Arab Republic of Egypt
Egyptian Natural Gas Holding Company

Environmental and Social Impact Assessment Framework for Greater Cairo Natural Gas Connections Project

Executive Summary

27 September 2007

EcoConServ ENVIRONMENTAL SOLUTIONS

LIST OF ACRONYMS AND ABBREVIATIONS

ALARP	As Low As Reasonably Practical
AST	Above-ground Storage Tank
CULTNAT	Center for Documentation Of Cultural and Natural Heritage
CAPMAS	Central Agency for Public Mobilization and Statistics
EDHS	Egyptian Demographic and Health Survey
EEAA	Egyptian Environmental Affairs Agency
EGAS	Egyptian Natural Gas Holding Company
ESDV	Emergency Shut Down Valve
ESIAF	Environmental and Social Impact Assessment Framework
ESMMF	Environmental and Social Management and Monitoring Framework
FGD	Focus Group Discussion
HDR	Human Development Report
HP	High Pressure
HSE	Health Safety and Environment
IGEM	Institute of Gas Engineers and Managers
GASCO	Egyptian Natural Gas Company
GCR	Greater Cairo Region
LPG	Liquefied Petroleum Gas
LFL	Lower Flammable Limit
LP	Low Pressure
MOSEA	Ministry of State for Environmental Affairs
MSDS	Material Safety Data Sheet
NG	Natural Gas
NGO	Non-Governmental Organizations
PE	Poly Ethylene
PPM	Parts Per Million
PRS	Pressure Reduction Station
PSV	Pressure Safety Valve
QRA	Quantitative Risk Assessment

RAP	Resettlement Action Plan
RPF	Resettlement Policy Framework
SFD	Social Fund for Development
Town Gas	The Egyptian Company for Natural Gas Distribution for Cities
UNDP	United Nations Development Programme
UFL	Upper Flammable Limit
UST	Underground Storage Tank
WB	The World Bank
$	United States Dollars

Exchange Rate: $ / L.E. = 5.68 as of 19 April 2007

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1. Preamble

This executive summary is aimed at presenting the main findings of the Environmental and Social Impact Assessment Framework (ESIAF) for the Greater Cairo Natural Gas Connections Project. For a more thorough review of baseline data and of relevant environmental and social issues within the project areas, the reader is referred to four main reports, the Environmental and Social Impact Assessment Framework (ESIAF), the Quantitative Risk Assessment (QRA) , the Resettlement Policy Framework (RPF) and the Socioeconomic Condition and Willingness to Pay (WTP).

The project shall be implemented by the Egyptian Natural Gas Holding Company (EGAS) and its affiliate company, the Egyptian Company for Natural Gas Distribution for Cities (Town Gas), with the Assistance of the World Bank. The Project would support the Government's ongoing program to expand the access to piped natural gas in the Greater Cairo area where the feasibility study prepared by Town Gas has estimated that approximately 2 million households can be connected to the network over the next 6 years. This number has been determined based on criteria established for suitability of connections, taking into account issues related to safety and structural integrity of buildings. The rationale for the Government's program is to replace the consumption of the relatively more expensive Liquefied Petroleum Gas (LPG), which to a large extent is imported, with the relatively cheaper piped natural gas, which in addition to reducing the energy sector subsidy burden will also provide consumers with greater safety through the extensive regulation of this product as well as enhanced convenience.

Due to the nature and extensive geographic coverage of the proposed project and the uncertainty as to the exact roll-out of the consumer connections and some of the associated network infrastructure, an Environmental and Social Impact Assessment Framework (ESIAF) rather than a detailed Impact Assessment has been prepared. The aim of the ESIAF is to provide an overview of the anticipated environmental and social safeguard issues related to natural gas distribution and connections to households in the Greater Cairo Area; and to develop environmental guidelines to be followed for the subsequent gradual phased implementation of the Project. The specific objectives of the ESIAF are to:

- Assess the potential environmental and social impacts of the project in the project areas;
- Compare the impacts in relation to relevant national and international requirements and guidelines;
- Assess the environmental and safety guidelines typically practiced in the gas connection activities in Egypt, including the codes of safety and standards of operation used by EGAS and Town Gas;
- Develop an environmental and social management and monitoring framework for the mitigation of the potentially negative impacts and for monitoring compliance with the relevant environmental laws; and
- Assess the institutional capacity of the implementing agency and recommend measures for capacity building.

It should be noted that there was a possibility for the extension of the project to also include the Governorate of Alexandria which is served by the same implementing agencies, namely EGAS and Town Gas. Eventually EGAS decided not to include the Governorate of Alexandria.

The ESIAF has been prepared by a consortium of independent environmental and social consultants from EcoConServ Environmental Solutions, with guidance from Petroleum Safety and Environmental Services Co. (PETROSAFE) with regards to safety aspects pertaining to the operation of Pressure Reduction Stations (PRS).

2. Project Objectives and Description

2.1 Project Objectives

The proposed project is as an integral part of the country energy strategy which calls for greater use of natural gas and a reduction in government energy subsidies. It will contribute to achieving the Government plan for extending natural gas connections in the country through the coming 6 years. The following results are envisaged from the project:

- Doubling the number of inhabitants in Greater Cairo connected to natural gas services by connecting 2 million customers by year 2012;
- Covering wider areas and new developments of Greater Cairo;
- Achieving more stability of energy access to the targeted customers in Greater Cairo; and
- Achieving savings of about 1.6 million tons of LPG consumption by year 2012.

2.2 Project Components

The project will comprise adding reinforcement in about 40 km in the existing transmission mains (70 and 30 Bar) surrounding Greater Cairo, establishing five new (PRS) with addition of odorant in five of them, establishing distribution network of different pressures (7-0.1 bar) and gate regulators, establishing connections to residential units (at no more than 0.1 bar) and conversion of home appliances for preparing them to receive natural gas.

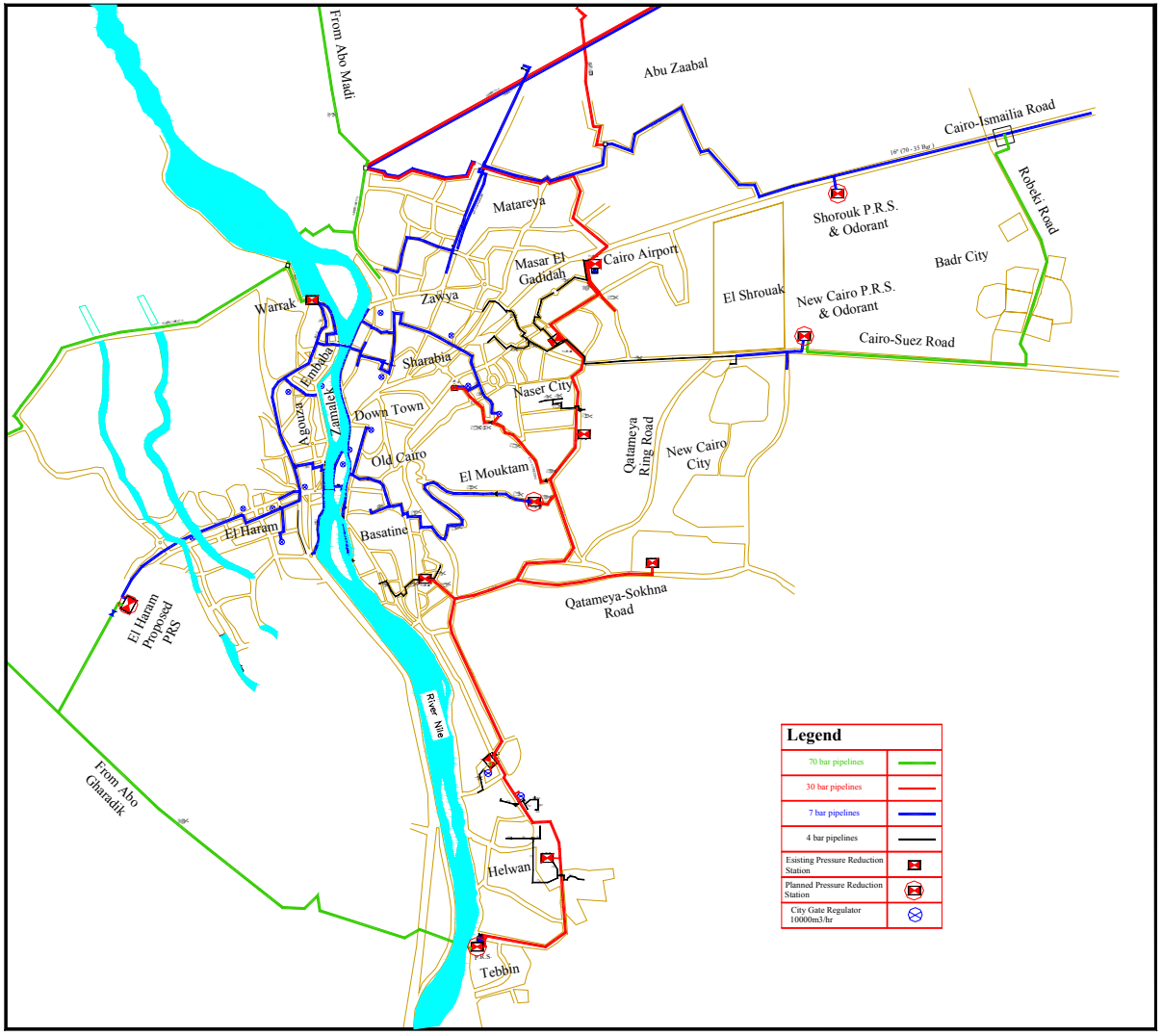
To enable the connections, significant upfront network investment is required. As such, network development and connections in household premises happen simultaneously across the targeted project area (Greater Cairo). Therefore, although the main features of the project has been identified; details of pipeline routings, exact locations of Pressure Reducing Stations, except one PRS, and city head regulators have not been confirmed at this stage. Such details will be completed during the course of implementation of the project. Furthermore, while a roll-out plan exists for the 2 million consumers, in reality the progress will vary depending on the status of contracts signed with customers. Nevertheless, over the proposed timeframe, the 2 million customers will be connected to the piped gas network.

The network shall be designed according to the standards of the Institute of Gas Engineers and Managers (IGEM) of the UK.

2.3 Covered Areas by the Project

About 1.8 million inhabitants of Greater Cairo are already connected to the natural gas network. The service has started in many districts of the city since early 1990s. Figure 2-1 illustrates the high pressure transmission mains surrounding Greater Cairo, main components of the existing network and proposed approximate locations of the new PRSs.

Figure 2-1: Natural Gas Network in Greater Cairo



The project will cover 28 districts in Cairo and Giza Governorates. The project will introduce the service in new areas which have not been connected before, and shall further extend the network in areas which are partially covered. Table 2-1 and Figure 2-2 below illustrate the coverage plan of the project.

During an initial survey of the areas, an attempt had been made to categorize the properties based on experience gained in the previous projects in Greater Cairo. The categories are:

- Category "I" Good condition and easily accessible single storey dwellings and flats: comprising Villas ranging in consumption from $1m^3$/hr to $40m^3$/hr, depending on the existence of swimming pools, boilers, in addition to the conventional types (cooker), etc. Eg. New Cairo.
- Category "II" Flats and other dwellings of a reasonable standard in areas with reasonable access: Rate of consumption from 0.1 to 0.4 m^3/hr. Areas: El Maadi, Masr El Gededa, Down Town, Nasr City, Faisal, El Haram, El Abbasia.

  Category III" Poor housing with possible access problems and likelihood of structural problems: Rate of consumption from 0.1 to 0.25 m^3/hr. Areas: El Wayly, El Zawya El Hammra, El Matria, Ein Shams, Dar El Sallam, Basateen, El Sharabia, Omrania, El Moneeb, Sakyet Meky, Bolak, Embaba, El Waraak.

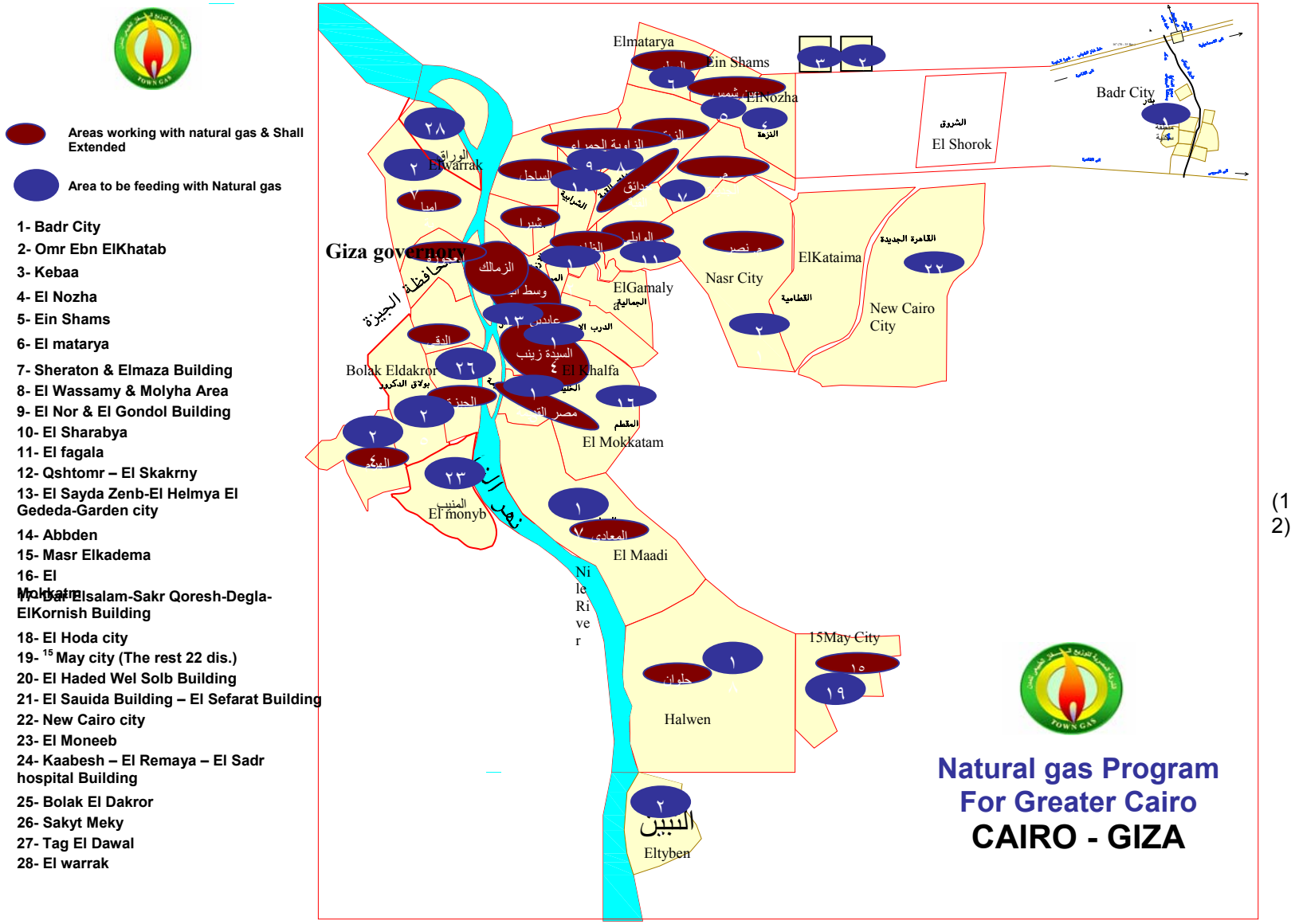
It is worth noting that areas where weak structures exist are classified by Town Gas as "no gas area" to avoid possible structural problems associated with establishing the network.

