rule in Energy Sphere, Ali Biniaz, Head of the Energy and International Economy Studies Group, Institute for Political and International Studies (IPIS), Ministry of Foreign Affairs, Islamic Republic of Iran

[34] JETRO Center, November 2015 issue, Area Report: Iran, Opening of a Big Market, Daisuke Yonekura, Middle East and Africa Division, Overseas Research Department, JETRO

oil-producing countries. Although thereafter the population of productive age will drop, it is estimated that it will maintain a higher population of productive age than the other oil-producing countries[35]. In addition, in Iran the trend towards nuclear families is progressing, and the spread of mobile phones, SNS, and other consumer goods is the same as in other countries[36].

Also, Iran is one of the most resource-rich countries in the world. Its known deposits of crude oil amount to 157.8 billion barrels (9% of the world share), making it No.4 in the world, and its known deposits of natural gas amount to 34 trillion m^3 (18% of the world share, in both cases as of the end of the year), making it No.1 in the world. If crude oil and natural gas are combined, the known deposits converted into crude oil equivalent exceed 250 billion barrels. Moreover, the development and production costs are particularly low. Iran has substantial latent economic potential[37].

Countries that are rich in resources tend to have a high dependence on these resources, and their industry in fields not related to resources tend to be underdeveloped, but in the case of Iran its revenue derived from oil as a percentage of its annual revenue is about 40%[38]. On the other hand, production of automobiles is about 1.5 million vehicles per year, and production of iron and steel is about 13 million tons per year. Industries other than oil production, such as the electric power industry, etc., have been developed based on foreign capital and technology, and there is also development due to Iranian companies. Iranian companies have an environment in which women can participate in society, and with an 82% literacy rate, the educational level is certainly not low compared with other developing countries of the world. Iran is not dependent on foreign companies alone, but it is developing as a result of their own people[39].

(2) Economic trends

Until the 1990s, imports were severely restricted due to the enormous repayments of foreign loans due to the cost of recovery from the war against Iraq. Decisive actions were taken to domestically manufacture many essentials such as automobiles, industrial machinery, etc. Desperate measures were taken to economize, while repaying loans, which contributed to the grim image of the country. In the 21st century this situation has changed. Incomes have greatly increased with the rapid increase in the price of crude oil, and they have become a net creditor nation with abundant foreign exchange reserves in the national treasury exceeding the total amount of debt[40].

[35] White Paper on International Economy and Trade 2016, Chapter 4 The Challenge of the New Frontier of Newly Developing Countries, METI

[36] Iran Business Guidebook – Pointers Regarding Lifting of Economic Sanctions and Attractive Businesses –, June 2016, Middle East and Africa Division, Overseas Research Department, JETRO

[37] International Political Economy after Lifting of Economic Sanctions on Iran, Proceedings of Osaka University of Commerce, Vol.11 No.3 (Report No.179), Professor Koji Nakatsu, Osaka University of Commerce

[38] White Paper on International Economy and Trade 2016, Chapter 4 The Challenge of the New Frontier of Newly Developing Countries, METI

[39] Oil and Natural Gas Review, The Islamic Republic of Iran – a Major Power in the Region, Shusaku Otomaru, Project Department, JOGMEC

[40] 2009 Report of the Iran Study Group "Comprehensive Research into Iran after the 2009 Presidential Election – Internal Affairs, Diplomacy, and International Relations –" Chapter 8 Iran in the Gulf Regional Economy, Hiroshi Kato, Executive Vice President of the Nippon Institute for Research Advancement, The Japan Institute of International Affairs

Table 7.2-1 Economic Trends in Iran

		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Actual GDP growth rate	%	4.21	5.70	9.12	0.92	2.32	6.58	3.75	(6.61)	(1.91)	2.97
Nominal GDP total	B$	218.34	257.77	337.33	391.17	396.74	463.97	564.46	418.91	380.35	404.13
Per person nominal GDP	$	3,146	3,657	4,733	5,419	5,420	6,241	7,511	5,512	4,941	5,183
Mining and manufacturing production index	*1	0.00	(2.84)	1.17	(0.01)	(7.12)	0.00	0.19	(20.04)	(10.17)	0.65
Rate of increase in consumer price index	%	10.35	11.89	18.44	25.32	10.79	12.37	21.49	30.53	34.73	15.55
Unemployment ratio	%	12.10	12.09	10.55	10.45	11.91	13.48	12.30	12.20	10.44	11.21
Export value	M$	55,181	75,738	89,200	119,693	74,432	98,693	129,973	102,271	84,687	86,064
(coefficient of extension)	%	34.58	37.25	17.77	34.19	(37.81)	32.59	31.69	(21.31)	(17.19)	1.63
Import value	M$	38,904	40,686	45,168	58,343	49,741	66,395	95,950	92,051	94,796	105,047
(coefficient of extension)	%	17.84	4.58	11.02	29.17	(14.74)	33.48	44.51	(4.06)	2.98	10.81
Policy interest rate	%	11.78	11.56	11.60	13.30	13.14	11.94	11.16	14.81	14.76	16.94
USD exchange rate	IRR	8,964	9,171	9,281	9,429	9,864	10,254	10,616	12,176	18,414	25,942

*1 Growth rate based on index of crude oil production (2010 = 100), calculated by JETRO.

Source: Country and Region-specific Information, Basic Economic Indices, JETRO

During the Ahmadinejad Administration the emphasis in the economic policy of Iran was on the rural and urban poor, but the result of these dole-out policies was an increase in inflation. In addition, as the economic sanctions were strengthened by the international community, the currency, rial, dropped in value, and overseas investment and crude oil exports reduced, so the economy decelerated. The Ahmadinejad Administration reduced subsidies on wheat and gasoline on the one hand, and on the other hand rationalized subsidies provided directly to the poor, but the economy did not improve. There was negative growth in 2012 and 2013, and the inflation rate in June 2013 reached +45.1% compared with the same month the previous year. Unemployment exceeded 12%, and the Iranian economy stagnated.

Then in June 2013 the presidential election was won by President Rouhani who advocated economic reconstruction. The aim was to reconstruct the economy by promoting a “resistant economy” by growing domestic industry, without dependence on the export of resources such as crude oil, etc., which were affected by the economic sanctions. In 2014 the inflation rate dropped greatly, and in addition the GDP growth rate turned to positive growth for the first time in three years. Note that with the drop in crude oil prices from 2014 onwards, subsidies on gasoline were reduced to reduce the financial burden and other measures were implemented.

However, the economy had been ruined by the long years of economic sanctions, and according to the IMF the forecast real GDP growth rate in 2015 is only +0.8% year on year.

The GDP growth rate in 2016 forecast by the IMF is +4.4% year on year. Thereafter steady growth of about 4% per annum is forecast up to 2020 as a result of the increase in crude oil production and the effect of lifting of economic sanctions[41].

(3) Industry in Iran

The GDP in Iran according to sector is as shown below.

Table 7.2-2 Breakdown of Iran's GDP

	1996-1997	2001-2002	2006-2007	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013
Agriculture, Forestry and Fisheries	14.79	11.22	8.81	7.39	9.01	8.46	7.99	10.63
Underground resources	14.74	15.82	21.39	19.17	14.74	16.49	16.40	10.01
Manufacturing industries	14.60	13.87	13.02	12.79	12.60	12.42	14.00	15.33
Water, electricity, gas	1.77	1.97	2.42	2.61	2.19	4.99	6.94	6.75
Construction	6.39	4.89	4.97	6.55	7.34	5.93	5.35	5.29
distribution staying etc.	15.90	15.96	14.18	13.94	14.38	13.89	14.22	15.31
Transport and communication	5.37	7.42	7.10	7.54	8.21	7.30	7.13	7.96
Money market	1.02	1.97	2.78	3.09	3.36	2.94	2.74	2.78
Real estate, etc.	13.01	12.00	11.12	12.67	12.70	12.67	11.05	12.55
Public education health	12.17	13.02	12.76	11.68	12.66	11.81	11.54	10.82
Others	0.24	1.86	1.45	2.57	2.81	3.10	2.64	2.57
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Nominal GDP (IRR Tri)	259	734	2,383	3,655	3,894	4,854	6,338	7,372
Actual GDP (IRR Tri)	307	365	525	567	582	615	639	606

Source: Iran Statistical Yearbook 1392, 22 National Account, Statistical Centre of Iran

Nominal GDP has increased by a factor of nearly 30 over 18 years, but the real GDP has about doubled. This demonstrates how high the recent inflation has been. In 2012 – 2013 (1391 in the Iranian calendar[42]) nominal GDP increased greatly but real GDP decreased, indicating negative growth. The average population increase in the past five years was 1.3%, so in terms of GDP per person the reduction is greater.

The characteristic of the Iranian economy is that its dependence on oil is not high for an oil-producing country, and the production of underground resources including oil and natural gas was the largest industry until 2011 – 2012, but due to the effect of the sanctions the share in 2012 – 2013 dropped to 10%. The industries with the greatest output in 2012 – 2013 were

[41] Return of Iran to the International Market – Opening of a Giant Market with the Lifting of Economic Sanctions and Implementation of Reforms?, Wakiko Ide, Economist, Economic Research Department, Daiwa Institute of Research, March 30, 2016

[42] The Iranian calendar is a solar calendar with Hegira as the starting year, and March 21 as the new year. The method of calculation is the same as that of the Gregorian calendar, so it coincides with the Western European calendar.

manufacturing and trade. Other industries having a share greater than 10% were primary industries including agriculture forestry and fisheries and livestock, real estate leasing, public services, education and health and social businesses.

7.2.2 Effect of Lifting of Economic Sanctions

(1) Economic sanctions and lifting of economic sanctions

Economic sanctions against Iran were placed by the USA immediately after the Islamic Revolution. However, Iran was particularly affected economically by the National Defense Authorization Act of 2011, which prohibited dollar transactions between foreign financial institutions that conducted financial transactions with Iranian financial institutions including the Central Bank for settlement of payments, and American financial institutions. As a result foreign financial institutions including Japanese banks were unable to continue financial transactions with Iran, so trade between Iran and overseas became difficult[43]. In this way Iran's trading partners were identified, oil exports reduced suddenly, and trade itself was reduced.

In the 2000s oil prices increased rapidly, so the Iranian economy expanded steadily, but the dole-out policies of President Ahmadinejad brought on inflation. In addition, exports reduced as a result of economic sanctions, foreign investment also reduced, and the economy turned for the worse. The value of the currency dropped, so prices spiraled, particularly imports, delivering a double whammy to the people. The stagnating economy and the reduction in oil exports directly affected the country's finances, so the government had no alternative but to reduce subsidies, and the price of wheat, fuel, etc., increased. As a result, there was negative growth for two consecutive years in 2012 and 2013.

In the 2013 presidential election the hardline conservatives were defeated and the pragmatist Rouhani was elected. The Rouhani Administration was coerced into the nuclear deal, and succeeded in the lifting of some of the economic sanctions. With the arrival of Implementation Day the USA lifted those economic sanctions imposed due to the nuclear problem that applied to non-Americans, but those sanctions that applied to Americans continued. Also apart from the sanctions due to the nuclear problem, the sanctions imposed due to terror activities, missiles, human rights problems, problems in Syria and Yemen, etc., continued. Therefore, if transactions are carried out with individuals or groups on the SDN list, American sanctions can still apply even to non-Americans, depending on the details of the transactions.

For foreign companies considering entry to the Iranian market, the keys are selection of business partner and thorough due diligence. It is necessary to confirm that American sanctions that have been maintained since Implementation Day are not infringed, for example confirm whether or not a potential customer is an individual or group (the IRGC and related companies, etc.) that appears on the list of those subject to sanctions[44].

Also, even if a customer from Japan is un-connected to the SDN list, if the company unloading at one of the main ports in Iran is on the SDN list, effectively unloading cannot be carried out,

[43] Return of Iran to the International Market – Opening of a Giant Market with the Lifting of Economic Sanctions and Implementation of Reforms?, Wakiko Ide, Economist, Economic Research Department, Daiwa Institute of Research, March 30, 2016

[44] Prospects for Oil and Natural Gas Resource Development in Iran Post Sanctions – Energy Outlook in Iran Viewed through Political, Economic, and Social Trends – Oil and Natural Gas Review, Vol.50 No.3, May 2016, Ito Mashino, Research & Analysis Department, JOGMEC

so there are concerns regarding barriers to transactions. In this case, it is necessary to confirm that the cargo handling company is not 50% owned by a company or individual on the SDN list[45].

(2) Effect of lifting of sanctions

As a result of the re-starting of transactions due to lifting of the sanctions, on the Iranian side growth is expected due to economic vitalization, and viewed from the outside it is a chance for business expansion. The dignitaries from each country and economic trade missions that have visited Iran since the nuclear deal of July 2015 are as shown below.

As shown in the table below, dignitaries and trade missions from various countries have visited Iran every month, from which the expectations from Iran and the level of potential can be seen. Japanese companies have also shown keen interest in trends in Japan. On August 8 – 10 after the final agreement, Daishiro Yamagiwa, State Minister of Economy, Trade and Industry visited Iran, and had discussions with Mr. Zanganeh, Minister of Petroleum, and Mr. Nematzadeh Minister of Industry, Mine and Trade. He was accompanied by about 20 Japanese companies[46]. All of these economic trade missions were trying to determine the status of Iran "post-sanctions", and opportunities for entry. On each visit various agreements were concluded regarding future cooperative relations. In addition President Rouhani visited Europe in January 2016, where it is reported that cooperation documents were agreed amounting to a total of 17 billion euros in Italy and 30 billion euros in France[47].

[45] Iran Business Guidebook – Pointers Regarding Lifting of Economic Sanctions and Attractive Businesses –, June 2016, Middle East and Africa Division, Overseas Research Department, JETRO

[46] JETRO Center, November 2015 issue, Area Report: Iran, Opening of a Big Market, Daisuke Yonekura, Middle East and Africa Division, Overseas Research Department, JETRO

[47] Situation in Iran after the Election, Middle East Cooperation Center News, April 2016, Sachi Sakanashi, Senior Analyst, JIME Center, Institute of Energy Economics, Japan

Visits by Prime Ministers or Presidents (Leading Visits by Economic Trade Missions)
Dr. Heinz Fischer, President of Austria (September 2015); Vladimir Putin, President of Russia (November 2015); Xi Jinping, President of the People's Republic of China (January 2016); Alexis Tsipras, Prime Minister of Greece (February 2016); Johann N. Schneider-Ammann, President of the Swiss Confederation (February 2016); Ahmet Davutoğlu, Prime Minister of Turkey (March 2016)
Visits by Foreign Ministers (Visits with Economic Trade Missions)
Foreign Secretary of the UK (August 2015); Foreign Minister of the Czech Republic (September 2015); Foreign Minister of Japan (October 2015); Foreign Minister of Denmark (January 2016); Foreign Minister of Germany (February 2016); Foreign Minister of Oman (February 2016); Foreign Minister of Romania (March 2016)
Other countries that have sent trade missions
German Minister of Economic Affairs and Energy (July 2015); Azerbaijan Minister of the Economy and Industry (August 2015); Italian Minister of Economic Development (August 2015); Japanese State Minister of Economy, Trade and Industry (August 2015); Polish Deputy Prime Minister and Minister of the Economy (September 2015); Brazilian Minister of Development, Industry and Foreign Trade (October 2015); Dutch Minister of Economic Affairs (November 2015); Italian Minister of Economic Development (November 2015); Lebanese Minister of Finance (December 2015); Slovenian Minister of the Economic Development and Technology (January 2016); Czech Minister of Industry and Trade (January 2016); Italian Minister of Agricultural, Food and Forestry Policies (February 2016); Azerbaijan Minister of the Economy and Industry (February 2016); Korean economic trade mission (February 2016); Finnish Minister of the Environment (February 2016); Albanian Deputy Foreign Minister (March 2016)

Source: Situation in Iran after the Election, Middle East Cooperation Center News, April 2016, Sachi Sakanashi, Senior Analyst, JIME Center, Institute of Energy Economics, Japan

Figure 7.2-1 Dignitaries and Trade Missions That Have Visited Iran

7.2.3 Iran's Economic Future

(1) Energy industry

The first expectation for the future is for the oil and natural gas energy industry. As stated previously, Iran is No.4 in the world in terms of the known oil reserves, and No.1 in the world in terms of natural gas, so it has plentiful resources.

Iran's crude oil production peaked in the 1970s at more than 6 million barrels per day, but due to the effect of the economic sanctions, etc., the present (November 2015) production has dropped to 2.8 million barrels per day. Mr. Zanganeh, the Minister of Petroleum, indicated that soon after lifting of sanctions production was increased by 500,000 barrels per day, and after several months production will be increased by a further 500,000 barrels per day, so the intention is that there will be a total of 1 million barrels additional production. The oil sector accounts for about 10% of Iran's GDP, and if production is increased it will be a major factor for increasing the economic growth rate. By a simple calculation, if production is increased by 36%, from 2.8 million barrels per day to 3.8 million barrels per day, this will result in more than 3% growth rate[48].

On the other hand, the International Energy Agency (IEA) has expressed the opinion that maximum potential for expansion is by 730,000 barrels per day. It has been estimated that with

[48] The Effect of Reintegration of Iran to the International Community – Focus on Promising Markets as Newly Developing Countries Slow Down, December 22, 2015, Yasuo Yamamoto, Chief Representative of London Office, Research Department – Europe and the Americas, Mizuho Research Institute, Ltd.

the return of Iran to the market in 2016, the price of oil will reduce by 5 – 15 dollars per barrel[49].

There are other problems. Since the imposition of economic sanctions on Iran, oil importers have changed their source of procurement to Iraq, Saudi Arabia, or Russia, and the hole caused by Iran's absence has already been filled by other oil-producing countries. Also, there are technical problems. Maintenance of the aging infrastructure and improving production efficiency at old oilfields will require a large amount of finance and time, and will also require the introduction of technology from overseas. There are also concerns that restrictions on insurance of oil tankers will affect the export of Iranian crude oil[50].

A target has been set to increase production to 5 million barrels per day after 10 years. This is said to require an investment of 280 billion dollars. There is a plan to invest 180 billion dollars by 2022. Hence, Iran is calling for external investment in the scale of 100 billion dollars. The field of activities of foreign companies can expand without limit for renewal and modernization of aged facilities, new development, and strengthening and expanding associated facilities. For the large plant manufacturers new business chances have come into view[51].

Natural gas production in 2014 was 172.6 billion m^3 per annum, an increase of 8.6 billion m^3 compared with the previous year. Also, in his statement on May 18, 2015, Mr. Javadi, Managing Director of NIOC, stated that production capacity had reached 255.5 billion m^3 per year. However, at present almost all the production is consumed domestically, and applied for maintaining the pressure in the oil strata, so the quantity for export is small. The target for the future is to increase natural gas annual production capacity by 36.5 billion m^3 each year, so that at the end of the sixth Five-year Plan it will have expanded to 474.5 billion m^3 per annum. The target for exports is to increase from the present about 11 billion m^3 per annum to 73 billion m^3 per annum[52].

(2) Other industries

As can be seen from the breakdown of GDP, there are various industries in Iran, so there is a wide range of opportunities for investment. The driving force in Iranian manufacturing industry is the automobile industry. The output in 2014 was 1.09 million vehicles, and the forecast output for 2015 is 1.4 million vehicles. The Government of Iran wants to increase the domestic production of automobiles to 3 million vehicles per year by 2025. Potentially the production capacity could be 3 – 4 million vehicles per year.

