Initial Environmental Examination

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Bangladesh: Natural Gas Infrastructure and Efficiency Improvement Project (Component 1 - Installation of Wellhead Gas Compressors at Location “A” of Titas Gas Field)

Prepared by Bangladesh Gas Fields Company Limited for the Asian Development Bank.

CURRENCY EQUIVALENTS
(as of 3 August 2016)

Currency unit	–	Taka (Tk)
Tk 1.00	=	$0.012755
$1.00	=	Tk78.40

ABBREVIATIONS

ADB	-	Asian Development Bank
AIIB	-	Asian Infrastructure Investment Bank
BGFCL	-	Bangladesh Gas Fields Company Limited
CITES	-	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DOE	-	Department of Environment
EA	-	Executing Agency
ECA	-	Environment Conservation Act
ECC	-	Environmental Clearance Certificate
ECR	-	Environment Conservation Rules
EIA	-	Environmental Impact Assessment
EMP	-	Environmental Management Plan
EMRD	-	Energy and Mineral Resources Division
ESMS	-	Environment and Safety Management System
GoB	-	Government of Bangladesh
GRC	-	Grievance Redress Committee
IEE	-	Initial Environmental Examination
LCC	-	Locational Clearance Certificate
MOEF	-	Ministry of Environment and Forests
MPEMR	-	Ministry of Power, Energy and Mineral Resources
NOC	-	No Objection Certificate
PIU	-	Project Implementation Unit
ROW	-	Right of Way
SPS	-	Safeguard Policy Statement

WEIGHTS AND MEASURES

^{o}C	-	degree Celsius
dB(A)	-	A-weighted decibel
ha	-	hectare
Hp	-	horsepower
lahk	-	100,000
ppb	-	parts per billion
ppm	-	parts per million
$\mu g/m^3$	-	microgram per cubic meter
m^2	-	square meter

NOTE

In this report, "$" refers to US dollars.

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EXECUTIVE SUMMARY

Introduction

1. The Project will be funded by Asian Development Bank (ADB) with cofinancing from the Asian Infrastructure Investment Bank (AIIB) at an estimated total cost of $447.6 million.

2. Component 1 of the Project will involve the installation of wellhead compressors at Location – A of Titas Gas Field. The Executing Agency (EA) for Component 1 is Bangladesh Gas Fields Company Limited (BGFCL), which is one of the operating companies of the Bangladesh Oil, Gas and Mineral Corporation (Petrobangla) under the Energy and Mineral Resources Division (EMRD) of the Ministry of Power, Energy and Mineral Resources (MPEMR). BGFCL is entrusted with the production of natural gas from its five producing fields and processing of gas to the transmission pipeline system.

3. Commercial gas production at the Titas Gas Field began in April 1968. Over time, wellhead pressure of wells has been decreasing at an average annual rate of 90 pounds per inch (psi) and within the next 3-5 years, it is estimated that natural gas flow can no longer maintain the gridline pressure without the installation of compressors before the existing natural gas process plants at Location A in the Titas Gas Field. Gas compressors will be essential to augment gas transmission capacity to meet the increasing gas demand.

Project Description

4. Component 1 will be located in about 0.6 hectare (ha) of land within the existing facility owned by BGFCL at Location A of the Titas Gas Field. No unauthorized public access to Location A is allowed by BGFCL. The existing natural gas processing facility of BGFCL at Location A of Titas Gas Field consists of major equipment such as five glycol dehydration units and one low-temperature separation unit with glycol injection. Two fractionation units separate the condensate, which is a by-product of gas processing, into liquid fuel as motor spirit (MS) and high speed diesel (HSD). MS and HSD are sold to Padma Oil Company Limited, and Meghna Petroleum Limited. The two gas treatment plant and one of the fractionating plants were financed by ADB.[1]

5. Component 1 will consist of seven reciprocating compressors with a capacity each of 60 million standard cubic feet (MMSCF) per day of natural gas. Five compressors will be operating at a time while two compressors will be standby. The compressors will require 5 MMSCF of natural gas daily as fuel for its operation and 16 tons of water per day for its closed recirculating cooling water system. Water requirements will be provided through borehole/deep tube well from the existing BGFCL natural gas processing plant facility. Make up water for the cooling system will be required only when leakage has occurred at pump packings through years of operation or when water has been drained to allow system repair. The daily output capacity of compressed gas from these compressors will be 300 MMSCF. Activities associated with the installation of the compressors from construction, testing and/or commissioning, and operation will follow relevant regulations of the Government of Bangladesh (GoB) and applicable industry and international standards.

[1] ADB. Project Performance Audit Report on the Second Natural Gas Development Project. November 1997. Loan 714-Bangladesh: Second Natural Gas Development Project. July 1984. http://www.adb.org/sites/default/files/evaluation-document/35316/files/pe492.pdf (Accessed 3 August 2016)

Environmental Requirements

Government of Bangladesh Requirements

6. Environmental Conservation Act (ECA) 1995 and Environmental Conservation Rules (ECR) 1997 of the GoB under the Department of Environment (DOE) of the Ministry of Environment and Forests (MOEF) classify Component 1 as a "red" category project requiring an initial environmental examination (IEE) for the issuance of the locational clearance certificate (LCC) and an environmental impact assessment (EIA) for the environmental clearance certificate (ECC) after obtaining the LCC. However, given that Component 1 will be located within an existing natural gas facility owned and operated by BGCFL with previous ECCs, BGFCL requested the DOE on 3 November 2015 for an exemption from submitting an IEE and EIA but instead consider their submission for an environmental management plan (EMP). BGFCL has a similar project where it required the installation of six wellhead compressors in their existing gas fields: Narsingdi Gas Fields (3 compressors), and Titas Gas Field-Location C (3 compressors). For these wellhead compressors in the two gas fields, DOE issued an ECC 17 July 2014 with EMP as supporting document. Based on the request of BGFCL, the DOE agreed on 25 January 2016 that for Component 1, an EMP will be submitted for the issuance of the ECC. Other existing facilities in the Titas Gas Fields (i.e., natural gas process plants, drilling of wells, and workover2 for Titas well #21) were issued their ECC by the DOE.

ADB and AIIB Requirements

7. The Safeguard Policy Statement (SPS) 2009 of ADB sets out the requirements for environmental safeguard that applies to all ADB-financed projects. The Asian Infrastructure Investment Bank (AIIB) was established in October 2014 as a multilateral bank and the Multilateral Interim Secretariat for Establishing the AIIB has developed the Draft Environmental and Social Framework that completed public consultations on 23 October 2015. The Project will adopt SPS 2009 as the unified environmental assessment and planning process for consultation, disclosure requirements and safeguard documentation to meet the safeguard principles and requirements of both of ADB and the AIIB. Based on SPS 2009, the project is category B requiring an IEE. Thus, this IEE is prepared to meet the requirements of ADB and AIIB. Aside from complying with the provisions set forth in SPS 2009, ADB also requires BGFCL to comply with the environmental requirements of the DOE. BGFCL will provide to ADB the ECC to be issued by the DOE for Component 1.

Anticipated Impacts and Mitigation Measures

8. Component 1 is not expected to cause significant adverse environmental impacts. Location A, where the compressors will be installed is within an area considered industrial. Construction-associated impacts such as increase in noise and dust levels, generation of waste, disruption to daily activities and local traffic are temporary and of short duration. The construction and installation of the compressors would not require use of a significant amount of water to result in generation of significant quantity of wastewater/sludge. BGFCL will require the EPC Contractor to prepare a Construction Management Plan describing the procedures and measures to mitigate these impacts.

9. During operation, BGFCL will require the EPC Contractor, who will continue during the first year of operation, to prepare a safety management plan and an emergency and disaster

[2] Gas well workover is a remedial work within the well in an attempt to increase the rate of gas flow.

preparedness plan. Staff will be trained on the proper handling and management of the compressor operations. Daily water requirements for recirculating cooling water system will be taken from groundwater wells from the existing gas processing facility.

10. Natural gas at Titas Gas Fields is about 97%$_{mole}$ methane (CH_4) and does not contain hydrogen sulfide (H_2S). Use of natural gas to fuel the compressors will result to emissions that are mainly carbon dioxide (CO_2). About 272 metric tons (MT) of CO_2 emissions per day will be contributed by Component 1 to greenhouse gas (GHG) emissions or about 99,280 MT CO_2 per year on a "worst scenario" of operating the seven compressors at the same time. Tree planting will be done at designated areas in Titas Gas Field not only to serve as sinks for the emissions but is required by Petrobangla in its key point installation (KPI). Carbon sequestration by trees is a complex process and involves several factors such as survival rate, species, age of tree to be planted, soil type, etc. Given these factors, only tree species common to Brahmanbaria will be planted such as Ashwatha tree (*Ficus religiosa)* belonging to the mulberry family, and Neem (*Azadirachta indica).*[2] The Department of Forest (DOF) will be consulted on the appropriate tree species to be planted at and around the Titas Gas Field.

11. Over time, compressors wear and may cause leaks of CH_4 and volatile organic compounds (VOCs). These fugitive emissions can be mitigated by techniques such as replacement of compressor rod packing, replacement of the piston rod, and refitting or realignment of the piston rod. In May 2016, the US EPA issued the requirements for reciprocating compressors focusing on monitoring (i.e., record keeping) and reporting (i.e., annually) of the condition of rod packing: (i) on or before every 26,000 hours of operation (operating hours must be monitored and documented), and (ii) every 36 months (monitoring and documentation of operating hours not required).[3] Among others, BGFCL will conduct monitoring and reporting of the condition of the compressor packing systems as fugitive emissions is a systems loss with associated costs.

12. Operation of natural gas compressors does not come without risks of explosion and fire given that natural gas is flammable. The lower explosion limit of CH_4 is 5% and the upper explosion limit is 15% in the presence of an ignition source. This means that CH_4 concentration lower than 5% ("too lean") and higher than 15% ("too rich) will not cause fire in the presence of ignition source. Component 1 will be within the area of the existing natural gas processing plant of BGFCL at Titas Gas Field. Given the capacity of natural gas being processed at this facility and its national economic significance, BGFCL has an environment safety management system (ESMS) as well as safety and hazard mitigation plan to address the risks of explosion or fire. Among others, the operation of BGFCL is subject to the Natural Gas Safety Rules 1991 (amended 2003) and The Factories Act 1965. In August 1993, a team of safety engineering experts from British Gas experts was engaged to conduct a safety audit of the entire operations of Petrobangla and concluded that all operating companies (which included BGFCL) are generally operating an adequate system and provided recommendations for safety program development which were incorporated in the ESMS.[4] ADB provided financing in March 2010 to

[2] US Environmental Protection Agency. GHG Equivalencies Calculator - Calculations and References. https://www.epa.gov/energy/ghg-equivalencies-calculator-calculations-and-references. (Accessed 3 August 2016)

[3] US EPA. Summary of Requirements for Equipment at Natural Gas Transmission Compressor Stations. https://www3.epa.gov/airquality/oilandgas/may2016/nsps-gas-transmission-fs.pdf. (Accessed 3 August 2016)

[4] World Bank. Gas Infrastructure Development Project. 1995. Environment and Safety Assessment Report: Summary. May 1994. http://www.worldbank.org/projects/P009533/gas-infrastructure-development-project?lang=en&tab=documents&subTab=projectDocuments. (Accessed 3 August 2016)

cover safety and supply efficiency improvement in Titas Gas Field.[5] The Bakhrabad Gas Field has wellhead compressors since 2007 and no trouble has been encountered during installation and operation.[6] Japan International Cooperation Agency (JICA) has financed the installation of wellhead compressors for Titas Gas Field Location "C" (three compressors) and Narshingdi Gas Field (three compressors) and the project was implemented in July 2014 to June 2018.[7] BGFCL also operates Narshingdi Gas Field and thus, has the experience to implement Component 1 following the highest standards and norms on safety.

13. At decommissioning, BGFCL will require the Contractor to prepare a decommissioning plan following the industry best practice. The decommissioning plan will be submitted to ADB for review and approval to ensure that it meets SPS 2009 and the World Bank Environmental, Health, and Safety General (EHS) Guidelines 2007 (or any updates).

14. All the impacts identified for the implementation of Component 1 can be readily mitigated by proper planning, compliance to design and relevant industry standards, and good engineering construction and management.

Analysis of Alternatives

15. The production wells at Titas Gas Field that require the installation of wellhead compressors are located within the existing natural gas facility of BGFCL. With the availability of a secured space to accommodate the required capacity of the wellhead compressor at Location A, and connections to water supply, electricity, fire and safety system including road access and other physical infrastructure, no other sites were considered. Aside from these existing technical support systems, the future expected capacity of the production wells once Titas well #5 is back in operation was also considered in selecting Location A. As part of design and planning of BGFCL, all the locations of the production wells at Titas Gas Field (i.e., Location A, C, E, and G, etc.) has earmarked land to accommodate the installation of compressors, as and when, the operation requires.

16. "Without project" option will stall planned national economic development dependent on a reliable supply of natural gas including the associated jobs that could have been generated. Without Component 1, the operations of existing industries and residential users of natural gas will be compromised due to decreasing gas flow from the Titas Gas Fields.

Information Disclosure, Consultation and Participation

17. Initial consultations were carried out on 18 October 2015 at the Union Parisad Office of Shuhilpur in Brahmanbaria District participated by 36 local residents. Some of the concerns raised were: (i) potential increase in noise and dust levels, (ii) poor sanitation due to construction waste, (iii) water pollution of natural water bodies like Titas River, and (iv) potential disruption of local residents in their daily activities during construction. Concerns associated with construction activities will be of short duration and temporary. Appropriate mitigation measures will be implemented to address these concerns. Expectations include: (i) local priority in hiring

[5] ADB. Loan 2622/2623-BAN: Natural Gas Access Improvement Project. 2010. http://www.adb.org/projects/38164-013/main#project-pds. (Accessed 3 August 2016)

[6] Japan International Cooperation Agency. Preparatory Survey on the Natural Gas Efficiency Project in the People's Republic of Bangladesh. Final Report. March 2014

[7] BGFCL. Annual Report 2013-2014. http://www.bgfcl.org.bd/~pavel/images/AnnaulReport2013-14/Page34-41.pdf. (Accessed 4 August 2016)

of workers and staff, (ii) engagement of local businesses/contractors, and (iii) timely and appropriate compensation to persons that may be potentially affected by Component 1.

18. Consultations will continue during implementation, as and when needed. A one-page flyer in Bangla about the project brief including the grievance redress mechanism (GRM) will be made available to the public by BGFCL at the project office and in their offices in Barishar and Dhaka as well as in their website.

Grievance Redress Mechanism

19. BGFCL has an existing grievance redress system (GRS) which is part of the mandatory strategic objectives of the Annual Performance Management of the GoB. BGFCL signs a yearly agreement with Petrobangla to comply with GRS. The GRS requires a mandatory designation of staff as focal point. The name of the designated staff and contact details are disclose to the website of BGFCL.

20. To meet the requirements of SPS 2009, a grievance redress mechanism (GRM) will be established by the Project Implementation Unit (PIU) of BGFCL to deal with complaints from affected persons (APs) that may be potentially raised during the implementation of Component 1. The APs can seek redress of their grievance at three levels: (i) the PIU-BGFCL or through the representative of the Engineering, Procurement and Construction (EPC) Contractor during construction phase, (ii) through the grievance redress committee (GRC), and (iii) the appropriate courts of law.[8] GRC will be set up by the PIU-BGFCL as soon as Component 1 commences and will consist of representative from the EPC Contractor, local government unit, designated staff of PIU-BGFCL on environmental issues (or a Consultant), and witness of the AP. PIU-BGFCL will ensure the representation of women in the GRC. The BGFCL staff designated in the existing GRS required by Petrobangla will be part of the GRC.

Environmental Management Plan

21. An environmental management plan (EMP) was prepared for the impacts identified for Component 1 (see **Table 9.1**). An estimated Tk320,000 per year will be allocated to conduct the activities included in the environmental monitoring plan. This amount will vary depending on the results during implementation.

22. During construction stage, the EPC Contractor will be responsible for implementing the relevant requirements in the EMP under the supervision of PIU-BGFCL. Prior to awarding of the civil works contract, the EPC Contractor will recruit an environmental staff (or a Consultant) to deal with environmental concerns associated with Component 1. PIU-BGFCL will provide an orientation to the EPC Contractor(s) and workers on their responsibility to comply with the EMP and the requirements of ADB and GoB during construction stage and until the end of first year of the operation stage.

23. During the second year of the operation stage, PIU-BGFCL will designate a staff who will be responsible to manage environmental compliance to ADB and GoB. Environmental staff may come from the Environment and Safety Department of BGFCL or will recruit a staff co-terminus with the project.

[8] Members of GRC will consist of: (i) BGFCL staff designated for GRS, (ii) representative from the EPC Contractor (during construction phase and first year of operation phase), (iii) local government unit representative, (iv) PIU-BGFCL designated staff (or consultant) on environmental issues, and (v) witness of the complainant.

24. Environmental monitoring reports will be submitted by BGFCL to ADB semi-annually during construction stage and annually during operation stage. These monitoring reports will be posted to ADB website as provided for in SPS 2009 and Public Communications Policy (PCP) 2011. PIU-BGFCL will ensure compliance to the requirements of ADB and GoB.

Conclusion and Recommendation

25. There is a great need to install compressors at Location A in Titas Gas Field to ensure the reliable supply of natural gas at the required pressure to facilitate transmission. Location A is about 0.6 hectare (ha) that will accommodate seven compressors where five compressors will be in operation at a time while two compressors will be standby.

26. Installation of these compressors will not cause significant adverse environmental impacts given that it is within an area considered for industrial use. Vegetation is mainly grassland. The DOE has issued the ECCs for the existing facilities. Since Component 1 is within an existing facility, the DOE advised the BGFCL to submit an EMP in securing the ECC instead of the usual IEE and EIA requirements for red category project.

27. Potential environmental impacts during construction stage may include increased level of noise and dusts, generation of waste from construction works, and disruption to daily activities in Ghatura mauza in Sadar Upazila, Brahmanbaria. These potential impacts can be mitigated by best construction engineering practices and adherence to relevant regulations of GoB and requirements of ADB. Mitigation measures are included in the EMP and the parameters for monitoring have been identified in the environmental monitoring plan.

28. While the local people consulted support the project, they raised concerns on compensation and participation in potential business opportunities. Continuous communication and/or consultations will be conducted during implementation on community safety and environmental management. Should there be any concerns not addressed during consultations, a grievance redress mechanism will be will be set up by the PIU-BGFCL.

29. This draft IEE will be publicly disclosed at the ADB website as required by SPS 2009 and PCP 2011. A project brief and/or factsheet which would include details on GRM will be prepared in Bangla and made available to the public at the PIU-BGFCL field office, in Barishar and in its liaison office in Dhaka.

30. Component 1 will have potential environmental impacts but these can be readily mitigated. Overall, the improvement in the supply of natural gas as a result of Component 1 is expected to contribute in meeting the growing demand for natural gas and in the economic development of Bangladesh.

1.0 BACKGROUND

1.1 Overview of the Project

31. The Project aims to increase the contribution of the energy sector to sustainable economic growth by financing the improvement of efficiency of gas production from existing gas field, and expansion of gas transmission pipeline through construction of gas transmission pipelines. The Project details are shown in **Table 1.1**. The total financing is estimated at $447.6 million. ADB will arrange financing of the foreign currency cost from its resources and through cofinancing with the Asian Infrastructure Investment Bank (AIIB).

Table 1.1 Project Details

Project	Description	Executing Agency
Component 1: Installation of well head compressors	Installation of wellhead gas compressor at Titas Field (Location A)	Bangladesh Gas Fields Company Ltd. (BGFCL)
Component 2: Construction of Chittagong-Bakhrabad gas transmission pipeline	Construction of 36-inch, 181 km Chittagong-Bakhrabad gas transmission pipeline	Gas Transmission Company Ltd. (GTCL)

32. Physical interventions of the Project will involve two components: (i) installing seven new wellhead gas compressors; and (ii) constructing 181 km 36 inch Chittagong-Bakhrabad gas transmission pipeline.

33. As the EAs, BGFCL and GTCL will each set up a Project Implementation Unit (PIU) for implementing, monitoring, and reporting on the progress of project implementation to ADB and GoB. The PIU will consist of technical, financial, and procurement staff, while additional safeguards support will be hired, as and when required. At present, BFGCL, and GTCL have their own environment unit. PIU will be responsible for safeguards compliance and project impacts monitoring. If necessary, consulting services will be provided to the PIU as support to supervision of technical due diligence process, safeguards due diligence, monitoring, and reporting.

34. A Steering Committee, chaired by the Secretary, EMRD will be established who will be responsible for coordinating the overall implementation of the Project. Members of Steering Committee will be the Chairman, Petrobangla, Managing Directors of BGFCL, GTCL and representatives from the Finance Division, Planning Commission, Economic Relations Division (ERD), and Implementation Monitoring and Evaluation Division (IMED).

1.2 Environmental Requirements for the Project

35. The Project will adopt the ADB's Safeguard Policy Statement (SPS) 2009 as the unified environmental assessment and planning process for consultation, disclosure requirements and safeguard documentation to meet the safeguard principles and requirements of both of ADB and the AIIB. Therefore, the Project will follow the environmental policies and review procedures of ADB as embodied in SPS 2009 as well as the relevant environmental requirements of the GoB. The Project is classified as Category B on environmental safeguard based on SPS 2009 which requires the preparation of an IEE.[9]

[9] ADB, Safeguard Policy Statement, June 2009, para. 50, p.19.

36. In terms of the environmental requirements of GoB under DOE, the project will be subject to the provisions set forth in the ECA of 1995 and the ECR 1997. According to these environmental regulations, the components fall within the Red category requiring both an IEE to secure the LCC from the DOE and an EIA to obtain the ECC after securing the LCC.

2.0 POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

2.1 Environmental Requirements of Bangladesh

37. The following presents the regulatory agency, process, regulations and international environmental agreements relevant to the Project.