Table 2-1: Coverage Plan for Natural Gas Connections Project in Greater Cairo

Governorate	Area	1st year (1,000 clients)	2nd year (1,000 clients)	3rd year (1,000 clients)	4th year (1,000 clients)	5th year (1,000 clients)	6th year (1,000 clients)	Total (1,000 client)
Cairo	El Maadi	17	9	8	6	5	5	50
	Helwan	15	13	13	13	13	13	80
	Masr El Gededa	10	10	10	10	10	10	60
	El Abassia	8	8	8	8	8	8	48
	MiddleTown and Old Cairo	15	15	15	15	15	15	90
	El Wayly	9	9	8	8	8	8	50
	Nasr City	15	15	15	15	15	15	90
	El Zawya El Hammra	15	15	15	15	15	15	90
	El Matria & Ein Shams	15	15	15	15	15	15	90
	New Cairo	35	35	35	35	35	35	210
	Dar El Salam & Basateen	35	35	35	35	35	35	210
	El Sharabia	Infra Structure	25	25	25	25	25	125
	Bader City	0	0	Infra Structure	Infra Structure	15	15	30
	El Mokatam	0	25	25	25	25	25	125
	El Shorouk	Infra Structure	8	8	8	8	8	40
Total of Cairo		189	237	235	233	247	247	1388
Giza	Faisal & El Haram	15	15	15	15	15	15	90
	Omrania	12	12	12	12	12	12	72
	El Moneeb	Infra Structure	15	15	14	14	14	72
	Sakyet Meky	8	8	8	8	8	8	48
	Bolak El Dakror	Infra Structure	18	18	18	18	18	90
	Embaba	10	10	10	10	10	10	60
	El Warrak	Infra Structure	Infra Structure	15	15	15	15	60
Total of Giza		45	78	93	92	92	92	492
	Total of Project	234	315	328	325	339	339	1880
	In Fill Total	20	20	20	20	20	20	120
Total of Plan		254	335	348	345	359	359	2000

Accessibility issues, associated traffic congestions, and the possibility of having structural problems have been addressed in the Environmental and Social Management and Monitoring Framework (ESMMF), and are detailed later in Section 6.

Figure 2-2: Districts Covered by the Project



(1
2)

Although the exact location of four of the new PRSs are not yet settled, it has been already confirmed that they will be located in El Haram, New Cairo, El Mokatam and El Shorouk districts. Town Gas has submitted requests to local authorities for allocating locations in each in these districts; however site allocation has not been finalized as of the preparation of this study. For the first four PRSs, Ranges of 1-3 km in desert roads, and the ring road, for each PRS location are presented to local authorities to select 50 x 50m areas for each PRS. All these ranges are in unpopulated areas.

The location of the fifth PRS, in Tebbin district shall be within an existing gas complex, which already includes an operating PRS operated by GASCO. The Tebbin location is the only location in a relatively populated area. The proposed site has a house located adjacent to its southern border.

2.4 Estimated Costs

The total program for connecting the 2 million prospective customers is estimated to cost US$921 million, of which material costs amount to about US$480 million, and the remainder is the contribution of the customers to connect (i.e., the connection charge). The World Bank has been requested to finance about US$400 million, reflecting a large share of the material costs.

2.5 Description of Preconstruction and Construction Phase

2.5.1 Planning and system design approach

Accurate maps of covered areas are obtained in order to collect sufficient information for reaching optimum design of the system. Surveying works may be carried out at a number of locations where maps are outdated or do not include recent developments. Routes and depths of existing underground infrastructure are obtained from different authorities (water lines, sewage lines, telecommunication lines, and electric cables), however, in some cases accurate mapping is lacking for underground infrastructure; and as such, trial pits are manually excavated to locate underground pipes in the field.

After design of the network, the contractor prepares a phased plan to construct the lines in coordination with Town Gas. This plan splits covered areas to "Sectors"; each sector normally contains about 5,000 customers, in about a 15-20 km length of the distribution mains.

2.5.2 Mobilization of equipment, materials and workers

According to the approved phased implementation plan, the contractor mobilizes the required construction equipment and materials. The contractor normally occupies a location for storing materials and equipment in the active "Sector", which is a location to be approved by the local authority. These storage locations include:

- Excavation machinery, eg., trenchers, backhoe excavators, jack hammers, loaders, cranes, manual tools, etc.
- Piping materials, eg., such as pipes, valves, elbows, coating materials.

- Stockpiles of sand and filling materials.
- Repair machinery, eg., compaction machinery, asphalt laying, concrete mixers, etc.
- Management caravan for the site engineers and staff.

The project will be in Greater Cairo, and therefore there will be no need for workers' camps, as the workers are expected to be from the city.

2.5.3 Construction under normal conditions

Prior to excavation works, pipeline routes shall be identified and marked in the field. Excavation works start by removing the asphalt layer using either a mechanical trencher or a jack hammer. The mechanical trencher also removes broken asphalt and base stones layer; and in case the jack hammer is used, road layers are then removed by an excavator.

The road base soil, underneath asphalt and stones, is then excavated either by a backhoe excavator or by manual excavation. The advantage of manual excavation is that it reduces the risks of breaking water, sewerage, electric or telecommunication lines which are unmapped. Typically the trench is 0.4 - 0.8m wide, and about 1.0 - 1.5m deep, depending on pipe material and diameter[1].

Excavated soils, broken asphalt and other waste materials during excavation are then loaded onto trucks, which transfer the waste to disposal areas. Due to the limited available space on Cairo streets, loading waste trucks are done upon excavation, whenever possible, in order to avoid stockpiling waste on site.

In some cases, where the groundwater table is shallow, the trench is dewatered before pipe laying. Dewatering pumps discharge pumped water into a drain or sewer manhole, according to area conditions.

After laying and welding the pipes in the trench, the pipes are surrounded with sand in order to absorb loads from the road. The sand should be effectively compacted in the trench in order to avoid road settlements, and subsequent cracks.

Before excavation, the Traffic Department gives conditional permission specifying the time that the traffic should be back to pre-excavation rates. In normal cases, daily construction works, for a pipe stretch of 350 - 400 m, starts at early morning and ends by full road repair the following morning. In some traffic crossings and main roads, the road is repaired within the same day, and some times night work is required.

Most of underground infrastructure in Greater Cairo has been established a long time ago, without accurate documentation for its routes and depths. Therefore, usually the excavation contractor is not aware of the exact locations of such pipes, and accordingly the risk of breaking infrastructure lines is relatively high. Normally the contractor takes

[1] There should be 1 meter sand cover above the pipe

caution by applying manual excavation to avoid such situations where he is obliged to pay for the damage.

If a line break occurs, the site manager gives immediate notification to the Police Department and the respective authority (according to the type of broken pipe). The authority then starts repairing the line as soon as possible, and later claims repair costs back from the contractor.

2.5.4 Special crossings

Vertical excavation could not be practiced when the natural gas line intersects with a waterway, a railway or a major road. Therefore a special crossing for such obstacles has to be made. This special crossing is made through tunneling, using suitable techniques such as Tunnel Boring Machines and micro tunneling. Excavation waste management is practiced in a similar way described earlier. However, crossing waterways usually results in relatively large amounts of water discharging out of the tunnel, which makes it necessary to pre-plan for drainage works.

Sometimes special crossings are done through existing bridges, which will only require fixing the line to the existing bridge.

2.5.5 Testing

After the line has been constructed, it should be tested to locate possible leaks. The testing could be done either through hydrostatic testing, or through air-gas testing. In the former, the pipe is filled with water and then pressurized to the desired level, along with pressure testing at different locations to detect leaks, after which water is drained. In the latter, air, or an inert gas, is used instead of water.

The former process is normally more complicated than the latter, because it needs highly efficient water drainage. This drainage takes place by the "pigging process", which includes forcing an object, the "pig", through the pipe by liquid or air pressure to totally drain the line before NG is fed.

2.5.6 Connections

Upon testing the line, connections to the dwellings commence. The connection starts from the main and goes across the road to the dwelling on both sides. At the edge of the building, a riser feeds different laterals which ends at the customer gas meter then to different home appliances.

Fixing the connections require earthworks perpendicular to the road. This will require blocking of the road, in the case of small roads having parallel alternatives; or executing staged excavation, in the case of main roads or small roads that are without parallel alternatives.

2.5.7 Conversion

Conversion is done for some home appliances by taking measures to safeguard against different pressures and calorific value of natural gas in comparison with LPG. Conversion works are practiced at the client's flat, by changing the injectors' properties of the appliance.

2.5.8 Construction works for PRSs and regulators

Constructing Pressure Reduction Stations and City Head Regulators are regular construction works in addition to connections between transmission mains and distribution mains. The PRS comprises two types of pressures, the first is the upstream pressure, which is a high pressure ranging from 30 to 70 Bar, while the second pressure is the down stream pressure, which is a low pressure ranging from 4 to 7 Bar.

2.6 Description of Operation Phase

2.6.1 PRS Operation

The PRS include seven main stages: inlet, filtration, heating, reduction, measuring, odorizing and outlet.

2.6.1.1 Inlet stage

The inlet parts of the PRS should be completely isolated from the cathodic system applied to the feeding steel pipes. This is achieved by installing an isolating joint with protection. The inlet stage includes the main station valve which could be controlled both locally and remotely for shutting off the PRS in case of emergencies.

2.6.1.2 Filtration stage

The aim of the filtration stage is to remove dust, rust, solid contaminants and liquid traces. Two filters and two separators are installed in parallel; each filter-separator operates with the full capacity of the PRS. During the operation of filter-separator line the other line is kept on standby. Filter-separator lines are equipped with safety devices such as differential pressure gauges, relief valves, liquid indicators, etc.

2.6.1.3 Heating stage

Because the difference between the inlet and outlet pressure is relatively high, icing normally occurs around outlet pipes. This may cause blockings and accordingly reduce or stop the gas flow. To avoid such circumstances, a heater is installed to keep the temperature of outlet pipes over 7°C. Each PRS is equipped with two heaters in parallel to allow for a standby heater in emergencies.

2.6.1.4 Reduction stage

Each PRS includes two reduction lines in parallel (to allow for a standby line). The lines are equipped with safety gauges, indicators and transmitters to maintain safe operation conditions. According to the IGEM standards, a reduction unit should be installed in a well ventilated-closed area or, alternatively, in an open protected area.

2.6.1.5 Measuring stage

After adjusting the outlet pressure, gas flow and cumulative consumption are then measured, to monitor NG consumption from the PRS and to adjust the dosing of the odorant as indicated below. Measuring devices should be sensitive to low gas flow, which normally occurs during the first stages after connecting a small portion of targeted clients.

2.6.1.6 Odorizing stage

The objective of the odorant is to enable the detection of gas leaks in residential units, at low concentration, before gas concentration becomes hazardous. The normally used odorant is formed from Tertiobutylmercaptin (80%) and Methylehylsulphide (20%). The normal dosing rate of the odorant is 12-24 mg/cm^3. The system will consist of a stainless steel storage tank, receives the odorant from 200-liter drums, injection pumps and associated safety devices. Operation of the odorant unit is controlled automatically, and could be switched to manual operation if needed.

2.6.1.7 Outlet stage

The outlet stage includes the outlet valve gauge, temperature indicators, pressure and temperature transmitters and non-return valves. The outlet pipes are also, as inlet pipes, isolated from cathodic protection by an isolating joint.

2.6.2 Repairs and replacement of the network

In case of leak detection, or damage of part of the network, the damaged pipe is replaced. The following procedures are usually followed:

- Stopping leaking line
- Excavating above the effected part (in case of distribution main or underground installation line)
- Venting the line
- Removing affected pipe
- Replacing effecting part and welding it at both ends
- Filling and road repair

2.6.3 Repairs in residential units

Normally repairs in residential units require making some adjustments in the home appliances, or changing in-house leaking connections. Same detection/replacing process described earlier are normally followed, in addition to possible adjustments of gas flow inside appliances.

3. Legislative and Regulatory Consideration

3.1 Applicable Environmental and Social Legislation in Egypt

3.1.1 Law 217/1980 for Natural Gas

The law organizes supply and connections of natural gas in residential areas, industrial areas and power plants. The law gives the Egyptian General Petroleum Corporation, together with one of the Petroleum Public Sector companies the responsibility for making the natural gas supply. The Law stipulates the following safeguards, which should be followed, during installation of natural gas in residential areas:

- The entity responsible for natural gas connections should undertake these connections in a manner that should not effect the safety of the connected building, its occupants or other parties. If such connections resulted in any damage to the building owner or occupant he should be subject to compensation (Article 2).
- All natural gas pipelines and structures should be established on state-owned land without payment of any duties (Article 2)
- It is not allowed for the entity in charge of licensing buildings to grant license for buildings, or for amendments of existing building, in which they are connected with natural gas, without approval from the entity responsible for natural gas connections. Violation of this article may lead to a change of the ownership of the violating building to be publicly owned (Article 3 and 4).
- It is not allowed to undertake excavation, building, demolition, pavement or any maintenance works in roads, squares and areas decided upon to be connected with natural gas, except in coordination with the entity responsible for natural gas connections. The entity responsible for natural gas connections is authorized to remove violations and claim associated removal costs from the violator (Article 5).

