ISLAMIC REPUBLIC OF IRAN
AIR QUALITY CONTROL COMPANY
(AQCC)

PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR IMPROVEMENT
OF
EQUIPMENT FOR AIR POLLUTION ANALYSIS
IN
TEHRAN

MARCH 2017

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

SUURI-KEIKAKU CO., LTD.
ORIENTAL CONSULTANTS GLOBAL CO., LTD.

GE
JR
17-039

Summary

1. Outline of Iran

Population of Republic Islamic of Iran (Islamic Republic of Iran (hereinafter referred to as "Iran") is 78.47 million people in 2014, total area of Iran is approximately 1.648 million km2, which is approximately 4.4 times of Japan. Iran is the second most pollution country in middle-east and west Asia area, Persian people of Aryan occupies 60% of the population of Iran.

Tehran is located between 1,200m and 1,600m in elevation from the sea level and the climate is classified as a step climate. Thus, Tehran is mild climate area in Iran. An annual rainfall is 232 mm (1951 - 2010 average). As for the average temperature per month, it is the lowest in January (3.8 ℃) and the highest in July (30.3 ℃)[1] The temperature reaches over 40℃ during summer days, however, it settles to around 20℃ at night. On the other hand, in winter, the lowest temperature often reaches under zero ℃, and sometimes covered by snow.

2. Background of the Project

Government of Iran developed "5th Development Plan of the Islamic Republic of Iran" (2011-2016), and prioritized air pollution reduction, especially on source contribution study and emission reduction of particulate matter, and emission reduction of greenhouse gases. Although legal framework development is under the jurisdiction of Department of Environment (DOE), Tehran Municipality established Air Quality Control Company (AQCC) in order to measure air quality, analyze air pollution, promote air pollution countermeasures to DOE, and support technical issues of other cities which have important role in air pollution control for Iranian megacities (Tehran Provincial Directorate of DOE (hereinafter referred to as DOE-TPD) is responsible for air quality monitoring).

Concentration of Carbon Monoxides (CO) of Tehran had been reduced to less than air quality standard of Iran throughout several projects, including Japanese cooperation project, "The Study on an Integrated Master Plan for Air Pollution Control in The Greater Tehran Area in The Islamic Republic of Iran (1994-1997)" and "The Study on Strengthening and Improving Air Quality Management in the Greater Tehran Area in the Islamic Republic of Iran (2002-2004)". However, concentrations of PM10, PM2.5, Sulfur Dioxide (SO2), and Nitrogen Dioxide (NO2) often exceed the Iranian Air Quality Standards and are still primary pollutants. Within the pollutants, emission sources contributions and pollution structure of PM10 and PM2.5 are still not clear, thus, clarification and development of the countermeasures are necessary. In addition, although the concentration of carcinogens in Tehran is high, monitoring by the administrative agencies is very limited because the pollutants consist of many substances, and emission sources and measurement methods are complicated.

In recent years, AQCC has compiled a comprehensive emission inventory including pollutants

[1] I.R OF IRAN METEOROLOGICAL ORGANIZATION (IRIMO) http://www.chaharmahalmet.ir/iranarchive.asp

other than CO. However, with regard to mobile sources to which AQCC is under jurisdiction, calculation of emission factors reflecting the actual state of automobile exhaust gas in Tehran is an issue. In order to plan and implement countermeasures corresponding to the reasons of air pollution in Tehran City, improvement of air quality monitoring is necessary to clarify the source contributions and structures of air pollution, and to develop and evaluate the effective air pollution reduction measures on both of conventional air pollutants such as PM, SO2, and NO2 and toxic air pollutants such as VOC and PAH which are newly addressed.

Based on the background described above, in October 2015, Iran applied Grant Aid Project "the Project for Improvement of Equipment for Air Pollution Analysis in Tehran" to Japanese Government.

The project was reviewed by the 27th Development Project Accountability Committee of Ministry of Foreign Affairs of Japan on 26th April 2016, and has decided to begin the project preparatory study.

The purpose of this Grant Aid Project is through "autonomous measurement and analysis on the situation of air pollutants emission, air quality, and air pollution structure in Tehran City will be possible", conduct "preparing measurement and analysis equipment necessary to study air pollutant emission situation, air quality, and pollution structure in Tehran city".

This project will contribute to the overall goal, "to promote the development and implementation of effective air pollution counter measures in Tehran city".

3. Outline and Contents of the Project

Based on the request of Iran, Government of Japan decided preparatory survey for the Project implementation, and JICA dispatched preparatory survey of the Project from 28 July to September 2016. The survey team discussed request contents with AQCC in Tehran. Based on survey results and related documents of the Project, contents, size and quantity for appropriate equipment was examined.

Based on the survey results above, from 9 December to 27 December 2016, JICA dispatched team which explained draft report of preparatory survey, explanation on outline of draft outline and discussion results, outline of the targeted equipment is shown as below.

Table Outline of the Targeted Equipment

Equipment	Unit
Engine Dynamometer System for Diesel Vehicle	1
Portable Emissions Measurement System (PEMS)	2
Ion Chromatography for Quantitative Analysis of Ions in Ambient Particles Matters (IC)	1
Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES)	1
Gas Chromatograph Mass Spectrometer (GC/MS/MS for PAH analysis)	1
Gas Chromatograph Mass Spectrometer (GC/MS/FID for VOC analysis)	1
Phase Contrast Microscope	1
Micro Balance	1
Electrical Low Pressure Impactor	1
Air Quality Monitoring Station including Cabin	5
Air Quality Monitoring Station excluding Cabin	2

4. Implementation Schedule and Project Schedule

(1) Implementation Schedule

Total project implementation period will be approximately 30 months, which includes 9 months for implementation design, 15 months for procurement of equipment, and 6 months for soft component 6 months.

(2) Project Cost Estimation

Cost to be borne by the Iranian Side is 65.17 million Japanese Yen (19,167.9 million IRR).

5. Project Evaluation

(1) Relevance

The Project for Relevance of the Project as Japanese Grant is from below view points of view.

① Consistency of air quality related goals and indicators of Sustainable Development Goals (SDGs)

② Lifting of economic sanction on Iran nuclear and correspondence of advance for Japanese related industry

③ Expected ripple effect to another cities through supporting to AQCC

④ Acceleration of air pollution control measures expected through supporting AQCC

⑤ Contribution to public health of Tehran citizen

(2) Effectiveness

Below expected outcomes will be implemented by the Project.

1) Quantitative indicators

Key indicators	Baseline (2015)	Target (year 2022)
Emission gas measurement to be conducted by engine dynamometer	—	6 Automobile emission gas measurements will be conducted by engine dynamometer at least 6 times a year.
Emission gas measurement to be conducted by Portable Emission Measurement System (PEMS)	—	5 Vehicle will be measured at least 5 times a year.
Air pollutants to be analyzed by chemical analysis equipment	—	2 All equipment will be utilized every year, each equipment will be analyzed at least two times a year.
Reliable data of air quality monitoring (stationary monitoring stations)	1,525~4,208	6,000 Reliable data will be obtained for at least 6,000 hours at a station a year.

2) Qualitative indicator

Air pollution reduction in Tehran

Contents

Summary
Contents
Location Map/Perspective
List of Figures & Tables
Abbreviations

Chapter 1 Background of the Project 1-1

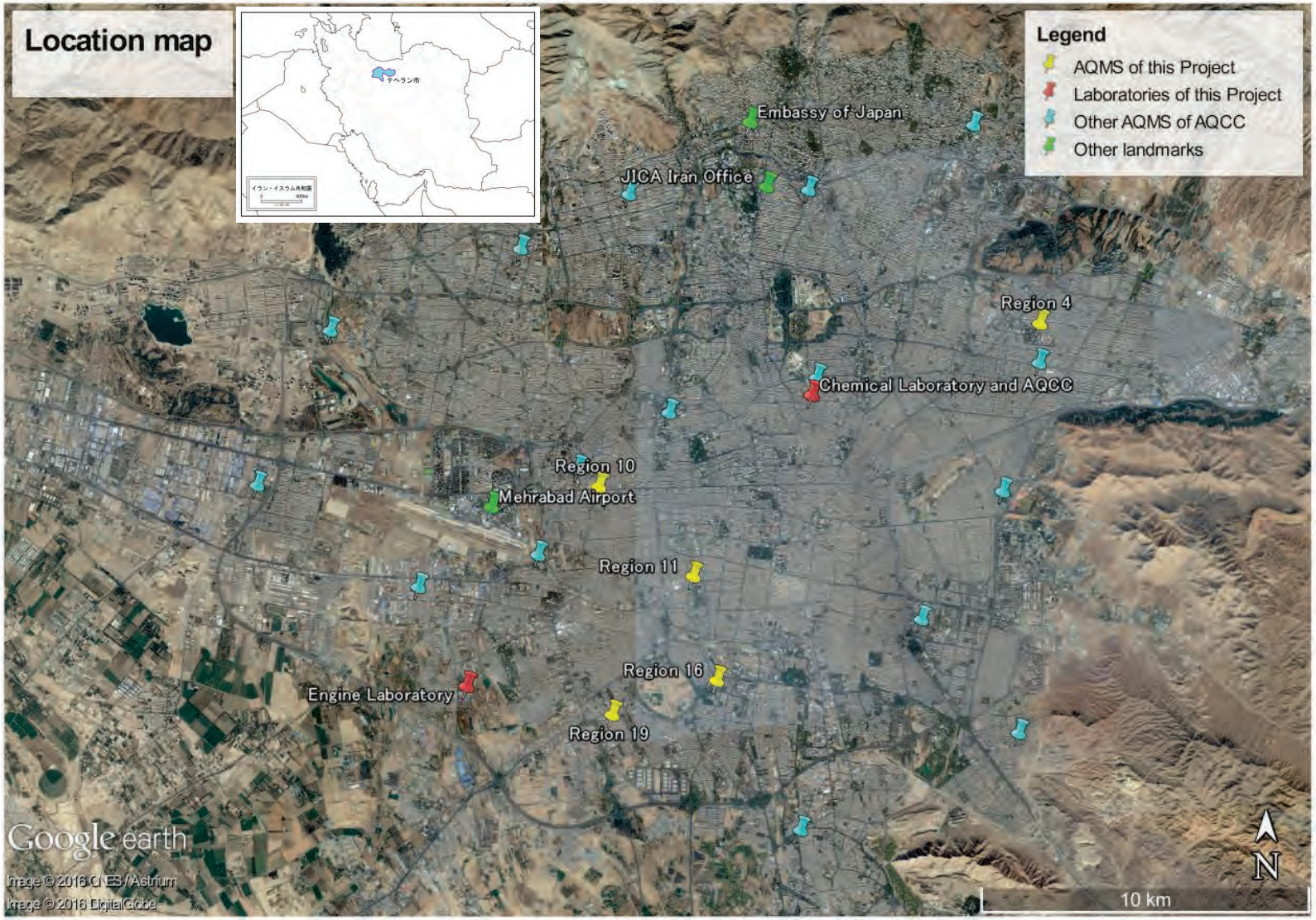
Chapter 2 Contents of the Project 2-1
2-1 Basic Concept of the Project 2-1
2-2 Outline Design of the Japanese Assistance 2-4
2-2-1 Design Policy 2-4
2-2-2 Basic Plan (Equipment Plan) 2-7
2-2-3 Outline Design Drawing (Site Plan, Laboratory Plan, Equipment Arrangement Plan) 2-21
2-2-4 Implementation Plan 2-27
2-2-4-1 Implementation Policy 2-27
2-2-4-2 Implementation Conditions 2-28
2-2-4-3 Scope of Works 2-31
2-2-4-4 Consultant Supervision 2-32
2-2-4-5 Quality Control Plan 2-32
2-2-4-6 Procurement Plan 2-34
2-2-4-7 Operational Guidance Plan 2-35
2-2-4-8 Soft Component (Technical Assistance) Plan 2-38
2-2-4-9 Implementation Schedule 2-74
2-3 Obligations of Recipient Country 2-75
2-4 Project Operation Plan 2-83
2-5 Project Cost Estimation 2-88
2-5-1 Initial Cost Estimation 2-88
2-5-2 Operation and Maintenance Cost 2-88

Chapter 3 Project Evaluation 3-1
3-1 Precondition 3-1

3-2 Necessary Inputs by Recipient Country 3-1
3-3 Important Assumptions 3-1
3-4 Project Evaluation 3-2
3-4-1 Relevance 3-2
3-4-2 Effectiveness 3-3

[Appendices]

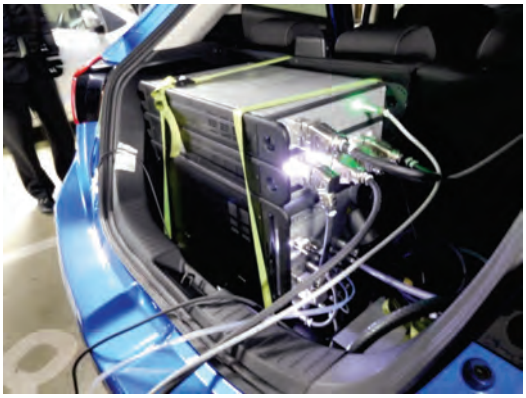
1. Member List of the Study Team
2. Study Schedule
3. List of Parties Concerned in the Recipient Country
4. Minutes of Discussions
5. Soft Component (Technical Assistance) Plan
6. Other Relevant Data (if applicable)
7. References


Location map
テヘラン市
イラン・イスラム共和国
Legend
AQMS of this Project
Laboratories of this Project
Other AQMS of AQCC
Other landmarks
Embassy of Japan
JICA Iran Office
Region 4
Chemical Laboratory and AQCC
Region 10
Mehrabad Airport
Region 11
Region 16
Engine Laboratory
Region 19
Google earth
Image © 2016 CNES / Astrium
Image © 2016 DigitalGlobe
N
10 km

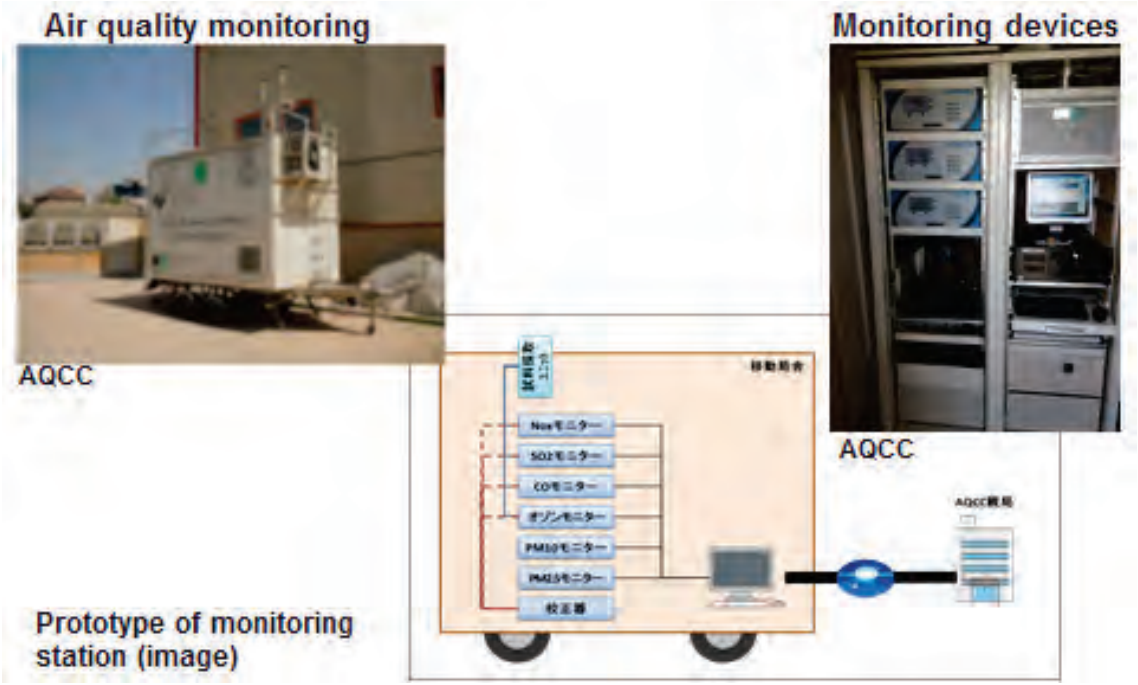
Perspective

Engine Dynamometer System for Diesel Vehicle

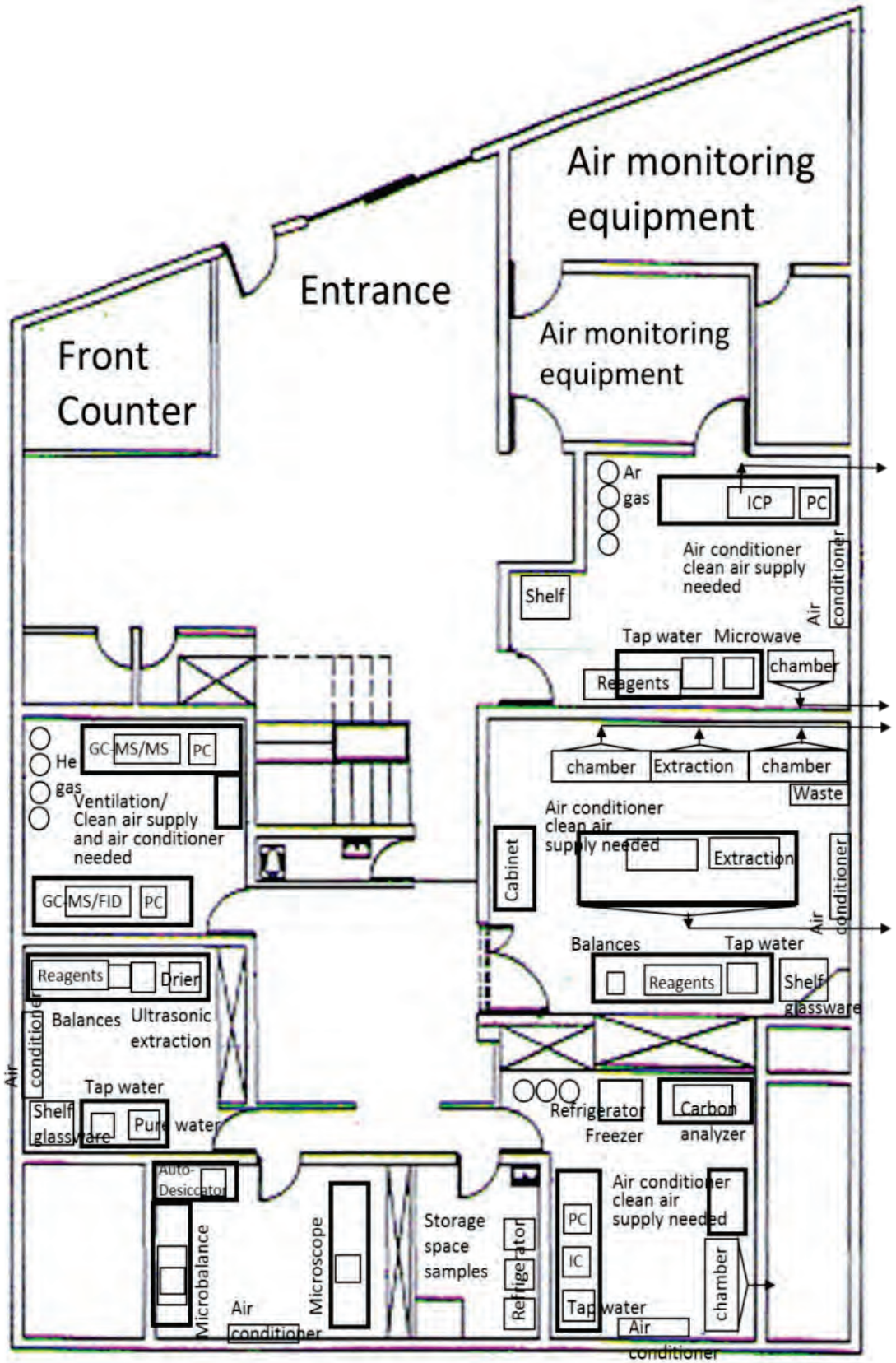
Portable Emission Measurement System (PEMS)



Engine Laboratory



Air Quality Monitoring Station



Chemical Laboratory

List of Figures & Tables

Table 1-1 Iranian Air Quality Standard and Count of Stations over than Standard 1-2
Table 2-1 Outline of the Project for AQCC 2-2
Table 2-2 Equipment Controlled by "List Control" of Export Control of Japan or United States of America 2-5
Table 2-3 Comparison of Requested Items and Project Components 2-8
Table 2-4 Key Specification and Count of Exhaust Emission Measurement Equipment 2-11
Table 2-5 Major Specifications of Equipment for the Chemical Analysis and the Ambient and Exhaust Particle Measurement 2-13
Table 2-6 Infrastructure Status at the Planned Facility for the Chemical Analysis Laboratory 2-15
Table 2-7 Major Specifications and Quantity of Equipment for Ambient and Exhaust Particle Measurement 2-16
Table 2-8 Main Specifications of Procurements for Air Quality Monitoring Stations 2-17
Table 2-9 Condition of Existing Monitoring Stations by AQCC 2-20
Table 2-10 Origins of Equipment 2-28
Table 2-11 Major Burdens by Each Government 2-31
Table 2-12 List of Sources of Equipment 2-34
Table 2-13 Initial Operation Guidance (Chemical Analysis Equipment and Ambient and Exhaust Particle Measurement Equipment) 2-36
Table 2-14 Outline of the Project 2-39
Table 2-15 Overall Goal of Soft Component 2-42
Table 2-16 Outcome of Soft Component 2-43
Table 2-17 Method to Confirm the Outcome Achievement 2-44
Table 2-18 Difference between Initial Operational Training and Soft Component 2-47
Table 2-19 Contents of Soft Component activities 2-48
Table 2-20 Performance and Capability for Training Instructor 2-51
Table 2-21 Implementation process of Soft Component (Draft) 2-52
Table 2-22 Outputs of Soft Component 2-52
Table 2-23 Implementation Process (Draft) 2-54

Table 2-24 Overview of the Support Plan of the Project 2-55
Table 2-25 Goal of Soft Component 2-58
Table 2-26 Outcomes of Soft Component 2-60
Table 2-27 Method to Confirm the Outcome Achievement 2-60
Table 2-28 Initial Operation Guidance and Analytical Technique Training in Soft Component 2-62
Table 2-29 Contents of Soft Component Activities 2-65
Table 2-30 Resource Input Plan from Japanese Side 2-69
Table 2-31 Performance and Ability Necessary for the Training Instructor 2-69
Table 2-32 Plan of Implementation Process of Soft Component 2-70
Table 2-33 List of Outcomes 2-71
Table 2-34 Plan of Implementation Process 2-73
Table 2-35 Implementation Schedule 2-74
Table 2-36 Cautionary Note about Infrastructure Renovation (Chemical Analysis Laboratory) 2-76
Table 2-37 Example of Major Equipment to be Purchased by Iranian Side 2-77
Table 2-38 Project Implementation Process and Responsibility of the Recipient Country for the Chemical Analysis Laboratory (Draft) 2-79
Table 2-39 Staffs of Related Section 2-84
Table 2-40 Approximate Annual Cost of the Major Consumables and Replacement Parts for Planned Procured Equipment 2-86
Table 2-41 Annual Labor Cost of Chemical Analysis Laboratory (Estimated) . 2-86
Table 2-42 Maintenance Cost of the First 10 Years 2-87

Figure 2-1 Site for Engine Dynamometer System 2-12
Figure 2-2 Location of the AQCC Building 2-14
Figure 2-3 Appearance of the Building and one of Rooms Planned for the Laboratory 2-15
Figure 2-4 Location of Air Quality Monitoring Stations 2-19
Figure 2-5 Site Plan (Draft) 2-21
Figure 2-6 Laboratory Plan (Draft) 2-21
Figure 2-7 Equipment Arrangement Plan 2-22
Figure 2-8 Building Overall Site Map 2-22
Figure 2-9 A Floor Plan (with Dimensions) of the First Floor in the AQCC Building 2-23

Figure 2-10 Equipment Layout (Draft) on the First Floor of AQCC Building .. 2-24
Figure 2-11 Location of the Top-five Stations in Priority Order 2-25
Figure 2-12 AQCC Owned Relocatable Cabin 2-26
Figure 2-13 Layout Plan of Air Quality Monitoring Station 2-26
Figure 2-14 Project Implementation Framework 2-27
Figure 2-15 Structure of AQCC and Numbers of Members 2-41
Figure 2-16 Division of Soft Component Target (Identified by Bold Line) 2-43
Figure 2-17 AQCC Organization Chart and Number of Members 2-58
Figure 2-18 The Division of Trainees to Attend Training on Analytical Technique (within bold line) 2-59
Figure 2-19 Organization and Staff Composition 2-84

Abbreviations

AMS	Aerosol Mass Spectrometer
APM	Ambient Particle Measurement
AQCC	Air Quality Control Company
AQMS	Air Quality Monitoring Station
CH4	Methane
CO	Carbon Monoxide
CO2	Carbon Dioxide
DOE	Department of Environment
DOE-TPD	Tehran Provincial Directorate, Department of Environment
DPF	Diesel Particulate Filter
EEPS	Engine Exhaust Particle Sizer
ELPI	Electrical Low Pressure Impactor
GC	Gas Chromatography
GC/MS	Gas Chromatography – Mass Spectrometry
GC/MS/MS	Gas Chromatography – Tandem Mass Spectrometry
GDP	Gross Domestic Product
HDV	Heavy Duty Vehicle
IC	Ion Chromatography
ICP-AES	Inductively Coupled Plasma Atomic Emission Spectroscopy
ICP-MS	Inductively Coupled Plasma – Mass Spectrometry
ISQO	Iran Standard & Quality Inspection Company
JICA	Japan International Cooperation Agency
LDV	Light Duty Vehicle
N2O	Nitrous Oxide
NH3	Ammonia
NO2	Nitrogen Dioxide
NOx	Nitrogen Oxide
O3	Ozone
PAH	Polycyclic Aromatic Hydrocarbon
PM	Particulate Matter
PM10	Particulate Matter less than 10 μm of particle size
PM2.5	Particulate Matter less than 2.5 μm of particle size
PMP	Particle Measurement Program

PN	Particulate Number
RDE	Real Driving Emissions
SMPS	Scanning Mobility Particle Seizer Spectrometer
SO2	Sulfur Dioxide
SOP	Standard Operating Procedures
THC	Total Hydrocarbons
TPWWC	Tehran Province Water and Sewage Company
VOC	Volatile Organic Compounds

Chapter 1 Background of the Project

1-1 General

Government of the Islamic Republic of Iran (hereinafter referred to as "Iran") developed "5th Development Plan of the Islamic Republic of Iran" (2011-2016), and prioritized air pollution reduction, especially on source contribution study and emission reduction of particulate matter, and emission reduction of greenhouse gases. Although legal framework development is under the jurisdiction of Department of Environment (DOE), Tehran Municipality established Air Quality Control Company (AQCC) in order to measure air quality, analyze air pollution, promote air pollution countermeasures to DOE, and support technical issues of other cities which have important role in air pollution control for Iranian megacities (Tehran Provincial Directorate of DOE (hereinafter referred to as DOE-TPD) is responsible for air quality monitoring).

Concentration of Carbon Monoxides (CO) of Tehran had been reduced to less than air quality standard of Iran throughout several projects, including Japanese cooperation project, "The Study on an Integrated Master Plan for Air Pollution Control in The Greater Tehran Area in The Islamic Republic of Iran (1994-1997)" and "The Study on Strengthening and Improving Air Quality Management in the Greater Tehran Area in the Islamic Republic of Iran (2002-2004)". However, as shown in Table 1-1, concentrations of PM10, PM2.5, Sulfur Dioxide (SO2), and Nitrogen Dioxide (NO2) often exceed the Iranian Air Quality Standards and are still primary pollutants. Within the pollutants, emission sources contributions and pollution structure of PM10 and PM2.5 are still not clear, thus, clarification and development of the countermeasures are necessary. In addition, although the concentration of carcinogens in Tehran is high, monitoring by the administrative agencies is very limited because the pollutants consist of many substances, and emission sources and measurement methods are complicated.

In recent years, AQCC has compiled a comprehensive emission inventory including pollutants other than CO. However, with regard to mobile sources to which AQCC is under jurisdiction, calculation of emission factors reflecting the actual state of automobile exhaust gas in Tehran is an issue. In order to plan and implement countermeasures corresponding to the reasons of air pollution in Tehran City, improvement of air quality monitoring is necessary to clarify the source contributions and structures of air pollution, and to develop and evaluate the effective air pollution reduction measures on both of conventional air pollutants such as PM, SO2, and NO2 and toxic air pollutants such as VOC and PAH which are newly addressed.

Based on the background described above, in October 2015, Iran applied Grant Aid Project "the Project for Improvement of Equipment for Air Pollution Analysis in Tehran" to Japanese Government.

The project was reviewed by the 27th Development Project Accountability Committee of Ministry of Foreign Affairs of Japan on 26th April 2016, and has decided to begin the project preparatory study.

Table 1-1 Iranian Air Quality Standard and Count of Stations over than Standard

Pollutant	Averaging Period	Standard		Count of Stations over than Yearly Standard	Count of Valid Stations in Annual Average	Ratio of Stations over than Standard
CO	8 Hours	9.4	ppm	----	----	----
	1 Hour	35	ppm	----	----	----
NO2	Maximum Hour of Day	100	ppb	----	----	----
	Year	21	ppb	12	14	86%
O3	Maximum Hour of Day	123	ppb	----	----	----
	8 Hours	75	ppb	----	----	----
PM2.5	Day	35	µg/m3	----	----	----
	Year	10	µg/m3	12	12	100%
PM10	Day	154	µg/m3	----	----	----
	Year	20	µg/m3	13	13	100%
SO2	Day	144	ppb	----	----	----
	Year	7	ppb	10	10	100%

Source: Tehran Air Quality Report (Period of March 2015 – March 2016), compiled by the Study Team

The purpose of this Grant Aid Project is through "autonomous measurement and analysis on the situation of air pollutants emission, air quality, and air pollution structure in Tehran City will be possible", conduct "preparing measurement and analysis equipment necessary to study air pollutant emission situation, air quality, and pollution structure in Tehran city".

This project will contribute to the overall goal, "to promote the development and implementation of effective air pollution counter measures in Tehran city".

In order to achieve the purpose described above, necessary equipment will be provided in order to develop autonomous measurement and analytical capability related to the emission situation of air pollutants, air quality, and pollution structure in Tehran city.

1-2 Natural Conditions

Tehran City is located in steppe climate, which is moderate climate in Iran. Annual rainfall is 232 mm (average from 1951 to 2010). Minimum average temperature (3.8 °C) is recorded in January. Maximum (30.3 °C) is recorded in July. Maximum temperature in summer reaches 40 °C in day time, but it goes down to around 20°C in night time. Minimum temperature in winter reaches minus temperature. Snow sometimes covers the ground.

1-3 Environmental and Social Considerations

Proposed project is classified as Category C because it is likely to have minimal adverse impact on the environment and society, according to "Japan International Cooperation Agency (JICA) - Guidelines for Environmental and Social Considerations (April 2010)"

Project includes the installation of engine dynamometer, PEMS, chemical analysis laboratory, ambient and exhaust particle studies laboratory, and air quality monitoring station. EIA (Environment Impact Assessment) is not necessary because it is not under the list of environment impact assessment regulation by MOE.

Noise, vibration and exhaust gas, and accessing traffic of the test vehicles are expected in engine dynamometer facility. Tehran municipality selected vacant property which is located at road side in industrial area, far from residential area. As the result, noise, vibration and exhaust gas of engine dynamometer will not affect the residential area.

Waste of chemical laboratory including toxic matters are planned to be stored in-site temporarily, and then delegated to waste operation companies as subcontract.

The locations of monitoring stations provided under the Project are in the premises of City / District hall and other relevant area, therefore the land acquisition and/or resettlement are not be expected.

Chanter 2 **Contents of the Project**

2-1 Basic Concept of the Project

2-1-1 Goal and Purpose

Government of the Islamic Republic of Iran (hereinafter referred to as "Iran") developed "5th Development Plan of the Islamic Republic of Iran" (2011-2016), and prioritized air pollution reduction, especially on source contribution study and emission reduction of particulate matter, and emission reduction of greenhouse gases. Although legal framework development is under the jurisdiction of Department of Environment (DOE), Tehran Municipality established Air Quality Control Company (AQCC) in order to measure air quality, analyze air pollution, promote air pollution countermeasures to DOE, and support technical issues of other cities which have important role in air pollution control for Iranian megacities (Tehran Provincial Directorate of DOE (hereinafter referred to as DOE-TPD) is responsible for air quality monitoring).

Concentration of Carbon Monoxides (CO) of Tehran had been reduced to less than air quality standard of Iran throughout several projects, including Japanese cooperation project, "The Study on an Integrated Master Plan for Air Pollution Control in The Greater Tehran Area in The Islamic Republic of Iran (1994-1997)" and "The Study on Strengthening and Improving Air Quality Management in the Greater Tehran Area in the Islamic Republic of Iran (2002-2004)". However, concentrations of PM10, PM2.5, Sulfur Dioxide (SO2), and Nitrogen Dioxide (NO2) often exceed the Iranian Air Quality Standards and are still primary pollutants. Within the pollutants, emission sources contributions and pollution structure of PM10 and PM2.5 are still not clear, thus, clarification and development of the countermeasures are necessary. In addition, although the concentration of carcinogens in Tehran is high, monitoring by the administrative agencies is very limited because the pollutants consist of many substances, and emission sources and measurement methods are complicated.

In recent years, AQCC has compiled a comprehensive emission inventory including pollutants other than CO. However, with regard to mobile sources to which AQCC is under jurisdiction, calculation of emission factors reflecting the actual state of automobile exhaust gas in Tehran is an issue. In order to plan and implement countermeasures corresponding to the reasons of air pollution in Tehran City, improvement of air quality monitoring is necessary to clarify the source contributions and structures of air pollution, and to develop and evaluate the effective air pollution reduction measures on both of conventional air pollutants such as PM, SO2, and NO2 and toxic air pollutants such as VOC and PAH which are newly addressed.

Based on the background described above, in October 2015, Iran applied Grant Aid Project "the Project for Improvement of Equipment for Air Pollution Analysis in Tehran" to Japanese Government.

The project was reviewed by the 27th Development Project Accountability Committee of Ministry of Foreign Affairs of Japan on 26th April 2016, and has decided to begin the project preparatory study.

The purpose of this Grant Aid Project is through "autonomous measurement and analysis on the situation of air pollutants emission, air quality, and air pollution structure in Tehran City will be possible", conduct "preparing measurement and analysis equipment necessary to study air pollutant emission situation, air quality, and pollution structure in Tehran city".

This project will contribute to the overall goal, "to promote the development and implementation of effective air pollution counter measures in Tehran city".

2-1-2 Basic Concept

Basic concept of the project to achieve the purpose described above is as follows.

Equipment in Table 2-1 will be provided in order to develop autonomous measurement and analytical capability related to the emission situation of air pollutants, air quality, and pollution structure in Tehran city.

Table 2-1 Outline of the Project for AQCC

Equipment		Expected Outcome	Input
1) Exhaust Emission Factor Measurement System	1.1) Engine Dynamometer System for Diesel Vehicle (400kW・4,000RPM) 1.1.1) Loading System 1.1.2) Measured-Data Acquisition 1.1.3) Test Stand Automation System 1.1.4) Media Conditioning Equipment 1.1.5) Exhaust Emission Measurement System	Administration capability can be focused to primary issues via developing emission factor specific for Tehran. In addition, higher performance countermeasures for Tehran specific conditions can be selected and promoted by measuring and comparing emission reduction performances of countermeasures.	1
	1.2) Portable Emissions Measurement System (PEMS)		1: Heavy Duty Vehicle (HDV) 1: Light Duty Vehicle (LDV)
2) Chemical Analysis Laboratory	2.1) Ion Chromatograph for Quantitative Analysis of Ions in Ambient Particle Matters	Analyzing emission source profile and source apportionment followed by conducting componential analysis on particulate matter, become available to make pollution abatement proposal to the relevant department.	1
	2.2) Inductively Coupled Plasma-Mass Spectrometry (ICP-AES) for Quantitative Analysis of Inorganic Constituents in Particulate Matters		1
	2.3) GC/MS/MS for PAH analysis		1
	2.4) GC/FID/MS for VOC analysis		1
	2.5) Phase Contrast Microscope for Conforming and counting asbestos		1
	2.6) Micro Balance for Weighting Filter Paper		1
3) Ambient and Exhaust Particle Studies Laboratory	3.1) Electrical Low Pressure Impactor		1
4) Air Quality Monitoring Station		It is expected that strengthening	5: Replacement

	of air quality monitoring contributes to clarify air quality condition in Teheran and to evaluate impact of control policies.	of Conventional Monitoring Stations 2: Mobile Monitoring Stations

2-1-3 Environmental and Social Considerations

Project includes the installation of engine dynamometer, PEMS, chemical analysis laboratory, ambient and exhaust particle studies laboratory, and air quality monitoring station. EIA (Environment Impact Assessment) is not necessary because it is not under the list of environment impact assessment regulation by MOE.

Noise, vibration and exhaust gas, and accessing traffic of the test vehicles are expected in engine dynamometer facility. Tehran municipality selected vacant property which is located at road side in industrial area, far from residential area. As the result, noise, vibration and exhaust gas of engine dynamometer will not effect the residential area.

Waste of chemical laboratory including toxic matters are planned to be stored in-site temporarily, and then delegated to waste operation companies as subcontract.

The locations of monitoring stations provided under the Project are in the premises of City / District hall and other relevant area, therefore the land acquisition and/or resettlement are not be expected.

2-2 Outline Design of the Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Policy

(1) Basic Policy

Tehran is continuously experiencing severe air pollution which is a level that warnings are being issued and tentative closing of education organizations and indoor standby. For this reason, the reduction of air pollution, especially the spontaneous emission gas measurement and analysis capacity improvement of the emission source of particulate matters and the control of the emission source control is required. The Project will install engine dynamometer adopted for Iran, laboratory for chemical analysis, laboratory for ambient and exhaust particles, and air quality monitoring stations to AQCC. These will be used in order to clarify the state of air pollutants emission and status of air quality in Tehran, and improve the analytical ability.

(2) Scope of the Project

The consultant team studied the background and contents of application by surveys in Tehran, throughout discussions of reason and prioritization of application, the consultant team reviewed the existing equipment owned by the executing agency. After the survey in Tehran, the consultant team developed specifications and quantities of equipment according to the basic policy mentioned above.

Discussion with the executing agency and cooperation contents decided as the results of the survey in Tehran and the analysis in Japan are described in "2-2 Basic Plan (Equipment Plan)".

2-2-1-2 Policy for Natural Environment

Tehran is located between 1,200 and 1,600 m in elevation from the sea level and the climate is classified as a step climate. Thus, Tehran is mild climate area in Iran. An annual rainfall is 232 mm (1951 - 2010 average). As for the average temperature per month, it is the lowest in January (3.8 °C) and the highest in July (30.3 °C)[1] The temperature reaches over 40°C during summer days, however, it settles to around 20 °C at night. On the other hand, in winter, the lowest temperature often reaches under zero °C, and sometimes covered by snow.

Since the target sites of the Project are scattered in Tehran, the selected installed equipment was designed by considering circumstances of Tehran such as the dry air and drastic temperature difference.

[1] I.R OF IRAN METEOROLOGICAL ORGANIZATION (IRIMO) http://www.chaharmahalmet.ir/iranarchive.asp

2-2-1-3 Policy for Socio-economic Conditions

As for economic sanctions against Iran, on January 16, 2016, P5 + 1 (US, the UK, France, Russia, China, and Germany) and Iran declared to implement the "Comprehensive Joint Action Plan (JCPOA)". Based on this, the United Nations, the United States, and the EU announced to cancel and stop the sanctions against Iran concerning nuclear weapons.

The sanctions have not been completely released, it became possible to deal with Iran without the US or American companies (for example, financial settlement by currencies other than the US dollar such as Japanese yen and euro) in general. However, the prohibition on export of US products to Iran still continues in accordance with the export control order. In addition, the prohibition on exports of Japanese products and technologies to Iran in accordance with the export trade control order of the list regulation stipulated by the Ministry of Economy, Trade and Industry is still continuing.

The policy was made by considering such restrictions on the Iran-specific import of equipment.