2.1.1 Environmental Agency

38. The Ministry of Environment and Forests (MOEF) is the agency that plans, promotes, coordinates and oversees the implementation of programs and plans on environment and forestry. MOEF manages all national environmental matters and is responsible for activities such as prevention and control of pollution, forestation and regeneration of degraded areas and protection of the environment. MOEF also conducts surveys, impact assessment, control of pollution, research, and collection and dissemination of environmental information and creation of environmental awareness among all sectors in Bangladesh.

39. MOEF performs its regulatory functions through DOE, which was created in 1989 as the primary government agency entrusted with regulating and enforcing environmental management regulations to ensure sustainable development and to conserve and manage the environment. DOE ensures the consistent application of environmental rules and regulations, and provides guidance, training and promotional campaign on improving the awareness of environmental issues.

2.1.2 Applicable Environmental Regulations

40. The main environmental regulations in Bangladesh to ensure that projects are implemented sustainably include the ECA of 1995 and the ECR of 1997.

41. ECA together with its amendments made in 2000, 2002 and 2010 sets forth the requirements for the protection of the environment, improvement of environmental standards, and the control and abatement of environmental pollution. By this Act, DOE is mandated to undertake any activity needed to conserve and enhance the quality of environment and to control, prevent and mitigate pollution.

42. The ECR provides for the rules relevant to the declaration of ecologically-critical areas, securing of environmental clearance certificate, environmental quality standards, acceptable limits for discharges of waste, and environmental guidelines on pollution prevention. Overall, the ECA and ECR outline the regulatory mechanism to protect the environment in Bangladesh.

43. **Requirement for Environmental Clearance Certificate** According to Section 12 of ECA 1995, no industrial unit or project can be established or undertaken without securing an ECC from the Director General, DOE. Based on ECR 1997, DOE has classified various development interventions according to the potential adverse environmental impacts for the purpose of issuing the ECC. This classification includes: (i) green, (ii) orange-A, (iii) orange-B,

and (iv) red. Green category are industries or projects considered to be relatively pollution-free, thus, no environmental study will be required while the Red category are industries/projects which may cause significant adverse environmental impacts and therefore, require an EIA.

44. An ECC is issued by the DOE for all existing industrial units and projects, and to all proposed industrial units and projects under the Green category. For projects and industrial units classified as Orange-A, Orange-B, and Red, securing the ECC involves two steps: (i) issuance of LCC, and then (ii) the ECC.

45. The project components (i.e., natural gas compressor, gas transmission pipeline, and gas distribution pipelines) fall within the Red category following the classification of DOE. As such, the EAs will be required to secure LCC and ECC. **Figure 2.1** shows the process of securing ECC for a Red category project while **Table 2.1** presents the relevant national environmental regulations, and other laws and policies while **Annex 1** gives the relevant environmental quality standards of Bangladesh.

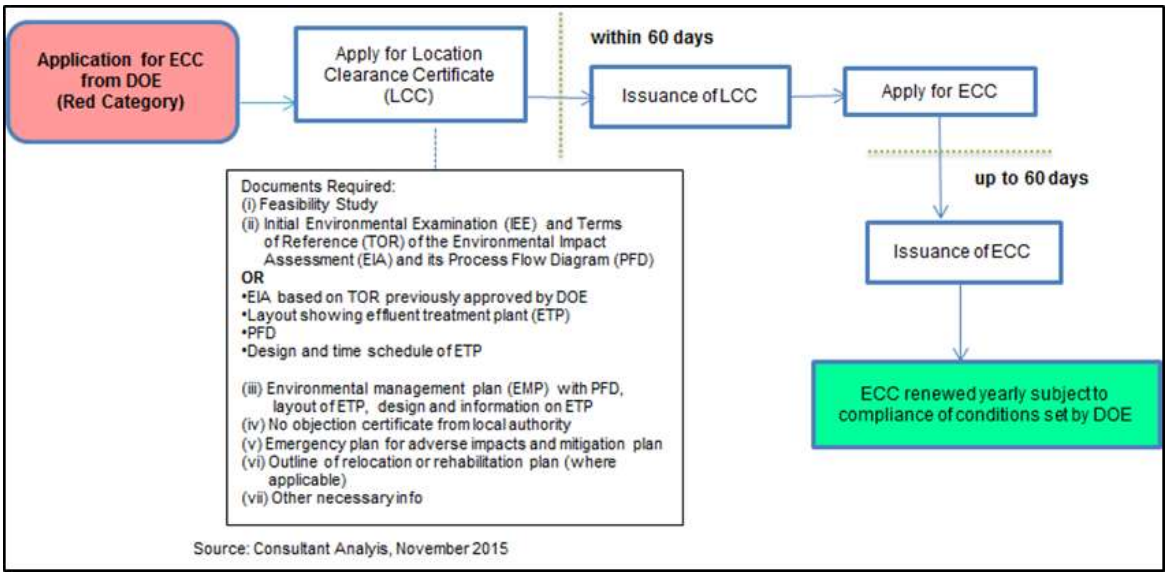


Figure 2.1 ECC Application Process for Red Category Project

Table 2.1 Relevant National Regulations, Laws and Policies

Regulation	Brief Description	Remarks
Environment Court Act 2000 (amended in 2002 and 2010)	This Act is under the Judiciary and MOEF to ensure the resolution of disputes on environmental and social damages resulting from any development activities. This Act also allows for the completion of environment-related legal proceedings effectively.	The EAs will ensure that all potential environmental issues/complaints will be dealt with effectively at the project level through the Project Implementation Unit (PIU). At present, the EAs have a grievance redress system (GRS) to address project-level complaints. GRS is part of the GoB Annual Performance Management System.

Regulation	Brief Description	Remarks
		ADB requires the establishment of a grievance redress mechanism in its funded-projects known to cause potential environmental impacts.
Vehicle Act 1927, the Motor Vehicles Ordinance 1983, and Bengal Motor Vehicle Rules 1940	These are under the Bangladesh Road Transport Authority (BRTA) which regulates vehicular emissions and noise including road safety.	BRTA regulations on vehicular emissions and noise will be complied with by vehicles that may be used during construction and operation of the project components.
Factories Act 1965 and Bangladesh Labour 2006	These regulations are the Ministry of Labour which provides for the occupational rights and safety of factory workers and the provision of comfortable work environment and reasonable working conditions.	Workers recruited under the project will be provided with what is relevant to them as set forth in these regulations.
The Forest Act 1927 (amended in 1982 and 1989)	Primary aim is to protect the forest resources and this Act is under MOEF.	No natural gas pipelines will be funded if it will traverse identified protected forest areas.
National Energy Policy (NEP) 2008	Under MPEMR and consistent with Vision 2021, this Policy focuses on energy security and efficiency, financial transparency, cost recovery, and a bigger role for the private sector. The Policy also identifies fuel strategies for energy sustainability and security according to priority: (i) natural gas, (ii) coal, (iii) energy efficiency, (iv) renewable energy, and (v) nuclear.	Components will be consistent with NEP 2008.
Telegraph Act 1885	This Act is under the Ministry of Posts and Telecommunication which provides power to the Telegraph Authority to alter position of gas or water pipes or drain (Sect. 14, a and b).	The Project will refer to the Bangladesh Telecommunications Company Limited (BTCL) on the selection of gas pipeline route.
Electricity Act 1910	This Act relates to the supply and use of electrical energy, and which allows any person to secure a license to supply energy and to put down or place electrical supply lines for the transmission of energy. Sect 19(1) of the Act provides that the licensee, in the exercise of any of the powers conferred by or under this Act, will cause as little damage, detriment and inconvenience as may be, and will make full compensation for any damage, detriment or inconvenience caused by him or by any one employed by him.	The Project will refer to the applicable provisions in this Act.
Gas Safety Rules 1991 (amended 2003)	Provides guidelines on the materials, design and construction of gas transmission and pipeline industry. This Safety Rules were based on the American National Standard Codes for Gas Transmission and Piping System.	EAs have been complying with these safety rules.

Regulation	Brief Description	Remarks
The Antiquities Act 1968 (amended 1976)	Regulation on the preservation and protection of antiquities.	Selection of project sites will refer to the requirements of this Act.
Natural Water Bodies Protection Act 2000	According to this Act, the character of water bodies i.e. rivers, canals, tanks, or floodplains identified as water bodies in the master plans or in the master plans formulated under the laws establishing the municipalities in division and district towns shall not be changed without approval of concerned ministry. This Act is under the Rajdhani Unnayan Kartipakkha/Town Development Authority/Municipalities.	Gas transmission and distribution pipelines that will cross rivers, ponds, canals, and drainage channels will refer to this Act and will secure the required approval and clearances.
Wildlife (Protection and Safety) Act 2012	The Act provides for the conservation and safety of biodiversity, forest and wildlife of the country by repealing the existing law relating to conservation and management of wildlife of Bangladesh.	In December 2013, IUCN Bangladesh launched its flagship project of updating the national Red list. Sites of subprojects will ensure that no species protected by this Act and the updated IUCN Red List (Bangladesh) will be affected.

Source: ADB Consultant, November 2015.

2.1.3 Relevant International Environmental Agreements

46. Aside from the national environmental regulations, international environmental agreements where Bangladesh is a party will be considered, as appropriate, in the screening and final selection of project components. **Table 2.2** lists applicable international environmental agreements that can provide guidance during the site selection and implementation of the project:

Table 2.2 Bangladesh Relevant International Environmental Agreements

International Environmental Agreement	Description	Date Ratified	Comments
Convention Concerning the Protection of the World Cultural and Natural Heritage (Paris 1972)	Entered into force on 23 November 1972, this convention defines and provides for the conservation of the world`s heritage by listing the natural and cultural sites whose value should be preserved.	3 November 1983	Site selection will refer to the existing list of natural and cultural sites, if available, or consult with relevant government agency to avoid impacts in areas of cultural and natural heritage value.
Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar 1971)	Provides a framework for national action and international cooperation for the conservation and sustainable use of wetlands and their resources. This convention entered into force on 21 December 1975.	21 September 1992	Identified Ramsar sites • Tangauar Haor (Northeast of Bangladesh) – declared in 1999 • Parts of Sundarban Reserved Forest (Southwest of Bangladesh) – declared 1992

International Environmental Agreement	Description	Date Ratified	Comments
			Project component site selection will avoid these two Ramsar sites.
Convention on Biological Diversity (1992)	A framework for biodiversity, entered into force on 29 December 1993, and requires signatories to develop national strategies (National Biodiversity Strategy and Action Plan) for the conservation and sustainable use of biological diversity.	3 May 1994	Project components will refer to the applicable National Biodiversity Strategy and Action Plan in selecting the sites. Any replacement of cleared vegetation resulting from the project will be consistent with the objectives and priorities of the Action Plan.
Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington 1973) – also known as CITES	Entered into force on 1 July 1975, this framework addresses the overharvesting and exploitation patterns that threaten species of flora and fauna. Under this Convention, the governments agree to restrict or regulate trade in species that are threatened by unsustainable patterns and to protect certain endangered species from overexploitation by means of a system of import/export permits.	20 November 1981	Project components will ensure that it will not cause any harvesting and exploitation of wild flora and fauna during pre-construction, construction, operation, and decommissioning.
Convention on the Conservation of Migratory Species of Wild Animals (Bonn 1979)	Sets the framework for agreements between countries that are important to the migration of threatened species. This Convention came into force on 23 June 1979.	1 December 2005	Consult relevant government authorities and/or experts to avoid areas known to be habitat of migratory species of wild animals in selecting sites of project components.
Vienna Convention for the Protection of the Ozone Layer 22 March 1985	A framework for efforts to protect the globe's ozone layer by means of systematic observations, research and information exchange on the effects of human activities on the ozone layer and to adopt legislative or administrative measures against activities likely to have adverse effects on the ozone layer.	2 August 1990	Project components will not use chemicals that can affect the ozone layer such as methyl chloroform, a solvent generally used for industrial processes.
Montreal Protocol on Substances that Deplete the Ozone Layer (a protocol to the Vienna Convention for the Protection of the Ozone Layer)	This international treaty was entered into force on 1 January 1989 and is designed to protect the ozone layer by phasing out the production of numerous substances that are responsible for ozone depletion. This treaty also requires controlling emissions of substances that deplete ozone.	2 August 1990	Project components will not use chemicals that can cause harm to the ozone layer.

International Environmental Agreement	Description	Date Ratified	Comments
Kyoto Protocol (1997)	An international agreement adopted on 11 December 1997 and entered into force on 16 February 2005, which commits its Parties to set internationally-binding emission reduction targets. This agreement is linked to the United Nations Framework Convention on Climate Change (UNFCCC).	22 October 2001	Project components will ensure zero or minimal fugitive natural gas emissions. Emissions from compressors will comply with the limits set by DOE.
UNFCCC (1992)	This framework came into force on 21 March 1994 and aims to achieve stabilization of greenhouse gas (GHG) concentrations in the atmosphere at a level low enough to prevent dangerous anthropogenic interference with the climate system.	15 April 1994	Project components will ensure zero or minimal fugitive natural gas emissions.
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989)	This convention came into force on 5 May 1992 which aims to reduce the amount of waste produced by signatories and regulates the international traffic in hazardous wastes.	1 April 1993	Project components will not generate hazardous wastes. Disposal of chemicals used (if and when needed) will follow the instructions in the material data safety sheet and this convention.
UNESCO World Heritage Convention 1972	This convention describes the concepts of nature conservation and the preservation of cultural properties. Parties agree to identify and nominate properties on their national territory to be considered for inscription on the World Heritage List, gives details of how a property is protected, and provides a management plan for its upkeep.	3 August 1983 (Accession) Accession – the state accepts the offer or the opportunity to become a party to a treaty already negotiated and signed by other states	UNESCO World Heritage Sites: • Sundarbans Reserve Forest (1997) • Historic Mosque City of Bagerhat (1985) • Ruins of the Buddhist Vihara of Paharpur (1985) Project components will make sure that site selection will not affect these sites.

Source: ADB Consultant, November 2015.

2.2 Environmental Requirements of Asian Development Bank and the Asian Infrastructure Investment Bank

47. This section discusses the key elements of the environmental requirements of ADB and the cofinancier, AIIB applicable to the Project.

2.2.1 Asian Development Bank

48. SPS 2009 provides for the environmental requirements and review procedures of ADB and applies to all projects and grants they finance. SPS 2009 comprises three key safeguard areas: environment, involuntary resettlement, and indigenous peoples; and aims to avoid adverse project impacts to both the environment and the affected people; minimize, mitigate and/or compensate for adverse project impacts; and help Borrowers to strengthen their safeguard systems and to develop their capacity in managing the environmental and social risks.

49. At the project identification phase, ADB uses a categorization system to indicate the significance of potential environmental impacts and is determined by the category of its most environmentally-sensitive component, including direct, indirect, cumulative, and induced impacts within the project's area of influence. The project categorization system is described in **Table 2.3**.

Table 2.3 Environmental Classification According to SPS 2009

Category	Definition	Assessment Requirement
A	Likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented, and may affect an area larger than the sites or facilities subject to physical works.	Environmental Impact Assessment (EIA)
B	Likely to have adverse environmental impacts that are less adverse than those of Category A. Impacts are site-specific, few if any of them irreversible, and in most cases mitigation measures can be designed more readily than Category A.	Initial Environmental Examination (IEE)
C	Likely to have minimal or no adverse environmental impacts.	No environmental assessment is required but the environmental implications of the project will be reviewed.
FI	Project involves investment of ADB funds to or through a financial intermediary (FI).	FIs will be required to establish an environmental and social management system commensurate with the nature and risks of the FI's likely future portfolio to be maintained as part of the FI's overall management system.

Source: ADB. Safeguard Policy Statement 2009, p. 19. http://www.adb.org/sites/default/files/institutional-document/32056/safeguard-policy-statement-june2009.pdf.

2.2.2 Asian Infrastructure Investment Bank

50. Established in October 2014 as a multilateral development bank, the Asian Infrastructure Investment Bank (AIIB) puts forward strong policies on governance, accountability, financial, procurement, and environmental and social frameworks.[10] The Multilateral Interim Secretariat for Establishing the AIIB has developed the Draft Environmental and Social Framework and has completed its public consultations on 23 October 2015. AIIB is expecting to have the Environmental and Social Framework operational by the end of 2015.[11]

51. The Draft Environmental and Social Framework consist of the environmental and social policy (ESP) and three mandatory environmental and social standards which set out the environmental and social requirements applicable to specific aspects of the AIIB operations.[12] The environmental and social standards (ESS) are: Standard 1 – Environmental and Social Assessment, Standard 2 – Involuntary Resettlement, and Standard 3 – Indigenous Peoples.

52. ESP is the overarching policy to facilitate the achievement of AIIB's mandate in supporting infrastructure development and in enhancing connectivity in Asia by integrating sound environmental and social management into its operations. Based on the ESP and ESS, AIIB classifies its projects according to four categories indicated in **Table 2.4**.

Table 2.4 Draft Environmental Classification of AIIB

Category	Definition	Assessment Requirements
A	Likely to have significant adverse environmental and social impacts that are irreversible, diverse or unprecedented that may affect an area larger than the sites or facilities subject to physical works.	Environmental and social impact assessment (ESIA) and an environmental and social management plan included in the ESIA
B	It has a limited number of potential adverse environmental and social impacts; the impacts are not unprecedented, and are neither irreversible nor cumulative; they are limited to the area of the operation; and have been successfully managed using good practice in an operational setting.	AIIB determines the specific environmental and social assessment requirements on a case-by-case basis.
C	It is likely to have minimal or no adverse environmental and social impacts.	No need for ESIA but a review of the environmental and social implications of the operation is required.
FI	Involves financing to or through a financial intermediary (FI)	---

Source: AIIB. Draft Environmental and Social Framework, 3 August 2015, p.8.

[10] AIIB. What is the Asian Infrastructure Investment Bank?. http://www.aiib.org/html/aboutus/AIIB/. (Accessed 17 November 2015)
[11] AIIB. Consultations on Draft Environmental and Social Framework. http://www.aiib.org/html/theme/Consultations_Draft/. (Accessed 12 November 2015)
[12] AIIB. Draft Environmental and Social Framework, 3 August 2015. http://www.aiib.org/uploadfile/2015/0907/20150907061253489.pdf. (Accessed 11 November 2015)

53. The ADB and the AIIB agreed to adopt SPS 2009 as the single environmental and social assessment and planning process for a unified documentation, consultation, and disclosure requirements to be complied by the EAs. SPS 2009 has 11 environmental safeguard principles and **Table 2.5** presents a comparison of the environmental safeguard principles of ADB, AIIB, and the GoB. Generally, the environmental requirements of ADB and the AIIB are similar. However, compared to the GoB requirements, there are several gaps (e.g., setting up of grievance redress mechanism and public disclosure of environmental reports) but can be readily addressed and complied with by the EAs.

Table 2.5 Comparison of Environmental Safeguard Principles

ADB			AIIB	GOB
SPS 2009			Draft Environment and Social Framework (3 August 2015)	
Principles		Delivery Process		
1	Use of screening process to determine the appropriate environmental assessment	Uses sector-specific rapid environmental assessment checklist for screening and assigns categories based on potential impacts: • A - EIA required (irreversible, diverse or unprecedented adverse environmental impacts) • B - IEE required • C - no environmental assessment required but a review of environmental implications • FI - ESMS required	Assigns categories based on potential social and environmental impacts • A – likely to have significant adverse environmental and social impacts that are irreversible, diverse or unprecedented; Environmental and Social Impact Assessment (ESIA) required • B - limited number of potential adverse environmental and social impacts, not unprecedented, and are neither irreversible nor cumulative, limited to the area of the operation, and have been successfully managed using good practice in an operational setting; specific environmental and social assessment requirements on a case-by-case basis • C – minimal or no adverse impact; no assessment required but implications reviewed • FI – Involves financing through FI	• ECA 1995 and ECR 1997 set screening criteria to classify industries/projects based on potential environmental impacts as follows: Green (pollution-free), Orange-A, Orange-B and Red (cause significant environmental impacts). These screening criteria are based on project or industry type and do not consider the scale and location. The category determines the level of environmental assessment.
2	Conduct an environmental assessment	• EIA and IEE - Identify potential impacts on physical, biological, physical cultural resources, and socioeconomic aspects in the context of project's area of influence (i.e., primary project site and facilities, and associated facilities) • ESMS for FIs	• ESIA - Identify potential direct, indirect, cumulative and induced environmental and social risks and impacts to physical, biological, socioeconomic (including impacts on livelihood through environmental media, health and safety, vulnerable groups, and gender) and cultural resources in the context of the Operation's area of influence	*Industry/project category* *Green* - no environmental assessment required *Orange A* - no IEE or EIA required but must provide process flow, lay-out showing effluent treatment plant, etc. *Orange B* - IEE required *Red* - both IEE and EIA are required
3	Examine alternatives	• Analyze alternatives to the project's location, design, and technology • Document rationale for selecting the particular	• Examine alternatives in terms of location, design, technology and components, and their potential environmental and social risks and impacts.	• Regulations (i.e., ECA 1995 and ECR 1997) do not require specifically the identification and analysis of alternatives

ADB			AIIB	GOB
SPS 2009			Draft Environment and Social Framework (3 August 2015)	
Principles		Delivery Process		
		project location, design, and technology • Consider "no project" alternative	• Consider "no project" alternative • Document rationale for selecting particular alternative proposed	
4	Prepare an environmental management plan (EMP)	• EMP to include monitoring, budget and implementation arrangements	• Environmental and social management plan (ESMP) to be included in the ESIA	• EMP and procedures included in the IEE and EIA (i.e., Orange-A, Orange-B, and Red category projects)
5	Carry out meaningful consultation	• Starts early and continues during implementation • Undertaken in an atmosphere free of intimidation • Gender inclusive and responsive • Tailored to the needs of vulnerable groups • Allows for the incorporation of all relevant views of stakeholders • Establish a grievance redress mechanism	• Begins early in the project preparation stage, is to be carried out on an ongoing basis throughout the implementation • Undertaken in an atmosphere free of intimidation or coercion • Gender inclusive, responsive and tailored to the needs of vulnerable groups • Incorporation of all relevant views of people affected and other stakeholders into decision-making. • Set up grievance redress mechanism to receive and facilitate resolution	• Public consultation and participation are not mandatory based on ECA 1995 and ECR 1997 • Grievance redress mechanism is not mentioned in ECA 1995 and ECR 1997 • EIA format required by DOE includes stakeholders consultation
6	Timely disclosure of draft environmental assessment (including the EMP)	•Draft EIA report posted on ADB website at least 120 days prior to Board consideration •Draft EA/EARF prior to appraisal •Final or updated EIA/IEE upon receipt •Environmental monitoring report submitted by borrowers upon receipt	• Draft environmental and social assessment reports before appraisal stage • Final or updated environmental and social assessment reports upon receipt • Environmental and social assessment reports during implementation under the frameworks upon receipt	• No requirement for public disclosure of environmental reports but DOE posts the Minutes of the Meeting on the application for environmental clearance certificate to its website, http://www.doe-bd.org/minutes.php
7	Implement EMP and monitor effectiveness	•Prepare monitoring reports on the progress of EMP •Retain qualified and experienced external experts or NGOs to verify monitoring information for Category A projects •Prepare and implement corrective action plan if non-compliance is identified •Requires submission of quarterly, semi-annual, and annual reports to ADB for review	• Set up procedures to monitor progress of ESMP implementation • Document, submit and disclose monitoring reports • Retain qualified experts to verify monitoring information for Operations with significant risks and impacts • Use independent advisory panels or specialist individual experts to monitor implementation of complex Operation	• ECC is subject to annual renewal based on compliance of the conditions set by DOE
8	Avoid areas of critical habitats (use of precautionary	Provides guidance on critical habitats	Avoidance of critical areas included	• ECA 1995 and ECR 1997 identifies ecologically-critical areas and the rules to protect them

ADB			AIIB	GOB
SPS 2009			Draft Environment and Social Framework (3 August 2015)	
Principles		Delivery Process		
	approach to the use, development and management of renewable natural resources)			
9	Use pollution prevention and control technologies and practices consistent with international good practices	• Refers to World Bank's Environmental Health, and Safety (EHS) General Guidelines 2007 • If national regulations differ, more stringent will be followed • If less stringent levels are appropriate in view of specific project circumstances, provide full and detailed justification	• Refers to World Bank Group's Environmental, Health, and Safety Guidelines	• Ambient and emission standards included in ECA 1995 and ECR 1997
10	Provide workers with safe and healthy working conditions	• Refers to EHS General Guidelines 2007 (or any updates)	Covers working conditions and community health and safety	• Occupational health and safety standards included in the Factories Act 1965 and the Bangladesh Labour Law 2006.
11	Conserve physical cultural resources (PCR) and avoid destroying or damaging them	• Use of field-based surveys and experts in the assessment • Consult affected communities on PCR findings • Use chance find procedures for guidance	• Use of field-based surveys and experts in assessment • Use "chance find "procedures	• Preservation and protection of cultural resources are within the Antiquities Act 1968.