3.1.2 Law 4/1994 for the Environment

The Law for the Environment, and its Executive Regulations Decree 338/1995 modified by Ministerial Decree 1741/2005, is the key legislation governing environmental protection in Egypt. The law includes articles that govern the following environmental aspects, which apply to the project:

- Processing of Environmental Impact Assessment for development projects, as a step in the licensing procedure.
- Handling of hazardous substances and wastes, such as the odorant agent used in Pressure Reducing Stations (PRSs). Empty containers of such substances are classified as hazardous waste.
- Limits for noise levels in working environment apply to excavation/construction activities in the project, and the ambient noise levels in different locations apply to areas near construction works of the project, and areas surrounding PRS locations.

- Protection of the air environment from pollution. The Executive Regulations of the law have determined maximum concentrations of air pollutants in ambient air, and standards for emissions from fuel machinery, which are applicable to excavation machinery (eg., trenchers, excavators).
- Controlling excavation works and corresponding waste disposal. There should be safeguards against air pollution during production, storage and transportation of excavation/construction waste.

3.1.3 Law 38/1967 for General Cleanliness

The conditions mentioned in the previous Section are also mentioned in Law 38/1967 for General Cleanliness and its Executive Regulations.

3.1.4 Law 93/1962 for Wastewater

Law 93/1962 regulates the disposal of wastewater, and liquids in general, to the sewerage network. The law applies to the project in two main aspects:

- In case of damage caused to the sewerage network during excavation; and
- In case dewatered water from excavated trenches is discharged to the sewerage network.

3.1.5 Law 48/1982 for Protection of the River Nile and Watercourses

Articles 2 and 3 of the Executive Regulations of Law 48/1982 states that it is forbidden to use the banks of watercourses for storage of waste or materials that could be dispersed, chemicals or toxic materials except in areas licensed from the Ministry of Irrigation and Water Resources. These articles may be most relevant for sites near the Nile/water courses, and sites were the pipeline will be laid by tunneling watercourses, in addition to excavation waste, lubricating oils, or chemicals used in tunneling equipment.

3.1.6 Law 117/1983 for Protection of Antiquities

The law defines antiquities as "each structure or movable object produced by different civilizations". The definition includes productions of arts, science, literature and religions from ancient ages upto 100 years ago. The definition also includes human corpses, and species from the same age, which have remained from ancient ages. All discovered antiquities are registered by Decrees of the Minister of Culture; this registration implies certain standards and precautions. Law 117/1983 Standards that are applicable to the project are:

- It is not allowed to demolish all or parts of antiquity structures, renovate or change the structure features (Article 13);
- The Minister of Culture identifies beautification zones surrounding antiquity sites. These beautification zones are considered part of the site, and it is not allowed to construct or excavate or plant trees inside these zones (Articles 19 and 20); and
- Any person who finds a movable antiquity, or parts of an antiquity structure, should notify the nearest administrative authority within 24 hours and should keep

the antiquity in its discovered status. The antiquity becomes the State's property (Article 24).

3.2 World Bank Guidelines and Safeguard Policies

The World Bank (WB) has identified 10 environmental and social safeguard policies that should be considered in its financed projects. The objective of these policies is to prevent and mitigate undue harm to people and their environment in the development process. Following are the policies which could be triggered by the project activities.

3.2.1 OP 4.01 – Environmental Assessment

According to the World Bank Operational Policy OP 4.01, the Natural Gas Connection Project in Greater Cairo is classified among Category A projects. Projects under this Category are likely to have significant adverse environmental impacts that are sensitive[2], diverse, or unprecedented.

The environmental impacts that are likely to be caused by the project shall be analyzed in this study. Mitigation measures shall be identified for all expected negative impacts, along with an Environmental Management and Monitoring Framework presenting mechanisms for implementation of these mitigation measures.

3.2.2 OP 4.11 – Physical Cultural Resources

Greater Cairo includes many sites, buildings and monuments that fall under the definition of Physical Cultural Resources[3]. Because the project will include significant excavations in many parts of Greater Cairo, which may be near sites of cultural value, there have been specific attention in this study to identify locations of such sites, and to develop mitigation measures for controlling effects on such sites. These mitigation measures are also reflected in the Environmental Management and Monitoring Framework.

3.2.3 OP 4.12 – Involuntary Resettlement

According to the WB's safeguard policy on Involuntary Resettlement, physical and economic dislocation resulting from WB funded developmental projects or sub-projects should be avoided or minimized as much as possible. Unavoidable displacement should involve the preparation and implementation of a Resettlement Action Plan (RAP) or a Resettlement Policy Framework (RPF)[4], to address the direct economic and social

[2] A potential impact is considered "sensitive" if it may be irreversible (e.g., lead to loss of a major natural habitat) or raise issues covered by OP 4.10, *Indigenous Peoples*; OP 4.04, *Natural Habitats*; OP 4.11, *Physical Cultural Resources*; or OP 4.12, *Involuntary Resettlement*.

[3] Physical Cultural Resources are defined as movable or immovable objects, sites, structures, groups of structures, and natural features, and landscapes that have archeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance.

[4] The RAP requires detailed knowledge about concerned interventions, while the RPF outlines overall resettlement objectives and principles

impacts resulting from the project or sub-project's activities causing involuntary resettlement.

It is not envisaged that the project at hand will result in the physical or economic dislocation of people. However, an RPF have been prepared in order to outline a proposed approach and workplan to guide the implementation, handover, and monitoring and evaluation of the resettlement process, in case OP 4.12 is triggered at any point.

4. Potentially Significant Environmental and Social Impacts

4.1 Positive Impacts

Achieving the project objectives will yield many social, economic and environmental benefits, and will help in meeting the targets of the overall Energy Strategy for the country.

Among the social benefits that could be achieved by the project during the construction phase are:

- Provide job opportunities to semi-skilled and unskilled laborers. Those are mostly poor people and their living conditions are harsh. The project could of a major importance to them, since it could be a main source of income during the construction phase.
- Achieve benefits to owners of cafés and small restaurants in the project areas from providing services to the construction workers.

Moreover, there will be numerous benefits accruing to the society from the project during the operation phase, some of which are:

- From a safety standpoint, using natural gas at residential areas is much safer than the use of LPG cylinders, due to the reduced risk of fire accidents.
- No threats of harmful behavior from gas cylinder distributors who enter homes to change the cylinders.
- Avoid contamination with insects and dirt which are normally associated with LPG cylinders.
- NG is available around the clock, which eliminates inconvenience caused when the LPG runs out during use
- Avoid noise associated with LPG cylinder distributors
- Reduce LPG cylinders' prices in the city, which shall be to the benefit of poor people who are not connected to NG
- Reduce child labor in gas cylinders' distribution.
- Minimizes difficulties of getting gas cylinders for handicapped people, women and elderly people.

The project shall also result in some environmental benefits, such as:

- Reducing exhaust emissions and dust generated from LPG trucks,
- Reducing traffic of such vehicles,

- Reducing consumption of fossil fuel by such vehicles, and
- Reducing environmental impacts associated with production and storage facilities of LPG cylinders.

4.2 Potentially Negative Impacts during Construction

By analyzing project activities during the construction phase, the most significant negative impacts that may be encountered are:

- Reduction of traffic flow
- Air Emissions
- Noise
- Risk to infrastructure
- Effects on some structures
- Effects on culturally valuable sites
- Waste Disposal

An Environmental and Social Management and Monitoring Framework (ESMMF) has been formulated to mitigate these impacts. The proposed mitigation measures are presented in Section 6.

4.2.1 Reduction of Traffic Flow

The installation of the natural gas network is bound to affect the traffic operations during construction. The construction will entail narrowing major roads by longitudinal and/or lateral excavation. Either method will produce different levels of impact on the major road network.

The narrowing of the road will reduce the number of traffic lanes available for traffic movement and will also entail the prohibition of on-street parking along the length of the road works. The narrowing may reduce the right-lane either partially or totally. In either case, traffic will shy away from the construction side and encroach with traffic in the adjacent lanes. Below is a summary of the major impacts on the arterial roads and local street systems. Mitigations measures to minimize traffic impacts are presented in Section 6.

4.2.1.1 Impacts on Arterial Road System

The arterial road network carries the highest traffic volume in the Greater Cairo Region (GCR) road system. A direct result of the construction works would be the reduction in the average travel speed on these roads. Although it is difficult to quantify such an effect without a detailed study, an approximation would be by using a hypothetical reduced number of lanes. For instance, if the construction work is carried out along Gesr El Suez Street, it is envisaged that the road capacity would be reduced by a nominal 25% and the volume-to-capacity ratio would be reduced to 0.93, i.e. capacity conditions. A similar exercise can be carried out for the remaining roads. The conclusion is that the level of service would be reduced at least one level.

The lateral excavation is bound to produce similar effect, however at only one section of the road. This method of construction entails the closure of a lane or more at a point along the road. In addition, as drivers approach such a construction site, would tend to change their lanes prior to site and adjust their speed to that of the traffic in the adjacent lanes, which causes more disturbances to traffic.

4.2.1.2 Impacts on Local Street System

By definition, the local street network carries the lowest traffic volume. Average travel speeds on these streets are as low as 15-20 km/hr. Disruptions to traffic due to the construction would be different from those for arterial roads. The local streets are narrow in width. The lateral excavation would mean almost blocking a direction. Therefore, traffic in both directions would be using one lane only. Opposing traffic (although little) can block the street if they arrive at the same time. Therefore, the level of service in this case will depend primarily on the judgment of each driver as to the best way to avoid blocking the street. In any case, lesser impact is envisaged on the local road network since they are considered low volume roads that are expected to use these streets at low speeds.

4.2.2 Air Emissions

Air emissions during construction will arise from:

- Excavation / backfilling operations which generates suspended particles
- Dispersion from stockpiles of waste or sand used for filling trenches
- Exhaust from excavation vehicles (excavators, trenchers, loaders, trucks) containing SO_x, NO_x, CO, VOCs … etc.

The effects of such impacts are expected to be local and short term; especially that soil stockpiling is normally minimal at the site, and is normally filled within the same day.

Another indirect source of air emissions is the traffic congestions that may occur. Air emissions from vehicles are usually effected by different modes of traffic, including traffic congestions. This was the conclusion of a study undertaken by the Ministry of State for Environmental Affairs (MOSEA) which covered three districts of Greater Cairo, aiming at correlating traffic density variation, traffic congestion and traffic flow to concentration of certain air pollutants.

The study was undertaken in 2001[5] by recording readings of El Kollaly, El Gomhoreya St. and Fom El Khalig air quality monitoring stations during certain traffic modes. The results of the study have been summarized in the following points, relevant to traffic congestions:

- When the traffic was standing, due to traffic jams, very high CO concentrations and relatively low SO_2 concentrations were recorded

[5] Source: Website of EEAA, EIMP programme (http://www.eeaa.gov.eg/eimp/impactfromtraffic.html)

- When the traffic moves with high speed the lower CO concentrations are recorded. Also relatively high PM_{10} concentrations have been recorded probably due to the effect of re-suspension of particles in streets by moving vehicles.

4.2.3 Noise

Construction activities will increase noise levels caused by excavation machinery. Construction noise varies from increase of noise intensity due to engine operation, and intermittent impacts which may take place during demolition of asphalt, either by a trencher or by a jack hammer.

The effects on construction labor are considered more significant, because they are exposed to high levels of noise for relatively longer periods. Residents of neighboring areas are the second level recipients of elevated noise levels, as the noise intensity will be relatively attenuated at their locations.

Traffic congestions, which could be caused by excavation works, also have effects on noise levels in the area, which may increase ambient average noise intensity levels.

4.2.4 Risk on Infrastructure

Most of underground infrastructure pipeline (such as water, sewerage and telecommunication) in Greater Cairo has been established long time ago, without accurate documentation for its routes and depths. Therefore, the risk of breaking infrastructure lines is relatively high. Normally the contractor applies manual excavation to avoid such situations where he is obliged to pay for the damage.

The most important environmental impact will arise in the case of breaking a sewerage pipe, where wastewater accumulates in the trench and, possibly, flood onto the streets causing significant nuisance to the surrounding environment.

Breakage of a water supply pipe may result in cutting the supply to a number of residential units, which may, if it is not repaired for a long period, direct residents to use other sources of water which may either be expensive or unsafe.

The effects of cutting telecommunication cables during excavation are mainly socioeconomic, due to cutting possible business communications.

4.2.5 Effects on Some Structures

Weak and old structures are very sensitive to differential settlements, which could be caused, mainly, by dewatering.

Excavation for natural gas pipelines is usually shallow and does not exceed 1.0 meter depth. In very few areas in Greater Cairo, ground water depth may be less than that. If groundwater was not encountered during excavation of normal trenches there will be no

effects. In case of groundwater being encountered and dewatering is applied, there might be effects if the dewatering was sustained for long duration. Dewatering in silty and sandy soils can move fine soil particles and wash it away through the surface pump, which creates voids and spaces in the soil surrounding the excavation and the nearby buildings.

It is worth noting that areas/sectors where weak structures exist are classified as "no gas area" by Town Gas to avoid such problems. Therefore the risks of causing damage to buildings are well considered and avoided by the normal construction procedures of Town Gas.

Another relatively minor risk which could be encountered is weakening of the structural system during drilling holes in the walls for house connections. Usually, wall drilling in load bearing masonry walls does not have an effect on the structural system. The walls with their long sections provide a large carrying capacity. The hole drilled for the pipe usually is very small compared to the wall section. Moreover, the beams of the flooring system are small and can easily be avoided by measuring the level of the drilling with respect to the ceiling. For skeleton type buildings, drilling in columns or beams could have significant effects on the structure; however, it is believed that this risk is well understood among connection workers and could be avoided.

