

Chapter 1

Introduction

1.1 Preamble

The Government of India has awarded Petroleum Exploration License under the Production Sharing Contract (PSC) for RJ-ON-90/1 onshore block in Rajasthan State to Cairn Energy India Limited (CEIL). The RJ-ON-90/1 block is located in Barmer and Jalore districts of south-western Rajasthan. CEIL has been conducting exploration activities within the block for the past eight years and discovered several commercially viable hydrocarbon reserves in the block. The current area of the block is approximately 5820 km² and lies between 24°47'7.58" to 26°26'00.99" N latitude and 71°15'41.17" to 72°4'39.29" E longitude. The block boundaries are shown in **Fig. 1.1**. CEIL is in the process of planning the development of these hydrocarbon discoveries.

CEIL has drilled several exploratory wells in the block and has been carrying out extensive seismic surveys to delineate the extent of the various hydrocarbon reserves and have made several hydrocarbon discoveries in the RJ-ON-90/1 block. They are Guda (1999), Saraswati (2001), Raageshwari (2003), Kaameshwari (2003), GR-F (2003), Mangala (2004), N-A (2004) & N-C (2004).

CEIL proposes to develop Northern zone oil fields namely Mangala and N-A, and Central zone oil fields namely Saraswati, and Raageshwari and Central zone gas field namely Raageshwari. All the fields are planned to be developed concurrently and are expected to be completed by October 2007.

CEIL has retained **National Environmental Engineering Research Institute (NEERI) to carryout Environmental Impact Assessment (EIA)** study for the proposed developments. This report presents the baseline data for various components of environment along with identification, prediction and evaluation of impacts leading to environmental management plan for minimizing / mitigating the adverse impacts due to proposed development block.

1.2 Proposed Development Plans

It is proposed to develop five fields in the block and the capacities of various field developments are presented in **Table 1.1**.

The salient features of the development plan are:

- The plan will cover the development of the Mangala, N-A, Saraswathi, Raageshwari Oil fields and the Raageshwari Gas field. **All the above fields and the planned facilities are located within Barmer district, Rajasthan**
- A total of 568 wells including 303 hydrocarbon production wells, 235 injection wells, 24 saline water bore wells for the extraction of saline water and 6 saline water injection wells will be drilled
- The aggregate production from these fields will be 128,000 barrels of oil per day
- Cumulative production of associated gas at rates up to 30 Million Standard Cubic Feet Per Day (MMSCFD) from the 4 fields will be used for internal consumption purposes such as lift gas, heating, and captive power generation
- The Raageswari Gas field will produce upto 20 MMSCFD which will be entirely used for captive power generation
- Captive Power Plant of 50 MW power generation capacity will be established and operated at a central location to meet the energy requirements of Mangala & N-A fields development. The power plant would use crude oil or natural gas or both as fuel. The power supply will be distributed to the various facilities through either buried cables or through over-head lines.
- Saline water well field identified approximately 9 km south of the N-A field development area will be developed to source saline groundwater required for injection into the oil reservoir of Mangala and N-A field. The development will consist of 24 bore-wells, storage reservoir and interconnecting pipeline to the Mangala field Central Processing Facility (CPF)

- The freshwater requirements for the oil facility process, domestic and greenbelt requirement will be met by desalinating the saline groundwater.
- The development strategy assumes that early production from some of the low producing fields will be trucked until the export pipeline arrangements have been implemented. Oil will be sold to Indian Oil Corporation Limited (IOCL), the buyer nominated by the Government of India (GoI). Additionally there could be internal trucking of crude within the block from the smaller discoveries to loading points, from where it will be transported through pipelines
- There would be a network of pipelines connecting well pads, GGS, Central Processing Facility (CPF) and Central Tank Farm (CTF) carrying well-fluids, saline groundwater, produced water, lift gas, stabilised oil, injection water, lift gas, hot oil supply and return, etc.
- The size of pipelines would vary from 3" to 28" and the pipelines would be buried and laid within a 30 m wide pipeline corridor. The pipeline corridor would connect the various facilities within a field (well-pads, GGS, CPF & CTF) and between the various fields in the block. The approximate total length of the pipeline would be about 300 km.
- The CPF at the Mangala field will have a common waste treatment and storage facility including facilities for secure landfill and incinerator.
- Desalination Plant and injection water treatment plant of 60,000 m³/day capacity will be installed at the Mangala CPF
- The reject stream from the desalination plant will be disposed off in deep dump wells (> 1500 m deep) through dedicated injection wells located in the injection field
- Interconnecting roads as required will be developed to connect the various facilities for operational requirements.