Although the automobile industry's share of GDP in Iran is at present about 10%, automobile ownership per 1,000 population is only 1/4 that of the USA and 1/3 that of Germany. Sales of

[49] International Political Economy after Lifting of Economic Sanctions on Iran, Proceedings of Osaka University of Commerce, Vol.11 No.3 (Report No.179), Professor Koji Nakatsu, Osaka University of Commerce

[50] Prospects for Oil and Natural Gas Resource Development in Iran Post Sanctions – Energy Outlook in Iran Viewed through Political, Economic, and Social Trends – Oil and Natural Gas Review, Vol.50 No.3, May 2016, Ito Mashino, Research & Analysis Department, JOGMEC

[51] International Political Economy after Lifting of Economic Sanctions on Iran, Proceedings of Osaka University of Commerce, Vol.11 No.3 (Report No.179), Professor Koji Nakatsu, Osaka University of Commerce

[52] Prospects for Oil and Natural Gas Resource Development in Iran Post Sanctions – Energy Outlook in Iran Viewed through Political, Economic, and Social Trends – Oil and Natural Gas Review, Vol.50 No.3, May 2016, Ito Mashino, Research & Analysis Department, JOGMEC

automobiles in 2014 were 900,000 vehicles. If incomes increase, there is likely to be further increases in the automobile market in Iran[53].

There is likely to be demand for renewal in various infrastructure fields due to the effect of the economic sanctions in Iran over a long period of time. In addition, energy subsidies have been reduced, which is rare in the Middle East oil-producing countries, so in the energy efficiency field investment is expected, such as development of subways in cities, etc. Also, in the tourism field, Iran possesses many World Heritage sites such as Isfahan and Persepolis. In addition, the public security within the country is more stable than neighboring countries, so an expansion in visitors is expected, and therefore investment is expected in the hotel industry, etc. In the sixth Five-year Plan, the government places emphasis on investment from overseas, and the expansion of investment in each field is a key to vitalizing the Iranian economy[54].

7.2.4 Future Prospect of Iranian Economy

As described above, it is expected that there is great potential for economic development in Iran in the future. The greatest concern is “snap back”. Even if this does not occur, if in the future the hardline conservatives gain political power and the investment environment in Iran deteriorates, investment from overseas will decrease, and the economy may not expand as expected. It is considered that political stability is the key to economic stability in the future. The following are forecasts for the Iranian economy by the IMF, but these are likely optimistic forecasts.

[53] International Political Economy after Lifting of Economic Sanctions on Iran, Proceedings of Osaka University of Commerce, Vol.11 No.3 (Report No.179), Professor Koji Nakatsu, Osaka University of Commerce

[54] Return of Iran to the International Market – Opening of a Giant Market with the Lifting of Economic Sanctions and Implementation of Reforms?, Wakiko Ide, Economist, Economic Research Department, Daiwa Institute of Research, March 30, 2016

Table 7.2-3 Forecast of Iranian Economy

		2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021
Nominal GDP	*1	9,421	11,034	11,992	14,043	15,935	17,695	19,372	21,150
Real GDP	%	-1.9	3	0	4.3	4	4.1	4.4	4.4
Real GDP (oil and gas)	%	-8.9	4.8	0.5	16.9	8.8	2.9	2.5	2.5
Real GDP (excluding oil)	%	-1.1	2.8	-0.1	2.8	3.4	4.3	4.6	4.6
Average price increase	%	34.7	15.5	15.1	11.5	8.3	6.3	5	5
Year-end price increase	%	19.7	16.2	14	9	7.5	5	5	5
GNP deflator	%	34.3	12.2	8.7	12.3	9.1	6.6	4.9	4.6
Unemployment	%	10.4	10.6	11.9	12.5	12.6	12.4	12.2	11.9

*1 In trillion of IRR

Source: IMF Country Report No.15/349 ISLAMIC REPUBLIC OF IRAN, 2015 ARTICLE IV CONSULTATION – PRESS RELEASE; STAFF REPORT; AND STATEMENT BY THE EXECUTIVE DIRECTOR FOR THE ISLAMIC REPUBLIC OF IRAN, Dec. 2015

7.3 Financial Status (External environment analysis 3)

7.3.1 Financial Status in Iran

The financial status in Iran from 2000 onwards is as shown in the following table.

Table 7.3-1 Financial Trends in Iran

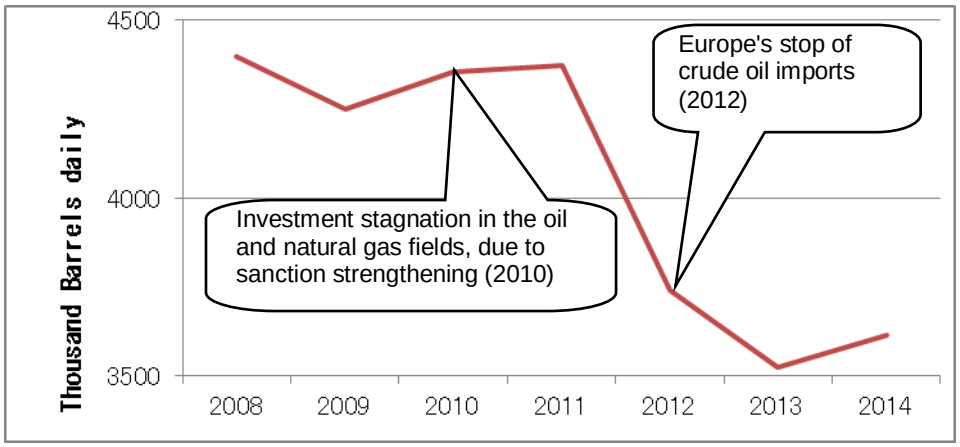
		2000	2004	2006	2008	2010	2011	2012	2013	2014
General revenue	Bil IRR	147,295	352,606	611,469	851,710	1,049,659	1,203,714	1,015,803	1,326,785	1,606,800
General revenue	GDP Ratio	23.45	22.28	25.78	22.74	21.88	19.15	14.21	14.08	14.56
General expenditure	Bil IRR	104,704	297,493	564,866	828,826	917,548	1,165,082	1,039,256	1,415,138	1,735,115
General expenditure	GDP Ratio	16.67	18.8	23.81	22.13	19.13	18.54	14.54	15.02	15.73
Fiscal revenue and expenditure	Bil IRR	42,591	55,113	46,603	22,885	132,111	38,632	-23,453	-88,353	-128,315
Fiscal revenue and expenditure	GDP Ratio	6.78	3.48	1.97	0.61	2.75	0.62	-0.33	-0.94	-1.16
Net debt	Bil IRR	58,640	78,493	-20,720	-106,312	94,221	-169,727	413,963	-159,528	-236,613
Net debt	GDP Ratio	9.34	4.96	-0.87	-2.84	1.96	-2.7	5.79	-1.69	-2.14
Total debt	Bil IRR	94,610	264,116	295,592	347,612	583,914	558,765	1,200,197	1,450,718	1,724,043
Total debt	GDP Ratio	15.06	16.69	12.46	9.28	12.17	8.89	16.79	15.4	15.63
Current balance	Bil USD	13	1	21	23	27	59	23	27	16
Current balance	GDP Ratio	11.98	0.5	7.99	5.84	5.89	10.52	4.02	6.97	3.82

Source: International Monetary Fund, World Economic Outlook Database, April 2016

From 2000 onwards the price of crude oil was high and stable, so Iran's finances were favorable. The balance of fiscal revenue and expenditure was basically in the black, and revenue growth exceeded that of GDP by more than 20%. The balance of revenue and expenditure fluctuated greatly from year to year, but the amount was not large, and above all the balance of revenue and expenditure did not fall into the red. In particular from 2008 onwards when the price of crude oil soared, the total debt was less than half the revenue, so its financial situation was good thanks to being one of the most resource-rich countries in the world.

This all changed from 2012 onwards. As stated previously, as a result of the American economic sanctions restrictions were imposed on Iranian trade, and oil exports suddenly reduced. Revenue from the oil industry accounted for 60% of revenue[55], so the country's finances were greatly affected. The sanctions started from 2011, but the effect was only felt in earnest from 2012 onwards. In addition, in 2012 the EU instituted settlement measures to prohibit the import of crude oil. In 2012 oil revenue as a percentage of GDP dropped sharply to 14.21% from 19.15%. In subsequent years also it remained at around 14% of GDP.

[55] The Increasing Uncertainties in the Political and Economic Situation in Iran, Sumiko Teranaka, Chief Economist, Research and Analysis Department, Japan Institute for Overseas Investment, July 2008



Source: White Paper on International Economy and Trade 2016, Chapter 4 The Challenge of the New Frontier of Newly Developing Countries, METI

Figure 7.3-1 Crude Oil Production in Iran

As stated previously, the population of Iran is large and its industry is diverse, so oil as a percentage of GDP is not high for an oil-producing country, and was in the 20% range. However, it is high as a percentage of government revenue and was around 60% as stated previously. This is because government revenue depended on oil, so the taxation system was not developed. It can be said that the effort to impose and collect taxes was neglected since sufficient revenue could be obtained from oil.

It is necessary to reduce expenditure by the amount that revenue is reduced. Annual expenditure was reduced from 2012 onwards, to the level of about 14 – 15%. There is a limit to the reduction in expenditure, so expenditure cannot be reduced as much as the reduction in revenue. Therefore, the financial deficit expanded. From 2012 onwards the financial deficit increased, and in 2014 the financial deficit exceeded 1% of GDP.

It is anticipated that Iran's crude oil exports will expand with the lifting of some of the economic sanctions. For the crude oil market where the price is continuously dropping due to an excess of supply, the increase in Iran's crude oil is one further factor to ease the supply and demand. An increase of 1 million barrels per day is the equivalent of more than 1% of the world's crude oil production. The crude oil price (WTI) as of the beginning December 2015 has dropped to the 1 barrel = high $30s level, but there is a risk that it will drop further with the increase in Iran's production and re-starting exports, thereby putting pressure on the economies and finances of the other oil-producing countries[56]. In terms of the fiscal 2016 budget, the forecast oil revenue is about 33 billion dollars, compared with about 25 billion dollars in fiscal 2015, which was the lowest level recorded in four years. This is less than 30% of the oil revenue in 2012 prior to the start of measures to prohibit the export of crude oil by Europe and

[56] The Effect of Reintegration of Iran to the International Community – Focus on Promising Markets as Newly Developing Countries Slow Down, December 22, 2015, Yasuo Yamamoto, Chief Representative of London Office, Research Department – Europe and the Americas, Mizuho Research Institute, Ltd.

America[57]. For financial health in the future, it is necessary to escape from dependence on oil. In the 2016 budget oil revenue dropped to 25%.

7.3.2 Securing Tax Revenue

As stated previously, the energy industry as a percentage of GDP dropped to 10% in 2012 – 2013. There is a possibility that it dropped further subsequently. Oil revenue as a percentage of government revenue was about 60% up to the early 2000s, then tended to reduce, and now is about 40%. In the fiscal 2016 budget oil revenue was set at 25%[58]. It is considered that this is because sufficient taxation is not being raised from industries apart from the oil industry.

The main taxation system in Iran is as follows[59].

1) Corporation taxation
   - Corporation income tax (25%)
   - Real estate tax (25%)

2) Individual taxation
   - Individual income tax (progressive tax rate up to 35%)
   - Inheritance tax (maximum rate 65%)
   - Tax on incidental income (progressive tax rate up to 35%)
   - Social insurance contributions (employers 23%, employees 7%)

3) Indirect taxation (excluding customs duty)
   - Value added tax (VAT) (8%)
   - Stamp duty (0.2%)

At first glance the taxation system would appear to be developed, but actually the taxation revenue relative to the GDP is insufficient, so there is a problem somewhere. Looking at it from a systematic perspective, there are many industries that are exempt from corporation tax.

[57] Prospects for Oil and Natural Gas Resource Development in Iran Post Sanctions – Energy Outlook in Iran Viewed through Political, Economic, and Social Trends – Oil and Natural Gas Review, Vol.50 No.3, May 2016, Ito Mashino, Research & Analysis Department, JOGMEC

[58] Prospects for Oil and Natural Gas Resource Development in Iran Post Sanctions – Energy Outlook in Iran Viewed through Political, Economic, and Social Trends – Oil and Natural Gas Review, Vol.50 No.3, May 2016, Ito Mashino, Research & Analysis Department, JOGMEC

[59] Iran's Taxation System and Accountancy Handbook, JETRO Dubai, March 2014

Table 7.3-2 Industries that are Exempt from Iranian Corporation Tax

Type	Tax exemption rate	Period
Agriculture	100%	Permanently
Industry, mining	80%	4 years
Industry, mining (developing regions)	100%	20 years
Tourism	50%	Permanently
Export services, non-oil products	100%	Five-year Plan time period
Education and sports	100%	Permanently
Cultural events	100%	Permanently
Traditional crafts	100%	Permanently
Salaries (in developing regions)	50%	Permanently
Activities within free zones	100%	20 years

Source: Tax System in the Islamic Republic of Iran, July 2015 Meyer-Reumann & Partners – BEITEN BURKHARDT – Krenkler & Partner Berliner Wirtschaftsgespräche – Legal Alliance – Sesam Business Consultants

Old industries such as agriculture and traditional crafts are frequently exempt from taxation, and the time period is permanent. In particular as can be seen from Table 7.2-2, agriculture is a major industry that accounts for 10% of GDP. Note that in the case of individual taxation, agricultural income (all primary industries) are exempt from taxation.

Regarding tax avoidance, for example it is said that IRGC controls 1/3 of the GDP of Iran[60], and Mostazafin is one of the Bonyads with a deep association with IRGC. Mostazafin is a foundation that was established to receive the assets of the Shah after the Iranian Revolution, with the objective of supporting those involved in the Iran-Iraq War and poor people. At present, it owns more than 400 companies, and is said to have total assets exceeding 120 billion dollars. The foundation is involved in a wide variety of industries, such as food, chemicals, mail boats, transport, metals, petro-chemicals, construction materials, dams, towers, plantations, horticulture, livestock, tourism, hotels, commercial services, and finance[61]. Bonyads are exempt from taxation, so the IRGC can avoid taxation legally by using these Bonyads.

In 2008 a 3% value added tax (VAT) was introduced into the taxation system, mainly with the objective of escaping from dependence on revenue from oil sales (in the fifth Five-year Plan it is stated that VAT rate will be increased by 1% annually up to 8%). Merchants of bazaars that are a core feature of the Iranian economy have gone on strike to protest the introduction of VAT, so its application is not complete, and it is applied only to foreign companies and some other companies[62].

Another field to which it is not applied is the underground economy. The size of the underground economy relative to GDP in 2011 (data for 2007) was 20.5%[63]. With the

[60] Entering the Iranian market, January 2016, KPMG
[61] EXPLAINING THE ECONOMIC CONTROL OF IRAN BY THE IRGC, 2011 Matthew Douglas Robin
[62] Oil and Natural Gas Review, The Islamic Republic of Iran – a Major Power in the Region, Shusaku Otomaru, Project Department, JOGMEC
[63] Underground Economies as a Percentage of GDP – International Comparison Statistics and Trends, Global Note http://www.globalnote.jp/post-3916.html

imposition of economic sanctions in earnest from 2012 onwards, the underground economy such as smuggling expanded, so it is considered that at present the percentage relative to GDP is larger.

An issue for the future is the necessity to improve the bias in the imposition of taxation by developing the taxation system and strengthening its operation.

7.3.3 Reduction of Subsidies

In Iran as in other Middle Eastern countries, subsidies were paid on everyday essentials such as wheat and energy. These subsidies could not be spared when reducing expenditure. In Iran, subsidies were applied to energy such as gasoline, diesel, electricity, etc., and basic foods such as bread, eggs, cooking oil, etc.

Income group	Range of Expenditures	Natural Gas	Gaso-line	Elec-tricity	Kero-sene	LNG	Gas Oil	Motor Oil, etc.	Bus/ Taxi Fares	Air -plane Fares	Rial -road Fares	Total Subsidy	As a % of Household Income
1	36–227	42.909	4.770	8.759	12.717	1.144	0.000	0.014	1.509	0.000	0.000	71.821	44
2	227–308	68.178	10.332	13.728	16.158	1.262	0.201	0.046	2.697	0.000	0.006	112.608	42
3	308–376	77.135	14.430	17.035	20.725	1.344	0.052	0.083	3.120	0.005	0.019	133.946	39
4	376–443	92.619	18.784	18.594	22.104	1.438	0.013	0.111	3.722	0.007	0.012	157.404	39
5	443–519	105.431	23.829	22.547	17.971	1.411	0.000	0.178	4.640	0.000	0.021	176.028	37
6	519–607	113.020	27.807	25.103	23.814	1.352	0.000	0.205	4.789	0.006	0.037	196.133	35
7	607–721	142.275	33.392	28.465	16.937	1.446	0.431	0.326	5.664	0.034	0.053	229.025	35
8	721–890	179.052	39.781	31.318	18.234	1.338	0.000	0.383	6.392	0.099	0.035	276.631	35
9	890–1,219	235.015	46.933	37.048	16.462	1.239	0.262	0.494	7.466	0.229	0.174	345.321	34
10	1,219–5,190	335.117	66.173	49.528	15.922	1.803	0.027	0.742	9.035	1.455	0.201	480.004	27
11	1,594–5,190	395.288	72.198	57.463	9.523	1.665	0.054	0.837	9.212	2.568	0.183	548.992	25
12	2,624–5,190	481.929	77.666	62.488	9.149	1.467	0.000	0.914	12.362	4.972	0.100	651.047	20
Average	651	144.373	28.691	26.216	18.907	1.437	0.103	0.268	5.100	0.187	0.058	225.340	35

Income group	Range of Expenditures	Bread 1	Bread 2	Bread 3	Bread 4	Bread 5	Eggs	Solid Oil	Sugar Cubes	Sugar	Total subsidy	As a % of Household Income
1	36–227	1.081	1.837	0.381	1.573	0.548	1.878	2.392	0.892	0.299	10.881	7
2	227–308	1.531	3.306	0.629	1.845	0.626	2.434	3.505	1.295	0.513	15.683	6
3	308–376	2.100	3.568	0.665	2.039	0.666	2.805	4.170	1.576	0.684	18.273	5
4	376–443	2.420	3.572	1.003	1.882	0.722	2.936	4.745	1.739	0.797	19.816	5
5	443–519	2.771	3.759	0.953	2.110	0.742	3.155	5.147	2.019	1.024	21.680	5
6	519–607	2.549	3.721	1.164	2.148	0.824	3.330	5.718	2.135	1.163	22.752	4
7	607–721	2.508	4.398	1.386	2.136	0.866	3.563	6.127	2.394	1.273	24.651	4
8	721–890	2.627	4.719	1.619	2.571	0.891	3.907	6.632	2.467	1.465	26.898	3
9	890–1,219	3.163	5.096	1.802	3.117	0.869	4.115	7.157	2.592	1.620	29.531	3
10	1,219–5,190	3.832	5.972	2.474	3.254	1.001	5.117	9.017	3.071	2.139	35.877	2
11	1,594–5,190	4.262	6.185	3.023	3.536	0.927	5.288	9.168	3.203	2.301	37.892	2
12	2,624–5,190	2.393	5.705	3.006	3.086	0.914	6.256	10.620	3.931	2.400	38.311	1
Average	651	3.085	5.015	1.510	2.846	0.975	4.171	6.848	2.533	1.374	28.357	4

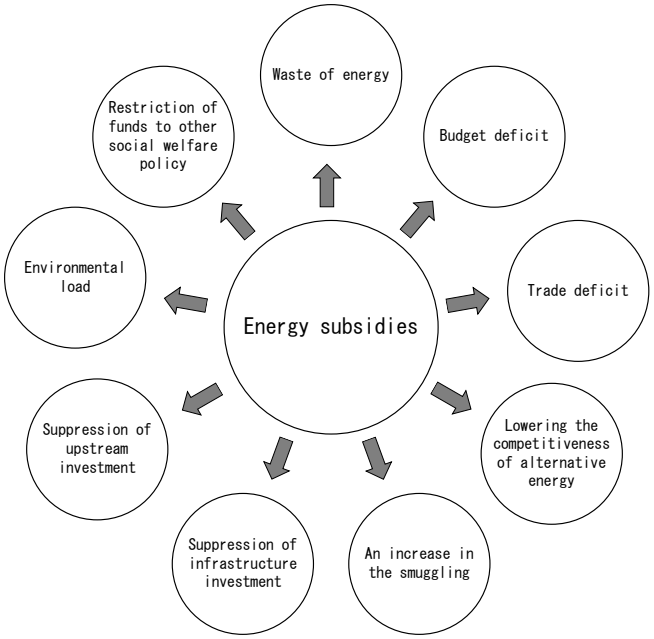
Figure 7.3-2 Breakdown of Subsidies in Iran According to Income Level in 2010[64] (Unit: US dollars)

Source: Export constraint and domestic fiscal reform: Lessons from 2011 subsidy reform in Iran, Firouz Gahvari, Department of Economics, University of Illinois, Seyed Mohammad Karimi, Interdisciplinary Arts and Sciences University of Washington, This version, August 2015

[64] These are simulation results, and not actual amounts.