2-2-1-4 Policy for Procurement and Special Conditions/Business Practice

Among the equipment requested by AQCC, those listed in Table 2-2 are excluded from this project because they are controlled by "list control" of Export Control of Japan or by export control of United States of America.

Table 2-2 Equipment Controlled by "List Control" of Export Control of Japan or United States of America

Category	Controlled by "List Control" of Export Control by Ministry of Economy, Trade and Industry, Japan	Export Control of United States of America
Exhaust Emission Measurement	None	➢ Some brand equipment
Chemical Analysis	Inductively Coupled Plasma-Mass Spectrometry (ICP-MS)	➢ Thermal-Optical transmitter (TOT) Carbon Analyzer (*)
Ambient and Exhaust Particle Studies Laboratory	None	➢ Semi-Continuous OC-EC Field Analyzer
Air Quality Monitoring	None	➢ None
Complementary equipment (VOCs multi-components automated analyzer)	None	➢ None

* Thermal-Optical transmitter (TOT) Carbon Analyzer is one of the key analyzer to analyze PM contents, and strongly recommended to be procured in the future when the sanction is over.

2-2-1-5 Policy for Utilizing Local Resources (Construction Company and Consultants)

Iranian resources are to be used for setting concreate to install equipment, antitheft fence, and electricity equipment, and equipment installation. Unpacking, loading, assembly, and installation are planned to be executed by the local workers under the supervision of Japanese engineers.

2-2-1-6 Policy for Operation and Maintenance

AQCC, Air Quality Control Company in Tehran Municipality, measures, monitors, and analyzes atmospheric pollutants at Air Quality Monitoring Stations installed in Tehran Municipality. AQCC carries out the survey for air pollution countermeasures methods by automobile exhaust gas, setting air pollution standards, and setting the regulation/proposals in cooperation with other relevant agencies.

The department in charge of the Project is a newly established Chemical Analysis Laboratory (newly hired 4 staff) under Maintenance & Measurement Division and Automobile Exhaust Gas Laboratory (newly hired 3 staff) (Refer to "Chapter 4: Operation and Maintenance Plan of the Project").

Since AQCC officials require advanced expertise, staff in charge of chemical analysis laboratory and automobile exhaust gas laboratory will be employed from those who obtained professional education on chemical analysis and automobile exhaust gas measurement at universities and/or companies.

Furthermore, it is planned that a sufficient organization system will be operated by arranging experts with doctor degree on chemical analysis and automobile exhaust gas measurement as AQCC advisers.

2-2-1-7 Policy for Equipment Grade

The grade of grant equipment is specified as equipment which comply with Japanese or international standards, and equipment which includes advanced technology of Japan in the fields of monitoring, measurement and analysis for air pollutants and vehicle emission including PM.

2-2-1-8 Policy for Methods and Period of Procurement

If engine dynamometer requiring building construction and chemical laboratory equipment requiring interior work of laboratory which are to be burden of Iranian side fails to finish on time, the procurement schedule may be necessary to be changed.

In order to minimize such possibility, this project is designed to check burden of Iranian side frequently by procurement consultants, which are added at the detailed designing period. In addition, in order to minimize the delay of equipment which will not be affected by these burdens,

tenders are proposed to 3 lots, engine dynamometer system, chemical laboratory equipment, and others (PEMS and air quality monitoring stations).

2-2-2 Basic Plan (Equipment Plan)

2-2-2-1 Principles

Through the procurement of the equipment to measure air pollutants emission, monitor air quality, and analyze pollution structure in Tehran Municipality, the Project will contribute to measure air pollutant emission, monitor air quality, and analyze pollution structure by Tehran Municipality.

To attain the project goal as mentioned above, discussion with the related agencies, surveys in Tehran and technical study/analysis in Japan were properly conducted to design the project scope.

Table 2-3 shows a comparison of the requested items and the Project components determined through the discussions with the related agencies, the surveys in Tehran, and the technical study/analysis in Japan.

Table 2-3 Comparison of Requested Items and Project Components

Requested Items		Project Components	Quantity	Note
1) Exhaust Emission Measurement Equipment	1.1) Chassis Dynamometer System for Gasoline Vehicles (200kW・8,000RPM) 1.1.1) Loading System 1.1.2) Measured-Data Acquisition 1.1.3) Test Stand Automation System 1.1.4) Media Conditioning Equipment 1.1.5) Exhaust Emission Measurement System	Excluded		There are 2 sets in Tehran City and they are able to be used temporally by some payment, the equipment was excluded.
	1.2) Engine Dynamometer System for Diesel Vehicles(400kW・4,000RPM)(*) 1.2.1) Loading System 1.2.2) Measured-Data Acquisition 1.2.3) Test Stand Automation System 1.2.4) Media Conditioning Equipment 1.2.5) Exhaust Emission Measurement System	Included	1	No change
	1.3) Portable Emission Measurement System (PEMS)	Included	1 for Heavy Duty Vehicle 1 for Light Duty Vehicle	No change
2) Laboratory equipment for chemical analysis	2.1) Ion-Exchange Chromatography (for quantitative analysis of ions in ambient particulate matters)	Included	1	No change
	2.2) Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) (for quantitative analysis of inorganic constituents in particulate matters)	ICP-AES (Atomic Emission Spectrometry) as alternate	1	ICP-MS is difficult to be exported to Iran because it is controlled by Export Control of Japan. ICP-AES is proposed as alternative equipment.
	2.3) GC/MS/MS (for quantitative analysis of PAH)	Included	1	No change
		GC/MS/FID (for VOC analysis) is added.	1	Equipment for VOC analysis is added because VOC measurement is important for AQCC although it was not listed in the original request.
	2.4) Thermal-Optical Transmitter (TOT) Carbon analyzer for quantitative analysis of carbon constituents in particulate matters	Excluded		Excluded because it is only produced in USA, and is a subject to USA's export control to Iran

	2.5) X-Ray Fluorescence Analysis (XRF) for quantitative of inorganic constituents in particulate matters	Excluded		Same as above
	2.6) Phase Contrast Microscope for Confirming and counting asbestos	Included	1	No change
	2.7) Micro balance for weighting filter paper	Included	1	No change
3) Equipment for ambient and exhaust particle measurement	3.1) Particle Measurement Program instrument – for Official Homologation Measurement	Excluded		Request was not clear throughout the study. Particulate Counter is included in Category 1.2) and 1.3).
	3.2) Scanning Mobility Particle Seizer Spectrometer or EEPS for Laboratory Size Distribution of Particles	ELPI (Electrical Low Pressure Impactor) as alternative	1	Alternative equipment from Finland is selected because the original request (SMPS and EEPS) are subject to USA's export control to Iran.
	3.3) Lab and Vehicle Measurement of Size, Number, Surface, and Calculated Mass – Ambient Particle Measurement	Excluded		Request was not clear throughout the study.
	3.4) Semi-Continuous OC-EC Field Analyzer	Excluded		Same as above
	3.5) Aerosol Mass Spectrometer for providing Quantitative Size and Chemical	Excluded		Same as above
	3.6) Aerosol generator	Excluded		Same as above
	3.7) Large – particle Aerosol Generator	Excluded		Same as above
4) Air quality monitoring station (Not requested and proposed by JICA)		Equipment for air quality monitoring station as additional	7 sets. 5 sets for air quality monitoring stations, and 2 sets for Specific Survey	Air quality monitoring is one of the primary tasks of AQCC. Air quality monitoring equipment was added because damages are commonly found in the current stations.
5) Complementary equipment such as VOCs multi-components automated analyzer (Not requested and proposed by JICA)		Excluded	—	VOC can be monitored by GC/MS/FID (for VOC analysis) in Category 2. AQCC suspends air quality monitoring by simple VOC automated analyzer because it is lower priority, maintenance and repair budgets are not enough. VOCs multi-components automated analyzer, of which maintenance requires more budget and technology, has lower possibility to be maintained, thus, it is excluded.

*1: 4,000 rpm is requested although it was written as 40,000 rpm in the original application.

2-2-2-2 Equipment Plan

Each plan of equipment to be procured by the Project is as follows.

(1) Equipment for Exhaust Emission Measurement

1) Scope of the Project (Equipment Name, Key Specification, Quantity and Purpose)

Air pollution is a serious issue in Tehran City. Schools and public sector offices closes temporary whenever warning is announced. Although AQCC elaborated emission inventory to analyze air pollution, the vehicle emission factors used were not representing the conditions of Tehran thus revising is necessary. AQCC has proposed to upgrade emission standards, to supply lower sulfur fuels which are necessary for stricter emission standards, and to introduce DPF which will be necessary until emission standards is upgraded. However, it is not easy to elaborate, evaluate, and promote these air pollution reduction plans because of the very limited data on the condition of Tehran (such as high sulfur fuels, 1000m elevation, and driving manners). In order to elaborate emission factors and to evaluate emission reduction technologies, 1 set of engine dynamometer emission measurement system and 2 sets of portable emission measurement system (PEMS, one for heavy duty vehicle, and another for light duty vehicle) are planned to be procured, and to be installed to a vehicle emission laboratory that will be newly established in AQCC.

Chassis Dynamometer System for Gasoline Vehicles in the request is excluded because there are 2 sets are available temporally in Tehran City although usage fee is necessary.

Regarding the PM samples of vehicle emission, its weighing will be studied. However, countermeasures will depend on PM emission component. PM samples are recommended to be analyzed by (2) Equipment for chemical analysis, or subcontract in the future.

2) Engine Dynamometer System for Diesel Vehicles

Measurement by PEMS will be conducted by on-road driving. Since the measured results will be affected by the traffic conditions and the traffic signals, and unifying the test conditions of several tests is impossible. Engine dynamometer emission measurement system is included in this Project because test conditions must be unified for comparison and evaluation of engines and emission reduction systems. The target engines planned for the measurement are of heavy duty vehicles, which emits large share of pollutants emission, emissions not yet reduced enough, and the reduction of its traffic in the central city area are not possible. The specification of the engine dynamometer and emission measurement systems for procurement is set by the vehicle specification of public transportation being used currently and expected to be used in near future.

For the above reasons, the range of target engines of dynamometer is set as follows; 200 ~ 400 kW for the range of maximum power, 1200 ~ 2600 Nm for the range of maximum torque, and 2,000 ~ 4,000 rpm for the range of maximum engine speed. The specification of emission

analyzer covers from EURO-I to EURO-VI. The specification of test cycle automation system is selectable for test cycles of EURO-I to EURO-VI and programmable for any original test cycles which may be developed for Tehran. The specification of dilution tunnel is set as partial flow dilution instead of full, since the system is not planned to be used for certification.

3) Portable Emission Measurement System (PEMS)

In the past, chassis dynamometer system, which requires large operation cost, was necessary because the emission analyzers were too large to board on vehicles. However, the emission analyzers have become smaller in last decades due to the improved technology. Emission measurement is now possible by using PEMS without chassis dynamometer system. In addition, PM can be filtered and weighed by PEMS even if it is on-board style. Now, PEMS models certified by Economic Commission for Europe (ECE) and/or United States Environmental Protection Agency (USEPA) became possible to be procured. In order to utilize these advantages from now, the specification of PEMS is concluded as follows; weight and quantity of particulates and gas pollutant are measured in parallel, and PEMS are to be certified by ECE or USEPA. The 2 sets of PEMS that consist one PEMS for Heavy Duty Vehicle (HDV) and the other PEMS for Light Duty Vehicle (LDV) are necessary because there is no PEMS certified for both of HDV and LDV.

Table 2-4 Key Specification and Count of Exhaust Emission Measurement Equipment

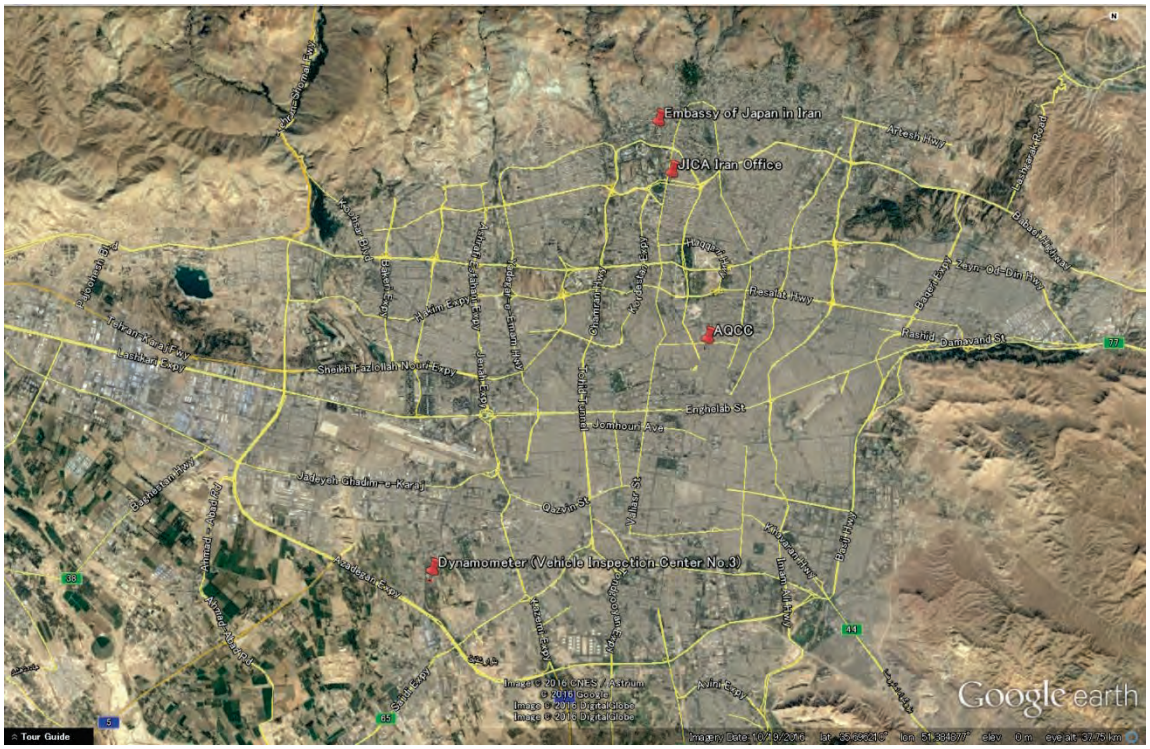
Name	Unit	Key Specification
Engine Dynamometer System for Diesel Vehicles	1	- Range of target engines; 200 ~ 400 kW for maximum power, 1200 ~ 2600 Nm for maximum torque, and 2,000 ~ 4,000 rpm for maximum engine speed - Test Cycle: selectable from EURO IV to VI, and programmable for original test cycle which may be developed in future in Tehran - Emission measurement system: Complying with EURO-I to III and VI (Remarks: partial dilution method, and air condition is not pressurized to the sea level). Ten pollutants to be measured: CO, NOx, THC, CH4, CO2, NH3, SO2, N2O, PM, and PN
Portable Emission Measurement System (PEMS)	2	- Measurement Method: PEMS for HDV complying with Heavy Duty Vehicle test of UN/ECE Regulation No. 49. PEMS for LDV complying with EURO-6c of Real Driving Emission for Light Duty Vehicle (LDV) - Pollutants to be measured are CO, CO2, NOx, THC, PM, and PN for HDV. CO, CO2, NOx, PM, and PN for LDV

Source: JICA Study Team

4) Site Selection

AQCC requested for an installation site somewhere in Tehran Municipality because there is not enough space in the current AQCC to set the engine dynamometer system. Vacant space found in a vehicle inspection center owned by Tehran Municipality was nominated. The space was checked in the view point of equipment installation and use, and selected as an installation site.

The selected site is located in the industrial zone at the south-western area of Tehran as shown in Figure 2-1. The distance from AQCC is approximately 14 km, which is one third of the distance to airport.



Source: JICA Study Team

Figure 2-1 Site for Engine Dynamometer System

(2) Chemical Analysis Equipment

1) Equipment considered for Cooperation (Specifications)

Table 2-5 shows the major specification of equipment used for chemical analysis and particle measurement in ambient air and exhaust gas.

Table 2-5 Major Specifications of Equipment for the Chemical Analysis and the Ambient and Exhaust Particle Measurement

Equipment	Major Specifications	Purpose
Ion Chromatograph (IC)	Flow rate range: About 0.010～5.000ml/min Detector: Electrical conductivity detector Eluent electric conductivity: Suppressor system(for Anion), Suppressor or Non-suppressor system(for Cation) Other components: Guard column, Column oven, Auto-sampler, Data processing unit, etc.	Ion component analysis of particulate matter in ambient air Anion: Cl^-, NO_3^-, SO_4^{2-}, etc. Cation：NH_4^+, Na^+, K^+, Mg^{2+}, Ca^{2+}, etc.
Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES)	ICP observation: Axial/radial view Spectrometer: Echelle optics RF generator RF power: 1.6kW or more Output stability: Within 0.3% Efficiency: 75% or more Range of wavelength: 167-800nm Resolution: 0.005nm at 200nm Other components: Auto-sampler, Hydride generator, Data processing unit, etc.	Metal component analysis of particulate matter in ambient air. Na, Al, Si, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Rb, Mo, Sb, Cs, Ba, La, Ce, Sm, Hf, W, Ta, Th, Pb, etc.
Gas Chromatograph Mass Spectrometer (GC/MS/MS for PAH analysis)	Column oven temperature: 450℃ maximum Ion source: EI Detector: Metal quadrupole with pre-rod Mass range: 10~1090 m/z Scan rate: 20,000 u/sec Minimum event time: 3msec Other components: Auto-sampler, Data processing unit, etc.	PAH analysis of particulate matter in ambient air
Gas Chromatograph Mass Spectrometer (GC/MS/FID for VOC analysis)	Column oven temperature: 450℃ maximum Ion source: EI Detector1: Metal quadrupole with pre-rod Mass range: 10~1090 m/z Scan rate: 20,000 u/sec Minimum event time: 10msec Detector2: FID detector Minimum detected quality: 1.5pg C/sec Other components: Auto-sampler, Thermal desorption equipment, Data processing unit, etc.	VOC analysis of volatile organic compound in ambient air Mainly analyzed by sampling tube and thermal desorption method
Phase Contrast Microscope	Infinity-corrected optical system Corresponds to phase contrast, polarization, and dispersion observation Eyepiece: With eyepiece graticule Objective lens: × 10, × 40 (phase contrast, polarization, dispersion) Light source: 50 W or more (halogen lamp) Other components: Digital camera, Image recording and processing PC system, etc.	Analysis of asbestos in ambient air collected on filters
Micro Balance	Maximum weighting capacity: 5g or more and 22g or less Readability: 0.001mg Repeatability (standard deviation) 0.0025 mg Linearity ± 0.010 mg Weighing pan size: approx. 25 mm φ Weighing pan size for filter: about 50 to 95 mmφ	Measurement of particulate matter mass in ambient air collected on filters

	External dimensions: 260 (W) x 470 (D) x 330 (H) mm or less Built-in calibration weight Other components: static eliminator, external calibration weight, etc.	
Environmental Chamber for Micro Balance一	Glove box type temperature and humidity control chamber Control range: temperature 21.5 ± 1.5 ℃, humidity 35 ± 5% Control method: Heater, electronic cooling or refrigerant, ultrasonic humidification It must be possible to install a micro balance in the chamber Other components: Vibration suppression table	Providing necessary measuring condition (temperature, humidity) for weighing mass of particulate matter in ambient air collected on filter. A micro balance is set inside the chamber
Electrical Low Pressure Impactor	Particle size range: 0.006-10μm Number of size classes: 14 Sample flow rate: 10LPM Sampling rate: 10 Hz Other components: exhaust gas particulate matter diluter, computer for operating the equipment	Measurement the size distribution of particles in ambient air or and automobile exhaust gas in real time.

2) Site Selection

AQCC occupies the four story building, owned by Tehran Municipality, located in the residential area, on the Varavini St. 7th district near the center of Tehran city. The ground floor of the building is currently used as the equipment rooms for the air quality monitoring stations, and partially used as an office for AQCC staffs as well. The other floors of the building are used as office for AQCC staffs. The chemical analysis laboratory is planned to be installed on the ground floor.

The minimum space necessary for the equipment planned to be procured by this grand aid is reserved on the first floor of AQCC building. However, AQCC only owns this building, thus even if AQCC intends to introduce other new equipment in the future, it is difficult to secure a space.

Figure 2-2 Location of the AQCC Building

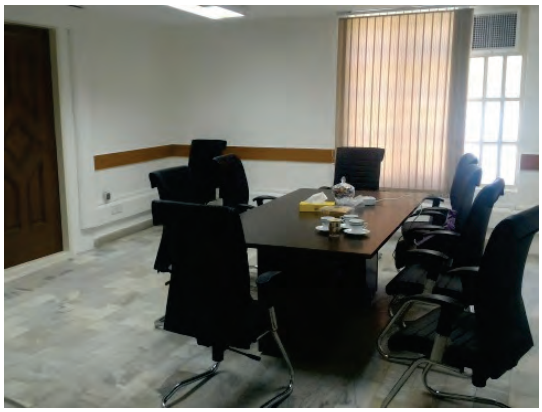



Figure 2-3 Appearance of the Building and one of Rooms Planned for the Laboratory

Since AQCC has no experience of having and operating a chemical analytical laboratory, this is the first lab to be established. The infrastructure status on the first floor of this building is shown in Table 2-6.

Table 2-6 Infrastructure Status at the Planned Facility for the Chemical Analysis Laboratory

Related Infrastructure	Installation Status
Electrical facility	With abundant petroleum resources, the capacity of electricity distribution from the Tehran commercial power supply is of good quality. Almost no blackout occurs. After step down from the commercial power supply, low pressure 220 V, 50 Hz is supplied to each floor. In addition, 3-phase 380 V is supplied to the AQCC building. The shape of the outlet on the wall is:  Ground wire is not set. Each room has ceiling lightings.  
Water supply sanitation facility	Water tap is located on the first floor as shown in the equipment layout. Seat style and squat type are installed as flush toilets.
Air-conditioning ventilation equipment	Window air conditioner is installed. There is no central air conditioning system that supplies dust removed and temperature and humidity controlled air to each room on the first floor. In each room the ceilings and the walls are flat. There is neither intake duct nor exhaust duct.
Fire extinguishment system	Not installed.
Drainage facility	There is drainage facilities associated with water supply sanitation facility.
Gas piping	Gas piping is installed to the AQCC building. Gas piping is not installed to the each room.
Communication	Telephone and internet access are installed.

facility	
Other	Equipment for AQCC's air quality monitoring station already occupies 2 rooms; other 2 rooms are currently used as office space. There is currently no equipment installed, which are necessary for a chemical analysis laboratory, such as draft chamber, lab bench, drainage facility, exhaust gas treatment facility.

(3) Equipment for Ambient and Exhaust Particle Measurement

1) Equipment Considered for Cooperation (Specifications)

The ambient and exhaust particle measurement equipment are excluded from procurement of this cooperation project because these equipment are made in the US and inhibited to export to Iran. However, electronical low pressure impactor has specifications similar to the requested equipment of SMPS (Scanning Mobility Particle Seizer Spectrometer) or EEPS (Engine Exhaust Particle Sizer), electronical low pressure impactor was arranged to be procured from Finland as the alternative equipment.

Particle size distribution analyzing equipment, SMPS or EEPS are subject of US export regulation due to US products. Therefore, the equipment was changed to electronical low pressure impactor as the alternative, as shown in Table 2-6. Since specification of the alternative equipment are 10 Hz of sampling rate, and 0.006-10μm of particle size range in real time measurement available, it is appropriate as alternative equipment

Table 2-7 Major Specifications and Quantity of Equipment for Ambient and Exhaust Particle Measurement

Equipment	Quantity	Major Specification
Electrical Low Pressure Impactor	1	Particle size range: 0.006-10μm Number of size classes: 14 Sample flow rate: 10LPM Sampling rate: 10 Hz Other components: exhaust gas particulate matter diluter, computer for operating the equipment

Source：JICA Study Team

2) Site Selection

The chemical analysis laboratory, which is newly established on the first floor at AQCC building, is selected as the installation site. The circumstances of site selection is same as (2) Chemical Analysis Equipment.

(4) Air Quality Monitoring Station

1) **Specification**

Types of air quality monitoring stations could be categorized as “conventional monitoring” and “special survey”. Special survey is designed based on the some specific purposes. Five (5) stations are categorized as conventional monitoring and two (2) are special survey.

Target pollutants are NOx, SO2, CO, Ozone, PM10, and PM2.5 which are regulated by the Iranian ambient air quality standards, and monitored by the AQCC. Therefore the procurement contains monitoring devices for above six (6) parameters, and air sampling system, calibration unit as ancillary facilities. In addition to above procurement, relocatable monitoring cabin and its ancillary facilities (air conditioner and room light) are included as the monitoring stations for “social survey”.

AQCC has agreed to provide six (6) sets of monitoring cabins by procuring new sets or renovating existing sets to increase the number of monitoring stations for update.

Table 2-8 lists procurements and main specifications.

Table 2-8 Main Specifications of Procurements for Air Quality Monitoring Stations

Name of devices	Number	Main Specification
NOx Monitor	7	Measuring method: Chemiluminescence Range: 0 - 1ppm Detection limit: < 1ppb Span drift: < ± 1 % of full scale / day
SO_2 monitor	7	Measuring method: U.V. fluorescence Range: 0 – 0.5ppm Detection limit: < 1ppb Span drift: < ± 1 % of full scale / day
CO monitor	7	Measuring method: Non-dispersive infrared ray Range: 0 – 50ppm Detection limit: < 0.1ppm Span drift: < ± 1 % of full scale / day
Ozone monitor	7	Measuring method: U.V. photometry Range: 0 – 1ppm Detection limit: < 1ppb Span drift: < ± 1 % of full scale / day
PM10 monitor	7	Measuring method: β-ray absorption or Optical light scattering Range: 0 – 1,500μg/m^3 Detection limit: < 1μg/m^3 Span drift: < ±2% of full scale / day
PM2.5 monitor	7	Measuring method: β-ray absorption or Optical light scattering Range: 0 – 1,000μg/m^3

		Detection limit: Span drift:	< 1μg/m^3 < ±2% of full scale / day
Carburation unit (diluter)	7	Refine method : Principle: Reference gas: Stability:	Catalyst oxidation and adsorbent absorption Mass flow rate ratio mixing, Gas phase titration Certified gas cylinder (SO_2、NOx、CO), Ozone generator ±2 % of concentration of generated gas
Air sampling unit	7	Height of suction point: 1m above the roof top of the stations ±2 % of concentration of generated gas Material of sampling route: Borosilicate glass or PTFE	
Monitoring cabin	2	Type: Stability of temperature: Capacity of storage of cylinders:	Mobile cabin Reaching at 25℃ within 30 min. Three (3) cylinders or more

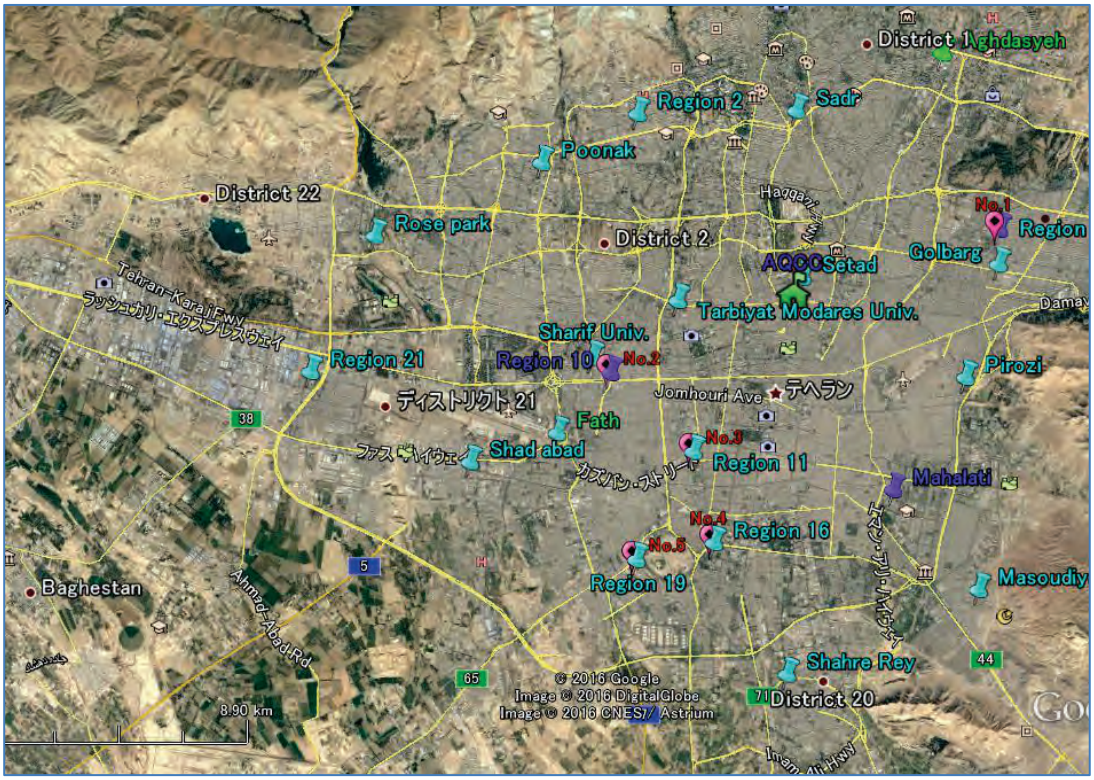
Source: JICA Study Team

Since AQCC has used the data transferring system developed by them, such software will be excluded from the procurement plan.

2) Site Selection

AQCC has twenty-one (21) ambient air quality monitoring stations located in Teheran City, which are mostly in the public area controlled by the Teheran City Government. AQCC indicated that thirteen (13) stations of them are seriously malfunctioned. The procurement plan will aim to update the top five (5) stations with high priority. On the other hand, two (2) mobile stations will be newly procured for the purposes of some specific survey such as monitoring of PM in a tunnel. These two (2) stations are also expected to be used as a back-up of existing monitoring stations.

Future procured stations will be designed as relocatable of the cabins. Figure 2-4 describes the monitoring location, while Table 2-9 indicates the condition of the existing monitoring stations.



Note: Numbers in red (No.1 - No.5) shows the order of priority for update

Source: JICA Study Team

Figure 2-4 Location of Air Quality Monitoring Stations

Table 2-9 Condition of Existing Monitoring Stations by AQCC

Name	Date of Survey (in 2016)	Category (*1)	Manufacturing Maker(*2)	Operational Condition as of Date of Survey						Priority
				NOx	SO_2	O^3	CO	PM 10	PM 2.5	
Region 4	13th Aug.	traffic	Env. SA-micro	working	not working cannot repair	working	working	nil	working	1
Region 10	17th Aug.	traffic	Env. SA-micro	under repair	working	under repair	under repair	nil	working	2
Region 11	17th Aug.	urban	Env. SA-micro	out of working	working	out of working	out of working	out of working	nil	3
Region 16	9th Aug.	urban	Env. SA-micro	working	under repair	working	working	nil (under repair)	nil	4
Region 19	17th Aug.	urban	Env. SA-micro	Transfer to Region 16 station				under repair	nil	5
Region 2	9th Aug.	urban	Env. SA	working	under repair	under repair	wrong data	working	working	6
Masoudiyeh	28th Aug.	urban	Env. SA	no function	working	working	working	working	no function	7
Golbarg	28th Aug.	urban	Env. SA	no function	working	working	working	working	working	8
Poonak	27thAug	urban	Env. SA	working	under repair	working	working	working with alarm	working	9
Shahre Rey	28th Aug.	urban	Env. SA	under repair	under repair	working	error since 2 days ago	working	no function	10
Aghdasyeh	13th Aug.	sub-urban	Env. SA	working	Error (chopper fault)	unstable data	not working (flow fault, zero error)	working	working	11
Rose park	27th Aug	urban	Env. SA	not function	not function	under repair	not function	working	working	12
Setad	13th Aug.	urban	Env. SA	working	under repair	under repair	signal error	working	working	13
Fath	9th Aug.	urban	Ecotech	working	under repair	working	working	working	nil	-
Mahalati		traffic	Ecotech	Not surveyed						-
Pirozi	28th Aug.	urban	Ecotech	no function	working	working	working	working	working	-
Region 21	17th Aug.	urban	Env. SA-micro	working	working	working	under repair	not working (error)	working	-
Sadr	10th Aug.	urban	Ecotech	working	under repair	working	working but possible wrong data	nil	working	-
Shad abad	17th Aug.	urban	Ecotech	working	under repair	working	error since 2 days ago	working	working (change filter)	-
Sharif University		urban	Ecotech	Not surveyed						-
Tarbiyat Modares University	10th Aug.	urban	Ecotech	working	working	working	working	working	working	-

(1) Traffic: Major road side, Urban: Urban area, Sub-urban: Sub-urban area

(2) Env. S.A.: Environmental S.A. (France) Env. S.A.-micro: Micro station, Environmental S.A. (France) Ecotech (Australia)

Source: JICA Study Team

2-2-3 Outline Design Drawing (Site Plan, Laboratory Plan, Equipment Arrangement Plan)

(1) Engine Dynamometer System

Site plan, laboratory plan, and equipment arrangement plan are shown in Figure 2-5 to Figure 2-7.

Notes: Land boundary is shown in yellow. Land for building is shown in red.

Figure 2-5 Site Plan (Draft)

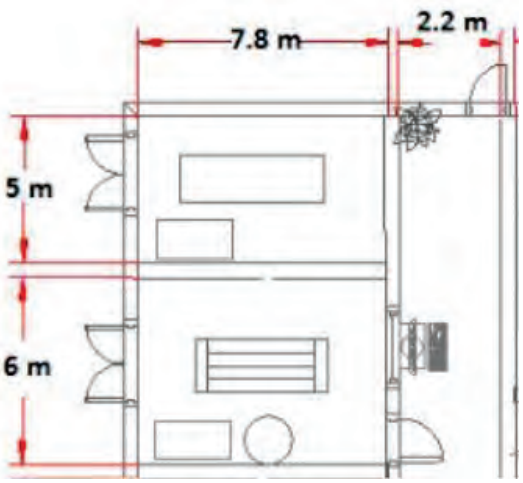
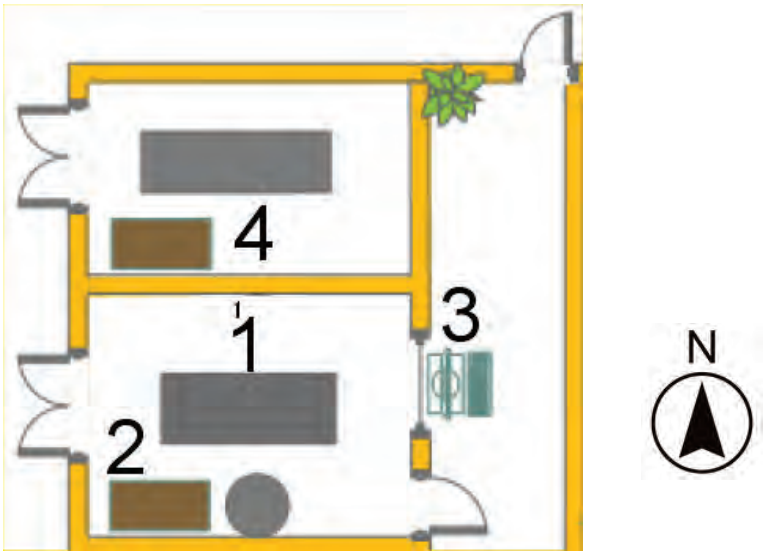


Figure 2-6 Laboratory Plan (Draft)



Remark: 1: Dynamometer, 2: Emission analyzers, 3: Control Panel, 4: Utilities

Figure 2-7 Equipment Arrangement Plan

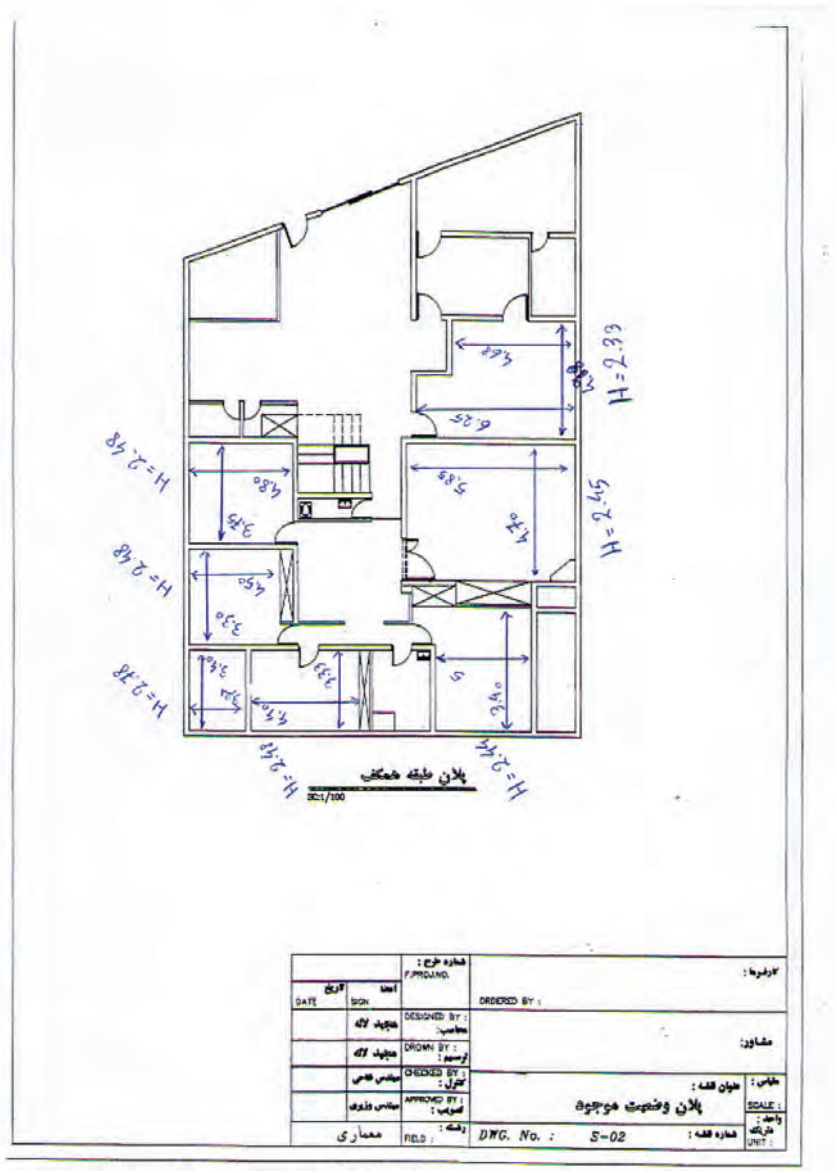
(2) Chemical Analysis Equipment

AQCC has planned to establish a chemical analysis laboratory on the first floor of the AQCC building. The Figure 2-8 shows the overall site map of AQCC building.

Note：Red solid line shows building, Yellow dash shows site

Figure 2-8 Building Overall Site Map

Figure 2-9 shows a floor plan (with dimensions) of the first floor in the AQCC building



Source：AQCC

Figure 2-9　A Floor Plan (with Dimensions) of the First Floor in the AQCC Building

Figure 2-10 shows the equipment layout (draft) of the first floor in the AQCC building. This equipment layout is a proposed plan by the Japanese side.