The scope of EIA report covers the Rajasthan hydrocarbon development project including the facilities stated above.

1.3 Project Cost & Schedule

The development cost over the field life is presently estimated to be between US\$ 560 million to 850 million (Rs 2,520 Crores to 3,825 Crores), depending on the field

configuration that would be selected based on the results of the sub-surface investigation and the Front-End-Engineering-Design (FEED) Study.

CEIL proposes to develop all the five fields concurrently and the entire project is expected to be completed and **production to commence by October 2007**. Since the amount of work required for developing the southern fields are comparatively less, CEIL may bring Saraswati & Raageswari oil fields into early **production by April 2006**

1.4 Project Setting

The current block area of RJ-ON-90/1 block is approximately 5820 km². The proposed development project is located within five identified pockets within the block area. The block lies between 24°47'7.58" to 26°26'00.99" N latitude and 71°15'41.17" to 72°4'39.29" E longitudes. The block is located in Barmer and Jalore districts of south-western Rajasthan i.e. within the Indian Thar. It covers parts of Baitu, Barmer and Guda Malani tehsil in Barmer district and Sanchor and Bagoda in Jalore district.

The proposed development fields **are entirely located in Barmer district in the Baytoo, Barmer & Gudha Malani tehsil.**

1.5 Climatic Conditions

The long term analysis of micro-meteorological conditions of Barmer district based on the last 30 years data has been carried out for the post-monsoon, winter and summer seasons. In this analysis, September-October, December-January-February and April-May-June are considered to be representative of post-monsoon, winter and summer seasons respectively.

Based on 1951 to 1980 climatological data, the minimum annual mean temperature in Barmer district is 6.3°C and maximum annual mean temperature is 45.8°C. The extreme temperature ranged from -1.7 to 48.9°C in the given period. The relative humidity ranged from 31% to 74%, 27% to 53% and 23% to 67% in post monsoon, winter and summer season respectively. The cloud cover is observed to be in the range of 1.3 to 2.4 oktas. The annual average rainfall in 30 years is recorded to be 262.9 mm. The predominant wind direction switches over from N-W/N-E sector in winter season to S-W sector in summer season.

1.6 Topography

Apart from a small offshoot of the Aravalli hills in the east, the area is a vast sand covered tract with substratum of gneiss, hornblende and quartz, which at some locations rise up through the sand, in some instances to a height of about 243 to 304 meter. The only river of this region is the Luni (salt river), which rises about 7 km north of Ajmer in the Aravalli

ranges and passes through the Pachpadra and Guda-Malani tehsils of Barmer and Sanchor tehsil of Jalore divisions. It flows for 482 km before draining into the Arabian Sea at the Rann of Kutch in Gujarat. The Luni river is seasonal and comparatively shallow, although at places it is over 2 km wide. Its main tributaries are Lilri, Raipur sukri, Bandi, Mitri, Jawai Khari, Sagi and Johari which all rises in the Aravalli. Almost half of the RJ-ON-90/1 region falls in the Luni river basin. The area remains dry throughout the year except for few days rain during July-September.

This region is the largest producer of bentonite which is used as grouting material in engineering construction, in drilling mud and in insecticide, paint, pharmaceutical, vegetable oil and petroleum industries. The important minerals produced in this district are bentonite, gypsum, silicious earth and salt yielding good annual revenue. Gypsum deposits are located at Phulsund, Kawas and Utarlai and is used in the manufacture of fertilizer, plaster of paris, distemper and cement.

1.7 Infrastructure Resource Base

1.7.1 Electricity

The power supply in the district comes from Debari Grid Station near Udaipur via Jalore. The 132 KV Grid Station of the district is located at Balotra and the 33 KV station is located at Barmer. Of the 1,625 villages, 1,500 villages are electrified.

1.7.2 Water

The block lies in primarily arid and semi arid zone with vast areas of sand covered tracts on bedrock of gneiss and sedimentary depositions. The entire stretch of the block is covered by sandy soils with golden colored sandy dunes. The depth of groundwater in the development area ranges between 75 – 100 m. The aquifers in the study area are mostly brackish with pockets of sweet water in confined and unconfined aquifers.