Source: ADB consultant, November 2015

2.3 Compliance of Component 1 to Environmental Requirements

2.3.1 Requirements of DOE

54. According to Sect 12 of ECA 1995 and ECR 1997, Component 1 is a Red category project requiring an IEE for the issuance of the LCC and an EIA for the ECC (after securing the LCC). Given that Component 1 will be located within an existing natural gas facility owned and operated by BGCFL with previous ECCs, BGFCL requested DOE on 3 November 2015 for an exemption from submitting an IEE and EIA but instead consider their submission for an environmental management plan (EMP). BGFCL has a similar project where it required the installation of six wellhead compressors in their existing gas fields: Narsingdi Gas Fields (3 compressors), and Titas Gas Field-Location C (3 compressors). For these wellhead compressors in the two gas fields, DOE issued an ECC 17 July 2014 with EMP as supporting document. Based on the request of BGFCL, the DOE agreed on 25 January 2016 that for Component 1, an EMP will be submitted for the issuance of the ECC.

2.3.2 Requirements of ADB and AIIB

55. Based on SPS 2009, the Project is category B requiring an IEE. Thus, this IEE is prepared to meet the requirements of ADB. Aside from complying with the provisions set forth in

SPS 2009, ADB also requires BGFCL to comply with the environmental requirements of the DOE. BGFCL will provide to ADB the ECC to be issued by the DOE for Component 1.

3.0 DESCRIPTION OF THE PROJECT

3.1 Need for the Project

56. Natural gas is a significant source of commercial energy in Bangladesh and is the prime mover of its national economy. BGFCL is one of the operating companies under the Bangladesh Oil, Gas and Mineral Corporation (Petrobangla) entrusted with production of natural gas from its producing fields and processing of gas to the transmission pipeline system. Titas Gas Field is one of the six gas fields being operated by BGFCL.

57. Commercial gas production in Titas Gas Field began in April 1968 and over time, wellhead pressure of some wells has been decreasing gradually. It has been recorded that the wellhead pressure decreases at an average rate of 90 pounds per inch (psi) per year and is estimated that within the next 3-5 years, natural gas flow can no longer maintain the gridline pressure at Location A of the Titas Gas Field without the installation of compressors before the existing natural gas process plants. Gas compressors will be essential to augment gas transmission capacity to meet the increasing gas demand.

58. At present, 25 wells have been drilled at the Titas Gas Field. Out of these 25 wells, nine wells (i.e., #1, 2, 4, 5, 7, 15, 20, 21, and 22) are adjacent to the site of the seven compressors. From the eight out of the nine wells, about 235 million standard cubic feet (MMSCF) of gas daily is being processed. Given this scenario, installation of seven wellhead gas compressors with a capacity of 60 MMSCF per day has been considered. Out of the seven wellhead compressors, five compressors will operate continuously and two compressors will be standby.

3.2 Location of the Project

59. Component 1 will be located within the Titas Gas Field owned and operated by BGFCL. Titas Gas Field is in Ghatura Mauza in Sadar Upazila under the Brahmanbaria District and is about 100 km northeast of Dhaka City, and approximately 40 kilometers (km) northwest from the border of India. About 6,000 square meters (m^2) or 0.6 hectare (ha) will be required for Component 1 but no land acquisition will be needed as this will be located in Location “A” of the Titas Gas Field. Location “A” is a restricted area and public entry is prohibited. Only authorized access is allowed. **Figure 3.1** shows the location of Titas Gas Field, **Figure 3.2** presents the location of Component 1, and **Figure 3.3** shows the overview of Location A.

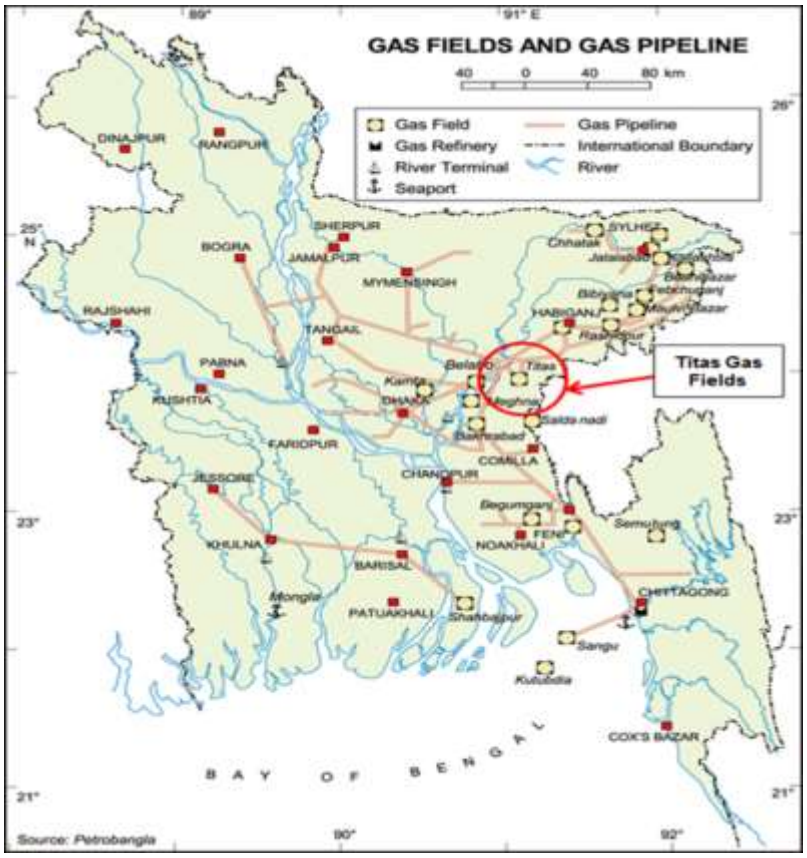


Figure 3.1 Location of Titas Gas Field

Figure 3.2 Location of Component 1

Source: Japan International Cooperation Agency. Preparatory Survey on the Natural Gas Efficiency Project in the People's Republic of Bangladesh. Final Report. March 2014

Figure 3.3 Overview of Titas Gas Field Location A

3.3 Existing Natural Gas Facilities at Titas Gas Field

60. There have been 25 gas wells drilled so far at Titas Gas Field.[13] The wells are spread over eight different locations (i.e., Location A, C, D, E, F, G and H) stretched at a distance of about 11 km. A daily average of 508.62 million cubic feet of gas was produced from this field in June 2016. The gas produced has been processed through eight glycol dehydration plants, four low-temperature separation (LTS) units, and two units of LTS with glycol dehydration.

61. The by-product of gas processing from Titas Gas Field is condensate of about 353 barrels (bbls) per day. This condensate is further processed in two fractionating plants with a capacity of about 500 bbls each. The fractionation process yields liquid fuel as motor spirit (MS) and high speed diesel (HSD). MS and HSD are sold to Padma Oil Company Limited. The two gas treatment plant and one of the fractionating plants were financed by ADB.[14]

3.4 Major Components of the Project

62. The compressor station will consist of compressor and driver units with ancillary facilities, pipelines and associated valves, and office buildings for control unit. The equipment packages and installations generally include:

a) Compressor and driver unit
b) Inlet scrubber
c) Inlet filter separator
d) Air cooler
e) Lube oil cooler
f) Liquid/waste storage tank
g) Fuel gas skid
h) Vent stack
i) Station isolation valves
j) Main line bypass valves
k) Flow meters

[13] BGFCL. Titas Gas Field. http://bgfcl.org.bd/index.php/operation/fields-of-bgfcl/titas-gas-field. (Accessed 1 August 2016)

[14] ADB. Project Performance Audit Report on the Second Natural Gas Development Project. November 1997. Loan 714-Bangladesh: Second Natural Gas Development Project. July 1984. http://www.adb.org/sites/default/files/evaluation-document/35316/files/pe492.pdf (Accessed 3 August 2016)

l) Motor control center/switch gear
m) Suction strainer
n) Anti-surge system
o) Cold recycle valve
p) Gas alternator
q) Fuel gas system and tank
r) Transformer
s) Instrument and utility air package
t) Fire water pumps and tank
u) Borehole and borehole pump
v) Water tank and purifier unit
w) Septic system
x) Security hose
y) Fire hydrant, and;
z) Control room.

63. Associated civil works for compressor foundation and ancillary facilities will be done within the premises of Titas Gas Field. **Figure 3.4** shows the general layout in the existing gas facility at Titas Gas Field incorporating the proposed seven compressors of Component 1 while **Table 3.1** presents the features of the compressor. **Table 3.2** gives the natural gas composition in Titas Gas Field.

Table 3.1 Features of the Compressor

Feature	Description
Type of compressor	Reciprocating
Total driver/engine power	Approx. 14,430 Hp
Total number of units to be installed	7
Number of unit, operation at a time	5
Number of unit, standby	2
Source of fuel	Natural gas from gas field
Capacity of each compressor	60 MMSCFD
Suction pressure of compressor	600-700 PSIG
Delivery pressure of compressor	Minimum 1,200 PSIG
Daily output capacity of compressed gas	300 MMSCF
Daily fuel requirement for compressors	5 MMSCF
Daily water requirements	16 tons
Source of water supply	Borehole/Deep tube well

Table 3.2 Chemical Composition of Natural Gas in Titas Gas Field

Chemical Composition	Percent by Mole
Methane, CH_4	96.924
Ethane, C_2H_6	1.805
Propane, C_3H_8	0.361
i-butane, C_4H_{10}	0.087
n-butane	0.052
i-pentane, C_5H_{12}	0.022
n-pentane	0.017
Hexane, C_6H_{14}	0.039
Heptane, C_7H_{16}	0.018
Nitrogen, N_2	0.367
Carbon dioxide, CO_2	0.308

Source: Japan International Cooperation Agency. Preparatory Survey on the Natural Gas Efficiency Project in the People's Republic of Bangladesh. Final Report. March 2014

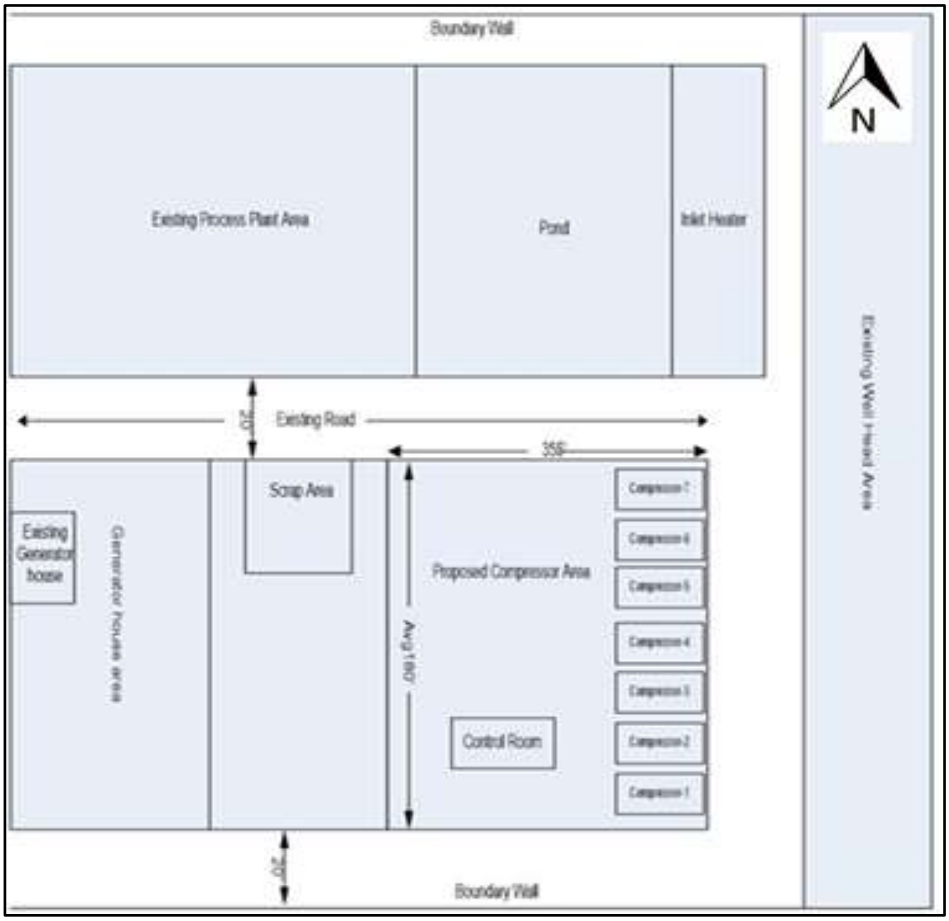


Figure 3.4 General Layout of Compressors

3.5 Reciprocating Compressor

64. A gas compressor is a mechanical device that increases the pressure of gas by reducing its volume. Compressors are similar to pumps which can increase the pressure on a fluid and can transport the fluid through a pipe. Component 1 will install reciprocating compressors.

65. Positive displacement units are those in which successive volumes of gas are confined within a closed space and elevated to a higher pressure. Reciprocating compressors are positive displacement machines where the compressing and displacing element is a piston having a reciprocating motion within a cylinder. As the piston moves forward in the cylinder, it compresses the air or gas into a smaller space, thus raising its pressure.

66. The reciprocating compressors, which are commonly called "piston compressors," compress gas by using a piston, cylinder, and valve arrangement. Major components in a typical reciprocating compressor are frame or crankcase, cylinder, crankshaft, piston, bearings, and compressor valves. The frame is a heavy, rugged housing containing all the rotating parts and on which the cylinder and crosshead guide is mounted. The cylinder is a pressure vessel that contains the gas in the compression cycle. The distance piece provides separation between the compressor cylinder and the compressor frame. The crankshaft rotates around the frame axis and drives the connecting rod, piston rod, and piston. The piston is located at the end of the piston rod and acts as the movable barrier in the compressor cylinder. Bearings located

throughout the compressor frame assure proper radial and axial positioning of compressor components. Main bearings are fitted in the frame to properly position the crankshaft. The essential function of compressor valves is to permit gas flow in the desired direction and to block all flow in the opposite (undesired) direction. **Figure 3.4** shows the process flow with Component 1 synchronized with the existing equipment while **Figure 3.5** shows a photograph of a reciprocating compressor.

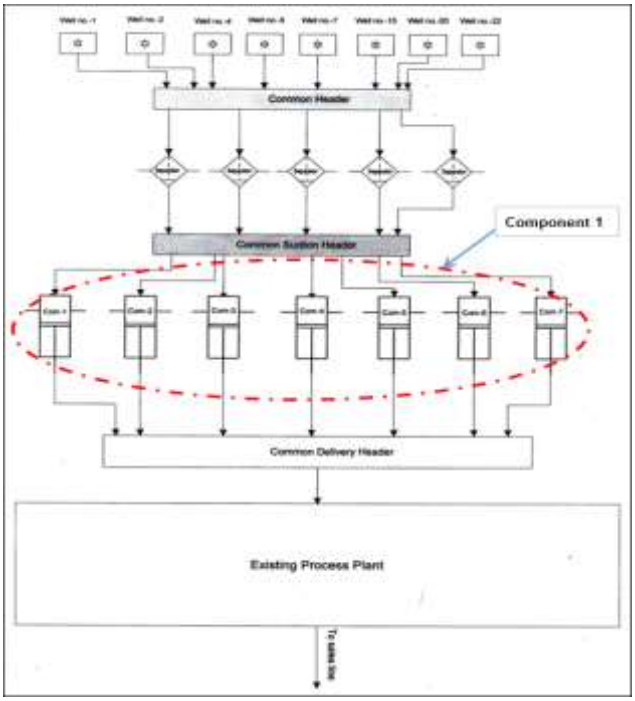


Figure 3.4 Proposed Layout of Component 1 with Existing Facility

Figure 3.5 Photograph of Reciprocating Compressor

3.6 Environmental Considerations

67. BGFCL gives special priority on the environment and safety activities at all stages of their existing installations. Safety rules are properly followed and personal protective equipment are used by staff.

68. BGFCL has a total of 11 staff under the Environment and Safety Department (ESD). The ESD manages environment and safety related activities and conducts visits to installations.

69. For Component 1, wastewater that may be generated, which is minimal, will be disposed of properly in the pond within the existing facility. Wastewater will mainly come from the repair and maintenance of the compressors. Oil and water separator will be used for oily drains from repair and maintenance. Wastewater and ambient air quality standards of DOE will be provided to the manufacturer(s)/supplier(s) of the compressors. Guaranteed emissions from the compressors will comply with the DOE requirements. The compressors will require 5 MMSCF of natural gas to power its operations.

70. Saplings of different types of trees species common in Brahmanbaria under the plantation program of BGFCL will continue as mitigation measure to contain noise levels from the existing facility and enhance air quality. Aside from the fire-fighting system as part of emergency preparedness, sufficient number of fire extinguishing equipment is available at strategic location within the existing facility in the event of fire. BGFCL has an existing environment safety management system (ESMS) since 2000. The safety and hazard mitigation plan of BGFCL is given in **Annex 5**.

71. Trainings on environmental management and safety-related awareness among all officers and staff are part of continuing human resources development. Special importance is given on environmental considerations and safety operations associated with the development activities of BGFCL. No major maintenance works in areas considered critical is done without prior consultation and clearance from relevant agencies of GoB to ensure occupational and public safety.

3.7 Proposed Project Schedule

72. Component 1 will be implemented approximately 1,800 days following the 365 days of operation and maintenance (O & M) by the EPC Contractor. **Table 3.3** gives the proposed implementation schedule.

Table 3.3 Project Implementation Schedule

Activity	Target Date
Signing of Loan agreement between GoB and ADB	July 2016 (to be updated)
Engagement of Consultant	31 Oct 2016
Floating of the Bid	1 January 2017
Technical bid closing (First stage)	10 March 2017
ADB's approval on technical bid evaluation (First stage)	30 June 2017
Price bid opening (Second stage)	15 July 2017
ADB's approval on price bid evaluation report (Second stage)	31 August 2017
Issue of NoA /PG Submission/ Contract signing	1 November 2017

L/C opening and request to ADB for issuing commitment letter and issuance of commitment letter by ADB	1 January 2018
Effectiveness of contract/ commitment of works	1 February 2018
Completion of the works	31 December 2019
O & M by EPC Contractor	31 December 2020

3.8 Project Activities

73. The associated activities in the installation of the wellhead compressors at Location A are described in the following sections:

3.8.1 Pre-construction phase

74. Major activities at this phase will involve: (a) the technical and financial feasibility study, (b) suitable site selection, (c) detailed design of the compressor station, (d) environmental assessment, and (e) the selection and/or awarding of the Contractor for actual physical installation.

3.8.2 Construction phase

75. During the construction phase, various works such as material procurement and mobilization, earthworks for site preparation, and civil and electrical works for the installation of equipment packages will be undertaken. These activities are discussed below:

a. Transportation and handling of equipment and construction materials

76. Construction material and equipment for civil and mechanical works will be transported using large trailers, lorries and trucks. Permission will be secured from the Roads and Highways Department for use of the existing access roads to transport these material and equipment.

b. Civil works

77. Earthworks in foundation: The construction work of the compressor station needs earthworks for excavation of the foundation up to the required depth following the engineering drawings and specification for the compression station and ancillary buildings. The excavated earth will be stored temporarily in the nearby open space and will be used to backfill once the foundation work is completed. Backfilling of the excavated areas will be done by local sand or any material specified in the design.