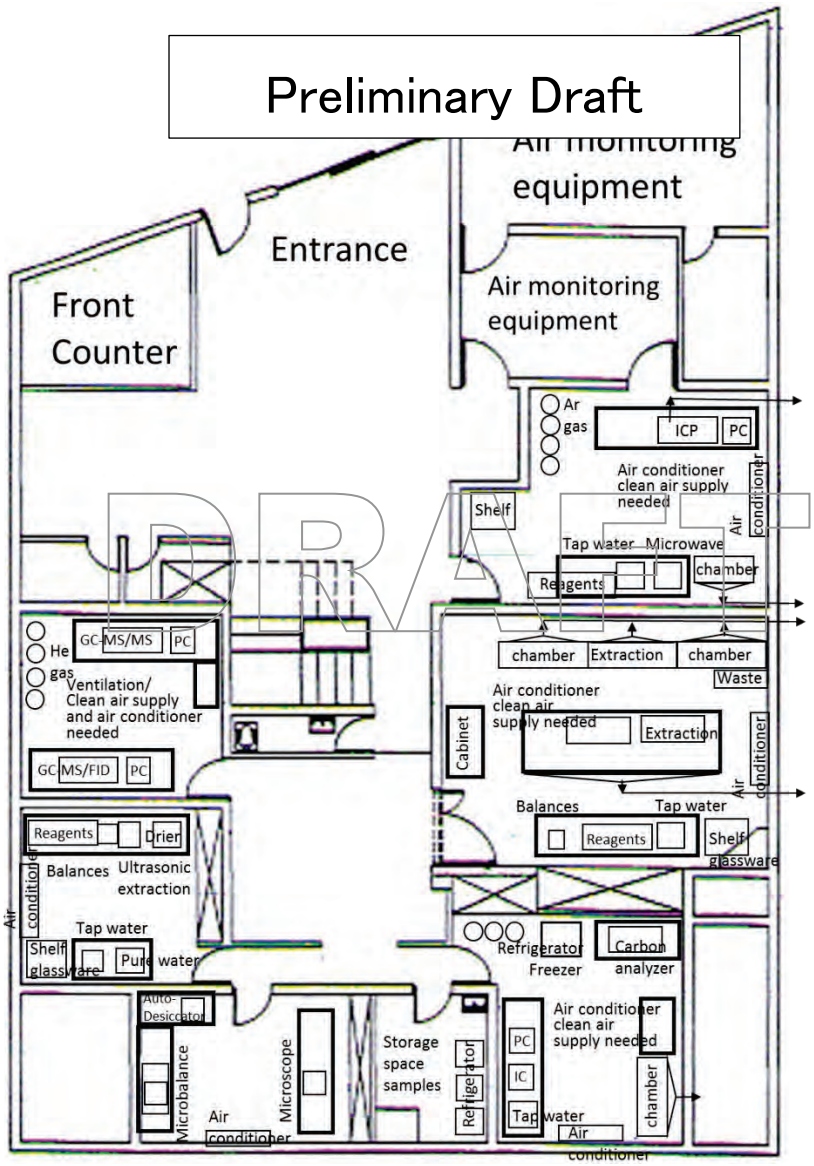


Figure 2-10 Equipment Layout (Draft) on the First Floor of AQCC Building

Chemical analysis laboratory	Equipment planned to be installed (procured by Japanese side)	Area(m^2)
Metal analysis room (including sample preparation)	ICP	Approx.27
Sample preparation room (solvent extraction for PAH, etc.)	—	Approx.27
Ion analysis, carbon analysis room	IC	Approx.17
Sample storage room	—	Approx.7
Micro balance, microscope room	Micro balance, environmental chamber, phase contrast microscope	Approx.14
Sample preparation room (ion analysis, etc.)	—	Approx.15
GC analysis room	GC/MS/MS, GC/MS/FID	Approx.18

(3) Air Quality Monitoring Equipment

The monitoring stations are located in the public area and have no plan to be relocated. Since monitors of the top-five monitoring stations to be updated has micro-station made by Environmental S.A., which has capacity smaller than the ordinal type. Thus, these stations will require to be relocated within the same premises. Figure 2-11 shows the location of the top-five prioritized stations.

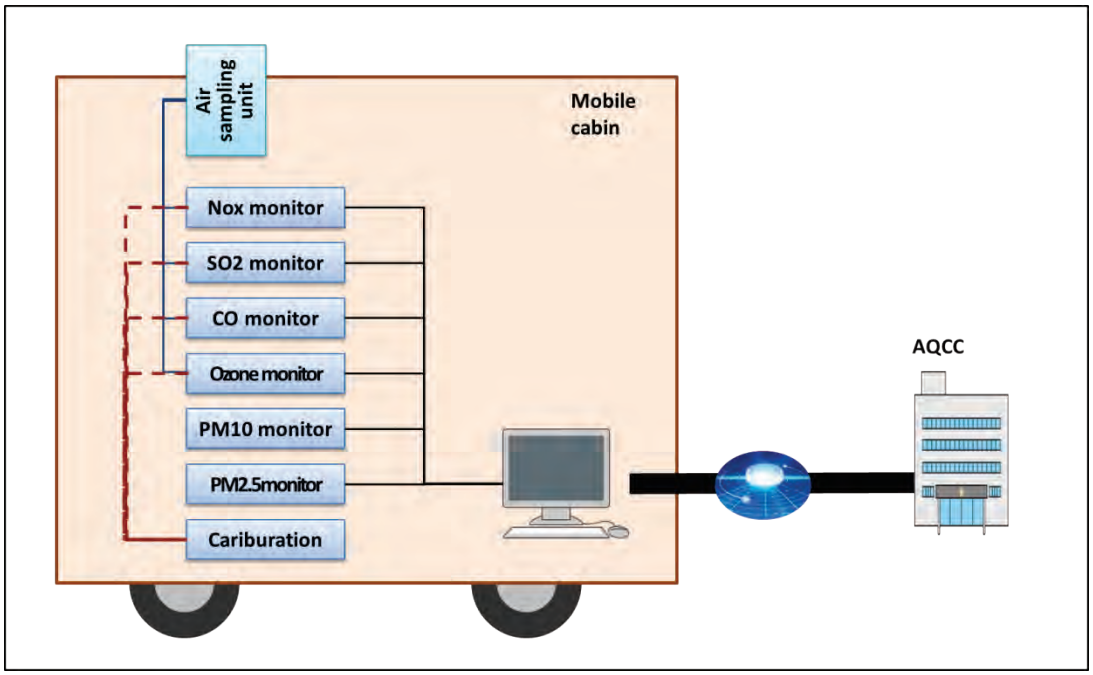
Source: JICA Study Team

Figure 2-11 Location of the Top-five Stations in Priority Order

Procured items (such as monitoring devices, calibration unit, and air sampling unit) will be set in the existing relocatable cabin owned (shown in Figure 2-12) or newly procured by AQCC or granted. Figure 2-13 shows tentative layout plan of monitoring station.

Source: JICA Study Team

Figure 2-12 AQCC Owned Relocatable Cabin



Source: JICA Study Team

Figure 2-13 Layout Plan of Air Quality Monitoring Station

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

(1) The Project Implementation Framework

The Project framework at the implementation phase is shown in Figure 2-14.

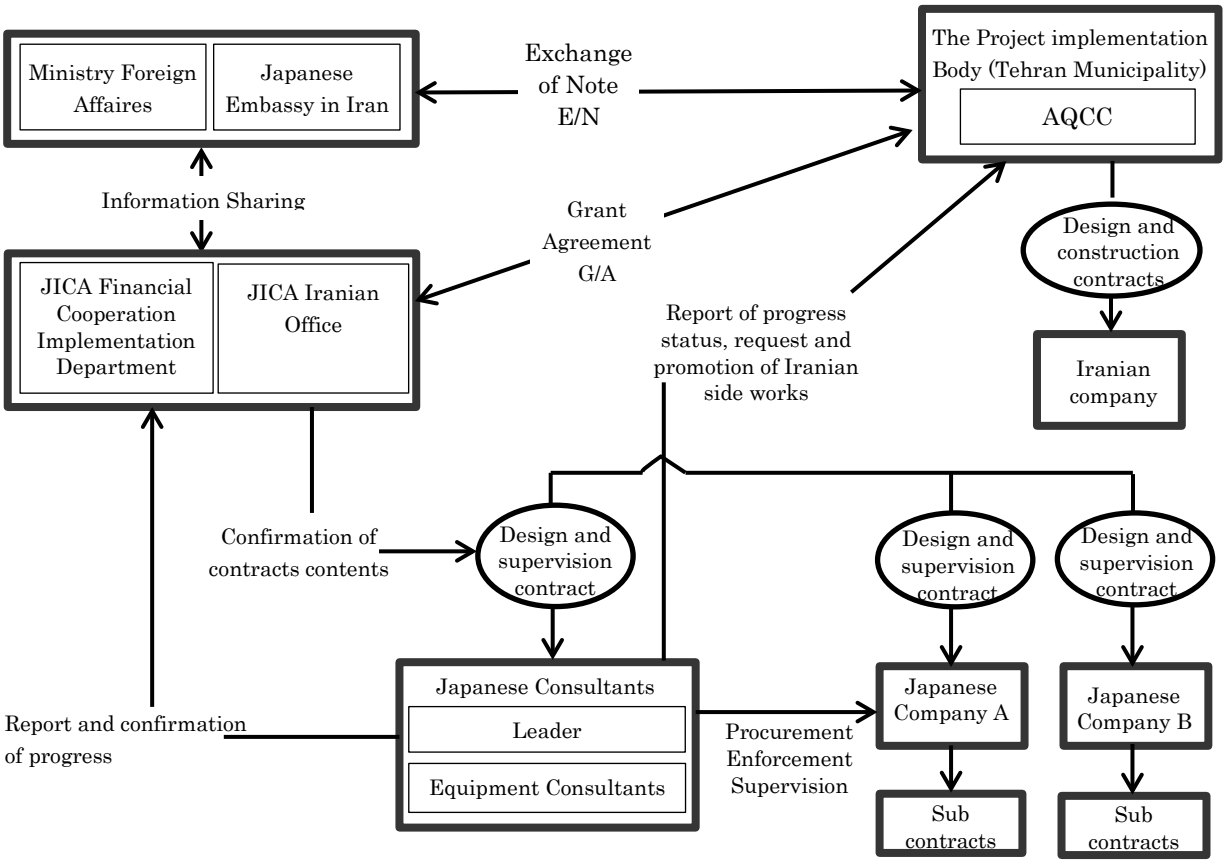


Figure 2-14 Project Implementation Framework

(2) Utilization Field of Local Company

Concreate construction, anti-theft fence, and electricity facilities construction for installation equipment will be procured from Iran. Unpacking, emplacement, assembly, and installation of all equipment will be conducted by local workers under guidance of engineers from Japanese companies.

2-2-4-2 Implementation Conditions

(1) Procurement Conditions

1) Third Country Product

In principle, equipment used in this Project will be Japan, as shown in Table 2-10. However, equipment used by ELPI (Electrical Low Pressure Impactor) will be from Third country.

Table 2-10 Origins of Equipment

Equipment		Japan	Iran	Third Country
1) Exhaust Emission Measurement Equipment	1.1) Engine Dynamometer System for Diesel Vehicles(400kW・40,000RPM) 1.1.1) Loading System 1.1.2) Measured-Data Acquisition 1.1.3) Test Stand Automation System 1.1.4) Media Conditioning Equipment 1.1.5) Exhaust Emission Measurement System	●		
	1.2) Portable Emission Measurement System (PEMS)	●		
2) Laboratory equipment for chemical analysis	2.1) Ion-Exchange Chromatography (for quantitative analysis of ions in ambient particulate matters)	●		
	2.2) ICP-AES (for quantitative analysis of inorganic components in ambient particulate matters)	●		
	2.3) GC/MS/MS (for quantitative analysis of PAH)	●		
	2.4) GC/MS/FID (for VOC analysis)	●		
	2.5) Phase Contrast Microscope for Confirming and counting asbestos	●		
	2.6) Micro balance for weighting filter paper	●		
3) Equipment for ambient and exhaust particle measurement	3.1) Electrical Low Pressure Impactor (ELPI)			●
4) Air quality monitoring station		●		

(2) Implementation Conditions

1) Exhaust Emission Measurement Equipment

A) Remarks on Burden of Iranian Side

In order to finish equipment installation in the limited period after custom clearance, all the burdens of Iranian side, shown below, must be ready and adjusted to be able to connect to the granted equipment.

- Building must be ready for use, including building plan, construction permission before construction completion
- Utilities must be ready for use, plan, permissions, procurement, and installation of power devices, chillers, air conditioners required for emission gas measurement, and fuel supply equipment

In order to avoid delay of the schedule, it is necessary for Japanese and Iranian side to follow the progress of Iranian burdens frequently. The follow ups will be made at building design completion, building permission application, building permission, designing the details with constructor(s), construction intermediate control, construction completion control, utilities specification, utilities procurement, and utilities installation.

B) Remarks on Grant Equipment Installation

Iran has no experience in installing engine dynamometer for heavy duty vehicle within last 10 years. There are no engineers or technicians with experiences in engine dynamometer in this scale in Iran. In order to complete the installation in the limited time in the Grant Aid schedule, experienced technicians in engine dynamometer and related equipment installation are necessary to be involved in the equipment installation task.

For adjustment of the diesel engine, equipment is necessary to be installed to the engine and be operated. Engineers of suppliers will install and adjust the grant aid equipment, while diesel engine are being prepared, installed, and operated as Iranian responsibility. This includes renting engine, making mounting parts for the engine, and connecting all the necessary pipe and cable connections from utilities to the engine. AQCC will conduct with aid from public transportation company and vehicle manufactures.

2) Chemical Analysis Equipment

Using the existing building owned by AQCC, a new chemical analysis laboratory is planned for construction. The rooms to be used are designed for the office use, and in order to use the rooms

as a laboratory, additional construction are required. The least amount of additional constructions is shown in the chapter 3 (2).

The staffs of AQCC are have no experience in laboratory, but DOE-TPD's laboratory (for environmental analysis), a laboratory in Tehran University of Medical Sciences, and laboratories at private companies are in Tehran. There are specialized contractors who can renovate rooms to chemical analysis laboratory. It is planned that AQCC will outsource the renovation to the specialized contractors.

This equipment layout is only for a reference, and it is necessary to re-examine the detailed installation layout, while assuming the indoor space, usability, flow line of workers, and equipment procures of Iranian side.

3) Air Quality Monitoring Station

A) Considerations to Set-up the Monitoring Devices in the Cabin Owned by AQCC

In general, monitoring devices with the cabin are procured because it is complicated to adjust the layout of monitoring devices and sampling inlets with existing cabin.

Five units in the procurement plan will be set in the relocatable cabin provided by the AQCC, therefore the followings shall be considered:

- To support AQCC to purchase the same / similar type of existing cabin as much as possible
- To immediately inform the specification of cabin provided by AQCC to the successful company of the bid in order to support the manufacturer to design the layout plan accurately
- To share the progress of procurement of relocatable cabin among AQCC and support the manufacturer and JICA Study Team to dispatch the engineers to Teheran for installment at the effective timing.

B) Considerations to Link the Existing Data Transferring System used by AQCC

AQCC has used three (3) different component of monitoring devices from two (2) manufacturing firms. Previously, AQCC used individual software given by each manufacturer, however, AQCC changed to other software developed by AQCC. This system is easier to adjust to the different systems which were used in the past such as HORIBA. Therefore, this system was

selected and exclude procurement of data transferring software. In order to connect to the existing system, the followings shall be considered:

- Indicate to use the ordinal transferring protocol, widely adopted to the specification
- Immediately inform the specification of protocol to AQCC in order to support AQCC to update their software

2-2-4-3 Scope of Works

The following table summarizes the responsibilities of GOJ and GOI for the Project.

Table 2-11 Major Burdens by Each Government

Items	To be covered by Grant Aid	To be covered by Recipient Side
1. Secure properties and/or space necessary for the implementation of the Project and for clearing the sites		●
2. Construct the facility if necessary and install the equipment (construction of fences and etc.)		●
3. Clear the sites if necessary		●
4. Construct the building for Engine Dynamometer System for Diesel Vehicle		●
5. Improve laboratory facility for chemical analysis		●
6. Procure containers for air quality monitoring stations	●	●
7. Obtain necessary permissions for implementation of the Project		●
8. 1) Marine or Air transportation from Japan to the Recipient country	●	
2) Tax exemption and customs clearance of the products at the port of disembarkation		●
3) Internal transportation from the port of disembarkation to the project site	●	
9. Ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient country with respect to the purchase of the products and the services as well as the employment of the Agent are to be borne by the Authority without using the Grant and its accrued interest		●
10. Accord Japanese nationals and/or nationals of third counties, including such nationals employed by the Agent, whose services may be required in connection with the supply of the products and the services for such facilities, all assistance that they may need for their entry into the Recipient country and stay therein for the performance of their work		●
11. Ensure that the products are maintained and used properly and effectively for the implementation of the Project		●
12. Bear all the expenses, other than those covered by the Grant and its accrued interest, necessary for the implementation of the Project		●
13. Bear the bank commission paid to the Japanese bank for banking services based upon the B/A		●
14. Consider the environmental and social conditions in the implementation of the Project		●

Details of the responsibilities for Implementing Agency are described in “Chapter 3: Obligations of Recipient Country”.

2-2-4-4 Consultant Supervision

The Consultant will dispatch a Japanese expert as resident procurement supervising engineer and will perform the overall supervision of all the installation work.

The details of the consulting services during the implementation period are as follows.

- Confirmation and approval of production drawings and necessary documents for the equipment
- Technical meetings with AQCC
- Confirmation of the results of the initial performance and connection tests for the equipment to be installed, which is planned to be conducted by the manufactures in Japan
- Confirmation of the results of the comprehensive performance tests for the entire systems, which is planned to be conducted by the manufactures in Japan
- Attendance of factory inspections / pre-shipment inspection
- Arrangement of collation inspections prior to shipment in Japan
- Attendance of the initial calibration and repacking for each site in Iran
- Supervise the progress and safety control of the Supplier
- Attendance of the installation, the adjustment, and the commissioning
- Approval of documents regarding the acceptance test procedures and test implementation plans
- Supervise the acceptance tests (final inspection) and issue completion certificates
- Supervise the initial operation and maintenance training conducted by the Supplier
- Preparation of progress reports and completion report to be submitted to the related organizations

2-2-4-5 Quality Control Plan

(1) Inspection and Acceptance Test Implementation Plan (Equipment)

1) Principles

During the period of manufacturing of the equipment, the Consultant shall review all production drawings for the equipment to be submitted by the Supplier in terms of conformity with the contract documents and technical specifications, and authorize necessary approvals. In addition, during the equipment installation work, the Consultant shall review the construction plan

(including implementation structure), implementation schedule, and installation procedures submitted by the Supplier and authorize necessary approvals.

2) Inspections

As for the quality assurance of the equipment, the following inspections and acceptance tests will be conducted prior to the handover of the equipment.

- Connection Tests, Comprehensive Performance Tests

  Connectivity tests and the comprehensive performance tests are required to be carried out by the manufactures. The test result certificates shall be checked and confirmed by the Consultant.

- Factory Inspections

  Prior to the shipment of the equipment out of the factory, each and all pieces of equipment shall be inspected as to their conformity with required specifications and also conduct the performance tests for the system.

- Collation Inspections prior to Shipment

  Although quantities of the principal equipment shall be confirmed at the time of the factory inspection, the quantities of all equipment shall be confirmed during the collation inspections prior to shipment to be conducted by a third party inspection agency. The inspection shall be conducted at the Port of Yokohama.

- Initial Calibration and Repacking for Each Site

  For the equipment procured from Japan, the third countries and/or Iran, unpacking, numerical inspections, initial calibration and repacking for each site will be conducted in the presence of the Consultant at Tehran.

- Performance and Connectivity Tests

  Performance and connectivity tests will be conducted immediately after the installation of the equipment at each site. Especially, regarding the equipment installed at each air monitoring station, the data transmission between the equipment and the existing PC system installed in the existing cabin will be checked and confirmed. The tests will be conducted with the presence of the Consultant, if at all possible. The specifications and the number of pieces of equipment will be checked and confirmed prior to the installation.

- Acceptance Test and Handover

In the presence of AQCC, the Consultant and the Supplier, the equipment and the systems will be inspected to determine if they satisfy the required performance and functions. After the inspection, the test results will be confirmed by AQCC, the Consultant, and the Supplier, and then the equipment and the systems will be handed over to AQCC.

2-2-4-6 Procurement Plan

(1) Sources of Equipment

The lists of sources of the major equipment procured by the Project are shown below.

Table 2-12 List of Sources of Equipment

Items		Japan	Iran	Third Countries
1) Exhaust Emission Measurement	1.1) Engine Dynamometer System for Diesel Vehicle (400kW・40,000RPM) 1.1.1) Loading System 1.1.2) Measured-Data Acquisition 1.1.3) Test Stand Automation System 1.1.4) Media Conditioning Equipment 1.1.5) Exhaust Emission Measurement System	●		
	1.2) Portable Emissions Measurement System (PEMS)	●		
2) Chemical Analysis in the Laboratory	2.1) Ion Chromatograph for Quantitative Analysis of Ions in Ambient Particle Matters	●		
	2.2) Inductively Couple Plasma – Atomic Emission Spectrometry (ICP-AES)	●		
	2.3) Gas Chromatograph-Mass Spectrometer (GC/MS/MS) System for Quantitative of PAH	●		
	2.4) Gas Chromatograph-Mass Flame Ionization Detector (GC/MS/FID) System for Quantitative of VOC	●		
	2.5) Phase Contrast Microscope for Conforming and Counting Asbestos	●		
	2.6) Micro Balance for Weighting Filter Paper	●		
3) Ambient and Exhaust Particle Studies	3.1) Electrical Low Pressure Impactor for Laboratory Size Distribution of Particles (ELPI)			Finland
4) Air Quality Monitoring Station		●		

(2) Transportation Plan

1) Equipment Procured from Japan

The equipment to be procured in Japan will be shipped from the port of Yokohama and be unloaded at the Bandar Abbas port. About thirty days are necessary from Yokohama to Bandar

Abbas for marine transport, and custom clearance at Bandar Abbas, and then, land transportation will be carried out. After the custom clearance, the equipment for AQCC will be unpacked and numerical examination and system operation check will be conducted. Then, the equipment will be re-packaged for each site.

2) Equipment Procured from the Third Countries

Electrical Low Pressure Impactor (ELPI) is not procured from Japan, thus it will be procured from the third country (Finland). The ELPI will be transported from Japanese port along with other equipment, although the country of origin is Finland.

3) Equipment Procured Locally

As for the engine dynamometer system for diesel vehicle, the equipment for installation such as a fork lift, hoist, and hydraulic jack will be procured.

4) Insurance

Regarding the transport insurance and assembling insurance in Iran, the insurance must be purchased from locally authorized insurers. On the other hand for non-compensatory project, transport insurance shall be standard with all risks insurance, according to the guideline of Japan grant aid project, covering from the shipping port in Japan to the destination in the Recipient country including inland transportation. In order to implement the Project smoothly, Japanese insurance company shall insure the insurance, if necessary.

2-2-4-7 Operational Guidance Plan

(1) Exhaust Emission Measurement Equipment

AQCC will employ 3 or more new experts and start the vehicle emission laboratory section since AQCC has never had engine dynamometer system. AQCC and the new employers will experience the laboratory design, procurement, installation, initial operational training, and Soft Component. Throughout these experiences, the laboratory is designed for a smooth start.

- All the 3 core members of vehicle emission laboratory section will be employed from engineers or technicians with experiences using or installing engine dynamometer system and emission measurement.

- One of the 3 will be employed from or before the beginning of planning, where the other 2 will be employed before June 2018. All of them will be experienced in planning, procurement, installation, and adjustment on all the equipment of Iranian Burdens.
- Engine for initial operation training must be prepared for operation with Iranian responsibility.

Joint operation of grant aid equipment and Iranian undertaking equipment will be trained by Software Component after the initial operational training.

(2) Chemical Analysis Equipment

Since AQCC has no experience of possession and operation of a chemical analysis laboratory, personnel with a certain degree of knowledge in chemistry, such as educated in chemical analysis, are planned to be hired. However, since not many analytical lab engineers have experience using all of the equipment, the equipment are advanced, and operation procedures are varied by manufacturers, the initial operation guidance will be carried out focused on fundamental operation method of equipment.

Although the operation procedures of equipment differ greatly among Ion chromatograph, the contents of operation guidance are the same in inductively coupled plasma emission spectrometer (ICP-AES) and gas chromatograph mass spectrometer (GC/MS/MS (VOC), GC/MS/FID (PAH)). Table 2-13 shows the contents of initial operation guidance of the equipment mentioned above, and phase contrast microscope and balance, and electrical low pressure impactors used as ambient and exhaust particle measurement equipment.

Table 2-13 Initial Operation Guidance (Chemical Analysis Equipment and Ambient and Exhaust Particle Measurement Equipment)

Analytical equipment	Content of initial operation guidance
Ion Chromatograph (IC) Inductively coupled plasma emission spectrometer (ICP-AES) Gas chromatograph mass spectrometer (GC/MS/MS (VOC) Gas chromatograph mass spectrometer (GC/MS/FID (PAH))	- Explanation of overview and parts of equipment - Turning on and off of equipment - Method file creation, analysis setting modification - Qualitative / quantitative analysis - Data analysis, printing of results - Daily maintenance
Phase contrast microscope	- Explanation of overview, parts, and assembly of equipment - Turning on and off of equipment - Adjustment of observation method before and

	during observation - Taking photos - Daily maintenance
Microbalance	- Explanation of overview and parts of equipment - Turning on and off of equipment - Explanation of fundamental operation method of weighing - Daily maintenance
Electrical low pressure impactor	- Explanation of overview and parts of equipment - Connection of wire and tube - Turning on and off of equipment - Analyzation setting modification, beginning and end of sampling - Explanation of utilization method of the software - Daily maintenance

(3) Air Quality Monitoring Station

Since AQCC has conducted ambient air quality monitoring, they have sufficient basic skill for operation and maintenance. The initial training are planned to be conducted by the manufacturer and focus on the following issues.

- The procured monitors will be different from what AQCC has been using. Therefore the training will concentrate on understanding the interface of the monitor, advanced function, and etc.
- The specification indicates not only "β-ray absorption method" but also "Optical light scattering method" for PM10 and PM2.5 in order to widely encourage various manufacturers to enroll the bidding. Since this methodology has not been introduced in Iran, the training menu shall include the principle of optical light scattering method.

Since strengthening of operation and maintenance activities for air quality monitoring is indicated as one of the important tasks of the technical cooperation project, the results of initial training under the grant project could be linked to the technical cooperation project.

The methodology of "special survey" may be dependent on the specific purposes. However, the principle of operation and maintenance technique may be same as those for conventional monitoring. It is possible that the technical cooperation project to give a support and a suggestion to AQCC for designing special survey if AQCC has no experience, such as " Tunnel Survey (estimation of contribution of air pollutants by calculation of concentration difference between the upper stream and downstream in closed tunnel).

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

(1) Equipment for Exhaust Emission Measurement Laboratory

1) Background for Planning Soft Component

A) Background of the Project

Concentration of Carbon Monoxides (CO) of Tehran had been reduced to less than air quality standard of Iran throughout several projects, including Japanese cooperation "The Study on an Integrated Master Plan for Air Pollution Control in The Greater Tehran Area in The Islamic Republic of Iran (1994-1997)" and "The Study on Strengthening and Improving Air Quality Management in the Greater Tehran Area in the Islamic Republic of Iran (2002-2004)". However, concentrations of PM10, PM2.5, Sulfur Dioxide (SO2), and Nitrogen Dioxide (NO2) are often over Iranian Air Quality Standards and are still the primary pollutants, which are evaluated as serious air pollution. As a result of exceeding the standard, schools close temporary or request the citizens to stay indoors. The Government of Islamic Republic Iran prioritizes air pollution reduction especially in source study of particle matters and emission reduction, in the 5^{th} 5years plan (from 2011 to 2016).

However, Tehran Municipality does not have PM emission measurement equipment or PM components analysis equipment, and cannot analyze PM component or PM source contribution. Emission source and air pollution structure are not understood enough. Therefore, it is difficult to study air pollution reduction including identification of PM sources contribution and emission reduction methods.

In order to solve the issues above, grant aid project of "the Project for Improvement of Equipment for Air Pollution Analysis in Tehran" will supply the equipment for exhaust emission measurement, chemical analysis, ambient and exhaust particle studies, and air quality monitoring to Air Quality Control Company which is the subsidiary of Tehran Municipality. In order for Tehran Municipality to improve sustainable monitoring and analysis capacity for air pollutant emission monitoring, the air quality monitoring and air pollution structure are studied.

Table 2-14 Outline of the Project

Equipment		Expected Outcome	Input
1) Exhaust Emission Factor Measurement System	1.1) Engine Dynamometer System for Diesel Vehicle (400kW・40,000RPM) 1.1.1) Loading System 1.1.2) Measured-Data Acquisition 1.1.3) Test Stand Automation System 1.1.4) Media Conditioning Equipment 1.1.5) Exhaust Emission Measurement System	Administration capability can be focused to primary issues via developing emission factor specific for Tehran. In addition, higher performance countermeasures for Tehran specific conditions can be selected and promoted by measuring and comparing emission reduction performances of countermeasures.	1
	1.2) Portable Emissions Measurement System (PEMS)		One for Heavy Duty Vehicle (HDV) One for Light Duty Vehicle (LDV)
2) Chemical Analysis Laboratory	2.1) Ion Chromatograph for Quantitative Analysis of Ions in Ambient Particle Matters	Conducting component analysis of particulate matter, analyzing emission source profile and source apportionment, understanding the concentration of toxic substance such as benzo [a] pyrene and benzene, and analyzing of asbestos enable to propose countermeasure of pollution to the city of Tehran and relevant departments.	1
	2.2) Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) for Quantitative Analysis of Inorganic Constituents in Particulate Matters		1
	2.3) GC/MS/MS for PAH analysis		1
	2.4) GC/FID/MS for VOC analysis		1
	2.5) Phase Contrast Microscope for Conforming and counting asbestos		1
	2.6) Micro Balance for Weighting Filter Paper		1
3) Ambient and Exhaust Particle Studies Laboratory	3.1) Electrical Low Pressure Impactor		1
4) Air Quality Monitoring Station		It is expected that strengthening of air quality monitoring contributes to clarify air quality condition in Teheran and to evaluate impact of control policies.	7

B) Necessity of Soft Component

AQCC plans to conduct measurement by establishing new Vehicle Emission Laboratory Section and training new employees because AQCC does not have emission measurement equipment of engine dynamometer.

For emission measurement by engine dynamometer, it is necessary not only to operate the dynamometer and analyzers, but also to mount test engine, to operate related equipment according to test cycles, such as engine, fuel supply system, chilled water supply system for cooling engine, and air conditioning for dilution tunnel. It is also necessary to analyze the recorded data after the dynamometer test.

AQCC do not have engine dynamometer emission measurement system now. It will not be easy to operate the equipment as mentioned above even if AQCC will employ expert with experience of engine dynamometer. The initial operational training by equipment manufacture is not enough because the training of combined operation of grant aid equipment and utilities undertaken by Iranian side will be necessary.

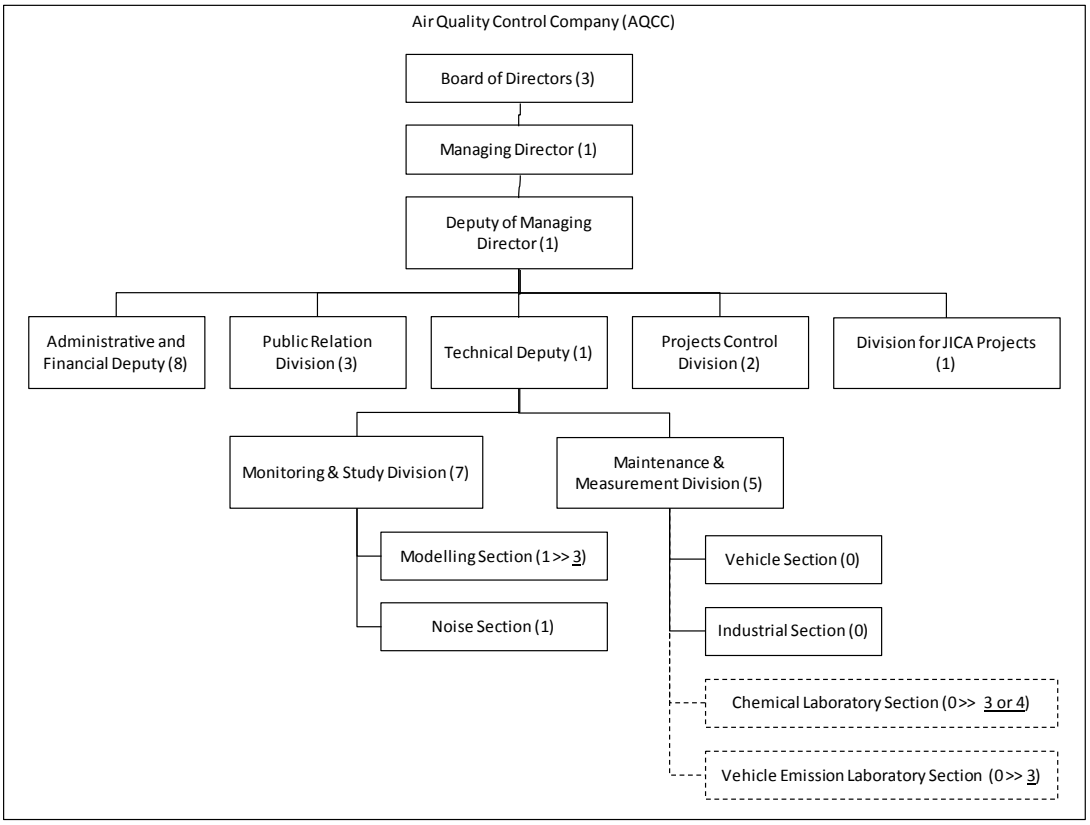
Therefore, Soft Component is necessary in order for AQCC to begin using the total system of engine dynamometer emission measurement equipment and to establish a method for AQCC to develop its capacity by itself.

C) Organization for Operation and Maintenance

AQCC, as Air Quality Control Company of the city of Tehran, which interacts with the related organizations, plays a role to prepare proposals for establishing standards and regulations, through air pollutants monitoring at air quality stations, analysis, and research on countermeasure of exhaust gases from vehicle. The operation and maintenance of the equipment are in charge of the managing director of AQCC, the deputy of managing director, the technical deputy (department manager 1 personnel), Maintenance and Measurement division (five personnel including the division chief), and both newly established Chemical analysis laboratory (newly hired four personnel) and Vehicle emission laboratory (newly hired three personnel).

Since AQCC staff needs expert knowledge, staff to be in charge of the equipment should be hired from personnel with specialized education on chemical analysis and vehicle emission measurement at universities or companies, by June 2018. Furthermore, since experts with Ph.D. in chemical analysis and vehicle emission gas measurement will be posted to assist AQCC as advisers, sufficient structure for the operation and maintenance will be established.

The structure of AQCC is shown in Figure 2-15.



Remarks: Dotted box sections don't exisit now, and will be necessary to use Grant Aid Equipment.
Numbers inside () indicate count of officers. Underlined numbers indicates officer count plans of AQCC.

Figure 2-15 Structure of AQCC and Numbers of Members

2) Goal of Soft Component

AQCC will use new engine dynamometer emission measurement system in order to measure air pollutants contained vehicle exhaust. However, AQCC has no experience in such measurement. This Soft Component is designed for AQCC to begin the exhaust measurement smoothly and AQCC experts to study emission measurement.

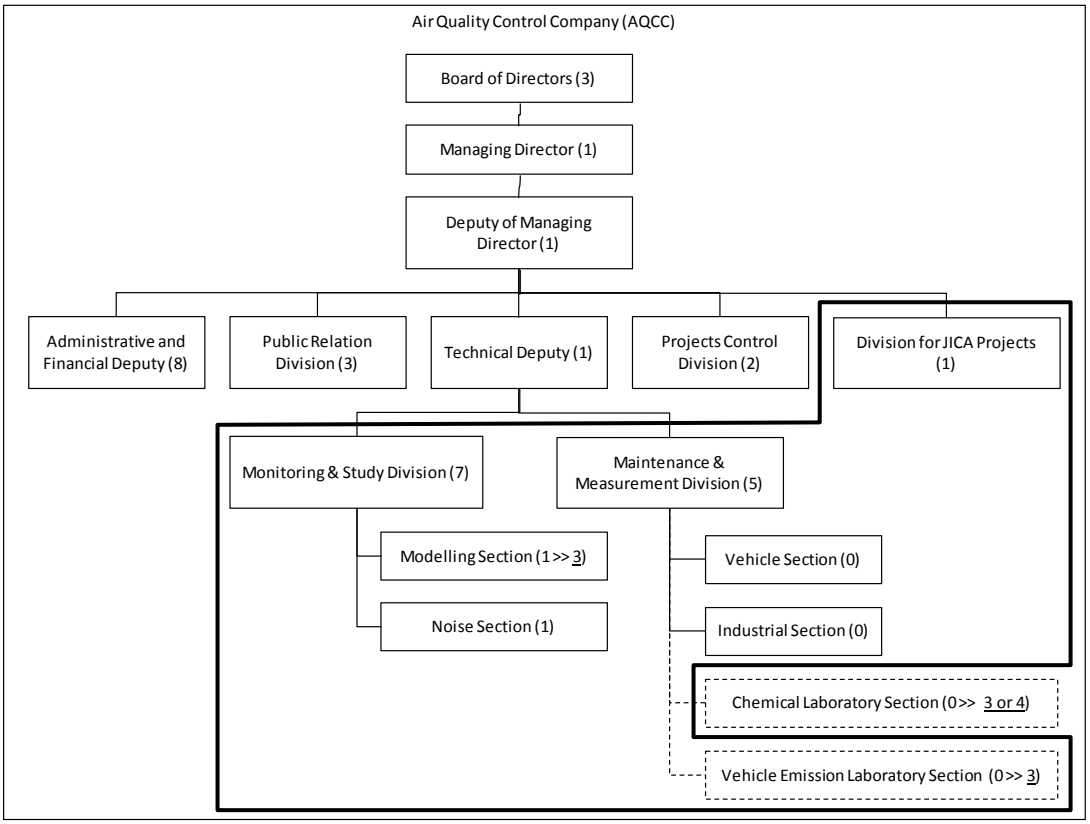
Operation manuals are prepared in details for equipment, and the total volumes are few meters thickness. The manuals will be used to solve any issues, and not suitable to use when training the initial operators or additional operators in future. Soft Component will compile Basic Operational Procedure Manual by which operators will understand the coordinated operation of equipment.

Table 2-15 Overall Goal of Soft Component

Goal	➢ Throughout exhaust measurement by engine dynamometer exhaust emission measurement system, air pollution reduction in Tehran City will be promoted mainly in vehicle emission control including vehicle emission control, fuel control, and vehicle transportation demand control.

Target of Soft Component will be experts of AQCC. Key staffs will be 3 persons who will be allocated to Vehicle Emission Laboratory Section. In addition, to ensure smooth technical transfer at times of personnel positioning, personnel from additional 2 or 3 more experts of Monitoring & Study Division or Maintenance & Measurement Division of AQCC will participate. The divisions of the target staffs are shown in Figure 2-16.

One of the 3 staffs must be employed from or before the beginning of planning, where the other 2 must be employed before June 2018. All 3 staffs must be experienced in planning, procurement, installation, and adjustment in all the equipment of Grant Aid and Iranian burdens, and trained by Initial Operational Training. In addition, the staffs will be allocated to Vehicle Emission Laboratory continuously after Soft Component.



Remarks: Dotted box sections don't exisit now, and will be necessary to use Grant Aid Equipment.
Numbers inside () indicate count of officers. Underlined numbers indicates officer count plans of AQCC.

Figure 2-16 Division of Soft Component Target (Identified by Bold Line)

3) Outcome of Soft Component

Table 2-16 shows the 4 points of expected outcomes on Soft Component, based on the project goal mentioned above.

Table 2-16 Outcome of Soft Component

Outcome
1. Master the series of operations of exhaust emission measurement using engine dynamometer system 1) Master the purpose, principle and risk of each equipment 2) Master how to mount engines 3) Master the series of operations of related equipment
2. Master the data processing recorded by the equipment 1) Master the operation of recorded data
3. Master maintenance of equipment 1) Master maintenance of equipment
4. Compile operational handbook 1) Compile Basic Operational Procedure Manual that covers coordinated operation of related equipment.

4) Method to Confirm the Outcome Achievement

The methods to confirm the outcome achievement is shown in Table 2-17. The time to confirm the outcome is set to be at the end of on-site training.

The training is programed with not only lectures but also with practical exercises using the installed equipment in order to draw proactive involvement of the trainees.

The achieved outcome will be confirmed by checking analysis result of testing sample (analysis result record), checking trainees understandings (understanding test), and preparation of operation documents (standard operating procedure) conducted by the trainees.

Table 2-17 Method to Confirm the Outcome Achievement

Outcome	Indicator	Means of Verification
Master operations	1) Trainees understand the purpose, principle, and risk of each equipment 2) Trainees understand the procedure to mount engines 3) Trainees understand the series of operations of related equipment	Training record Data measured Understanding test
Master the data processing	1) Trainees understand data processing	Training record Data processed Understanding test
Master maintenance of equipment	1) Trainees understand maintenance of equipment	Training record Maintenance record Understanding test
Compile operational handbook	1) Basic Operational Procedure Manual is compiled	Basic Operational Procedure Manual

5) Soft Component Activities (Input Plan)

Input activities for the expected achievement of Soft Component are shown below.