This is an Inter-State project shared by Gujarat and Rajasthan, the storage reservoir known as Sardar Sarovar Dam is located in Gujarat, where the Narmada Canal starts, and after traversing 458 km in Gujarat enters Rajasthan near Silu village in Sanchore Tehsil of Jalor District. The project is designed to supply 616 million cubic meters per year of irrigation water to Barmer & Jalore districts in Rajasthan, and provide drinking water to 124 villages in Barmer and Jalore Districts, covering a target population of 3,50,000. The project is expected to be completed by 2007. The total length of main canal in Rajasthan will be 74 km and total length of distributaries will be 1403 km. in Jalore & Barmer districts irrigating 130 km of command area

The Indira Gandhi canal is being extended upto Gadra Road in the district. This is likely to provide adequate quantity of not only drinking water but also to irrigate about 0.1 million hectares of agriculture land. The flow of the canal would also improve water level of the wells in the area covered by the flow. The canal extension project is expected to be completed within the next 3 to 4 years

1.7.3 Road Transport

The district is linked by road with Jaisalmer, Jodhpur, Pali, Jalore, Jaipur, Ajmer and Ahmedabad. The total length of roads in the district was 5,109 kms as on 31 March 2000. Major Roads within the block are NH-15 (58.89 km), NH-112 (33.28 km), SH-16 (43.0 km) SH-28 (54.37 km); these roads add up to a total length of 189.5 km.

Most revenue villages in the Gram Panchayats do not have any motorable road. Only kutcha roads or pathways exist, which keep shifting due to movement of sand. 30% of the revenue villages, were approachable only through kutcha roads. More than 92% of the villages do not have any internal village roads or have only kutcha pathways. There is only limited public transport facility in the area and this too is mainly confined to the areas along the main roads / highways.

1.7.4 Rail Transport

The district is linked with neighbouring districts of Jodhpur, Jalore and Jaipur in the State and with Agra in UP and Munawa in Pakistan, by railway line. The total length of rail line in the district is 254 km with 30 railway stations. The Northern Railway Main Line passes through the block, the total length of the line within the block is 36.55 km. There are regular railway services connecting Barmer to Jodhpur, Jaipur and Delhi.

1.7.5 Air Transport

The nearest airport is at Jodhpur located about 220 km from Barmer

1.7.6 Defence Establishment

Uttarlai, one of the forward airbases of South Western Air Command, is located 10 km from Barmer. There is a Border Security Force (BSF) campus contiguous with the urban area boundaries of Barmer town.

1.7.7 Communication Facilities

There is regular postal and telecommunication services connecting the various town and villages of Barmer district to the rest of the country. There are 479 post offices, 104 telegraph offices, 64 telephone exchanges and 894 public call offices

1.7.8 Industrial Scenario

There are no significant industrial activities or industrial area falling within the project area and the nearest industrial area is Balotra, which is about 100-km northeast from the centre of the block. There are five industrial areas in Barmer district with about 3000 small scale units. Some isolated mining activities, machining works, gypsum manufacture, small-scale textile dyeing and printing, leather products manufacture, brick kilns, bentonite grinding, cement bricks manufacture, embroidery, and tailoring, flour mills, granite cutting and polishing, guar gum, non-edible oil, oil mills, plaster of paris, stone crushing, wooden furniture manufacturing are carried out. The export items are Gaur gum, handicraft, hand embroidered items and woolen carpets.

1.7.9 Major Crops and Production

In Barmer, generally some kharif (summer) crops are grown with well water. Common kharif crops are bajra, jowar, maize, pulses and oilseeds. Rabi crops are also sown when Luni river floods. The main rabi crops are wheat, with gram and barley in some areas.

1.7.10 Minerals

Barmer district is rich in mineral deposits such as lignite, gypsum, saliceous earth, salenite masonry stone, bentonite and limestone.

1.8 Environmental Impact Assessment

With a view to assess the environmental impacts arising due to the proposed development plan in the RJ-ON-90/1, Rajasthan, CEIL retained the **National Environmental Engineering Research Institute (NEERI), Nagpur** to prepare an Environmental Impact Assessment (EIA) Report for various environmental components including air, noise, water, land and biological components along with parameters of human interest which may be affected and to prepare an Environmental Management Plan (EMP) for mitigating adverse impacts. Environmental monitoring was conducted during summer season of year 2004 and has been used to identify potential significant impacts. Modeling exercises have been carried out to predict and evaluate impacts due to proposed development plan. An environmental management plan is included in this report.