78. Foundation treatment: The foundation area will be investigated geo-technically. Results of geo-technical test will help in designing the foundation of the required structures and in identifying the type of the foundation treatment required. Various types of treatments such as wooden *bullah* piling, pre-cast reinforced cement concrete (RCC) piling or in-situ concrete piling, sand piling, removal of peat or loose soil will be identified after the geo-technical investigation.

79. RCC work: The RCC works would be required for roof, column, beam, floor, foundation of steel structure, etc.

80. Brick work up to plinth level and superstructure: Brickworks will be done for construction of office with bricks and coarse sand and cement up to roof level.

81. Back-filling by local sand material: Back-filling will be done by local sand material in the excavated area of foundation and floor of the building.

82. Plastering and finishing (electric wiring, distemper or plastic paints): Concealed electric wiring with good quality and proper size of wire are will be done and provision of bulb and switchboard will be conducted. Plastering of walls inside and outside and the roof of the building will be done accordingly while curing works will be done for at least three weeks. After the curing works, distemper of plastic painting will be done on the walls and roof of the building.

83. Sanitary works: Sanitary works such as laying down of sewerage line with either PVC or RCC, installation, fitting and fixing of toilet accessories will be done for all the buildings.

84. Water supply system: Existing water supply system, where available, will be used for water requirements in the compressor stations and associated buildings. In places where there is no supply system, tube wells will be installed to supply water for the workers and staff at the station.

85. Boundary fencing with concrete pillars and barbed wire: The project site will be protected from unwanted encroachment and unauthorized public access by fencing the property boundary with barbed wire fitted with concrete pillar 3 meters (m) apart.

c. Installation of compressor equipment and auxiliaries

86. After completion of the building, all equipment will be installed at the compressor station (outdoor and indoor) following the specifications and standards of the engineering design drawings. During the installation of the equipment, solid waste, liquid waste or noise may be generated. At the same time, accidental failure of the equipment may occur.

d. Safety measures

87. Component 1 will have the following safety measures:

88. Fire-fighting equipment: As the compressor station is a vital installation, fire-fighting equipment of appropriate specification will be procured and installed.

89. First aid materials: First aid boxes will be kept in designated locations within the compressor station.

90. Boundary wall and security: A reasonable height of boundary will be constructed and protection wire will be provided on the walls. Also, trained security guards will be provided.

91. Personnel protective equipment (PPE): All workers and staff will be provided with PPE and will be required to use the same during construction and operation & maintenance phase.

e. Testing and commissioning of compressors and ancillary equipment

92. After installation (outdoor and indoor) works are completed, each equipment will be tested according to manufacturers' specifications and GoB relevant standards. If all the tests are successful, the compressor station will be commissioned accordingly.

f. Tree planting

93. Location A that will accommodate the seven compressors for Component 1 is already a developed empty land, that is, no clearing of trees will be involved. Thus, there is no need to replace trees during the construction phase. However, in compliance with the rules for KPI such as Titas Gas Field, tree planting after the construction phase will be part of site rehabilitation.

g. Safety monitoring and training

94. In BGFCL, there is a field environmental safety committee involved with the environment and safety issues in the KPI. This committee is part of the ESD and is responsible for formulating guidelines, developing procedures, and assisting the operating personnel in the field to implement environment-friendly and safe procedures in their operations. Selected BGFCL staff participate regularly to health, safety and environment (HSE) training programs in the country. The Contract of the EPC Contractor will include a condition to provide environmental and safety trainings on-site to staff.

3.8.3 Operation phase

95. During the operation phase, the compressor station will run with regular maintenance activities. Emissions from burning natural gas to provide power to the compressors will be generated. Noise level close to the compressors will be higher during their operation.

3.8.4 Decommissioning phase

96. At the end of its economic life, the compressors may be replaced or totally scrapped. Location A will be rehabilitated by removing and cleaning of all waste materials and refuse. Remaining structures that may no longer be useful, concrete and other solid waste material will be disposed of at an appropriate disposal site. Machine parts and other materials will be sorted to determine those that can be reused or recycled. Small quantity of wastewater will be generated due to cleaning of work site at the time of decommissioning of compressors and hydro testing of pipelines.

4.0 DESCRIPTION OF THE ENVIRONMENT (BASELINE DATA)

97. The project area of influence covers the location of the seven wellhead compressors (about 0.6 ha) within the existing natural gas processing facility of BGFCL in the Titas Gas Field in Sadar Upazila. Available secondary data used to describe the existing environment is at the district level of Brahmanbaria.

4.1 The Titas Gas Field

98. The gas field is an elongated structure of north-south asymmetrical anticline measuring about 19 kilometer (km) by 10 km with a vertical closure of 500 meter (refer to **Figure 3.1**). There are eight production wells identified in Titas Gas field (#1, 2, 4, 5, 7, 15, 20, and 22). According to Petrobangla, the total recoverable gas reserve from the Titas Gas Field is estimated at 7,582 billion cubic foot (BCF). Commercial gas production from Titas Gas Field commenced in April 1968 and as of 31 January 2016, about 4,098.82 BCF of natural gas has been recovered or about 54.06% of total reserves identified.

4.2 Existing Natural Gas Process Plant at Titas Gas Field

99. The proposed site for Component 1 is the Location A which is within the existing natural gas facility of BGFCL at Titas Gas Field. The DOE has issued the corresponding ECCs for the natural gas process plants, the production wells, and the workover for Titas well #21 which are all within the existing Titas Gas Field. Aside from the eight natural gas wells, the existing facility consists of access roads, low-temperature separators, glycol dehydration towers, generator house, office administration building, fire-fighting and safety equipment system, heaters, pond, workshop/maintenance area, and scrap area. There are eight glycol dehydration units to dry the natural gas, four low-temperature separation (LTS) units, another two units of LTS with glycol dehydration, and two fractionation units. **Figure 4.1** presents the plant layout while **Figure 4.2** shows the process plants.

100. An estimated 517 MMSCFD of natural gas from this process plant is produced and supplied to the transmission pipeline systems of Titas Gas Transmission and Distribution Company Ltd. (TGTDCL) and the Gas Transmission Company Ltd. (GTCL).

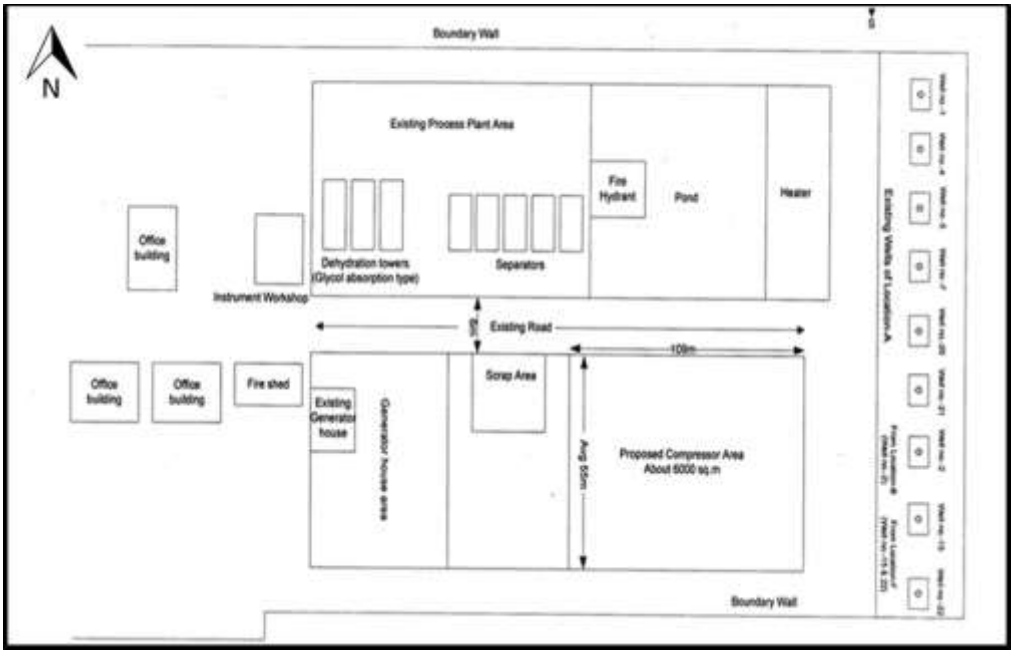


Figure 4.1 Plant Layout of Existing Facility at Titas Gas Field

Figure 4.2 Natural Gas Process Plant at Titas Gas Field

4.3 Physical Environment

101. Available secondary data from relevant government agencies were used to describe the existing environment at the level of Brahmanbaria District. Secondary data were taken from the District Statistics 2011 published by the Bangladesh Bureau of Statistics in 2013, Geology Survey of Bangladesh, Library of the Prime Minister's Office, International Union for Conservation of Nature (IUCN), and other relevant sources.

4.3.1 Topography

102. Titas Gas Field is located in mainly flat, alluvial floodplain area surrounded by plains with somewhat steeper topography and is traversed by the perennial Titas River. Aside from the Titas River, the entire area is also drained by several minor water ways and canals. The Titas Gas Field is about 24 feet above mean sea level. The area is not vulnerable to river floods.

4.3.2 Climate

103. Bangladesh is divided into seven climatic sub-regions. Brahmanbaria is located within the south-central zone characterized by an annual rainfall ranging from 200 cm to 250 cm and a temperature of 18°C in January and reaches 28°C in April until July (see **Figure 4.3**). According to the District Statistics 2011, data collected by the Bangladesh Meteorological Department from 2008 to 2011 show an average humidity of 75.2%.

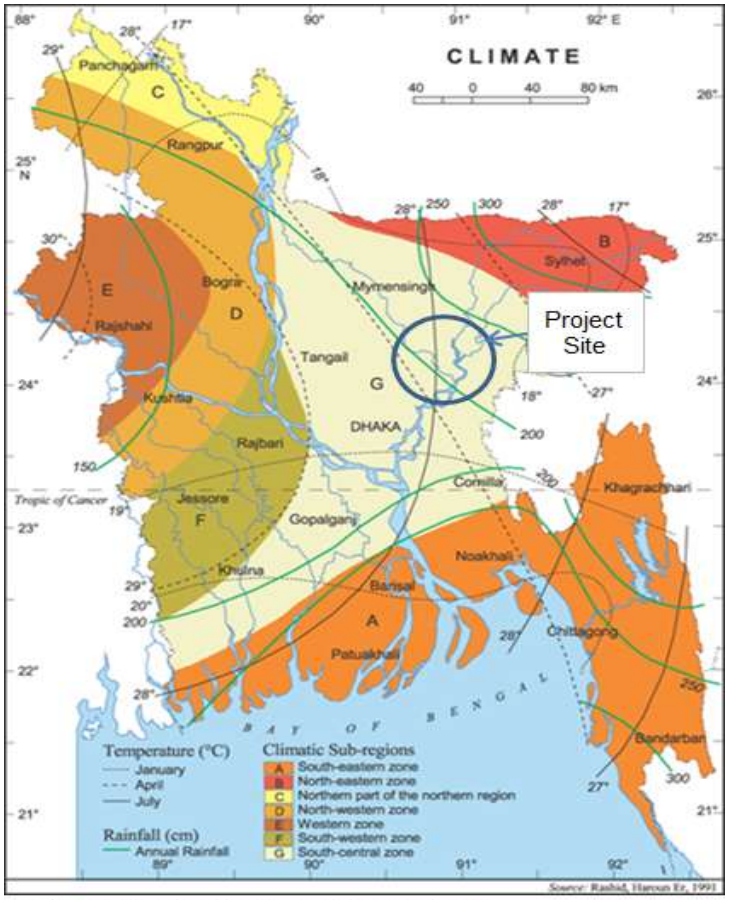
4.3.3 Air quality

104. The DOE conducts regular ambient air quality monitoring through their Clean Air and Sustainable Environment (CASE) Project covering eight cities in Bangladesh with 11 continuous air sampling stations.[15] The CASE project, funded by the World Bank started in May 2009 and will be until December 2016. Monthly monitoring results were posted in their website for public information from November 2011 until December 2015.

105. The eight cities include: Dhaka, Gazipur, Narayagonj, Chittagong, Sylhet, Khulna, Rajshahi, and Barisal. Dhaka has three monitoring stations, Chittagong has two stations and the rest of the cities have one station each. Parameters being monitored in these stations include: PM_{10}, $PM_{2.5}$, CO, SO_2, NO_2, O_3, and hydrocarbons (HC). Out of the 11 sampling stations of DOE, the nearest station to Titas Gas Field is in Narayagonj. Based on the monitoring results in December 2015, only NO_2, O_3, $PM_{2.5}$ and PM_{10} were available for Narayagonj. Results show that NO_2, $PM_{2.5}$ and PM_{10} exceeded the ambient air quality standards of DOE of 53 ppb (24 hr average), 65 µg/m^3 (24 hr average), and 150 µg/m^3 (24 hr average), respectively. Levels of O_3 both in 1-hr and 8-hr average are way below the DOE standards of 120 ppb (1 hr) and 80 ppb (8 hr).

106. At Titas Gas Field, ambient air quality sampling was conducted on 20 December 2015 by a third party laboratory in front of the gate of Location A. Results show that suspended particulates is 40 µg/m^3 (limit is 500 µg/m^3) and NO_x is 60 µg/m^3 (limit is 100 µg/m^3). Ambient level of CO, lead, and SO_x are all non-detectable.

[15] Ministry of Environment and Forests. Clean Air and Sustainable Environment Project. http://case.doe.gov.bd/index.php?option=com_content&view=article&id=5&Itemid=9. (Accessed 24 February 2016)



Source:http://lib.pmo.gov.bd/maps/images/bangladesh/Climate.gif

Figure 4.3 Climate Map

4.3.4 Ambient noise

107. The environmental quality standard for Bangladesh (DoE-1991) has set noise guidelines for industrial sites in Bangladesh. Noise level should not exceed 75 dB(A) during daytime and 70 dB(A) at night. Facility operation will ensure that these noise levels are not exceeded in more than 50 m from the facility. There are no settlements within the Titas Gas Field area as the residential buildings for staff and workers are outside the boundaries of the facility. Hearing protection or ear muffs are provided to workers where noise levels exceed 80 dB(A). Workers are not required to be at the compressors' site as these are designed to be operated and continuously monitored remotely in a separate control room. During inspections and regular checks, workers will be required to wear earplugs/muffs.

108. Ambient noise level was measured on 20 December 2015 in front of the gate of Location A in Titas Gas Field and recorded 51.5 dB [the limit for industrial area during daytime is 75 dB(A)].

4.3.5 Soil type

109. Brahmanbaria is predominantly covered by non-calcareous dark grey floodplain soil. This type of soil is characterized by dark grey, finely mottled brown, and brown soils with dark

grey flood coatings, with seasonally acid top soils and near-neutral sub-soils. This is also mainly seasonally deeply flooded soils of the old Brahmaputra-Karatoya-Bangali (Part) and old Meghna estuarine floodplains. The non-calcareous dark grey floodplain soil is slightly acid to somewhat alkaline in reaction.

110. Soil sampling was conducted on 20 December 2015 in front of the gate of Location A and the results are given in **Table 4.1**.

Table 4.1 Soil Sampling Analysis, Location A

Parameter	Value
pH	5.6
Total nitrogen, % (w/w)	0.61
Organic matter, % (w/w)	1.2
Potassium, meq/100g	0.12
Phosphorous, ppm	9.21
Manganese, ppm	3.0
Sulfur, ppm	1.12
Magnesium, meq/100g	2.0
Calcium, meq/100g	5.5

4.3.6 Seismicity

111. Bangladesh is divided into three seismic zones: Zone I – Severe (Seismic Factor, 0.08g), Zone II – Moderate (Seismic Factor, 0.05g), and Zone III – Minor (Seismic Factor, 0.04g). Brahmanbaria is located under Zone II representing a region of recent uplift Pleistocene and blocks of the Barind and the western extension of the folded belt (see **Figure 4.4**). All the existing structures in Titas Gas Field were designed incorporating the seismicity of Brahmanbaria.

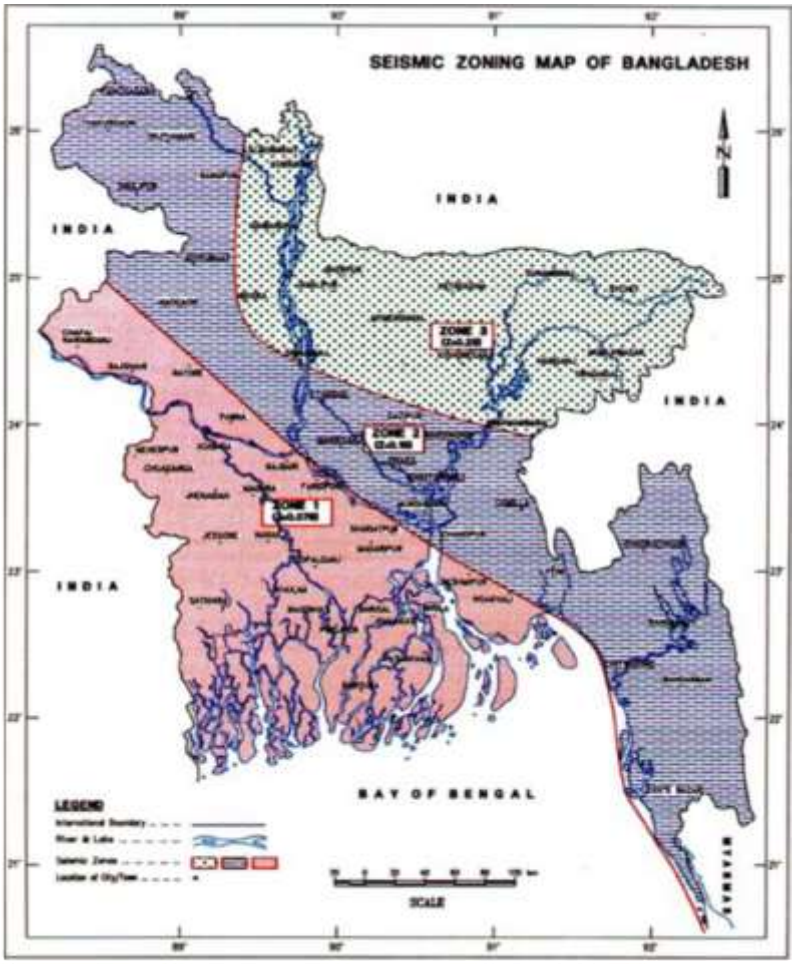


Figure 4.4 Seismic map of Bangladesh

4.3.7 Water resources

112. Titas River and its tributaries are the main water resource within the Titas Gas Field. There are several khals and ponds that carries run off from adjacent areas. In surrounding areas, surface water is used for irrigation, drinking for domestic animals, bathing, fish cultivation and possibly as potable water in some locations.

113. The ground water table fluctuation indicates the recharge and discharge to the groundwater reservoir. The highest ground water occurs during the month of August to September when the aquifer recharges fully and the lowest ground water table occurs during April to May. Ground water is a stable source of water supply for various activities including irrigation, domestic purpose and industrial applications in the project area. In Titas Gas Field, the water table is 25 feet below the surface. There is a pond at Titas Gas Field reserved for use during the dry season.

4.4 Biological Environment

114. The allocated area for the compressors within the existing BGFCL gas processing facility is mainly grassland. The conservation status of species in Bangladesh based on the IUCN Red List of Threatened Species is being updated which started in December 2013 and funded by the World Bank. The last assessment specifically by the IUCN Bangladesh was conducted in 2000.

4.4.1 Terrestrial Habitat

115. According to District Statistics 2011 Brahmanbaria published by the Bangladesh Bureau of Statistics, the principal trees found in the district are as follows:

- Banyan or commonly known as bat tree (*Ficus benghalensis*)
- Pipal or ashwatha (*Ficus religlosa*)
- Neem (*Azadirachta indica*)
- Bel (*Aegle marmelos*)

116. Some of the fruit-bearing trees and used medicinally include: rana or petraj (*Aphanamixls polystachia*), jarul (*Legerstroemia speciosa*), jamun (*Enginer jambolan*), amly-tentul (*Tamariandus indica*), mango (*Mangifera indica*), betel nut (*Areca catechu*) and mandar (*Erythrina variegata*). There are also several species of palms: kadamba (*Anthoephalus cadamba*), gab (*Diospyros precatorius*), date palm (*Phoenix sylvestris*). Some of the species used by local people for varying purposes include: Jalpai or olive (*Elaeocarpus tectorius*) where the fruit is used as curry; the simul (*Bombax ceiba*) used as stuffing for mattresses and pillows; palmyra palm (*Borassus flabellifer*) where its wood is used for housing construction and the leaves for making fans of different sizes. Coconut (*Cocos nucifera*) is grown abundantly in Brahmanbaria.

117. Some of the trees with commercial value include: karoi (*Albizza procera*), garjan (*Dipterocarpus turbinatus*), and jarul (*Legerstroemia speciosa*).

118. Most of the species identified in Brahmanbaria are not included in the IUCN Red List of Threatened Species. However, garjan (*Dipterocarpus turbinatus*) is listed as Critically Endangered when assessed in 1998 on conservation status based on habitat loss.[16] IUCN recognized that the assessment for this species needs updating. Palmyra palm (*Borassus flabellifer* L. variety *madagascariensis* Jum. & H.Perrier) is considered synonymous to the species, *Borassus madagascariensis* and evaluated as Endangered by IUCN (2012).[17] Location A for Component 1 is mainly grassland (see **Figure 4.5**).

119. The Mongoose (*Herpestes edwardsi*) is common and there are few monkeys (*Macaca mulatta*) and squirrels (*Callosciurus pygerythrus*). Some of the birds include kingfisher (*Alcedo atthis*), king crow (*Corvus macrorhynchos*), wood pecker (*Picus myrmecophoneus*), sparrows (*Passer domesticus*), and moyna (*Acridotheres tristis).* These species are listed as least concern in the IUCN Red List of Threatened Species.