In the beginning, draft version of Basic Operational Procedure Manual, which will be used for the training, will be prepared.

For final finishing of the activity, training outcome seminar will be held for the trainee to present the achieved knowledge to the AQCC executives and colleagues.

Table 2-19 shows the activity of the soft component.

Outcome 1: Master operations

<Contents>

1) Lecture on Safety Management

   Lecture safety management, and confirm the responsibilities for safe operation

2) Lecture on Measurement Principle and Basic Operations

   Lecture the measurement principles and basic operation, and confirm the understandings of the trainees

3) Mounting Engine

   Check parts to mount engine on dynamometer, mount engine using pickup truck, hoist and tools to adjust the rotation axis, and then connect and adjust fuel pipe, exhaust gas pipe, and necessary sensors.

4) Test operation of engine and dynamometer

   Run engine and dynamometer by configuring their controllers.

5) Configuration and Calibration of Exhaust Analyzers

   Configure, adjust, and calibrate exhaust analyzers.

6) Exhaust Measurement

   Measure exhaust by coordinate operation of dynamometer, engine, exhaust analyzers, and other sensors.

7) Unmounting Engine

   Unmount engine from dynamometer

Outcome 2: Master the data processing

<Contents>

1) Lecture and exercise on the data processing

   ・Lecture the data processing, and measurement report

   ・To present the measurement report and to discuss the data for air pollution reduction

Outcome 3: Master maintenance of equipment

<Contents>

1) Lecture and exercise on equipment maintenance

   ・Lecture and exercise the maintenance on engine dynamometer, exhaust analyzers, and related equipment

Outcome 4: Compile Basic Operational Procedure Manual

<Contents>

1) **Compile Basic Operational Procedure Manual**

・Compile Basic Operational Procedure Manual that is necessary for the lecture and training above.

・Trainees will update Basic Operational Procedure Manual based on the understandings throughout the activities for Output 1 to 3.

Engine dynamometer exhaust measurement system consists of many kind of equipment including Iranian burdens. At first measurement of Soft Component, it is important to understand a series of measurement operation rather than details understanding of many kind of equipment. Therefore, it is prioritized to understand a series of measurement operation in the first measurement. On the other hand, the engineers need to master measurement for various type engines in various conditions. Next for the measurement, it is prioritized to increase application capacity by educating the details of equipment. In addition, their understandings are to be deepened by encouraging attention throughout the following procedure; a subject will be given to the trainee after the 1st measurement in order to develop interests on engine dynamometer measurement for the 2nd measurement. Intermediate break will be prepared in the middle of Soft Component period.

The engine dynamometer exhaust measurement requires engine up to 500kg, dynamometer which gives resistivity to the engine for vehicle weight up to 10 ton or more, electricity for these power, fuel storage and cylinder gases which requires special permission. These cause variety of risks such as high speed rotation, high temperature exhaust pipes and gases and other dangers (such as fuel and high pressure gases). Safety management education is scheduled in order to prevent any accident related to Grant Aid equipment.

This Soft Component assumes to use the engine mounting parts and connecting equipment which is prepared for Grant Equipment installation and adjustment. Therefore, the engine for Soft Component must be the same engine used for installation and adjustment. These assumptions are listed in the burdens of Iranian side.

The contents of initial operational training by the supplier and analytical training by Soft Component are compared in Table 2-18.

Just after the analyzer installation by supplier engineer, trainees of AQCC are planned to be trained for their initial operational training. The training is limited to the Grant Aid equipment, and not covers the other necessary lectures and trainings such as safety management education,

series of operation together with utilities of Iranian burdens, output data processing, reporting, and Basic Operational Procedure Manual compilation.

Soft Component is aimed to guide AQCC to measure exhaust gas safely, including safety management lecture, training from a series of operation of all the related equipment to reporting, and compile Basic Operational Procedure Manual.

Table 2-18 Difference between Initial Operational Training and Soft Component

	Initial Operational Training	Soft Component
Engine Dynamometer System	・Explanation of Grant Aid Equipment ・Basic operation of Grant Aid Equipment, such as starting, measurement and stopping ・Explanation of software attached	・Safety Management Education ・Fuel Supply, Cooling Water Supply, and Dilution Air Supply ・Engine Mounting ・Exercise the Series Operation of Equipment Related ・Processing of Data Recorded ・Supporting to Compile Basic Operational Procedure manual

Table 2-19 Contents of Soft Component activities

	Purpose and Activity Summary	Day Count of Implementation		Target	Implementation Resource
		1st Period(*)	2nd Period (*)		
	Preparation and Plan Discussion				
a) Plan Confirmation and Preparation	Discussion and confirmation of the plan with JICA Iran Office and AQCC on Soft Component and request. Coordination with test engine supplier	1	1	AQCC Responsible official Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Team Leader) Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
b) Equipment Check and Training Preparation	Check all the necessary equipment, not only Grant Aid equipment such as engine dynamometer, exhaust analyzers, controllers, censors, and gas supply control unit, but also Iranian Burdens such as water chiller, air conditioner, fire extinguisher, and develop (in the 1st period, and update in the 2nd period) Basic Operational Procedure Manual	3	2	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Team Leader) Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
	Outcome 1: To master operations				
1-1 Lecture on Safety Management	Lecture safety management, and to confirm the responsibilities for safe operation	1	1	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Team Leader) Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
1-2 Lecture on Measurement Principle and Basic Operations	Lecture the measurement principles and basic operation, and to confirm the trainees understandings. The contents include plan of necessary equipment (i.e. coupling and engine mounting equipment), fuel supply piping, and equipment check before testing, emergency response against troubles in the emission test.	2	2	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Team Leader) Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)

1-3 Mounting Engine	Check parts to mount engine on dynamometer, to mount engine using pickup truck, hoist and tools to adjust the rotation axis, and then to connect and adjust fuel pipe, exhaust gas pipe, and necessary sensors.	3	3	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
1-4 Test operation of engine and dynamometer	Run engine and dynamometer only to configure the controllers to realize the test cycle of engine	2	2	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
1-5 Configuration and Calibration of Exhaust Analyzers	Configure, adjust and calibrate exhaust analyzers (11 gas pollutants, particulate matter mass and particulate matter count. 13 parameters in total)	1	1	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
1-6 Exhaust Measurement	Check equipment, to configure and adjust equipment for test cycle, and then measure exhaust by cooperated operation of dynamometer, engine, exhaust analyzers and other sensors, and then to measure exhaust.	1	1	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
1-7 Unmounting Engine, and checking equipment	Unmount engine from dynamometer, and to check equipment	1	1	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
	Outcome 2: To master the data processing				
2-1 Lecture and exercise on the data processing	Lecture the data processing, and measurement report To present the measured data for maximum usage of the equipment	1	1	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
	Outcome 3: To master maintenance of equipment				
3-1 Lecture and exercise on	Lecture and exercise equipment maintenance procedure and interval	1		AQCC Vehicle emission laboratory	Japanese Consultant 1 person (Operational Training 1)

equipment maintenance	on both of Grant Aid Equipment (i.e.: engine dynamometer, emission analyzers, controllers, censors and gas supply controllers) and Iranian burdens (i.e.: Water chiller, air conditioner, fire extinguishers).			personnel Technical department personnel	Japanese Consultant 1 person (Operational Training 2)
	Outcome 4: To compile Basic Operational Procedure Manual				
4-1 Compile Basic Operational Procedure Manual	Compile Basic Operational Procedure Manual that is necessary for the lecture and training above. Trainees will update Basic Operational Procedure Manual based on the understandings throughout the activities for Output 1 to 3		2	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Team Leader) Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
	Others				
Reporting Training	Presentation of training and discussion on measurement plans	1	1	AQCC Managing Director Deputy Managing Director Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Team Leader) Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
	Presenting themes, schedule discussion and capacity assessment	1	1		
	Reporting and discussion to JICA Iran Office and AQCC	1	1		

* Priorities and Goals are different in 1st and 2nd periods. Details are mentioned in the main text.

6) Resources to Implement Soft Component

A) Japanese Consultant

Equipment of this Grant Aid Project includes special and latest equipment. Since the trainings require expertise, it is not possible to conduct training by Iranian local resources as subcontract. For this reason, it is proposed to conduct Soft Component through outside Iran resources.

To implement the activities described above, 3 Japanese consultants are necessary as shown in Table 2-20.

Team Leader (1 person) will discuss with AQCC and JICA on details plans, coordinate the training course including the Iranian burdens, and compile Basic Operational Procedure Manual with other Japanese consultants. Operational Training Personnel (2 persons) will lecture safety management, and guide mounting engine, preparing dynamometer, exhaust measurement, and data processing. Since most activities are necessary to be conducted at two locations separately in cooperation, 2 persons are allocated for Operational Training Personnel. They will carry out Soft Component efficiently by mutual cooperation.

Table 2-20 Performance and Capability for Training Instructor

Title	Activities	Experience required	Capability required
Vehicle Exhaust Measurement Equipment (Team Leader)	Discussion and coordination with AQCC and JICA, training preparation, and operation and maintenance organizational setup	Similar training in the activities allocated	Expertise in the field of exhaust measurement output application
Vehicle Exhaust Measurement Equipment (Operational Training 1)	Operational training on engine dynamometer system (2 persons are allocated because many works such as mounting engine and adjusting equipment requires cooperated work at 2 locations)		Expertise in the field of exhaust measurement using engine dynamometer system
Vehicle Exhaust Measurement Equipment (Operational Training 2)			

B) Interpreter of Local Employment

It is expected that English communication is difficult with the technicians and administrators of installation sites. One English-Persian interpreter is required.

7) Implementation Process of Soft Component

Implementation process plan for this Soft Component is shown in Table 2-21 and Table 2-23.

Table 2-21 Implementation process of Soft Component (Draft)

		Year 2019										Consultant	
		1	2	3	4	5	6	7	8	9	10	Count	M/M
Main Project	Initial Operational Training by Manufactures						0.50			0.50			
Soft Component	Team Leader											1	1.00
	Operational Training 1											1	2.00
	Operational Training 2											1	2.00
Reference				New Year Holiday		Ramadan	1.00	Review by AQCC		1.00			
Total												3	5.00

New Year day of Iranian Calendar is in 2 weeks around the Vernal Equinox Day, which are the Iranian holiday season. Ramadan in 2019 is expected to start on 5th may until 3rd June. In order to allocate 1 month of full capacity days for Soft Component, the Soft Component is proposed to start after Ramadan.

Soft Component is planned to 2 period, 1st period and 2nd period, because of the reason described in "5) Soft Component Activities (Input Plan)".

8) Outputs from Soft Component

Outputs of Soft Component are shown in Table 2-22.

Table 2-22 Outputs of Soft Component

1) Soft Component implementation status report
2) Basic Operational Procedure Manual
3) Progress Report
4) Final Report
5) Soft component completion report

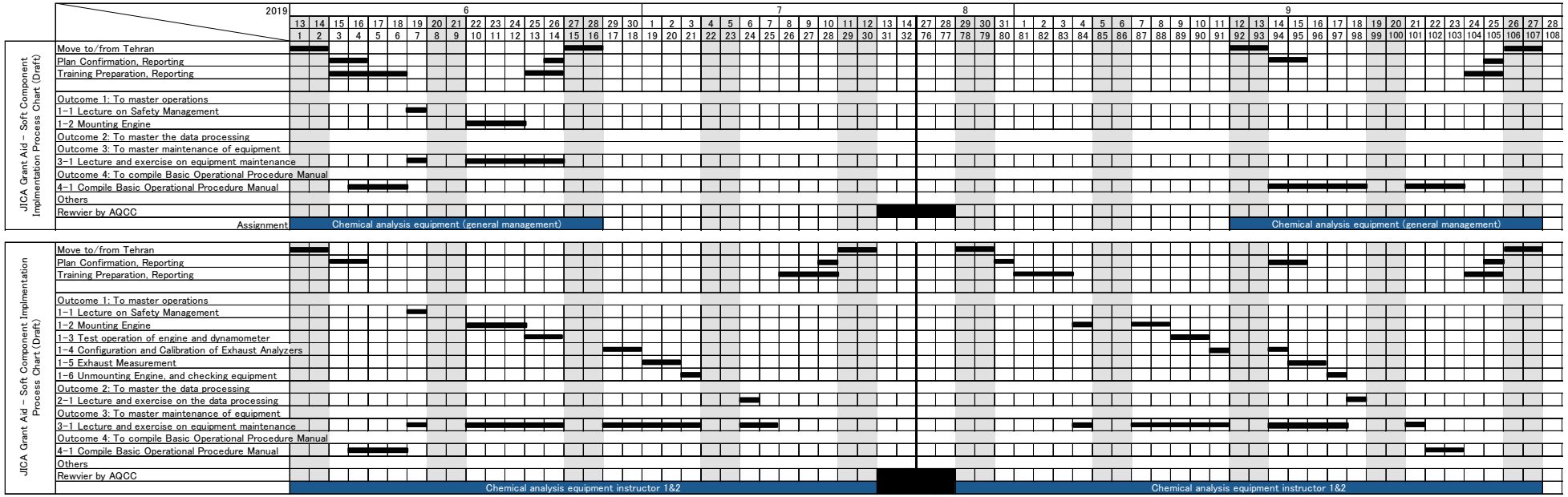
9) Responsibility of Executing Agency in the Partner Country

In order to continuously and effectively utilize equipment procured by this Grand Aid, AQCC which is the executing agency needs to implement the following contents.

- Land large enough for engine dynamometer emission measurement laboratory
- Building for engine dynamometer emission measurement laboratory

- Utilities for engine dynamometer emission measurement laboratory (Water chiller, air conditioner, power utility, fuel supply utility, fire extinguish utility, and etc.)
- One of the 3 must be employed from or before the beginning of planning, where the other2 must be employed before June 2018. All of 3 must have experienced in planning, procurement, installation, and adjustment on all the equipment of Grant Aid and Iranian Burdens, and then trained by Initial Operational Training. In addition, they must be allocated to Vehicle Emission Laboratory continuously after Soft Component.
- Basic Operational Procedure Manual will be updated periodically.
- Human resources development in order to continue using the laboratory.
- Materials and consumables necessary for engine dynamometer laboratory (burrowing engines to be tested, burrowing emission reduction system to be evaluated, standard and carrier gases, PM sampling filters, maintenance and support contract of utilities)
- Engine, mounting parts and connection parts that will be used for installation and adjustment of engine dynamometer are available for the period of Soft Component.

Table 2-23 Implementation Process (Draft)



(2) Chemical Analysis Equipment

1) Background for Planning Soft Component

A) Background of the Project

The city of Tehran has reduced the carbon mono oxide (CO) concentration below the standard value of Iranian government, with Japanese cooperation of “Development survey: The study on an integrated master plan for air pollution control in the greater Tehran area in the Islamic Republic of Iran (1994-1997)”, and “The study on strengthening and improving air quality management in the Greater Tehran area in the Islamic Republic of Iran (2002-2004)”. However, air pollutants concentrations such as PM10 and PM2.5, sulfur dioxide (SO2), and nitrogen dioxide (NO2) are exceeding the Iranian standard values, and for the safety, educational institutions has closed temporary, and warnings were issued to stay inside buildings.. For this reason, the Government of the Islamic Republic of Iran prioritizes the reduction of air pollution, especially in specifying the source and reducing the particulate matter in the 5th Five-year plan (2011-2016).

Meanwhile, the city of Tehran does not own equipment for component analysis of particulate matter, and component composition and source contribution analysis cannot be carried out, thus, the source and pollution structure are not sufficiently clarified. For this reason, it is difficult to investigate the countermeasures of air pollution such as identifying source and reduction method based on the component analysis results.

This Grand aid project, "The Project for improvement of equipment for air pollution analysis in Tehran," responding to the above issue, facilitates to improve autonomous measurement and analysis capacity related to air pollution emission, air pollution status, and pollution structure in Tehran, by providing necessary equipment of exhaust emission measurement, chemical analysis, ambient and exhaust particle measurement, and air quality monitoring station to Air Quality Control Company (AQCC) founded by the city of Tehran,

Table 2-24 Overview of the Support Plan of the Project

Equipment		Expected achievement	Input plan
1)Exhaust Emission Measurement Equipment	1.1) Engine Dynamometer system for Diesel vehicle(400kW・40,000RPM) 1.1.1) Loading System 1.1.2) Measured-Data Acquisition 1.1.3) Test Stand Automation System 1.1.4) Media Conditioning Equipment	By constructing an emission factor that meets the specific conditions of the city of Tehran, identifying emission source and pollutants that	1

	1.1.5) Exhaust Emission Measurement System	should be treated with priority, that makes administrative capacity available to concentrate on solving the issue. In addition, measurement of the effect of a various countermeasure devices enables to make plans for action effectiveness expected under the Tehran's unique condition.	
	1.2) Portable Emission Measurement system		Heavy duty vehicle 1 Light duty vehicle 1
2)Chemical Analysis Equipment	2.1) Ion Chromatograph (Ion analysis of PM in ambient air)	Conducting component analysis of particulate matter, analyzing emission source profile and source apportionment, understanding the concentration of toxic substance such as benzo [a] pyrene and benzene, and analyzing of asbestos enable to propose countermeasure of pollution to the city of Tehran and relevant departments.	1
	2.2) ICP-AES(Inorganic analysis of PM)		1
	2.3) GC/MS/MS(PAH analysis)		1
	2.4) GC/MS/FID(VOC analysis, added)		1
	2.5) Phase contrast microscope (Asbestos analysis)		1
	2.6) Microbalance		1
3)Ambient and Exhaust Particle Measurement Equipment	3.1) Electrical Low Pressure Impactor		1
4)Air Quality Monitoring Station		Reinforcing in monitoring enables to perceive the current status in city of Tehran and check the effect of countermeasure.	7

B) Necessity of Soft Component

Since AQCC does not own a chemical analysis laboratory for air pollution measurement, AQCC plans to establish a new section, to train personnel for analytical tasks.

Using equipment planned to be procured by this project, component analysis of pollution such as particulate matter requires relatively sophisticated skills. In order to acquire analytical skills for the component analysis of particulate matter in the ambient air, a long term of training such as several months to years will be necessary for analysis operation staff and also personnel who manage the analytical work to increase experiment such as skill and knowledge

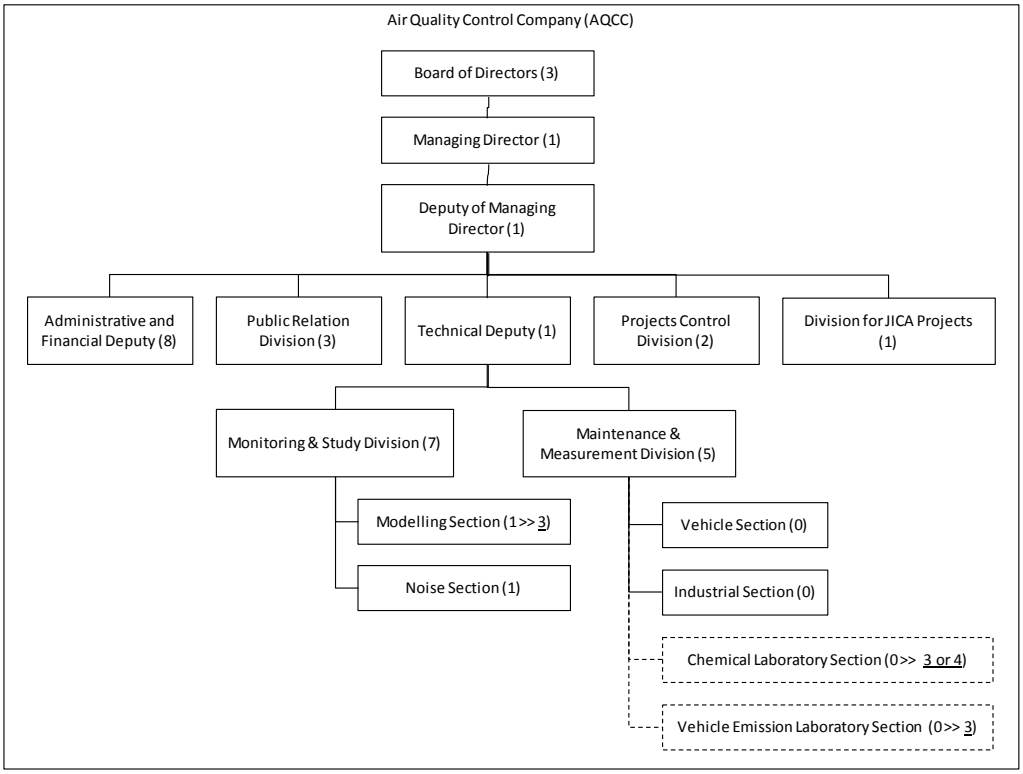
Considering of no chemical analysis laboratory at AQCC, it is not easy to train the trainees up to the satisfied level in a short period, and it is necessary to educate and train in a long-term perspective. The activities are planned for technical projects regarding sampling, data analysis, and utilization of results. Consequently, Soft Component is necessary for the sample analysis.

C) Organization of Operation and Maintenance

AQCC interacting with related organizations plays a role to make proposals for establishing standards and regulations, through air pollutants monitoring at air quality stations, analysis, and research on countermeasure of exhaust gases from vehicle. Operation and maintenance of the equipment is taken in charge by the managing director of AQCC, the deputy of managing director, the technical deputy (department manager 1 personnel), Maintenance and Measurement division (5 personnel including the division chief), and both newly established Chemical analysis laboratory (newly hired 4 personnel), and Vehicle emission laboratory (newly hired 3 personnel).

As AQCC staff should have expert knowledge, staff for the section in charge of the equipment, should be hired from those who have specialized education on chemical analysis and vehicle emission measurement at universities or companies, by June 2018. Furthermore, since those experts who have Ph.D. in chemical analysis and vehicle emission gas measurement assist AQCC as advisers, it is considered that sufficient organization for the operation and maintenance is established.

The organization chart of AQCC is shown in Figure 2-17.



Remarks: Dotted box sections don't exisit now, and will be necessary to use Grant Aid Equipment.
Numbers inside () indicate count of officers. Underlined numbers indicates officer count plans of AQCC.

Figure 2-17 AQCC Organization Chart and Number of Members

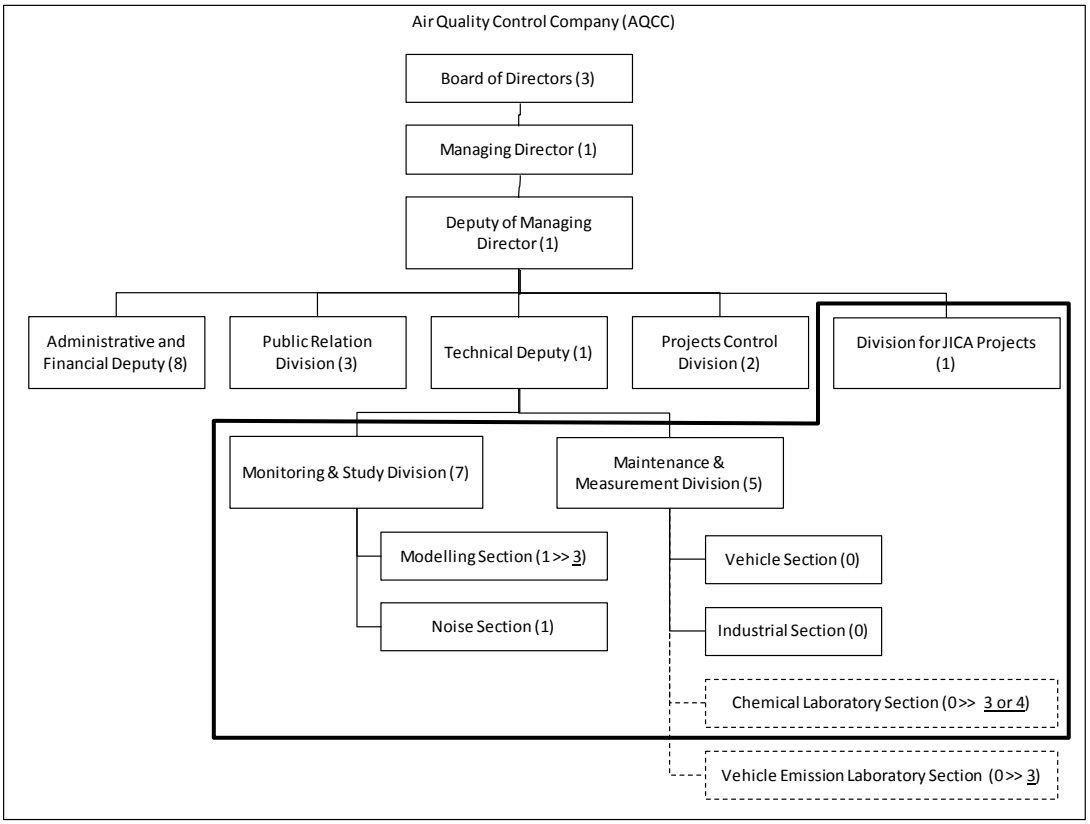
2) Goal of Soft Component

In response to severe air pollution, AQCC needs to establish a new chemical analysis laboratory, conduct research to understand air pollution mechanism of particulate matter, etc., and clarify the emission source in order to countermeasure the air pollution. However, AQCC has no experience in analyzing particulate matter, VOC, PAH, and asbestos in ambient air using chemical analysis equipment. Aiming to the smooth operational launch of this project, a goal is set for the staffs in charge to acquire appropriate analysis technique.

Table 2-25 Goal of Soft Component

Goal	By conducting the analysis of particulate matter, VOC, PAH, and asbestos in ambient air, study of effective countermeasure on air pollution is promoted in the city of Tehran.

Figure 2-18 shows the divisions of trainees to be attending the analytical technique training. For the Soft Component, 3 personnel belonging to the chemical analysis laboratory will play the center role. However, there is a possibility that personnel in charge of the task may be changed due to retirement. Even in that case, AQCC believes smooth succession of tasks is important in a long perspective. Therefore, AQCC aims to assign 2 to 3 personnel from technical division (Monitoring & Study Division, Maintenance & Measurement Division), and total of 5 to 6 personnel will conduct the assignment for training the technique.



Remarks: Dotted box sections don't exisit now, and will be necessary to use Grant Aid Equipment.
Numbers inside () indicate count of officers. Underlined numbers indicates officer count plans of AQCC.

Figure 2-18 The Division of Trainees to Attend Training on Analytical Technique (within bold line)

3) Outcome of Soft Component

Table 2-26 shows the 4 expected outcomes on Soft Component, based on the project goal mentioned above.

Table 2-26 Outcomes of Soft Component

Outcome
1. Acquire analysis technique 1) The measurement principle of analysis is understood. 2) Learn how to prepare and handle reagents 3) Learn how to prepare and handle sample 4) Learn preparation procedure
2. Acquire analysis methods and maintenance of equipment in order to achieve the purpose. 1) Learn operating procedure to analyze components of particulate matter, etc. that is needed to achieve the goal 2) Learn how to maintain analytical equipment.
3. Acquire how to calculate of analysis results 1) Learn how to organize data
4. Prepare operating procedure 1) Prepare analysis procedure documents (standard operating procedure, SOPs)

4) Method to Confirm the Outcome Achievement

The methods to confirm the outcome achievement are shown in Table 2-27. The outcome will be confirmed at the end of on-site training. The training program is planned that not only lectures but also practical exercises shall be done using installed equipment in order to acquire proactive involvement of the trainees.

The method to confirm the outcome achievement is by checking analysis result of testing sample (analysis result record), checking understandings of the trainees (understanding test), and preparation of operation documents (standard operating procedure) conducted by trainees

Table 2-27 Method to Confirm the Outcome Achievement

Outcome	Items of outcome achievement	Method to confirm
Acquire analysis technique	1) Trainees understand the measurement principle of analysis. 2) Trainees understand how to prepare and handle reagents. 3) Trainees understand how to prepare and handle sample. 4) Trainees understand preparation procedure.	Training record Understanding test
Acquire analysis methods and maintenance of equipment in order to achieve the purpose	1) Trainees understand operating procedure to analyze components of particulate matter, etc. that is needed to achieve the goal. 2) Trainees understand how to maintain analytical equipment.	Training record Data result Understanding test Maintenance record
Acquire how to calculate of analysis results	1) Trainees understand how to organize data.	Training record Analysis result record Understanding test
Prepare operating procedure	1) Trainees prepare analysis procedure documents (standard operating procedure, SOPs).	Standard operating procedure

5) Soft Component Activities (Input plan)

Input activities on the expected achievement of Soft Component are shown below.

The draft documents of standard operation procedure will be prepared to learn how to operate prior to their training, based on manuals provided from manufactures or some information regarding the glass wear cleaning or handling of chemical reagents.

Also, as final activity, the trainee will present the achievements from the activity to AQCC executives and colleagues in the training seminar.

Table 2-29 shows the activity of the soft component. Since multiple activities are performed concurrently in some cases, the days of training activity was assigned proportionally.

Outcome 1: Acquire analysis technique

<Contents>

1) Lecture on measurement principle of analysis
   - Lecture the basics of analytical chemistry and presume the abilities of trainees.
   - Review the fundamental knowledge of analysis measurement principle, structure, and function of equipment.
2) Lecture and practical training on preparation and handling of reagents
   Lecture on reagents characteristics, caution in reagents handling, and reagents management which are necessary in the operation tasks, and practical training on reagents preparation.
3) Lecture and practical training on preparation and handling of sample
   Lecture and practical training on sample preparation, handling, and storage method.
4) Lecture and practical training on the pretreatment procedure.
   Lecture and practical training on sample pretreatment procedure before instrumental analysis is carried out.

Outcome 2: Acquire analysis methods and maintenance of equipment in order to achieve the purpose

<Contents>

1) Lecture and practice of analysis method necessary to achieve purpose
   - Review operational procedures and repeat training practice.
   - Prepare calibration curves and check the sensitivity.
   - Analyze standard and/or sample to obtain analysis data.
2) Lecture and practical training on analytical equipment maintenance

Learn maintenance procedures and maintenance period of equipment and peripheral devices.

Outcome 3: Acquire calculation method of analysis results

<Contents>

1) Lecture and practical training on organizing data

Learn how to organize data and produce analysis result record.

Outcome 4: Prepare standard operating procedure

<Contents>

1) Produce standard operating procedure

Trainees review training contents of outcome 1 to 3, and produce standard operating procedure for analysis and data organizing.

Initial operation guidance is guidance on handling of analytical instruments carried out by manufacturers. Although this guidance will provide the explanations of the installed equipment, it is inadequate to train on pretreatment, analysis, organizing data, and analysis management in order to achieve the goal of analysis of particulate matter, PAH, VOC, and asbestos.

In order to launch the usage of equipment suited to the goal, Soft Component is necessary for explanation of analysis outline, guidance of reagents and sample handling, sample pretreatment, quantitative analysis, organizing analysis data, and preparing standard operating procedure.

The contents of initial operation guidance conducted by manufacturers and analytical technique training in Soft Component are shown in Table 2-28. The details of Group A and B will be described in the procurement method of resource implementation.

Table 2-28 Initial Operation Guidance and Analytical Technique Training in Soft Component

Chemical analysis equipment	Initial operation guidance	Analytical technique training in Soft Component
Principle	・Guidance of operation on equipment procured by the project (including attached software)	・A series of analysis training using several equipment (including the use of equipment procured by Iranian side) to analyze the target substance.
Gas chromatograph (PAH)	・Explanation of overview and parts of equipment ・Explanation of turning on and	・Explanation of analysis summary on object substance (PAH) ・Guidance on handling sample and

	off of equipment power, and fundamental operation method for measurement. ・Explanation of how to use the attached software	reagents ・Guidance on analysis pretreatment ・Checking sensitivity of equipment and conduct quantitative analysis. ・Review on analytical equipment operation ・Guidance on calculation of analysis data ・Guidance on preparation of standard operating procedure
Gas chromatograph (VOC)	Same as above	・Explanation of analysis summary on object substance (VOC) ・Guidance on handling sample and reagents ・Guidance on analysis pretreatment ・Checking sensitivity of equipment and conduct quantitative analysis. ・Review on analytical equipment operation ・Guidance on calculation of analysis data ・Guidance on preparation of standard operating procedure
Ion Chromatograph	Same as above	・Explanation of analysis summary on object substance (Ion) ・Guidance on handling sample and reagents ・Guidance on analysis pretreatment ・Checking sensitivity of equipment and conduct quantitative analysis. ・Review on analytical equipment operation ・Guidance on calculation of analysis data ・Guidance on preparation of standard operating procedure
ICP	Same as above	・Explanation of analysis summary on object substance (Inorganic) ・Others, as same as above
Phase contrast microscope	・Explanation of overview and parts of equipment ・Explanation of turning on and off of equipment power, and fundamental operation method for measurement.	・Explanation of analysis summary on object substance (Asbestos) ・guidance of asbestos counting method ・Guidance on calculation of analysis data and preparation of standard operating procedure
Micro balance	・Explanation of overview and parts of equipment	・Guidance on handling sample (filter sample)

	・Explanation of turning on and off of equipment power, and fundamental operation method for measurement	・Guidance on pretreatment method for measurement ・Guidance on measurement method of sample ・Guidance on calculation of analysis data and preparation of standard operating procedure

Table 2-29 Contents of Soft Component Activities

	Aim / Summary of activity	Duration of implement						Attendance	Implementation resources
		Phase contrast microscope	Micro balance	IC	ICP	Gas chromatograph (VOC)	Gas chromatograph (PAH)		
		A,B	A,B	B	B	A	A	AQCC training group (A, B)	
Preliminary preparation / report									
a) Prior consultation	Discussion and reporting at JICA office and AQCC Explanation of Soft Component activities, Cooperation Request	0.5				1		AQCC Responsible official Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)
b)Equipment operation status check, training preparation	Check the operation status of main and peripheral equipment confirming and/or washing of pretreatment equipment, pure water making equipment, washing equipment, dedicated and common glassware, consumables, standard substances, reagents, and gases for analyzer, etc. that Iranian side procured. Preparing draft of standard operating procedure (SOP)	1.5		2	2	2	2	AQCC Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)
Outcome1 Activities related to acquiring analysis techniques									
1-1 Lecture on measurement	Lecture the basics of analytical chemistry and	1.5	1.5	1	1	1	1	AQCC Chemical analysis	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP)

principle of analysis	presume the abilities of trainees. Review the foundation of analysis measurement principle, structure, and function of equipment							laboratory personnel Technical department personnel	Japanese Consultant 1 person (VOC, PAH)
1-2 Lecture and practical training on preparation and handling of reagents	Lecture on reagents characteristics, caution in reagents handling, and reagents management necessary in the operation tasks, and practical training on reagents preparation. Since PAH requires a wide variety of reagents and that also increases preparation work by double for washing devices, compared to other analysis.			1	1	1	2	AQCC Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)
1-3 Lecture and practical training on preparation and handling of sample	Lecture and practice training on sample preparation, handling, and storage method Since VOC requires time to prepare sampling tube and confirming blank result, it takes double as compared to other analysis.			0.5	1	2	1	AQCC Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)

1-4 Lecture and practical training on the pretreatment procedure.	Lecture and practical training on sample pretreatment procedure before instrumental analysis is carried out ICP, VOC, PAH were secured for 3 days because the preprocessing procedure is more complicated than that of IC analysis, and as repetition practice is planned.			1	3	3	3	AQCC Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)
Outcome2 Activities related to acquiring analysis methods and maintenance of equipment in order to achieve the purpose									
2-1 Lecture and practical training of measurement using analytical equipment	Lecture and practical training as follows. (Phase contrast microscope, micro balance) measurement of pretreated sample, and obtain analysis data (Other equipment) - Measure the standard sample and prepare calibration curve. - Measure the pretreated sample and obtain analysis data. - For proficiency, conduct repetition measurement and obtain analysis data. - For quality control, confirm whether correct concentration can be measured using standard sample.	2	1.5	3	4	4	4	AQCC Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)

2-2 Lecture and practical training on analytical equipment maintenance	Learn maintenance procedures and maintenance period of equipment and peripheral devices			0.5	1	1	1	AQCC Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)
Outcome3 Activities related to acquiring calculation method of analysis results									
3-1 Lecture and practical training on organizing data	Based on the data obtained from the analyzer or the data obtained by visual observation of asbestos with a microscope, analysis result records are prepared.	0.5	0.5	1	2	2	2	AQCC Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)
Outcome4 Activities related to preparing standard operating procedure									
4-1 Produce standard operating procedure	Review training contents of outcome 1 to 3, and produce standard operating procedure for analysis and data organizing.	1.5		2	2	2	2	AQCC Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)
Other									
Report on training achievement	Report on training achievement at debrief meeting.	1		1	1	1	1	AQCC Responsible official Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)

※ Soft Component analytical technique training and attendees

AQCC training group A： Micro balance, phase contrast micro scope, gas chromatograph (PAH, VOC)

AQCC training group B： Micro balance, phase contrast micro scope, IC, ICP

6) Procurement Method of Implementation Resources for Soft Component

A) Japanese Consultant Personnel

Since analytical equipment procured in this cooperation project includes special and latest equipment, the training activities with re-entrustment of Iranian local resources cannot be planned. Therefore, it is proposed that implement of training activities should be carried out by utilizing outside Iran resources.

For the activities described in the preceding paragraph, a general manager for consultation and coordination with AQCC and JICA will be assigned, and manage the activities for six types of equipment shown in Table 2-30. Though each 6 types of equipment require expertise, in order to reduce the number of trips, consultants who can provide training for multiple equipment were considered. As a result, as shown in Table 2-30, it is possible to reduce to 2 consultants, one of being in charge of 2 types of gas chromatograph, and the other in charge of other equipment. The total number of trips will be 2 times for general manager and 1 for each of consultants with training in chemical analysis equipment.

Table 2-31 shows the assignment and role, and the required performance and ability.

Table 2-30 Resource Input Plan from Japanese Side

		Assignment, Measurement item	Personnel dispatch or re-entrust	Period (M/M)	number of people
Chemical analysis equipment		General manager	Order-received consultant	0.83	1
A	Gas chromatograph	PAH	Order-received consultant	1.00	1
B	Gas chromatograph	VOC		1.07	
C	Ion chromatograph	Ion component	Order-received consultant	0.70	1
D	ICP	Inorganic		0.87	
E	Phase contrast microscope	Asbestos		0.60	
F	Micro balance	Paticulate matter			
Total				5.07	3

Table 2-31 Performance and Ability Necessary for the Training Instructor

Assignment	Field / Role	Performance	Ability
Chemical analysis equipment (general management)	Consultation and coordinating task with AQCC and JICA, preparation task of training, and preparing reports	Similar training in the field in the past	Familiar with chemical analysis equipment which in charge
Chemical analysis equipment instructor 1	Gas chromatograph(PAH、VOC)		
Chemical analysis equipment instructor 2	Gas chromatograph(ICP, phase contrast microscope, micro balance)		

B) Interpreter of Local Employment

Technicians and administrators of installation sites are expected to have difficulties on communication in English, 1 English-Persian interpreter will be necessary for each group.

7) Implementation Process of Soft Component

The plan of implementation process for this Soft Component is shown in Table 2-32 and Table 2-34.

Table 2-32 Plan of Implementation Process of Soft Component

Implementation process			2019								Consultant	
			1	2	3	4	5	6	7	8	person	M/M
	Initial operation guidance (by manufacturer)		■	■				0.30 ▼		0.53 ▼		
Soft Component	Chemical analysis equipment(General manager)							■	1.00	■	1	0.83
	A. Gas chromatograph	PAH							■	1.07	1	2.07
	B. Gas chromatograph	VOC								■		
	C. Ion chromatograph	Ion component							0.87	■	1	2.17
	D. ICP	Inorganic						0.60	■	0.70		
	E. Micro balance	Paticulate matter						■				
	F. Phase contrast microscope	Asbestos						■				
Remarks					New Year's holiday		Ramadan					
Total											3	5.07

Note: ▼ Implementation status report

AQCC request all personnel in the chemical analysis laboratory to attend the analysis technique training. If the training from A to F were sequentially conducted, the costs will be large due to general management and allocation of car.

In order to reduce the costs, trainees to attend the analysis technology training will be divided into 2 groups (A and B), and 2 trainings will be conducted in parallel. Training group A is mainly responsible for gas chromatograph (PAH) and gas chromatograph (VOC), and training group B is mainly responsible for ion chromatography and ICP. The trainings of phase contrast microscopes and micro balances can be attended by both groups.