4.2.6 Effect on Culturally Valuable Sites

The effects on culturally valuable sites could take place according to the following reasons:

- Causing structural damage to a monument due to possible dewatering during excavation;
- Causing effects on a monument's foundations due to excavation works;
- Causing damage to the monument's body by vibration of machinery;
- Reducing the aesthetic value of the site; and
- Improper management of discovered antiquities during excavation.

The first aspect has been discussed in the previous Section. Dewatering could cause differential settlement to the monument's structure, which poses risks to its structural integrity. This could be more applicable if the groundwater table was reduced under the foundation level.

In the second aspect, the foundation of the monument could be affected if excavation works were close to the foundation, and the foundation level is relatively shallow. This could also cause deferential settlement and may cause cracks and stability risks to the monument's body.

The third aspect is about the risk of vibrations, caused by machinery such as trenchers and jack hammers, which may cause risks to the monument's body. These vibrations could cause cracks and surface damage to the stones of the monument, and risks its stability.

The forth aspect is more about architecturally valuable sites, which are not registered as antiquities. A site could be classified as architecturally valuable for its artistic design, its elevation view, artistic balcony, windows, domes or other components. Fixing gas risers and connections next to such components may reduce their artistic value.

The final aspect, although has a very low possibility of occurrence because most streets of Greater Cairo have been excavated for infrastructure, is mentioned in the Antiquities Law presented in Section 3. Finding an antiquity during excavation could risk the loss or damage of this antiquity if improperly managed.

4.2.7 Waste Disposal

Wastes that are generated during the construction phase include:

- Excavated soil and excess sand;
- Concrete and bricks waste;
- Demolished asphalt;
- Containers of chemicals and lubricant oils used for construction machinery;
- Possibly damaged asbestos water pipes during excavation; and
- Dewatered water from trenches.

Excavated soil and concrete/bricks waste are inert materials. Improper disposal of such wastes will only have aesthetic effects on the disposal site. The legal standards of Law 4/1994 for the Environment and Law 38/1967, discussed in Chapter 2, stipulate that these wastes should be disposed in licensed sites by the local authority, which minimizes any aesthetic effects of such waste.

The asphalt waste could have some hazardous components, such as tar, lubricating oils, some heavy metals, etc. However, its solid nature minimizes the transport risk of such components to the environment. Disposal of asphalt waste to a construction waste disposal site is common practice in Egypt, which is normally not associated with significant environmental risks because of the dry weather nature of the country.

Empty containers of chemicals and lubricating oils, are considered hazardous waste. They should be disposed of in an approved hazardous waste handling facility for proper treatment/disposal[6]. However generation of such waste is not a direct result for construction activities of the project, but rather relates to maintenance of equipment, therefore, it is believed that by preventing fueling/lubricating activities on construction sites no empty containers will need disposal, as further detailed in Section 6. On the other hand, it is worth noting that Town Gas implements a policy for returning empty containers of hazardous substances to vendors.

[6] It is worth noting that there were no such facilities available in Egypt before 2005, when few specialized facilities started operation for certain types of waste

Asbestos waste is also hazardous waste. If an asbestos pipe is broken throughout the excavation process, wasted parts of the pipe should be sprayed with water, to prevent emissions of asbestos-containing dust, and transported to an approved hazardous waste landfill, or a well contained cell in the construction waste disposal site. Friable asbestos waste could form significant health risks to workers, pedestrians and residents of neighboring areas, therefore efficient management of such waste, if generated, will be very important. It is worth noting that the probability of generating asbestos waste is relatively low, because usually the damage is fixed through hole-repair rather than pipe replacement. Also handling of such waste, if generated, is the responsibility of the Water Authority as further discussed in Section 6.

Improper drainage of dewatering water may result in forming stagnant water ponds around the construction site, which can develop, if not drained, infiltrated or evaporated, to form nuisance and an environment for breeding of insects.

Normally dewatered water is relatively clean water, which could be drained to a public sewer or even discharged to a watercourse, which may be applied during tunneling a special crossing under a watercourse. However, there can be exceptions to that, when dewatering is performed from a contaminated trench or near a source of pollution seepage to groundwater. This could apply during trenching beside, or under, fuel service stations, any Underground Storage Tank (UST) or Above-ground Storage Tank (AST) system, where groundwater could contain hydrocarbons or chemicals. Although such cases could be rare, its occurrence would require collection of contaminated water for special treatment/disposal. Discharging contaminated water with significant amounts of chemicals and hydrocarbons is not legally acceptable neither to sewers nor to fresh watercourses according to Laws 93/1962 and 48/1982, respectively.

4.2.8 Potential Impacts of PRS Construction

Under the project, five PRSs will be constructed in El Haram, New Cairo, El Mokattam, El Shorouk and El Tebbin districts. The exact locations of the four former PRSs are not yet settled, although certain, wide, areas have been identified by Town Gas for choosing the locations. The final decision on this issue will be up to the Local Authority. These four areas are relatively remote, as indicated in Section 2, and distanced from populated areas. The fifth PRS, in El Tebbin, is located in a relatively populated area, with a house directly adjacent to the location.

The negative impacts or risks associated with the construction of PRSs are related to the handling of construction waste, noise and air pollution from construction machinery which have all been discussed earlier. Therefore the impacts of the four remote PRS construction could be negligible. The most important impact from constructing El Tebbin PRS is the noise to the adjacent house.

The Gas Law stipulates that all constructions should be on public-owned land, therefore it is not expected that construction of PRSs will entail involuntary resettlement. An exception to this is the case of El Tebbin PRS which has a house adjacent to its southern

border. If mitigation measures recommended by the study are accurately followed, there will be no need for resettling the inhabitants of this house.

4.2.9 Social Impacts During Construction

During construction phase, there are a number of possible negative social impacts for the project that need to be considered, namely:

- Installment payments raise some concerns. Poor people are very concerned concerning the installment fees. People also feel discriminated against since the first phase of gas connections was mainly aimed at connecting to the Class I districts and the people there did not have to pay any connection fees. However, poor people have to pay LE 1,500.
- Might cause conflicts because it is not available for all people. It may also cause conflicts between tenants and property owners (that are subject to the new law for rented houses), since each party will want the other to be responsible for paying the installation fees.
- Cause limited effects to business of neighboring shopkeepers.

4.3 Potential Negative Impacts during Operation

4.3.1 Improper handling of the Odorant

The odorant containing Tertiobutylmercaptin (80%) and Methylehylsulphide (20%) is classified as a hazardous substance. The MSDS of the odorant, identifies the following hazardous properties:

- Highly flammable;
- Thermal decomposition giving flammable and toxic products;
- Irritant; and
- Toxic to aquatic flora and fauna.

Handling the odorant will require license from the Egyptian General Petroleum Corporation, according to the stipulations of Law 4/1994. It will also be required to keep a register for management practices followed in PRSs.

Improper handling of the odorant includes:

- Storage in unsafe conditions, in terms of occupational health and safety; and
- Leakage to the environment causing different types of hazards related to its high reactivity and possible production of pollutants. This release to the environment could take many forms such as:
    - Discharge of remaining odorants in containers, after use, in land or sewers;
    - Disposal of used containers with domestic waste, or by open disposal; and
    - Recycling of used containers for other materials.

4.3.2 Noise of PRS

The pressure reducers normally cause noise generated from the reducers' pipes. The generated noise is constant (not intermittent).

During the second Public Consultation, presented in Section 7, the issue of PRS noise was raised. The proposed location for El Tebbin PRS, under the project, includes an operating PRS of GASCO. The location has an adjacent house to its southern border, the inhabitants of this house have made some complaints about noise from the existing PRS. Accordingly a visit has been undertaken to the location on 3 January 2007, followed by another visit on 4 April 2007, to measure noise levels at the location of the reducers, the location of staff offices, and the location of the adjacent house. Figures 5-1 to 5-3 present the measurement results.

The measurements indicate that the noise level at a point near the house (LAeq = 72.2 dBA) was higher than the noise at the reducers source (LAeq = 64.5 dBA) while the noise level at the staff offices was the lowest (58.9). The calculated Day and Night Equivalent (DNL) on the house location, on a later visit, was 78.5[7] dBA.

The proposed location of Tebbin PRS is on the highway used usually by heavy traffic to transport goods between Cairo and Upper Egypt, therefore the area near the road is very noisy. It is believed that the high noise level at the house adjacent to the GASCO complex in Tebbin, which exceeds the ambient noise level identified by Law 4 even for areas of heavy industries, is caused by the traffic.

In order to accurately identify the contribution of the existing GASCO PRS to the noise level at the adjacent house, it was required to take measurements during PRS operation and shutdown, but it was not possible to shut down the PRS due to logistical reasons. Therefore an empirical rule has been empoloyed for assessing noise impact at the adjacent house if the new PRS is installed beside the existing GASCO PRS, this rule is recommended by the UK Environment Agency[8].

The rule works based on the following principals:

- Accumulative effect for two sources of noise depends on the difference between them, if the two sources have similar noise levels the accumulative noise from both sources will be 3 dBA above noise from single source. The higher the difference between the two sources the lower the extra accumulative noise level, and if the difference between the two sources reaches 10 dBA or more the extra accumulative effect will be zero

[7] The DNL was calculated by 10 dBA to measured levels from 10:00 pm to 7:00 pm.
[8] Integrated Pollution Prevention and Control (IPPC), Horizontal Guidance for Noise, Part 2- Noise Assessment and Control

- Predicting noise levels at a distance could be calculated using the following equation if the ground between the source and receiver is hard (paved for example)[9]
  Lp = Lw – 20 Log r – 8
  Where: Lp is noise level at receiver, Lw is noise level at source and r is the distance

By applying the above rules and assuming the new PRS will cause the same noise level at source, as the existing GASCO PRS, and the reducers have been installed right beside the existing reducers, which is the worst case scenario, the accumulative noise level at source will be (LAeq) 67.5 dBA. By applying the distance attenuation equation mentioned above the noise levels at different distances from source are presented in the following table.

Table 4-1: Distance attenuation of noise predicted for one PRS and two adjacent PRSs

Distance from source (m)	0	4	8	12	16	20	24	28	32
Predicted noise level caused by one reducer (dBA)	64.5	44.5	38.4	34.9	32.4	30.5	28.9	27.6	26.4
Predicted noise level caused by two reducers (dBA)	67.5	47.5	41.4	37.9	34.4	33.5	31.9	30.6	29.4

At Tebbin location, given that the existing reducers of GASCO PRS is more than 20 meters from the southern border, it could be concluded that the measured LAeq of 72.2 has no contribution from PRS reducers as the noise level difference between the nearby traffic and the PRS is definitely more than 10 dBA. It could also be concluded that if the other PRS is installed, there will be no impact as well because the difference will still be more than 10 dBA, given that the distance is more than 4 meters from the adjacent house, which certainly will be the case.

For the other four PRSs, assuming the ambient noise levels are complying with Law 4/1994 standards for low noise residential areas (50 dBA at morning, 45 dBA at evening and 40 dBA at night)[10], if a 20 meters buffer distance kept between the reducers and the PRS fences there will be no impact outside the PRS borders.

4.3.3 Safety aspects of PRS operation

The safety risks associated with the operation of PRSs have been assessed for the workers and the public at large using Quantitative Risk Assessment (QRA) modeling and the results have been compared with international risk acceptance criteria "As Low As Reasonably Practical – ALARP".

[9] This equation does not take into account many environmental factors that can affect predictions over distance such as weather, air absorption, source strength variation, ground attenuation effects, barriers and reflections. But all these factors are not accurately defined at this stage

[10] Because the other PRSs are located near highways, background noise levels at these locations are most probably higher than that, which, if true, will further reduce noise impacts from the PRSs

The QRA has been performed for a typical PRS with odorant. The following risks have been analyzed:

- Flammable gases dispersion (Gas Clouds) ;
- Flash fires; and
- Jet fires.

For the purpose of the analysis it has been assumed that the Pressure Reduction Stations are within restricted entry open area. For the PRS leak scenario, the release rate has been simulated based on 3-hole sizes of 0.25-inch representing instrument fitting failure (pin hole leak); 1.0-inch representing small pipe leak (minor leak); and 4.0-inch leak representing a 4-inch pipe full bore rupture or 4-inch hole size in a larger pipe diameter (major leak or catastrophic failure). This corresponds to a 5-mm, 25-mm and 100-mm leak sizes.

The maximum of the two types of pressures have been simulated to represent the worst case and mild case respectively, 70 Bar as High Pressure (HP) and 7 Bar as Low Pressure (LP). The jet fire (flame length) and heat radiation distances are measured in meters.

The gas dispersion distances have been calculated in meters in concentration terms of Lower Flammability Limits (LFL) and Upper Flammability Limits (UFL) presented by Parts Per Million (ppm) concentrations in order to represent the flammability range of the released gas cloud; however the extent of damage is presented by LFL only.

The heat radiation from flash fires will not significantly affect humans, equipment or structures due to the short duration of flash fires. Fire consequence analysis has been described in details in the full QRA report, which details the hazardous effects from different types of fires.

The following table presents the generic extent of damage distances as a result of the consequence modeling simulation analysis.

Table 4-2: Generic Extent of Damage Distances from PRS Leaks in Meters

Case No.	Leak type	Leak size in Meters	Leak size in Inches	High Pressure Side (70 Bar)		Low Pressure Side (7 Bar)	
				Jet Flame (m)	Gas Cloud (m)	Jet Flame (m)	Gas Cloud (m)
1	Pin Hole	0.005	0.25	6.5	3.5	2.2	1.2
2	Minor leak	0.025	1.00	25	11.2	8.5	5.5
3	Major leak	0.100	4.00	70	30	25	11

From the extent of damage distances calculated, it can be observed that major or catastrophic equipment failure has the maximum potential extent of damage due to increased leak size. The maximum extent of damage is 70 meters in the worst case conditions. In such case, a gas cloud in LFL can reach a distance of 32m downwind, if

not ignited. If the release ignited in the form of a jet flame, the heat radiation flux contour of 12kw/m^2 would reach a distance of about 50m while the 6kw/m^2 flux can reach 90m.