Several reasons why the subsidy policy was implemented can be considered. The first is related to social policy as a whole. Social welfare concepts such as charity, etc., are strong in Islam, so in Islamic countries frequently subsidies are provided as a policy towards the low income people. Also, an objective is to nurture domestic industry. For further development, it is necessary to transform the industrial structure that greatly depends on oil and natural gas into a more diversified structure. Therefore, in order to nurture manufacturing industry in particular, in some cases subsidies are provided to improve the economic competitiveness within the country by providing low priced fuel and low priced electricity. In particular, investment by foreign companies is essential for such diversification of industry, and low energy prices within the country is a part preparation of conditions to attract overseas capital[65]. Also, subsidies stabilize prices by controlling prices, and has the effect of protecting against unstable international price fluctuations.

On the other hand, subsidies cause major problems.



Source: FY2014 Ministry of Foreign Affairs Foreign and Security Affairs Research Project (General Project) "The Middle East as a Global Strategy Issue – Outlook to 2030 and Response –" Chapter 6 Subsidies and Structural Reform, Yoshikazu Kobayashi, the Japan Institute of International Affairs

Figure 7.3-3 Problem Points with Energy Subsidies

The above figure shows nine problem points. The effects on finances include fiscal deficits, trade deficits, limitation of funds for other social welfare policies, etc.

In Iran, the momentum towards reduction and reform of subsidies increased during the 2000s and later as the domestic demand for energy increased, and expenditure on subsidies started to put pressure on finances. Initially the gasoline price was increased in stages, and the domestic retail price was set by the gasoline distribution system introduced in 2007 to IRR 1,000/L ($0.09/L) up to 100 L per month for a driver that owned an automobile, and above that amount

[65] FY2014 Ministry of Foreign Affairs Foreign and Security Affairs Research Project (General Project) "The Middle East as a Global Strategy Issue – Outlook to 2030 and Response –" Chapter 6 Subsidies and Structural Reform, Yoshikazu Kobayashi, The Japan Institute of International Affairs

at IRR 4,000/L ($0.38/L). Then this staged increase was continued further, and in December 2010 the price was raised to IRR 4,000/L up to 100 L per month, and above this amount at IRR 7,000/L. The increase in domestic retail price that was scheduled for 2012 was frozen due to the rise in inflation rate, but in April 2014 prices were raised again to IRR 7,000/L for amounts allocated up to 100 L, and above this amount to IRR 10,000/L, etc. On a nominal price basis, the gasoline price increased by a factor of 7 in seven years, through a major reduction in subsidies[66].

This reduction in subsidies was applied to other energy sources also, producing the same effect. The domestic demand for petroleum products in 2011 was reduced by 3% compared with 2009, and electricity demand also was reduced by 2%. Also in conjunction with these reductions in subsidies, a cash grant of $45 per month was given to low income households, which manifested as an income redistribution effect, such as a reduction of the Gini coefficient, which represents income disparity, from 0.41 to 0.37[44].

Income group	Range of Expenditures	Pre-reform price subsidies	Post-reform price subsidies	Direct rebates	Change in the amount of subsidies
		S^h	$S_e'^h$	$B^h = n^h b$	$\Delta S^h = B^h + S_e'^h - S^h$
1	36–227	84.246	21.968	33.206	–29.073
2	227–308	124.662	31.611	42.568	–50.482
3	308–376	151.049	38.680	46.511	–65.858
4	376–443	174.676	43.890	48.764	–82.022
5	443–519	184.584	46.630	50.811	–87.143
6	519–607	213.674	54.825	51.649	–107.199
7	607–721	236.202	59.619	53.270	–123.313
8	721–890	282.724	70.478	53.497	–158.749
9	890–1,219	347.913	86.811	54.328	–206.774
10	1,219–5,190	508.787	133.082	55.945	–319.759
11	1,594–5,190	592.932	159.709	55.122	–378.101
12	2,624–5,190	718.259	202.499	55.112	–460.647
Average	651	239.962	59.716	49.055	–131.192

Source: Export constraint and domestic fiscal reform: Lessons from 2011 subsidy reform in Iran, Firouz Gahvari, Department of Economics, University of Illinois, Seyed Mohammad Karimi, Interdisciplinary Arts and Sciences University of Washington, This version, August 2015

Figure 7.3-4 Effect of Subsidy Reform in Iran According to Income Level (Unit: USD) with Trade Restrictions[67]

From 2011 economic sanctions came into force in earnest, and trade was restricted, so it is considered that the calculations based on these assumptions are close to the reality. Subsidies including fixed cash handouts were reduced for all income levels, but the percentage reduction was higher for higher income households. The reduction in the main price subsidies was greater for the higher income households, due perhaps to a policy objective to protect the lower income households, but it can be seen that the actual beneficiaries of the subsidies were the high income households.

[66] FY2014 Ministry of Foreign Affairs Foreign and Security Affairs Research Project (General Project) "The Middle East as a Global Strategy Issue – Outlook to 2030 and Response –" Chapter 6 Subsidies and Structural Reform, Yoshikazu Kobayashi, The Japan Institute of International Affairs

[67] These are the results of simulation assuming a balanced budget, and are not actual amounts.

When it is a viewpoint of the income hierarchy distinction, it is announced that Supplementary Income Payment do not paid to 24 million people in April, 2016 with much income, and Supplementary Income Payment will not be paid to 3 million in addition in January, 2017[68].

7.3.4 Financial Forecasts

It is forecast that the financial status will improve in the future. The following is the financial forecast by the IMF.

Table 7.3-3 Forecast of Iran's Financial Status

	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021
Revenue	14.1	14.6	13.2	14.5	15.5	15.4	15.4	15.4
Tax	5.2	6.4	6.8	7.2	7.6	7.7	7.9	8.1
Other revenue	8.8	8.1	6.4	7.3	7.9	7.7	7.6	7.3
Oil revenue	6.5	5.7	3.9	4.9	5.6	5.5	5.4	5.2
Expenditure	15.0	15.7	15.4	15.9	15.8	15.7	15.6	15.6
Payments	12.7	13	12.8	12.7	12.5	12.3	12.2	11.9
Net acquisition of non-financial assets	2.3	2.7	2.7	3.2	3.3	3.4	3.5	3.7
Net financial transactions (result)	-2.2	-1.2	-2.2	-1.3	-0.3	-0.3	-0.2	-0.2
Net financial transactions (budget)	-0.9	-1.2	-2.2	-1.3	-0.3	-0.3	-0.2	-0.2
Net financial transactions (excl. oil)	-10.6	-8.2	-7.2	-7.1	-6.9	-6.7	-6.5	-6.3
Financial assets	-0.5	-1	-1.1	-0.5	0.4	0.4	-0.1	0
Debt	1.7	0.2	1.4	0.9	0.7	0.7	0.1	0.1

Source: IMF Country Report No.15/349 ISLAMIC REPUBLIC OF IRAN, 2015 ARTICLE IV CONSULTATION – PRESS RELEASE; STAFF REPORT; AND STATEMENT BY THE EXECUTIVE DIRECTOR FOR THE ISLAMIC REPUBLIC OF IRAN, Dec. 2015

The balance of fiscal revenue and expenditure (net financial transactions) is forecast to change from -0.3% to -0.2% after 2017 – 2018 when the results of lifting of economic sanctions will appear. Although it will not become positive, it is forecast to recover to a level at which there is virtual equilibrium. The reason it does not become positive is considered to be because as transactions with overseas re-start, financial transactions with overseas will also increase, and in particular it is forecast that financial transactions due to ODA, etc., will increase. Looking at the details, expenditure is stable between 15.6% and 15.9%. On the other hand it is considered that revenue will increase from 13.2% to 15.4%. Oil revenue as a percentage of total revenue will be stable in the 30% range from 2017 – 2018 onwards. As stated in the economic trends section, in this period it is forecast that the effective GDP growth rate will be around 4%. It is considered that the non-oil revenue will grow at the same rate as GDP.

On the other hand, the balance of fiscal revenue and expenditure (net financial transactions (excluding oil)) is forecast to steadily reduce from -10.6% in 2013 – 2014 to -6.3% in 2020 – 2021. The IMF forecasts that the gradual reduction in dependency on oil revenue will progress.

68

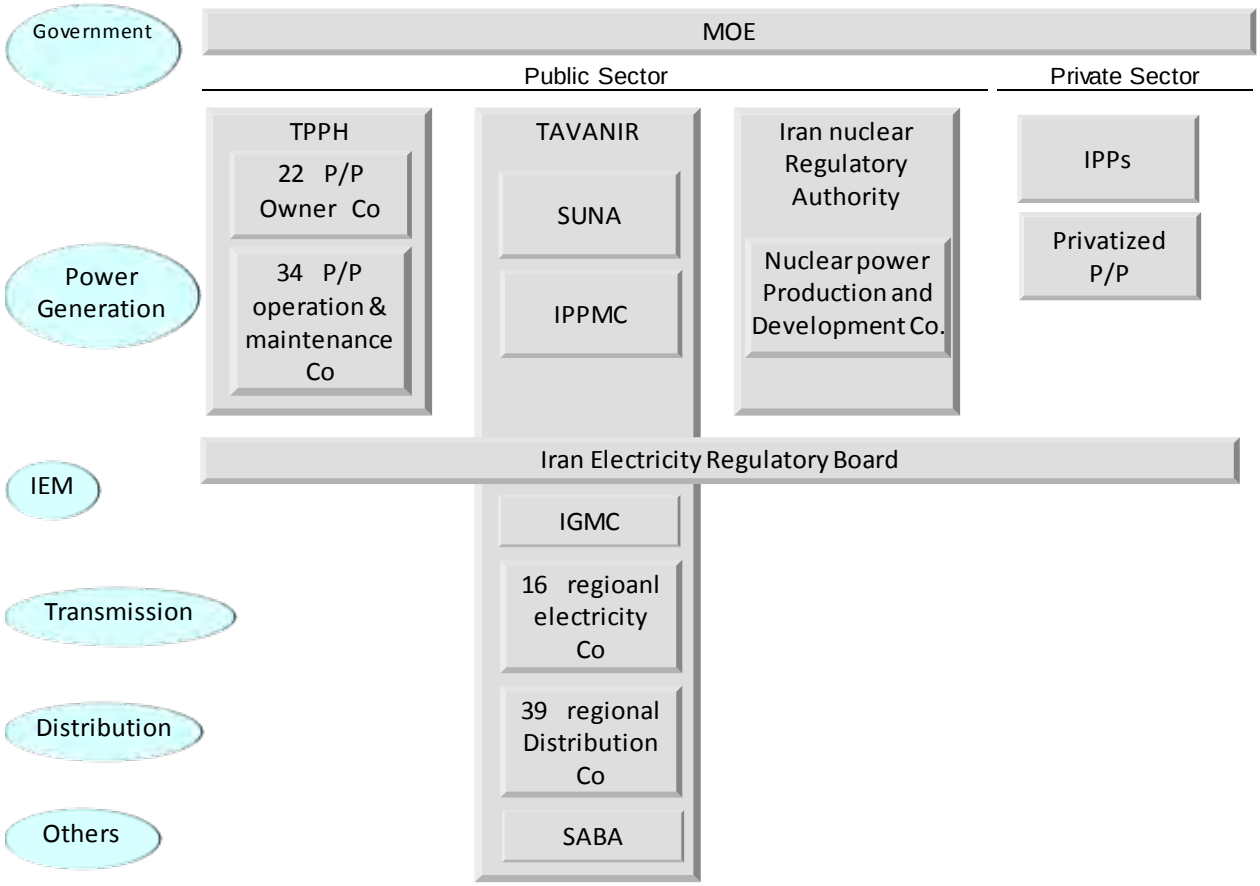
https://financialtribune.com/articles/economy-domestic-economy/57153/3m-more-to-be-cut-from-irans-cash-subsidy-list

7.4 Electric Power Sector Policy (Internal environment analysis 1)

7.4.1 Electric Power Sector System

The electrical power sector system in Iran viewed from the point of view of electrical power distribution and sales is as follows. The Ministry of Energy (MOE) has responsibility for the electrical power sector as a whole, and the Deputy Minister for Electricity and Energy is responsible for the electrical power sector. In 2016, the system of subsidiaries changed. Until last year, TAVANIR was responsible for the whole system of electrical power generation, transmission, and distribution, but in 2016, TPPH was established, and of the electrical power generation sector, the thermal generation sector was transferred from TAVANIR. In addition, the Iran Nuclear Regulatory Agency is responsible for nuclear power.

Private sector electrical power generation includes IPPs and privatized power plants. IPP indicates a power plant developed by the private sector by a BOO or BOT scheme, and privatized power plant indicates a nationally owned power plant that has been privatized.



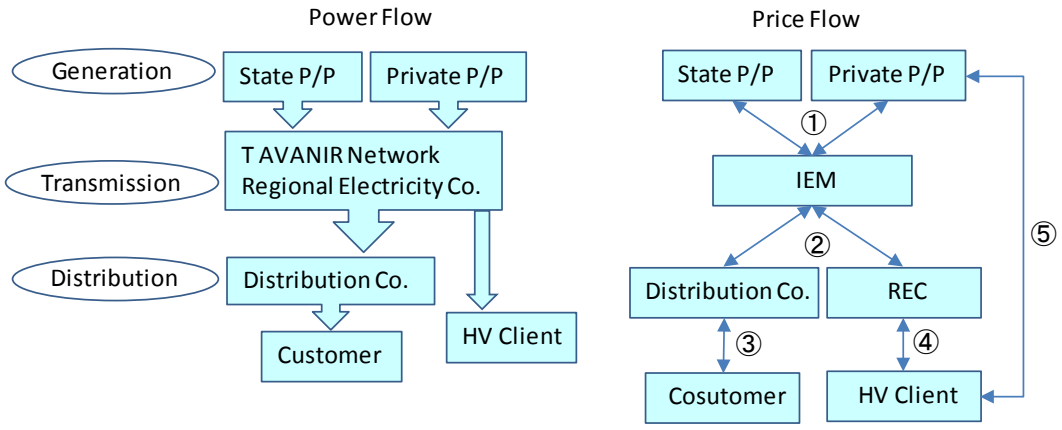
Source: TPPH

Figure 7.4-1 Diagram of the Iran Electrical Power Sector System

7.5 Electrical Power Distribution (Internal environment analysis 2)

7.5.1 Electrical Power Distribution Routes

Iran has its own electrical power transaction form and its own electrical power pricing system. The following is an overview explanation.



Source: Prepared by the Study Team from data obtained

Figure 7.5-1 Power Flow and Price Flow

The power generation sector in Iran is broadly divided into nationally-owned power plants and privately-owned power plants. The nationally-owned power plants include thermal power plants possessed by TPPH and power plants other than thermal power plants possessed by Tavanir. The privately-owned power plants include privatized power plants and power plants constructed by the private sector. The electrical power generated is transmitted via the Tavanir transmission network and delivered to the distribution companies, and the distribution companies deliver it to their customers. Some of the electrical power is delivered to VHV and HV customers via the transmission lines.

The flow of price differs slightly from the actual flow of electrical power. Iran has an electronic electrical power wholesale market known as IEM, operated and managed by IGMC, and regulated by the Iran Electricity Regulatory Board. The electrical power generated is sold through the Iranian Electricity Market (IEM), and viewed from the IEM there is the sellers' price (1) and the buyers' price (2). The electrical power purchased at the IEM is sold to VHV and HV customers by the transmission companies (4), and the distribution companies sell to the other customers (3). Also, private power generators can conclude bilateral sales contracts with VHV and HV customers (5). Also, ECA contracts and renewable energy are exceptions to the above table. The outline of electricity prices of the IEM and others is provided below.

7.5.2 Liberalization of the Electrical Power Wholesale Market

(1) Overview of the IEM

IEM is the electrical power wholesale market operated and managed by IGMC via an electronic network. IGMC and the market are controlled by the Iran Electricity Regulatory Board (IREB).

1) Iran Grid management Co. (IGMC)[69]

Iran Grid Management Co. was established based on Article (G) Note 12 of the Budget Act of 2004, and started activities in the second half of 2005.

Article (G), note 12:

Since 2004, Tavanir is permitted to purchase all the shares of any subsidiary using their own financial resources, transfer management of the nationwide transmission network and all transactions, establish an electrical power market, and transfer to that company.

The rules proposed by the Ministry of Energy were confirmed by MPO, approved by the Council of Ministers, confirmed by the Guardian Council, and were finally issued to the Ministry of Energy by the Cabinet.

Objectives and Scope of Activities

- To develop the national network and carry out transmission and monitoring, in order to ensure electrical power supply in the country and to maintain the safety and continuity of the network.
- To provide open access to the network for government and non-government participants, for transmission and distribution.
- To provide the conditions for competitive transactions, and to establish, operate, and develop the electrical power market and electrical power storage.
- To adopt effective policies for the introduction of competition in electrical power generation and distribution, and to implement the necessary policies in order to ensure supply of electrical power and to revitalize the activities of non-government organizations, within the scope of authority of the Ministry of Energy.

2) Iran Electricity Regulatory Board (IREB)[70]

The IREB was established in 2003 by the Ministerial Decree of the Minister of Energy, from a necessity to reorganize and reregulate the electrical power system.

IREB is a government bureau that supervises the electrical power market, and guarantees the fairness and justice of the electrical power market environment through its actions. Its specific actions include supervising the compliance of the procedures adopted by the market operators with the market methods defined by law. In addition, they monitor the function and relationships of the market participants including IGMC that function as the system and market operators. Finally, IREB has the authority to process demands on the market players.

The Regulatory Board has held more than 240 meetings in order to formulate market rules, amend the existing rules (about 100 rules), and provide decisions in cases of dispute.

Selection of personnel for the Energy Board of Directors is initially carried out by recommendation of members by the Deputy Minister for Electricity and Energy of the Ministry of Energy, and the final decision whether a proposed person is nominated as a member is made

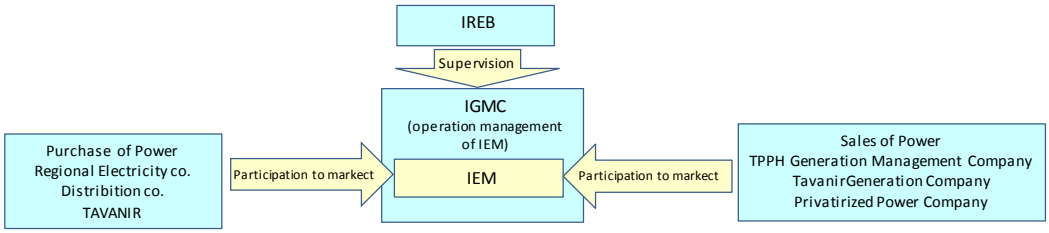
[69] IGMC's HP http://www.igmc.ir/en/
[70] IGMC's HP
http://www.igmc.ir/en/Company-units/Deputies/Electricity-Market/Market-in-depth#1740153-regulatory-board

by the Minister of Energy. Members are selected for their individual specialty, and at present, the Regulatory Board includes seven members, with a term of appointment of 2 years.