Meanwhile, there is 2 weeks holiday in March, since Vernal Equinox Day is a New Year's Day in Iran. In addition, Ramadan in 2019 is expected from May 5th to June 3rd, and the efficiency of work during Ramadan period will considerably decrease. In order to reduce the number of trips, though there will be 4 months of blank after the initial operation guidance, the time schedule is planned that the training starts after Ramadan.

8) Outputs from Soft Component

The outcomes of the Soft Component are shown in Table 2-33.

Table 2-33 List of Outcomes

1) Soft Component implementation status report 2) Progress Report 3) Standard operating procedure(SOPs) 4) Final Report 5) Soft component completion report

9) Responsibility of Executing Agency in the Partner Country

In order to continuously and effectively utilize equipment procured by this Grand Aid, AQCC which is the executing agency needs to implement the following contents.

- Personnel to be placed in the chemical analysis laboratory should be those who have the following analysis experience. It is desirable that personnel will be experienced in all analytical fields.

  ✧ Measurement of asbestos using phase contrast microscope
  ✧ Microanalysis using micro balance
  ✧ Ion component analysis using ion chromatograph
  ✧ Inorganic component analysis using ICP
  ✧ VOC component analysis using gas chromatograph mass spectrometer
  ✧ PAH component analysis using gas chromatograph mass spectrometer

- Renovation of building for the chemical analysis laboratory such as electricity, gas, water supply, draft chamber, air conditioning equipment, and etc.

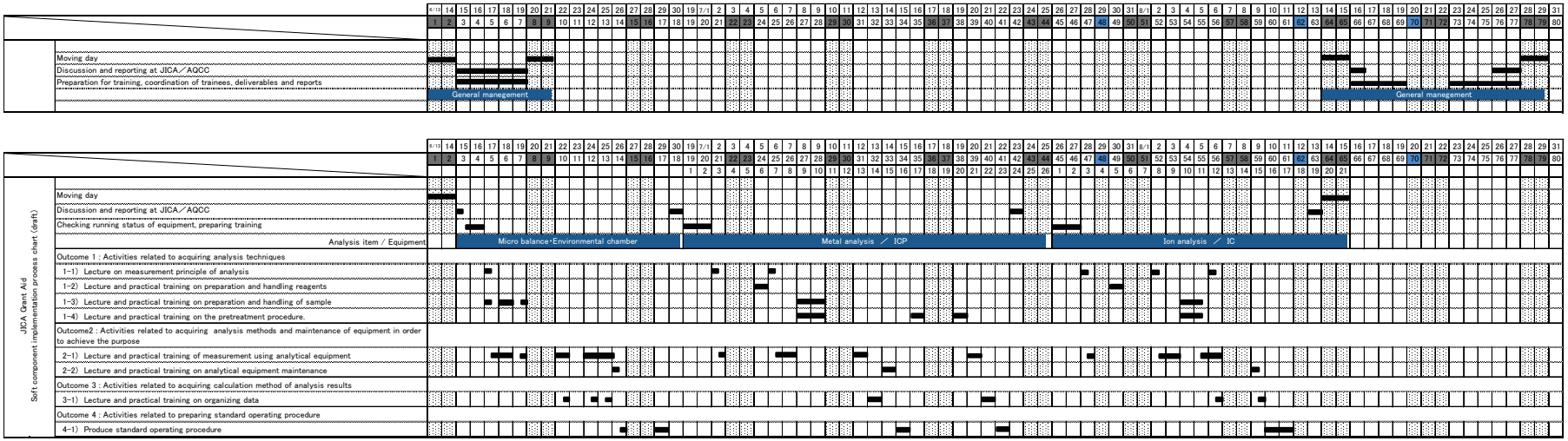
- Equipment such as pretreatment equipment, pure water making equipment, dryer, refrigerator (refrigerator facility), general balance, ultrasonic cleaner device, hot plate, pH meter, laboratory bench, standard reagents, general reagents, high purity gases for analytical equipment, glassware, filter paper, consumable items, and etc. those needed for chemical analysis laboratory should be installed.

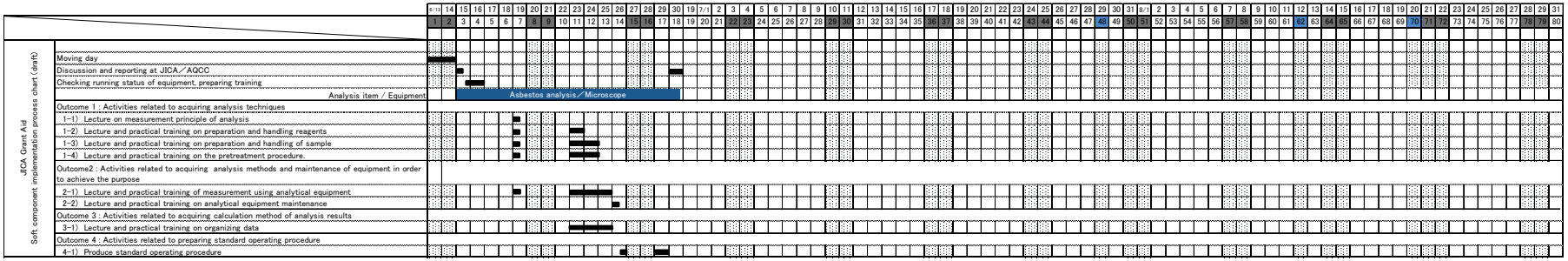
- Procurement of sampling equipment (VOC, PAH)

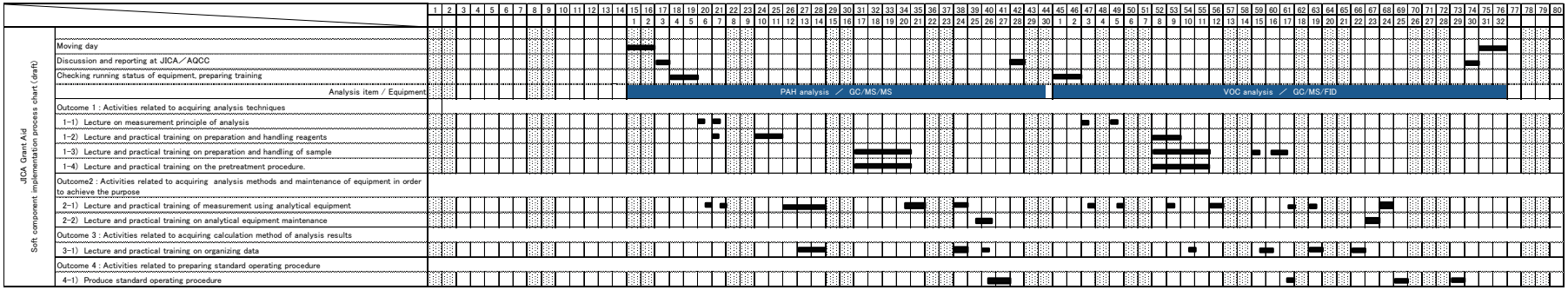
- Procure at least 20 of VOC sampling tubes (Tenax).

- Preparation of at least 3 samples for analysis training (asbestos, ion, inorganic, PAH, and VOC analysis)
- Personnel will be continually allocated for the chemical analysis laboratory.
- Revision of standard operating procedures (SOPs), when it is necessary.
- Continue on human resource development for the above activities.

Table 2-34 Plan of Implementation Process







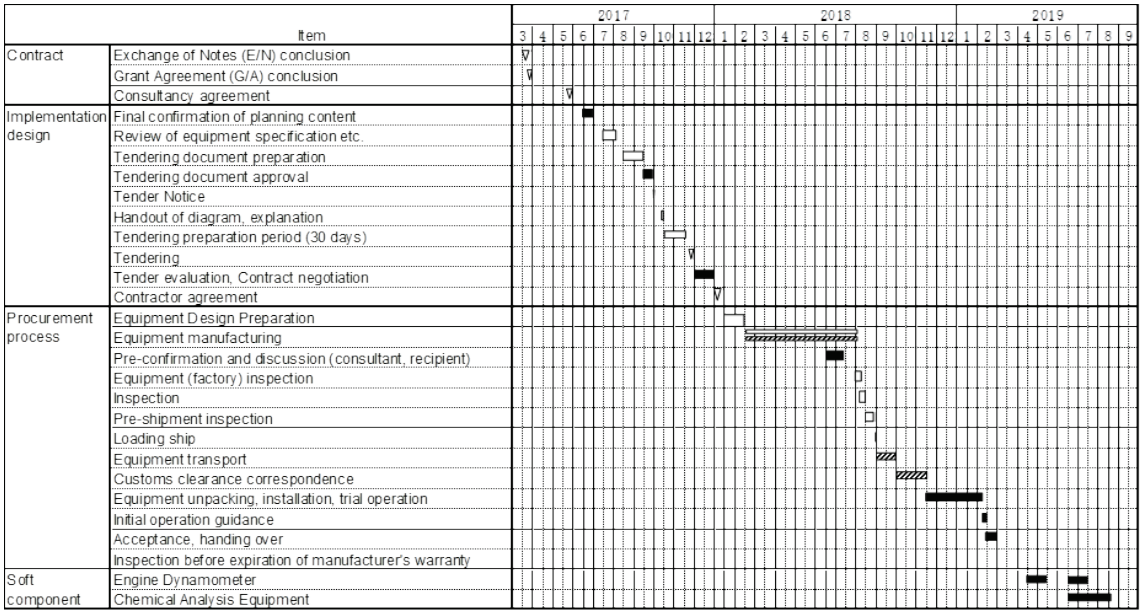
(3) Air Quality Monitoring Station

Since ambient air quality monitoring has been conducted by AQCC, and the technical cooperation project taken further will have task of trainings for operation of monitoring station; Soft Component under the grant project is not necessary.

2-2-4-9 Implementation Schedule

The most rational implementation schedule for the procurement and installation work of the project is as shown below. Total project implementation period will be 24.6 months, which includes 9.7 months for detailed design and tender process, 11.3 months for procurement and 3.6 months for the Soft Component.

Table 2-35 Implementation Schedule



2-3 Obligations of Recipient Country

(1) Construction of Facilities of Engine Dynamometer System for Diesel Vehicles

1) Property Allocation

The building of AQCC office is located in the mixed area of residential and commercial in the central business district. The property has no enough space to construct the new engine dynamometer system. Since residences are nearby, the location is not suitable for hazardous storage such as fuel tanks and standard gases. AQCC reserved large enough unused property within Vehicle Inspection Center under the support of Traffic and Transportation Department of Tehran Municipality.

2) Permissions and Contracts (such as Construction Permission, Electricity Contracts, Fuel Storage Permissions)

AQCC will design the laboratory, and undertake necessary permissions such as construction permission, contracts such as electricity, and other permissions such as fuel storage, soon after E/N. Tender of granted equipment will not start before the construction permission is approved. After all of the permissions are approved, the granted equipment will start the production.

3) Building Construction

Just after winner of the tender is announced, AQCC will start the detail designing of the building with the constructor for the building of engine dynamometer. The granted equipment will not be shipped until the building construction is completed.

4) Procurement and Installation of Utilities such as Electricity, Air Conditioner, Duct, and Fuel Storage

AQCC will start the procurement of the utilities such as electricity, air conditioner, duct, and fuel storage. The granted equipment will not be shipped until all the utilities are installed and ready for use.

(2) Foundation of Chemical Analysis laboratory Facility

1) Securing the Space

For chemical analysis laboratory, equipment planned to be procured under Grant Aid will be installed at the first floor of AQCC Building. In order to secure space for the chemical analysis equipment, relocation of office rooms used by other departments located on the same first floor will be necessary.

2) Procurement and Installation of Utilities, Air Conditioners, Exhaust Equipment, and etc.

Regarding the infrastructure of chemical analysis laboratories, some cautionary notes are shown in Table 3-1, and the Iranian side will need to correspond to the cautionary notes.

Table 2-36 Cautionary Note about Infrastructure Renovation (Chemical Analysis Laboratory)

Infrastructure	Status
Electrical facility	It may be necessary to change the capacity of the switchboard according to the electric power required for the equipment installed in each room. The grounding is necessary in each room. Add grounded outlet. Power supply wiring will be necessary when equipment requires 3-phase 380 V power supply is introduced. Install voltage stabilizer for major analytical instruments.
Water supply sanitation facility	Some rooms do not have water piping installed. Some lab rooms require tap water, and some lab rooms do not require tap water. In the equipment layout plan, consider which rooms require tap water, and install plumbing.
Air-conditioning ventilation facility	Draft chambers are necessary for analysis rooms in order to treat acid vapors and volatile gases of organic solvents generated in sample treatment. In the ICP which uses acid, draft chamber is necessary to neutralize the waste gas and discharge to the outside. Since the two sides of the AQCC building are close to the adjacent buildings and premises, it is preferable to discharge the gases to outdoors from the other two sides. In PAH, a draft chamber needs to adsorb organic waste gases generated by the solvent extraction. On the other hand, an indoor air conditioning system supplies air with adjusted temperature and humidity, and if it is possible, exhausts air to outside. When the draft chamber discharges the exhaust gases to outdoors, design the air supply/exhaust system by considering the balance of air flow rates of both air supply and discharge. Since the height of the room ceiling is only 2.4 m, there is not much space to arrange a ceiling fan and a supply exhaust duct on ceiling. For this reason, consideration will be necessary for selecting air conditioners and draft chambers, such as the arrangement of direction of airflow thus the air will not directly blow the equipment.
Firefighting extinction facility	At least set up a fire extinguisher (Powder, foam type).
Drainage facility	Construct drainage facility along with water supply sanitation facility.
Gas piping	Although natural gas is not used by the equipment planned, in some cases it will be convenient to use natural gas in general work in analytical laboratory. Install gas piping by considering the necessities and dangers.
Communication facility	Construct LAN environment by considering the necessity of the Internet environment and connection of analytical equipment.
Other	Install the dedicated gas piping and regulator on the wall connecting the high pressure gas cylinder to the analytical equipment.

In order for the equipment delivery and installation, the infrastructure renovation shown above for the chemical analysis laboratory must be completed before arrival of the procured equipment by the Grand aid to AQCC. To secure the acceptance condition of procured equipment for definite, the condition of the tendering announcement is set as follows. The condition for tendering announcement is to have AQCC to launch the infrastructure renovation by the end of August 2017 as shown in Table 3-3. Also, the renovation must be completed by the end of January 2018. If the budget allocation for renovation requires budget negotiation for March 2017, AQCC have to consult with the advisors of AQCC and ask for specialized dealers who design and construct chemical analysis laboratory to prepare the renovation plan, and conduct necessary measures, such as budget application. Contents of renovation will be discussed with JICA side as necessary.

3) Procurement and Installation of General Equipment for Laboratory

In addition to the analytical equipment planned to be imported from Japan and the above-mentioned infrastructure renovation, there are indispensable various laboratory equipment such as reagents and glassware.

Table 2-37 Example of Major Equipment to be Purchased by Iranian Side

Chemical analysis laboratory	Necessary equipment (Example)
Metal analysis room (Including sample preparation	Draft chamber, microwave digestion system, hot plate, carrier gas, gas piping, gas cylinder regulator, standard reagents, and various reagents
Sample preparation room (PAH, etc. solvent extraction)	Draft chamber, oven, drying rack, extractor (Soxhlet, Kjeldahl, etc.), centrifuge, ultrasonic cleaner, and balance (for reagent preparation
Ion analysis, carbon analysis room	Draft chamber, standard reagents, various reagents, carrier gas, gas piping, regulator for gas cylinder, and refrigerator
Sample storage room	Sample storage shelf and refrigerator
Micro balance, microscope room	Filter transparency equipment, desiccator, various reagents, and quartz and Teflon filter paper
Sample preparation room (ion analysis, etc.)	Pure water equipment, ultrasonic cleaner, oven, and pH meter
GC analysis room （PAH、VOC analysis）	Gas piping, carrier gas, regulator for gas cylinder, standard reagents, various reagents, sampling tube, desiccator, and standard gas
Common to all rooms	Air conditioning, laboratory bench, desk, chair, various glassware, storage container, sample storage shelf, equipment storage shelf, cylinder stand, paper wiper, cleaning agent, and voltage stabilizing device as necessary

Consider layout of equipment procured by Iranian side together with equipment procured by Japanese side.

In order to deliver and install the equipment procured by Grand aid, the pretreatment equipment and general equipment for the chemical analysis laboratory shown above (excluding small items) are necessary to be procured and the installation to be completed before the equipment arrive to AQCC. To secure the acceptance of procured equipment for definite, it is desirable that pretreatment equipment and general equipment for the laboratory will be procured promptly after completion of the infrastructure renovation. If budget allocation regarding to the pretreatment equipment and general equipment for the laboratory requires budget negotiation for the March 2017, AQCC have to consult with the advisors of AQCC, and prepare procurement plans, and take necessary measures, such as budget application. Also for budget applications for the March 2018, conduct necessary measures for equipment necessary to be procured.

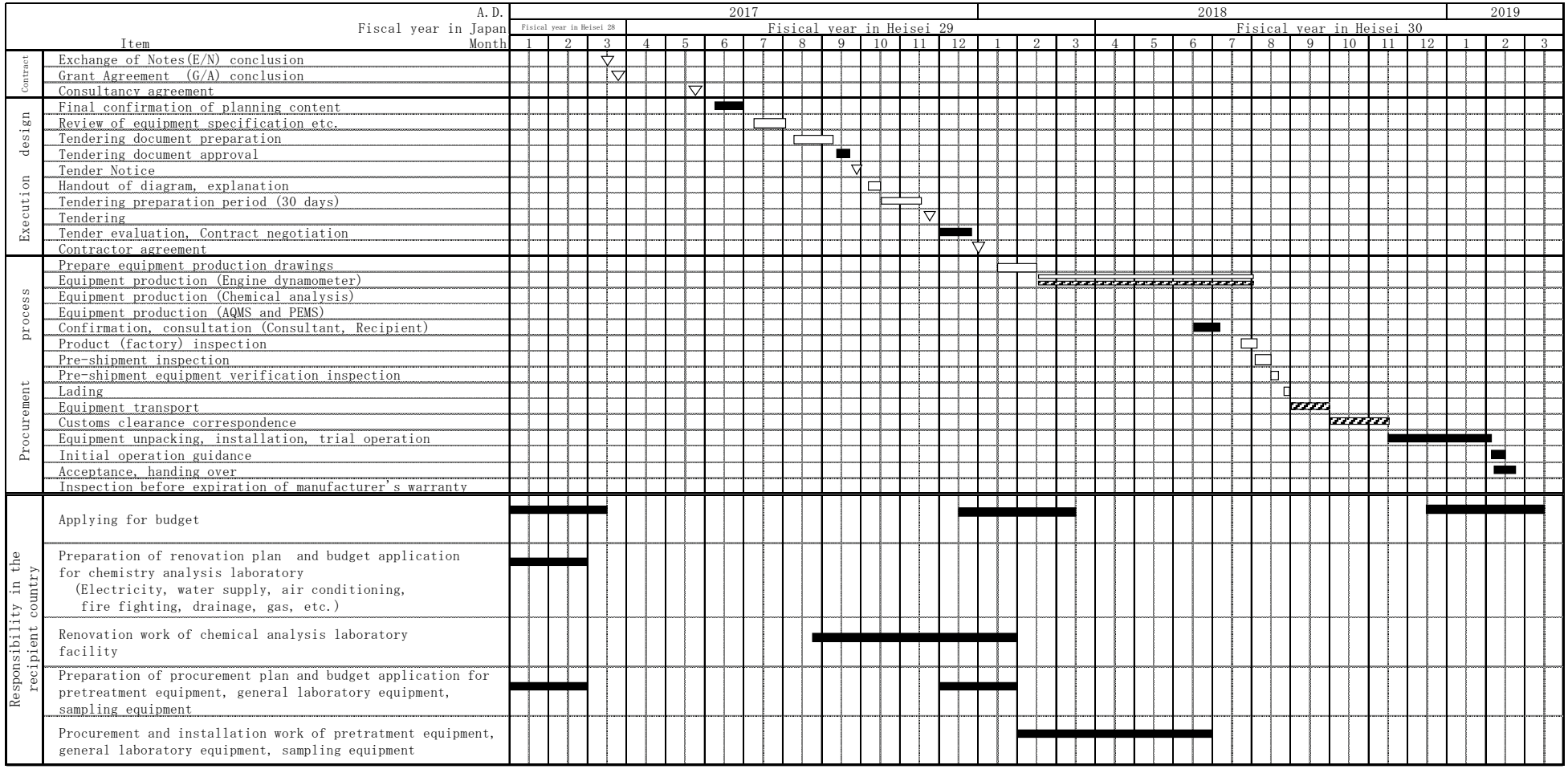
Conditions to announce the tendering is proposed as follows. A budget for procurement of the pretreatment and general equipment for the laboratory is secured by the end of August 2017 before the announcement of tendering.

4) Procurement and Installation of Sampling Equipment

- VOC and PAH sampling equipment will be procured under the support of advisors of AQCC such as university professor with knowledge of ambient air measurement.
- As required, additionally procure sampling equipment for particulate matter and asbestos in the ambient air.
- Secure places to store sampling equipment.

As well as infrastructure renovation and pretreatment equipment shown above, in order to the budget allocation regarding to the sampling equipment for the March 2017 or at the latest as March 2018, AQCC have to consult with the advisors of AQCC, and prepare procurement plans, and conduct the necessary measures, such as budget application.

Table 2-38 Project Implementation Process and Responsibility of the Recipient Country for the Chemical Analysis Laboratory (Draft)



(3) Procurement of Air Quality Monitoring Station

1) Fixed Monitoring Station (5 sets)

- **Provision of cabins for the monitoring station**

  Five sets of monitoring devices will be installed in the mobile cabins provided by AQCC.

- **Update / provision of ancillary facilities**

  Ancillary facilities (Air conditioner, fire extinguishing, UPS, and etc.) installed in the existing cabins will be re-used; therefore AQCC will be responsible for the re-installment of the facilities.

- **Provision of standard gases**

  AQCC shall provide standard gases (SO2, NOx, and CO) for calibration.

- **Coordination between relevant organization for relocating monitoring station**

  In case of relocation of monitoring station within the premises, AQCC shall properly coordinate with the relevant organizations.

- **Provision of data transferring system and personal computers**

  AQCC shall provide data transferring system and personal computers.

2) Mobile Station for Special Survey (2 sets)

- **provision of ancillary facilities**

  AQCC shall provide ancillary facilities for monitoring station (UPS, fire extinguishing equipment, and etc. except air conditioner and room light).

- **Coordination between relevant organization for permission of the survey**

  When the survey is to be conducted, AQCC shall coordinate with the relevant organization for the use of property for the survey.

- **Security of electric source**

  AQCC shall secure the electric source at the survey location, or provide a power-suppled car.

- **Provision of data transferring system and personal computers**

  AQCC shall provide data transferring system and personal computers.

- **Provision of a tow truck**

AQCC shall provide a tow truck for towing mobile station to the survey site when the special survey is conducted.

(4) Customs Clearance

Prompt customs clearance of the products imported from Japan and/or third countries at the ports of disembarkation in the Recipient country shall be facilitated by the Implementing Agency for the smooth implementation of the Project. The customs duties and other necessary taxes and charges shall be exempted, which will be the responsibility of the Implementing Agency.

(5) Tax Exemption

Exemptions of customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient country with respect to the purchase of the products and the services as well as the employment of the Agent shall be taken care of by the Implementing Agency without using the Grant or its accrued interest.

(6) Transport Insurance

Regarding transportation insurance and assembling insurance in Iran, insurance must be purchased from locally authorized insurers. On the other hand, set transportation insurance covering all risks insurance according to the guideline of Japan grant aid project as a standard this insurance will cover from shipping port in Japan to the destination in the Recipient country including inland transportation. In order to implement the Project smoothly, Implementing Agency will take control thus Japanese insurance company is able to insure the insurance as required.

(7) Expediencies

Expediencies shall be granted to allow Japanese nationals and/or nationals of third counties, including such nationals employed by the Agent, whose services may be required in connection with the supply of the products and the services for such facilities, for their entry into the Recipient country and stay therein for the performance of their work.

(8) Proper Operation and Maintenance

The products procured and installed by the Project shall be maintained and used properly and effectively for the implementation of the Project.

(9) Expenditures other than the Grant

All the expenses, other than those covered by the Grant and/or its accrued interest, necessary for the implementation of the Project shall be burdened by the Implementing Agency.

1) Removal of Existing Obstacles at Project Site

In case of existing obstacle(s) at project site where equipment will be installed, the Implementing Agency shall bear the removal expense of such obstacles and shall remove the obstacles without delay as required.

2) Obtaining Permits

Application for and acquisition of all permits with regard to the Project shall be conducted by the Implementing Agencies without delay, and necessary expenses shall be burdened by the Implementing Agencies.

3) Securing Personnel Participating in Training on the Initial Operation and Soft Components

The Implementing Agency shall secure personnel to participate the training of the initial operation and soft components and bear the necessary expenses incurred by the personnel participating in the trainings.

(10) Banking Arrangement (B/A)

The Recipient will open an account at Japanese bank using the name of Iranian country. Based on the B/A, the Recipient should make payments of commissions to the bank.

(11) Environmental and Social Considerations

Environmental and social considerations in the implementation of the Project shall be taken into account, and the necessary procedures and expenses shall be burdened by the Implementing Agencies as required.

2-4 Project Operation Plan

(1) Project Operation Plan for AQCC

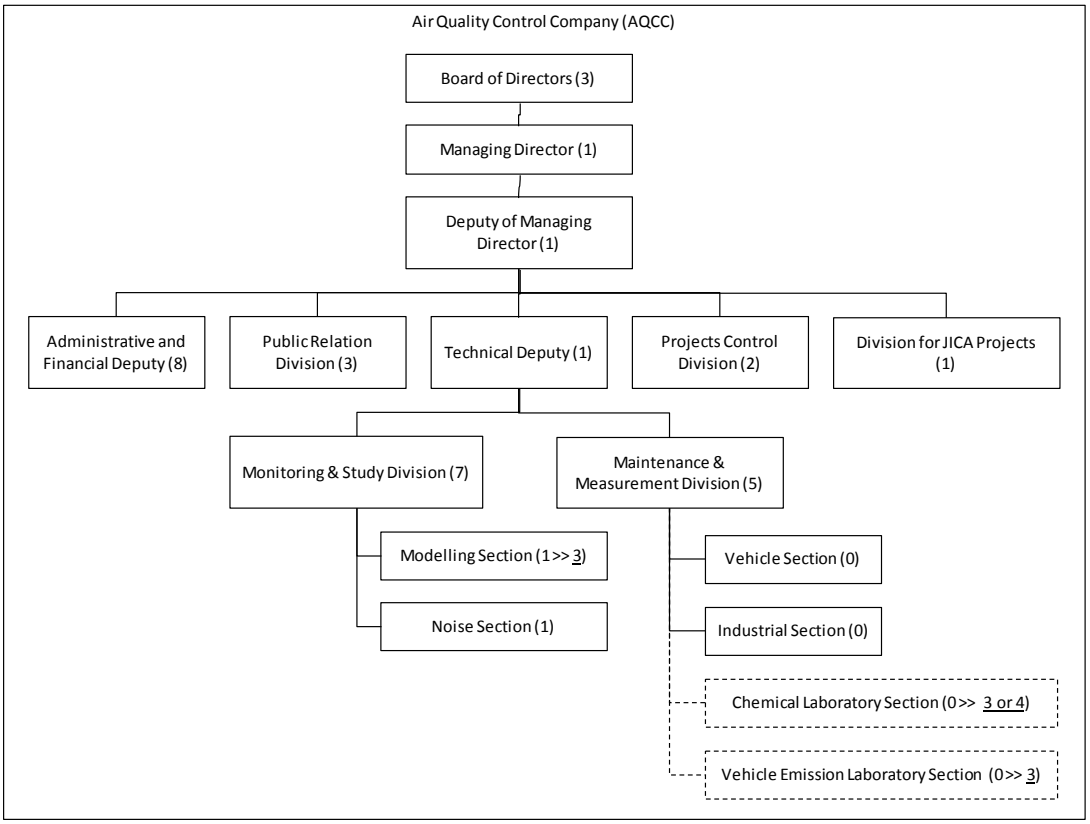
1) Operation and Maintenance Framework

AQCC, Air Quality Control Company in Tehran Municipality, measures, monitors, and analyzes pollutants in the ambient air at Air Quality Monitoring Stations in Tehran Municipality. In addition, AQCC plays a role to conduct the survey for methods of air pollution countermeasures of automobile exhaust gas, establish air pollution standards, and establish the regulation/proposals in cooperation with other relevant agencies.

The department in charge of the Project is a newly established chemical analysis laboratory (newly hired 4 staffs) under Maintenance & Measurement Division and automobile exhaust gas laboratory (newly hired 3 staffs).

Staffs in charge of chemical analysis laboratory and automobile exhaust gas laboratory are newly hired from those who obtained professional education on chemical analysis and automobile exhaust gas measurement at universities and/or companies since AQCC officials require advanced expertise.

Furthermore, a sufficient organization system is planned to be established to operate the project by arranging experts with doctor degree on chemical analysis and automobile exhaust gas measurement as the AQCC advisers.



Remarks: Dotted box sections don't exisit now, and will be necessary to use Grant Aid Equipment.
Numbers inside () indicate count of officers. Underlined numbers indicates officer count plans of AQCC.

Figure 2-19 Organization and Staff Composition

Table 2-39 Staffs of Related Section

Name	Position	Expertise	Degree
Dr. Vahid Hosseini	Managing Director	Various field of Air Pollution	Ph.D. Mechanical Eng.
Mr. Hossein Reza Shahidzadeh	Deputy of Managing Director	Various field of Air Pollution	B.S. Electronic Eng. M.A. Traffic Eng.
Mr. Mohammad Ali Najafi	Head of JICA Projects	Various field of Air Pollution	M.A. Chemical Eng.
Dr. Andreas Mayer	AQCC Advisor	Particles	Ph.D. Mechanical Eng.
Dr. Mohammad Arhami	AQCC Advisor	Source Apportionment and Particles	Ph.D. Civil Eng.
Dr. Ali Eshaghi	AQCC Advisor	Analytical Chemistry, Environmental Chemistry	Ph.D. Chemistry
Dr. Mohammad Saeed Saeedi	AQCC Advisor	Particles	Ph.D. Mechanical Eng.
Mr. Ali Masoomi	AQCC Advisor	Emission Measurement of Vehicles	M.A. Mechanical Eng.

2) Operation and Maintenance Plan

Exhaust Emission Measurement Equipment

Operation and maintenance of engine dynamometer is planned to be supported by other organization which operate engine dynamometer and workshops of public bus operator under control of Traffic and Transportation Department. Those of Portable Emission Measurement System (PEMS) are planned to be trained in the technical cooperation for emission factor development although AQCC has experiences in using the simplified PEMS.

Equipment for Chemical Analysis Laboratory and Ambient and Exhaust Particle Measurement

Currently, AQCC do not own a chemical analysis laboratory and this will be the first laboratory to be established. In this laboratory, 3 personnel educated in relation of chemical analysis with analysis experience and knowledge, and 1 personnel as an assistant staff will be assigned. In addition, the assistance of Maintenance & Measurement Division which the laboratory belongs, and in case of necessity, the cooperation of the AQCC advisor such as professor of university will be requested to conduct the operation of the chemical analysis laboratory and equipment maintenance. Currently, only 1 equipment of ambient and exhaust particle measurement is owned, and the operation and maintenance will be conducted by Maintenance & Measurement Division. The manager of Division for JICA project will be also responsible for the operation and maintenance.

Regarding the equipment for chemical analysis and ambient and exhaust particle measurement, the maintenance/inspection and replacement/replenishment of consumable parts of periodical equipment are the essential to maintain in good condition for a long time use, according to the instruction manual attached. Also for laboratory facilities to maintain in good condition, such as draft chamber, the periodical maintenance/inspection and replacement/replenishment of consumable parts are necessary.

Air Quality Monitoring Station

As of August 2016, 2 engineers have operated and daily maintained the monitoring stations. AQCC has planned to outsource the equipment calibration work, maintenance, and repairing to the private firms.

3) Operation and Maintenance Cost

Exhaust Emission Measurement Equipment

Cost for human resources is 5,000 EUR per month in minimum, consisting of 1 manager, 1 test engineer, 2 technicians, and 2 secretaries, according to the Iranian consultant. Operational cost depends on measurement plan especially in operation hours

and numbers of engines to be tested. Assuming that 1/6 of a sample Japanese laboratory which tests the engine for 24 hours, 48,000 USD is necessary. Accordingly, the operation and maintenance cost will be 104,000 USD in minimum.

Equipment for Chemical Analysis Laboratory and Ambient and Exhaust Particle Measurement

The major consumables and replacement parts for the procured equipment by the Grant aid is estimated to be around 30 thousand dollars per year. In addition, the annual labor cost of 4 persons assigned in the chemical analysis laboratory is estimated to be about 64 thousand dollars per year, thus the operation and maintenance expenses are expected to be at least 94 thousand dollars per year.

Table 2-40 Approximate Annual Cost of the Major Consumables and Replacement Parts for Planned Procured Equipment

Equipment	Cost of consumables and replacement parts (US Dollar/year)
Ion chromatograph (IC)	11,000
Inductively coupled plasma emission spectrometer (ICP-AES)	6,000
Gas chromatograph mass spectrometry (GC/MS/MS) (PAH analysis)	3,000
Gas chromatograph mass spectrometry (GC/MS/FID) (VOC analysis)	7,000
Electrical low pressure impactor	3,000
Total	30,000

Table 2-41 Annual Labor Cost of Chemical Analysis Laboratory (Estimated)

Personnel	Labor cost* (US Dollar/(year・person))*	Number of persons	Labor cost (US Dollar/year)
Chemical analysis engineer	17,000	3	51,000
Chemical analysis assistant staff	13,000	1	13,000
Total	―	4	64,000

*Labor cost: Labor cost was estimated based on the Overview of Iran Professional Workforce (March 2015).

Air Quality Monitoring Station

AQCC estimated the operation and maintenance cost for air quality monitoring in 2013 to be approximately USD 17 thousands per year per station, which most of the expenses is used for the spare parts and the consumables. While standard gases (NOx, SO2 and CO) are estimated to be approximately USD 8,000, the annual maintenance cost will be approximately 25 thousand USD in total. While the annual maintenance cost in Japanese case is roughly estimated to be 2 million Yen (equivalent to 19 thousand USD), the cost in this Project is reasonable compared with Japan.

In general monitoring devices are overhauled or replaced in every 7 years, although AQCC has kept using old-dated model over 10 years by replacement of parts, repairs, and etc. In order to overhaul, replace monitoring devices in every 10 years, approximately 210 thousand USD of budget is necessary to be secured. The following table describes overall maintenance cost in the first 10 years. Additional human cost will not be required since number of monitoring stations will not increase.

Table 2-42 Maintenance Cost of the First 10 Years

Year	1	2	3	4	5	6	7	8	9	10
Regular check (2 times/month and every one year)	x	x	x	x	x	x	x	x	x	x
	Provided by grant									
Calibration (2times / month)	x	x	x	x	x	x	x	x	x	x
Overhaul / replacement (every 10 years)										x
Total costs (1,000 USD)	8 / year			25 / year						235

x：implemented

Regular check: Replacement of parts, consumables, flow check. Operation check, error check, calibration, etc.

Cleaning of sampling line, replacement of parts, performance check, etc. taken one time in every year

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

(1) Cost to be borne by the Iranian Side

19,167.9 million IRR (Approx. 65.17 million Japanese Yen)

① Bank Commissions
387.2 million IRR (Approx. 1.32 million Japanese Yen)

② Building Construction for Engine Dynamometer
5,947.2 million IRR (Approx. 20.22 million Japanese Yen)

③ Preparation for Chemical Laboratory
8,935.8 million IRR (Approx. 30.38 million Japanese Yen)

④ Preparation for Air Quality Monitoring Stations
3,897.7 million IRR (Approx. 13.25 million Japanese Yen)

(2) Estimation Conditions

①	Date of Estimate	:	September, 2016
②	Exchange Rate	:	1 US$ = JPY 104.59, 1 IRR = JPY 0.0034
③	Implementation Period	:	as shown in "2-2-4-9 Implementation Schedule"
④	Others	:	The Project shall be implemented in accordance with the Grant Aid scheme of Japan

2-5-2 Operation and Maintenance Cost

Estimated operation and Maintenance costs for the equipment procured by the Project are as follows;

1) Exhaust Emission Measurement Equipment

Personnel cost is estimated as 5,000 EUR per month, as the total of one manager, one test engineer, one technicians and 2 laboratory secretaries.

Operation cost depends on the count and hours of tests. It is estimated as 58,000 USD per year, assuming that 1/6 of a Japanese case where engine is tested almost continuously for 24 hours per day. Total cost is estimated as 104,000 USD per year.

2) Equipment for Chemical Analysis Laboratory and Ambient and Exhaust Particle Measurement

Total cost is estimated as 100,000 USD per year in minimum, including analysis operational cost.

3) Air Quality Monitoring Station

AQCC estimated the operation and maintenance cost for air quality monitoring in 2013 to be approximately USD 17 thousands per year per station, which most of the expenses is used for the spare parts and the consumables. Total cost with standard gas is USD 25 thousands per year per station. While the annual maintenance cost in Japanese case is roughly estimated to be 2 million Yen (equivalent to 19 thousand USD), the cost in this Project is reasonable compared with Japan.

In general, monitoring devices are overhauled or replaced in every 7 years, although AQCC has kept using old-dated model over 10 years by replacement of parts, repairs, and etc. In order to overhaul, replace 70% of monitoring devices in every 10 years, approximately 150 thousand USD of budget is necessary to be secured.

Chapter 3 Project Evaluation

3−1 Precondition

The Project is consisted of 3 activities: 1-To construct facility of automobile emission gas laboratory in vacant space to be owned by Tehran Municipality, to arrange engine dynamometer and emission gas measurement equipment, and Portable Emission Measurement System (PEMS), 2-Chemical analysis chemical analysis laboratory will be constructed in vacant space of AQCC office, and to arrange chemical analysis equipment, and 3-Exchange of monitoring equipment for existing air quality monitoring stations (stationary monitoring stations). The exchange has no precondition on land acquisition. However, undertakings to be described in Chapter 3 such as budgetary provision of Tehran and approval and permission on new construction of automobile emission gas laboratory, budgetary provision of Tehran Municipality, tax exemption procedures, bank arrangement on related equipment for chemical analysis laboratory and implementation of construction, it is precondition that Iranian side will prevent implementation of the Project from delaying of necessary procedures of Iran.

3−2 Necessary Inputs by Recipient Country

To achieve whole plan of the Project, below items will be appropriately conducted and prepared by Iranian side.

・Implementation of undertakings to be already described in Chapter 3

・To deploy necessary personnel and budget for utilization and maintenance facilities to be constructed and equipment to be procured

・To prepare necessary utilities on procured equipment of laboratory in existing building.

3−3 Important Assumptions

Important assumptions of the Project are as follows;

- Implementation of undertakings
- Emergency incidents, such as acts of terrorism, will not occur.
- Legal framework related with the Project, such as Export Control by Ministry of Economy, Trade and Industry, Japan and import control and permission controls of Iran, will not be amended, because the Project is designed legal and export/import conditions from August to December 2016.

3−4 Project Evaluation

3-4-1 Relevance

The Project is concluded as relevance of Japanese Grant Aid, because of the following information.

1) Consistency of air quality related goals and indicators of Sustainable Development Goals (SDGs)

The objective of the Project is to improve precision of measurement and analysis of air pollution sources and emission and understanding of generation mechanism by installation of equipment for air pollution analysis in Tehran, thereby contributing to reduction of air pollution. The Project purpose and below three goals and indicators on air quality improvement among SDGs accord.

・Goal 3: Health and welfare (3.9 Considerable reduction of mortality and number of disease by toxic chemical matters and air pollution)

・Goal 11: Sustainable urban and human residence of safe and resilient (11.6 environmental impact mitigation in urban areas through consideration air quality

・Goal 12: Sustainable production and consumption (12.4 sharp emission reduction to air, mitigation of negative impact to human health and environment

2) Expected ripple effect to another cities through supporting to AQCC

Although Tehran Municipality is local government, Mayor has position of Minister corresponding until 1990s. Tehran Municipality is important position in Iran. AQCC is organized under Tehran Municipality, which is semipublic agency for air pollution measurement and air pollution control measures, another cities expect technical support through pioneer activities by AQCC.