The minor leak has a localized extent of damage within the PRS boundary or battery limits due to medium leak size. The calculated extent of damage is 25 meters.

While the pin hole leak has the minimum localized extent of damage due to small leak size, the minimum extent of damage is 6.5 meters in the mild case condition. On the other hand, the probability of occurrence or failure frequency of major leak or catastrophic equipment failure is deemed to be much lower than a pin hole leak.

Release from the odorant storage tank, is one of the critical events. A release from the tank pressure relief valve as a result of overfilling or over-pressure was modelled. Dispersion down-wind from the PSV will extend a distance greater than 250m for lower concentration (10 ppm) while the higher concentration (1000 ppm) will extend about 120m. In order to reduce these distances to be within the borders of the PRS (50x50m) a flare for igniting any release from the odorant tank PSV will be activated. The jet flame of such flare, in case of odorant release, would be of 20m in length, and a 12kw/m^2 heat radiation contour would extend 17m down-wind, while a 25kw/m^2 contours would extend 13m down-wind.

The risks have been assessed for the industrial workers and general public representing the two types of risk namely the "Individual Risk" and "Social Risk" within the PRS. For the general public, the simulation assumed that the station is surrounded by busy roads, as well as the public buildings. The conclusion drawn from the QRA is that the risk is within the acceptable limits, if safety precautions have been considered and strictly followed in the design, operation and maintenance of such facilities. This is further analyzed in Section 6.

4.3.4 Social impacts During Operation

Some of the negative social impacts that might occur during the operation phase are:

- For those who will pay through installments, this may be an added financial burden that is difficult to meet.
- Increase unemployment amongst LPG cylinders' distributors. (Governmental sector distributors – licensed private sector distributors and non official distributors)
- LPG cylinders' distributors who have received a loan from the Social Fund may not be able to repay their loans and the interest which may result in a serious legal situation. Table 4-3 presents the numbers and locations of those borrowers.
- Temporary workers may cause problems at the end of the project when they are no longer needed.
- Increase in the rent prices of the apartments that are connected to natural gas.

Table 4-3: Number of Individuals Who Have Received Loans from the Social Fund to Distribute LPG Cylinders

District	Paid the Loan Back?		Total
	Yes	No	
Helwan - 15th of May - Tora	36	5	41
El Tebbin - El Saf	19	7	26
El Matarya - El Sharabeia - El Zaher - El Zaweia	46	5	51
Nasr City - New Cairo	19	0	19
El Salam - El Shrouq - El Nahda - Badr	22	5	27
El Maadi - El Sayeda Zeinab - Dar El Salam - Misr El Qadeima	78	12	90
Giza City	56	18	74
Total	**276**	**52**	**328**

Because there will be many areas not served by the project, such as the squatters surrounding Greater Cairo, there will still be business opportunities for LPG cylinders' distributors.

5. Analysis of Alternatives

5.1 No Project Alternative

The Natural Gas Connections Project in Greater Cairo, coincide with the entire Government Energy Strategy to expand natural gas connections among households, as well as among other sectors. This energy strategy, as indicated in Section 2, is expected to yield many economic and social benefits in terms of providing a more stable energy source, achieving savings in LPG consumption and enhancing safety in utilizing energy.

In addition to being part of an overall strategy, the project will have many benefits which have been indicated earlier in the project objectives and positive impacts. The "no project alternative" has been discussed with a sample from the local community, in the social survey undertaken among the activities of the ESIAF. Many people thought the "no project alternative" will prevent achieving many advantages that are expected as results of the project, such as:

- Providing clean and stable source of energy;
- Improving house cleanliness, as LPG cylinders usually contains dirt and insects;
- Reduce noise caused by LPG distributors;
- Reduce price of LPG cylinders due to reduced demand;
- Reduce child labor, who are commonly working in LPG cylinders distribution; and
- Reduce inconvenience to handicapped people, in delivering LPG cylinders to their houses.

Two alternative energy sources could be considered for comparison purposes with the proposed expansion of natural gas distribution included in this project, which are (a) to continue with LPG as current practice, or (b) to convert to electricity. Each is considered in turn below.

- **LPG:** The majority of LPG consumed in Egypt is imported and its costs are subsidized by the Government to ensure that it is affordable by the lower income groups; however there is no differentiation and everyone benefits from the subsidy. Introduction of piped natural gas to replace LPG will help to remove those subsidies and reduce the import of that fuel. The proposed project is also expected to produce very positive improvements in gas utilization safety. In the natural gas industry in Egypt, appliance standards, fittings and conversions are strictly controlled and only trained and qualified people are allowed to carry out installation. In the case of LPG, this does not apply so the conversion of existing LPG appliances helps to eliminate existing unsafe installations as well as expansion of unsafe use of LPG.

- **Electricity**: The second alternative is to convert all homes to use electricity for all energy supply applications. Whilst electricity is more efficient at the point of

use, there are considerable inefficiencies in power generation from fossil fuels with about 50% efficiency if combined cycle plants are available. Additional power stations would be needed to cope with the additional demand created by utilization of electricity in homes, which most probably would work also by natural gas. Power losses through transmission and distribution are also significantly higher than their natural gas equivalents which would add to the overall inefficiency of its utilization.

For such reasons, the "no project" alternative is not a favored option.

5.2 Sequence of Progressing Alternatives

Construction of the gas network within the city comprise two main components, the first being the distribution network in the direction of longitudinal roads, and the second being the connection network to the residential units perpendicular to road direction on both sides.

Progressing from constructing the distribution network to constructing the connection network could be practiced through two alternatives:

- Alternative 1: Complete the construction of the distribution network and then start the connection network at a later stage.
- Alternative 2: Complete both networks simultaneously in one stage

Advantages of Alternative 1 over Alternative 2 are:

- Technical problems during line testing could be avoided, as detecting leaks in the main pipe will be much easier if no connections are placed;
- Phasing of connections could be done corresponding with signed contracts for new customers;
- Lower risks for re-excavating parts of the line including leaks; and
- Shorter traffic disturbance time for the first excavation stage because there are no lateral intersections with the traffic flow.

Advantages of Alternative 2 over Alternative 1 are:

- Amount of excavation/filling works slightly less, because intersections between mains and connection trenches are excavated only once;
- Makes mobilization of equipment, areas of storage occupied only once; and
- Traffic disturbance occurs only once.

The environmental benefits and negative impacts for the two alternatives are close. The amount of excavations in the two alternatives are approximately equal, however, the second alternative has a clear advantage of causing disturbance only once for the same street, in addition to less air emissions and traffic disturbance caused during equipment mobilizations. Assuming all other technical or financial factors are equal then Alternative 2 may be slightly more advantageous from an environmental perspective. However, because phasing of connection works will depend mainly on developing contracts with

new customers, it is envisaged that there would not be objection in going along with Alternative 1.

5.3 Routing Alternatives

Routing alternatives apply to transmission mains, distribution mains and connection mains. For transmission mains alternatives, the selected project alternative is to provide reinforcements to the existing mains using the same route. The main advantage of this selection is to get the benefit from the design of the existing route which forms a ring around Greater Cairo. This helps access to different geographic locations with a minimum length of pipelines. Forming another route for the required new mains shall achieve the same technical objective, but by losing this advantage. Therefore the reinforcement alternative is the favored one.

Deciding on routing alternatives for the distribution and connection networks is premature at this stage. However selecting optimum routes for these networks is crucial to avoid as much environmental and social impacts as possible, as detailed earlier in the discussion of the impacts of the construction phase (Section 4.2). It is very important to avoid as much sensitive sites as possible to minimize environmental and social impacts, therefore this has been considered in the Environmental Management and Monitoring Framework presented in the following Section.

6. Environmental and Social Management and Monitoring Framework

6.1 Objectives of the ESMMF

The objectives of this Environmental and Social Management and Monitoring Framework, is to develop a mechanism for implementing mitigation measures for expected negative impacts and to monitor the efficiency of these mitigation measures based on relevant environmental indicators. The ESMMF identifies certain roles and responsibilities for different stakeholders for implementation, supervision and monitoring.

Also in this section is an assessment for the capacity of the implementing agency, EGAS and Town Gas, for implementing this ESMMF, along with recommendations for improving their capacity and resources.

6.2 Management and Monitoring activities During Construction Phase

6.2.1 Management of Traffic

The mitigation measures are proposed to maintain the existing level of service and to minimize disruptions to vehicular movements:

1. Construction During Off-peak Periods: It is essential to plan for the construction works outside the peak periods of the main arterial road network. The works would be scheduled during off-peak periods, mostly during night time. During peak periods, work will be stopped and the road space is re-instated for use by traffic. Also during the month of Ramadan, all occupations of most streets should be stopped. Although this procedure will provide minimal impact on the traffic flow, the construction program of work may be, consequently, extended for a longer period of time. Times of construction are identified by the local Traffic Department in a conditional excavation permit issued to the implementing company, based on the Traffic Department operational experience in the subject area,
2. Signage and Markings: Construction works require proper information disseminated to motorists. This can be done by provision of informational and directional signs posted prior to the construction zone so that drivers can react in due time and maintain safe driving. The Egyptian Road Code of Practice (Ministry of Housing, 1998) provides standard arrangements for construction zones. Markings, in the form of lane lines and directional arrows are also needed to guide the drivers to the proper lane changes and turning. Pedestrian crossings can be also provided at proper locations as dictated by each site.
3. Traffic Detour: In some important roads it would be required to maintain the movements of traffic at a reasonable level of service. Therefore the Traffic Department may implement traffic detouring, which has proven to be a potential solution. This detouring will be based on a traffic study to produce a traffic circulation plan. This study, undertaken by Traffic Department, normally includes

an area wide analysis of the road system coupled with traffic counts if needed. Alternatives of the circulation plan will be produced and evaluated in terms of level of service, driving convenience, access to adjacent land uses and pedestrian mobility.

4. Re-structuring the Road Right-of-way: The arterial road network in the Greater Cairo Region (GCR) mostly has a wide right-of-way. It comprises sidewalks, traffic lanes and a median. Therefore, normally it would be possible to re-structure the road's cross section to accommodate the construction works and maintain traffic movement along the road. Reduction of the sidewalk, reduction of the median width and reduction of the lane width are possible measures. These measures will also be implemented by the local Traffic Department in order to keep traffic flow at adequate levels in some roads, based on a traffic study for these roads. This traffic study normally includes road inventory coupled with traffic and pedestrian counts. Alternatives of the cross section, public transport services and pedestrian crossing will be produced and evaluated in terms of level of service, driving convenience, access to adjacent land uses and pedestrian mobility.

All the above mitigation measures will be implemented by, or in coordination with, Traffic Departments of Cairo and Giza. Traffic studies recommended in mitigation measures 3 and 4 will also be undertaken by the Traffic Departments, according to traffic requirements.

Monitoring of traffic flow will also be done by the local Traffic Department to make sure that flow reduction is within acceptable levels. Strong coordination should be established between the Traffic Department and the Town Gas HSE Department to ensure following the identified mitigation measures. Town Gas HSE should record any comments by the Traffic Department regarding violations by the contractor of excavation permits to avoid such incidents at later stages.

6.2.2 Management of Air Emissions

Mitigation measures for reducing air emissions are mainly stipulated by Law 4/1994. The following mitigation measures are considered minimum standards:

1. Excavated soil stockpiles and stored sand should be located in sheltered areas. Fine sand should be covered with appropriate covering material, such as polyethylene or textile sheets to avoid soil dispersion
2. Transportation of excavation/construction waste should be through licensed and sufficiently equipped vehicles with suitable special box or provided with a cover to prevent loose particles of waste and debris from escaping into the air or dropping on the road
3. Disposal of excavation/construction waste should be in licensed locations by the local authority.
4. Air emissions of excavation machinery should be within the standards of Annex 6 of the executive regulations of Law 4/1994

Because dust emissions from construction works are non-point source pollution, it will not be possible to monitor direct emission levels. On the other hand, monitoring ambient total suspended particles or PM_{10} could be misleading because of the interference of other pollution sources. Therefore monitoring activities shall focus on making sure that point sources from the exhaust of excavation machinery are within Law standards, and that mitigation measures are well documented.

6.2.3 Management of Noise

Mitigation measures for avoiding unacceptable, and above legal standards of noise levels include:

1. Prevent exposure of construction workers to different noise levels and noise impacts according to the Law standards. This could be achieved through adjusting working hours, breaks, and exposure duration to be within the permissible limits.
2. Provide construction workers with ear muffs.
3. Minimize construction through nighttime whenever possible. Implementing this measure should be balanced with avoiding peak hours of heavy traffic. If construction works are to take place in important traffic roads, avoiding traffic disturbance in day time may outweigh reducing noise levels in the afternoon or night times and vice versa.

Monitoring of noise levels during construction shall include:

1. Measurements of noise intensity at the locations of construction, where workers are exposed to the noise.
2. At locations where mechanical hammers are used, measurements of noise intensity of impacts, and the corresponding number of impacts at the construction location.
3. Recording of the reaction and complaints of the neighboring areas about the noise levels.

It is worth noting that monitoring ambient noise levels at locations of residential areas may be misleading because of the interference of other factors.

6.2.4 Management of Excavation Activities Posing Risk on Infrastructure

Town Gas has certain procedures in place to confront emergency situations related to breaking of infrastructure lines. The company supervisor calls the Police Department and emergency department in the relevant infrastructure company for immediate repair of the damage, in which the contractor is invoiced for. The mitigation measures below are concentrating on preventive measures and documentation:

Mitigation measures for avoiding breaking infrastructure pipes:

1. Collecting most accurate maps for infrastructure routes from Information Centers in Cairo and Giza Governorates and asking them for site markings, whenever available, and making such data available to the contractor prior to commencing the works

2. Excavating manual trial pits in each street to locate the pipes before using mechanical excavation.
3. In case an infrastructure pipe being damaged, the standard procedures of Town Gas should be followed, as described before, in addition to preparing a documented report on the accident. The documentation report should include:
    a. Time and place of accident;
    b. Name of contractor;
    c. Type of infrastructure line;
    d. Description of accident circumstances and causes;
    e. Actions taken and responses of different parties, such as infrastructure company;
    f. Duration of fixing the damage; and
    g. Damage caused (description shall be according to observation, expertise judgment, reports of the infrastructure company).
4. Analysis and statistics should be undertaken periodically for the accidents that have taken place, with recommendations to reduce such risks in consequent excavation activities.