[16] Ashton, P. 1998. *Dipterocarpus turbinatus*. The IUCN Red List of Threatened Species 1998: e.T33016A9749000. (Accessed 27 February 2016)

[17] Rakotoarinivo, M. & Dransfield, J. 2012. *Borassus madagascariensis*. The IUCN Red List of Threatened Species 2012: e.T38452A2869399. (Accessed 27 February 2016)

Figure 4.5 Vegetation in Location A, Titas Gas Field

4.4.2 Aquatic Habitat

120. Some of the commonly available fish in Brahmanbaria are ruhi of salmon (*Labeo rohita*), mrigel (*Cirrhinus mrigala*), kalbous (*Labeo calbasu*), and katla or carpo (*Catla catla*). Shoal fish (*Channa striatus*), and shing (*Heteropneustes fossilis*) are also found in large quantity in beels and khals. Principal varieties of fish are boal/sheatfish (*Wallago atttu*), chital (*Notopterus chitala*), long-whiskered catfish (*Mystus aor*), baghair (*Bagarius bagariuis*), pangas (*Pangasius pangasius*), rita (*Rita rita*), bain or eel (*Mastacembelus armatus*), chapila (*Gudusia chapra*), gulsha (*Mystus bleekeri*), tengra (*Mystus vittatus*), chanda (*Mene maculata*), kakila (*Strongylura strongylura*), phalli or flat fish (*Notopterus notopterus*), pabda or butter fish (*Ompok pabda*), chela (*Chela atpar*), koi or climbing fish (*Anabas testudineus*), kholisha (*Colisa fasciatus*), puti (*Barbus puntius*), sharputi (*Systomus sarana*), taki (*Channa punctatus*), and walking fish (*Ophiocephalus striatus*).

121. Of these species, butter fish (*Ompok pabda)* is listed as Near Threatened by the IUCN Red List of Threatened Species (2010).[18]

4.5 Socio-economic Condition

122. The Bangladesh Bureau of Statistics (June 2012) show that the population of Brahmanbaria Zila (District) in 2011 reached 2,840,498 consisting of 538,937 households with an average household size of 5.25.[19] The annual population growth rate is 1.6% while

[18] Tenzin, K. & Ng, H.H. 2010. Ompok pabda. The IUCN Red List of Threatened Species 2010: e.T166509A6224736. http://dx.doi.org/10.2305/IUCN.UK.2010-4.RLTS.T166509A6224736.en. (Accessed 2 March 2016)

[19] Bangladesh Bureau of Statistics. Community Report. Brahmanbaria Zila. June 2012. http://203.112.218.66/WebTestApplication/userfiles/Image/Census2011/Chittagong/Brahmanbaria/Brahmanbaria%20at%20a%20glance.pdf. (Accessed 24 February 2016)

the literacy rate is 45.3%. The population is predominantly rural representing about 84%. Population density is 1,510 persons per km^2.

123. Religion is represented by 90.73% Muslim and 9.07% Hindu. Occupation is predominantly in agriculture (44.79%), agricultural labour (15.82%), wage labour (3.13%), commerce (12.26%), service (6.8%), fishing (2.02%), transport (1.85%), weaving (2.39) and other services (10.94%).

124. Most of the land within the project area is cultivable land. About 95% produce Boro rice and other paddy, crops while about 20% produce robi crop after Aman rice harvest. Other than Titas Gas Field, there are no big industrial areas. However, there are a few rice mills, brick fields, and small industries.

125. About 80% of the households have electricity, while the rest use kerosene for lighting. While Titas Gas Field is close, only about 15% of the households have access to natural gas for cooking. Other households use firewood, cow dung, straw and garbage as fuel for cooking.

126. Approximately 12-25% of the population use pond or river water for domestic use while the rest use groundwater from shallow or deep tube wells.

5.0 ANTICIPATED IMPACTS AND MITIGATION MEASURES

127. The main objective of installing compressors is to increase the pressure in the natural gas pipeline to facilitate transmission. Titas Gas Field will benefit from the new compressors due to the declining line pressure of extracted gas from the well fields. As such, there is no alternative site except Location A since the compressor system will be reinforcement for Titas Gas Field to facilitate an efficient operation of its overall natural gas system.

128. The associated potential environmental impacts for the installation of the compressor system have been identified and presented according to project stages.

5.1 Pre-construction stage

129. Activities in this phase will include the selection of the suitable space for installation of the gas compressors and the technical assessment on the capacity, type, design, and utilities that will be required for its operation.

130. Given that flowing wellhead pressure of natural gas will decline over time of continuous production, BGFCL facilities have allocated space for compressors in the event the operations would require their installation.

131. Location A, which covers about 0.6 ha of land, is owned by BGFCL and is within the Titas Gas Field with an existing natural gas processing plant. No land acquisition will be required and Titas Gas Field is considered an industrial area. Vegetation in Location A is mainly grassland. Utilities such as power and water supply systems are available. No economic displacement is expected.

132. DOE has issued the required ECCs for the two natural gas process plants and the well fields. Since Component 1 will be within an area with issued ECCs from the DOE, BGFCL will be only required to submit an EMP for Component 1 to DOE in securing the ECC.

5.2 Construction stage

133. During this stage, activities will include site preparation, transportation of equipment and construction materials to Location A, installation of compressors, testing and commissioning of the compressor system, and site clean-up after construction works.

5.2.1 Site preparation and transport of construction equipment and materials

Natural hazards

134. **Seismicity** Brahmanbaria is within Zone II according to seismicity in Bangladesh. Zone II means moderate with seismic factor of 0.05g. Existing facilities in Titas Gas Field incorporated seismicity in their design and will also incorporate in the design specifications of the foundation, structures, compressors, and ancillary equipment for Component 1.

135. **Flooding** Titas Gas Field and Location A are developed high land with 7.32 m above mean sea level (MSL) as the reduced level reference. In 2004, the highest flood level in Brahmanbaria was recorded at 7.65 m above MSL. Given this, the design of construction works for Component 1 will take into account the highest flood level.

136. **Cyclone** Local seasonal storms start in late February and reach its maximum in April. Severe storms are generally associated with tornadoes. Based on experience by BGFCL, the Titas Gas Field is not cyclone-prone area.

Impacts on land and vegetation

137. Clearing of land and excavation will be done for the foundation of compressors. Vegetation in Location A is mainly grassland. Earthmoving works may cause potential erosion and localized flooding. Erosion control measures will be provided, if needed. Construction management plan will be required from the EPC Contractor to ensure that impacts during construction will be minimal. Excavated topsoil will be used for backfilling.

138. Areas to be used as workshop involving oil, lubricant and other solvents will be lined with concrete or any impervious material to prevent soil contamination. An oil-water separator will be provided in the workshop area.

Impacts on physical cultural resources

139. The site for the seven wellhead compressors is within an area considered industrial and Titas Gas Field is not identified as a potential cultural interest. Given that excavation and earth moving works will be involved in the site preparation, **Annex 2** presents the chance find procedures.

Impacts on people

140. Activities during site preparation may cause potential safety risks to workers and community, occupational and safety risks to workers and staff, and disruption to daily activities

of local people. In terms of safety, BGFCL adheres to the following national regulations: (i) Mineral Gas Safety Rules 1971, (ii) Natural Gas Safety Rules 1991, (iii) The Bangladesh Petroleum Act 1974, and the (iv) Factories Act 1965.

141. Some of the common occupational safety risks involve accidents in welding, electrical works, and use of crane, trench collapse, and fire and explosions. BGFCL has an existing Safety and Hazard Mitigation Plan as well as the ESMS. However, to prevent these accidents from happening in Component 1, BGFCL will require the EPC Contractor to prepare a safety management plan for their approval before any installation works.

142. Location A is within the Titas Gas Field, thus, unauthorized public access is not allowed. Prior to start of construction, the EPC Contractor will provide fence or barricade, sufficient lights, clear warning and danger signs, and will assign security personnel to prevent accidents, trespassing, and pilferage.

143. To minimize disruption in road crossings and daily activities of local people, EPC Contractor will schedule transportation movements, provide visible warning signs that will be posted at designated sites within Location A, the adjacent facility and nearby settlements. The warning signs will also consider people with disabilities. In case heavy equipment and machinery will be transported to Location A, the EPC Contractor will issue announcements to local settlements that will be affected through posters/notification or through the local radio station. Drivers of construction vehicles will be required to strictly follow road regulations particularly on speed.

144. Due to construction works, there will be additional construction workers and staff at Titas Gas Field. PIU-BGFCL will conduct briefing to EPC Contractor(s), workers and staff on the compliance to the requirements of ADB and DOE, create awareness of sexually-transmitted diseases such as HIV/AIDs, and good housekeeping. The EPC Contractor will be required by BGFCL to use local labour force for manual work and for clerical and office jobs if they are eligible.

145. To minimize occupational health and safety risks, BGFCL will require the EPC Contractor to follow the World Bank EHS General Guidelines 2007 (or any updates) and to provide workers and staff with sanitary facilities, wash areas, safe drinking water, first aid and fire-fighting equipment (non-ozone depleting), and garbage bins. Aside from these facilities, workers will be provided with hard hats, safety shoes and belts, and other personal protective equipment needed to do the work safely. Good housekeeping will be enforced at all times. Solid waste generated from Location A will be disposed of in authorized and certified landfill in Brahmanbaria.

146. Periodic and also random safety patrols will be carried out by BGFCL and/or EPC Contractor to ensure that all works are carried out in a safe manner according to the safety management plan.

Air and noise impacts

147. Site preparation works will cause increase in dust and noise levels as well as vehicular emissions. These impacts may come from heavy equipment and construction vehicles working in Location A as well as from transporting construction materials. Earthmoving works and excavation may increase dust levels and affect local ambient air quality. Increased noise levels and vibration may come from excavation works, use of heavy equipment and construction

vehicles. BGFCL will require the EPC Contractor to maintain construction vehicles to meet emission standards by DOE including the observance of low-speed to reduce noise. Noise-generating activities will be limited to daytime hours only and there will be no blowing of horns for vehicles. Warehouse for construction materials will be provided on-site to reduce trips of material delivery. Opened land areas or sources of dust will be sprayed with water, as needed while trucks transporting dust-generating construction materials will be covered to contain dust levels.

Water quality impacts

148. Titas Gas Field is traversed by the Titas River but will not be affected by the construction activities in Location A. Potential impacts that may affect water quality are generation of sewage from construction workers and localized flooding which could result in construction delays. Sanitary facilities will be provided to workers and EPC Contractor will be required to have stormwater management plan including drainage plan.

5.2.2 Installation and testing of compressors and ancillary equipment

149. During the installation and testing, potential impacts such as public and occupational health and safety risks, emissions from testing works and generation of waste may result. The design of the compressors and ancillary equipment will be in accordance with applicable international safety codes and standards. BGFCL has the experience and track record of safety operations in the gas sector. Civil, electrical, mechanical, and structural construction works including the installation and testing of compressors will be undertaken by similarly experienced international EPC Contractor(s) who use high industry standards of safety and environmental protection.

150. A safety plan will be prepared by the EPC Contractor for approval by BGFCL prior to installation and testing works. Liquid waste such as oily and cooling system drains, and spent lube oil generated during testing will be treated prior to disposal using oil-water separator.

5.3 Operation stage

151. The presence of additional seven compressors in Titas Gas Field is expected to generate employment. But may also potentially cause hazards such as fire or explosion due to operational failure, disturbance to settlements nearest to the BGFCL natural gas facility, may pose occupational health risks due to noise from compressors, will contribute to greenhouse gas (GHG) emissions, will use about 16 tons of water daily for its operation, and some drainage congestion may occur occasionally during monsoon season due to reduced open space. Drainage congestion can be minimize by proper stormwater design and management.

152. Standard operating and safety procedures following national requirements, industry standards, and international best practice will be strictly implemented. Since the EPC Contractor will manage Component 1 during the first year of its operation, BGFCL will require them to prepare a safety management plan and an emergency and disaster preparedness plan.

Water requirements for cooling

153. The daily water requirements will be for the recirculating cooling water system and will be taken from groundwater wells from the existing gas processing facility. Make up water will be needed only when leakage has occurred at pump packings or when water has been drained

to allow for system repair. During the dry season, a reserved water pond will be used as back-up for deep tube well. Rain harvesting will be done and other water conservation measures will be explored.

Noise generated by compressors

154. The existing BGFCL facility at Titas Gas Field is considered an industrial area and settlements are located relatively far from it. Compressors will be within highly sound-insulated buildings to minimize the noise generated during operation. There is an existing boundary wall south of the compressor site but protective boundary wall with sufficient height may be constructed as buffer, if needed. The compressors will be operated by experienced staff that will observe and monitor the operations for signs of failure or maintenance needs during normal operation. Operation of compressors can be remotely monitored 24 hours a day in a separate and centralized computer control room. One of the causes of noise and vibration is dirty and worn out components, inadequate lubrication, etc. Preventative maintenance of the compressors will be employed to prevent this. Noise generated by the compressors will be minimized by the use of engineered noise-suppression devices such as silencers, baffles and absorbent liners. Workers exposed to high level noise will be required to use earplugs/muffs and will be rotated every 2 hours.

Contribution to GHG emissions

155. Natural gas at Titas Gas Fields is about 97%$_{mole}$ methane (CH_4) and does not contain hydrogen sulfide (H_2S). Use of natural gas to fuel the compressors will result to emissions that are mainly carbon dioxide (CO_2). About 272 metric tons (MT) of CO_2 emissions per day will be contributed by Component 1 to greenhouse gas (GHG) emissions or about 99,280 MT CO_2 per year on a "worst scenario" of operating the seven compressors at the same time. Tree planting will be done at designated areas in Titas Gas Field not only to serve as sinks for the emissions but is required by Petrobangla in its key point installation (KPI). Carbon sequestration by trees is a complex process and involves several factors such as survival rate, species, age of tree to be planted, soil type, etc. Given these factors, only tree species common to Brahmanbaria will be planted such as Ashwatha tree (*Ficus religiosa)* belonging to the mulberry family, and Neem (*Azadirachta indica).*[20] The Department of Forest (DOF) will be consulted on the appropriate tree species to be planted at and around the Titas Gas Field.

156. Over time, compressors wear and may cause leaks of CH_4 and volatile organic compounds (VOCs). These fugitive emissions can be mitigated by techniques such as replacement of compressor rod packing, replacement of the piston rod, and refitting or realignment of the piston rod. In May 2016, the US EPA issued the requirements for reciprocating compressors focusing on monitoring (i.e., record keeping) and reporting (i.e., annually) of the condition of rod packing: (i) on or before every 26,000 hours of operation (operating hours must be monitored and documented), and (ii) every 36 months (monitoring and documentation of operating hours not required).[21] Among others, BGFCL will conduct monitoring and reporting of the condition of the compressor packing systems as fugitive emissions is a systems loss with associated costs. BGFCL will require suppliers of compressors to have guaranteed emissions that meet the limits set by the DOE and the World

[20] US Environmental Protection Agency. GHG Equivalencies Calculator - Calculations and References. https://www.epa.gov/energy/ghg-equivalencies-calculator-calculations-and-references. (Accessed 3 August 2016)

[21] US EPA. Summary of Requirements for Equipment at Natural Gas Transmission Compressor Stations. https://www3.epa.gov/airquality/oilandgas/may2016/nsps-gas-transmission-fs.pdf. (Accessed 3 August 2016)

Bank/International Finance Corporation Environmental, Health and Safety (WB/IFC EHS) General Guidelines 2007 (or any update).

Risks of explosion and fire

157. Operation of natural gas compressors does not come without risks of explosion and fire given that natural gas is flammable. The lower explosion limit of CH_4 is 5% and the upper explosion limit is 15% in the presence of an ignition source. This means that CH_4 concentration lower than 5% ("too lean") and higher than 15% ("too rich) will not cause fire in the presence of ignition source. The compressors are designed with safety features such as fire-suppression system that will be triggered by heat, fire or smoke detection, and continuous monitoring devices along with emergency shutdown systems capable of isolating the station and safely venting the gas very quickly in the unlikely event of an emergency.

158. Component 1 will be within the area of the existing natural gas processing plant of BGFCL at Titas Gas Field. Given the capacity of natural gas being processed at this facility and its national economic significance, BGFCL has an environment safety management system (ESMS) as well as safety and hazard mitigation plan to address the risks of explosion or fire. Among others, the operation of BGFCL is subject to the Natural Gas Safety Rules 1991 (amended 2003) and The Factories Act 1965. In August 1993, a team of safety engineering experts from British Gas experts was engaged to conduct a safety audit of the entire operations of Petrobangla and concluded that all operating companies (which included BGFCL) are generally operating an adequate system and provided recommendations for safety program development which were incorporated in the ESMS.[22] ADB provided financing in March 2010 to cover safety and supply efficiency improvement in Titas Gas Field.[23] The Bakhrabad Gas Field has wellhead compressors since 2007 and no trouble has been encountered during installation and operation.[24] Japan International Cooperation Agency (JICA) has financed the installation of wellhead compressors for Titas Gas Field Location "C" (three compressors) and Narshingdi Gas Field (three compressors) and the project was implemented in July 2014 to June 2018.[25] BGFCL also operates Narshingdi Gas Field and thus, has the experience to implement Component 1 following the highest standards and norms on safety.

159. All the relevant civil, mechanical, structural, and electrical standards will be complied with. Non-ozone depleting fire-fighting systems will be available at strategic locations within Location A and security personnel will be provided. Regular drills on emergency preparedness procedures will be conducted twice a year to train staff and workers in the event of emergency or disaster. BGFCL will explore the opportunities to involve the settlements in the immediate vicinity of Titas Gas Field in conducting the drills on emergency preparedness.

5.4 Decommissioning stage

[22] World Bank. Gas Infrastructure Development Project. 1995. Environment and Safety Assessment Report: Summary. May 1994. http://www.worldbank.org/projects/P009533/gas-infrastructure-development-project?lang=en&tab=documents&subTab=projectDocuments. (Accessed 3 August 2016)

[23] ADB. Loan 2622/2623-BAN: Natural Gas Access Improvement Project. 2010. http://www.adb.org/projects/38164-013/main#project-pds. (Accessed 3 August 2016)

[24] Japan International Cooperation Agency. Preparatory Survey on the Natural Gas Efficiency Project in the People's Republic of Bangladesh. Final Report. March 2014

[25] BGFCL. Annual Report 2013-2014. http://www.bgfcl.org.bd/~pavel/images/AnnaulReport2013-14/Page34-41.pdf. (Accessed 4 August 2016)

160. This stage will involve dismantling of compressors and ancillary equipment at the end of its economic life (about 35 years). Dismantling activities may pose occupational and safety risks, generation of waste, and emissions from hauling vehicles, large construction equipment, and dust from sources such as structure removal, and dumping. A decommissioning plan following the industry best practice will be required by BGFCL to the Contractor who will conduct the dismantling works. The decommissioning plan will be submitted to ADB for review and approval to ensure that it meets SPS 2009 and the World Bank Environmental, Health, and Safety General (EHS) Guidelines 2007 (or any updates).

161. All left-over structures, concrete, solid waste materials and other debris will be disposed of at designated disposal site. Solid waste will be sorted to determine recyclable/reusable materials that can be sold as scrap or used for other projects while non-hazardous waste will be sent to appropriate disposal sites.

6.0 ANALYSIS OF ALTERNATIVES

162. The primary objective of including Component 1 is to maintain the natural gas flow from the production wells (i.e., Titas # 1, 2, 4, 5, 7, 15, 20, 21 and 22) to the national grid transmission and distribution lines. These production wells are located in Location A of the Titas Gas Fields and their wellhead pressure has been decreasing gradually. To ensure a steady and reliable flow of natural gas from these production wells, it is crucial to install wellhead gas compressors before the existing natural gas process plants.

163. Since the production wells are located within the existing natural gas facility of BGFCL, no other sites were considered except Location A. Location A provides for a secured space available to accommodate the required capacity of the wellhead compressor. No further land acquisition is necessary. The water supply, electricity, fire and safety system including road access and other physical infrastructure are readily available in Location A. Selecting this site is the optimal and most cost effective. The availability of the required systems to support the operation of wellhead compressor is the major criteria for selecting Location A.

164. Aside from the availability of technical support systems from the existing facility of BGFCL, future expected capacity of the production wells was also considered. At present, the daily capacity from the eight production wells (i.e., Titas # 1, 2, 4, 5, 7, 15, 20 and 22) ranges from 230 million standard cubic feet (MMSCF) to 235 MMSCF. Additional work from the suspended Titas production well #21 will result to additional supply of natural gas approximately 12 MMSCF to 15 MMSCF per day. With mainstreaming of Titas well #21, the estimated future capacity from these nine wells will be 270 MMSCF of natural gas daily. Considering this estimated capacity, installation of seven wellhead compressors having a capacity of 60 MMSCF per day will be needed (i.e., five compressors operating and two compressors as standby).

165. A “without project” option will stall planned national economic development dependent on the reliable supply of natural gas including the associated jobs that could have been generated. Aside from the planned economic development, the operations of existing industries and residential users of natural gas will be compromised due to decreasing flow of natural gas from Titas gas fields. **Table 6.1** presents a summary of comparing “with project” and “without project” options.