Tehran Municipality and AQCC is as pioneer existence of urban air pollution control measures in Iran, AQCC has potential capacity to support to another cities beyond administrative framework of Tehran Municipality, air pollution emission measurement and analysis equipment to be installed by the Project, and AQCC spontaneous air pollution emission measurement and analysis capabilities to be expected by utilization of the equipment can be used for AQCC's training of air pollution measurement and analysis technology to other cities.

3) Promotion of air pollution control measures to be expected through supporting to AQCC

It is expected that AQCC will utilize that air pollution monitoring and analysis equipment to be procured by the Project, and improve the skills of monitoring and analysis. AQCC which has spontaneous air pollution monitoring and analysis capacities is utilized, air pollution control and air pollution sources are precisely understood, Tehran Municipality and related agencies of national level will be strengthened by utilizing reliable data and technical examination results, through various committees by Iranian side, it is expected that detailed preparation and implementation of air pollution control measures will be promoted.

4) Contribution to public health of Tehran citizen

AQCC spontaneous air pollution emission measurement and equipment to be procured by the Project and analysis capabilities to be expected by utilization of the equipment contributes to air pollutants, especially PM to impact the health, air quality and VOC measurement and analysis of VOC will be utilized, health maintenance to Tehran citizen will be contributed.

For example, at present, even though air quality monitoring equipment to be out of order is not a few, AQCC has to conduct evaluation of air pollution and warning announcement. Five stations of all air quality monitoring stations will be renewed by the Project, number of available measurement hours will be acquired, and appropriate warning announcement can be issued. Also, as the results, appropriate and effective air pollution control measures will be able to be selected and promoted, air pollution will be reduced, number of warning announcement days decrease.

5) Synergy Effect with Technical Cooperation Project Planned

JICA plans to start a new for-years technical cooperation project with AQCC from 2017, titled as PROJECT FOR CAPACITY DEVELOPMENT ON AIR POLLUTION CONTROL IN TEHRAN MUNICIPALITY IN THE ISLAMIC REPUBLIC OF IRAN. It will coordinate a counterpart working group with AQCC and DOE-TPD, and will develop capacities on their air quality monitoring, air pollution structure analysis, elaboration and evaluation of air pollution control measures. The Project is expected to utilize the equipment of this Project, by enhancing analysis on air pollution structure and reason of Tehran City, and the resulted as proposals on air pollution control measures supported by scientific background data.

3-4-2 Effectiveness

Below expected outcomes will be implemented by the Project.

(1) Quantitative indicators

Key indicators	Baseline (2015)	Target (year 2022)
Emission gas measurement to be conducted by engine dynamometer	—	6 Automobile emission gas measurements will be conducted by engine dynamometer at least 6 times a year.
Emission gas measurement to be conducted by Portable Emission Measurement System (PEMS)	—	5 Vehicle will be measured at least 5 times a year.

Air pollutants to be analyzed by chemical analysis equipment	—	2 All equipment will be utilized every year, each equipment will be analyzed at least two times a year.
Reliable data of air quality monitoring (stationary monitoring stations)	1,525~4,208	6,000 Reliable data will be obtained for at least 6,000 hours at a station a year.

(2) Qualitative indicator

Air pollution reduction in Tehran

Appendix 1. Member list of the Study Team

1) Site Survey (from 28th July 2016 until 8th September 2016)

Name	Position	Organization
Mr. SHIBATA, Kazunao	Team Leader	Environmental Management Team 2, Environmental management Group, Global Environment Department, JICA
Mr. YAMAMOTO, Tsuyoshi	Planning Management	Environmental Management Team 2, Environmental management Group, Global Environment Department, JICA
Mr. YAMADA, Taizo	Air Pollution Countermeasures	Senior Adviser, JICA
Dr. WAKAMATSU, Shinji	Air Pollution Monitoring and Measurement Equipment	Professor, Ehime University/ Former President, Japan Society for Atmospheric Environment
Mr. TABATA, Toru	Team Leader / Air Quality Measurement and Control Planning -1	Suuri-Keikaku Co., Ltd.
Mr. FUJIMOTO, Masahiko	Deputy Team Leader / Air Quality Measurement and Control Planning - 2	Oriental Consultants Global Co., Ltd.
Mr. MAEDA, Hiroyuki	Equipment, Operation and Maintenance Planning for Vehicle Exhaust Gas Measurement	Suuri-Keikaku Co., Ltd.
Mr. SATO, Takahisa	Equipment, Operation and Maintenance Planning for Chemical Analysis Laboratory and Ambient and Exhaust Particle Studies Laboratory	Suuri-Keikaku Co., Ltd. (Green Blue Corporation)
Mr. KURAMOTO, Kenichi	Equipment, Operation and Maintenance Planning for Air Quality Monitoring Stations	Oriental Consultants Global Co., Ltd.
Mr. MOJI, Takahiro	Procurement Planning / Estimation / Equipment Import-Export	Oriental Consultants Global Co., Ltd.

2) DOD Explanation (From 9th December 2016 until 27th December 2016)

Name	Position	Organization
Mr. SHIBATA, Kazunao	Team Leader	Environmental Management Team 2, Environmental management Group, Global Environment Department, JICA
Mr. YAMAMOTO, Tsuyoshi	Planning Management	Environmental Management Team 2, Environmental management Group, Global Environment Department, JICA
Mr. YAMADA, Taizo	Air Pollution Countermeasures	Senior Adviser, JICA
Mr. TABATA, Toru	Team Leader / Air Quality Measurement and Control Planning -1	Suuri-Keikaku Co., Ltd.
Mr. FUJIMOTO, Masahiko	Deputy Team Leader / Air Quality Measurement and Control Planning - 2	Oriental Consultants Global Co., Ltd.
Mr. MAEDA, Hiroyuki	Equipment, Operation and Maintenance Planning for Vehicle Exhaust Gas Measurement	Suuri-Keikaku Co., Ltd.

Appendix 2. Study Schedule

1) Field Survey

			SHIBATA Kazunao	YAMAMOTO Tsuyoshi	WAKAMATSU Shinji	YAMADA Taizo	TABATA Toru	FUJIMOTO Masahiko	MAEDA Hiroyuki	SATO Takahisa	KURAMOTO Kenichi	MOJI Takahiro
1	7/28	Thu					From Tokyo		From Tokyo			
2	7/29	Fri					To Tehran		To Tehran			
3	7/30	Sat					Prearations		Preparations			
4	7/31	Sun					Discussions with AQCC and related organizations		Discussion with AQCC and related organizations (including potential suppliers)			
5	8/1	Mon										
6	8/2	Tue										
7	8/3	Wed										
8	8/4	Thu					Internal meeting		Internal meeting	Internal meeting	Internal meeting	
9	8/5	Fri					Reporting		Reporting	Reporting	Reporting	
10	8/6	Sat					Studying legal framework specially for custom		Site surveys	Site surveys	Site surveys	
11	8/7	Sun										
12	8/8	Mon										
13	8/9	Tue										
14	8/10	Wed										
15	8/11	Thu					Internal meeting		Internal meeting	Internal meeting	Internal meeting	
16	8/12	Fri					Reporting		Reporting	Reporting	Reporting	
17	8/13	Sat					Discussions with AQCC and related organizations	From Tokyo	Planning	Planning	Planning	
18	8/14	Sun						To Tehran				
19	8/15	Mon						Discussions with AQCC and related organizations				
20	8/16	Tue	From Tokyo To Tehran									
21	8/17	Wed	Meeting with MOFA									
22	8/18	Thu	JICA Office, Embassy of Japan		From Tokyo To Tehran		Internal meeting	Internal meeting	Internal meeting	Internal meeting	Internal meeting	
23	8/19	Fri	Internal meeting			From Tokyo To Tehran	Reporting	Reporting	Reporting	Reporting	Reporting	From Tokyo
24	8/20	Sat	Kickoff meeting with AQCC, Presentation by Professor Wakamatsu, Progress Report Presentation by Consultant Team, Site Visit to Engine Dynamometer and Air Quality Monitoring Stations						Site review visit, and Discussion for minites of meeting			To Tehran
25	8/21	Sun	Discussion on Minutes of Discussion, Site Visit to Sharif University									Studying legal frameworks and procedures
26	8/22	Mon	Discussion on Minutes of Discussion, Discussin with Deputy Mayor									
27	8/23	Tue	Discussion on Minutes of Discussion, Internal Meeting									
28	8/24	Wed	Signature on Minutes of Discussion, Reporting to JICA Iran Office									
29	8/25	Thu	From Tehran	Internal meeting	From Tehran to Tokyo		From Tehran	Internal meeting	Internal meeting	Internal meeting	Internal meeting	Internal meeting
30	8/26	Fri					To Tokyo	Reporting	Reporting	Reporting	Reporting	Reporting
31	8/27	Sat						Discussion with AQCC and related organizations	Planning	Planning	Planning	Studying legal frameworks and procedures
32	8/28	Sun										
33	8/29	Mon										
34	8/30	Tue									From Tehran	
35	8/31	Wed									To Tokyo	
36	9/1	Thu						Internal meeting	From Tehran	Internal meeting		Internal meeting
37	9/2	Fri						Reporting	To Tokyo	Reporting		Reporting
38	9/3	Sat						Discussion with AQCC and related organizations		Planning		Studying legal frameworks and procedures
39	9/4	Sun										
40	9/5	Mon										
41	9/6	Tue										
42	9/7	Wed						From Tehran		From Tehran		From Tehran
43	9/8	Thu						To Tokyo		To Tokyo		To Tokyo

2) Discussion on Draft Report

			SHIBATA Kazunao	YAMAMOTO Tsuyoshi	YAMADA Taizo	TABATA Toru	FUJIMOTO Masahiko	MAEDA Hiroyuki
1	12/9	Fri				From Japan		From Japan
2	12/10	Sat				To Tehran	From Japan	To Tehran
3	12/11	Sun				Discussion	To Tehran	Discussion
4	12/12	Mon				Discussion on Report, updating Report		
5	12/13	Tue						
6	12/14	Wed						
7	12/15	Thu				Internal meeting	Site Survey	
8	12/16	Fri	From japan			Internal meeting		
9	12/17	Sat	to Tehran, Internal meeting of Japanese side					
10	12/18	Sun	Discussion on Minutes of Discussion, including the presentation on Draft Final Report					
11	12/19	Mon	Meeting with Deputy of Deputy Mayor, Discussion on Minutes of Discussion					
12	12/20	Tue	Discussion on Minutes of Discussion, Consumable Supply					
13	12/21	Wed	Signature on Minutes of Discussion, Additional General Discussion, Reporting to Embassy of Japan					
14	12/22	Thu	To Tokyo		To Tokyo	From Tehran	Reporting	Reporting
15	12/23	Fri				To Tokyo	Reporting	Reporting
16	12/24	Sat					Followup meetings	Followup meetings
17	12/25	Sun					Followup meetings	To Tokyo
18	12/26	Mon					Followup meetings	
19	12/27	Tue					To Tokyo	

Appendix 3. List of Parties Concerned in the Recipient Country

Tehran Municipality

Maziar Hosseini, Dr.	Deputy Mayor of Traffic & Transportation of Tehran Municipality

DOE-TPD

Hadj Hadi, Mr.	DOE-TPD Laboratory manager

AQCC

Vahid Hosseini, Dr.	Managing Director
Hossein Shahidzadeh, Mr.	Deputy Director
Mohammad Ali Najafi, Mr.	Head of Measurement and Maintenance Dept.
Maryam Naderi, Ms.	Head of Air Pollution Monitoring Dept.
Ahmad Taheri, Mr.	Expert
Hossein Hassankhani, Mr.	Expert (Measurement)
Solmaz Ahadi, Ms.	Expert (Air Pollution)
Mohsen Roshani, Mr.	Expert (Air Pollution)

Appendix 4. Minutes of Discussions

Minutes of Discussions
on the Preparatory Survey for the Project for
Improvement of Equipment for Air Pollution Analysis in Tehran
(Explanation on Draft Preparatory Survey Report)

With reference to the minutes of discussions signed between Tehran Municipality, Air Quality Control Company of Tehran Municipality (hereinafter referred to as "the Iranian side") and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on 24th August, 2016 and in response to the request from the Government of the Islamic Republic of Iran (hereinafter referred to as "Iran") dated 20th October 2015, JICA dispatched the Preparatory Survey Team (hereinafter referred to as "the Team") for the explanation of Draft Preparatory Survey Report (hereinafter referred to as "the Draft Report") for the Project for Improvement of Equipment for Air Pollution Analysis in Tehran (hereinafter referred to as "the Project"), headed by Mr. Kazunao Shibata, Director of Environmental Management Team 2, Environmental Management Group, Global Environment Department, JICA from 17th to 21st December, 2016.

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

Tehran, 21st December, 2016

柴田和直

Mr. Kazunao Shibata
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

V. Hosseini

Dr. Vahid Hosseini
Managing Director
Air Quality Control Company
Tehran Municipality
Islamic Republic of Iran

شرکت کنترل کیفیت هوا
وابسته به شهرداری تهران

M Hosseini

Dr. Maziar Hosseini
Deputy of Traffic and Transportation of Tehran Municipality
Islamic Republic of Iran

ATTACHEMENT

1. Objective of the Project

   The objective of the Project is to improve precision of measurement and analysis of air pollution sources and emission and understanding of generation mechanism by installation of equipment for air pollution analysis in Tehran, thereby contributing to reduction of air pollution.

2. Title of the Preparatory Survey

   Both sides confirmed the title of the Preparatory Survey as "the Preparatory Survey for the Project for Improvement of Equipment for Air Pollution Analysis in Tehran".

3. Equipment List

   Both sides confirmed the list of equipment to be provided by the Project as shown in Annex 1.

4. Project Site

   Both sides confirmed that the sites of the Project are located in Tehran as shown in Annex 2.

5. Responsible Authority for the Project

   Both sides confirmed that the authorities responsible for the Project are as follows:

   5-1. Air Quality Control Company of Tehran Municipality (hereinafter referred to as "AQCC") will be the executing agency for the Project (hereinafter referred to as "the Executing Agency"). The Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project and ensure that the undertakings for the Project shall be taken care by relevant authorities properly and on time. The organization charts are shown in Annex 3.

   5-2. The line agency of the Executing Agency is the Tehran Municipality. The Tehran Municipality shall be responsible for supervising the Executing Agency on behalf of the Government of Iran.

6. Contents of the Draft Report

   After the explanation of the contents of the Draft Report by the Team, the Iranian side agreed to its contents.

7. Cost Estimate

   Both sides confirmed that the cost estimate including the contingency explained by

V.H.

the Team is provisional and will be examined further by the Government of Japan and JICA for its approval. The contingency would cover the additional cost against natural disaster, unexpected natural conditions, etc.

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

9. Procedures and Basic Principles of Japanese Grant
The Iranian side agreed that the procedures and basic principles of Japanese Grant as described in Annex 4 shall be applied to the Project. In addition, the Iranian side agreed to take necessary measures according to the procedures.

10. Timeline for the Project Implementation
The Team explained to the Iranian side that the expected timeline for the project implementation is as attached in Annex 5.

11. Expected Outcomes and Indicators
Both sides agreed that key indicators for expected outcomes are as follows. The Iranian side will be responsible for the achievement of agreed key indicators targeted in year 2022 and shall monitor the progress based on those indicators.
[Quantitative indicators]
11-1 Emission gas measurement to be conducted by engine dynamometer
Automobile emission gas measurement will be conducted by engine dynamometer at least 6 times a year.
11-2 Emission gas measurement to be conducted by Portable Emission Measurement System (PEMS)
Vehicle will be measured at least 5 times a year.
11-3 Air pollutants to be analyzed by chemical analysis equipment
All equipment will be utilized every year, each equipment will be analyzed at least two times a year.
11-4 Reliable data of air quality monitoring (stationary monitoring stations)
Reliable data will be obtained for at least 6,000 hours at a station a year.
[Qualitative indicator]
Air pollution reduction in Tehran

12. Technical Assistance ("Soft Component" of the Project)
Considering the sustainable operation and maintenance of the products and services

V.H.

granted through the Project, a technical assistance is planned under the Project. The Iranian side confirmed to deploy necessary number of counterparts who are appropriate and competent in terms of its purpose of the technical assistance as described in the Draft Report.

13. Undertakings of the Project

Both sides confirmed the Undertakings of the Project as described in Annex 6 and those schedule as shown in Annex 7. With regard to exemption of customs duties, internal taxes and other fiscal levies as stipulated in No.5 of "(2) During the Project Implementation" of Annex 6, both sides confirmed that such customs duties, internal taxes and other fiscal levies include VAT, commercial tax, income tax and corporate tax, which shall be clarified in the bid documents by the Iranian side.

The Iranian side assured to take the necessary measures and coordination including allocation of the necessary budget which are preconditions of implementation of the Project. It is further agreed that the costs are indicative, i.e. at Outline Design level. More accurate costs will be calculated at the Detailed Design stage.

Both sides also confirmed that the Annex 6 will be used as an attachment of G/A.

The Iranian side agreed to integrate those undertakings into the annual programs of the Tehran Municipality and AQCC and allocate necessary budget from the fiscal year 2017.

14. Monitoring during the Implementation

The Project will be monitored by the Executing Agency and reported to JICA by using the form of Project Monitoring Report (PMR) attached as Annex 8. The timing of submission of the PMR is described in Annex 6.

15. Project Completion

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

16. Ex-Post Evaluation

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

V.H.

17. Items and measures to be considered for the smooth implementation of the Project

Both sides confirmed the items and measures to be considered for the smooth implementation of the Project as follows:

17-1. Tax Exemption

Both sides confirmed that import tax, customs duties, internal taxes and other fiscal levies which may be imposed in Iran with respect to the purchase of the products and the services should be exempted. The Iranian Side shall take necessary measures for those exemption. The Iranian Side is waiting for an authorization letter for tax exemption from the Planning and Budget Organization (PBO). If those exemption is not provided by the PBO, the Iranian Side shall conduct budgetary provision on import tax, customs duties, internal taxes and other fiscal levies.

17-2. Land for the Laboratory for Engine Dynamometer System

Both sides confirmed that expected site for the Laboratory for engine dynamometer system is located in the vehicle inspection center No.3 and the Iranian side agreed to provide an official letter on the decision of land use by the the Iranian Side to JICA Iran office until 10th of January, 2017.

17-3. Laboratories for the Equipment

Both sides confirmed that the Iranian Side shall construct/prepare Laboratories on time such as Laboratory for engine dynamometer system, Laboratory for chemical analysis, and Air quality monitoring station containers which are critical for the installation of equipment.

17-4. Allocation of Qualified Personnel

Both sides confirmed that the Iranian Side shall allocate a necessary number of qualified personnel for Laboratory for engine dynamometer system and Laboratory for chemical analysis as shown in Annex 3, for the smooth implementation of the Project and utilization of equipment.

17-5. Signers of official documents related to the Project

In order to assure the project implementation schedule, the Iranian side agreed to inform to JICA Iran Office the signers for Exchane of Notes (E/N), Grant Agreement (G/A), and Banking Arrangement (B/A) for the Project until 10th of January 2017, by consulting relevant ministries with the support of JICA Iran Office.

18. Schedule of the Study

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

19. Environmental and Social Considerations

V.H.

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

20. Disclosure of Information

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

21. Operation and Maintenance of Equipment

Both sides confirmed that the cost necessary for the Project such as operation and maintenance will be funded by the Iranian Side.

22. Synergy between the Grant Aid and Technical Cooperation Project

Both sides agreed that the synergy and effective coordination between the Project and technical cooperation project "Project for Capacity Development on Air Pollution Control in Tehran Municipality" (hereinafter referred to as "Technical Cooperation," should be pursued, in order to maximise expected outcomes. For example, the number of equipment such as Portable Emission Measurement Systems and Air Quality Monitoring Station to be provided by the Tehchnical Cooperation need to be reviewed in order to avoid duplication. On the other hand, in order to enhance the Project related operations, additional activities may be examined for the Technical Cooperation Project in future. For those purposes, both sides exchanged preliminary opinions.

23. Supply of Spare Parts and Consumables

Both sides agreed that it is very important for the Iranian Side to be able to procure necessary spare parts and consumables for sustainability of operation and maintenance of equipment. The Team explained that in principle, the supplier for Japan's Grant Aid projects is required to secure supplies of spare parts and consumables for the recipient for at least five years after the completion of projects. The Team explained that in General Japanese manufacutrues provides spare parts & consumables at least 7 years after the finish of production of each model and if the model is not discontinued, the support remains even longer. Both sides will make their best effort to award the longest possible warrantee period of minimum 5 years in the final purchasing contracts. Both sides confirmed that further details will be examined for each of the equipment in the stage of bidding document preparation,

V.H.

taking into account any adverse conditions.

Annex 1 Equipment List
Annex 2 Project Site
Annex 3 Organization Chart
Annex 4 Japanese Grant
Annex 5 Project Implementation Schedule
Annex 6 Major Undertakings to be taken by the Government of Iran
Annex 7 Iranian Undertakings Schedule
Annex 8 Project Monitoring Report (template)

Annex 1

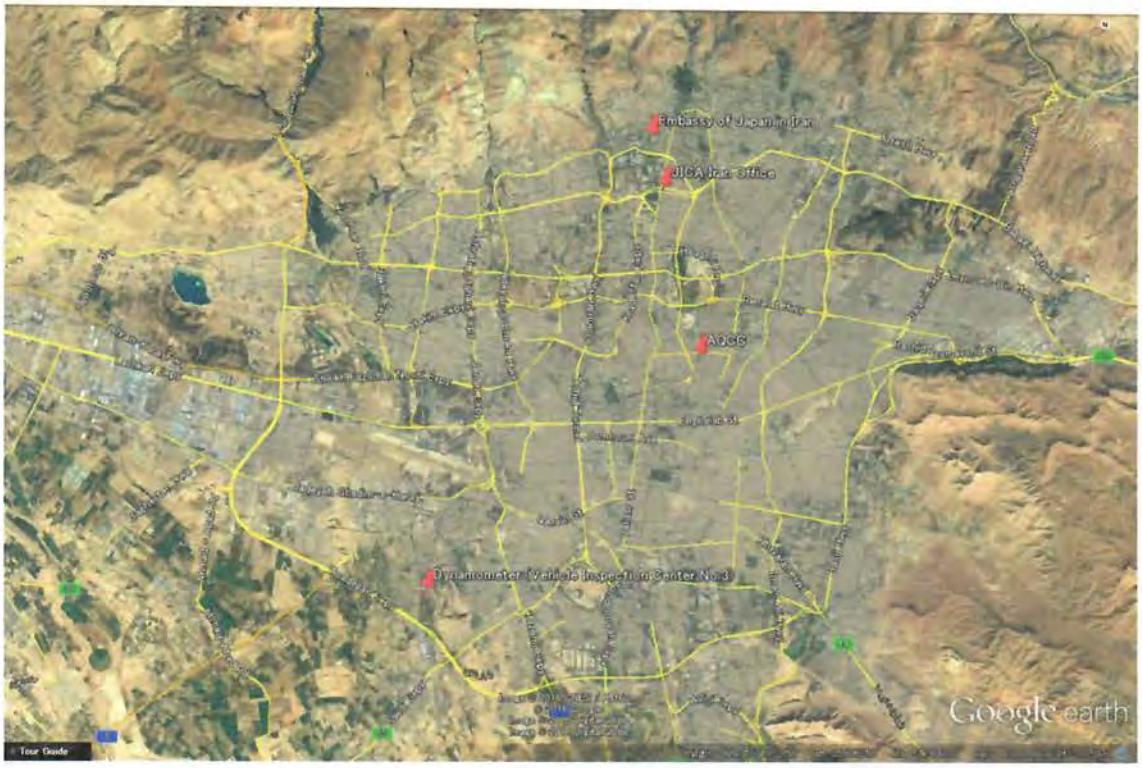
Equipment List

Items		Quantity of Equipment
1) Exhaust Emission Measurement	1.1) Engine Dynamometer System for Diesel Vehicle (400kW・4,000RPM) 1.1.1) Loading System 1.1.2) Measured-Data Acquisition 1.1.3) Test Stand Automation System 1.1.4) Media Conditioning Equipment 1.1.5) Exhaust Emission Measurement System	1
	1.2) Portable Emissions Measurement System (PEMS)	1: Heavy Duty Vehicle (HDV) 1: Light Duty Vehicle (LDV)
2) Chemical Analysis in Laboratory	2.1) Ion Chromatograph for Quantitative Analysis of Ions in Ambient Particle Matters	1
	2.2) Inductively Couple Plasma – Atomic Emission Spectrometry (ICP-AES)	1
	2.3) Gas Chromatograph-Mass Spectrometer (GC/MS/MS) System for Quantitative of PAH	1
	2.4) Gas Chromatograph-Mass Flame Ionization Detector (GC/MS/FID) System for Quantitative of VOC	1
	2.5) Phase Contrast Microscope for Conforming and Counting Asbestos	1
	2.6) Micro Balance for Weighting Filter Paper	1
3) Ambient and Exhaust Particle Measurement	3.1) Electrical Low Pressure Impactor for Laboratory Size Distribution of Particles (ELPI)	1
4) Air Quality Monitoring Station		5: Replacement of Conventional Monitoring Stations 2: Mobile Monitoring Stations

Note: Spare parts and consumables that are recommended to be replaced periodically will be included for at least 1 year.

Annex 2 Project Site

1. Engine Dynamometer

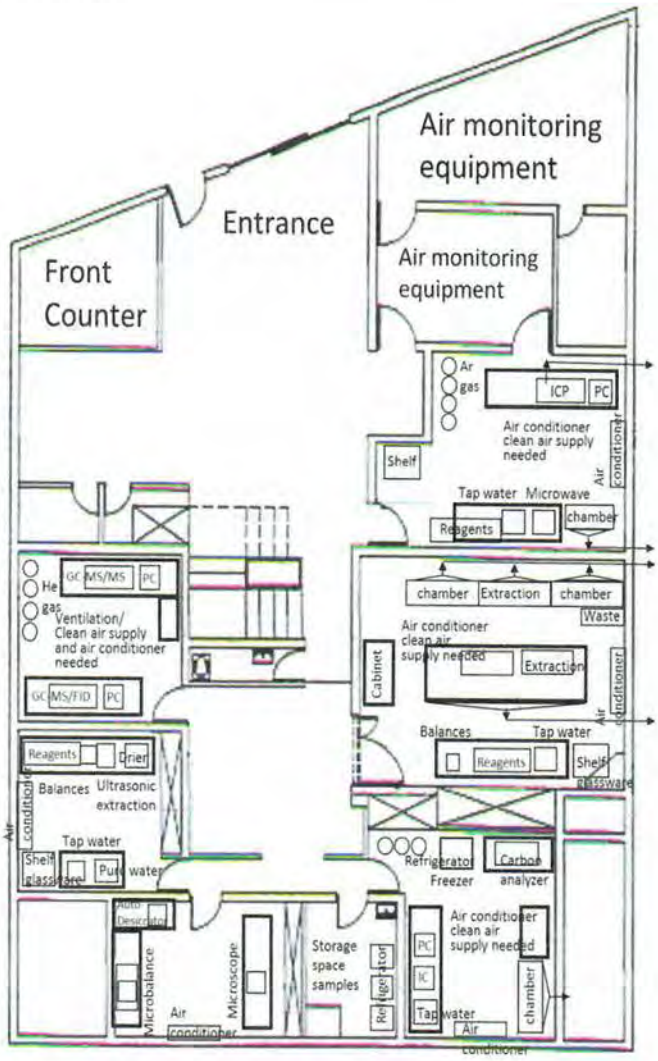


Location of Exhaust Emission Measurement Laboratory

Land Plan - Alghadir Motorcycle & Light Vehicle Mechanized Technical Inspection Centre (No. 3)

H. V.H.

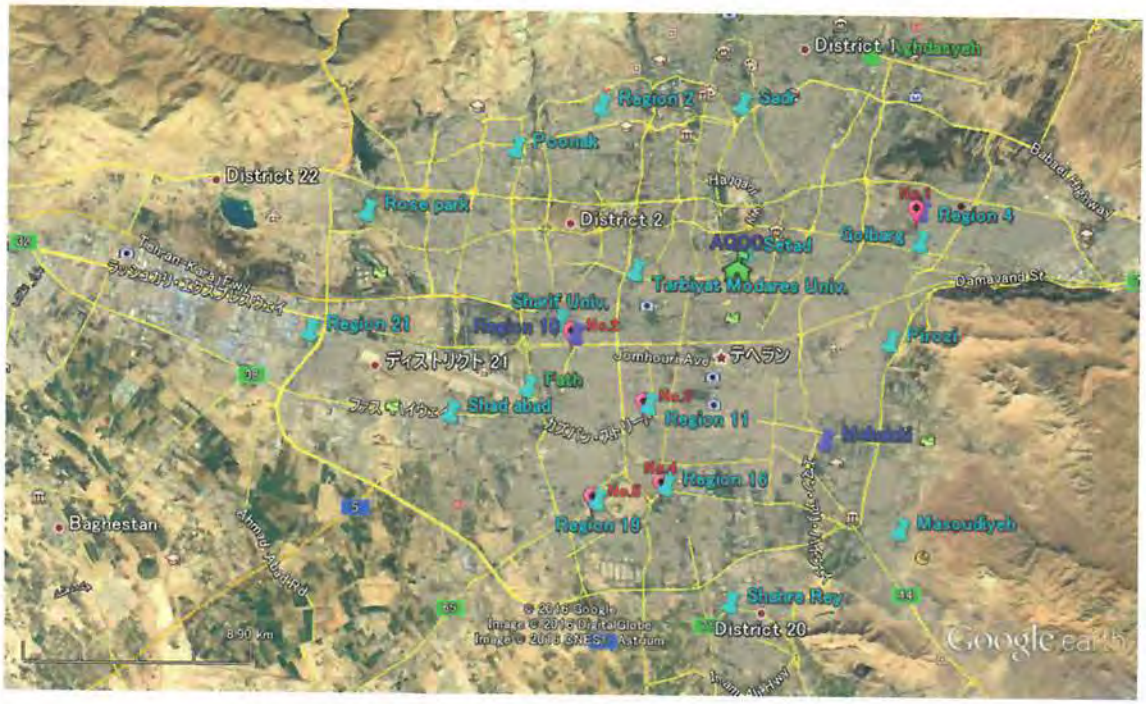
2. Chemical Laboratory



Floor plan（First floor of AQCC）

Source: SHOWA Science Co.
Draft Chamber, Exhaust Duct

3. Air Quality Monitoring



Number in Red: Top 5 locations to be updated

Location of Air Quality Monitoring Station by AQCC

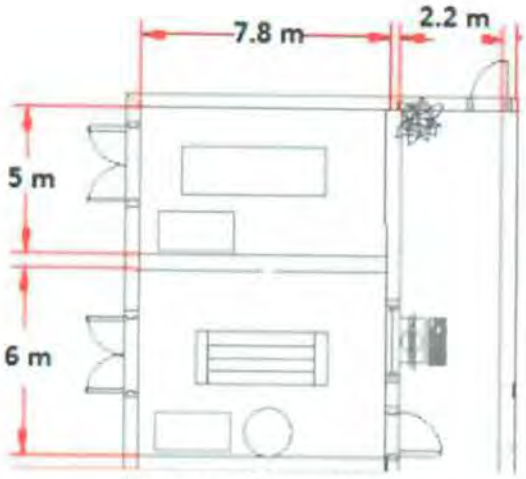
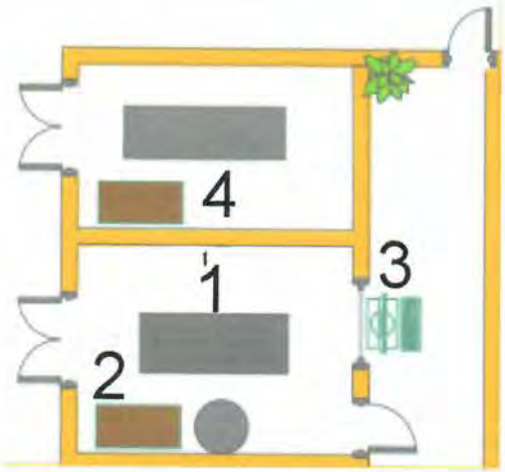


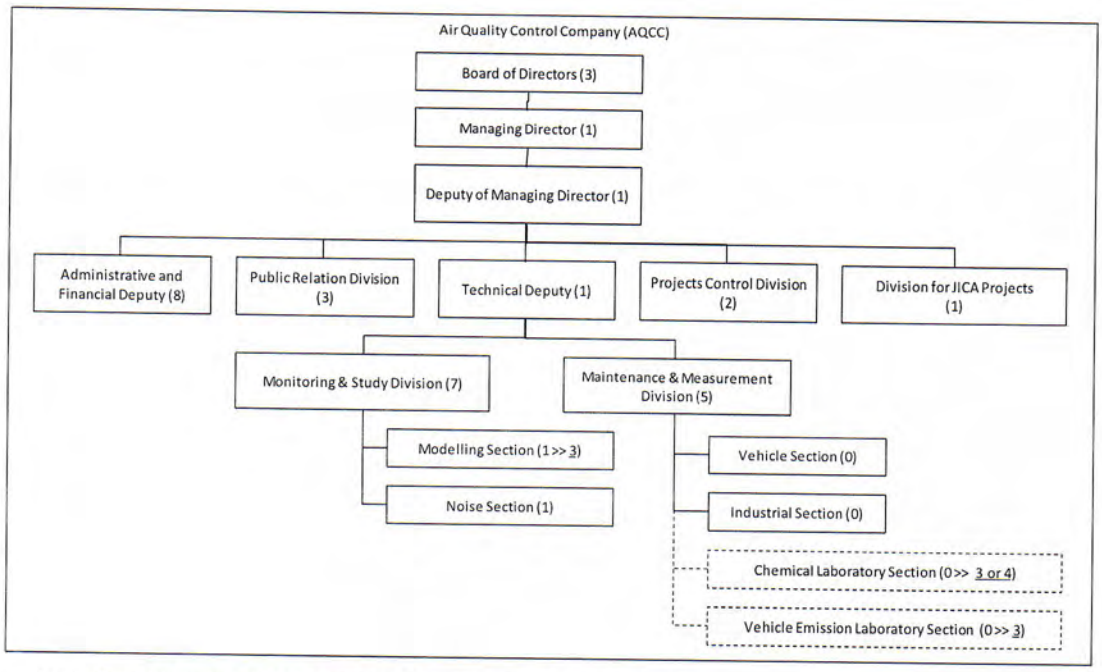
Figure Floor Plan



1: Engine dynamometer, 2: Emission Measurement System, 3:Control Desk, 4:Utilities

Equipment Allocation

Annex 3



Remarks: Dotted box sections don't exisit now, and will be necessary to use Grant Aid Equipment.
Numbers inside () indicate count of officers. Underlined numbers indicates count of officers planned by AQCC.

AQCC Organization Chart

JAPANESE GRANT

The Japanese Grant is non-reimbursable fund provided to a recipient country (hereinafter referred to as "the Recipient") to purchase the products and/or services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. Followings are the basic features of the project grants operated by JICA (hereinafter referred to as "Project Grants").

1. Procedures of Project Grants

Project Grants are conducted through following procedures (See "PROCEDURES OF JAPANESE GRANT" for details):

(1) Preparation

- The Preparatory Survey (hereinafter referred to as "the Survey") conducted by JICA

(2) Appraisal

-Appraisal by the government of Japan (hereinafter referred to as "GOJ") and JICA, and Approval by the Japanese Cabinet

(3) Implementation

Exchange of Notes

-The Notes exchanged between the GOJ and the government of the Recipient

Grant Agreement (hereinafter referred to as "the G/A")

-Agreement concluded between JICA and the Recipient

Banking Arrangement (hereinafter referred to as "the B/A")

-Opening of bank account by the Recipient in a bank in Japan (hereinafter referred to as "the Bank") to receive the grant

Construction works/procurement

-Implementation of the project (hereinafter referred to as "the Project") on the basis of the G/A

(4) Ex-post Monitoring and Evaluation

-Monitoring and evaluation at post-implementation stage

2. Preparatory Survey

(1) Contents of the Survey

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

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of

relevant agencies of the Recipient necessary for the implementation of the Project.

- Evaluation of the feasibility of the Project to be implemented under the Japanese Grant from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.
- Confirmation of Environmental and Social Considerations

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

JICA requests the Recipient to take measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the executing agency of the Project. Therefore, the contents of the Project are confirmed by all relevant organizations of the Recipient based on the Minutes of Discussions.

(2) Selection of Consultants

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

(3) Result of the Survey

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

3. Basic Principles of Project Grants

(1) Implementation Stage

1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes (hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the Recipient to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Recipient to define the necessary articles, in accordance with the E/N, to implement the Project, such as conditions of disbursement, responsibilities of the Recipient, and procurement conditions. The terms and conditions generally applicable to the Japanese Grant are stipulated in the "General Terms and Conditions for Japanese Grant (January 2016)."

V.H.

2) Banking Arrangements (B/A) (See "Financial Flow of Japanese Grant (A/P Type)" for details)

a) The Recipient shall open an account or shall cause its designated authority to open an account under the name of the Recipient in the Bank, in principle. JICA will disburse the Japanese Grant in Japanese yen for the Recipient to cover the obligations incurred by the Recipient under the verified contracts.

b) The Japanese Grant will be disbursed when payment requests are submitted by the Bank to JICA under an Authorization to Pay (A/P) issued by the Recipient.

3) Procurement Procedure

The products and/or services necessary for the implementation of the Project shall be procured in accordance with JICA's procurement guidelines as stipulated in the G/A.

4) Selection of Consultants

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

5) Eligible source country

In using the Japanese Grant disbursed by JICA for the purchase of products and/or services, the eligible source countries of such products and/or services shall be Japan and/or the Recipient. The Japanese Grant may be used for the purchase of the products and/or services of a third country as eligible, if necessary, taking into account the quality, competitiveness and economic rationality of products and/or services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm, which enter into contracts with the Recipient, are limited to "Japanese nationals", in principle.

6) Contracts and Concurrence by JICA

The Recipient will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be concurred by JICA in order to be verified as eligible for using the Japanese Grant.

7) Monitoring

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

8) Safety Measures

The Recipient must ensure that the safety is highly observed during the implementation of the Project.

9) Construction Quality Control Meeting

Construction Quality Control Meeting (hereinafter referred to as the "Meeting") will be held for quality assurance and smooth implementation of the Works at each stage of the Works. The member of the Meeting will be composed by the

V.H.

Recipient (or executing agency), the Consultant, the Contractor and JICA. The functions of the Meeting are as followings:

a) Sharing information on the objective, concept and conditions of design from the Contractor, before start of construction.

b) Discussing the issues affecting the Works such as modification of the design, test, inspection, safety control and the Client's obligation, during of construction.

(2) Ex-post Monitoring and Evaluation Stage

1) After the project completion, JICA will continue to keep in close contact with the Recipient in order to monitor that the outputs of the Project is used and maintained properly to attain its expected outcomes.

2) In principle, JICA will conduct ex-post evaluation of the Project after three years from the completion. It is required for the Recipient to furnish any necessary information as JICA may reasonably request.

(3) Others

1) Environmental and Social Considerations

The Recipient shall carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the Recipient and JICA Guidelines for Environmental and Social Considerations (April, 2010).

2) Major undertakings to be taken by the Government of the Recipient

For the smooth and proper implementation of the Project, the Recipient is required to undertake necessary measures including land acquisition, and bear an advising commission of the A/P and payment commissions paid to the Bank as agreed with the GOJ and/or JICA. The Government of the Recipient shall ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient with respect to the purchase of the Products and/or the Services be exempted or be borne by its designated authority without using the Grant and its accrued interest, since the grant fund comes from the Japanese taxpayers.

3) Proper Use

The Recipient is required to maintain and use properly and effectively the products and/or services under the Project (including the facilities constructed and the equipment purchased), to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Japanese Grant.