3) Overview of the IEM System

The Iran Electricity Regulatory Board (IERB) was established in the second half of the year 2001. The main activities of this committee was to survey the existing electrical power markets in other countries. The objective of this research was to utilize the past experience in the world. Eventually the IEM model was proposed, and based on this model the "Electrical Power Transaction Regulations" were adopted by the Council of Ministers in September 2003. Finally, the IEM started officially on November 23, 2003, and a competitive environment was provided for the sale and transaction of electrical power. Following this newly established energy market, in the autumn of 2004 IGMC was established[71].

The participants in the market on the electrical power supply side are almost all domestic electrical power generation companies, and include the thermal power plants of TPPH, the other power plants of Tavanir, and the private power companies. Although it is said that there are others, according to IGMC the amount of their sales is negligible. The electrical power demand side includes the distribution companies (that sell to normal customers), the regional electric companies (that sell to customers that purchase directly from the transmission lines), and Tavanir (for export).



Source: Prepared by the Study Team based on data obtained

Figure 7.5-2 Overview of the IEM

(2) Transactions on IEM

In Iran, there are three types of electrical power wholesale transaction: the day-ahead market, the power exchange, and bilateral contracts. All these transactions are managed by the IEM, and supervised by IREB. Basically, the electrical power generated by power plants within the country is sold via the IEM. Exceptions include first of all Energy Conversion Agreements (ECA) and Power Purchase Agreements (PPA), but there are no private power plants that have adopted PPAs, so the exception are substantially ECAs only. The period of ECAs is 5 years, and at present, effectively there are 7-9 companies[72]. ECAs are described later. Another exception is renewable energy, for which separate Feed In Tariffs are provided according to the type of energy.

1) Day Ahead Market

This is the main market of the IEM, and accounts for about 90% of the electrical power transacted on the IEM. It is an auction for the electrical power for the following day. All stations submit tenders on the day prior to supply of electrical power. The sellers submit prices and

[71] IGMC の HP
http://www.igmc.ir/en/Company-units/Deputies/Electricity-Market/Market-in-depth#1740154-introduction-to-iem
[72] Interview with IGMC

quantities in their tenders. Customers submit demand quantities only. In reality, this mechanism is a one-sided auction for the sellers.

Sales Bidding

Bidder	Quantity	Unit Price
A	20	120
	10	140
B	30	110
	20	170
C	10	100
	20	150
D	40	130
	10	160

Sales Bid Price

Unit Price	Successful Bidder	Quantity	Cumulative Value
100	C	10	10
110	B	30	40
120	A	20	60
130	D	30	90
140	A	10	100
150	C	20	120
160	D	10	130
170	B	20	150

Source: Prepared by the Study Team based on data obtained

Figure 7.5-3 Mechanism for Determining the Day Ahead Market Price

A uniform price is not determined by the auction in the Day Ahead Market, but tenders are fulfilled up to the total demand quantity of the buyers. Explaining the example in the figure above, assume the tenders of the sellers is as shown in Figure 7.5-3, and the cumulative demands of the buyers is 110. In this case, the tenders for sale in the cumulative column are successful until 110. The total quantity of the tenders with prices from 100 to 140 are successful, and a quantity of 10 is successful for the tender of price 150. The upper limit of the price is determined by the sellers' maximum tender price limit set by the Regulatory Board.

The following table shows the trend in transaction quantity, transaction value, and unit sales price on the IEM.

Table 7.5-1 Trend of Transactions at the Day Ahead Market

Year	Auction (MWh)	Bilate + Exchange	Sold amounts IRR Mil	Unit price IRR/kWh
2011-12	221,480,240	0	88,881,067	401
2012-13	237,840,481	0	95,182,381	400
2013-14	250,892,134	2,926,134	122,582,186	494
2014-15	263,852,290	20,130,990	151,532,510	622
2015-16	270,217,289	48,710,541	157,433,606	711

Source: IGMC

Both transaction volume and transaction value have increased year-by-year as the electrical power demand increased within the country. The unit price increased suddenly after 2014–2015, but this is considered to be coupled with the consumer prices. As discussed later, after the increase in consumer prices in 2011, increases in 2012 and 2013 were deferred, and from 2014, price increases occurred every year. The above prices follow the same trend.

The above sold amounts include Capacity Payments and Ancillary Service Payments.

Capacity Payment: This is a payment payable in accordance with the capacity made available to the IEM, with the objective of development of additional generating capacity. The Electricity Regulatory Board produces a table of average unit price (vertical axis: time (24 hours in 1 power unit), horizontal axis: day (365 days)), and calculates the unit price × capacity. For the peak times when the quantity used is large the unit price is increased.

Ancillary Service Payment: This is a payment for quality of electrical power, each PP applies to provide market operators with types of service, and the market operator calculates the price in accordance with the quality.

Type of Ancillary Service are as follows.

- Self-start (black start) power plants
- Frequency trimming
- Wattless power

Table 7.5-2 Breakdown of IGMC Electricity Purchase Price (IRR/kWh)

YEAR	Electricity unit price	Capacity rate	Ancillary service	TOTAL
2013-14	341	152	2	496
2014-15	427	193	4	624
2015-16	421	291	4	717
2016-17	367	249	3	619

Source: IGMC

2) Power exchange

Power exchange is a futures transaction for electrical power. Basically, a transaction is established between the buyer and the seller for the price, quantity, period, etc. In the case of sellers, this system can only be used by the private generation companies. Also, an upper limit on the quantity of electrical power that can be transacted in the Power exchange is determined for each power generating unit. The transactions on the Power exchange are excluded from transactions on the Day Ahead Market, for both sellers and buyers.

3) Bilateral contracts

This is a method whereby sellers and buyers carry out direct negotiations to determine the price. Buyers and sellers can freely negotiate regarding the price and quantity. However, it is necessary to apply to the system operator and obtain approval for transactions. Almost all bilateral contracts are long-term contracts.

4) Buyers price

As stated above, the IEM is a one-sided auction, in which the sellers submit tenders based on the principle of competition, but the buyers only apply for the quantity that they require. IGMC purchases the electrical power applied for by the buyers, and sells it to the buyers. Seles price to a buyer is the sum that divided an amount of money that IGMC purchased by a volume. IGMC calculates the power transmission line fee for use by place (transmission distance), use time and voltage, and it is caluculated for transion rate and transmission charges announcing.

The following is a breakdown of the average sales price to buyers.

Table 7.5-3 Breakdown of IGMC Sales Price (IRR/kWh)[73]

YEAR	Electricity unit price	Transmission charge	TOTAL
2013-14	435	66	502
2014-15	631	80	717
2015-16	721	142	895
2016-17	626	126	762

Source: IGMC

(3) Transactions other than the electrical power wholesale market - ECA & Renewable energy

As stated previously, basically, the electrical power generated and sold using the Tavanir network is transacted on the IEM, but there are exceptions. These exceptions are the ECA contracts and renewable energy.

1) Energy Conversion Agreement (ECA)

ECAs were started in 2004 with the objective of promoting private power generation. If a private power producer concludes an ECA with TPPH (formerly Tavanir), for the first 5 years TPPH will buy the power produced by the power producer at a favorable price. According to TPPH, the price varies depending on the unit price table, and the unit price table is amended every year taking into consideration the rate of increase in commodity prices, fluctuations in exchange rate, etc. What price from the unit price table is applied is determined based on the generation efficiency of the power plant. As a rule fuel is provided free of charge to those that have concluded an ECA.

2) Renewable energy

The government plans to increase the share of solar energy and wind energy to 10% of the total generation capacity by the year 2024[74]. In order to promote the use of renewable energy, the Ministry of Energy requires that electrical power from private power producers that generate electricity using renewable energy be purchased. In the Act introduced in 2011, the Ministry of Energy requires the purchase of electrical power under a long-term contract with a price guarantee for 20 years. The guaranteed prices are adjusted in accordance with the local CPI and the exchange rate with the dollar[75]. The following are the purchase prices for electricity produced by renewable energy in 2015.

[73] Although Electricity unit price is different on Table 7.5-1, Table 7.5-2 ,Table 7.5-3, this is because transmission loss increases with the amount that quantity, IGMC which quantity of electricity at the power station, IGMC really purchased a denominator each sold from the power station a place measuring because far-off, and a denominator becomes small little by little.

[74] Power Industry in Iran Emphasis on Stock Market, Atieh Brokerage Co.

[75] Iran power sector Enough to double GDP, Sector overview Equity Research 20 January 2016, Renaissance Capital

Table 7.5-4 Purchase Price for Renewable Energy Power Generation

Type	Detail	IRR/kWh	Note
Biomass	Landfill	2,900	
	Anaerobic digestion	3,150	
	Incineration	5,870	
Wind	50 MW or more	4,060	
	Less than 50 MW	4,970	
	Less than 1 MW	5,930	*1
Solar	More than 10 MW	5,600	
	10 MW or less	6,750	
	100 kW or less	8,730	*1
	20 kW or less	9,770	*1
Geothermal (including excavation and procurement of equipment)		5,770	
Expansion turbine		1,800	
Loss reduction in industrial processes		3,050	
Small-scale hydroelectric 10 MW or less		3,700	
Others excluding hydroelectric		4,873	

Note *1: For consumers, and connection capacity is limited

Source: Iran power sector Enough to double GDP, Sector overview Equity Research 20 January 2016, Renaissance Capital

7.5.3 Electrical power consumer prices

(1) Trend in electrical power consumer prices

The electrical power prices for consumers are determined by law. In accordance with the price revision of 2016, the Cabinet decided on a price increase of 10% in August. According to the MOE, the average price after the revision of 2015 was about 600 IRR/kWh, but it is envisaged that the average retail price after this revision will be 670 IRR/kWh.

The procedure is that Tavanir carries out the necessary calculation, and produces a document, and submits it to the MOE. After approval by the MOE, it is passed to the Cabinet. The electrical power price is determined by law, but it is not necessary that it be approved by Parliament (Majilis), but it can be set by the Cabinet. The revision is normally carried out in December, but if necessary, a supplementary revision can be made in March.

Officially, the above is the procedure for determining the electrical power consumer price, but because it is a political decision, the opinion of Tavanir is not necessarily reflected in the price. Therefore, the price revision is not carried out every year, and in recent years, no price revision was made in 2012 and 2013. It is considered that this was related to the price revisions carried out consecutively in December 2010 and March 2011. Currently the cost of sales is higher than the sales tariff, and Tavanir wants to increase the price until the cost of sales equals the sales tariff. However, the electrical power price is determined politically, so it is not known when this will be achieved. In addition, the future price is substantially not under the control of Tavanir, so it is difficult to prepare medium and long-term financial plans, etc.

A price table for the electrical power consumer prices has been prepared according to the type of consumer. The following is the main price table in accordance with the Electrical Power Price Act.

Table 7.5-5 Tariff 1 Residential Uses

Base Price kWh/IRR

Quantity used (kWh)	2010	2011	2014	2015	2016
Up to 100	270	300	372	409	450
Over 100-200	320	350	434	477	525
Over 200-300	720	750	930	1,023	1,125
Over 300-400	1,300	1,350	1,674	1,841	2,025
Over 400-500	1,500	1,550	1,922	2,114	2,325
Over 500-600	1,900	1,950	2,418	2,660	2,926
Over 600	2,100	2,150	2,666	2,933	3,226

Source: TAVANIR

Table 7.5-6 Tariff2 Public Uses

Year	Tariff code		with power above 30 kw				with 30 kw power or less			
			Power price (kw/IRR)	Energy price (kwh/IRR)			Power price (kw/IRR)	Energy price (kwh/IRR)		
				Middle load hours	peak load hours	Low load hours		Middle load hours	peak load hours	Low load hours
2010	A-2	1	30,000	1,000	2,000	500	-	1,200	2,400	600
		2	25,000	300	600	150	-	400	800	200
	B-2		12,000	150	300	75	-	200	400	100
2011	A-2	1	30,000	1,100	2,200	550	-	1,300	2,600	650
		2	25,000	340	680	170	-	440	880	220
	B-2		12,000	190	380	95	-	240	480	120
2014	A-2	1	37,200	1,364	2,728	682	-	1,612	3,224	806
		2	31,000	422	844	211	-	546	1,092	273
	B-2		14,880	236	472	118	-	298	596	149
2015	A-2	1	44,640	1,637	3,274	819	-	1,934	3,868	967
		2	37,200	506	1,012	253	-	655	1,310	328
	B-2		17,856	283	566	142	-	358	716	179
2016	A-2	1	49,104	1,801	3,602	901	-	2,127	4,245	1,064
		2	40,920	557	1,114	279	-	721	1,442	361
	B-2		19,642	311	622	156	-	394	788	197

Source TAVANIR

Table 7.5-7 Tariff3 Production Uses (Water and Energy)

Year	Tariff code		with power above 30 kw				with 30 kw power or less			
			Power price (kw/IRR)	Energy price (kwh/IRR)			Power price (kw/IRR)	Energy price (kwh/IRR)		
				Middle load hours	peak load hours	Low load hours		Middle load hours	peak load hours	Low load hours
2010	A-3		-	135	270	68	-	135	270	68
	B-3		12,000	175	350	88	-	215	430	108
	C-3	Option 1	20,000	225	450	113	-	325	650	163
		Option 2	-	325	650	163				
2011	A-3		-	80	160	40	-	80	160	40
	B-3		12,000	155	310	78	-	195	390	98
	C-3	Option 1	20,000	205	410	103	-	305	610	153
		Option 2	-	305	610	153				
2014	A-3		-	100	200	50	-	100	200	50
	B-3		14,880	194	388	97	-	242	484	121
	C-3	Option 1	24,800	254	508	127	-	378	756	189
		Option 2	-	378	756	189				
2015	A-3		-	110	220	55	-	110	220	55
	B-3		16,368	213	426	107	-	266	532	133
	C-3	Option 1	27,280	279	558	140	-	416	832	208
		Option 2	-	416	832	208				
2016	A-3		-	121	242	61	-	121	242	61
	B-3		18,005	234	468	117	-	293	586	147
	C-3	Option 1	30,008	307	614	154	-	458	916	229
		Option 2	-	458	916	229				

Source: TAVANIR

Table 7.5-8 Tariff4 Production Uses (Industry and Mine)

Year	Tariff code		with power above 30 kw				with 30 kw power or less			
			Power price (kw/IRR)	Energy price (kwh/IRR)			Power price (kw/IRR)	Energy price (kwh/IRR)		
				Middle Load Hours	Peak Load Hours	Low Load Hours		Middle Load Hours	Peak Load Hours	Low Load Hours
2010	A-4	Option 1	32,000	340	680	170	-	440	880	220
		Option 2	12,000	390	780	195				
	B-4	Option 1	18,000	200	400	100	-	270	540	135
		Option 2	9,000	240	480	120				
2011	A-4	Option 1	32,000	340	680	170	-	440	880	220
		Option 2	12,000	390	780	195				
		Option 3	-	430	860	215				
	B-4	Option 1	18,000	200	400	100	-	270	540	135
		Option 2	9,000	240	480	120				
		Option 3	-	270	540	135				
2014	A-4	Option 1	39,680	422	844	211	-	546	1,092	273
		Option 2	14,880	484	968	242				
		Option 3	-	534	1,068	267				
	B-4	Option 1	22,320	248	496	124	-	336	672	168
		Option 2	11,160	298	596	149				
		Option 3	-	336	672	168				
2015	A-4	Option 1	47,616	506	1,012	253	-	655	1,310	328
		Option 2	17,856	581	1,162	291				
		Option 3	-	641	1,282	321				
	B-4	Option 1	26,784	298	596	149	-	403	806	202
		Option 2	13,392	358	716	179				
		Option 3	-	403	806	202				
2016	A-4	Option 1	52,378	557	1,114	279	-	721	1,442	361
		Option 2	19,642	639	1,278	320				
		Option 3	-	705	1,410	353				
	B-4	Option 1	29,462	328	656	164	-	443	886	222
		Option 2	14,731	394	788	197				
		Option 3	-	443	886	222				

Source: TAVANIR

Table 7.5-9 Tariff5 Other Uses

Price Category			2010	2011	2014	2015	2016
with power above 30 kw							
Power price (kw/IRR)			30,000	20,000	24,800	29,760	32,736
Energy price (kwh/IRR)	Middle load hours		1,000	1,100	1,364	1,637	1,801
	peak load hours		2,000	2,200	2,728	3,274	3,602
	Low load hours		500	550	682	819	901
with 30 kw power or less							
consumption/month (Kwh/month)		Up to 100	1,000	1,100	1,364	1,637	1,801
		Over 100-200	1,000	1,150	1,426	1,711	1,882
		Over 200-300	1,400	1,200	1,488	1,786	1,965
		Over 300-400	1,400	1,250	1,550	1,860	2,046
		Over 400-500	1,400	1,400	1,736	2,083	2,291
		Over 500-600	1,400	1,600	1,984	2,381	2,619
		Over 600	2,000	1,800	2,232	2,678	2,946

Source: TAVANIR

The month for revision of the prices in the above tables varies from year to year; in fiscal 2010, it was December, in fiscal 2011, it was April, in fiscal 2014, it was April, and in fiscal 2015, it was March 2016. Note that the Iranian calendar starts during March and ends during March. Although it was not possible to obtain the information during the survey, as stated previously, there was a price revision actually in September 2016, in which the price increase is likely to about 10% over the previous year's price.

The average sales prices as a result of applying the above sales tariff table were as follows.

Table 7.5-10 Average Electrical Power Sales Price (IRR/kWh)

Year	Residential	Commercial	Agriculture	Industrial	Others	Average	Percentage increase
2005	102.74	176.81	21.56	201.57	539.74	152.08	
2006	102.92	181.70	21.25	200.41	541.16	152.78	0.5%
2007	124.67	159.61	20.97	205.86	507.95	164.98	8.0%
2008	119.34	228.92	21.98	204.61	552.36	174.25	5.6%
2009	129.00	152.00	21.00	206.00	501.00	165.00	-5.3%
2010	142.26	226.53	46.80	263.58	599.10	208.70	26.5%
2011	334.84	51.56	125.65	441.91	1275.25	409.48	96.2%
2012	337.46	491.01	131.10	427.52	1339.45	407.01	-0.6%
2013	364.80	516.30	133.40	442.60	1342.20	418.50	2.8%
2014	439.40	617.60	177.90	542.60	1664.00	525.60	25.6%

Source: Electric power industry in Iran 2014-2015

The price increases in fiscal 2010 and 2011 overlapped, so the sales price increased greatly, and the increase was about double. Thereafter in fiscal 2012 and 2013 there was no price revision, but a price revision was carried out in 2014.

In addition, it is considered that the future direction of the price is upwards, but as the price itself is a political matter, when and how much the price increase will be is impossible to predict.

(2) Sales prices to VHV and HV customers

Different prices are applicable to VHV and HV customers that directly purchase their electrical power from the transmission lines, and not via the distribution network. Basically, the price is determined by contract negotiated individually between the parties in long-term contracts.

(3) Electrical power subsidies

In law, Tavanir is a company, but from the financial viewpoint, it also has the aspect of a government organization. As a company, it is basically self-supporting, but exceptionally it is paid subsidies from the government. However, as a government organization, Tavanir prepares a budget, and differences between forecast expenditure and income are paid from the national budget, so that income and expenditure in the budget are balanced.

Viewed as a government organization from the point of view of governmental accounting, income and expenditure are balanced, and the income is broadly divided into electrical power

income and disbursements from the government. When Tavanir is considered as a self-supporting organization, the budget dispersed from the government is effectively considered to be a subsidy.

To date the cost of sales has always been higher than the sales tariffs. The following is a comparison between the cost of sales and sales tariffs, but as the data for the fuel subsidies up to 2010 are not clear, the data is not complete. In addition, it was not possible to obtain the data for 2012. From 2013 onwards, fuel subsidies were abolished.

From the following table it can be seen that the unit prices even after deducting fuel subsidies are higher than the sales tariffs. The amount of the difference is the result after settlement of accounts. However, payments are made from the budget as described above, so effectively there is an indemnity from the government as a subsidy.