Table 6.1 Comparison of "With Project" and "Without Project" Options

Description	"With Project" Option	"No Project" Option
Supply of natural gas	Increase availability and reliable flow of natural gas for transmission and distribution to industry, transport, and residential purposes	Decreasing flow of natural gas supply for transport and distribution will continue
Economic development	More opportunities for the area to develop economically due to reliable supply of natural gas	Slower economic development due to shortage of available natural gas
Impacts to ecologically-sensitive areas	No impacts expected as the project site is within an existing facility owned by BGFCL which is considered an industrial area	No impacts
Impacts to flora and fauna	Minimal impacts; the proposed project site is mainly grassland and no presence of mature trees	No impacts
Greenhouse gas (GHG) emissions	Using 5 MMSCF per day of natural gas to fuel the operation of the wellhead compressors will contribute about 272.2 MT CO_2 per day.	No GHG contribution
Water requirements	About 16 tons of water will be required by the wellhead compressors	No water requirements needed
Disruption to local residents	Minimal effect (i.e., temporary and short duration during construction/ installation) since the project site is located within an existing facility	No related local disruptions
Employment	There will be jobs associated with the project during construction and operation phase.	No creation of jobs
Living conditions of related service areas of BGFCL	Potential improvement in living conditions due to availability of reliable flow of natural gas	Same level of living conditions or likelihood of worsening living conditions due to poor service of BGFCL associated with shortfall in reliable natural gas flow

7.0 INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

166. Location A is within the existing Titas Gas Field which is considered industrial given the presence of two natural gas process plants and production wells. Initial consultations were conducted on 18 October 2015 to inform the local residents within the immediate vicinity of Titas Gas Field about the project and to gather their opinion/suggestions/concerns, if any. The preliminary consultations were undertaken as part of the preparation of the IEE.

167. Thirty-six participants attended the consultations at Union Parisad Office of Shuhilpur under Brahmanbaria District (see **Annex 3**). During the consultation, BGFCL discussed briefly the features of Component 1 briefly and the potential impacts. BGFCL emphasized that Component 1 will be located within the existing premises of the Titas Gas Field.

168. Some of the concerns raised by the participants include the following:

- Potential increase of noise levels from vehicles, compressors and equipment at Location A that may disrupt settlements and wildlife;
- Water pollution of natural water bodies like the Titas River as the water is used for agriculture and other domestic purposes;
- Movement of vehicles may affect the mobility of people, especially women, children and disabled person from one place to another;
- Potential air pollution due to dust and gaseous emissions from compressors; and,
- Environmental pollution due to poor sanitation during construction, waste materials, and other social nuisance should be controlled.

169. Aside from these concerns, the participants will be expecting for the following:

- Local residents should be employed in different activities during implementation of Component 1 on a priority basis.
- Local businessmen/contractors should be engaged in different phases of Component 1 during construction and development on a 'priority' basis.
- Compensation in any form should be properly and promptly given so that the actual affected persons can get their full share at the right time.

Table 7.1 presents the summary of the initial consultations.

Table 7.1 Summary of Initial Consultation

Items Discussed by BGFCL	Issue Raised by Stakeholders	BGFCL's Response
Features of Component 1 and the impacts during implementation in Location A of Titas Gas Field	Build up new industries	New compressors will sustain gas production from wells
	Reduce unemployment	Labour will be taken from respective locality
	Social and economic developments	Living standards will improve
	Timely compensation to affected persons	Monitoring of payment
	Potential pollution of air and surface water	Monitoring will be implemented
	Movement of vehicles may	Local traffic management plan

Items Discussed by BGFCL	Issue Raised by Stakeholders	BGFCL's Response
	disrupt mobility of local people	
	Sanitary problem	Appropriate sanitary facilities will be provided to workers during construction
	Increased noise level	Appropriate noise mitigation measures will be implemented at the compressors' site

170. Consultations will continue, as appropriate during implementation. A one-page flyer in Bangla about Component 1 and information on GRM will be made available to the public at the project site and at the BGFCL office in Birashar, Brahmanbaria and in Dhaka. Brief information about Component 1 will also be made available at the BGFCL website. Information disclosure will refer to the Right to Information Act 2009 of GoB and the policies of ADB: SPS 2009 and the Public Communications Policy (PCP) 2011.

8.0 GRIEVANCE REDRESS MECHANISM

8.1 Existing Structure of Handling Grievance at BGFCL

171. At present, handling of grievance at the BGFCL is within the Grievance Redress System (GRS) which is part of the mandatory strategic objectives of Annual Performance Management (APM) of the GoB (represented by the Energy and Mineral Resource Division). BGFCL has signed an agreement with Petrobangla on 28 October 2015 to comply with GRS. This agreement will be signed and renewed annually.

172. GRS requires the mandatory designation of staff as Focal Point and consequently disclose the name of the designated staff and contact address in the company's website. Following the requirements of GRS, BGFCL has designated a staff and publish the same at the BGFCL's website. Compliance to GRS is a Performance Indicator in the APM.

8.2 Handling Grievance as Required by SPS 2009

173. To ensure that complaint(s) will be addressed properly during the implementation of Component 1, the Project Implementation Unit (PIU) will establish a grievance redress mechanism (GRM).

Objectives of GRM

174. GRM will ensure a process of receiving and resolving complaint(s) promptly from persons that may be affected by Component 1. Following the requirements of SPS 2009, the GRM will involve a process that is understandable, transparent, gender-responsive, culturally-appropriate, and easily accessible to affected persons without cost and retribution.

Structure of GRM

175. Affected persons (APs) can seek redress of their grievance at three levels: (i) the PIU-BGFCL or through the representative of the Engineering, Procurement and Construction (EPC)

Contractor during construction phase, (ii) through the grievance redress committee (GRC), and (iii) the appropriate courts of law.[26]

176. PIU-BGFCL will set up a grievance redress committee (GRC) as soon as the ADB and GoB approve the project. The GRC will continue to function from construction until the operation phase and will consist of representatives from the EPC Contractor (during construction), local government unit, designated staff of PIU-BGFCL on environmental issues (or Consultant), and witness of the complainant. BGFCL will ensure the representation of women in the GRC. The BGFCL staff designated in the existing GRS required by Petrobangla will be part of the GRC.

177. GRC will be responsible for resolving complaint(s) and will convene once a month to review the complaint(s) received, if any. GRC will resolve complaint(s) within 30 days from the date of receipt and will keep a record indicating the name of complainant and nature of complaint, status of resolving the complaint, decisions or actions undertaken, and the date the decision was effected. Records on grievances will be summarized and included in the environmental monitoring reports to be submitted by BGFCL twice a year to ADB during construction phase and annually during operation phase.

178. PIU-BGFCL will disclose the grievance redress procedure to project stakeholders such as the contact person and details on how and where to contact them, how to file a grievance, and the time for the GRC to resolve the concerns. The PIU-BGFCL will review the implementation of the GRM regularly to assess the effectiveness of the process and to examine their ability to address grievances. The cost of implementing the GRM will be part of the administration cost borne by PIU-BGFCL.

9.0 ENVIRONMENTAL MANAGEMENT PLAN

179. The environmental management plan (EMP) presents the activities to be undertaken in every phase of project implementation to minimize the adverse impacts and to enhance positive impacts. EMP also includes the monitoring and institutional arrangements needed. **Table 9.1** presents a summary of the EMP while **Table 9.2** presents the monitoring plan.

180. As part of project's readiness and compliance to environmental requirements of GoB, **Annex 3** presents the No Objection Certificate (NOC) from the local authority. NOC is one of the documents required to secure the LCC from the DOE.

9.1 Implementation Arrangements

181. BGFCL will set up a PIU responsible for project management and safeguards compliance monitoring of EPC contractor during the construction stage. The EPC Contractor will recruit an environmental staff (or a Consultant) who will be primarily responsible for ensuring that the EMP is properly implemented during construction. The Environmental staff (or consultant) of the EPC will coordinate and interact with the PIU on compliance to ADB requirements, relevant government agencies and local authorities on clearances (as needed), and will prepare the environment section of the Project's Quarterly Progress Report (QPR) submitted to the PIU for review. The environment section in the Project's QPR will be

[26] Members of GRC will consist of: (i) BGFCL staff designated for GRS, (ii) representative from the EPC Contractor (during construction phase and first year of operation phase), (iii) local government unit representative, (iv) PIU-BGFCL designated staff (or consultant) on environmental issues, and (v) witness of the complainant.

summarized by the PIU and submitted as environmental monitoring reports to ADB at least twice a year during construction, which will posted on ADB's website.

182. Should there be any change in the configuration, capacity, or design of the compressors, this IEE will be revised and/or updated and submitted to ADB prior to any construction works. BGFCL will be responsible in the revision or updating of the IEE.

183. Prior to any construction work, the EPC Contractor(s) will be informed by the PIU-BGFCL on their responsibility to comply with the EMP and the requirements of ADB. Specific responsibilities of the EPC Contractor in the EMP will be monitored by their Environment staff (or Consultant) for compliance. Overall compliance of the EPC Contractor to the EMP and ADB requirements will be supervised by the PIU-BGFCL and/or staff of the Environment and Safety Department of BGFCL. The same implementation arrangements will be followed during the first year of the operation stage when it will be operated by the EPC Contractor.

184. During the second year of operation stage, PIU-BGFCL will designate a staff who will be responsible to deal with the environmental issues and compliance to GoB and ADB's environmental requirements. DOE requirements will include submission of EMP for Location A and yearly renewal of ECC. Requirements of ADB will include submission of environmental monitoring reports annually. The environmental monitoring report will be reviewed by ADB and posted on their website as required by SPS 2009 and PCP 2011.

185. In the event of non-compliance to any environmental covenant in the loan agreements, PIU-BGFCL will prepare a corrective action plan (CAP) describing the process and actions they will undertake to ensure compliance. The CAP will be submitted to ADB for review and disclosure to their website. BGFCL will submit the environmental monitoring reports starting from the date the loan became effective.

9.2 Environment Safety Management System (ESMS) at BGFCL

186. As one of the operating companies of Petrobangla, BGFCL also has an existing ESMS at Titas Gas Field. BGFCL has an Engineering and Safety Department (ESD) with a total of 11 staff. ESD consists of two sections: (i) Environmental Engineering, and (ii) Safety Engineering with four staff each section.

187. Aside from the relevant environment and safety regulations of GoB, the ESMS provides BGFCL guidance and tools needed to ensure safe and environmentally-sound operations. The ESMS consists of 23 elements organized in 10 environment and safety categories where BGFCL can focus on. These categories include: (1) policy and leadership, (2) continuous improvement, (3) safety and health, (4) risk management, (5) incident reporting and investigation, (6) emergency preparedness and response, (7) environmental protection, (8) training and orientation, (9) community relations, and (10) regulatory requirements.

188. The ESMS Manual covers:

(i) *Environment and Safety Guidance Manual* – there are 23 elements that provides guidance needed to meet the environment and safety requirements
(ii) *Environment and Safety Procedures Manual* – consists of 73 requirements in the form of procedures

189. The ESMS was developed in 2000 by Petrobangla with the assistance of international experts.

9.3 Safety and Hazard Mitigation Plan at BGFCL

190. Given the nature of natural gas processing, safety is an integral part of BGFCL's operations to ensure protection of their employees, contractors, properties, the environment and the public as a whole. **Annex 5** presents the details of the safe and hazard mitigation plan.

Table 9.1 Environmental Management Plan

Project Activity	Environmental Component Likely to be Affected	Description of Potential Environmental Impact	Mitigation/Enhancement Measures	Estimated Cost ($ million)	Responsible Unit
Planning and Pre-Construction Stage					
• Selection of suitable space for installation of gas compressors within the premises of Titas Gas Field • Obtain clearance from DOE • Procurement process (Tender evaluation, approval, contract awarding, etc.)	• Land and vegetation	• Loss of habitat and vegetation clearing • Land acquisition • Change in existing land use	• Use of environmental factors in selection criteria to minimize potential adverse impacts. • No land acquisition required – site selected at Location A is within Titas Gas Field owned by BGFCL. • Land development to suit the change in current use.	0.57 (for land development included in the Project cost)	BGFCL
	• People	• Physical displacement of people and structures • Economic loss to people	• Location A is a vacant land owned by BGFCL. •No physical or economic displacement		
	• Water	• Abstraction of water for compressors	•Existing water system at Titas Gas Field will be used. •Water will come from borehole or deep tube well. •Incorporate water conservation initiative like rain harvesting.		
Construction Stage					
Orientation for contractor and workers	• People	•Awareness of workers on the environmental requirements and their responsibility •Understanding of EPC Contractor(s) of their responsibility in implementing the EMP	• Conduct briefing of EPC Contractor(s) on EMP, records management, and reporting. • Identify areas to be monitored and the required mitigation measures. • Create awareness of sexually-transmitted diseases such as HIV/AIDs.	Included in the costs of EPC Contractor(s)	EPC Contractor(s), PIU-BGFCL, or Environmental Consultant
Hiring of project staff and workers	• People	• Conflict due to potential workers' migration • Dispute over transparency of hiring	• EPC Contractor(s) will be required to use local labour for manual work and eligible local workforce for clerical and office jobs. • There is adequate supply of local labour. Scale of Component 1 is not expected to cause workers' migration.	---	EPC Contractor(s), PIU-BGFCL, or Environmental consultant

Project Activity	Environmental Component Likely to be Affected	Description of Potential Environmental Impact	Mitigation/Enhancement Measures	Estimated Cost ($ million)	Responsible Unit
Presence of workers at construction sites	• People	• Potential increase in demand for services such as food, temporary housing, etc. will create opportunities for small-scale business	• None required.	---	---
• Site preparation • Transportation of equipment and machinery to Location A	• People	• Potential safety risks to workers and community • Disruption to the activities of local people	• Location A is within the perimeter of Titas Gas Field – unauthorized public access is not allowed. • Fence or barricade (as appropriate), sufficient lights, clear warning signs and danger signals will be provided to minimize occupational and safety risks. • Assign security personnel to prevent accidents, trespassing, and pilferage. • EPC Contractor(s) to direct drivers to strictly follow road regulations.	Included in the costs of EPC Contractor	EPC Contractor, PIU-BGFCL, or Environmental consultant
		• Interference with road crossings	• Schedule transportation movements to minimize disruption of local traffic. • Danger and clearly visible warning signs will be posted at designated sites within Location A and also in the adjacent facility. • Construction vehicles to strictly follow road regulations particularly on speed • Implement temporary pedestrian management plan.		
		• Potential occupational health and safety risks to workers	• Provide sanitary facilities and wash areas. • Provide safe drinking water and garbage bins. • Enforce good housekeeping at all times • Provide workers with hard hat, safety shoes and belts. • Set up first aid treatment within construction sites and field office including fire-fighting system. • Observance and compliance with relevant safety measures required by law and best engineering practices.		

Project Activity	Environmental Component Likely to be Affected	Description of Potential Environmental Impact	Mitigation/Enhancement Measures	Estimated Cost ($ million)	Responsible Unit
			• Provide communication devices such as walkie-talkie to designated workers. • Follow World Bank EHS General Guidelines 2007 (or any updates)		
	• Land and vegetation	• Loss of habitat for terrestrial flora and fauna	• Location A is only about 0.6 ha and vegetation is mainly grassland - minimal vegetation will be cleared. • Tree planting will be done as required for KPI after completion of construction works. • Excavated soil will be stored in designated areas and/or borrow areas following the spoils disposal plan. • Will supervise to ensure minimum area to be used for construction activities.		
	• Water	• Generation of sewage from construction workers • Localized flooding	• To provide sanitary facilities to workers and safe drinking water. • Avoid earthworks during rainy season • Implement drainage and stormwater management plan.		
	• Air and noise	• Heavy equipment and construction vehicles may increase vehicular emissions • Transport of construction materials to constructions sites may increase dust level • Earthmoving works and excavation may increase dust levels • Increase in noise level and vibration from excavation and heavy equipment and construction vehicles	• EPC Contractor will be required to maintain construction vehicles to minimize vehicular emissions. • Will enclose construction sites temporarily to contain dust dispersion. • Warehouse for construction materials onsite will be provided to reduce trips of material delivery. • Opened land areas or sources of dust will be sprayed with water (as needed). • Transport of dust-generating materials will be covered. • Observance of low speed by vehicles to reduce noise. • Noise-generating works will be done		

Project Activity	Environmental Component Likely to be Affected	Description of Potential Environmental Impact	Mitigation/Enhancement Measures	Estimated Cost ($ million)	Responsible Unit
			between 7AM and 7PM. • Will require EPC Contractor to instruct drivers that there will be no blowing of horns.		
• Installation of compressors, ancillary equipment, and piping works • Testing and commissioning of compressors	• People	• Public and occupational safety risks	• Closely monitor operation as the machine comes to normal operating conditions. • A safety plan will be prepared by the EPC contractor for approval by BGFCL prior to the installation works.	Included in overall construction costs	EPC Contractor, PIU-BGFCL/Supervising Consultant, Environmental consultant
	• Air and Noise	• Emissions from testing works	• Use of inert gas to purge the compressor case or cylinders of air, needed. • Will conduct noise quality test to check with specifications.		
	• Water	• Generation of waste	• Liquid waste such as oily and cooling system drains, and spent lube oil discharged from testing/commissioning activities will be treated prior to disposal. Oil and water separators will be provided.		
Operation Stage					
Presence of additional seven compressors in Titas Gas Field	• People	• Hazards such as fire or explosion due to operational failure	• Standard operating and safety procedures following national requirements, industry standards, and international best practice will be strictly implemented. • An emergency preparedness and disaster management plan will be required from the EPC Contractor. • Existing environment safety management system (ESMS) in other BGFCL facilities will be replicated. • Staff will observe the compressor operation for signs of failure or maintenance needs during normal operation. • Will provide security personnel • All electrical wiring will have appropriate grounding and	Included in the O & M costs	EPC Contractor during the first year of O & M, PIU-BGFCL, Environmental staff or consultant

Project Activity	Environmental Component Likely to be Affected	Description of Potential Environmental Impact	Mitigation/Enhancement Measures	Estimated Cost ($ million)	Responsible Unit
			deactivation of live power lines during maintenance work. • Compressors are designed with safety features in case of failure such as fire-fighting system. • Will maintain and comply with mechanical, structural, and electrical standards.		
		• Generation of employment	• Additional staff will be needed during operation of the compressors	---	
		• Potential disturbance to settlements and occupational health risks due to noise generated from compressors	• Settlements are outside the perimeter of Titas Gas Field. • Will provide enclosure of compressors and ear muffs to workers. • Workers exposed to high noise levels will be rotated every 2 hours. • Protective boundary wall with sufficient height will be constructed as buffer, if needed.	Included in the overall construction costs	PIU-BGFCL, Environmental staff or consultant
	• Air	• Contribution to greenhouse gas (GHG)	• About 272 MT of CO_2 emissions per day will be contributed by compressors. • Common species of trees such as neem (*Azadirachta indica*) and Ashwatha (*Ficus religiosa*) will be planted on designated areas within the Titas Gas Plant to provide sinks for GHG emissions. BGFCL-ESD together with environmental staff in PIU (or consultant) will coordinate with the DOF on the appropriate tree species to be planted. • Regular maintenance of equipment and strict monitoring of leaks.	Included in the O & M costs	PIU-BGFCL, Environmental staff or consultant
	• Water	• Use of 16 tons of water daily to operate the compressors • Some drainage congestion may occur	• Reserved water pond will be used as back-up for deep tube well during the dry season. • Proper drainage works will be done during construction stage.	Included in the O & M costs	PIU-BGFCL, Environmental staff or consultant

Project Activity	Environmental Component Likely to be Affected	Description of Potential Environmental Impact	Mitigation/Enhancement Measures	Estimated Cost ($ million)	Responsible Unit
Decommissioning Stage					
Dismantling of compressors and ancillary equipment	• People	• Occupational safety risks	• Will prepare a decommissioning plan following international best practice, national regulations, and industry standards	Included in the O & M costs	BGFCL, Environmental staff or consultant
	• Land	• Generation of solid waste	• All left-over structures, concrete, solid waste materials and other debris will be disposed of at designated disposal site. • Solid waste will be sorted to determine recyclable/reusable materials that can be sold as scrap or used for other projects. • Non-hazardous waste will be sent to appropriate disposal sites.		
	• Air and noise	• Emissions will be generated from hauling vehicles, large construction equipment, and dust from sources such as structure removal, and dumping	• Dismantling activities will be done during daytime. • Movement of vehicles and equipment will be scheduled to avoid traffic and excess vehicular emissions. • Hauling trucks will be covered and opened land areas will be sprayed with water, as needed to control dust level.		
	• Water	• Generation and disposal of liquid waste	• Small amount of wastewater that will be generated from cleaning the work site will be discharged into soak well within the premises of the Titas Gas Field. • Spent oil, hydraulic fluids, coolants, solvents, and cleaning agents will be treated similar to O & M stage. These industrial wastes will be placed in containers, labeled, and transported or hauled by licensed hauler of industrial waste.		

Table 9.2 Environmental Monitoring Plan

Environment Component	Parameter(s)	Frequency/Year	Sampling Station	Amount (Lump Sum Tk)
Surface water quality	TDS, COD, BOD, pH, DO,TSS	2 (During dry and monsoon)	Pond near main gate at Titas Gas Field, Titas River	20,000.00
Groundwater	pH, Fe, Mn, As, oil & grease, Pb, depth of water table (or depth to groundwater)	2 (During dry season and monsoon season)	Borehole at Location A facility	50,000.00
Drinking water	Fe, Mn, As, Pb, coliform (total or fecal)	2 (During dry and monsoon seasons)	Location A facility	50,000.00
Soil	Heavy metal (Pb and Cr), oil, and grease	2 (During dry season and monsoon season) Note: one sampling for baseline data on Pb and Cr	Location A facility	50,000.00
Solid wastes	Quantity (will include sanitary waste and housekeeping status)	Monthly during construction	Location A	50,000.00
Road traffic/ traffic	Arrangement, safety	Daily ocular inspection during construction stage and weekly during operation stage	From main gate of Titas Gas Field to Location A	15,000.00 (cost during operation stage; monitoring cost during construction stage will be included in EPC Contractor budget)
Air	CO, NO_x, SO_x, Lead	Twice a year during construction and yearly during operation phase	One sampling point near Location A project site and another sampling station 1 km downwind from Location A	25,000.00
Noise	Noise level in dB(a)	Twice a year during construction and yearly during operation phase	One sampling point near Location A project site and another sampling station 1 km downwind from Location A	10,000.00
Health and safety	Incidence of accidents, outbreak of disease(s), number of absences of workers due to illness	Quarterly during construction stage and semi-annually during operation phase	Construction site at Location A and soon after Location A facility	50,000.00
Total				**320,000.00**

10. CONCLUSION AND RECOMMENDATION

191. There is a great need to install compressors at Location A in Titas Gas Field to ensure the reliable supply of natural gas at the required pressure to facilitate transmission. Location A is about 0.6 hectare (ha) that will accommodate seven compressors where five compressors will be in operation at a time while two compressors will be standby.