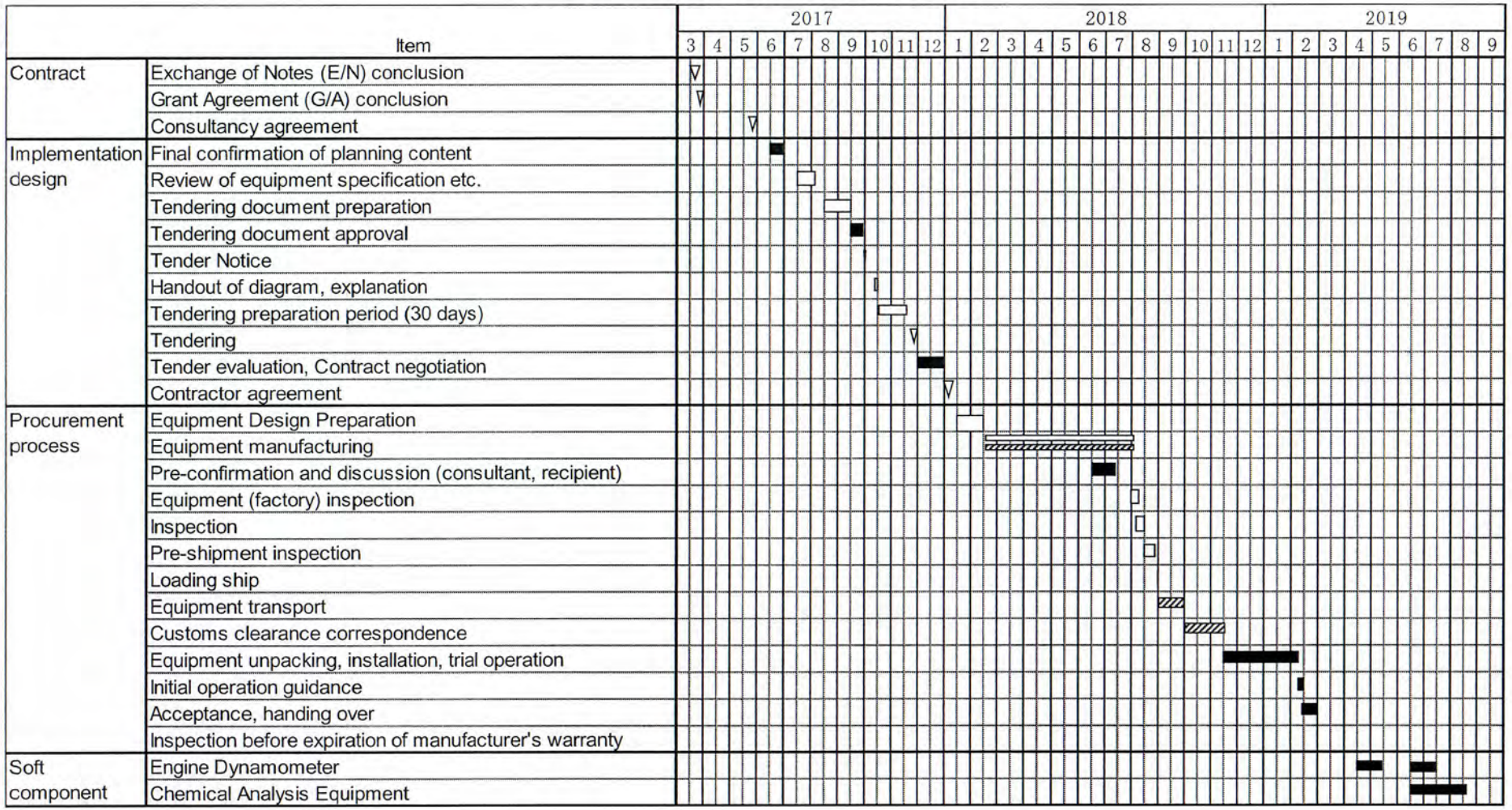
V.H.

4) Export and Re-export

The products purchased under the Japanese Grant should not be exported or re-exported from the Recipient.

Annex 5

Project Implementation Schedule



	Item	2017										2018												2019								
		3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9
Contract	Exchange of Notes (E/N) conclusion																															
	Grant Agreement (G/A) conclusion																															
	Consultancy agreement																															
Implementation design	Final confirmation of planning content																															
	Review of equipment specification etc.																															
	Tendering document preparation																															
	Tendering document approval																															
	Tender Notice																															
	Handout of diagram, explanation																															
	Tendering preparation period (30 days)																															
	Tendering																															
	Tender evaluation, Contract negotiation																															
	Contractor agreement																															
Procurement process	Equipment Design Preparation																															
	Equipment manufacturing																															
	Pre-confirmation and discussion (consultant, recipient)																															
	Equipment (factory) inspection																															
	Inspection																															
	Pre-shipment inspection																															
	Loading ship																															
	Equipment transport																															
	Customs clearance correspondence																															
	Equipment unpacking, installation, trial operation																															
	Initial operation guidance																															
	Acceptance, handing over																															
	Inspection before expiration of manufacturer's warranty																															
Soft component	Engine Dynamometer																															
	Chemical Analysis Equipment																															

Annex 6

Major Undertakings to be taken by the Government of Iran

1. Specific obligations of the Government of Iran which will not be funded with the Grant

(1) Before the Tender

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To open bank account (B/A)	within 1 month after the signing of the G/A	AQCC		
2	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the consultant	within 1 month after the signing of the contract	AQCC		
3	To bear the following commissions to a bank in Japan for the banking services based upon the B/A		AQCC/ Tehran municipality		
	1) Advising commission of A/P	within 1 month after the signing of the contract(s)	AQCC/ Tehran municipality		
	2) Payment commission for A/P	every payment	AQCC/ Tehran municipality	32.9 million IRR	
4	To implement land allocation for engine dynamometer laboratory	within 1 month after the signing of the G/A	AQCC/ Tehran municipality		
5	1) To secure emergency budget for tax exemption, if the tax exemption is not provided.	before notice of the bidding document	AQCC/ Tehran municipality	44.9 billion IRR	
	2) Engine dynamometer laboratory To secure budget for engine dynamometer building, to finish applying building permission To design requirements of each utilities, and to finish applying permission for utilities and the acquisition of construction permission for engine dynamometer building, To complete the implementation design and detailed design of each facility	before notice of the bidding document	AQCC/ Tehran municipality	5,947.2 million IRR	
	3) Chemical analysis laboratory To secure budget for facilities on chemical analysis laboratory, and to confirm requirements To complete selection of company to construct chemical analysis laboratory To complete the laboratory design in AQCC including waste management To start construction for chemical analysis laboratory	before notice of the bidding document	AQCC/ Tehran municipality	8,935.8 million IRR	
	4) Air quality monitoring stations To secure budget for air quality monitoring station containers To complete design for five containers of air quality monitoring stations	before notice of the bidding document	AQCC/ Tehran municipality	3,897.7 million IRR	
6	To submit Project Monitoring Report (with the result of Detail Design)	before preparation of bidding document	AQCC		
7	To allocate 1 qualified personnel for the installation, the technical assistance and the operation of the Engine dynamometer laboratory	before preparation of the implementation design and detailed design of the Engine	AQCC/ Tehran municipality	581 million IRR per year	

		dynamometer laboratory			

(B/A: Banking Arrangement, A/P: Authorization to pay, N/A: Not Applicable)
Note: Completion of undertakings of No.5 on time is indispensable for conducting the tender.

(2) During the Project Implementation

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the Supplier(s)	within 1 month after the signing of the contract(s)	AQCC		
2	To bear the following commissions to a bank in Japan for the banking services based upon the B/A		AQCC/ Tehran municipality		
	1) Advising commission of A/P	within 1 month after the signing of the contract(s)	AQCC/ Tehran municipality		
	2) Payment commission for A/P	every payment	AQCC/ Tehran municipality	354.3 million IRR	
3	To ensure prompt unloading and customs clearance at ports of disembarkation in Iran and to assist the Supplier(s) with internal transportation therein	during the Project	AQCC		
4	To accord Japanese nationals and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the country of the Recipient and stay therein for the performance of their work	during the Project	AQCC		
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be exempted without using the Grant	during the Project	AQCC		
6	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	during the Project	AQCC		
7	1) To submit Project Monitoring Report after each work under the contract(s) such as shipping, hand over, installation and operational training	within one month after completion of each work	AQCC		
	2) To submit Project Monitoring Report (final)	within one month after signing of Certificate of Completion for the works under the contract(s)	AQCC		
8	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the site(s)				
	1)Electricity 2)The distributing line to the site	before start of the installation of equipment	AQCC		
	3)Water Supply 4)Drainage	before start of the installation of equipment	AQCC		
9	1) Completion of building and facilities on engine dynamometer laboratory	Before shipping	AQCC		
	2) Completion of chemical laboratory	Before shipping	AQCC		
	3) Completion of five air quality monitoring station containers	Before shipping	AQCC		

	4) Completion of procedures for tax exemption and custom clearance of each equipment	Before shipping	AQCC		
10	To take necessary measure for tax exemption and custom clearance of each equipment.	Before shipping	AQCC		
11	To take necessary safety measures during the installation of equipment	during the installation of equipment	AQCC		
12	To allocate 3 qualified personnel for the installation, the technical assistance and the operation of the chemical laboratory	Before shipping	AQCC/ Tehran municipality	1,743 million IRR per year	
13	To allocate 2 qualified personnel for the installation, the technical assistance and the operation of the engine dynamometer laboratory	Before shipping	AQCC/ Tehran municipality	1,162 million IRR per year	
14	To submit a report concerning completion of the Project	within six months after completion of the Project	AQCC		

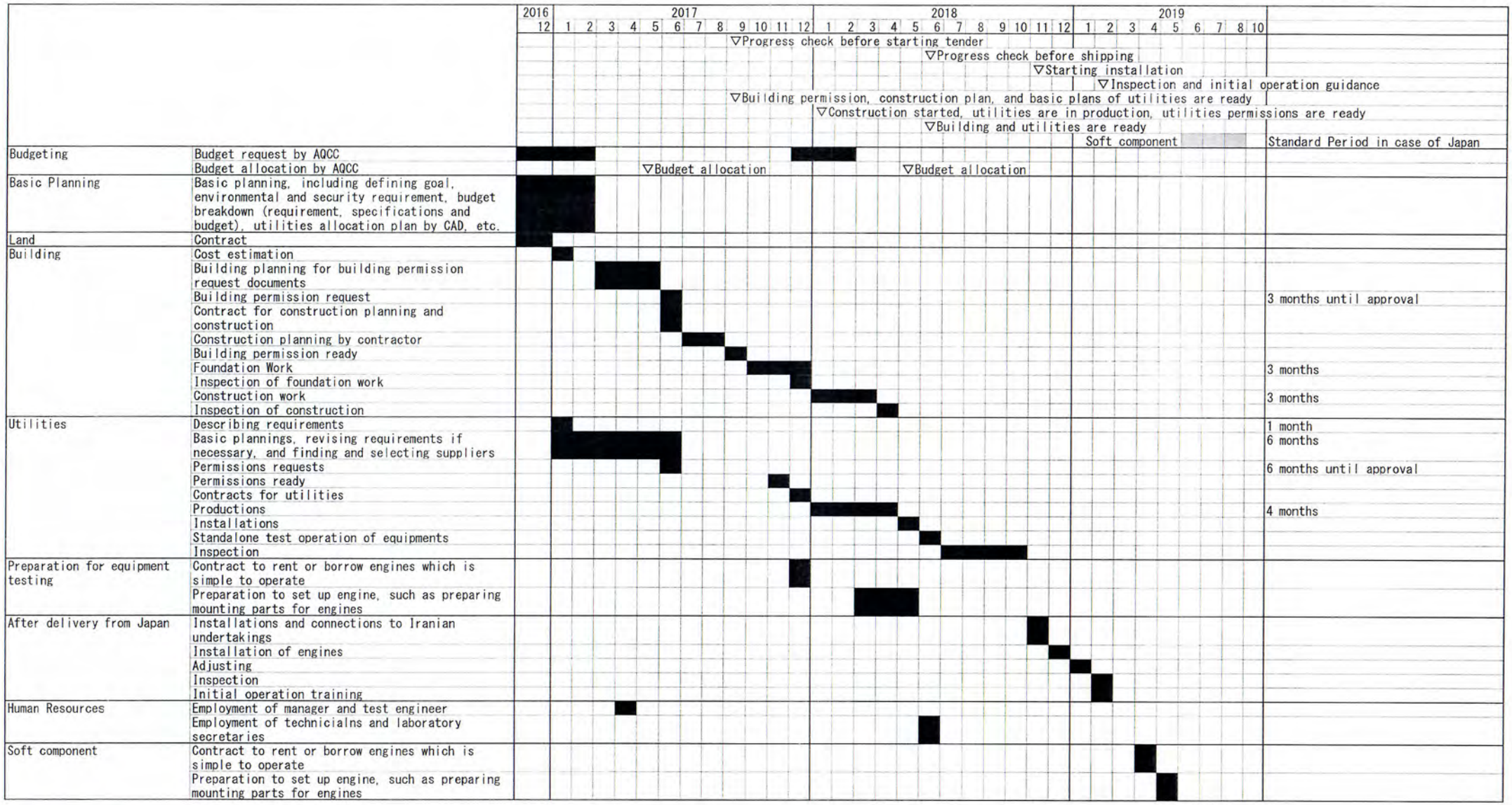
Note: Completion of undertakings of No.9, 10 on time is indispensable for conducting the shipping.

(3) After the Project

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	1) Exhaust emission measurement operation and maintenance cost	After completion of the Project	AQCC/ Tehran municipality	1744 million IRR per year	
	2) Chemical analysis in the laboratory / Ambient and exhaust particle studies operation and maintenance cost	After completion of the Project	AQCC/ Tehran municipality	3,230 million IRR per year	
	3) Air quality monitoring station at least for operation and maintenance for 7 stations	After completion of the Project	AQCC/ Tehran municipality	3,843million IRR per year	
2	1) Cost of VOC sampling major equipment(2sites)	After completion of the Project	AQCC/ Tehran municipality	388 million IRR per year	
	2) Cost of PAH sampling major equipment cartridge method(2 sites, per 100 samples)	After completion of the Project	AQCC/ Tehran municipality	625 million IRR per year	

H. V.H.

Annex 7: Iranian Undertakings Schedule



G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

Project Monitoring Report
on
Project Name
Grant Agreement No. XXXXXXX

20XX, Month

Organizational Information

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

General Information:

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

V.H.

1: Project Description

1-1 Project Objective

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

1-3 Indicators for measurement of "Effectiveness"

Quantitative indicators to measure the attainment of project objectives		
Indicators	Original (Yr)	Target (Yr)
Qualitative indicators to measure the attainment of project objectives		

2: Details of the Project

2-1 Location

Components	Original *(proposed in the outline design)*	Actual
1.		

2-2 Scope of the work

Components	Original* *(proposed in the outline design)*	Actual*
1.		

Reasons for modification of scope (if any).

(PMR)

V.H.

2-3 Implementation Schedule

Items	Original		Actual
	(proposed in the outline design)	*(at the time of signing the Grant Agreement)*	

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations

See Attachment 2.

2-4-2 Activities

See Attachment 3.

2-4-3 Report on RD

See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant(Confidential until the Bidding)

Components			Cost (Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			
Total				

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

2-5-2 Cost borne by the Recipient

Components			Cost (1,000 Taka)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			

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

Reasons for the remarkable gaps between the original and actual cost, and the countermeasures (if any)

(PMR)

2-6 Executing Agency

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

Original *(at the time of outline design)* name: role: financial situation: institutional and organizational arrangement (organogram): human resources (number and ability of staff):
Actual *(PMR)*

3: Operation and Maintenance (O&M)

3-1 Physical Arrangement

- Plan for O&M (number and skills of the staff in the responsible division or section, availability of manuals and guidelines, availability of spareparts, etc.)

Original *(at the time of outline design)*
Actual *(PMR)*

3-2 Budgetary Arrangement

- Required O&M cost and actual budget allocation for O&M

Original *(at the time of outline design)*
Actual *(PMR)*

4: Potential Risks and Mitigation Measures

- Potential risks which may affect the project implementation, attainment of objectives,

U.M.

sustainability
- Mitigation measures corresponding to the potential risks

Assessment of Potential Risks (*at the time of outline design*)

Potential Risks	Assessment
1. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
2. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
3. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
Actual Situation and Countermeasures	
(PMR)	

H. V.H.

5: Evaluation and Monitoring Plan (after the work completion)

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

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

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

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

H. U.H.

Attachment

1. Project Location Map
2. Specific obligations of the Recipient which will not be funded with the Grant
3. Monthly Report submitted by the Consultant

Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
- Contractor's Main Staff List

4. Check list for the Contract (including Record of Amendment of the Contract/Agreement and Schedule of Payment)
5. Monitoring sheet on price of specified materials (Quarterly)
6. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final)only)
7. Pictures (by JPEG style by CD-R) (PMR (final)only)
8. Equipment List (PMR (final)only)
10. Drawing (PMR (final)only)
11. Report on RD (After project)

H. V.H.

Attachment 6

Monitoring sheet on price of specified materials

1. Initial Conditions (Confirmed)

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

2. Monitoring of the Unit Price of Specified Materials

(1) Method of Monitoring : ●●

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

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

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

-

-

-

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

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

PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR IMPROVEMENT
OF
EQUIPMENT FOR AIR POLLUTION
ANALYSIS
IN
TEHRAN

FINAL REPORT

Appendix 5

Soft Component (Technical Assistance) Plan

March 2017

SUURI-KEIKAKU CO., LTD.
ORIENTAL CONSULTANTS GLOBAL CO., LTD.

Contents

(1) Equipment for Exhaust Emission Measurement Laboratory 1
1) Background for Planning Soft Component 1
2) Goal of Soft Component 4
3) Outcome of Soft Component 6
4) Method to Confirm the Outcome Achievement 7
5) Soft Component Activities (Input Plan) 7
6) Resources to Implement Soft Component 14
7) Implementation Process of Soft Component 15
8) Outputs from Soft Component 15
9) Responsibility of Executing Agency in the Partner Country 15
(2) Chemical Analysis Equipment 18
1) Background for Planning Soft Component 18
2) Goal of Soft Component 21
3) Outcome of Soft Component 22
4) Method to Confirm the Outcome Achievement 23
5) Soft Component Activities (Input plan) 24
6) Procurement Method of Implementation Resources for Soft Component 32
7) Implementation Process of Soft Component 33
8) Outputs from Soft Component 34
9) Responsibility of Executing Agency in the Partner Country 34

(1) Equipment for Exhaust Emission Measurement Laboratory

1) Background for Planning Soft Component

A) Background of the Project

Concentration of Carbon Monoxides (CO) of Tehran had been reduced to less than air quality standard of Iran throughout several projects, including Japanese cooperation "The Study on an Integrated Master Plan for Air Pollution Control in The Greater Tehran Area in The Islamic Republic of Iran (1994-1997)" and "The Study on Strengthening and Improving Air Quality Management in the Greater Tehran Area in the Islamic Republic of Iran (2002-2004)". However, concentrations of PM10, PM2.5, Sulfur Dioxide (SO2), and Nitrogen Dioxide (NO2) are often over Iranian Air Quality Standards and are still the primary pollutants, which are evaluated as serious air pollution. As a result of exceeding the standard, schools close temporary or request the citizens to stay indoors. The Government of Islamic Republic Iran prioritizes air pollution reduction especially in source study of particle matters and emission reduction, in the 5^{th} 5years plan (from 2011 to 2016).

However, Tehran Municipality does not have PM emission measurement equipment or PM components analysis equipment, and cannot analyze PM component or PM source contribution. Emission source and air pollution structure are not understood enough. Therefore, it is difficult to study air pollution reduction including identification of PM sources contribution and emission reduction methods.

In order to solve the issues above, grant aid project of "the Project for Improvement of Equipment for Air Pollution Analysis in Tehran" will supply the equipment for exhaust emission measurement, chemical analysis, ambient and exhaust particle studies, and air quality monitoring to Air Quality Control Company which is the subsidiary of Tehran Municipality. In order for Tehran Municipality to improve sustainable monitoring and analysis capacity for air pollutant emission monitoring, the air quality monitoring and air pollution structure are studied.

Table 1　Outline of the Project

<table>
<tr><th colspan="2">Equipment</th><th>Expected Outcome</th><th>Input</th></tr>
<tr><td rowspan="2">1) Exhaust Emission Factor Measurement System</td><td>1.1) Engine Dynamometer System for Diesel Vehicle (400kW・40,000RPM)
1.1.1) Loading System
1.1.2) Measured-Data Acquisition
1.1.3) Test Stand Automation System
1.1.4) Media Conditioning Equipment
1.1.5) Exhaust Emission Measurement System</td><td rowspan="2">Administration capability can be focused to primary issues via developing emission factor specific for Tehran.　In addition, higher performance countermeasures for Tehran specific conditions can be selected and promoted by measuring and comparing emission reduction performances of countermeasures.</td><td>1</td></tr>
<tr><td>1.2) Portable Emissions Measurement System (PEMS)</td><td>One for Heavy Duty Vehicle (HDV)
One for Light Duty Vehicle (LDV)</td></tr>
<tr><td rowspan="6">2) Chemical Analysis Laboratory</td><td>2.1) Ion Chromatograph for Quantitative Analysis of Ions in Ambient Particle Matters</td><td rowspan="7">Conducting component analysis of particulate matter, analyzing emission source profile and source apportionment, understanding the concentration of toxic substance such as benzo [a] pyrene and benzene, and analyzing of asbestos enable to propose countermeasure of pollution to the city of Tehran and relevant departments.</td><td>1</td></tr>
<tr><td>2.2) Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) for Quantitative Analysis of Inorganic Constituents in Particulate Matters</td><td>1</td></tr>
<tr><td>2.3) GC/MS/MS for PAH analysis</td><td>1</td></tr>
<tr><td>2.4) GC/FID/MS for VOC analysis</td><td>1</td></tr>
<tr><td>2.5) Phase Contrast Microscope for Conforming and counting asbestos</td><td>1</td></tr>
<tr><td>2.6) Micro Balance for Weighting Filter Paper</td><td>1</td></tr>
<tr><td>3) Ambient and Exhaust Particle Studies Laboratory</td><td>3.1) Electrical Low Pressure Impactor</td><td>1</td></tr>
<tr><td colspan="2">4) Air Quality Monitoring Station</td><td>It is expected that strengthening of air quality monitoring contributes to clarify air quality condition in Teheran and to evaluate impact of control policies.</td><td>7</td></tr>
</table>

B)　Necessity of Soft Component

AQCC plans to conduct measurement by establishing new Vehicle Emission Laboratory Section and training new employees because AQCC does not have emission measurement equipment of engine dynamometer.

For emission measurement by engine dynamometer, it is necessary not only to operate the dynamometer and analyzers, but also to mount test engine, to operate related equipment according to test cycles, such as engine, fuel supply system, chilled water supply system for cooling engine, and air conditioning for dilution tunnel. It is also necessary to analyze the recorded data after the dynamometer test.

AQCC do not have engine dynamometer emission measurement system now. It will not be easy to operate the equipment as mentioned above even if AQCC will employ expert with experience of engine dynamometer. The initial operational training by equipment manufacture is not enough because the training of combined operation of grant aid equipment and utilities undertaken by Iranian side will be necessary.

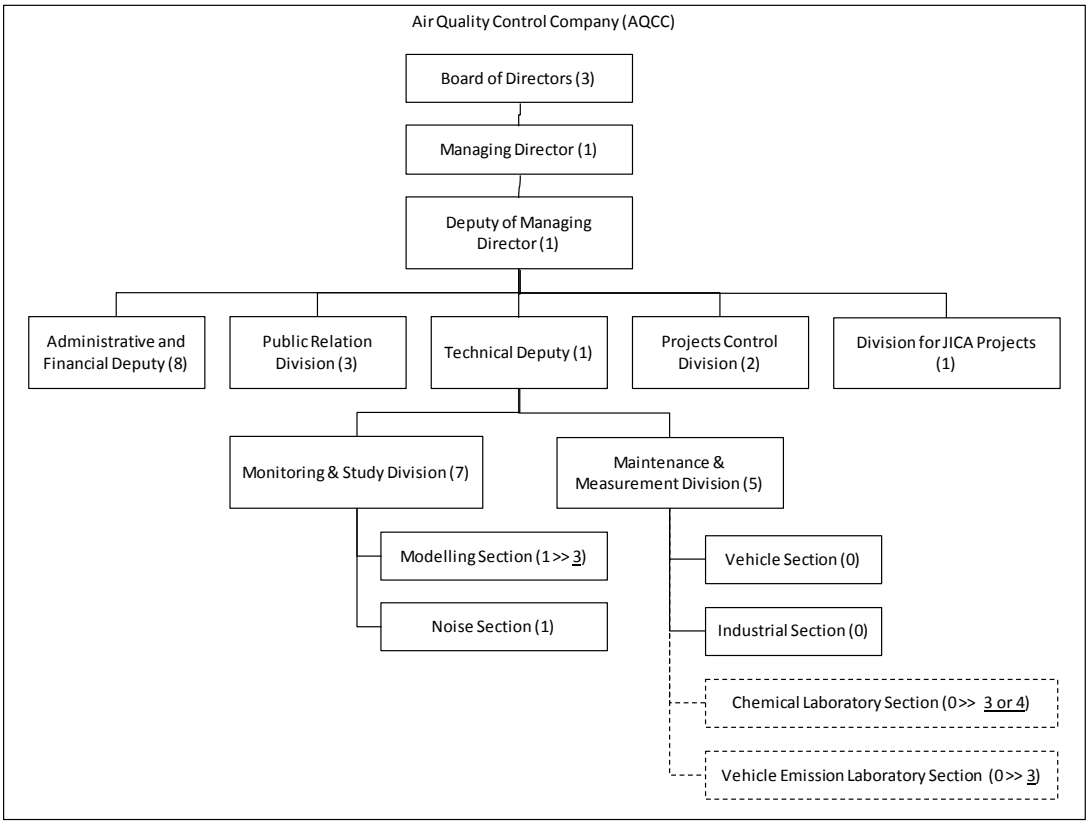
Therefore, Soft Component is necessary in order for AQCC to begin using the total system of engine dynamometer emission measurement equipment and to establish a method for AQCC to develop its capacity by itself.

C) Organization for Operation and Maintenance

AQCC, as Air Quality Control Company of the city of Tehran, which interacts with the related organizations, plays a role to prepare proposals for establishing standards and regulations, through air pollutants monitoring at air quality stations, analysis, and research on countermeasure of exhaust gases from vehicle. The operation and maintenance of the equipment are in charge of the managing director of AQCC, the deputy of managing director, the technical deputy (department manager 1 personnel), Maintenance and Measurement division (five personnel including the division chief), and both newly established Chemical analysis laboratory (newly hired four personnel) and Vehicle emission laboratory (newly hired three personnel).

Since AQCC staff needs expert knowledge, staff to be in charge of the equipment should be hired from personnel with specialized education on chemical analysis and vehicle emission measurement at universities or companies, by June 2018. Furthermore, since experts with Ph.D. in chemical analysis and vehicle emission gas measurement will be posted to assist AQCC as advisers, sufficient structure for the operation and maintenance will be established.

The structure of AQCC is shown in Figure 1.



Remarks: Dotted box sections don't exisit now, and will be necessary to use Grant Aid Equipment.
Numbers inside () indicate count of officers. Underlined numbers indicates officer count plans of AQCC.

Figure 1 Structure of AQCC and Numbers of Members

2) Goal of Soft Component

AQCC will use new engine dynamometer emission measurement system in order to measure air pollutants contained vehicle exhaust. However, AQCC has no experience in such measurement. This Soft Component is designed for AQCC to begin the exhaust measurement smoothly and AQCC experts to study emission measurement.

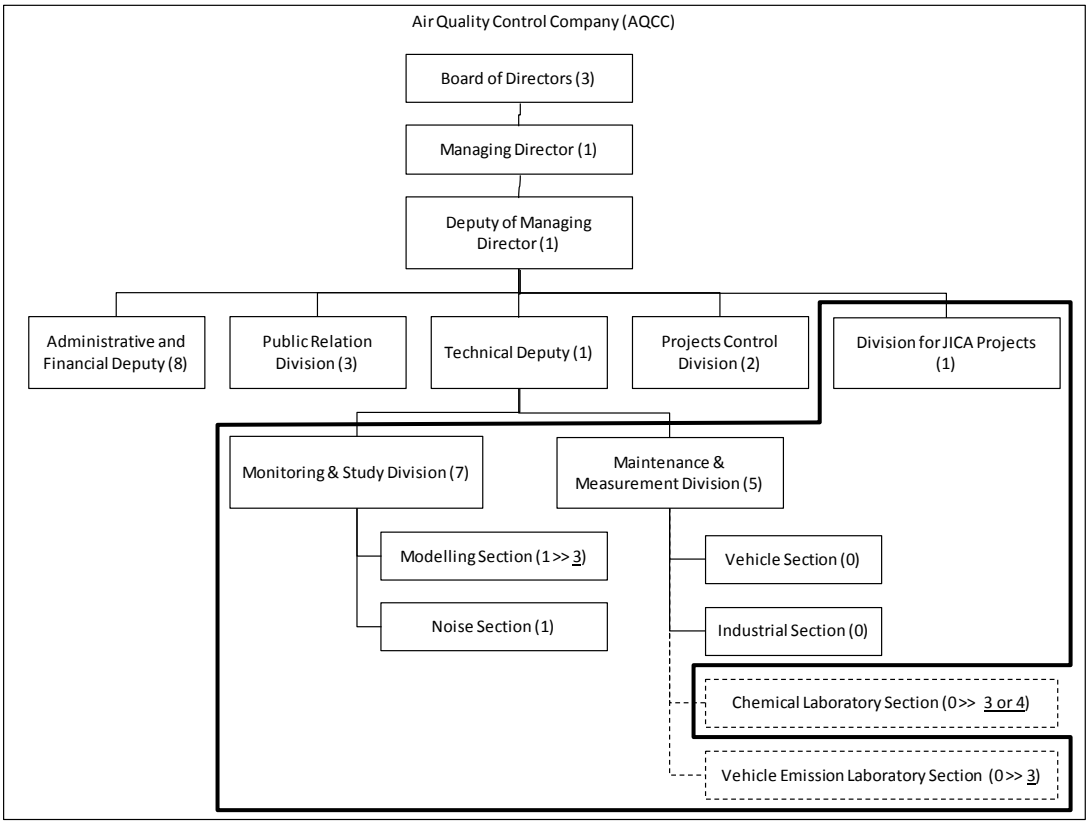
Operation manuals are prepared in details for equipment, and the total volumes are few meters thickness. The manuals will be used to solve any issues, and not suitable to use when training the initial operators or additional operators in future. Soft Component will compile Basic Operational Procedure Manual by which operators will understand the coordinated operation of equipment.

Table 2 Overall Goal of Soft Component

Goal	➢ Throughout exhaust measurement by engine dynamometer exhaust emission measurement system, air pollution reduction in Tehran City will be promoted mainly in vehicle emission control including vehicle emission control, fuel control, and vehicle transportation demand control.

Target of Soft Component will be experts of AQCC. Key staffs will be 3 persons who will be allocated to Vehicle Emission Laboratory Section. In addition, to ensure smooth technical transfer at times of personnel positioning, personnel from additional 2 or 3 more experts of Monitoring & Study Division or Maintenance & Measurement Division of AQCC will participate. The divisions of the target staffs are shown in Figure 2.

One of the 3 staffs must be employed from or before the beginning of planning, where the other 2 must be employed before June 2018. All 3 staffs must be experienced in planning, procurement, installation, and adjustment in all the equipment of Grant Aid and Iranian burdens, and trained by Initial Operational Training. In addition, the staffs will be allocated to Vehicle Emission Laboratory continuously after Soft Component.



Remarks: Dotted box sections don't exisit now, and will be necessary to use Grant Aid Equipment.
Numbers inside () indicate count of officers. Underlined numbers indicates officer count plans of AQCC.

Figure 2 Division of Soft Component Target (Identified by Bold Line)

3) Outcome of Soft Component

Table 3 shows the 4 points of expected outcomes on Soft Component, based on the project goal mentioned above.

Table 3 Outcome of Soft Component

Outcome
1. Master the series of operations of exhaust emission measurement using engine dynamometer system 1) Master the purpose, principle and risk of each equipment 2) Master how to mount engines 3) Master the series of operations of related equipment
2. Master the data processing recorded by the equipment 1) Master the operation of recorded data
3. Master maintenance of equipment 1) Master maintenance of equipment
4. Compile operational handbook 1) Compile Basic Operational Procedure Manual that covers coordinated operation of related equipment.

4) Method to Confirm the Outcome Achievement

The methods to confirm the outcome achievement is shown in Table 4. The time to confirm the outcome is set to be at the end of on-site training.

The training is programed with not only lectures but also with practical exercises using the installed equipment in order to draw proactive involvement of the trainees.

The achieved outcome will be confirmed by checking analysis result of testing sample (analysis result record), checking trainees understandings (understanding test), and preparation of operation documents (standard operating procedure) conducted by the trainees.

Table 4 Method to Confirm the Outcome Achievement

Outcome	Indicator	Means of Verification
Master operations	1) Trainees understand the purpose, principle, and risk of each equipment 2) Trainees understand the procedure to mount engines 3) Trainees understand the series of operations of related equipment	Training record Data measured Understanding test
Master the data processing	1) Trainees understand data processing	Training record Data processed Understanding test
Master maintenance of equipment	1) Trainees understand maintenance of equipment	Training record Maintenance record Understanding test
Compile operational handbook	1) Basic Operational Procedure Manual is compiled	Basic Operational Procedure Manual

5) Soft Component Activities (Input Plan)

Input activities for the expected achievement of Soft Component are shown below.

In the beginning, draft version of Basic Operational Procedure Manual, which will be used for the training, will be prepared.

For final finishing of the activity, training outcome seminar will be held for the trainee to present the achieved knowledge to the AQCC executives and colleagues.

Table 6 shows the activity of the soft component.

Outcome 1: Master operations

<Contents>

1) Lecture on Safety Management

   Lecture safety management, and confirm the responsibilities for safe operation

2) Lecture on Measurement Principle and Basic Operations

   Lecture the measurement principles and basic operation, and confirm the understandings of the trainees

3) Mounting Engine

   Check parts to mount engine on dynamometer, mount engine using pickup truck, hoist and tools to adjust the rotation axis, and then connect and adjust fuel pipe, exhaust gas pipe, and necessary sensors.

4) Test operation of engine and dynamometer

   Run engine and dynamometer by configuring their controllers.

5) Configuration and Calibration of Exhaust Analyzers

   Configure, adjust, and calibrate exhaust analyzers.

6) Exhaust Measurement

   Measure exhaust by coordinate operation of dynamometer, engine, exhaust analyzers, and other sensors.

7) Unmounting Engine

   Unmount engine from dynamometer

Outcome 2: Master the data processing

<Contents>

1) Lecture and exercise on the data processing

   ・Lecture the data processing, and measurement report

   ・To present the measurement report and to discuss the data for air pollution reduction

Outcome 3: Master maintenance of equipment

<Contents>

1) Lecture and exercise on equipment maintenance

   ・Lecture and exercise the maintenance on engine dynamometer, exhaust analyzers, and related equipment

Outcome 4: Compile Basic Operational Procedure Manual

<Contents>

1) **Compile Basic Operational Procedure Manual**

・Compile Basic Operational Procedure Manual that is necessary for the lecture and training above.

・Trainees will update Basic Operational Procedure Manual based on the understandings throughout the activities for Output 1 to 3.

Engine dynamometer exhaust measurement system consists of many kind of equipment including Iranian burdens. At first measurement of Soft Component, it is important to understand a series of measurement operation rather than details understanding of many kind of equipment. Therefore, it is prioritized to understand a series of measurement operation in the first measurement. On the other hand, the engineers need to master measurement for various type engines in various conditions. Next for the measurement, it is prioritized to increase application capacity by educating the details of equipment. In addition, their understandings are to be deepened by encouraging attention throughout the following procedure; a subject will be given to the trainee after the 1st measurement in order to develop interests on engine dynamometer measurement for the 2nd measurement. Intermediate break will be prepared in the middle of Soft Component period.

The engine dynamometer exhaust measurement requires engine up to 500kg, dynamometer which gives resistivity to the engine for vehicle weight up to 10 ton or more, electricity for these power, fuel storage and cylinder gases which requires special permission. These cause variety of risks such as high speed rotation, high temperature exhaust pipes and gases and other dangers (such as fuel and high pressure gases). Safety management education is scheduled in order to prevent any accident related to Grant Aid equipment.

This Soft Component assumes to use the engine mounting parts and connecting equipment which is prepared for Grant Equipment installation and adjustment. Therefore, the engine for Soft Component must be the same engine used for installation and adjustment. These assumptions are listed in the burdens of Iranian side.

The contents of initial operational training by the supplier and analytical training by Soft Component are compared in Table 5.

Just after the analyzer installation by supplier engineer, trainees of AQCC are planned to be trained for their initial operational training. The training is limited to the Grant Aid equipment, and not covers the other necessary lectures and trainings such as safety management education,

series of operation together with utilities of Iranian burdens, output data processing, reporting, and Basic Operational Procedure Manual compilation.

Soft Component is aimed to guide AQCC to measure exhaust gas safely, including safety management lecture, training from a series of operation of all the related equipment to reporting, and compile Basic Operational Procedure Manual.

Table 5 Difference between Initial Operational Training and Soft Component

	Initial Operational Training	Soft Component
Engine Dynamometer System	・Explanation of Grant Aid Equipment ・Basic operation of Grant Aid Equipment, such as starting, measurement and stopping ・Explanation of software attached	・Safety Management Education ・Fuel Supply, Cooling Water Supply, and Dilution Air Supply ・Engine Mounting ・Exercise the Series Operation of Equipment Related ・Processing of Data Recorded ・Supporting to Compile Basic Operational Procedure manual

Table 6 Contents of Soft Component activities

	Purpose and Activity Summary	Day Count of Implementation		Target	Implementation Resource
		1st Period(*)	2nd Period (*)		
	Preparation and Plan Discussion				
a) Plan Confirmation and Preparation	Discussion and confirmation of the plan with JICA Iran Office and AQCC on Soft Component and request. Coordination with test engine supplier	1	1	AQCC Responsible official Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Team Leader) Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
b) Equipment Check and Training Preparation	Check all the necessary equipment, not only Grant Aid equipment such as engine dynamometer, exhaust analyzers, controllers, censors, and gas supply control unit, but also Iranian Burdens such as water chiller, air conditioner, fire extinguisher, and develop (in the 1st period, and update in the 2nd period) Basic Operational Procedure Manual	3	2	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Team Leader) Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
	Outcome 1: To master operations				
1-1 Lecture on Safety Management	Lecture safety management, and to confirm the responsibilities for safe operation	1	1	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Team Leader) Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
1-2 Lecture on Measurement Principle and Basic Operations	Lecture the measurement principles and basic operation, and to confirm the trainees understandings. The contents include plan of necessary equipment (i.e. coupling and engine mounting equipment), fuel supply piping, and equipment check before testing, emergency response against troubles in the emission test.	2	2	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Team Leader) Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)

1-3 Mounting Engine	Check parts to mount engine on dynamometer, to mount engine using pickup truck, hoist and tools to adjust the rotation axis, and then to connect and adjust fuel pipe, exhaust gas pipe, and necessary sensors.	3	3	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
1-4 Test operation of engine and dynamometer	Run engine and dynamometer only to configure the controllers to realize the test cycle of engine	2	2	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
1-5 Configuration and Calibration of Exhaust Analyzers	Configure, adjust and calibrate exhaust analyzers (11 gas pollutants, particulate matter mass and particulate matter count. 13 parameters in total)	1	1	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
1-6 Exhaust Measurement	Check equipment, to configure and adjust equipment for test cycle, and then measure exhaust by cooperated operation of dynamometer, engine, exhaust analyzers and other sensors, and then to measure exhaust.	1	1	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
1-7 Unmounting Engine, and checking equipment	Unmount engine from dynamometer, and to check equipment	1	1	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
	Outcome 2: To master the data processing				
2-1 Lecture and exercise on the data processing	Lecture the data processing, and measurement report To present the measured data for maximum usage of the equipment	1	1	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
	Outcome 3: To master maintenance of equipment				
3-1 Lecture and exercise on	Lecture and exercise equipment maintenance procedure and interval	1		AQCC Vehicle emission laboratory	Japanese Consultant 1 person (Operational Training 1)

equipment maintenance	on both of Grant Aid Equipment (i.e.: engine dynamometer, emission analyzers, controllers, censors and gas supply controllers) and Iranian burdens (i.e.: Water chiller, air conditioner, fire extinguishers).			personnel Technical department personnel	Japanese Consultant 1 person (Operational Training 2)
	Outcome 4: To compile Basic Operational Procedure Manual				
4-1 Compile Basic Operational Procedure Manual	Compile Basic Operational Procedure Manual that is necessary for the lecture and training above. Trainees will update Basic Operational Procedure Manual based on the understandings throughout the activities for Output 1 to 3		2	AQCC Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Team Leader) Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
	Others				
Reporting Training	Presentation of training and discussion on measurement plans	1	1	AQCC Managing Director Deputy Managing Director Vehicle emission laboratory personnel Technical department personnel	Japanese Consultant 1 person (Team Leader) Japanese Consultant 1 person (Operational Training 1) Japanese Consultant 1 person (Operational Training 2)
	Presenting themes, schedule discussion and capacity assessment	1	1		
	Reporting and discussion to JICA Iran Office and AQCC	1	1		

* Priorities and Goals are different in 1st and 2nd periods. Details are mentioned in the main text.