Monitoring activities for such risks, is basically documenting, analyzing reasons that led to the accident and updating procedures to avoid future accidents. Monitoring environmental consequences of such accident, such as depth of effected soils, volumes of effected groundwater, and other social effects are believed to be unnecessary action by the implementing company, though it might be recommended for the authority owning the infrastructure line (Water and Sewage Authority or Telecommunication Authority) for their research activities.

6.2.5 Management of Dewatering Activities Posing Risk on Structures Stability

Mitigation measures:

1. Screening of the 28 districts to identify areas/sectors including buildings with potential structural problems. Areas with potential problems should be excluded from the project to avoid any structural problems on existing buildings. This screening process should be done by a technical committee formed by the Design, Projects and Operation Departments of Town Gas.
2. In areas of high groundwater level, a tight excavation/dewatering schedule should be implemented through preplanning and supervision of implementation to avoid lengthy dewatering activities.

Monitoring activities will be mainly done through supervision of the work of Town Gas Area screening committee, and reviewing site reports of the HSE supervisor.

6.2.6 Management of Culturally Valuable Sites

Law 117/1983 for Protection of antiquities has set certain standards that should be followed during excavation works near a registered antiquity site. The Supreme Council for Antiquities emphasizes that collaboration should be established between the Council

and the infrastructure developer during construction near an antiquity. These standards and requirements are followed among the following proposed mitigation measures:

1. Identifying a comprehensive list of all Greater Cairo registered antiquities, falling within the domain of the project and possibly risked by construction activities. This will be done by taking construction permits from the Local Authority including conditional permits from the Supreme Council of Antiquities in areas identified by the Council. It is expected that the council will identify certain stretches of the network where the mitigation measures presented below, or some them, should be implemented.
2. Provide supervision from the Supreme Council of Antiquities on implementation of construction works at identified locations
3. If dewatering activities are to take place, the process should be undertaken under the supervision of foundation engineers who shall perform necessary soil investigations. The process should be tight in time schedule to avoid elongated dewatering, and possibly use under-trench culvert or tunnel to preserve groundwater table under the monument
4. Reduce vibration, in identified locations of antiquities:
    a. using manual tools whenever possible
    b. phasing work to eliminate generation of resultant vibrations from several machinery
    c. Establish cutoff barrier through a vertical trench, whenever needed, to absorb vibrations
5. Fixing gas risers on back sides of architecturally valuable structures to avoid artistic sides and components.
6. The chance find process, In case an antiquity is found during excavation, includes stopping excavation works, and contact the Supreme Council of Antiquities to handle the site.

Monitoring activities will be site specific according to the requirements and conditional permits granted by the Supreme Council for Antiquities.

1. Monitor vibration levels at the monument location during excavation; and
2. Undertake geophysical survey for some locations prior to construction, according to the instructions of the Supreme Council for Antiquities.

The Town Gas HSE site supervisor will be responsible for documenting the monitoring activities in monthly reports delivered to EGAS.

These mitigation measures, if required, shall be implemented by the Council, while the cost will be covered by Town Gas.

6.2.7 Management of Waste Disposal

The following mitigation measures are recommended for waste management:

1. Allocating certain areas, in each Sector, for stockpiling waste soil and construction waste, in coordination with the local authority. These areas should be

selected so as not to cause significant obstruction to traffic and the waste should be covered to prevent dust dispersion. The waste should be hauled at the end of each working day to the allocated disposal site, taking into consideration covering of the hauling vehicle, as indicated earlier. It is worth noting that Governorates of Cairo and Giza have allocated authorized disposal sites for construction waste in Al Waffaa Wal Ammal and Shabramant disposal sites respectively, Annex 8 includes an authorization letter from Giza Governorate for disposal of construction waste of the project, while a similar letter from Cairo Governorate is currently being processed. No soil stockpiling is allowed on banks of waterways. Normally asphalt waste could be disposed of with construction waste according to the previously mentioned procedures. However, it is recommended, as a best environmental practice, to segregate asphalt waste and to send it to an asphalt mixing plant for recycling. Because recycling of asphalt is not common practice in Egypt, there are doubts that an asphalt plant will accept the waste. For such circumstances this recommendation should not be compulsory.

2. As an important pollution prevention measure, fueling, lubricating or adding chemicals for excavation should not take place at the construction site. Accordingly no empty chemicals/oils containers will be generated by direct project activities.
3. Further to the above measure, in case such waste containers of hazardous materials are generated in the construction site due to unusual circumstances, the contractor should collect these containers and transfer it to the hazardous waste landfill in Nasserya/Alexandria[11]. This measure should be specified in the construction contract and supervised by Town Gas site supervisor.
4. In case of damaging of asbestos pipes during excavation, the Water Authority, which will carry out the repairs, will be responsible for handling the waste asbestos according to their procedures. There were no available documented procedures by the Water Authority, during the preparation of the ESIAF, illustrating their handling methods of such waste. Because the possibilities for generating such waste are quite low, and that the waste management will be undertaken by a separate party, not by the implementing agency, the recommended actions by Town Gas HSE supervisor is to advise the Water Authority with the acceptable procedures which is to spray the waste and dispose of it in a special cell within the construction waste disposal site, normally used by the Water Authority, and cover this cell after disposal.
5. Preplanning drainage of dewatering water and taking necessary permits from the sewage authority, or irrigation authority. No land disposal should be accepted for the resulting water
6. If dewatering is taking place from a contaminated trench, or contains hydrocarbons that could be observed or smelled, contaminated water should be collected in barrels and transported to a wastewater treatment facility, and possibly oil catchers belonging to one of the affiliate companies, for special

[11] The Nasserya hazardous waste facility is currently being operated under supervision of Alexandria Governorate

treatment. Alternatively such waste could be transferred to the hazardous waste facility in Nasserya/Alexandria[12].

Monitoring activities for ensuring sound waste management practices shall depend mainly upon observation of waste stockpiles of soil and construction waste to ensure the frequency of removal from site, and whether they contain hazardous components. For contaminated water produced during the dewatering process, also field observation of oily appearance and possibly odour would indicate whether to classify this water as hazardous waste or not.

A matrix illustrating management and monitoring activities during construction, proposed responsibilities of different stakeholders and approximate costs are given in Tables 6-1 and 6-2.

[12] Although the hazardous waste landfill in Alexandria started in 2005 by accepting only dry waste, it has recently introduced physical/chemical treatment processes and hence started to accept liquid and oily waste

Table 6-1: Environmental Management Matrix During Construction

Impact	Mitigation measures	Project Phase	Responsibility of mitigation	Responsibility of direct supervision	Means of supervision	Estimated Cost of mitigation / supervision
Reduction of traffic flow	Construction during off peak periods	Preconstruction and Construction	Traffic department to grant conditional license and Contractor to implement	Town Gas HSE + Traffic Department	Ensure contractor has valid conditional permit + Field supervision	- Contractor management costs that shall be included in normal bid price - Town Gas management costs
	Signage and marking	Tender and Construction	Contractor	Town Gas HSE + Traffic Department	Ensure inclusion in tender + Field supervision	- Contractor management costs that shall be included in normal bid price - Town Gas management costs
	Traffic detour	Preconstruction and Construction	Traffic Department	Traffic Department	Ensure detouring efficiency	Cost by Traffic Department
	Road restructuring	Construction	Traffic Department	Traffic Department	Ensure adequate traffic flow	Cost by Traffic Department
Air emissions	Sound storage, transportation and disposal of stockpiles	Construction	Contractor	Town Gas HSE supervisor	Field supervision	- Contractor management costs that shall be included in normal bid price - Town Gas management costs

	Ensure that air emissions of construction machinery within legal standards	Tender and preconstruction	Contractor	Town Gas HSE	Review vehicle exhaust certificate	- Contractor management costs that shall be included in normal bid price - Town Gas management costs
Noise	- Protect construction workers on site	Tender and Construction	Contractor	Town Gas HSE	Ensure inclusion in tender + Field supervision	- Contractor management costs that shall be included in normal bid price - Town Gas management costs
	- Avoid night noisy works whenever possible	Construction	Contractor	Town Gas HSE	Field supervision	- Contractor management costs that shall be included in normal bid price - Town Gas management costs
Risk of damaging infrastructure	- Collect infrastructure maps and site tracing	Construction	Town Gas HSE Department and Governorate Information Center	Town Gas HSE Manager	Review HSE site reports	- Town Gas management costs
	- Use trial pits	Tender and construction	Contractor	Town Gas HSE Supervisor	Ensure inclusion in tender + Field supervision	- Contractor costs in normal bid price - Town Gas management costs
	- Prepare and Analyze accidents reports	Construction	Town Gas HSE Research	Town Gas HSE Manager	Review periodic HSE reports	- Town Gas management costs

Effect on structures by dewatering activities	Screening of areas / sectors	Design	Town Gas Technical Committee	Town Gas Design Manager + HSE Manager	Review committee's reports	- Town gas management costs
	- Tight dewatering schedule	Construction	Contractor	Town Gas HSE Supervisor	Field supervision	- Contractor responsibility: Included in normal contractor bid - Town Gas Management Costs
Effects on monuments	Locate problematic areas of the network	Design	Supreme Council for Antiquities through permitting procedure of Local Council	Town Gas HSE Manager	Review permitting procedures and ensure review of Council	Cost by Supreme Council for Antiquities
	Supervise construction	Construction	Expert from Supreme Council of Antiquities	Town Gas HSE Manager + HSE supervisor	Review field reports + site supervision	- L.E. 3,000 / site for supervision and measurement of vibration - Town Gas management costs
	Control dewatering process	Construction	Contractor	Supreme Council Expert + Town Gas HSE Supervisor	Field supervision	- L.E. 15,000 / site above normal contractor bid price - Expert supervision included in previous item - Town Gas management costs
	Reduce vibrations	Tender + Construction	Contractor	Supreme Council Expert + HSE Supervisor	Ensure inclusion in tender + Field supervision	- L.E. 10,000 / site above normal contractor bid price - Expert supervision included in previous item - Town Gas management costs

	Preserve architecturally valuable sites	Construction	Contractor	Town Gas HSE Supervisor	Field supervision	- Normal contractor bid price - Town Gas Management Costs
	Preserve any found antiquity	Construction	Town Gas HSE supervisor	Town Gas HSE Manager	Review field reports	- Normal contractor bid price - Town Gas Management Costs
Waste disposal	- Control over construction waste	Construction	Contractor	Town Gas HSE supervisor	Field supervision	- Contractor responsibility: Included in normal contractor bid
	Prevent fueling, lubricating and any activity that would entail production of hazardous materials empty containers	Construction	Contractor	Town Gas HSE supervisor	Field supervision	- Contractor responsibility: Included in normal contractor bid
	Transfer empty hazardous waste containers, if generated under unusual circumstances, to Alexandria landfill	Construction	Contractor	Town Gas HSE supervisor	Field supervision and review manifest documents	About L.E. 1,300/yr above normal contractors bid[13]

[13] This figure has been derived assuming 2 loads of containers are generated each load is 0.5 ton which costs L.E. 650 including shipment and landfill fee. (landfill fee is L.E. 300/ton and rent of pick-up vehicle is about L.E. 500/trip)

	Adequate management of asbestos and any possible hazardous waste	Construction	Water Authority	Town Gas HSE Supervisor + HSE Manager	Field supervision + review of Water Authority manifests	- Costs by Water Authority - Town Gas management costs
	Arrange effective drainage during dewatering	Construction	Contractor	Town Gas HSE supervisor	Field supervision	- Contractor responsibility: Included in normal contractor bid
	Transfer any contaminated water resulting from dewatering to an adequate facility such as Alexandria Landfill	Construction	Contractor	Town Gas HSE supervisor	Field supervision	- About L.E. 1,000/yr above normal contractors bid[14]

[14] This figure has been derived assuming 1 load of contaminated water barrels is transferred each year wighing 1 ton at a cost of L.E. 1,000 including transportation and landfill fee in addition to supervision and administrative costs

Table 6-2: Environmental Monitoring Matrix During Construction

Impact	Monitoring indicators	Responsibility of monitoring	Duration of monitoring	Location of monitoring	Methods of monitoring	Estimated Cost of monitoring
Reduction of traffic flow	Comments and notifications from Traffic Department	Town Gas HSE department	During construction. Reporting in monthly reports	Construction site	Documentation in HSE monthly reports	Town Gas management costs
Air emissions	HC, CO% and opacity	Contractor	Once before construction + once quarterly for each vehicle	Vehicles licensing Department	Measuring exhaust emissions in an authorized institution	L.E 200 / Vehicle
Noise	Noise intensity, exposure durations and noise impacts	Town Gas HSE Department	Once quarterly during construction, with at least one measurement per contractor per sector	Construction site	Noise meter	Town Gas management costs
	Complaints from residents	Town Gas HSE Supervisor	During construction. Reported in monthly reports	Construction site	Documentation in HSE monthly reports	Town Gas management costs
Risk of damaging infrastructure	Accidents documentation	Town Gas HSE Department	During construction. Reported in monthly reports	Construction site	Documentation in HSE monthly reports	Town Gas management costs

Effect on structures by dewatering activities	Duration of dewatering and lowered water level	Town Gas HSE Department	During dewatering activities. Reported in monthly reports	Construction site	Documentation in HSE monthly reports	Town Gas management costs
Effects on monuments	Vibration	Supreme Council for Antiquities	During construction near sites identified by the Council	Construction site	Vibration test	Included in Supreme Council Expert's input
	Buried antiquities	Supreme Council for Antiquities	Once before construction if required by the council	Streets identified by the Council	Geophysical survey	L.E. 3000/ km of street
	Documentation	Town Gas HSE supervisor	During construction. Reported in monthly reports	Construction site	Documentation in HSE monthly reports	Town Gas management costs
Waste Management	Accumulated waste	Town Gas HSE Supervisor	During construction. Reported in monthly reports	Construction site	Observation and documentation	Town Gas management costs
	Existence of hazardous waste in waste piles or at site	Town Gas HSE Supervisor	During construction. Reported in monthly reports	Construction site	Observation and documentation	Town Gas management costs
	Existence of water ponds from dewatering	Town Gas HSE Supervisor	During construction. Reported in monthly reports	Around construction site	Observation and documentation	Town Gas management costs

6.3 Management and Monitoring activities During Operation Phase

6.3.1 Management of Odorant Handling

The MSDS of the odorant provides information on the required storage conditions and procedures to be followed in emergencies. For the disposal of empty containers, the MSDS indicates that the remaining product could be either destroyed by oxidation using dilute solutions of hydrogen peroxide and sodium hypochlorite, or alternatively through incineration.