192. Installation of these compressors will not cause significant adverse environmental impacts given that it is within an area considered for industrial use. Vegetation is mainly grassland. DOE has issued the ECCs for the existing facilities. Since Component 1 is within an existing facility, DOE advised the BGFCL to submit an EMP in securing the ECC instead of the usual IEE and EIA requirements for red category project.

193. Potential environmental impacts from during construction stage may include increased level of noise and dusts, generation of waste from construction works, and disruption to daily activities in Ghatura mauza in Sadar Upazila, Brahmanbaria. These potential impacts can be mitigated by best construction engineering practices and adherence to relevant regulations of GoB and requirements of ADB. Mitigation measures are included in the EMP and the parameters for monitoring have been identified in the environmental monitoring plan.

194. While the local people consulted support the project, they raised concerns on compensation and participation in potential business opportunities. Continuous communication and/or consultations will be conducted during implementation on community safety and environmental management. Should there be any concerns not addressed during consultations, a grievance redress mechanism will be will be set up by the PIU-BGFCL.

195. This draft IEE will be publicly disclosed at the ADB website as required by SPS 2009 and PCP 2011. A project brief and/or factsheet will be prepared in Bangla and made available to the public at the PIU-BGFCL field office, in Barishar and in Dhaka.

196. Component 1 will have potential environmental impacts but these can be readily mitigated. Overall, the improvement in the supply of natural gas as a result of Component 1 is expected to contribute in meeting the growing demand for natural gas and in the economic development of Bangladesh.

Annex 1

Relevant Environmental Quality Standards of Bangladesh
(From the Environment Conservation Rules 1997**)**

SCHEDULE – 2
Standards for Air
[See Rule 12]

Density in microgram per cusec meter

Sl. No.	Categories of Area	Suspended Particulate Matter (SPM)	Sulphur Dioxide	Carbon Monoxide	Oxides of Nitrogen
a	Industrial and mixed	500	120	5,000	100
b	Commercial and mixed	400	100	5,000	100
c	Residential and rural	200	80	2,000	80
d	Sensitive	100	30	1,000	30

Notes:

(1) At national level, sensitive area includes monuments, health center, hospital, archeological site, educational institution, and government designated areas (if any).

(2) Industrial units located in areas not designated as industrial areas shall not discharge pollutants which may contribute to exceeding the standard for air surrounding the areas specified at Sl. nos. c and d above.

(3) Suspended particulate matter means airborne particles of a diameter of 10 micron or less.

SCHEDULE – 3
Standards for Water
[See Rule 12]

(A) Standards for inland surface water

	Best practice-based classification	Parameter			
		pH	BOD (mg/l)	DO (mg/l)	Total Coliform (number/100 ml)
a.	Source of drinking water for supply only after disinfecting:	6.5-8.5	2 or less	6 or above	50 or less
b.	Water usable for recreational activity :	6.5 – 8.5	3 or less	5 or more	200 or less
c.	Source of drinking water for supply after conventional treatment:	6.5 – 8.5	6 or less	6 or more	5,000 or less
d.	Water usable by fisheries:	6.5 – 8.5	6 or less	5 or more	---
e.	Water usable by various process and cooling industries :	6.5 – 8.5	10 or less	5 or more	5,000 or less
f.	Water usable for irrigation:	6.5 – 8.5	10 or less	5 or more	1,000 or less

Notes:

1. In water used for pisiculture, maximum limit of presence of ammonia as Nitrogen is 1.2 mg/l.
2. Electrical conductivity for irrigation water – 2,250 µmhoms/cm (at a temperature of 25°C); Sodium less than 26%; boron less than 0.2%.

(B) Standards for drinking water

Sl	Parameter	Unit	Standard
1.	Aluminum	mg/l	0.2
2.	Ammonia (NH_3)	mg/l	0.5
3.	Arsenic	mg/l	0.5
4.	Barium	mg/l	0.01
5.	Benzene	mg/l	0.01
6.	BOD_5 at 20^oC	mg/l	0.2
7.	Boron	mg/l	1.0
8.	Cadmium	mg/l	0.005
9.	Calcium	mg/l	75

Sl	Parameter	Unit	Standard
10.	Chloride	mg/l	150 – 600*
11.	Chlorinated alkanes		
	Carbon tetrachloride	mg/l	0.01
	1,1 dichloroethylene	mg/l	0.001
	1,2 dichloroethylene	mg/l	0.03
	Tetrachloroethylene	mg/l	0.03
	Trichloroethylene	mg/l	0.09
12.	Chlorinated phenols		
	Pentachlorophenol	mg/l	0.03
	2,4,6 trichlorophenol	mg/l	0l03
13.	Chlorine (residual)	mg/l	0.2
14.	Chloroform	mg/l	0.09
15.	Chromium (hexavalent)	mg/l	0.05
16.	Chromium (total)	mg/l	0.05
17.	COD	mg/l	4.0
18.	Coliform (fecal)	n/100 ml	0
19.	Coliform (total)	n/100 ml	0
20.	Color	Hazen unit	15
21.	Copper	mg/l	1.0
22.	Cyanide	mg/l	0.1
23.	Detergents	mg/l	0.2
24.	DO	mg/l	6.0
25.	Fluoride	mg/l	1
26.	Hardness (as $CaCO_3$)	mg/l	200 – 250
27.	Iron	mg/l	0.3 – 1.0
28.	Kjeldahl Nitrogen (total)	mg/l	1.0
29.	Lead	mg/l	0.05
30.	Magnesium	mg/l	30 – 35
31.	Manganese	mg/l	0.1
32.	Mercury	mg/l	0.001
33.	Nickel	mg/l	0.1
34.	Nitrate	mg/l	10
35.	Nitrite	mg/l	Less than 1
36.	Odor	mg/l	Odorless
37.	Oil and grease	mg/l	0.01
38.	pH	---	6.5 – 8.5
39.	Phenolic compounds	mg/l	0.002
40.	Phosphate	mg/l	6.0
41.	Phosphorous	mg/l	0
42.	Potassium	mg/l	12
43.	Radioactive materials (gross alpha activity)	Bq/l	0.01
44.	Radioactive materials (gross beta activity)	Bq/l	0.1
45.	Selenium	mg/l	0.01
46.	Silver	mg/	0.02
47.	Sodium	mg/	200
48.	Suspended particulate matter	mg/	10
49.	Sulfide	mg/	0
50.	Sulfate	mg/	400
51.	Total dissolved solids	mg/	1,000
52.	Temperature	^{o}C	20 – 30
53.	Tin	mg/	2.0
54.	Turbidity	JTU	10.0
55.	Zinc	mg/	5.0

SCHEDULE – 4
Standards for Sound
[See Rule 12]

Sl No.	Category of areas	Standards determined at dBa unit	
		Day	Night
a	Silent zone	45	35
b	Residential area	50	40
c	Mixed area (mainly residential area, and also simultaneously used for commercial and industrial purposes)	60	50
d	Commercial area	70	60
e	Industrial area	75	70

Notes:
1. The time from 6 a.m. to 9 p.m. is counted as daytime.
2. The time from 9 p.m. to 6 a.m. is counted as night time.
3. Area up to a radius of 100 meters around hospitals or educational institutions or special institutions/ establishments identified/to be identified by the Government is designated as Silent Zones where use of horns of vehicles or other audio signals, and loudspeakers are prohibited.

SCHEDULE – 5
[See Rule 12]
Standards for Sound originating from Motor Vehicles or Mechanized Vessels

Category of Vehicles	Unit	Standards	Remarks
*Motor Vehicles (all types)	dBa	85	As measured at a distance of 7.5 meters from exhaust pipe.
		100	As measured at a distance of 0.5 meter from exhaust pipe.
Mechanized Vessels	dBa	85	As measured at a distance of 7.5 meters from the vessel which is not in motion, not loaded and is at two thirds of its maximum rotating speed.
		100	As measured at a distance of 0.5 meter from the vessel which is in the same condition as above.

* At the time of taking measurement, the motor vehicle shall not be in motion and its engine conditions shall be as follows:-
(a) Diesel engine – maximum rotating speed.
(b) Gasoline engine –at two thirds of its maximum rotating speed and without any load.
(c) Motorcycle – If maximum rotating speed is above 5000 rpm; two thirds of the speed, and if maximum rotating speed is less than 5000 rpm, three-fourth of the speed.

SCHEDULE – 6
Standards for Emission from Motor Vehicles
[See Rule 12]

Parameter	Unit	Standard Limit
Black Smoke	Hartridge Smoke Unit (HSU)	65
Carbon Monoxide	gm/km	24
	Percent area	04
Hydrocarbon	gm/km	02
	ppm	180
Oxides of Nitrogen	gm/km	02
	ppm	600

* As measured at two thirds of maximum rotating speed.

SCHEDULE – 7
Standards for Emission from Mechanized Vessels
[See Rule 12]

Parameter	Unit	Standard Limit
Black Smoke*	Hartridge Smoke Unit (HSU)	65

* As measured at two thirds of maximum rotating speed.

SCHEDULE – 8
Standards for Odor
[See Rule 12]

Parameter	Unit	Standard Limit
Acetaldehyde	ppm	0.5 - 5
Ammonia	ppm	1- 5
Hydrogen sulfide	ppm	0.02 – 0.2
Methyl disulfide	ppm	0.009 – 0.1
Methyl sulfide	ppm	0.01 – 0.2
Styrene	ppm	0.4 – 2.0
Trimethylamine	ppm	0.005 – 0.07

Notes:

(1) Following regulatory limit shall be generally applicable to emission/exhaust outlet pipe of above 5 meter height:

$Q = 0.108 \times He^2Cm$ (Where Q = Gas Emission rate Nm^3/hour)

He = Height of exhaust outlet pipe (m)

Cm = Above mentioned limit (ppm)

(2) In cases where a special parameter has been mentioned, the lower limit shall be applicable for warning purposes, and the higher limit shall be applicable for prosecution purpose or punitive measure.

SCHEDULE – 9
Standards for Sewage Discharge
[See Rule 12]

Parameter	Unit	Standard Limit
BOD_5	mg/l	40
Nitrate	mg/l	250
Phosphate	mg/l	35
Suspended solids	mg/l	100
Temperature	^oC	30
Coliform	Number per 100 ml	1,000

Notes:

(1) This limit shall be applicable to discharges into surface and inland waters bodies.

(2) Sewage shall be chlorinated before final discharge.

SCHEDULE – 10
Standards for Waste from Industrial Units or Projects Waste
[See Rule 13]

Sl. No.	Parameter	Unit	Places for determination of standards		
			Inland Surface Water	Public Sewerage system connected to treatment at second stage	Irrigated Land
1	Ammoniacal Nitrogen (as elemental N)	mg/l	50	75	75

Sl. No.	Parameter	Unit		Places for determination of standards		
				Inland Surface Water	Public Sewerage system connected to treatment at second stage	Irrigated Land
2	Ammonia (as free NH_3)	mg/l		5	5	15
3	Arsenic (As)	mg/l		0.2	0.05	0.2
4	BOD_5 at 20^oC	mg/l		50	250	100
5	Boron	mg/l		2	2	2
6	Cadmium (as Cd)	mg/l		0.5	0.05	0.05
7	Chlorine	mg/l		600	600	600
8	Chromium (as total Cr)	mg/l		0.5	1.0	1.0
9	COD	mg/l		200	400	400
10	Chromium (as Cr^{+6})	mg/l		0.1	1.0	1.0
11	Copper (Cu)	mg/l		0.5	3.0	3.0
12	Dissolved oxygen (DO)	mg/l		4.5 – 8	4.5 – 8	4.5 – 8
13	Electrical conductivity (EC)	µmho/cm		1,200	1,200	1,200
14	Total dissolved solids	mg/l		2,100	2,100	2,100
15	Fluoride (as F)	mg/l		2	15	10
16	Sulfide (as S)	mg/l		1	2	2
17	Iron (as Fe)	mg/l		2	2	2
18	Total Kjeldahl nitrogen (as N)	mg/l		100	100	100
19	Lead (as Pb)	mg/l		0.1	1.0	0.1
20	Manganese (as Mn)	mg/l		5	5	5
21	Mercury (as Hg)	mg/l		0.01	0.01	0.01
22	Nickel (as Ni)	mg/l		1.0	2.0	1.0
23	Nitrate (as elemental N)	mg/l		10	Not yet fixed	10
24	Oil and grease	mg/l		10	20	10
25	Phenolic compounds (as C_6H_5OH)	mg/l		1.0	5	1
26	Dissolved Phosphorous (as P)	mg/l		8	8	15
27	Radioactive substance	To be specified by Bangladesh Atomic Energy Commission				
28	pH	---		6 – 9	6 – 9	6 – 9
29	Selenium (as Se)	mg/l		0.05	0.05	0.05
30	Zinc (as Zn)	mg/l		5	10	10
31	Temperature	^oC	Summer	40	40	40
			Winter	45	45	45
32	Suspended solids	mg/l		150	500	200
33	Cyanide (as Cn)	mg/l		0.1	2.0	0.2

Notes:

(1) These standards shall be applicable to all industries or projects other than those specified under the heading "Standards for sectorwise industrial effluent or emission."

(2) Compliance with these standards shall be ensured from the moment an industrial unit starts trial production, and in other cases, from the moment a project starts operation.

(3) These standards shall be inviolable even in case of any sample collected instantly at any point of time. These standards may be enforced in a more stringent manner if considered necessary in view of the environmental conditions of a particular situation.

(4) Inland Surface Water means drains/ponds/tanks/water bodies/ditches, canals, rivers, springs and estuaries.

(5) Public sewerage system means treatment facilities of the first and second stage and also the combined and complete treatment facilities.

(6) Irrigable land means such land area which is sufficiently irrigated by waste water taking into consideration the quantity and quality of such water for cultivation of selected crops on that land.

(7) Inland Surface Water Standards shall apply to any discharge to a public sewerage system or to land if the discharge does not meet the requirements of the definitions in notes 5 and 6 above.

Annex 2
Chance Find Procedures for Physical Cultural Resources

1.0 Introduction

These procedures describe the measures to be undertaken if an accidental discovery or chance find, or an encounter with a physical cultural resource (PCR) occurred during the construction phase. The chance find procedures will be finalized as Physical Cultural Resources Plan (PCRP) by BGFCL and the Contractor(s), in consultation with the Department of Archaeology (DOA) or the Ministry of Cultural Affairs to ensure compliance to The Antiquities Act 1968 (amended 1976), National Cultural Policy 2006, and applicable regulations. The PCRP will be included in the Construction Management Plan that will be required from the Contractor(s). These procedures aim to identify and promote the preservation, protection, and recording of any PCR that may be discovered or exposed during the earthmoving works and ground alteration at Location A in Titas Gas Field.

2.0 Orientation and/or Briefing of Workers

The Contractor(s), with the assistance from the DOA or Ministry of Cultural Affairs and PIU-BGFCL, will conduct an orientation or training for all workers, particularly those who will be involved in earth movements and excavation on how to recognize artifacts that they may encounter or discover.

An archeological map of Bangladesh (if available) will be obtained from the DOA or other relevant sources to examine if there are potential "hot spots" within Titas Gas Field. This map will be part of the references on-site to guide the construction supervision staff in determining the potential "hot spots."

3.0 Procedures

3.1 General

In case a PCR was encountered during excavation, construction activities in the area will be stopped. The site or area discovered will be marked or demarcated using a global positioning system (GPS) unit to determine the exact coordinates and photographs will be taken. The construction supervision staff of the Contractor and PIU-BGFCL site engineer/staff will secure the site to prevent damage, loss or pilferage of removable objects. The PIU-BGFCL site engineer or designated staff will be responsible for coordinating with the DOA.

If the encounter involves removable items, a security person will be posted until the representative of DOA or Ministry of Cultural Affairs arrives to assess and determine its value. The DOA staff will be responsible in determining the appropriate course of action. Further excavation or earth moving works may be conducted at the distance and demarcation area recommended by the DOA staff.

If the chance find will have significant cultural value, this may entail consequent changes in the lay-out particularly if the discovery is considered or assessed as remains of cultural or archeological importance that is not removable.

The Contractor will not be entitled for compensation due to work stoppage as a result of the discovery and its associated subsequent actions.

3.2 Assessment and Recovery

Appropriate heavy equipment such as wheel loader will be made available to recover the excavated material from the excavation site to allow the geologist onsite or the DOA staff to inspect, recover or conduct sampling. A safe storage area will be provided to protect the discovered object. If the chance find is part of a large artifact, deposit or structure, the inspection or recording will include photography and video on an "as-is, where is" manner. The exact location will be recorded using a GPS unit.

3.3 Resumption of Work

The Contractor can continue with excavation and construction works within the affected area after the DOA staff has given clearance. All the discovered objects of value will be given to the Government.

4.0 Reporting

The Contractor will prepare a Chance Find Report within a week showing the date and time of discovery, specific location, description of the PCR, and interim protection measures implemented. This Report will be submitted to PIU-BGFCL who will provide it to the DOA or Ministry of Cultural Affairs.

Annex 3

Public Consultation

Meeting with Chairman, Councilor and Local People of Shuhilpur Union Porisad
Place: Shuhilpur Union Porisad Office
Date: 18 October 2015

Photo 1

Photo 2

Photo 3

Attendance Sheet

BANGLADESH GAS FIELDS COMPANY LIMITED

Installation of Wellhead Compressors at Location-A of Titas Gas Field

Public Consulting Meeting

Place : Shulkilpur Union Parishad Office Date : 18-10-15

Sl. No.	Name	Age	Occupation	Address	Cell No.	Signature
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BANGLADESH GAS FIELDS COMPANY LIMITED

Installation of Wellhead Compressors at Location-A of Titas Gas Field

Public Consulting Meeting

Place: Shuhilpur Union Porishad Office Date: 18-10-15

Sl. No.	Name	Age	Occupation	Address	Cell No.	Signature
[illegible]	[illegible]	৪০	[illegible]	[illegible]	[illegible]	[illegible]
৬০	[illegible]	৬০	[illegible]	[illegible]	0192488 [illegible]	[illegible]
৬১	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
৬২	[illegible]	২২	[illegible]	[illegible]	[illegible]	Ahine
৬৩	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
৬৪	[illegible]	৪৮	[illegible]	[illegible]	[illegible]	
৬৫	মোঃ [illegible]	৬০	চাকরি	খাটুরা	[illegible]	[illegible]
৬৬	মোঃ কবির মোল্লা	২৮	চাকুরী	[illegible]	01950980800	কবির

Annex 3
No Objection Certificate from the Local Authority

বিসমিল্লাহির রাহমানির রাহিম

মোঃ আজিজুর রহমান লিটন
চেয়ারম্যান
সুহিলপুর ইউনিয়ন পরিষদ
সদর উপজেলা, ব্রাহ্মণবাড়িয়া

Md. Azizur Rahman Liton
Chairman
Shuhilpur Union Porishad
Sadar Upazilla, Brahmanbaria

অনাপত্তি পত্র

এই মর্মে প্রত্যায়ন করা যাচ্ছে যে, ব্রাহ্মণবাড়িয়া জেলার ৩নং সুহিলপুর ইউনিয়ন পরিষদ অন্তর্গত ঘাটুরা মৌজায় অবস্থিত তিতাস লোকেশন-এ এলাকায় বাংলাদেশ গ্যাস ফিল্ডস কোম্পানী লিমিটেড-এর নিজস্ব জায়গায় ওয়েলহেড কম্প্রেসর স্থাপন করলে অত্র এলাকার জনগণের কোন আপত্তি নেই। তাছাড়াও কোম্পানীর কাজ চলাকালীন সময়ে এলাকার জনসাধারণ সার্বিকভাবে সহযোগিতা করবে এবং কোনরূপ বাধা সৃষ্টি করবে না।

চেয়ারম্যান
৩নং সুহিলপুর ইউনিয়ন পরিষদ
ব্রাহ্মণবাড়িয়া সদর

ফোন : ০৮৫১-৫৭১৯৩, মোবাইল : ০১৭১১-০০৩০৬৫, ০১৯৭১- ০০৩০৬৫
E-mail : uisc.shuhilpur@gmail.com

English Translation of the NOC (below)

It is certified that the people of Shuhilpur Union Parishad No.3 have no objection if Bangladesh Gas Fields Company Limited install wellhead compressor at their own premises of Location-A, Mouza: Ghatura, dist: Brahmanbaria. Besides, people of this area will extend necessary co-operations during project implementation period and will not create any problem.

Annex 4

Safety and Hazard Mitigation Plan at BGFCL

General Safety Procedure (GSP)

The safety policy will be updated from time to time. The policy will be signed and dated by the Chief Executive Officer. The policy will be discussed with all personnel. The Project Director should periodically review the policy and reissue the policy. The *Gas Safety Rules 1991 (Amendment* 2003) shall be followed for the implementation of the project. Detailed rules and procedures identifying company and legislative requirements and expectations must be communicated to employees and contractors.

Standard Operating Procedure

To determine compliance with safety and hazard issues while performing a task, efforts should be made to ensure the following:

- Ensure that employees affected by these tasks participate in the development of safe work procedures;
- Ensure that employees are involved in the maintenance of safe work procedures;
- Arrange safety training for all concerned employees on safe work procedures and refresher training thereafter;
- Where practical, observe employees performing critical tasks to ensure Review records and to ensure that employees receive training on hazardous work procedures, codes and practices; and that they follow the operating procedures and general safety; and
- That they follow the operating procedures and general safety.

Safety Orientation and Training

Initial safety training is one of the most important aspects of any safety program. Employees and contractors must receive some level of basic training, specific to the facility and nature of the job. It must be ensured that appropriate orientation is given to: Employees, Contractors, Sub-contractors and Visitors.

The orientation shall also include a review of the following:

- Company safety policy and procedures;
- a Specific job hazards
- Safety precautions
- Job responsibilities
- Regulatory requirements
- Company enforcement policy and
- Worker's right-to-know and authority to refuse unsafe work.