6) Resources to Implement Soft Component

A) Japanese Consultant

Equipment of this Grant Aid Project includes special and latest equipment. Since the trainings require expertise, it is not possible to conduct training by Iranian local resources as subcontract. For this reason, it is proposed to conduct Soft Component through outside Iran resources.

To implement the activities described above, 3 Japanese consultants are necessary as shown in Table 7.

Team Leader (1 person) will discuss with AQCC and JICA on details plans, coordinate the training course including the Iranian burdens, and compile Basic Operational Procedure Manual with other Japanese consultants. Operational Training Personnel (2 persons) will lecture safety management, and guide mounting engine, preparing dynamometer, exhaust measurement, and data processing. Since most activities are necessary to be conducted at two locations separately in cooperation, 2 persons are allocated for Operational Training Personnel. They will carry out Soft Component efficiently by mutual cooperation.

Table 7 Performance and Capability for Training Instructor

Title	Activities	Experience required	Capability required
Vehicle Exhaust Measurement Equipment (Team Leader)	Discussion and coordination with AQCC and JICA, training preparation, and operation and maintenance organizational setup	Similar training in the activities allocated	Expertise in the field of exhaust measurement output application
Vehicle Exhaust Measurement Equipment (Operational Training 1)	Operational training on engine dynamometer system (2 persons are allocated because many works such as mounting engine and adjusting equipment requires cooperated work at 2 locations)		Expertise in the field of exhaust measurement using engine dynamometer system
Vehicle Exhaust Measurement Equipment (Operational Training 2)			

B) Interpreter of Local Employment

It is expected that English communication is difficult with the technicians and administrators of installation sites. One English-Persian interpreter is required.

7) Implementation Process of Soft Component

Implementation process plan for this Soft Component is shown in Table 8 and Table 10.

Table 8 Implementation process of Soft Component (Draft)

		Year 2019										Consultant	
		1	2	3	4	5	6	7	8	9	10	Count	M/M
Main Project	Initial Operational Training by Manufactures						0.50			0.50			
Soft Component	Team Leader											1	1.00
	Operational Training 1											1	2.00
	Operational Training 2											1	2.00
Reference				New Year Holiday		Ramadan	1.00	Review by AQCC		1.00			
Total												3	5.00

New Year day of Iranian Calendar is in 2 weeks around the Vernal Equinox Day, which are the Iranian holiday season. Ramadan in 2019 is expected to start on 5th may until 3rd June. In order to allocate 1 month of full capacity days for Soft Component, the Soft Component is proposed to start after Ramadan.

Soft Component is planned to 2 period, 1st period and 2nd period, because of the reason described in "5) Soft Component Activities (Input Plan)".

8) Outputs from Soft Component

Outputs of Soft Component are shown in Table 9.

Table 9 Outputs of Soft Component

1) Soft Component implementation status report
2) Basic Operational Procedure Manual
3) Progress Report
4) Final Report
5) Soft component completion report

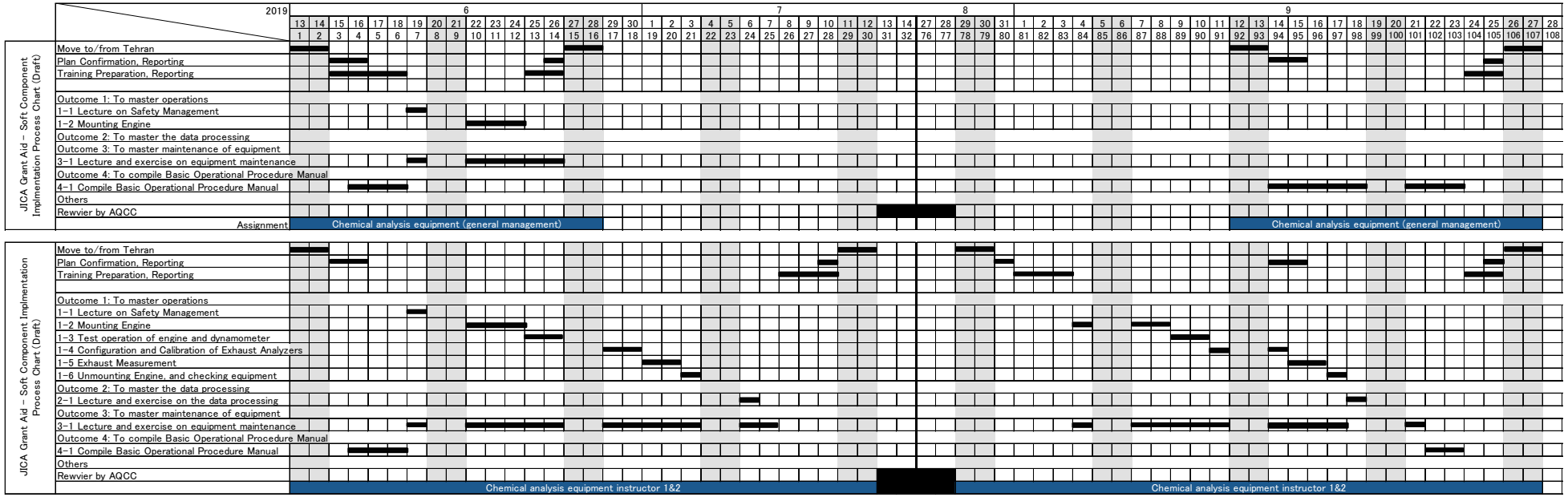
9) Responsibility of Executing Agency in the Partner Country

In order to continuously and effectively utilize equipment procured by this Grand Aid, AQCC which is the executing agency needs to implement the following contents.

- Land large enough for engine dynamometer emission measurement laboratory
- Building for engine dynamometer emission measurement laboratory

- Utilities for engine dynamometer emission measurement laboratory (Water chiller, air conditioner, power utility, fuel supply utility, fire extinguish utility, and etc.)
- One of the 3 must be employed from or before the beginning of planning, where the other2 must be employed before June 2018. All of 3 must have experienced in planning, procurement, installation, and adjustment on all the equipment of Grant Aid and Iranian Burdens, and then trained by Initial Operational Training. In addition, they must be allocated to Vehicle Emission Laboratory continuously after Soft Component.
- Basic Operational Procedure Manual will be updated periodically.
- Human resources development in order to continue using the laboratory.
- Materials and consumables necessary for engine dynamometer laboratory (burrowing engines to be tested, burrowing emission reduction system to be evaluated, standard and carrier gases, PM sampling filters, maintenance and support contract of utilities)
- Engine, mounting parts and connection parts that will be used for installation and adjustment of engine dynamometer are available for the period of Soft Component.

Table 10　Implementation Process (Draft)



(2) Chemical Analysis Equipment

1) Background for Planning Soft Component

A) Background of the Project

The city of Tehran has reduced the carbon mono oxide (CO) concentration below the standard value of Iranian government, with Japanese cooperation of “Development survey: The study on an integrated master plan for air pollution control in the greater Tehran area in the Islamic Republic of Iran (1994-1997)”, and “The study on strengthening and improving air quality management in the Greater Tehran area in the Islamic Republic of Iran (2002-2004)”. However, air pollutants concentrations such as PM10 and PM2.5, sulfur dioxide (SO2), and nitrogen dioxide (NO2) are exceeding the Iranian standard values, and for the safety, educational institutions has closed temporary, and warnings were issued to stay inside buildings.. For this reason, the Government of the Islamic Republic of Iran prioritizes the reduction of air pollution, especially in specifying the source and reducing the particulate matter in the 5th Five-year plan (2011-2016).

Meanwhile, the city of Tehran does not own equipment for component analysis of particulate matter, and component composition and source contribution analysis cannot be carried out, thus, the source and pollution structure are not sufficiently clarified. For this reason, it is difficult to investigate the countermeasures of air pollution such as identifying source and reduction method based on the component analysis results.

This Grand aid project, "The Project for improvement of equipment for air pollution analysis in Tehran," responding to the above issue, facilitates to improve autonomous measurement and analysis capacity related to air pollution emission, air pollution status, and pollution structure in Tehran, by providing necessary equipment of exhaust emission measurement, chemical analysis, ambient and exhaust particle measurement, and air quality monitoring station to Air Quality Control Company (AQCC) founded by the city of Tehran,

Table 11 Overview of the Support Plan of the Project

Equipment		Expected achievement	Input plan
1)Exhaust Emission Measurement Equipment	1.1) Engine Dynamometer system for Diesel vehicle(400kW・40,000RPM) 1.1.1) Loading System 1.1.2) Measured-Data Acquisition 1.1.3) Test Stand Automation System 1.1.4) Media Conditioning Equipment	By constructing an emission factor that meets the specific conditions of the city of Tehran, identifying emission source and pollutants that	1

	1.1.5) Exhaust Emission Measurement System	should be treated with priority, that makes administrative capacity available to concentrate on solving the issue. In addition, measurement of the effect of a various countermeasure devices enables to make plans for action effectiveness expected under the Tehran's unique condition.	
	1.2) Portable Emission Measurement system		Heavy duty vehicle 1 Light duty vehicle 1
2)Chemical Analysis Equipment	2.1) Ion Chromatograph (Ion analysis of PM in ambient air)	Conducting component analysis of particulate matter, analyzing emission source profile and source apportionment, understanding the concentration of toxic substance such as benzo [a] pyrene and benzene, and analyzing of asbestos enable to propose countermeasure of pollution to the city of Tehran and relevant departments.	1
	2.2) ICP-AES(Inorganic analysis of PM)		1
	2.3) GC/MS/MS(PAH analysis)		1
	2.4) GC/MS/FID(VOC analysis, added)		1
	2.5) Phase contrast microscope (Asbestos analysis)		1
	2.6) Microbalance		1
3)Ambient and Exhaust Particle Measurement Equipment	3.1) Electrical Low Pressure Impactor		1
4)Air Quality Monitoring Station		Reinforcing in monitoring enables to perceive the current status in city of Tehran and check the effect of countermeasure.	7

B) Necessity of Soft Component

Since AQCC does not own a chemical analysis laboratory for air pollution measurement, AQCC plans to establish a new section, to train personnel for analytical tasks.

Using equipment planned to be procured by this project, component analysis of pollution such as particulate matter requires relatively sophisticated skills. In order to acquire analytical skills for the component analysis of particulate matter in the ambient air, a long term of training such as several months to years will be necessary for analysis operation staff and also personnel who manage the analytical work to increase experiment such as skill and knowledge

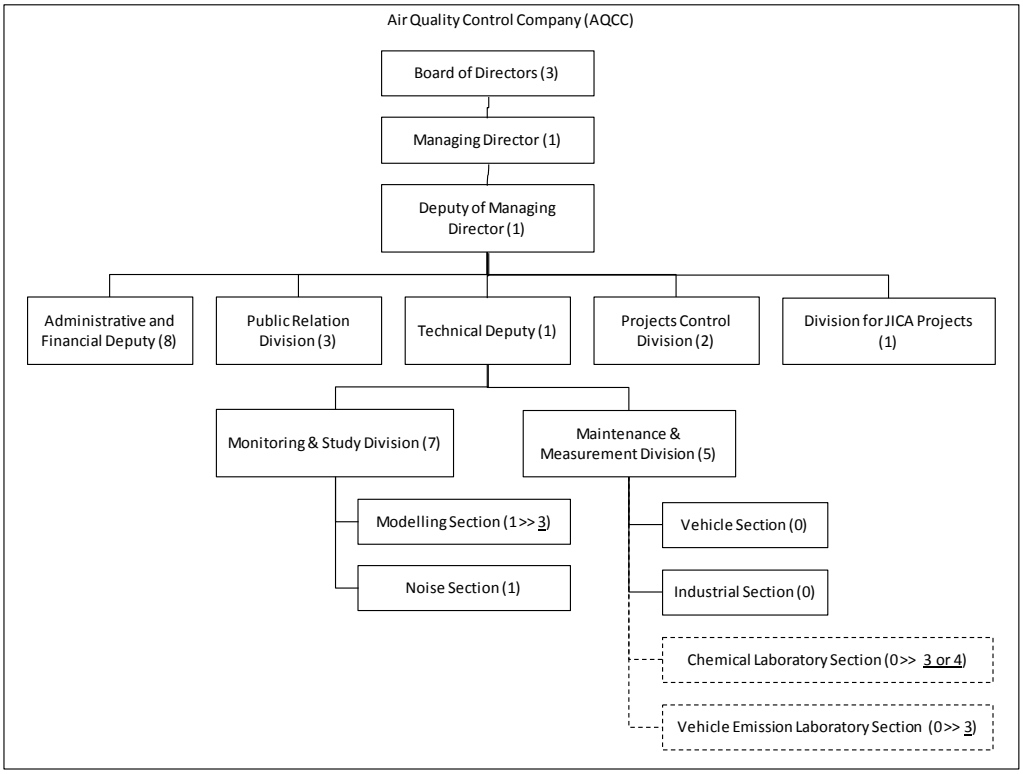
Considering of no chemical analysis laboratory at AQCC, it is not easy to train the trainees up to the satisfied level in a short period, and it is necessary to educate and train in a long-term perspective. The activities are planned for technical projects regarding sampling, data analysis, and utilization of results. Consequently, Soft Component is necessary for the sample analysis.

C) Organization of Operation and Maintenance

AQCC interacting with related organizations plays a role to make proposals for establishing standards and regulations, through air pollutants monitoring at air quality stations, analysis, and research on countermeasure of exhaust gases from vehicle. Operation and maintenance of the equipment is taken in charge by the managing director of AQCC, the deputy of managing director, the technical deputy (department manager 1 personnel), Maintenance and Measurement division (5 personnel including the division chief), and both newly established Chemical analysis laboratory (newly hired 4 personnel), and Vehicle emission laboratory (newly hired 3 personnel).

As AQCC staff should have expert knowledge, staff for the section in charge of the equipment, should be hired from those who have specialized education on chemical analysis and vehicle emission measurement at universities or companies, by June 2018. Furthermore, since those experts who have Ph.D. in chemical analysis and vehicle emission gas measurement assist AQCC as advisers, it is considered that sufficient organization for the operation and maintenance is established.

The organization chart of AQCC is shown in Figure 3.



Remarks: Dotted box sections don't exisit now, and will be necessary to use Grant Aid Equipment.
Numbers inside () indicate count of officers. Underlined numbers indicates officer count plans of AQCC.

Figure 3 AQCC Organization Chart and Number of Members

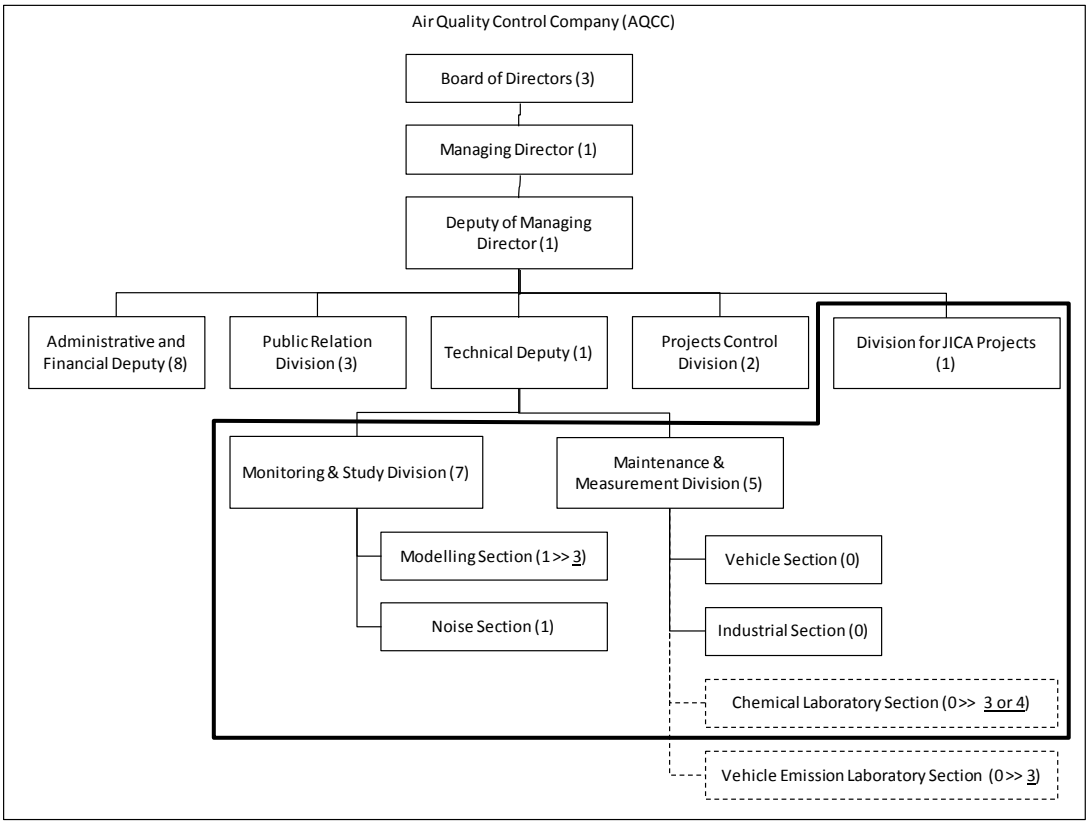
2) Goal of Soft Component

In response to severe air pollution, AQCC needs to establish a new chemical analysis laboratory, conduct research to understand air pollution mechanism of particulate matter, etc., and clarify the emission source in order to countermeasure the air pollution. However, AQCC has no experience in analyzing particulate matter, VOC, PAH, and asbestos in ambient air using chemical analysis equipment. Aiming to the smooth operational launch of this project, a goal is set for the staffs in charge to acquire appropriate analysis technique.

Table 12 Goal of Soft Component

Goal	By conducting the analysis of particulate matter, VOC, PAH, and asbestos in ambient air, study of effective countermeasure on air pollution is promoted in the city of Tehran.

Figure 4 shows the divisions of trainees to be attending the analytical technique training. For the Soft Component, 3 personnel belonging to the chemical analysis laboratory will play the center role. However, there is a possibility that personnel in charge of the task may be changed due to retirement. Even in that case, AQCC believes smooth succession of tasks is important in a long perspective. Therefore, AQCC aims to assign 2 to 3 personnel from technical division (Monitoring & Study Division, Maintenance & Measurement Division), and total of 5 to 6 personnel will conduct the assignment for training the technique.



Remarks: Dotted box sections don't exisit now, and will be necessary to use Grant Aid Equipment.
Numbers inside () indicate count of officers. Underlined numbers indicates officer count plans of AQCC.

Figure 4 The Division of Trainees to Attend Training on Analytical Technique (within bold line)

3) Outcome of Soft Component

Table 13 shows the 4 expected outcomes on Soft Component, based on the project goal mentioned above.

Table 13 Outcomes of Soft Component

Outcome
1. Acquire analysis technique 1) The measurement principle of analysis is understood. 2) Learn how to prepare and handle reagents 3) Learn how to prepare and handle sample 4) Learn preparation procedure
2. Acquire analysis methods and maintenance of equipment in order to achieve the purpose. 1) Learn operating procedure to analyze components of particulate matter, etc. that is needed to achieve the goal 2) Learn how to maintain analytical equipment.
3. Acquire how to calculate of analysis results 1) Learn how to organize data
4. Prepare operating procedure 1) Prepare analysis procedure documents (standard operating procedure, SOPs)

4) Method to Confirm the Outcome Achievement

The methods to confirm the outcome achievement are shown in Table 14. The outcome will be confirmed at the end of on-site training. The training program is planned that not only lectures but also practical exercises shall be done using installed equipment in order to acquire proactive involvement of the trainees.

The method to confirm the outcome achievement is by checking analysis result of testing sample (analysis result record), checking understandings of the trainees (understanding test), and preparation of operation documents (standard operating procedure) conducted by trainees

Table 14 Method to Confirm the Outcome Achievement

Outcome	Items of outcome achievement	Method to confirm
Acquire analysis technique	1) Trainees understand the measurement principle of analysis. 2) Trainees understand how to prepare and handle reagents. 3) Trainees understand how to prepare and handle sample. 4) Trainees understand preparation procedure.	Training record Understanding test
Acquire analysis methods and maintenance of equipment in order to achieve the purpose	1) Trainees understand operating procedure to analyze components of particulate matter, etc. that is needed to achieve the goal. 2) Trainees understand how to maintain analytical equipment.	Training record Data result Understanding test Maintenance record
Acquire how to calculate of analysis results	1) Trainees understand how to organize data.	Training record Analysis result record Understanding test
Prepare operating procedure	1) Trainees prepare analysis procedure documents (standard operating procedure, SOPs).	Standard operating procedure

5) Soft Component Activities (Input plan)

Input activities on the expected achievement of Soft Component are shown below.

The draft documents of standard operation procedure will be prepared to learn how to operate prior to their training, based on manuals provided from manufactures or some information regarding the glass wear cleaning or handling of chemical reagents.

Also, as final activity, the trainee will present the achievements from the activity to AQCC executives and colleagues in the training seminar.

Table 16 shows the activity of the soft component. Since multiple activities are performed concurrently in some cases, the days of training activity was assigned proportionally.

Outcome 1: Acquire analysis technique

<Contents>

1) Lecture on measurement principle of analysis
   - Lecture the basics of analytical chemistry and presume the abilities of trainees.
   - Review the fundamental knowledge of analysis measurement principle, structure, and function of equipment.
2) Lecture and practical training on preparation and handling of reagents
   Lecture on reagents characteristics, caution in reagents handling, and reagents management which are necessary in the operation tasks, and practical training on reagents preparation.
3) Lecture and practical training on preparation and handling of sample
   Lecture and practical training on sample preparation, handling, and storage method.
4) Lecture and practical training on the pretreatment procedure.
   Lecture and practical training on sample pretreatment procedure before instrumental analysis is carried out.

Outcome 2: Acquire analysis methods and maintenance of equipment in order to achieve the purpose

<Contents>

1) Lecture and practice of analysis method necessary to achieve purpose
   - Review operational procedures and repeat training practice.
   - Prepare calibration curves and check the sensitivity.
   - Analyze standard and/or sample to obtain analysis data.
2) Lecture and practical training on analytical equipment maintenance

Learn maintenance procedures and maintenance period of equipment and peripheral devices.

Outcome 3: Acquire calculation method of analysis results

<Contents>

1) Lecture and practical training on organizing data

Learn how to organize data and produce analysis result record.

Outcome 4: Prepare standard operating procedure

<Contents>

1) Produce standard operating procedure

Trainees review training contents of outcome 1 to 3, and produce standard operating procedure for analysis and data organizing.

Initial operation guidance is guidance on handling of analytical instruments carried out by manufacturers. Although this guidance will provide the explanations of the installed equipment, it is inadequate to train on pretreatment, analysis, organizing data, and analysis management in order to achieve the goal of analysis of particulate matter, PAH, VOC, and asbestos.

In order to launch the usage of equipment suited to the goal, Soft Component is necessary for explanation of analysis outline, guidance of reagents and sample handling, sample pretreatment, quantitative analysis, organizing analysis data, and preparing standard operating procedure.

The contents of initial operation guidance conducted by manufacturers and analytical technique training in Soft Component are shown in Table 15. The details of Group A and B will be described in the procurement method of resource implementation.

Table 15 Initial Operation Guidance and Analytical Technique Training in Soft Component

Chemical analysis equipment	Initial operation guidance	Analytical technique training in Soft Component
Principle	・Guidance of operation on equipment procured by the project (including attached software)	・A series of analysis training using several equipment (including the use of equipment procured by Iranian side) to analyze the target substance.
Gas chromatograph (PAH)	・Explanation of overview and parts of equipment ・Explanation of turning on and	・Explanation of analysis summary on object substance (PAH) ・Guidance on handling sample and

	off of equipment power, and fundamental operation method for measurement. ・Explanation of how to use the attached software	reagents ・Guidance on analysis pretreatment ・Checking sensitivity of equipment and conduct quantitative analysis. ・Review on analytical equipment operation ・Guidance on calculation of analysis data ・Guidance on preparation of standard operating procedure
Gas chromatograph (VOC)	Same as above	・Explanation of analysis summary on object substance (VOC) ・Guidance on handling sample and reagents ・Guidance on analysis pretreatment ・Checking sensitivity of equipment and conduct quantitative analysis. ・Review on analytical equipment operation ・Guidance on calculation of analysis data ・Guidance on preparation of standard operating procedure
Ion Chromatograph	Same as above	・Explanation of analysis summary on object substance (Ion) ・Guidance on handling sample and reagents ・Guidance on analysis pretreatment ・Checking sensitivity of equipment and conduct quantitative analysis. ・Review on analytical equipment operation ・Guidance on calculation of analysis data ・Guidance on preparation of standard operating procedure
ICP	Same as above	・Explanation of analysis summary on object substance (Inorganic) ・Others, as same as above
Phase contrast microscope	・Explanation of overview and parts of equipment ・Explanation of turning on and off of equipment power, and fundamental operation method for measurement.	・Explanation of analysis summary on object substance (Asbestos) ・guidance of asbestos counting method ・Guidance on calculation of analysis data and preparation of standard operating procedure
Micro balance	・Explanation of overview and parts of equipment	・Guidance on handling sample (filter sample)

	・Explanation of turning on and off of equipment power, and fundamental operation method for measurement	・Guidance on pretreatment method for measurement ・Guidance on measurement method of sample ・Guidance on calculation of analysis data and preparation of standard operating procedure

Table 16 Contents of Soft Component Activities

	Aim / Summary of activity	Duration of implement						Attendance	Implementation resources
		Phase contrast microscope	Micro balance	IC	ICP	Gas chromatograph (VOC)	Gas chromatograph (PAH)		
		A,B	A,B	B	B	A	A	AQCC training group (A, B)	
Preliminary preparation / report									
a) Prior consultation	Discussion and reporting at JICA office and AQCC Explanation of Soft Component activities, Cooperation Request	0.5				1		AQCC Responsible official Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)
b)Equipment operation status check, training preparation	Check the operation status of main and peripheral equipment confirming and/or washing of pretreatment equipment, pure water making equipment, washing equipment, dedicated and common glassware, consumables, standard substances, reagents, and gases for analyzer, etc. that Iranian side procured. Preparing draft of standard operating procedure (SOP)	1.5		2	2	2	2	AQCC Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)
Outcome1 Activities related to acquiring analysis techniques									
1-1 Lecture on measurement	Lecture the basics of analytical chemistry and	1.5	1.5	1	1	1	1	AQCC Chemical analysis	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP)

principle of analysis	presume the abilities of trainees. Review the foundation of analysis measurement principle, structure, and function of equipment							laboratory personnel Technical department personnel	Japanese Consultant 1 person (VOC, PAH)
1-2 Lecture and practical training on preparation and handling of reagents	Lecture on reagents characteristics, caution in reagents handling, and reagents management necessary in the operation tasks, and practical training on reagents preparation. Since PAH requires a wide variety of reagents and that also increases preparation work by double for washing devices, compared to other analysis.			1	1	1	2	AQCC Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)
1-3 Lecture and practical training on preparation and handling of sample	Lecture and practice training on sample preparation, handling, and storage method Since VOC requires time to prepare sampling tube and confirming blank result, it takes double as compared to other analysis.			0.5	1	2	1	AQCC Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)

1-4 Lecture and practical training on the pretreatment procedure.	Lecture and practical training on sample pretreatment procedure before instrumental analysis is carried out ICP, VOC, PAH were secured for 3 days because the preprocessing procedure is more complicated than that of IC analysis, and as repetition practice is planned.			1	3	3	3	AQCC Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)
Outcome2 Activities related to acquiring analysis methods and maintenance of equipment in order to achieve the purpose									
2-1 Lecture and practical training of measurement using analytical equipment	Lecture and practical training as follows. (Phase contrast microscope, micro balance) measurement of pretreated sample, and obtain analysis data (Other equipment) - Measure the standard sample and prepare calibration curve. - Measure the pretreated sample and obtain analysis data. - For proficiency, conduct repetition measurement and obtain analysis data. - For quality control, confirm whether correct concentration can be measured using standard sample.	2	1.5	3	4	4	4	AQCC Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)

2-2 Lecture and practical training on analytical equipment maintenance	Learn maintenance procedures and maintenance period of equipment and peripheral devices			0.5	1	1	1	AQCC Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)
Outcome3 Activities related to acquiring calculation method of analysis results									
3-1 Lecture and practical training on organizing data	Based on the data obtained from the analyzer or the data obtained by visual observation of asbestos with a microscope, analysis result records are prepared.	0.5	0.5	1	2	2	2	AQCC Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)
Outcome4 Activities related to preparing standard operating procedure									
4-1 Produce standard operating procedure	Review training contents of outcome 1 to 3, and produce standard operating procedure for analysis and data organizing.	1.5		2	2	2	2	AQCC Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)
Other									
Report on training achievement	Report on training achievement at debrief meeting.	1		1	1	1	1	AQCC Responsible official Chemical analysis laboratory personnel Technical department personnel	Japanese Consultant 1 person (Asbestos, Micro balance, IC, ICP) Japanese Consultant 1 person (VOC, PAH)

※ Soft Component analytical technique training and attendees

AQCC training group A： Micro balance, phase contrast micro scope, gas chromatograph (PAH, VOC)

AQCC training group B： Micro balance, phase contrast micro scope, IC, ICP

6) Procurement Method of Implementation Resources for Soft Component

A) Japanese Consultant Personnel

Since analytical equipment procured in this cooperation project includes special and latest equipment, the training activities with re-entrustment of Iranian local resources cannot be planned. Therefore, it is proposed that implement of training activities should be carried out by utilizing outside Iran resources.

For the activities described in the preceding paragraph, a general manager for consultation and coordination with AQCC and JICA will be assigned, and manage the activities for six types of equipment shown in Table 17. Though each 6 types of equipment require expertise, in order to reduce the number of trips, consultants who can provide training for multiple equipment were considered. As a result, as shown in Table 17, it is possible to reduce to 2 consultants, one of being in charge of 2 types of gas chromatograph, and the other in charge of other equipment. The total number of trips will be 2 times for general manager and 1 for each of consultants with training in chemical analysis equipment.

Table 18 shows the assignment and role, and the required performance and ability.

Table 17 Resource Input Plan from Japanese Side

		Assignment, Measurement item	Personnel dispatch or re-entrust	Period (M/M)	number of people
Chemical analysis equipment		General manager	Order-received consultant	0.83	1
A	Gas chromatograph	PAH	Order-received consultant	1.00	1
B	Gas chromatograph	VOC		1.07	
C	Ion chromatograph	Ion component	Order-received consultant	0.70	1
D	ICP	Inorganic		0.87	
E	Phase contrast microscope	Asbestos		0.60	
F	Micro balance	Paticulate matter			
Total				5.07	3

Table 18 Performance and Ability Necessary for the Training Instructor

Assignment	Field / Role	Performance	Ability
Chemical analysis equipment (general management)	Consultation and coordinating task with AQCC and JICA, preparation task of training, and preparing reports	Similar training in the field in the past	Familiar with chemical analysis equipment which in charge
Chemical analysis equipment instructor 1	Gas chromatograph(PAH、VOC)		
Chemical analysis equipment instructor 2	Gas chromatograph(ICP, phase contrast microscope, micro balance)		

B) Interpreter of Local Employment

Technicians and administrators of installation sites are expected to have difficulties on communication in English, 1 English-Persian interpreter will be necessary for each group.

7) Implementation Process of Soft Component

The plan of implementation process for this Soft Component is shown in Table 19 and Table 21.

Table 19 Plan of Implementation Process of Soft Component

Implementation process			2019								Consultant	
			1	2	3	4	5	6	7	8	person	M/M
	Initial operation guidance (by manufacturer)							0.30 ▼		0.53 ▼		
Soft Component	Chemical analysis equipment(General manager)								1.00		1	0.83
	A. Gas chromatograph	PAH								1.07	1	2.07
	B. Gas chromatograph	VOC										
	C. Ion chromatograph	Ion component							0.87		1	2.17
	D. ICP	Inorganic						0.60		0.70		
	E. Micro balance	Paticulate matter										
	F. Phase contrast microscope	Asbestos										
Remarks					New Year's holiday		Ramadan					
Total											3	5.07

Note: ▼ Implementation status report

AQCC request all personnel in the chemical analysis laboratory to attend the analysis technique training. If the training from A to F were sequentially conducted, the costs will be large due to general management and allocation of car.

In order to reduce the costs, trainees to attend the analysis technology training will be divided into 2 groups (A and B), and 2 trainings will be conducted in parallel. Training group A is mainly responsible for gas chromatograph (PAH) and gas chromatograph (VOC), and training group B is mainly responsible for ion chromatography and ICP. The trainings of phase contrast microscopes and micro balances can be attended by both groups.

Meanwhile, there is 2 weeks holiday in March, since Vernal Equinox Day is a New Year's Day in Iran. In addition, Ramadan in 2019 is expected from May 5th to June 3rd, and the efficiency of work during Ramadan period will considerably decrease. In order to reduce the number of trips, though there will be 4 months of blank after the initial operation guidance, the time schedule is planned that the training starts after Ramadan.

8) Outputs from Soft Component

The outcomes of the Soft Component are shown in Table 20.

Table 20 List of Outcomes

1) Soft Component implementation status report
2) Progress Report
3) Standard operating procedure(SOPs)
4) Final Report
5) Soft component completion report

9) Responsibility of Executing Agency in the Partner Country

In order to continuously and effectively utilize equipment procured by this Grand Aid, AQCC which is the executing agency needs to implement the following contents.

- Personnel to be placed in the chemical analysis laboratory should be those who have the following analysis experience. It is desirable that personnel will be experienced in all analytical fields.

  ✧ Measurement of asbestos using phase contrast microscope
  ✧ Microanalysis using micro balance
  ✧ Ion component analysis using ion chromatograph
  ✧ Inorganic component analysis using ICP
  ✧ VOC component analysis using gas chromatograph mass spectrometer
  ✧ PAH component analysis using gas chromatograph mass spectrometer

- Renovation of building for the chemical analysis laboratory such as electricity, gas, water supply, draft chamber, air conditioning equipment, and etc.

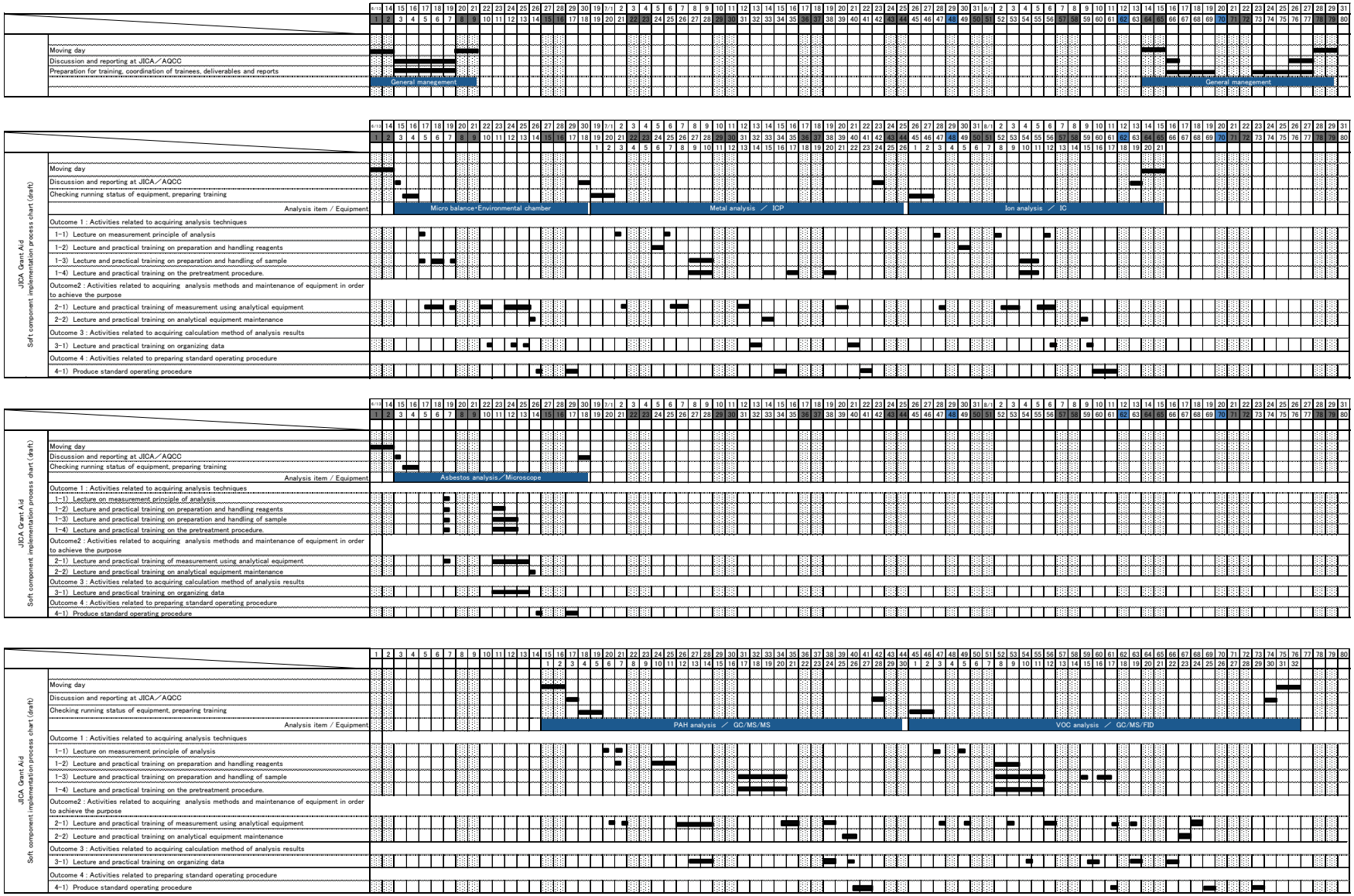
- Equipment such as pretreatment equipment, pure water making equipment, dryer, refrigerator (refrigerator facility), general balance, ultrasonic cleaner device, hot plate, pH meter, laboratory bench, standard reagents, general reagents, high purity gases for analytical equipment, glassware, filter paper, consumable items, and etc. those needed for chemical analysis laboratory should be installed.

- Procurement of sampling equipment (VOC, PAH)

- Procure at least 20 of VOC sampling tubes (Tenax).

- Preparation of at least 3 samples for analysis training (asbestos, ion, inorganic, PAH, and VOC analysis)
- Personnel will be continually allocated for the chemical analysis laboratory.
- Revision of standard operating procedures (SOPs), when it is necessary.
- Continue on human resource development for the above activities.

Table 21 Plan of Implementation Process



Appendix 6. Other Relevant Data (if applicable)

None

Appendix 7. References

No.	Title	Type	Issued by	Date
1	Report of the Fact-Finding Mission on Air Pollution Control in Tehran Municipality (in Japanese)	Digital Data	JICA	2015
2	Report of the Detailed Planning Survey for Project for Capacity Development on Air Pollution Control in Tehran Municipality (in Japanese)	Digital Data	JICA	2015
3	AQCC Company Statute	Digital Data	AQCC	1993
4	Tehran Annual Air Quality Report - Period of March 2015 – March 2016	Digital Data	AQCC	2016
5	The Results of Second Fifth Year Action Plan (2014-2018) in the field of Traffic & Transportation	Digital Data	Tehran Municipality	2016
6	Human's Environmental Laws, Regulation, Criteria and Standards	Digital Data	DOE-TPD	2016
7	Diesel Engine Test Cell Project Report 1: Test Cell Instruments Technical Specification Report 2: Test Cell Technical Data Report 3: Lab 3D View	Digital Data	Dina Electronics	2015
8	Diesel Engine Test Cell Project – Technical details of the Test Cell equipments	Digital Data	Dina Electronics	2015
9	Diesel Engine Test Cell – Design and Construction	Digital Data	Azmoon Sanat Arvin	2016
10	List of Air Quality Monitoring Station in Teheran (monitored by DOE-Teheran)	Digital Data	DOE-TPD	2016
11	Gasoline & Diesel Quality Impacts on Light & Heavy Duty Vehicles's Pollutants Emissions	Digital Data	AQCC	2013
12	DPF installation and monitoring	Digital Data	AQCC	2015
13	Research & Test Center (Power Point presentation of the Center)	Digital Data	ISQI	2016