Table 7.5-11 Cost of Sales, Subsidies, Sales Tariffs

(IRR/kWh)

Year	Cost of sales	Fuel subsidies	Diff	Budget	Sales tariff
2004	-	-	301.0	149.9	151.1
2005	-	-	316.6	164.5	152.1
2006	-	-	326.1	173.8	152.3
2007	-	-	310.0	145.0	165.0
2008	-	-	397.7	223.4	174.3
2009	-	-	430.0	265.0	165.0
2010	-	-	537.4	328.7	208.7
2011	1,240.1	649.0	591.1	181.6	409.5
2012	-	-	-	-	407.0
2013	1,107.0	0.0	1,107.0	688.4	418.7
2014	1,131.0	0.0	1,131.0	605.4	525.6

Source：Electric power industry in Iran 2011-2012、2014-2015

Chapter 8 Environmental and Social Considerations

8.1 Social and Environmental Conditions That Are the Base

8.1.1 Geography / Climate

• Geography

The total area of Iran is 1,648,000km², consisting of land area of 1,636,000 km² and water area of 12,000 km². It is the 18th largest country in the world, and the 2nd largest in the Middle East. Iran has borders with Azerbaijan (length of border 432km) and Armenia (32km) in the northwestern portion of the country. The Caspian Sea is located at the northern edge of the country. Iran has borders with Turkmenistan (992km) to the northeast, Pakistan (909km) and Afghanistan (936km) to the east, and Turkey (499km) and Iraq (1,458km) to the west. The Persian Gulf and Gulf of Oman are located to the south. Iran has a topography where basins and plateaus are separated by mountains. The western part of Iran has a comparatively high population density, but there are quite a few mountains in this region, such as the Zagros Mountains and Alburz Mountains, which include Mt. Damavand, the highest peak in Iran (Altitude 5,604m). On the other hand, there are desert regions in the eastern part of Iran that have nearly no people, including the Kavir Desert, with high concentrations of salt, as well as a sprinkling of salt-water lakes. There are only a few plains in Iran. The large ones consist of the plain along the Caspian Seacoast and the plain at the mouth of the Arvand River (Shatt al-Arab River) at the north edge of the Persian Gulf.

Source: Pars Times

Figure 8.1-1 National Map of Iran

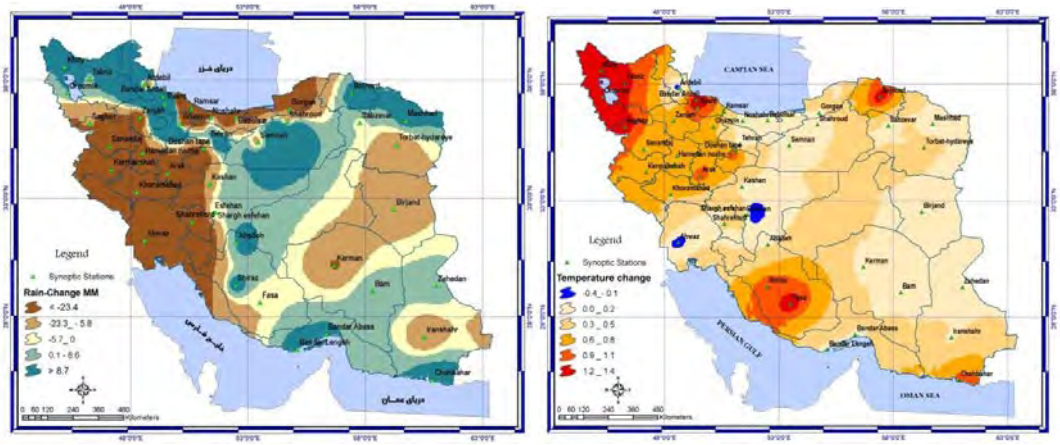
• Water System

Iran has over 3,450 rivers, consisting of six main river basins. The most important rivers are the Karoun River (14,619 million m^3) and Dez River (8,825 million m^3) which flow into the Persian Gulf, and the Sefidrood River (6,491 million m^3) and Aras River (2,317 million m^3) which flow into the Caspian Sea. Other important rivers consist of the Zayandehrood River (1,473 million

m^3), Atrak River (877 million m^3) and Hirman River (142 million m^3). The volume of water flowing into the Urmia Lake is 5,971 million m^3. One characteristic of the water system in Iran is the fact that while there is an abundant volume of water flowing into the Persian Gulf and Caspian Sea, the volume of water in other portions of the water system is comparatively small. Historically in Iran, manmade underground water channels have been used to feed the abundant underground water resources in the plateaus for agricultural development in low-lying arid zones such as Qanat and Karez.

• Climate

Iran can be roughly divided into three climate zones: Continental climate, West Asian dry climate and Caspian Sea warm and wet climate. In general, there are extreme differences between hot and cold in the continental climate zone due to the high altitude. In particular, almost all regions except for the Persian Gulf coastal area and Gulf of Oman coastal area are extremely cold during the winter. The majority of the country has a desert climate or steppe climate, but the northern edge of Iran (Caspian Sea coastal plain) belongs to a warm and wet climate zone, and while the temperature drops to around 0°C during the winter, the climate is wet throughout the year, with the temperature rarely going above 29°C during the summer. The annual rainfall in the eastern portion of this plain is 680mm or more, and 1700mm or more in the western portion of the plain. Tehran and other inland highlands have something between a steppe climate and desert climate, with very cold winters during which there is snowfall and the minimum temperature drops to around 10°C below freezing. On the other hand, the summers are dry and hot, with the temperature rising to near 40°C during the day. The highlands in western Iran have something between a steppe climate and subarctic climate, with extreme cold during the winter, and heavy snowfall in the mountainous regions, making this a very harsh season. The central basin in eastern Iran is dry, with a desert climate, extensive deserts and annual rainfall of less than 200mm. In particular, the southeastern desert near Pakistan is a region with severe heat, and the average temperature during the summer reaches 38°C. The southern portion of Iran along the Persian Gulf and Gulf of Oman coastline have mild winters, with extremely hot and humid summers during which the average temperature is around 35°C.



Source: Gary Lewis, “Challenges to and from the Environment in Iran”, Iran’s Natural Heritage Symposium, Jan. 24 2014

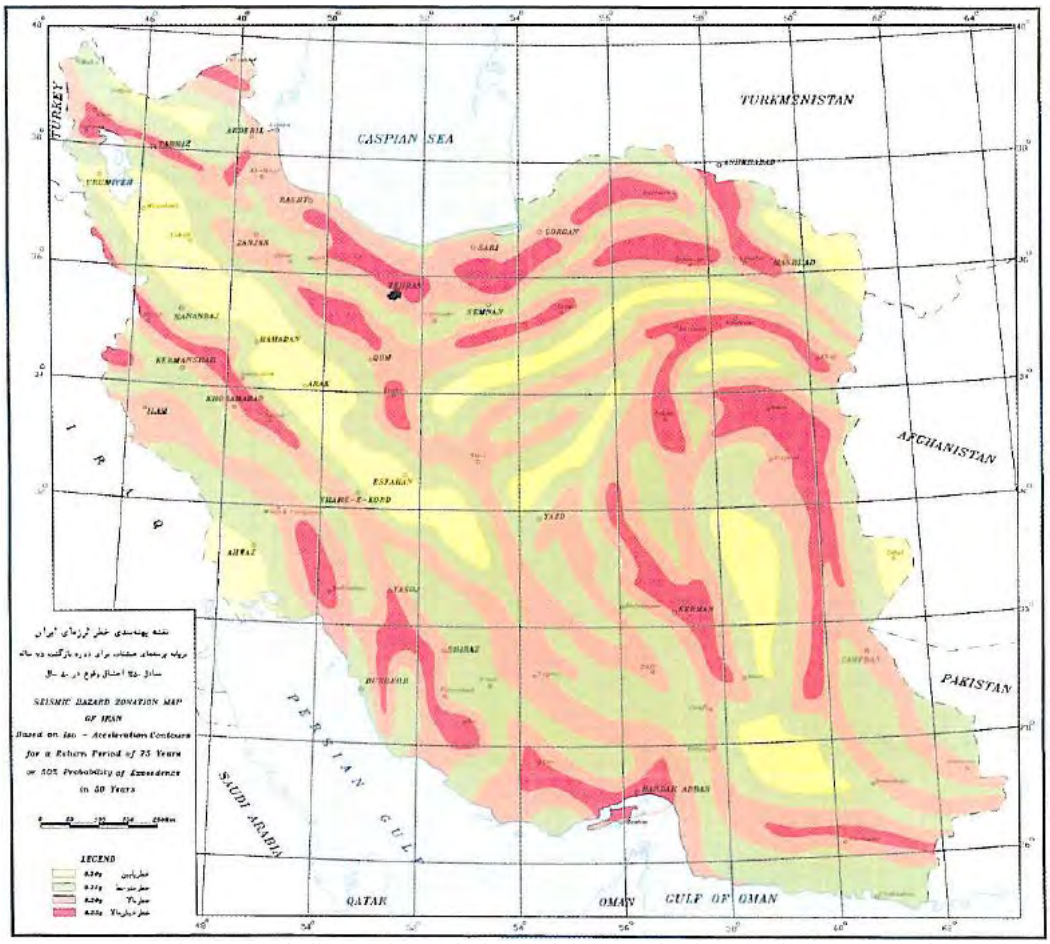
Figure 8.1-2 Rainfall/Temperature Change Forecast (Change Forecast for 2010-2039 Based on Change Between 1976-2005)

• Natural Disasters

Iran has many disaster risks. Iran, which is located in a region which is globally known as a barren arid zone, is frequently hit by droughts. The other main types of natural disasters consist of floods, sand storms and dust storms. However, the foremost concern consists of the

earthquake risk along the western border and in the northeastern region. Iran has suffered an extremely large number of earthquakes that have caused extensive damage due to its location in the Alpine-Himalaya mountain system.

Among damage caused by past earthquakes, memory of the Bam Earthquake (Magnitude 6.6) that occurred at 1:56 in the morning on December 26, 2003 is still fresh. This earthquake was followed by a number of large aftershocks for some time that are rarely seen in Iran. In addition, the magnitude 7.7 earthquake that struck the northern part of Iran on June 20, 1990 destroyed several hundred villages and towns, with more than 40,000 people died, 60,000 people injured and over 400,000 persons displaced.



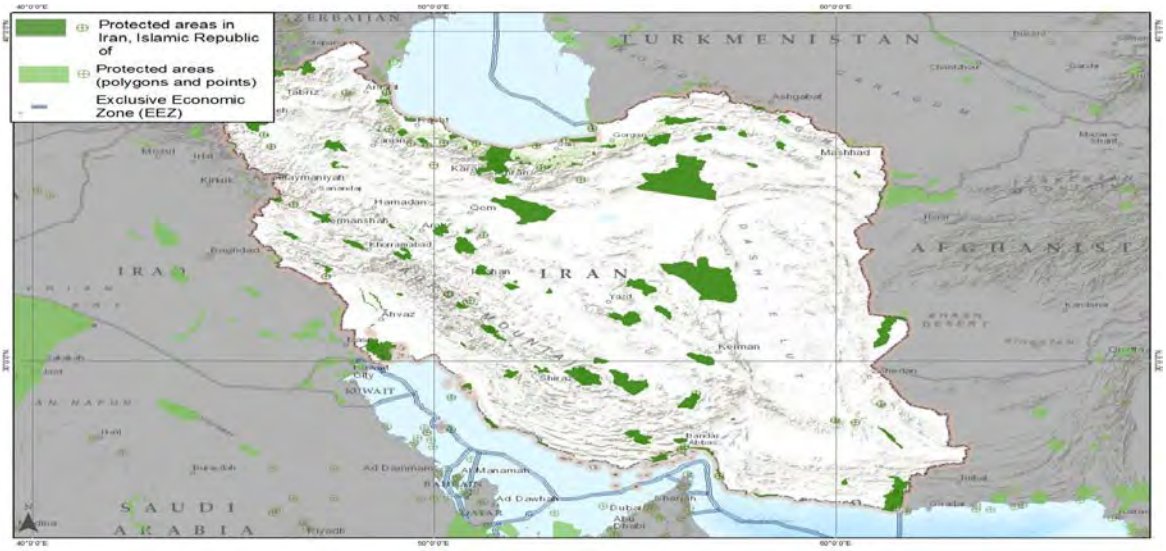
Source: Behrooz Tavakoli & Mohsen Ghafory-Ashtiany, "Seismic Hazard Assessment of Iran", Annali di Geofisica, vol. 42, N. 6, December 1999

Figure 8.1-3 Earthquake Risk Zone Classification Map ("Extremely High", "High", "Normal", "Low")

• Ecosystem

Iran is the habitat for approximately 8,000 types of plants, 140 types of mammals, 293 types of reptiles, 112 types of fish and 23 types of amphibians. Iran is also the home of many trees and plants that can be used for industrial purposes and traditional medicine applications. However, approximately 20% of the plants in Iran are suffering from endemic diseases. In addition, as of the year 2001, 20 types of mammals and 14 types of birds were in danger of extinction, including bears and cheetahs that live in the Balochistan region, Caspian sea lions, Persian lump deer, Siberian cranes, sea turtles, cobras, elephant seals, Caspian Sea wolves and dolphins. The

fact that 74 types of wildlife are included in the Red List (list of endangered species) published by the IUCN (International Union for Conservation of Nature) also indicates that the current condition of the ecosystem in Iran is in a precarious state.



Source: UNEP World Conservation Monitoring Centre (UNEP-WCMC), World Data on Protected Area (WDPA)
Data Status Report of Islamic Country of Iran, 2016

Figure 8.1-4 Protected Areas in Iran

- Protected Areas

The Department of Environment (DoE) was established by law in Iran in 1971 in order to protect the ecosystem, which is widely dispersed throughout the country, which was the year the Ramsar Treaty was concluded, and at the same time, six wildlife protection areas and 35 protected areas were designated. The said law stipulates designated areas with the objective of protecting and conserving four types of ecosystems. Designated areas consist of national parks, wildlife protection areas, protected areas and national nature monuments. These four types of designated areas are entrusted to the DoE, and have a total area of 7,563,983 ha.

Designated areas in Iran are on the rise on a yearly basis, increasing from 194 areas in 2010 to 274 areas in 2014. As of 2014, there were 29 national parks, 44 wildlife protection areas, 35 national monuments and 166 protected areas, 10 of which are managed as biosphere reserves. The area of all designated areas amounts to 10.4% of the total area of Iran.

Table 8.1-1 Type and Area of Designated Protected Areas in Iran

Type	Q'ty	Area	Percentage of All Protected Areas (%)	Percentage of National Territory
National Park	29	2,001,624	15.18	1.2
National Nature Monument	35	35,576	0/19	0.023
Wildlife Protected Area	44	5,595,746	29.49	3.4
Other Protected Area	166	9,116,779	55.12	5.5
Total	274	17,086,402.32	100	10.3

Source: Department of Environment, Fifth National Report to the Convention on Biological Diversity, April 2015

8.1.2 Environmental Problems

According to indicators in the UNEP (United Nations Environmental Programme), Iran is positioned 117th out of 133 countries in the world, and in 2011, air pollution in Iran reached the

worst level in the world. The main environmental problems in Iran consist of air pollution in cities, destruction of forests, overgrazing, desertification, loss of marshland due to droughts, salt pollution, pollution of the Persian Gulf due to oil spills and water pollution.

• Air Pollution

Air pollution in cities is terrible, mainly caused by exhaust gas from automobiles and gas emissions from oil refineries and plants. Lead is mixed into a large portion of the fuel used for automobiles, and there are many vehicles that do not have equipment to treat exhaust gas in an appropriate manner. In addition, the price of fuel which is kept low by subsidies by the government results in the problem of a pattern of high fuel consumption and not making efficiency improvements. In recent years, the number of patients with respiratory diseases has increased in the capital Tehran and Arak, a metropolis in the western part of the country.

According to the World Bank, economic loss due to diseases caused by air pollution amounted to approximately 260 million dollars, which is 0.23% of the GDP of Iran. In addition, according to the WHO, the number of deaths due to air pollution was 17,947 (2008), giving the country a rank of the 12th largest number of deaths due to air pollution in the world.

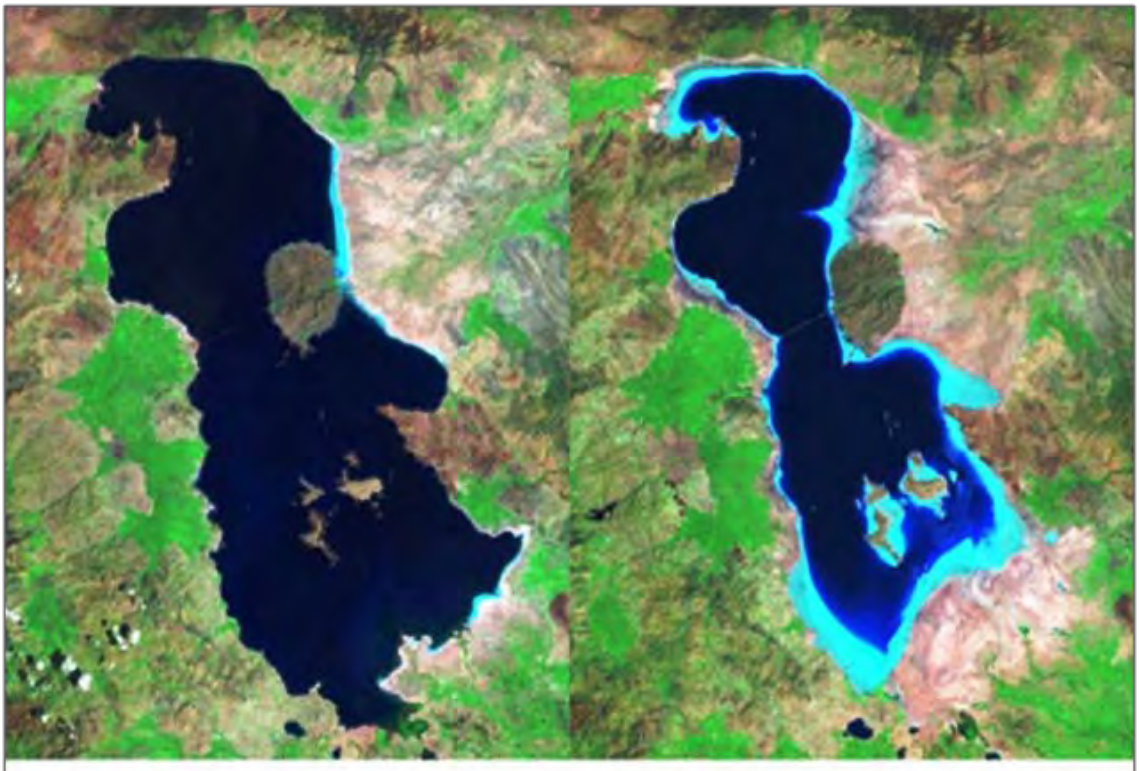
Year	NO_X			SO_X			CO			SPM		
	Transport	all	%	Transport	all	%	Transport	all	%	Transport	all	%
1996	482,353	814,698	59.21	222,069	1,159,598	19.15	4,168,382	4,263,156	97.78	174,008	236,419	73.60
1997	490,038	842,184	58.19	223,518	1,172,586	19.06	4,338,136	4,430,472	97.92	175,199	240,163	72.95
1998	500,054	858,251	58.26	220,343	1,087,576	20.26	4,810,020	4,908,250	98.00	172,917	237,721	72.74
1999	524,900	892,054	58.84	232,242	1,103,852	21.04	5,002,008	5,097,447	98.13	182,228	246,873	73.81
2000	565,982	956,179	59.19	249,045	1,151,368	21.63	5,461,405	5,557,984	98.26	195,451	262,169	74.55
2001	598,386	994,424	60.17	249,045	1,190,598	20.92	5,889,325	5,989,137	98.33	204,878	272,013	75.32
2002	659,670	1,056,752	62.42	313,360	1,182,885	26.49	6,504,356	6,606,247	98.46	223,215	285,893	78.08
2003	715,088	1,111,248	64.35	332,732	1,138,572	29.22	7,282,205	7,388,756	98.56	238,642	301,288	79.21
2004	753,808	1,169,293	64.47	325,793	1,431,784	22.75	7,845,632	7,956,644	98.60	249,234	313,600	79.48
2005	813,004	1,256,222	64.72	347,322	1,537,588	22.59	8,640,983	8,749,131	98.76	266,242	335,148	79.44
2006	853,845	1,346,571	63.41	354,657	1,675,534	21.17	9,512,573	9,619,466	98.89	273,446	351,091	77.88
2007	844,749	1,378,958	61.26	405,219	2,849,946	14.22	8,331,409	8,456,502	98.52	285,428	367,240	77.72
2008	885,245	1,808,553	48.95	423,770	3,197,234	13.25	8,685,865	8,973,628	96.79	299,968	386,758	77.56

Source: Amir Hossein Mohammadi et al, Evaluation of the Iran's Fuel Consumption and Emissions Reduction Policies in Transportation Sector, 2011

Figure 8.1-5 Air Pollutant Emissions and Share by Transport Sector (Tons)

• Water Crisis

Iran is located in an arid zone, and approximately 70% of rainfall evaporates. In addition, inappropriate water resource management is accelerating desertification and loss of marshland due to overuse of water resource such as ground water and surface water. In particular, the increase in the use of water for electric power generation and agriculture is posing the danger of the depletion of fresh water resources. In 2013, the Vice-Minister of the Ministry of Energy that manages water resources officially announced that water resources in Iran are in a critical situation. In addition, in the same year, Minister Kalantari of the Ministry of Agriculture announced that the water crisis in Iran is more of a national threat to Iran than Israel or the United States, and if the situation is not improved, Iran will become a land on which people can no longer live within 30 years.