Town Gas is currently practicing the oxidation of the container remains. After evacuation of odorant containers (metal barrels) in the PRS holding stainless steel tank, the PRS staff adds hydrogen peroxide, sodium hypochlorite, sodium hydroxide and detergents to the remaining odorant in the container, with continuous rolling to ensure that all sides of the container have been exposed to the oxidation solution. These treatment procedures are documented in the instructions of the HSE department and followed by PRSs' staff. This process destroys the hazardous properties of the remaining odorant product; however there were no certain arrangements in place for disposal of the treatment solution remaining in the containers. Therefore the containers, including the treatment solution, are currently stored in PRSs.

Although the oxidation process in environmentally acceptable, the accumulation of treated containers in PRSs will cause area limitations inside PRSs and could effect their efficient operation.

During the preparation of this report, an inquiry has been forwarded to a hazardous waste facility in Nasserya-Alexandria, which has recently introduced physical/chemical treatment processes, if they would accept the empty odorant containers. The facility confirmed that they would accept the containers with a price of L.E. 300/ton given that Town Gas would be responsible for the transportation.

Accordingly Town Gas should arrange with the supplier of odorant that the vehicle transporting odorant containers should also transfer the empty containers, after evacuation, to the hazardous waste facility in Alexandria. When the truck arrives, all containers should be evacuated in the odorant holding tank, then the containers should be closed and returned back to the truck. The truck driver should sign haulage register form with number of empty containers being shipped, which should also be signed with Alexandria facility personnel for delivery. Town Gas should keep these records with their Environmental Register.

Odorant containers management will be implemented in four PRSs from the five planned to be operating by the project; Mokattam PRS will not have odorant facility as it receives the gas with odorant injected in the existing Hiliopolis PRS. Assuming an odorant dosage rate of 20 ml/1000 m3 gas, container empty weight of 25 kg, capacity of container is 200 liter, truck load is sufficient for 15 containers, landfill fee is L.E. 300/ton and truck trip to

Alexandria is L.E. 500 per, the total cost for such arrangement is expected to be about L.E. 16,300/year. These calculations are presented in Table 7-3 below.

Table 6-3: Estimated quantities of odorant containers and cost of disposal

PRS Name	Gas consump. m3/hr	Odorant consump. (l/yr)	containers consump. (container/yr)	Waste Qty. (ton/yr)	No. of truck loads (loads/yr)	Disposal cost (L.E/yr)	Transportation cost (L.E/yr)	Total cost (L.E/yr)
Haram	40,000	7,008	35	1	3	263	1,500	1,763
Tebbin	300,000	52,560	263	7	18	1,971	9,000	10,971
N. Cairo	60,000	10,512	53	1	4	394	2,000	2,394
Shorok	20,000	3,504	18	0	2	131	1,000	1,131
Totals	**420,000**	**73,584**	**368**	**9**	**27**	**2,759**	**13,500**	**16,259**

Although the above table assumes that all PRS will work at full capacity from day one, the extra estimated costs will be considered as contingency.

The monitoring and supervision of the oxidation process was taking place by the Town Gas HSE department through bi-annual audits for each PRS. However, it is recommended to increase these audits to quarterly for each PRS, so as to include the performance of all PRSs in the Quarterly report. The audits should check waste manifests and compare it with odorant consumption data.

6.3.2 Management of Repairs and Maintenance

The same mitigation and monitoring measures discussed for the construction phase shall also apply to the repair and maintenance works that will require excavation.

6.3.3 Management of PRS Noise

The locations of four of the five new PRSs will be in relatively remote areas, if the Local Councils approves the Town Gas requests for the proposed locations. It is not expected that noise levels caused by the reducers will affect areas outside PRS fences if the reducers are located in the middle of the location (at least 20 meters away from all fences). This also applies for El Tebbin PRS, which has an adjacent house to its southern border. Therefore the following mitigation measures are recommended:

1. Location of the reducers should be at least 20 meters away from the PRS fences.
2. The reducers should be either in a well ventilated closed area, or in a protected open area according to IGEM standards. If the reducers are in an open area there should be wall barriers to dissipate the noise from PRS staff offices and the neighboring areas.

Town Gas is currently undertaking periodical monitoring of the noise levels at each existing PRS bi-annually. It is expected that the noise monitoring for the new PRSs will take the same pattern. For El Tebbin PRS, it is recommended to increase noise

monitoring at different locations especially at the southern border on a monthly basis, along with recording complaints from neighboring sites.

6.3.4 Mitigation Measures for PRS Safety Risks

Recommended risk reduction measures have been proposed as points of improvement in order to enhance the PRS safety standards. These risk reduction measures (recommendations) are summarized as follows:

1. Remote actuation of isolation and slam-shut valves by Town Gas for different PRS's as well as the transmission pipelines.
2. Produce Hazardous Area Classification drawings for all Pressure Reduction Stations.
3. Planned preventive maintenance policy should be in place for the new PRSs. Also there is a need to produce a 'Station Manual' for each PRS, this manual should include formalized procedures, including precautions and a site scenario specific emergency plan, which should take wind direction, stability and interfaces with others, e.g. GASCO as well as the public living nearby, into account.
4. The control room inlet door should be located in the upwind direction away from the station (Inlet door should not face the PRS station). Alternatively, the control room should be provided by a secondary means of escape at the back side of the room, which shall be used in case of blockage of the main escape route by jet.
5. Self contained breathing apparatus (2 units at least) to be provided at each PRS for handling odorant releases.
6. Jet fire rated passive fire protection system to be applied to all safety critical shutdown valves ESDVs or Solenoid valves in order to maintain small isolatable inventories. (As applicable)
7. Pipeline marking signs should be added indicating in Arabic and in English "Do Not . Dig" and "High Pressure Pipeline Underneath" in order to prevent such extreme hazardous situation.
8. Install an elevated wind sock in the PRS site, which can be seen - from distance and from outside the fence - to determine the direction of gas migration in case of major gas leak, in addition to provision of portable gas detectors.
9. The design should fully comply with IGE TD/3 code requirements.

A QRA report detailing such risks and mitigation measures has been prepared.

6.3.5 Mitigation Measures for Social Impacts During Operation

1. Provide technical support and assistance to those who work in the distribution of LPG cylinders in the governmental stores through rehabilitation and training.
2. The owners of private cylinders' stores in some districts (New Cairo, El Shrouq/ Badr City/ El Hadied Wal Solb buildings/ El Hoda city/ Qeba – Omar Ebn El Khattab- Sheraton buildings) should be directed to distribute LPG cylinders in the areas that are not served by the project.

3. People who have received a loan from the Social Fund should be investigated, in order to identify how they will react regarding the natural gas project. Options that should be offered to them include:
    a. They can distribute in areas that are not served by natural gas project
    b. They can sell the cylinders and start another business (they used to do so).
4. Raising the level of awareness of the people in the project areas, especially inhabitants of areas surrounding PRSs, through different media channels and with the help of local NGOs. Raising awareness should focus on obtaining the correct understanding of PRS environmental and safety risks.
5. Re-consideration of the installation fees should be made, or alternatively a clear and realistic installment plan should be proposed and discussed with the people. A detailed willingness to pay study is currently being developed, in which different modes of installation installments will be recommended.
6. Subsidy should be provided for poor people who cannot afford paying for the installation fees. The willingness to pay study shall recommend the amount of such subsidy.
7. A natural gas emergency unit should be established in all of the project's 28 districts, (there are already 13 units). A social component should be added to these units to investigate the poor families' conditions and to review any cases which refuse to pay the installation and service fees.

A matrix illustrating management and monitoring activities during operation, proposed responsibilities of different stakeholders and approximate costs are given in Tables 6-4 and 6-5.

Table 6-4: Environmental Management Matrix During Operation

Impact	Mitigation measures	Project Phase	Responsibility of mitigation	Responsibility of direct supervision	Means of supervision	Estimated Cost of mitigation / supervision
Improper management of odorant during operation	Evacuation of odorant in holding tank and send empty containers to Nasserya hazardous waste facility in the same day	Operation	PRS staff	Town Gas HSE staff	Quarterly auditing for each PRS	L.E. 16,300 / yr for transportation and disposal of waste
Noise of PRS operation	Locate noisy pressure reducers away from PRS borders in residential areas	Design	Town Gas Design Department	Town Gas HSE Manager	Review of PRS layout	Town Gas management costs
	Build barrier walls between reducers and sensitive receptors when needed (at least required for Tebbin PRS)	Design and construction	Contractor	Town Gas HSE Manager	Field supervision of PRS construction	Contractor costs which shall be included in normal bid price
Potential safety risks due to PRS Operation	Remote actuation of isolation and slam-shut valves by Town Gas for different PRS's as well as the transmission pipelines.	Design	Designer	Project Dept	Document Review	Design Phase

Produce Hazardous Area Classification drawings for all Pressure Reduction Stations	Design	Designer	Eng. / Elect. Dept.	Document Review	Design Phase
Preventive maintenance policy and station manual	Design	Town Gas	Engineering Dept.		Preventive maintenance program and operating manual
Proper design of control room exit	Design	Designer	Projects Dept.	Document Review	
Provision of self contained breathing apparatus (2 pieces for each station) for handling odorant leaks	Operation	Town Gas	HSE Dept.	By Operators	$ 4000 each
Apply jet fire rated passive fire protection system to all critical safety shutdown valves ESDVs or Solenoid valves (As applicable)	Design	Designer	Projects Dept	Document Review	
Place marking signs indicating in Arabic and in English "Do Not Dig" and "High Pressure Pipeline Underneath"	Operation	Town Gas & GASCO	Engineering Dept.	Document Review	
Install an elevated wind sock and provision of portable gas detectors	Operation	Town Gas	HSE Dept		$ 3000 each

	The design should fully comply with IGE TD/3 code requirements	Designer	Designer	Project Dept.		Town Gas management costs
Social impacts	Provide technical support and assistance to workers in LPG stores under the umbrella of BUTAGASCO through rehabilitation and training or moving them to another area	Operation	BUTAGASCO	BUTAGASCO	Ensure adequate rehabilitation provided	BUTAGASCO management costs
	Provide following options to borrowers from SFD a. distribute in areas not served by project b. rehabilitation through training to start another business	Operation	SFD	EGAS	A list of them will be provided by Social Fund	- No cost if directed to distribute in other areas - Cost of rehabilitation depends on the type of alternative business
	Private LPG cylinders stores will be directed to distribute in other areas.	Operation	BUTAGASCO	EGAS	Ensure adequate substitution provided	- No cost
	Raising the level of awareness of the people in PRS areas.	Construction	NGOs in the districts	EGAS	Supervise awareness undertaken by NGO	About L.E. 5,000/ PRS area

	Prepare adequate installment plan for installation fees	Design	Town Gas	Town Gas	Supervised contracts under new plan	To be confirmed by a willing to pay study
	Subsidies for installation fees for poor people	Design	Subject to discussion with the the Competent authority	EGAS	Supervised contracts under new plan	To be confirmed by a willing to pay study
	Social staff to be appointed in emergency units in districts	Operation	Town Gas	EGAS	Field visits to the units	Town Gas management costs (salaries of new staff)

Table 6-5: Environmental Monitoring Matrix During Operation

Impact	Monitoring indicators	Responsibility of monitoring	Duration of monitoring	Location of monitoring	Methods of monitoring	Estimated Cost of monitoring
Improper management of odorant during operation	Number of treated containers	Town Gas HSE Department	Quarterly for each PRS	PRSs	Reviewing Environmental Register, compare with odorant delivery forms, observation of site	Town Gas management costs
Noise of PRS operation	Noise intensity	Town Gas HSE Department	Quarterly for each PRS	PRSs	Noise meter	Town Gas management costs

6.4 Reporting of Mitigation and Monitoring Activities

Reporting of mitigation measures and monitoring activities shall be undertaken by Town Gas HSE Department among the monthly and quarterly report currently being prepared and submitted to EGAS HSE Department. Each monthly report during design/tendering phase should include reporting on the following items[15]:

- Results of reviewing the network rout by Traffic Department and by the Supreme Council of Antiquities
- Activities and reports of the Technical Committee formed to screen areas/sectors based on structural integrity of its buildings
- Collected infrastructure maps from Competent Authorities and identified sectors containing asbestos water pipes
- Designer adherence to safety measures of PRS and buffer zones for noise
- Socioeconomic review of connection installments for poor people and adjustments made
- Review of designs, tender documents and contractors' tenders by Town Gas HSE Department, and their adherence to mitigation measures

During construction phase monthly reports should include as a minimum:

- Conditional permits and any comments or recommendations by Traffic Department and Supreme Council for Antiquities
- Evaluation of contractor's performance on applying his relevant mitigation measures
- Procedures undertaken by experts of Supreme Council of Antiquities
- Any accidents or breaking of infrastructure pipes
- Monitoring results of excavation machinery exhaust emission, noise and vibrations near antiquity sites, if required

During operation phase monthly reports should include as a minimum:

- Undertaken treatment activities of empty odorant containers in PRSs
- Monitoring results of PRSs noise
- Evaluation of the adherence of PRSs' staff to safety measures
- Rehabilitation and relocation undertaken to LPG distributors by BUTAGASCO and SFD
- Awareness campaigns undertaken in each district
- Social activities of staff of emergency units in districts

Results of each 3 monthly reports shall be analyzed in each quarterly report, with recommendations to improve performance, if required, in the following quarter

[15] If an item is not relevant to the activities of the month, the report should indicate that such activities were not active during the month

6.5 Criteria for selecting PRS locations

Because the exact location of the new PRSs, except for the proposed location of El Tebbin PRS in GASCO complex as mentioned earlier, are not confirmed at this stage, this criteria has been developed to help in selecting most suitable locations and the buffer zones to nearest inhabited areas.