Reporting Incidents and Accidents

All accidents and near-miss incidents shall be investigated to determine what caused the problem and what action is required to prevent a recurrence. Employees required to perform investigations shall be trained in accident investigation techniques. The incident/accident investigation should be a fact-finding exercise rather than fault-finding. The investigations will focus on collection of evidence to find out the “root cause” of the incident. The recommendations of the investigation report shall be implemented in phases.

The purpose of impact mitigation and counter measures is to avoid creating negative impacts wherever possible, to minimize impacts where they may be unavoidable and to generate opportunities for improvements or positive impacts where appropriate.

Personnel Protective Equipment (PPE)

It should be assessed to determine what personal protective and safety equipment is needed and the equipment must be available. A maintenance schedule must be developed for PPE and employees must be trained in fitting, care, maintenance and use of PPE.

Body Parts That Require Protection

The body and its internal organs can be seriously injured, by any violent impact with an object. A direct blow to any part of a worker's body, even with protection, can easily result in some injury, either major or minor. The following eight areas or parts of the body require protection:

- Head
- Eyes
- Torso
- Hearing
- Arms
- Hands
- Legs
- Feet

Head

The worker's head houses his brain, which controls all the motor and sensory functions of his body. Any blow to his head, no matter how slight, can be very dangerous and result in injuries ranging from dizziness to total disability and even death.

Eyes

One of our most valuable senses is light. One must protect his eyes from the dangers of flying objects, bright light and chemicals. Without eyes one would live a life in total darkness.

Hearing

Hearing damage is not often a result of an accident, unless someone has had a head injury. A more common problem is hearing loss which can occur one exposed to noise levels above the exposure limits, as outlined in the Noise Regulation.

The longer one is expected to high noise levels, the greater the potential hearing loss. Hearing loss associated with exposure to noise tends to be gradual. It may take several years before one can realize that for some reason he has difficulty hearing normal conversation. Hearing is a valuable asset which should be preserved, so the worker can have a full and productive life.

Hands

Our hands provide us with the ability to perform a wide variety of tasks ranging from playing a musical instrument to operating machinery. Hands and fingers are often caught in pinch points, cut, crushed, burned or broken.

Hands are the second most commonly injured part of the body. Many hands injure are a result of workers not watching where their hands are being placed, or using their hands to accomplish tasks for which tools will be used.

Arms
The workers arms provide the power to his hands to perform various tasks. Arms are not injured as frequently as hands, most arm injures happen when the worker is reaching for something. Since his strength is in his arms, he can injure himself by over-using or straining them. The worker must also protect his arms against being caught in machinery, burned, crushed or hit. An injury to the arms severely hampers the use of the hands.

Torso
The torso extends from the top of the shoulders to the buttocks. Injury to this part of the body usually involves the back. The back is the most commonly injured part of the body. Back injuries are often a result of poor lifting procedures, or lifting objects that are too heavy or awkward. Other parts of the torso that can be injured, excluding internal organs, are the chest, sides and stomach area. Injuries to these parts are usually strains, burns, contusions and lacerations.

Legs
The most injured part of the leg is the knee. These injuries are caused by stress on the knee from twisting and turning. Other injuries to the upper and lower legs are usually caused by tripping or falling. This van results in fractures, cuts and contusions.

Feet
Feet are the third most common injured part of the body. Injures to the feet are often caused by an object being dropped on them. Other injuries to this area of the body include having the foot run over, twisting an ankle or stepping on a protruding nail which goes through the sole of the footwear into the foot.

Types and Use of Personal Protective Equipment

In order to protect himself from injury the worker needs two things-the right attitude about safety and the right personal protective equipment (PPE).

As standard practice, all safety-conscious companies require appropriate personal protective equipment to be worn at the work site. Workers entering the work site without, personal protective equipment are prevented from working until they done their protective equipment. There is a wide variety of personal protective equipment to suit the different types of jobs and tasks they have to do.

Hard Hat
One of the most important pieces of personal protective equipment is the hard hat. One must wear an approved hard hat wherever there is a possibility of a hard injury on the job. For the best protection, make sure it has a good fit by adjusting the headband.

Eye protection
The worker's eyes are exposed to various hazards based on the type of job he is doing. That's why there are three different types of protective equipment for eyes. These are impact glasses with side shields (prescription impact glasses are acceptable), cover goggles and face shields. The worker should always check this equipment for defects and fit before using it.

Safety Glasses
Safety or impact glasses will protect the worker from the impact of flying particles when he is:

- Chipping or drilling
- Carrying out NDT work

- Grinding and polishing
- Handling wire and strips of material
- Cutting wire and metal
- Using a hammer and chisel on wood, metal or concrete
- Welding

Cover Goggles

The face shield is worn to protect eyes and face from the impact of flying objects and when mixing chemicals. One can wear the face shield for must jobs where air borne particles are created, such as using a grinder or chipping a weld. One can increase his protection by wearing a face shield over his cover goggles when handling hazardous materials.

Hearing Protection

Continued exposure to noise levels over 85 decibels can lead to hearing loss unless one is wearing appropriate hearing protection. There are three classes of hearing protection: A, B and C. They come in two basic types of hearing protection-ear muffs which are class A and ear plugs which can be either class B or C.

Hearing protection must be worn when noise levels are over 85 decibels. Class C ear plugs are acceptable for noise levels between 85 and 95 decibels. For sound levels of 96 to 105 decibels glass B ear plug are required. Ear muffs are recommended when noise levels are over 100 and are required for sound levels of 106 decibels and up.

Wearing both ear plugs and ear muffs in high noise areas will give the worker added hearing protection. As with all personal protective equipment make sure the worker's ear muffs and plugs are in good condition before using them.

Hearing Protectors

Sound level (dBA)	Class of Hearing Protectors
85-95	C Class
96-105	B Class
106 or above	A Class

Hand Protection

There are three common types of gloves one can use to protect his hands: cloth gloves, combination cloth and leather gloves, and chemical resistant gloves.

Cloth Gloves

Cloth gloves are used for general purpose work. They will protect workers hands from scratches, blisters and cuts when he is handling pipes, tools, and other material.

Cloth Leather Gloves

Gloves with leather palms and cloth backing are stronger than cloth gloves. The leather palms are puncture and tear resistant. This makes them good for handling tools of all kinds, including shovels and picks.

Responsibility of the Contractor

Potential impacts could originate from contractor's activities. Therefore, BGFCL shall ensure that Contractors take due responsibility to mitigate these negative impacts. Particularly, BGFCL will ensure that the Contractor:

- Takes reasonable steps to protect the environment and avoid damage and nuisance arising from their activities and operations.
- Complies with statutes and regulations concerning the execution of work.
- Familiarizes with legislation and regulations relating to environmental protection that is relevant to their activities.
- Refers to national environmental quality guidelines.
- Be responsible for the costs of cleaning up any environmental pollution resulting from their activities, if methods for doing so are available and effective.
- Maintains sites under their control in a clean and tidy condition and shall provide appropriate and adequate facilities for the temporary storage of wastes before disposal.
- Shall not allow used oil or other petroleum wastes to be used as dust suppressants and reasonable precautions shall be taken to control and prevent accidental blow off of gas and/or spillage of petroleum products or discharge into atmosphere or watercourses.
- Be responsible for the provision of adequate sanitary facilities for the construction workforce (including those employed under sub-contracts) at construction and camp sites. Vehicles operated by the Contractor (including sub-contractors) shall be maintained according to the original manufacturer's specifications and manuals with particular regard to the control of noise and/or smoke emissions.
- Takes reasonable measures to minimize dust-blow arising from sites under their control by regular watering of soil stockpiles, bare soil, haul roads, non-surfaced traffic areas and sources of fugitive dust, when conditions require dust suppression.
- Be responsible to pay compensation upon the appropriate monetary evaluation applicable to the local market if any damage is incurred to agricultural land or surrounding homesteads outside of the requisitioned land.
- Precautionary signboards/ danger signals/ propitiatory billboards shall be placed in appropriate places to notify people about the possible dangers particularly in the eve of non-destructive testing inspections involving radiations and including but not limited to hydrostatic testing & commissioning of the pipeline system.
- The contractor will be responsible for prior identification of any other projects around the project area that could affect the significance of predicted impacts and to take additional and reasonable mitigation measures required thereof.

Removes equipment, surplus material, rubbish and temporary works and leave the site in a clean condition to the satisfaction of the company's representatives after completion of construction activities.

Emergency Response and Disaster Management Plan

The initial response to an incident is a critical step in the overall emergency response. As with the emergency preparedness plan Bangladesh law does not yet require Emergency Response Plans at oil and gas facilities. However, like all other Industries and installations; gas production and process facilities must have adequate measures against accidents or incidents to meet the emergency. The purpose of having an Emergency Response Plan (ERP) is to:

- Assist personnel in determining the appropriate response to emergency situations.
- Provide personnel with established procedures and guidelines.
- Notify the appropriate Company Emergency Response Team personnel and regulatory/ Govt. agencies**.**
- Manage public and media relations.

- Notify the next-to-kin of accident victims.
- Promote inter-departmental Communications to ensure a “Companywide” Co-ordinated emergency response.
- Minimize the effects that disruptive events can have on company operations by reducing recovery times and costs.
- Respond to immediate requirements to safeguard the subtending environment and community.

As a general rule, the initial response is guided by three priorities Ranked in importance these priorities are:

1. People
2. Property
3. Environment

Emergency Response Procedures will identify who does what and when in the event of an emergency. Responsibility for who is in charge and their coordination of emergency actions shall be identified. Nature of Emergency & Hazardous Situations may be of any or all of the following categories:

I. Emergency
- Fire,
- Explosion,
- Medical emergency,
- Leaks and other releases of hazardous substances,
- Spillage of toxic chemical, and electrocution.

II. Natural Disasters
- Flood,
- Earthquake/ cyclone,
- Storm/ typhoon/ tornados, and
- Cloud burst lightning.

III. External Factors
- Food poisoning/water poisoning,
- Sabotage, and
- War.

Six Steps in Emergency Response

Step-1)
a) Determine the potential hazards associated with the incident, substance or circumstances and take appropriate action identify the type and qualities of dangerous goods involved and any known associated hazards.
b) Determine potential hazards stemming from local conditions such as inclement weather water bodies etc. and ensure that the initial response team is aware of these conditions.

Step-2)
Determine the source/ cause of the event resulting to the emergency and prevent further losses.

Step-3)
Conduct an assessment of the incident site for any further information on hazards or remedies.

Step-4)
Initiate redress procedures.

Step-5)
Report the incidence: its nature cause impact applied redress procedures and any further assistance required etc., to the appropriate company, government and/or land owner.

Step-6)
Take appropriate steps with respect to hazards to wildlife, other resources and addressing public and media concerns and issues, as applicable. Response priorities are to protect human lives, property and the environment.

Emergency Response Planning
The purpose of an Emergency Response Plan (ERP) is to describe the procedures to ensure the health and safety of staff and the public in the event of any incident. Although Emergency Response Plans for gas pipelines have a different scope than those of other facilities, the purpose and key elements of the plans are similar.

Three levels of planning (reduced, normal and special) may be used depending on the particular circumstance, potential incidence rate and the location and number of residents living in the community/ locality in close proximity along the project sites. The scope of the ERP is also dependent on the potential impact of the project activities, complexity of evacuation logistics and proximity to public facilities. A key feature of all plans is the designation of and Emergency Planning Zone which defines the area to be evacuated or protected in the event of an emergency. Another fundamental requirement of Emergency Response Planning is that discussions occur with local residents and public within the Emergency Planning Zone and must include any pertinent health factors which must be considered.

The contents of a plan must include a definition of "an Emergency" and an action plan to address that emergency. This includes defining the "Stages of Alert" that may be applicable for various aspects of the work. This is important since it requires good coordination between aspects such as welding, testing, commissioning and Tie-in etc. Each action plan defines what level of evacuation should be occurring, who should be notified, what monitoring should be done and when emergency response teams are notified.

Another essential component of an ERP is the definition of responsibilities of the emergency response personnel including: off-site and on-site personnel, team coordinators, safety and evacuation personnel, monitoring crews, public relations and government personnel. Evacuation procedures, evacuation centres, communication systems equipment lists and post emergency procedures must also be defined.

The roles and responsibilities for the various government departments are to be defined and coordinated within the plan which should include the provision for the company/government to establish an on-site command post and a main control headquarters to provide advice to affected persons, union parishads, local administrations, fire brigade and the media. To ensure preparedness, there should be provision for testing the response and usefulness of the planned emergency response exercises. These exercises usually involve the company and contractor

personnel as well as various government organizations and the community leaderships that would be involved in actual emergency incidents.

Specialized Equipment
All relevant emergency equipment should be maintained on site throughout the project. This includes items such as fire extinguishers/hoses self-contained breathing apparatus (SCBA) and personal protective gear etc.

The hazardous materials section of the local fire brigade has emergency response units with specialized equipment that would be appropriate for an explosion incident response. All local brigades should be checked for their ability to respond to certain incidents and should be notified of the operations taking place.

Training
It is critical that emergency responders have a clear understanding of the potential problems that exist as a result of an emergency situation, that they pre-plan for such an event, and have hands-on training prior to initial response to an actual incident. In-house training programs should be held by the company and designated first responders to test their capabilities.

Response teams have to be assembled, both on a company and community cooperative basis to deal with potential emergency situations. A 2-day training program that includes two field exercises would be effective for the attendees to gain hands-on training in coping with incidents typical of the gas pipeline construction and operations.

Safety Orientation
Initial safety orientation is one of the most important aspects of any safety program. Employees and contractors must receive some level of basic training, specific to the facility and nature of the job. It must be ensured that appropriate orientation is given to all employees, contractors, sub-contractors and visitors.

The orientation shall also include a review of the following:

- Company safety policy and procedures;
- Specific job hazards;
- Safety precautions;
- Job responsibilities;
- Regulatory requirements;
- Company enforcement policy; and
- Worker's right-to-know and authority to refuse unsafe work.

Approaches to Emergency Response
For this project emergency response systems should be in place to deal with dangerous goods uncontrolled releases spills, natural calamities fires burns and injuries. There are to be trained emergency response teams specific contingency plans and incident specific equipment packages in place to cope with these type of an emergency Should an incident occur immediate action must be taken to mitigate the impacts.

In order to minimize the possibility of injury to the responders and others it is important that emergency responders follow a specific sequence of actions as stepped out in the preceding paragraphs.

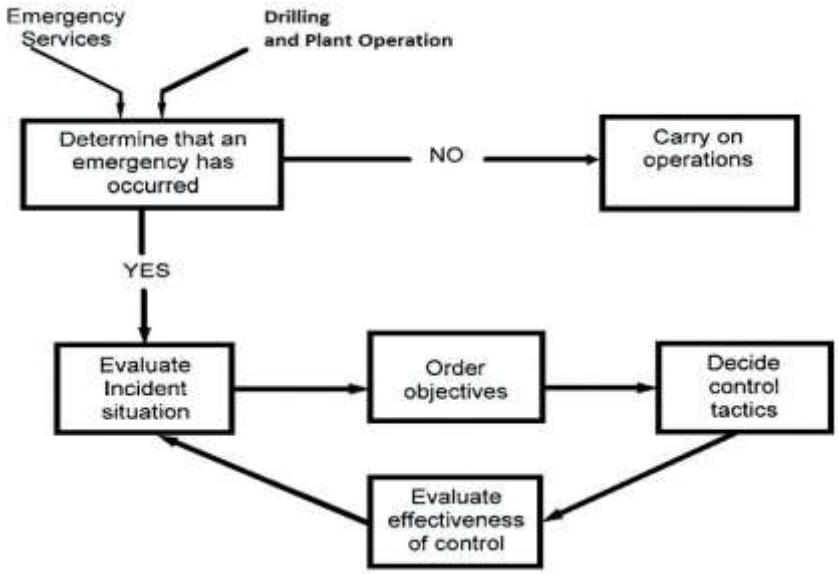

Figure showing the Approaches to Emergency Response

Guidelines for Disaster Management

Introduction

Disaster management is a four step exercise:

- The design and planning stage,
- The compressors operating stage,
- The short and important stage when disaster actually occurs, and
- The recovery stage.

It is imperative that all safety precautions are rigorously implemented so as to avoid any kind of accidental occurrence in the first place. At the design stage, this includes incorporating items of basic engineering planning and design for safety into all processes and providing suitable safety margins for equipment as per the various safety codes and standards in practice.

At the operation stage, disaster management is mainly preventative in nature, through the use of appropriate personal protective equipment and safe work procedures.
The disaster stage has the greatest potential for being mismanaged due to the typically somewhat chaotic and unplanned nature of the event. It is at this stage that pre-planning becomes critical.

Disaster Management in Operation Stage

Safe operating procedures will be laid down and followed to ensure safety, optimum operation and economy a safety audit will be undertaken periodically in conjunction with a training program. Furthermore, all accidents, however minor, will be investigated and reported in order to provide direct feedback to the operational planning mechanisms.

The risk and reliability assessment studies carried "but at the: design stage will be periodically reviewed and updated in the light of any actual experiences. This is because most of the

available data on failure rates" and similar parameters used in these computations are generally based on US or' European experience, not on those within Bangladesh.

During the operational phase access to work sites will be denied to unauthorized persons. Regular preventive maintenance and inspection procedures must be implemented and regular certification of high pressure equipment will be obtained.

These factors if implemented correctly will significantly reduce the possibility for a catastrophic event occurring.

Level of Incidents

In the event of a disaster at any location within the workplace, the area affected can be classified in the following four classes:

Level - I Operator level
Level - II Local/community level
Level - III Regional/National level
Level - IV International level

Only Level - I and Level - II class of incidents or accidents will applicable within the proposed project. Level - I, disasters may be the result of fires, explosions, oil spillages and spontaneous ignition of inflammable materials. This may affect persons working in and around moving machinery, other plant and various sites which have been mentioned as potential hazard areas.

Level - II disasters may happen due to sabotage or complete failure of all automatic control/warning systems, catastrophic failure of fuel oil storage tanks, chemical release or explosion. Transportation (road and rail) accidents could occur anywhere within or outside the complex and thus present additional problems of access and loss of time in taking remedial measures.

Incidents/Accident Investigation & Reporting System

Major disasters are often preceded by a string of minor incidents which are ignored, neglected or not fully understood. Therefore, a routine system will be enforced to ensure that all accidents are investigated and reported to the plant supervisors in a specified format such as the following:

- Background on the factors that might have made the incident possible;
- What form of energy release or toxic substance was involved?
- What was done to prevent accident (who responded and how)
- What effect did it produce on the immediate and surrounding environment?
- What repercussions did the incident have (loss of life damage to equipment and buildings) and
- Cost estimates of damage done and repairs needed.

Registers of all incidents will be kept and will be analyzed on a regular basis (at least monthly) to identify trends or patterns in incident occurrence In particular cases this may prevent significant chronic incidents or single-event events that are the result of an accumulation of either physically hazardous materials or substances, or operational complacency.

Preparedness

Having taken all the preventative measures, a Disaster Management Team (DMT) will be established which would be responsible for preparing a specific Disaster Management Plan for the project The team should meet at regular intervals to update the Disaster Management Plan based on accident data and any changes to support agencies The team should also undertake trial runs in order to be fully prepared and to improve upon the communication links response time and other critical factors.

Response

I. Set up Disaster Control Room

In the unlikely event of a disaster a Disaster Control Room (DCR) should be set up. The responsible officers of Disaster Control Group will assemble in the DCR and formulate control procedures as part of the contingency plans.

The DCR should have links with all site operations and an officer should maintain the DCR at all times. On receiving information about an accident, the officer should inform the Disaster Controller (DC) and/or other coordinators immediately.

II. Casualty Services

The Head of casualty services will be the Medical Officer who will secure and provide First Aid service to first aid patients on the spot.

Emergency Response Plans for Gas Field, Well and Field Camp

The following site specific Emergency Response Plan (ERP) has been developed to cover specific details for those emergencies which may be encountered during installation compressors at the fields and field camps. This ERP has been organized such that each of the anticipated emergencies has an Organization Plan, a List of Responsibilities and a List of Duties.

Field In-charge have overall operational responsibility of the field. The Operator will be notified as soon as the emergency reaches Level 2 and will assume overall responsibility and coordinate closely with the Field In-charge. All personnel, included contractors, must become familiar with site specific plans and duties. Supervisory personnel shall know and understand the entire Emergency Response Plan and their responsibilities and duties.

I. Table : Level of Emergencies

EMERGENCIES MAY BE CATEGORIZED INTO THE FOLLOWING THREE LEVELS	
Level-1	Emergency is a MINOR EMERGENCY, which can be controlled entirely by personnel and facilities, located within the immediate vicinity of the accident/incident site. The types of events that could be described as Level 1 emergencies are those which cause minor property or equipment damage that are non-disruptive to operations, and do not pose a safety risk to personnel or property outside of the boundaries of Company property
Level-2	Emergency is a SERIOUS EMERGENCY, which is disruptive but not extensive, and forces a portion of the Company operation to be temporarily suspended or shut down. Events or conditions which describe LEVEL 2 Emergencies are accidents/incidents that endanger the safety of personnel or the public outside of the boundaries of Company property, or have the potential to endanger the

EMERGENCIES MAY BE CATEGORIZED INTO THE FOLLOWING THREE LEVELS	
	safety of personnel or the public outside of the boundaries of Company property, and would require the notification of external support services.
Level-3	Emergency is a DISASTER EMERGENCY that forces the indefinite shut down of Company operations, or a sector of Company operations. Safe operating control has been lost, causing or having to cause; serious injuries or fatalities among employees, contractors or the public; extensive damage to Company property or equipment; or serious harm to the environment.

Field In-charge will assign personnel and duties to the following teams:

- Well Control
- Fire-lighting
- Rescue Pollution
- Control Support.

According to ERP, the Alarms that will have to be activated for emergency are:

- Horn-General rally for fire, gas and pollution &
- Siren - Personnel evacuation of work site.