Source: NASA, 2011

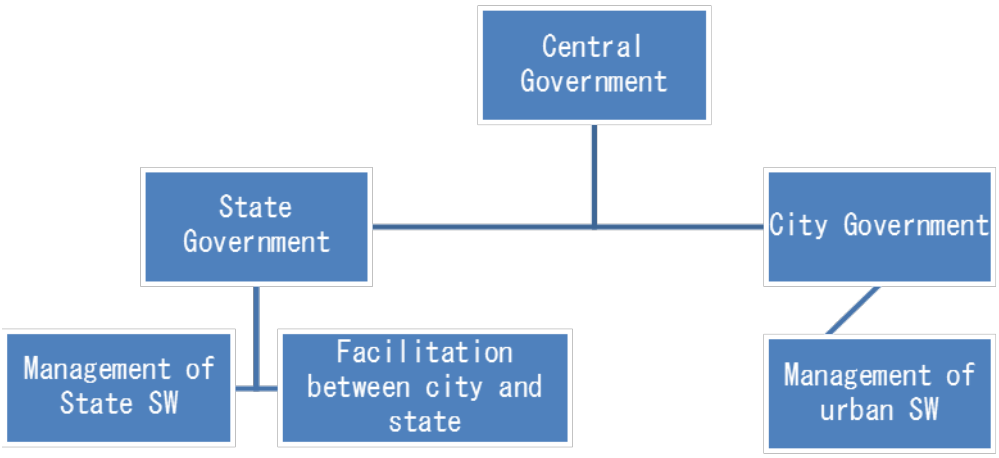
Figure 8.1-6 Change in Urmia Lake Surface Area Over Years (Left: 1985, Right: 2010)

- Soil Pollution

Several reports of soil pollution in Iran indicates that there is lead, arsenic and other heavy metal pollution in Mazandaran Province in the northern part of Iran and in the vicinity of industrial areas in Shiraz in the southern part of Iran. In addition, there are many cases in which phenol, aromatic compounds and other residual hydrocarbons generated by refineries are put into landfills, resulting in contamination of soil in the surrounding area due to leaching. Research papers have been issued by saying that the scale of soil pollution is proportionately high compared to the refining capacity of refineries in the vicinity.

- Waste Treatment

The Waste Management Act was established in Iran in 2004. This law classifies waste generated by human activity and waste discharged from electric power generation facilities into five types other than sewage that is defined as solid, liquid or gas: General waste, medical waste, specific waste (toxic, pathogenic, explosive, combustible, corrosive), agricultural waste and industrial waste. The law established strict regulations for the handling of medical waste and specific waste, and provides for the levying of fines in the event of violations. Local authorities are responsible for the management of waste, and have the ability to entrust individuals or entities with the sorting, collection and disposal of waste. In addition, waste management organizations have been created at local authorities starting in 2005. The waste management system in Iran is shown below.



Source: Mitsuo Yoshida "Trends and Issues for Modernization of General Waste Management Operations in Iran, Focus on Future Issues for ODA / Public-Private Partnership (PPP)" 2

Figure 8.1-7 Waste Management System in Iran

The rapid increase in the population of cities and expansion of cities in Iran has resulted in the volume of waste increasing on a yearly basis. According to data from 2004 for Tehran, the capital, the annual volume of solid waste was 2,555,000 tons. A breakdown of this waste based on weight indicates 68.8% of the waste is organic waste[76]. On the other hand, the amount of dry waste based on volume consisting of PET bottles, paper, cardboard, iron, glass, wood etc. amounted to 70%. However, due to the low amount of rainfall in Tehran, the necessity of dewatering to prevent soil contamination as a result of leaching is low since the water content of municipal waste is minimal. Solid waste accounts for 97% of waste in cities, with the remaining 3% consisting of medical waste, industrial waste and other waste.

According to a survey[77] conducted by the Ministry of Economy, Trade, and Industry of Japan in fiscal 2011, the main problems related to waste disposal in Iran consist of "overfilling of landfill sites, lack of appropriate processing of biogas and other substances generated at landfill sites, as well as an average distance of 70 km from the collection sites in cities to landfill sites, which is a major issue for local authorities in terms of operating costs caused by this transport distance that limits efficiency".

- PCB (Poly Chlorinated Biphenyl)

The Stockholm Convention on Persistent Organic Pollutants (POPs) that aims to eliminate or restrict the production and use of Poly Chlorinated Biphenyl (PCB), DDT and other persistent organic pollutants, reduce discharge of these pollutants and stipulates appropriate disposal methods for waste and other items that contain these substances which are persistent in the environment, have biological accumulation characteristics, are highly toxic to humans and other living organisms, and have the potential to travel long distances, was signed by Iran in 2005.

[76] Institutionen Ingenjörshögskolan, Waste Management System Modeling of Tehran, 2008
[77] Mitsubishi Research Institute, "Survey Report Concerning Fiscal 2011 Overseas Trends for Environmental Pollution, Environmental Regulations and Environmental Industry", 2012

The approximate estimated figures which are the results of the first inventory survey of PCBs that exist in Iran conducted by the Department of Environment starting in 2003 are shown below.

Table 8.1-2 PCB Inventory in Iran

Ministry Or Organization	Number of "pure" PCB equipment	"Pure" PCBs in Use in tons	Weight of "pure" PCB equipment in tons	Number of PCB Contaminated equipment	PCB contaminated oil in tons (over 50ppm <2000ppm)	PCB contaminated oil in tons (over 2000ppm)
Power & Energy	6200	1200	4200	2000	1530	120
Industries & Mines	500	300	1050	400	200	200
Oil	1000	200	700	400	300	300
Defense	2000	400	1400	200	400	400
Private Sectors	500	200	700	200	200	200
Total	10200	2300	8050	3200	2630	1220

Source: UNDP-GEF (2008) "National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants"

While taking of an inventory of PCBs is finally proceeding, technology and regulations concerning management and waste disposal have not kept up. The Department of Environment has established regulations concerning the recovery and storage of PCB contaminated oil by specified contractors that have been authorized, but the final disposal method has not been determined. In addition, the management conditions of PCB contaminated oil by specified contractors do not satisfy international standards.

8.1.3 Society

• Population

The population of Iran dramatically increased in the latter half of the 20th century, reaching 70 million in 2006. However, according to a large volume of research, the government is striving to control the growth rate of the population, and is thought to be attempting to stabilize the population at approximately 100 million. The population density is approximately 40 people per one square kilometer.

Iran is accepting foreign refugees (mainly Afghan refugees followed by Iraqi refugees), and is one of the countries in the world that has the most refugees, receiving high acclaim from the United Nations regarding this point. According to the World Bank, the immigrant (refugee) population in Iran was estimated to be 2,726,420 people as of 2015. However, Iran is striving to have the refugees return to their home country due to political and social factors. Conversely, it is estimated that there are between approximately two million to three million Iranians who emigrated overseas after the Islamic revolution in Iran to North America (Iranian Americans and Iranian Canadians), Western Europe, South America, Japan and other countries.

• Ethnic Groups

Classification of ethnic groups in Iran mainly depends on what language is spoken and the religion of the people. There are the following main ethnic groups that live in Iran: Persians (People who speak Persian: 51%), Azerbaijanis (People who speak Azerbaijani: 25%), Gilakis and Mazandaranis (People who speak Gilaki and Mazandarani: 8%), Kurds (7%), Arabs (4%), Balochi (2%), Lurs (2%), Turkmens (2%), Qashqai, Armenians, Georgians, Jews, Assyrians,

Talysh, Tati and others (1%). However, the above figures are simply one estimate, and there are no official statistics regarding the population / percentage of ethnic groups.

• Health and Hospital Facilities

Access to safe drinking water in Iran is the highest in the Middle and Near East, estimated to be 92%. As of 2007, access to safe drinking water was maintained at approximately 100% in cities and 80% in rural areas. On the other hand, sewage treatment facilities are extremely lacking, and sewage treatment facilities have not been completed for even a large portion of the citizens living in Tehran, with sewage being directly discharged to the ground water. In addition, the increase in population has made water shortages a serious problem, and pollution of groundwater is viewed as a problem that poses an increased health risk. At the same time that there is a problem with sewage, there are frequent cholera epidemics. In 2005, cholera infections were so bad that a warning was issued on television to not eat uncooked vegetables or buy ice on the street. However, when compared to international standards, the rate of infectious disease outbreaks is comparatively low. A comparatively low number of people are infected with HIV, and the rate is said to be 0.16% of the adult population (18,000 people in official records) (0.8% in North America). However, according to the WHO, the number of people infected with AIDS as of 2009 was 100,000 people. Furthermore, in terms of health in general, the number of people who suffered from malnutrition as of 2015 was approximately 40 Million, representing a rapid improvement tendency since 2012. Moreover, the death ratio due to infectious diseases, malnutrition and congenital diseases was 9.7% (2012).

• Unemployment and Poverty (Unemployment Rate: 11.2%) 12.8 (ILO Statistics 2014)

According to IMF statistics, the unemployment rate in Iran is 11.29% (2016). Unemployment had a decreasing tendency since 2010, but has continued to rise slightly since 2013. Furthermore, the government of Iran considers people who work one hour or more per week to be “employed”.

It has been pointed out that there is a tendency for an uneven number of the young to have been unemployed since the 1990s[78]. This is said to have rapidly risen with the increase in the young labor force population. Unemployment of people of age 30 or below accounts for 70 percent of the unemployed population. On the other hand, unemployment figures for the young generation when limited to cities is extremely low at only 3%.

Iran is classified as a middle-income country; with an average monthly salary of 500 U.S. dollars in 2010 (per capita GNI in 2012 was 13,000 U.S. dollars (PPP [Purchasing Power Parity])). The official poverty line in Tehran is 9,612 U.S. dollars, while the national poverty line is 4,932 U.S. dollars. In addition, in 2010, Iran’s Department of Statistical announced that approximately 10 Million Iranians live under the absolute poverty line and approximately 30 Million Iranians live under the relative poverty line.

• Education and Gender

According to an estimate in 2015, the rate of literacy was 93% of the population ages 15 or older, increasing substantially from a figure of 85% as of 2008. In addition, literacy among people of 15 – 24 years of age was even higher at 97%, with no gender difference.

Compulsory education is eight years in Iran from age 6, and the school attendance rate at elementary schools is nearly 100% for both boys and girls. The school attendance rate at middle schools is approximately 84% for boys and approximately 80% for girls. In addition, the education continuance rate for higher education (universities, junior colleges, etc.) is

[78] Hayata Kawaii “Social Change, Unemployment Problem Among Young Generation and Advances by Women in Society Since Islamic Revolution in Iran”, The Journal of Daito Asian Studies, Vol. 6 page 1-5 (20060331)

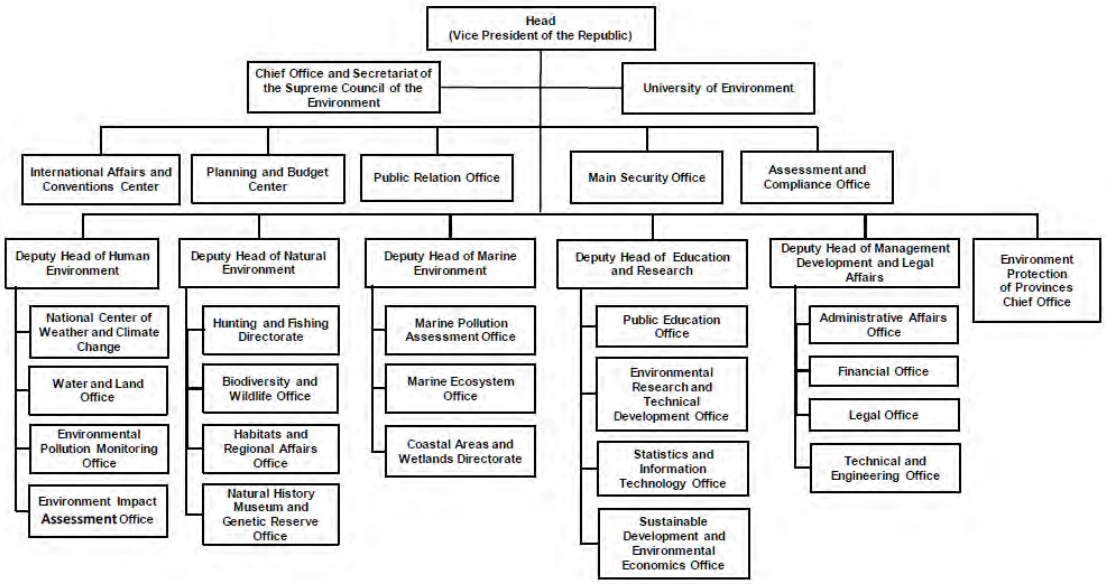
approximately 55%, but there is not a large difference between boys and girls, with girls accounting for approximately half the students. In particular, girls account for 70% of science and engineering classes. The main higher education institutions consist of Tehran University (1934), Amirkabir University of Technology (1958), Alzahra University (1964), Islamic Azad University (1982) and Sharif University of Technology (English version).

On the other hand, while there is a difference in employment opportunities for men and women, there has been the same level of gradual increase in the female population since 1986, and the labor force participation rate has risen, indicating women have made advances in entering society. Article 20 in the constitution of Iran stipulates there should be gender equity, but gender equity is denied in civil law and criminal law. In addition, Iran did not ratify the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW), which was adopted by the United Nations in 1985, on the basis that it violates Islamic law. However, the important point is that women are playing a conspicuously active role in society in general in Iran, although there are many limitations. One reason for this is a higher percentage of girls receiving higher education, and another reason is the social necessity for highly educated female specialists (doctors, etc.) to provide special services for women. Furthermore, according to the World Economic Forum held in 2015, the Gender Gap Index in Iran is 58, ranking it 141st in the world (Japan is 101st with 67 points, and Iceland is 1st with 88.10 points).

8.2 System and Organization for Environmental and Social Considerations

8.2.1 Department of Environment (DOE)

The Department of Environment was established in 1971 with the objective of protecting / improving the environment, preventing / managing pollution or deterioration that may hinder the environmental balance, and protecting wildlife and underwater life in territorial waters. The Department of Environment has provincial offices, and is conducting environmental monitoring at the provincial level. The organization structure of the Department of Environment is shown in Figure 8.2-1



Source: Department of Environment

Figure 8.2-1 Department of Environment (DOE) Organization Structure

8.2.2 Laws and Regulations Concerning Environmental Management

A. Main Domestic Legal System Concerning Environmental Management

The basic law for environmental management is the “Environmental Protection and Enhancement Act” which was promulgated in 1974 and revised in 1982. The Department of Environment is the authority having responsibility for applying / enforcing this law and regulations concerning environmental conservation.

Table 8.2-1 Main Laws and Regulations Concerning Environment in Iran

Laws/System Concerning Environment	Overview
No. 8592 (June 1974, Revised Nov. 1982)	Environmental Protection and Enhancement Act
1979	Article 50, Islamic Republic of Iran Constitution
1965 (Revised 1973)	Local Government Act (Describes authority concerning recommendations on air pollution, water pollution, sold waste treatment and pollution due to livestock raising)
1975	Implementation regulations of Environmental Protection and Enhancement Act that provides authority to grant environmental permits to DOE
1984	Guidelines concerning prevention of water pollution that indicate comprehensive regulations related to water pollution
1982	Water Distribution Act that indicates basic requirements to prevent pollution of fresh water resources
1992	Environmental hygiene guidelines that stipulate protection of drinking water
1993	Law concerning Iran's Marine Area in Persian Gulf and Gulf of Oman that stipulate basic requirements to prevent water pollution in Persian Gulf
1994	Order concerning environmental assessment made by Supreme Environmental Council
1996	Air Pollution Control Act that includes various sources of pollution such as industrial facilities, commercial facilities and vehicles
1996	Comprehensive regulations concerning sea pollution stipulated based on Iran's Marine Area Law enacted in 1993. Law concerning protection of marine area and borderline rivers from oil pollution as a result of construction / development of facilities on continental shelf and in special economic zones in Iran
1999	Implementation regulations for aquaculture protection concerning inland water and coastal aquaculture and fisheries
1999	Industry location regulations stipulating location regulations for commercial facilities
1999	Regulations concerning land use related to construction of facilities in areas outside city administrative areas that stipulate land use outside cities
2000	Air pollution implementation regulations that stipulate comprehensive rules for various types of air pollution based on Air Pollution Control Act
2004	Waste Management Act

Source: Trade Insurance Survey Report for OECD Member and Other Countries Concerning Environmental Problems, 2007

① Environmental Protection and Enhancement Act

The basic law for environmental protection in Iran is the Environmental Protection and Enhancement Act that was promulgated in June 1975, which was revised in November 1982. According to this law, the Department of Environment can order the owner of a plant to eliminate the source of pollution that is causing environmental pollution or stop operation. In addition, the Department of Environment is stipulated as the agency that creates laws, ordinances, regulations and guidelines concerning environmental protection.

② Laws and Regulations Concerning Air Pollution

Regulations concerning air pollution consist of the Air Pollution Control Rule of 1975 and the Air Pollution Control Act of 1994, which were established, based on the Environmental

Protection and Enhancement Act. These laws stipulate that the Department of Environment has the following responsibilities in order to prevent air pollution.

- Identification of source origin
- Establishment of allowable emissions values
- Examination and monitoring of plants and industry
- Setup of automobile emissions monitoring stations
- Provision of technical support to emissions monitoring stations operated by private sector
- Formulation of plans to reduce air pollution and instruction/guidance to industry

③ Laws and Regulations Concerning Water Pollution

The provisions of the Water Distribution Act of 1982 focus on the volume and quality to facilitate sustainable management of water resources. This law stipulates that managers of wells, qanats (underground water channels) and other water resources are responsible for preventing water pollution. In addition, the Water Pollution Control Rules that were established in 1984 based on the Environmental Protection and Enhancement Act stipulate monitoring of industrial and other water discharge, observation and other water discharge measures. Under this law, the Department of Environment is stipulated as being responsible for working with other government departments to cooperate on the enforcement of measures concerning the prevention of water pollution.

④ Laws and Regulations Concerning Waste Management

The Waste Management Act established in 2004 stipulates the framework for waste management in Iran. Furthermore, The Municipality Act of 1955 cites the role of local government in waste management and the prevention of industrial pollution.