This criteria depends on two main factors, representing the major impacts of the PRS to surroundings, the safety of neighboring areas from possible gas release accidents and noise associated with reducers operations. The following buffer zones are recommended between certain parts of the PRS and neighboring building and inhabited areas:

- Minimum distance between high pressure line (70 bar) and buildings outside the PRS should be 90 meters from the center line. This distance is based on worst case scenario of a 4-inch gas leak from the upstream side, in which a gas cloud in LFL can reach a distance of 32m downwind, if not ignited. If the release ignited in the form of a jet flame, the heat radiation flux contour of 12kw/m^2 would reach a distance of about 50m while the 6kw/m^2 flux can reach 90m

- The location of the PRS should have a blank area from four sides to allow for vehicle access in case of emergency. If 8 meters blank area could be maintained between PRS fences and nearest building, it should be sufficient for vehicles access from all sides of the PRS

- A minimum distance of 20 meters should be kept between reducers and nearest building. This will cause minimization of noise impacts to neighboring areas as mentioned earlier .

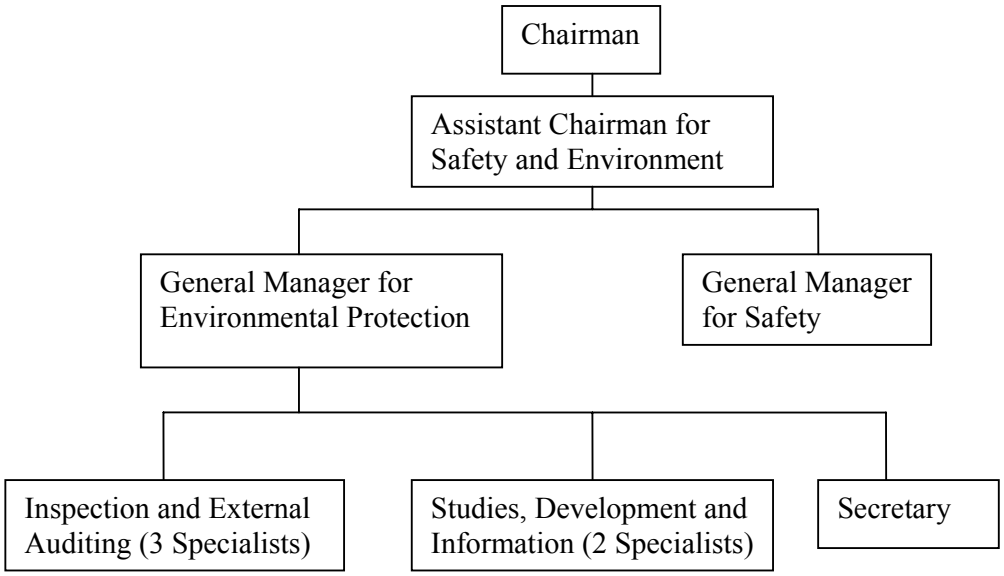
6.6 Institutional Framework for Implementation

6.6.1 Existing Environmental Management Structure of the Implementing Agency

The project shall be implemented by the Egyptian Natural Gas Holding Company (EGAS) and its affiliate company Town Gas. EGAS was established in 2001 as an entity focusing on developing Natural Gas business including upstream and downstream operations. EGAS has a number of affiliate companies with different specialties in the natural gas business chain.

The organizational chart, Figure 6-1, of EGAS indicates that the Assistant Chairman for Safety and Environment is responsible for environmental management, he supervises the General Manager for Environmental Protection and five environmental specialists.

Figure 6-1: Organizational Chart for Environmental Protection Department in EGAS



Being certified for ISO 14001:2004, EGAS has a well defined Environmental Management System in place and running. The Environmental Policy of EGAS mentions that the company is committed to:

- Comply with legislation relevant to their nature of activity;
- Provide training and awareness for their staff in order to carry out their work safely;
- Achieve continual improvement in the fields of safety, health and environment;
- Investigate and analyze incidents to prevent its recurrence;
- Follow-up companies and contractors compliance and implementation of health, safety and environment rules, regulations and provisions;
- Provide necessary information and data on health, safety and environment; and
- Ensure execution of the policy through setting objectives, targets and an action plan. The policy shall be reviewed whenever needed.

Staff members of EGAS carry out audits and inspections on affiliate companies, Town Gas being one of them, to make sure the EMS is being implemented according to set objectives and targets. As part of the EMS procedures, Town Gas is presenting monthly reports, and quarterly reports regarding its environmental performance. EGAS reviews these reports, and makes occasional site inspections to compare these reports with field conditions.

Being the implementing body of natural gas networks in cities, Town Gas has a direct involvement with the environmental management and monitoring of the natural gas network. The Environmental Department of Town Gas includes 5 specialists who are responsible for carrying out this task.

One of the standard tasks that the Environmental Department of Town Gas, which is followed up by EGAS, is establishing Environmental Register for PRSs and buildings, and frequent auditing of this register. For PRSs, the Environmental Register is audited by the HSE Department of Town Gas. The HSE Department audits each PRS twice

annually on the average, in addition to emergency inspections. The routine monitoring activities performed for each PRS include:

- Visual inspection of solid waste and scrap, and disposal methods;
- Visual inspection of existence of liquid waste such as leaked condensate hydrocarbons or chemicals used in the heaters;
- Checking that handling of hazardous waste is according to the approved procedures, which are described below;
- Use gas analyzers to measure SO_2, CO, CH_4 and O_2 in ambient air, and detect possible leaks; and
- Measure noise at different locations of the PRS.

Town Gas HSE personnel have received training on environmental auditing, environmental impact assessments for industrial establishments, and environmental legislation.

Environmental Departments in both EGAS and Town Gas have been less involved in design, planning, tendering and construction procedures of natural gas connection projects in cities. Their role has been more effective in the operational phase according to the described procedures above. However, the Safety Department in Town Gas usually reviews designs, and assigns a full time staff member to supervise the construction contractor, making sure that adequate safety measures are considered during design, and implemented during construction.

6.6.2 Required Resources

It has been concluded from the assessment of the existing practices of EGAS and Town Gas Environmental Departments are following sound environmental procedures in the operation phase. However, the involvement of both departments should be emphasized during the design, tendering and construction phases according to the screening criteria illustrated in Table 6-5.

Town Gas management should take procedures to involve the HSE department in the approval and clearance steps of project designs, tenders evaluation, phasing of implementation and construction. The involvement of Town Gas HSE Department should be reported in their monthly and annual reports submitted to EGAS, who should make sure that the integration of environmental aspects is adequately addressed during design, tendering and construction.

The existing manpower for EGAS is considered suitable for their role in reviewing monthly and quarterly reports produced by Town Gas, and performing infrequent inspection visits to PRSs. However it is recommended to increase the manpower capacity of Town Gas through recruiting additional personnel. The estimated manpower to be used exclusively for the environmental management and monitoring of the project is:

- About 3,000 person-days per year for an HSE site supervisor to shadow construction works.
- About 100 person-days for input during design and tender phase
- About 100 person-days per year for following up mitigation and monitoring through operation phase

The following are recommended training programs for EGAS/Town Gas staff to build their capacity for managing the project.

Table 6-6: Recommended Training Courses for EGAS/Town Gas Staff

Training course	Type of training	Particpating parties	Proposed Scheduling	Cost Estimate *in LE*
Tailored training on Environmental Management and monitoring for the project	Class room + on job training	- Environmental Department staff of EGAS - HSE staff of Town Gas - Design, Projects and Operations department staff (responsible for the project) of Town Gas	Once before detailed design of the project, and once before start construction	LE 50,000/course
Treatment of odorant containers	On Job training	- PRS staff - HSE staff of Town Gas	- Once before start operation of PRS - To be part of the oreintation of new PRS staff and HSE staff of Town Gas during project operation	Management costs of Town Gas
Safety aspects of PRS	Classroom + on Job training	- PRS staff - HSE staff of Town Gas	- Once before start operation of PRS - To be part of the oreintation of new PRS staff and HSE staff of Town Gas during project operation	L.E. 20,000/cource
Environmental auditing and inspection	Classroom + on job training	- New HSE staff of Town Gas recruited for the project	- Once upon recruitement of new HSE staff and once every two years of project duration	L.E. 20,000/cource
Socail training provided for employees of Town Gas emegency units to be able to prepare a case study for poor people	On job training	Emergency units staff	Once yearly	L.E. 20,000 /course

6.6.3 Estimated Budget

The estimated budget for implementing recommended environmental management and monitoring activities is US $ 850,000 during the six years of project construction. The breakdown for this budget is as follows:

- $ 270,000 as salaries/benefits for new Town Gas HSE supervisors to be recruited for the project. It has been assumed that 10 new staff members will be recruited at a total cost of $ 45,000 / year. Cost of input required by existing Town Gas / EGAS staff members is not included.
- $ 25,000 for monitoring vehicles emissions. It has been assumed that 30 excavation vehicles will be working each year and shall be monitored on quarterly basis. This cost is expected to be over normal contractor bid prices

- $ 300,000 for mitigation and monitoring activities for antiquity sites. It should be noted that there was no accurate estimation for number of antiquity sites that needs supervision. In order to reach an estimated budget, it has been assumed that the number of sites requires mitigation/monitoring is 50 sites, each shall cost $ 6,000.
- $ 55,000 gas detectors and PPE in PRSs
- $ 55,000 for training and capacity building for Town Gas staff
- $ 25,000 for awareness for citizens in the 28 districts
- $ 5,000 allowance for possible extra waste disposal requirements, which could be extra to normal contractor bid price
- $ 20,000 for disposal of odorant containers in the hazardous waste facility in Nasserya/Alexandria
- $ 10,000 Allowance for maintenance, rehabilitation and possibility purchase of new noise monitoring equipment
- $ 85,000 for contingencies and confrontation of unforeseen circumstances

7. Public Consultation

7.1 First Public Consultation

The first public consultation for this project was held on November 25th 2006 in Ramsis Hilton Hotel in Downtown Cairo.

There were 113 attendees, including representatives from:

- EGAS
- EEAA
- Towngas
- Petrosafe
- EcoConServ
- World Bank office in Cairo
- Local Districts (where the project will be implemented)
- local NGOS
- Academia
- Community (at large)

The meeting began with a number of opening statements made by representatives from EGAS, EEAA, and Town Gas. This was followed by a presentation made by the ESIAF consultants, which addressed the main features of the project and the identified environmental and social issues.

An open discussion session followed for around 2 hours during which many issues were raised. Some of these issues are highlighted below:

- The citizens' ability to pay, especially in low income areas, is doubtful. This comment has been addressed by many of the attendees including representatives of Cairo Governorate, Giza Governorate, two NGOs and representatives from the Ministry of Petroleum. Among the recommended solutions is that the Government should bear up to 90% of the installation costs, and that different installment options to facilitate payments of installation costs for citizens be in place. It has been recommended that such economic aspects should be addressed in the study.
- The issue that previous clients connected to NG have not paid for their connections has been raised. The representative from EGAS mentioned that it has been the Government's decision to provide partial finance of the project from end users to meet its construction costs.
- Monitoring of radon gas concentrations in residential units and possible leaks of methane inside these units have been raised as recommended activities in the ESMMF. Town Gas has clarified that radon and sulfur is being filtered in gas fields and do not enter to the network. For monitoring methane leaks, this shall be maintained through adding the odorant in PRSs.
- There was a recommendation that the responsibilities of the implementing agency (Town Gas) should include employing adequate criteria for the selection of contractors, who shall be responsible for applying control measures over the project activities.
- There was a recommendation that there should be training for the users of NG in addition to the training of Town Gas staff and contractors. There should be

awareness campaign in mass media about the safe use of NG. An NGO representative recommended that NGOs could play an active role in this awareness. EGAS representatives indicated that gas has been utilized in Egypt in the past decades and proved to be much safer than LPG.
- The risks of gas leaks and capacity of fire-fighting authorities in facing such risk have been also addressed. Again the proven high safety of gas utilization was emphasized.
- The social study should include members of Local Peoples Assembly for their role in the decision making process. This comment has been addressed by Cairo Governorate representative.
- There was a recommendation that LPG cylinder distributors could be substituted by employing them in the new project.
- There was a recommendation that the study and presentation should be available on the EGAS website to include a service for receiving comments from members of the public.

7.2 Second Public Consultation

The Second public consultation for this project was held on December 27th 2006 in Ramsis Hilton Hotel in Downtown Cairo.

There were ١٠٩ attendees, including representatives from:
- EGAS
- EEAA
- Town Gas
- Enppi
- Petrotrade
- GASCO
- Egypt Gas
- Ministry of Petroleum
- Social Fund for Development
- Ministry of Health
- Ministry of Manpower
- Media
- Environmental consultancy firms
- Local Districts (where the project will be implemented)
- Local NGOs
- Academia
- Community (at large)

The meeting began with opening statements made by the representatives from EGAS, EEAA, and Town Gas, followed by a presentation made by the ESIAF consultants, which addressed the main features of the project and the identified environmental and social issues.

An open discussion session followed for around 2 hours during which many issues were raised. Some of these issues are highlighted below.

- PRS locations selection was raised. There were recommendations for identifying buffer zones so as to prevent future urbanization from getting near PRSs. It was emphasized that the QRA prepared for the PRS considered populated surroundings of PRS, and that the risks of leaks/fires, if mitigation

measures were followed, are within the boundaries of the PRS and within an acceptable range.

- A representative from GASCO mentioned that the proposed location for El Tebbin PRS, is currently having a PRS operated by GASCO. The PRS is receiving complaints from an adjacent house about high noise levels and he suggested to consider an alternative location of this PRS.
- The issue of raising people's awareness regarding the utilization of NG was brought up. It was emphasized that EGAS should play an active role in this regard.
- It was emphasized that there should be a strong collaboration between Town Gas and its contractors and whatever body responsible for repaving the road, so that the road is effectively paved shortly after excavations works.
- It was also emphasized that construction solid waste should be effectively disposed in the allocated disposal sites.