⑤ Laws and Regulations Concerning Nature Conservation

The Environmental Protection and Enhancement Act (revised 1982) which is the basic environmental law in Iran stipulates the role of the Department of Environment and cites the importance of environmental protection. This law stipulates four types of nature preserves in Iran: “National Parks”, “National Nature Monuments”, “Wildlife Protection Areas” and “Protected Areas”. In addition, “Hunting Prohibited Areas”, “Marshland”, “Bird/Animal Protected Areas”, “Protecting Rivers” and “Special Ecosystem Reserves” are also designated in Iran, and these are all under the management of the Department of Environment.

⑥ Emission Standard

(i) Air Standard

Table 8.2-2 Air Standard in Iran

Substance	Average Time	Fiscal 2013			
CO	8 Hour Average	10,000	µg/m3	9.4	ppm
	1 Hour Average	40,000	µg/m3	35	ppm
SO2	Annual Average			7	ppb
	24 Hour Average			144	ppb
NO2	Annual Average			21	ppb
	24 Hour Average			100	ppb
PM10	Annual Average	20	µg/m3		
	24 Hour Average	154	µg/m3		
PM2.5	Annual Average	10	µg/m3		
	24 Hour Average	35	µg/m3		
O3	8 Hour Average			75	ppb
	1 Hour Average			124	ppb

Source: Department of Environment

(ii) Emission Standard Concerning Air Pollution

Table 8.2-3 Emission Standard from Power Plants (April 2016)

	Pollutant	Unit	Allowed Limit(Note-2)		Type of Fuel
			Grade-1 New	Greade-2 Old	
Smokestack/Heat Transfer Device	NOx	mg/Nm^3	150	300	Gas Fuel
		mg/Nm^3	200	400	Mazut Fuel
		mg/Nm^3	200	250	Gasoline Fuel
	SO2	mg/Nm^3	100	200	Gas Fuel
		mg/Nm^3	700	800	Mazut Fuel
		mg/Nm^3	100	150	Gasoline Fuel
	Particles	mg/Nm^3	100	150	Coal
	CO	mg/Nm^3	150	200	
	H,S	mg/Nm^3	6	8	

Source: Department of Environment

Notes-1

Reference oxygen got gas and liquid fuel is 3%, and, for solid fuel is 5%. For waste kiln this amount is 11%, for gas turbine 15% and in cement factory is 10%.
Each environment office will carry out revision if receiving the required documents regarding exhausted oxygen by industries.

Note-2

Grade-1 is the project which has never gotten approval of the EIA , and Grade-2 is the project which has gotten approval of the EIA. A standard applied by presence of the EIA approval changes.
In spite of whether it's newly-established, applied standard changes with a presence of EIA approval. .

(iii) Effluent Standard

Table 8.2-4 Effluent Standard from Power Plants (April 2016)

No	Pollutant Material	Unit	Discharge to Surface Water	Discharge to Absorbent Well
1	Cadmium (Cd)	mg/lit	0.1	1
2	Free Chloride (Cl)	mg/lit	1	1
3	Mercury (Hg)	mg/lit	Trace	Trace
4	Magnesium (Mg)	mg/lit	100	100
5	Nitrite as NO2	mg/lit	10	10
6	Nitrite as NO3	mg/lit	50	10
7	Phosphate as P	mg/lit	6	6
8	Lead (Pb)	mg/lit	1	1
9	Sulfite (SO3)	mg/lit	1	1
10	Sulfate (SO4)	mg/lit	400	400
11	Fat Oil	mg/lit	10	10
12	BOD	mg/lit	30 (instantly 50)	30(instantly 50)
13	COD	mg/lit	60 (instantly 100)	60 (instantly 100)
14	Dissolved Oxygen (DO)	mg/lit	2	-
15	Total Dissolved Substance (TDS)	mg/lit	Note 1	Note 2
16	Total Suspended Substance (TSS)	mg/lit	40 (instantly 60)	-
17	Sedimented Substance (SS)	mg/lit	0	-
18	pH		6.5 – 8.5	5 - 9
19	Temperature		Note 3	

Source: Department of Environment

Notes:

1. Discharge of higher concentrations than shown in the above table will only be permitted if chloride, sulphate, and the dissolved material of the receiving source does not increase more than 10% at a radius of 200 meter distance.
2. A higher concentration discharge than the above table is only allowed if chloride, sulphate and the dissolved substance of drainage are not more than 10% of consuming water
3. Temperature should be kept in a range that dose not increase the temperature of the receiving source to more than 3 degree at a radius of 200 meter.

(iv) Standard Concerning Noise/Vibration

Article 2 of the Noise Control Act that was issued in February 1999 stipulates environmental standards concerning noise as shown in Table 8.2-5. The standard for industrial areas will be applied for this project. Moreover, it should be noted that no regulation of vibration is established.

Table 8.2-5 Noise Limits in Industrial Areas (dBA)

Item	Daytime (07:00-22:00)	Night (22:00-07:00)
Residential Areas	55	45
Residential Areas + Commercial Areas	60	50
Commercial Areas	65	55
Residential Areas + Industrial Areas	70	60
Industrial Areas	75	65

Source: Department of Environment

B. International Treaties

The international treaties that Iran has signed/ratified are described below.

- UN Conference on the Man & Environment (Stockholm Declaration-1972)
- UN Conference on Environment & Development (Rio Declaration-1992)
- AGENDA 21-Character for Future (Rio-1992)
- Principal on the Conservation of the Forests (Rio-1992)
- United Nations Environment Program (UNEP-1972)
- International Union Conservation Nature & Natural Resources (1948)
- Convention on Wetlands (Ramsar-1971)
- Convention Concerning to the Protection of the World Cultural and Natural Heritage (UNESCO-1972)
- Convention for the Protection of the Ozone Layer (Vienna – 1987)
- Protocol on Substances that Deplete the Ozone Layer (Montreal – 1987)
- Convention on the Control of Trans-boundary Movement of Hazardous Wastes & Their Disposal (Basel – 1989)
- UN Framework Convention on Climate Change (New York – 1992)
- Kyoto Protocol to the UN Framework Convention on Climate Change (Kyoto–1998)
- UN Convention to Combat Desertification (Paris – 1994)
- Convention on the Prevention of Marine Pollution by Dumping of Waste and other Matter (London – 1972)
- Convention on Oil Pollution Preparedness, Response and Co-operation (London – 1990)
- Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (Brussels – 1969)
- Protocol Relating to Intervention on the High Seas in Cases of Pollution by Substances Other Than Oil (London – 1973)
- Berne Treaty on the Protection of Endangered Species in Their Habitats
- CITES Convention (Control of International Trade in Endangered Species)

8.2.3 Environmental Impact Assessment (EIA) System

The first regulations concerning environmental issues for development projects (mainly industrial activities) were established in Iran in 1975. The Supreme Council for the Environment approved the decree concerning environmental impact (Environmental Impact Assessment Decree 138) in March 1994. Decree 138 (12/04/1994) stipulates that the Department of Environment has jurisdiction over Environmental Impact Assessments (EIA), under the supervision of the Environmental High Council (EHC). Paragraph 82 in the "Law of the Second Five Year Development Plan (1994-1998)" requires that an EIA be implemented in parallel with all feasibility studies (F/S) for major development projects. In addition, Paragraph 105 in the "Law of the Third Five Year Development Plan (1999-2003)" requires that an EIA report be prepared at the stage the site is selected according to regulations determined by the Supreme Council for the Environment. According to this law, in the electric power generation sector, projects for the construction of thermal power plants and construction of dams are subject to an EIA. However, the results of interviews of companies that own thermal power plants clarified that rehabilitation projects for thermal power plants are not subject to an EIA from the standpoint of impact on the environment. The government of Iran has prepared a system concerning the documents required for EIA and for SEA with the support of the United Nations Development Programme (UNDP) under the Project for Environmental Impact Assessment Enabling Activities and Capacity Building, IRA/97/017 that was implemented starting in 1997 in preparation for the implementation of Decree 138 (12/04/1994). In addition,

EIA guidelines were formulated in 2001 for projects requiring an EIA with the support of the UNDP. In the electric power generation sector, guidelines concerning the "Construction of thermal power plants (>100MW) and dams (with a height of 15m or more) have been formulated. The range of impact that should be considered in an EIA requires that three areas be covered: Physical environment, ecological environment and socioeconomic environment.

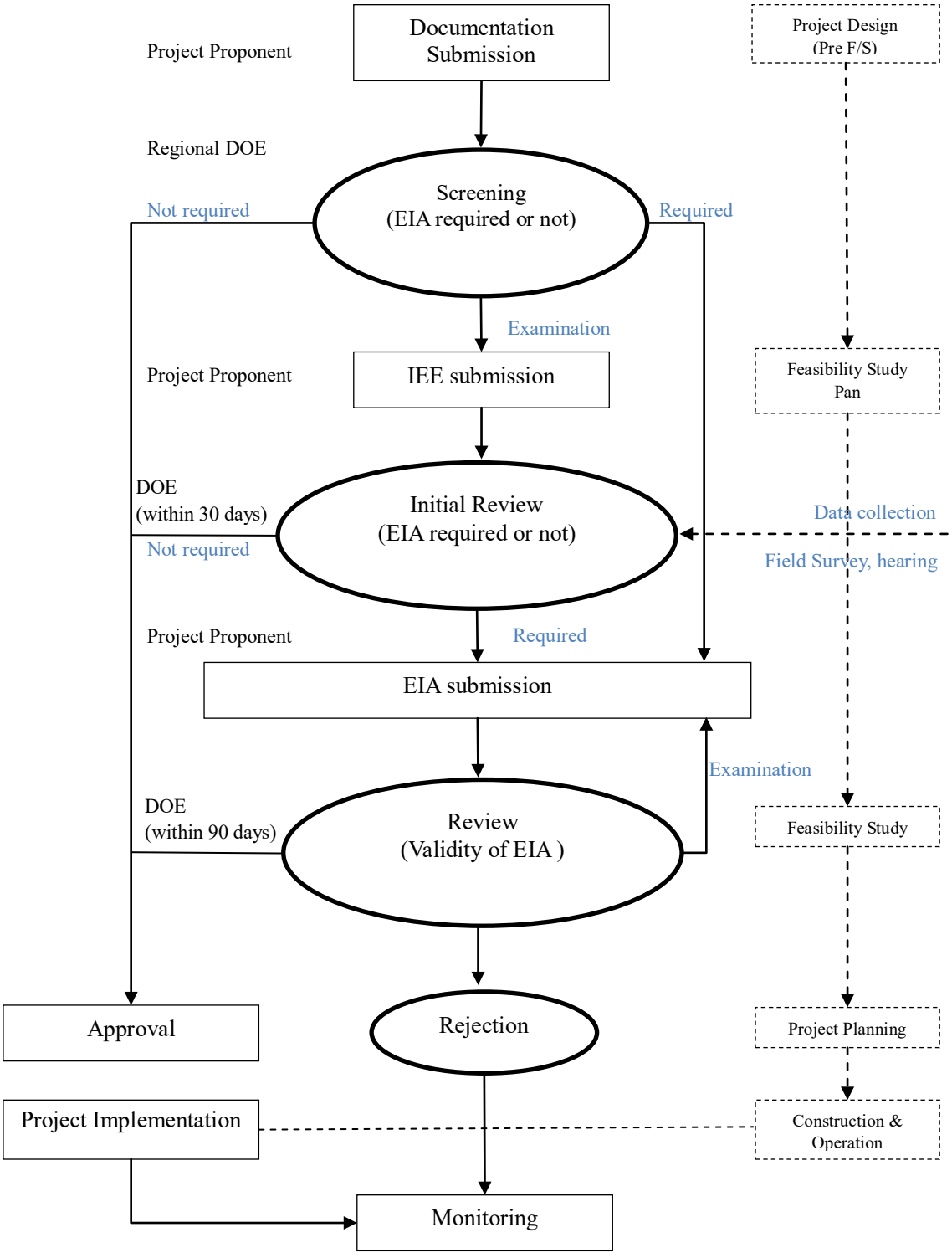
The basic EIA process is specified in the implementation regulations issued in 1997, under which the project implementing entity is required to conduct an EIA according to these regulations. Upon referring to the process indicated by the Department of Environment, it was found that it is stipulated that screening be performed in Iran, but it was found that regulations concerning explicit scoping work which is one of the most important processes in the EIA system, disclosure of the EIA report, public consultation or monitoring obligation of contractor do not exist. However, there is an obligation that is stipulated to conduct a questionnaire survey of neighborhood residents before the survey concerning the socioeconomic environment, and that measures to deal with issues of concern that became clear as a result of the questionnaire survey be described[79].

The EIA approval procedure flow is described in the implementation regulations issued in 1997.

The project implementing entity submits an application to the regional office of the Department of Environment (DOE), and that regional office performs screening as to whether or not an EIA is required for the said project. When the judgment is made that an EIA is required for the said project (when project deemed as one requiring EIA), the project implementing entity is requested to submit an "Advance (initial) EIA". After the completed "Advance EIA report" is submitted to the regional office of the Department of Environment, it is submitted to the Department of Environment main office (national office) in Tehran, and a review is conducted. The Department of Environment (DOE) determines whether or not an additional survey is required in one month, and when an additional survey is deemed necessary, the Department determines whether to approve, reject or conditionally approve the final version of the report that is resubmitted within three months. The Department of Environment submits the approved report to the government office with jurisdiction over the said project with recommendations.

The flow of the EIA approval procedure is shown in Figure 8.2-2.

[79] It has been clarified through interviews of the consultant that depending upon the target project, it may be exempt from implementation of a questionnaire survey of the neighborhood residents or environmental organizations. For example, this process is not required for construction of a combined cycle power plant.



Source: JICA Study Team

Figure 8.2-2 EIA Process

• Strategic Environmental Assessment (SEA)

In 2002, the Department of Environment requested support from the UNDP for SEA formulation together with MPO, and established the By-Laws on Article 183, 5th Economic, Social and Cultural Development Plan in Respect of Strategic Environmental Assessment (1391/2/30). In this law, the Environmental High Council (EHC) is the national authority in charge of SEA concerning national development plans, and the coordinating council in each region is in charge of regional development plans. The role of the regional coordinating council is to perform a strategic environmental impact assessment concerning regional development based on the standard established by the Environmental High Council (EHC), supervise activities for evaluation results, coordinate in the region in order to prepare regional development documents, establish indicators concerning environmental impact and perform evaluation. In addition, the By-laws on Article 185, 5th Economics, Social and Cultural Development Plan in respect of Sustainability Indices (1391/4/3), stipulates that indicators concerning sustainability should be established in accordance with decisions made by the 5th Five Year Development Plan, and that the Department of Environment should compile the required procedures. However, according to the Department of Environment, guidelines concerning SEA were still being prepared as of May 2016.

8.2.4 Site Acquisition / Resident Resettlement

When a site is newly acquired that is needed for construction of a power plant, electrical distribution or electric power substation cable laying, the process will proceed according to the many laws and regulations concerning land, real estate and city planning in Iran. Although there are clauses concerning involuntary resettlement in many laws, the respective clauses concerning the leasing of land and sales of land stipulate that government agencies cannot register rights for land required for a project unless the resident(s) are paid compensation required for expropriation of the land. Accordingly, it is deemed that the rights of residents are protected under current law. Furthermore, it is stipulated that the project entity should conduct negotiations with the resident(s) who own the rights to the land, and that the purchase price for the rights to the land be based on the market price. The main laws concerning land acquisition are listed below.

- The Civil Code of Iran (1928)
- Land Acquisition Law (1980)
- Law governing the Expropriation of Land for Public Projects, Military Usage and Infrastructure Improvements (1980)
- Law on Registration of Deeds and Properties

8.3 Collecting Data Required for Prediction, Evaluation and Monitoring of Impact

In this survey, in order to verify environmental problems at existing power plants, environmental data was obtained as reference examples from the Shahid Rajaee Power Plant and Shahid Mafatteh Power Plant which have been operating for nearly 20 years as important base load power in the suburbs of Tehran, and this data was used to verify environmental conditions during the scoping work that was conducted later. The environmental problems currently known at both power plants are described below.

- The main problems for operation of the existing Shahid Rajaee Power Plant consist of the high NOx emissions included in the exhaust gas and high SOx emissions included in the exhaust gas when operated using heavy fuel oil, which exceed the latest emissions standard values.

Table 8.3-1 Gas Emmision Value on Shahid Rajaee PP

Fuel	Natural Gas		Heavy Fuel Oil	
	Current Status	Regulatory Value	Current Status	Regulatory Value
NOx	242ppm	224ppm (300mg/m3N)	436ppm	299ppm (400mg/m3N)
SOx	—	70ppm (200mg/m3N)	478ppm	280 ppm (800mg/m3N)

- On the other hand, while the Shahid Mafatteh Power Plant currently satisfies the latest environmental regulations for NOx, SOx emissions included in exhaust gas when operated with heavy fuel oil exceed the standard value. However, operation with heavy fuel oil is limited to several days in one year (during the winter).

Table 8.3-2 Gas Emmision Value on Shahid Mofatteh PP

Fuel	Natural Gas		Heavy Fuel Oil	
	Current Status	Regulatory Value	Current Status	Regulatory Value
NOx	176ppm	224ppm (300mg/m3N)	328ppm	299ppm (400mg/m3N)
SOx	—	70ppm (200mg/m3N)	1267ppm	280 ppm (800mg/m3N)

- In addition, there are strict limits on underground water intake for the Shahid Mafatteh Power Plant, and plans call for the addition of dry cooling towers to reduce the amount of cooling water (one dry-type cooling tower has already been installed). Furthermore, in the region where this power plant is located, there have been reports of ground subsidence as a result of a drop in the groundwater level due to groundwater use for agricultural purposes and by the power plant.

Furthermore, diffusion simulation has been performed for the contaminants included in exhaust gas.

Both power plants have the problem of not satisfying the latest exhaust gas standards that were revised in April 2016.

Regarding the Shahid Rajaee Power Plant, there is a high possibility that the regulatory values can be satisfied by introducing low NOx burners and implementing various operation adjustments in order to optimize combustion. Furthermore, the only means to deal with the volume of SOx emissions is to change the fuel used during the winter, and the owner of the power plant is currently proceeding with an application to negotiate an increase in the volume of natural gas supplied to the plant.

8.3.1 Collection of Environmental Data for Power Plants

(1) Gas Emissions Data

Table 8.3-3 Gas Emissions Data for Rajaee Power Plant and Mofatteh Power Plant

	Sampling date	Unit	Steam Unit						Combined Unit					
			O2	CO2	CO	NOx	SO2	Fuel	O2	CO2	CO	NOx	SO2	Fuel
			%	%	ppm	ppm	ppm	-	%	%	ppm	ppm	ppm	-
Rajaee PP	Mar. 12nd, 2015	1	5.48	8.80	0	312	370	Gas and Mazut	15.45	3.61	2	150	61	Gas and Mazut
	Jun. 9th, 2016	1	5.48	9.04	0	242	0	Gas	14.48	4.22	3	123	0	Gas
	Aug. 28th, 2016	1	5.89	8.91	75	251	53	Gas	14.45	3.72	3	129	0	Gas
Mofatteh PP	May, 2016	3	3	13	2	194	2	N.G						
	Mar. 2016	2	4	12	0	85	0	N.G						
	Dec. 2015	4	3	12	3	315	1502	R.O						
	Sep. 2015	3	3	13	2	281	1320	R.O						
	Jun. 2015	2	5	12	2	302	1283	R.O						
	Mar. 2015	3	4	11	3	310	1301	R.O						
	Nov. 2014	2	4	12	1	292	1309	R.O						
	Jul. 2014	1	9	8	1	176	888	R.O-N.G						

(2) Water Discharge Data

Table 8.3-4 Water Discharge Data for Rajayee Power Plant and Mofatteh Power Plant

	DATE	PH	TSS mg/l	COD mg/l	BOD mg/l	NH3 mg/l	Mg mg/l	Ca mg/l	T c	Total Coliform in 100ml	Fecal Coliform in 100ml MPN
Moafatteh PP	2016/02	7.85	50	40	50	29	70	104	15	1100	1100
	2016/01	8.16	16	40	22	53	12	35	8	240	22
	2015/08	8.14	8	16	6	---	96	173	22	1100	43
	2015/07	7.7	360	115	70	---	63	107	24	1100	1100
	2015/02	7.6	12	7	2	---	12	13	14	1100	240
	2014/12	7.4	9	13	7	---	13	26	16	460	36
	2014/07	8.8	127	16	9	---	62	163	22	75	9
	DATE	PH	TSS mg/l	COD mg/l	BOD mg/l	Nitrate mg/l	Phosphate mg/l	Turbidity N.T.U	T c	Total Coliform in 100ml	Fecal Coliform in 100ml MPN
Rajaee PP	2014/05	7.54	6	12	5	61.13	4.3	4	24.5	>1100	1100
	2015/09	7.76	8	17	10	63.9	1.8	13	12	240	21
	2016/06	7.5	26	43.7	18.5	162	46	7.3	22.6	210	43
	2016/09	7.9	37	72.6	40	146	59.3	14.9	26.3	290	93
	2014/05	7.54	6	12	5	61.13	4.3	4	24.5	>1100	1100

8.4 Review of Environmental Impact of Power Plant and Substation Development Plans Required in Future

In this survey, due to the fact that deterioration of the important base load power supply was pointed out as a large problem in the electric power sector in Iran, a review was conducted that mainly focuses on the environmental impact when the power plants and substations are rehabilitated. The specific survey method consisted of review work in which interviews were conducted for the power plant management companies and Tehran regional electricity distribution company based on environmental impact assessment items in the following table. This table classifies / describes items thought to be necessary taking into consideration the characteristics of thermal power plant rehabilitation projects out of the classes / items specified in the environmental consideration item checklist presented in the JICA guidelines. Furthermore, in this survey, due to time limitations, the current survey will be implemented based on existing environmental data in order to review the environmental impact, and an actual on-site measurement survey will not be implemented.

The environmental impact prediction / evaluation is shown below as the results of the environmental impact review of the power plants and substations. Furthermore, when formulating each rehabilitation plan, an environmental management plan and monitoring modality need to be prepared based on these results.

Table 8.4-1 Relation of Environmental Impact Factors and Environmental Items in Power Plant Rehabilitation Plan

Environmental Elements				Construction				Operation						Assumed environmental issues
			Environmental Factors	loading and unloading of construction materials	operation of construction machinery	demolition works	industrial wastes	emissions from stack	waste water	process waste water	operation of power plant	loading and unloading of meintenance materials	wastes	
Pollution	air pollution	air	Sox					○						
			Nox	△				○				△		limited period of having heavy traffic
			PM	△				○				△		limited period of having heavy traffic
			dust			△		○				△		limited period of having heavy traffic
			hazardous					○						comply with applicable regulations
	noise		noise	○	○	○					○	○		heavy traffic is limited during night time. Also, conduct regular noise monitoring at the site boundary.
	vivration		vivration	△	△						△	△		limited period of having heavy traffic
	ordor													
	water pollution	water	dirt						○	○				monitoring to be conducted
			eutrophication						○	○				monitoring to be conducted
			Turbidity						○	○				monitoring to be conducted
			temperature						○	○				monitoring to be conducted
		bottom sediment	mud											no impact on bootom sediment from the project
			dirt											
		ground water	water level								△			effort to reduce ground water consumption
			quality				△						△	potential impact at the waste treatment site
	soil	Topography and geology												anchoring works at the beginneing of the construction
		soil ground	stability											to be checked before the construction
			subsidence											to be checked before the construction
		soil	contamination	△	△		△				△	△	△	potential impact at the waste treatment site
	others	Radio disturbance												
Biodiversity & Conservation	animal	Species-habitat												no influence as project are within the existing facility
	plants	Seed-community												no influence as project are within the existing facility
	ecology													no influence as project are within the existing facility
Social Environment	unvoluntary resettlement													no influence as project are within the existing facility
	population under poverty line													no influence as project are within the existing facility
	ethnic minority													no influence as project are within the existing facility
	employment & local economy													plan to hire workers from neighbor towns
	land use													no change on land use
	existing infrastructure and social services													enough social infrastructure
	conflict of interests													no change on the local activities
	cultural heritage													no cultural heritage around
	landcape													construction of collingtowers is to be announcement through media to the neighborhoods before the start of the construction
	epidimic			△										plan to hire workers from neighbor towns
	working condition			○							○	○		following safety manual
	accidents			○	○	○					○	○		following safety manual
Elements to be considered by stress level	wastes	solid waste					○				○	○	○	comply with applicable regulations
		hazardous waste	management				○				○		○	comply with applicable regulations
			soil contamination				△				△		△	comply with applicable regulations
	climate change			△				△	○					efficiency improvement (= less CO2 emissions) is expected
	natural dissaster													

※ ○ Impact needs to be considered, △ There is impact, but can be ignored

Normally, in the case that JICA supports both thermal power plants, development of large-capacity thermal power plants is classified as Category A,due to the large impact on the environment and society, but it is thought that for rehabilitation projects to upgrade equipment

at an existing power plant may be classified as Category B since the impact on the environment and society is extremely limited. As stated previously, the impact on the environment and society which is the main concern for rehabilitation projects mainly consists of the discharge / diffusion of environmental contaminants into the atmosphere. Fundamentally, effluent discharged from power plants is discharged to the surrounding area after processing at an effluent treatment facility within the power plant, and the environmental standards for effluent are maintained all the time. Naturally, since a site does not need to be newly acquired for a rehabilitation project, it does not involve any involuntary resettlement of residents.

Fundamentally, there will not be grading or other land preparation work during the rehabilitation projects, but when a portion of the project includes addition of cooling tower(s), there will be some grading work that is performed for anchoring of the tower, but this will be limited to work within the power plant site. In addition, there is the possibility of an impact on the scenery when cooling tower(s) are added. However, work that does not involve the installation of cooling towers does not have an impact on scenery. Regarding the area around the Shahid Rajaee Power Plant and Shahid Mafatteh Power Plant which are reference cases this time, scenic areas and heritage sites and ruins that are important historically / culturally have not been verified. In addition, endangered specifies have not been verified, and these issues may become a particular problem. Furthermore, in the interviews at the Shahid Mafatteh Power Plant where installation of cooling towers is being considered, plans do not call for the holding of a special explanatory meeting for the neighborhood residents to explain the issues for the installation of new cooling towers, but on the other hand, since this work will lead to a reduction in the volume of groundwater used which is a regional concern, it was verified that plans call for advertisements to be made concerning the work in the local newspapers and other media.

Both power plants face expressways, and are near medium scale cities with a population of 400 – 500 thousand people (city of Hamadan and Qazvin). Therefore, there are adequate lodging facilities for the increased number of workers to stay during construction work over a long period, and it is not expected to have an additional load on the existing infrastructure and social services. However, when the target power plant is located in a remote area, an environmental impact assessment needs to be carefully implemented from the standpoint of infrastructure and various services during construction work. Furthermore, it has been confirmed that laws in Iran stipulate that heavy items can only be transported during the night.

Consequently, the item in particular that can be expected to have a large impact for rehabilitation projects for existing power plants is the emission of atmospheric contaminants. Regulations of the Department of Environment make it mandatory to conduct ongoing environmental monitoring of exhaust gas and effluent. Therefore, introduction of monitoring facilities and the appropriate maintenance and management are indispensable. In addition, measures need to be implemented for ongoing monitoring of water quality, waste, soil contamination, noise/vibration and bad smells, as well as for the management and maintenance of equipment. Regarding the social environment and other such factors, it is expected that there will be a temporary impact on the regional economy and infrastructure due to the transit of construction vehicles during the work and noise / vibration / other types of disturbance during the work. However, in order to determine the details of the impact, a field survey needs to be conducted that includes the neighborhood residents to ascertain the actual situation, and those results need to be taken into consideration when implementing measures to alleviate obstructive factors for economic activity, make special arrangements for regional transport and establish work hour regulations.

The results of interviews conducted up until November 2016 for the respective environmental and social items are compiled in Table 8.4-2 below.

Table 8.4-2 Environmental Items Not Selected and Reason

Environmental Item	Reason Not Selected
Air Quality	There will be gas emissions due to operation of construction machinery and traffic of construction vehicles during construction work. However, since traffic of heavy vehicles will be limited to the initial construction period and the volume of traffic will be limited, the judgment is made that the impact will not be large. Furthermore, plans call for water to be sprinkled on the roads in the surrounding area as a measure to control dust caused by construction vehicles. There will be smokestack emissions due to facility operation after it is put into service. A simulation has already been implemented regarding the environmental standard for gas emissions, and the emissions at the maximum concentration where pollutants land have been compared against the environmental standard and verified (Sox emission exceed standard). Furthermore, since power plants are obligated to continuously perform monitoring by DOE, emissions concentration monitoring may be performed when the facility is put into service.
Noise/Vibration	Noise/vibration will be generated by construction vehicles during construction, but as stated above, since traffic of construction vehicles will be extremely limited, it is not expected to be a large problem. There is the possibility of noise/vibration during anchoring work in the initial construction period, but since this activity will be for a very short time, construction work plans will be explained to the surrounding residents over the media and other means before construction. As in the past, noise will be periodically measured at the site borders during the day/ night after the facility is put into service.
Offensive Odors	There will be no activities that cause offensive odors during construction/after in service.
Water Quality	It is not conceivable that activities during construction will have an adverse impact on the water environment. Water discharge will be monitored after put into service.
Wastes	Waste management/treatment will be performed according to Waste Management Law during construction/after placed in service. Furthermore, after placed in service, fly ash (hazardous waste) will be described and managed as hazardous waste, with an inventory of hazardous waste prepared/managed. In addition, disposal in an appropriate manner will be entrusted to a licensed subcontractor.
Soil Pollution	There is the possibility of soil pollution at waste disposal sites, but a licensed subcontractor will be used for disposal in the manner required by the Waste Management Law to ensure that disposal management is performed appropriately during construction and after placed in service. In addition, appropriate measures such as placing sheets will be taken in the work area during oil changes to prevent leakage of oil.
Radio Interference	NA
Ecosystem	Since construction activity/operation for rehabilitation will be performed within the existing power plant site, there is no possibility for adverse impact on the ecosystem.
Involuntary Resettlement	There is no resettlement for the above reason.
Ethnic Minorities and Indigenous Peoples	There is no impact on the ethnic minorities and disadvantaged population for the above reason.
Local Economies	There is no change in the local economy for the above reason.
Land Use	There is no change in land use since construction activity/operation will be performed within the existing power plant site.
Existing Social Infrastructure and Services	Adequate social infrastructure has been developed in vicinity of plant, and even when near 100 workers stay at the site temporarily, this will not create a large amount of stress for the social infrastructure or existing services.
Local Conflict of Interest	There will not be a change in vested interests since activities will be conducted at the existing power plant site.
Cultural Heritage	Since activities will be conducted at the existing power plant site, there will not be any activities that have a new impact on cultural heritages.

Landscape	Same as above (However, when a cooling tower needs to be constructed, work plans will be explained to the surrounding residents over the media and with other means before construction.)
Infectious Diseases	Nearly 100 workers will be newly hired during construction, but since plans call for hiring of workers in the vicinity, the risk of infectious disease is low.
Working Conditions	Safety management regulations/safety manual have been prepared at power plant.
Warming	Impact on warming during construction can be ignored. When put in service, plant will have smaller impact due to expected improvement in operating efficiency.
Natural Disaster	Activity will not adversely influence natural disasters or increase damage.

An environmental impact prediction / evaluation that shows the results of a review of the environmental impact of the substation facilities is shown below.

Table 8.4-3Relationship of Environmental Impact Factors and Environmental Items in Substation Rehabilitation Plan

Environmental Elements \ Environmental Factors				Construction				Operation						Assumed environmental issues
				loading and unloading of construction materials	operation of construction machinery	demolition works	industrial wastes	emissions from stack	waste water	process waste water	operation of power plant	loading and unloading of meintenance materials	wastes	
Pollution	air pollution	air	Sox					○						
			Nox	△				○				△		limited number of loadings
			PM	△				○				△		limited number of loadings
			dust			△		○				△		limited number of loadings
			hazardous					○						
	noise		noise	△	△	△						△		limited number of loadings
	vivration		vivration	△	△							△		limited number of loadings
	ordor													no activities causing ordor
	water pollution	water	dirt						○					
			eutrophication						○					
			Turbidity						○					
			temperature							△				no activities causing any impact on water
		bottom sediment	mud											
			dirt											
		ground water	water level											
			quality											
	soil	Topography and geology												
		soil ground	stability											no activities associated with land excavation
			subsidence											
		soil	contamination	○	○		○	○	○	○	○	○	○	potential impact at the waste treatment site
	others	Radio disturbance									△			no impact from the field test
Biodiversity & Conservation	animal	Species-habitat												no influence as project are within the existing facility
	plants	Seed-community												no influence as project are within the existing facility
	ecology													no influence as project are within the existing facility
Social Environment	unvoluntary resettlement													no influence as project are within the existing facility
	population under poverty line													no influence as project are within the existing facility
	ethnic minority													no influence as project are within the existing facility
	employment & local economy													plan to hire workers from neighbor towns
	land use													no change on land use
	existing infrastructure and social													enough social infrastructure
	conflict of interests													no change on the local activities
	cultural heritage													no cultural heritage around
	landcape													urban area or industrial zone
	epidimic			△								△		plan to hire workers from neighbor towns
	working condition			○							○	○		following safety manual
	accidents			○	○	○					○	○		following safety manual
Elements to be considered by stress level	wastes	solid waste					○				○	○	○	comply with applicable regulations
		hazardous waste	management				○				○		○	comply with applicable regulations
			soil contamination			△	△						△	no PCB use
	climate change													
	natural dissaster													

※ ○ Impact needs to be considered, △ There is impact, but can be ignored

Development of substations is not subject to EIA implementation in Iran, and when equipment at an existing substation is upgraded, since the impact on the environment and society is extremely limited, an EIA does not need to be prepared. However, for development that is dedicated to power transmission that includes rehabilitation of substations, there are some cases that this will involve resettlement of residents. In this event, the power transmission / substation company confirms the land owners on the route, the legal department in that company purchases land from the land owners, or implements price negotiations for the setting of rights. In Iran, there are almost no route plans that include the arbitrary construction of power poles for distribution of electricity for locations where buildings have already been constructed, and negotiations with land owners are often conducted with the objective of securing the offset distance been other structures and adjacent intersections as stipulated by law. A construction permit for a project can only be obtained after the land acquisition work by the legal department is completed.

The main environmental / social impact to be concerned about for a substation facility rehabilitation project consists of disposal of PCBs. The substation facilities in the suburbs of Tehran that were visited this time did not have any equipment that use PCBs, but there is the possibility that disposal of equipment that use PCBs may be required depending upon the substation. In addition, when power transmission lines are newly constructed, it is expected that grading and other land preparation work will be needed, raising the concern for impact on the scenery, and impact on historical / cultural heritage sites / ruins / protected areas. Furthermore, ongoing monitoring of whether or not there are any endangered specifies is thought to be necessary before construction is started and during the period of construction. However, the Department of Environment does not conduct ongoing environmental monitoring at substations.

Since the substations that were visited this time are located in densely populated zones such as residential areas and industrial parks, there are adequate lodging facilities for the increased number of workers during construction as well as social services. However, when the target substation is located in a remote region, it is thought that a more detailed survey needs to be conducted regarding the impact from the standpoint of the infrastructure and various services during the period of construction, such as actually visiting the site. Furthermore, since it has been confirmed that laws in Iran stipulate that heavy items can only be transported during the night, it is thought that noise / vibration due to the entrance and exit of construction vehicles will be limited.

Consequently, the item in particular that can be expected to have a large impact for rehabilitation projects for existing substations is the need to dispose of PCBs. In addition, measures need to be implemented for ongoing monitoring of water quality, waste, soil contamination, noise/vibration and bad smells, as well as for the management, maintenance and inspection of monitoring equipment. Regarding the social environment and other such factors, it is expected that there will be a temporary impact on the regional economy and infrastructure due to the transit of construction vehicles during the work and noise / vibration / other types of disturbance during the work. However, in order to determine the details of the impact, a field survey needs to be conducted that includes the neighborhood residents to ascertain the actual situation, and those results need to be taken into consideration when implementing measures to alleviate obstructive factors for economic activity, make special arrangements for regional transport and establish work hour regulations.

The results of interviews conducted up until November 2016 for the respective environmental and social items are compiled in Table 8.4-4 below.

Table 8.4-4 Environmental Items Not Selected and Reason

Environmental Item	Reason Not Selected
Air Quality	There will be gas emissions due to operation of construction machinery and traffic of construction vehicles during construction work. However, since traffic of heavy vehicles will be limited to the initial construction period and the volume of traffic will be limited, the judgment is made that the impact will not be large. Furthermore, plans call for water to be sprinkled on the roads in the surrounding area as a measure to control dust caused by construction vehicles. There will be no activities that influence air quality after put into service.
Noise/Vibration	Noise/vibration will be generated by construction vehicles during construction, but as stated above, since traffic of construction vehicles will be extremely limited, it is not expected to be a large problem. As in the past, noise will be periodically measured at the site borders during the day/ night after the facility is put into service.
Offensive Odors	There will be no activities that cause offensive odors during construction/after in service.
Water Quality	It is not conceivable that activities during construction/after in service will have an adverse impact on the water environment.
Wastes	Confirm whether or not there is any equipment that uses PCBs. When there is PCB waste, a contract is with a specified contractor is needed. Waste management/treatment will be performed according to Waste Management Law during construction/after placed in service. Furthermore, after placed in service, fly ash (hazardous waste) will be described and managed as hazardous waste, with an inventory of hazardous waste prepared/managed. In addition, disposal in an appropriate manner will be entrusted to a licensed subcontractor.
Soil Pollution	The possibility of soil pollution is greatly reduced since PCBs do not need to be disposed. In addition, there is a possibility of soil pollution at waste disposal sites, but a licensed subcontractor will be used for disposal in the manner required by the Waste Management Law to ensure that disposal management is performed appropriately during construction and after placed in service.
Radio Interference	Tests concerning radio interference has been conducted by the substation company.
Ecosystem	Adverse impact on the ecosystem is unlikely since the range of activity will be in an industrial area or in an urban area. In addition, since construction activity/operation for rehabilitation will be performed within the existing power plant site, there is no possibility for adverse impact on the ecosystem.
Involuntary Resettlement	There is no resettlement for the above reason.
Ethnic Minorities and Indigenous Peoples	There is no impact on the ethnic minorities and disadvantaged population for the above reason.
Local Economies	There is no change in the local economy for the above reason.
Land Use	There is no change in land use since construction activity/operation will be performed within the existing power plant site.
Existing Social Infrastructure and Services	Adequate social infrastructure has been developed in vicinity of plant, and even when near 20-30 workers stay at the site temporarily, this will not create a large amount of stress for the social infrastructure or existing services.
Local Conflict of Interest	There will not be a change in vested interests since activities will be conducted at the existing power plant site.
Cultural Heritage	Since activities will be conducted at the existing power plant site, there will not be any activities that have a new impact on cultural heritages.
Landscape	Same as above (However, when a cooling tower needs to be constructed, work plans will be explained to the surrounding residents over the media and with other means before construction.)
Infectious Diseases	Nearly 100 workers will be newly hired during construction, but since plans call for hiring of workers in the vicinity, the risk of infectious disease is low.

Working Conditions	Safety management regulations/safety manual have been prepared at power plant.
Warming	Impact on warming during construction can be ignored. When put in service, plant will have smaller impact due to expected improvement in operating efficiency.
Natural Disaster	Activity will not adversely influence natural disasters or increase damage.

When there is not a large change in the rehabilitation plan for power plant plants and substation facilities, preparation of an environmental management plan can be performed according to the above framework, and it is necessary to prevent the construction plan from having adverse impact on the surrounding environment, local society / economy / residents.