In order to assess the impacts of any proposed development, information is needed about its design, construction and operation. **It is often the case at this stage in the project planning/design process that final details are not fully resolved or may potentially be subject to minor change to suit the project requirements. For the purposes of this study, however, it is viewed that sufficient information is available to make an adequate assessment of the likely significant environmental impacts. Minor subsequent changes**

found necessary at the detailed design stage are unlikely to materially affect the finding of this EIA.

1.8.1 Scope of EIA

The Environmental Impact Assessment report is prepared based on one season baseline environmental quality data as per the guidelines and requirements of Ministry of Environment and Forests (MoEF), Central Pollution Control Board (CPCB) and Rajasthan State Pollution Control Board (RSPCB). The data as specified in the Environmental Questionnaires for appraisal of industrial projects at state/ central regulatory agencies is addressed in the EIA and Risk Assessment (RA) reports.

The scope of the study also includes detailed characterization of existing status of environment around the proposed development sites for various environmental components viz. air, noise, water, land, biological and socio-economic. The following reports have been prepared to establish baseline environmental quality and made use of in EIA study:

- Environmental sampling of air quality, water, soil and noise for the period March to June 2004. The number of stations and their locations have been fixed in a manner so that the entire block is representatively covered
- Social Baseline Study of the block including primary data collection at Panchayat level. The scope includes the socio-economic data and delineation of social intervention management plans
- Land-use and land classification study using satellite imagery and interpretation carried out by Rajasthan Remote Sensing Agency, Jodhpur - ISRO
- Study of the desert ecology (flora & fauna) carried out through Arid Farming Research Institute (AFRI), Jodhpur
- Water sourcing study carried out through Water Management Consultants, UK
- Reconnaissance Survey Report for oil, gas and water pipeline for onshore oil field development facilities carried out by SECON Surveys Pvt. Ltd

1.8.2 Objectives of EIA Report

- Collation of data on the present status of air, water, land, socio-economic and biological components of the environment including noise and parameters of human interest around the project site
- Identification, prediction and evaluation of significant impacts due to proposed

facilities on various environmental components for the pre-project, construction, commissioning, operation and closure stages of proposed project

- Preparation of environmental impact statement based on identification, prediction and evaluation of impacts
- Preparation of Environmental Management Plan (EMP) to be adopted for mitigation of anticipated adverse impacts
- Delineation of environmental quality monitoring programme to be pursued by CEIL as per the requirements of the RSPCB and MoEF on commissioning of project

1.8.3 Work Plan under each Environmental Component

1.8.3.1 Air Environment

- Collation of data on 24 hourly average background concentrations of SPM, RSPM (Size <10 μm), SO_2 , NO_x and levels of CO and HC around project site
- Collation of surface meteorological data like wind speed, wind direction, relative humidity, rainfall, ambient temperature, cloud cover etc. around the project site
- Prediction of impacts on air quality due to proposed operations through application of air quality models as stipulated in "Assessment of Impacts on Air Environment: Guidelines for conducting Air Quality Modeling" - a publication of Central Pollution Control Board.
- Recommendations on mitigation measures for air pollution such as source modifications, greenbelt development etc.

1.8.3.2 Noise Environment

- Collation of data on existing status of noise levels in residential, commercial, and silence zones around the project site and valve/booster/ compressor stations along the pipeline routes
- Prediction and evaluation of impacts due to increase in noise levels on the surrounding environment
- Recommendations on mitigation measures for noise pollution

1.8.3.3 Water Environment

- Collation of data on surface and ground water resources with respect to quality and quantity in the region
- Establishing information on groundwater quality around the project area
- Evaluation of quality of surface water bodies like rivers, streams intersecting the pipeline corridors
- Assessment of water availability and demand in the study region to estimate water balance for the proposed facilities
- Assessment of nature of effluents likely to be discharged into water bodies/ land and related impacts on the ecosystem
- Recommendations on water conservation measures, wastewater treatment methods, discharge locations and reuse/ recycle practices.

1.8.3.4 Land Environment

- Study of land-use pattern, cropping pattern, soil and irrigation water characteristics
- Prediction of anticipated impacts on land-use pattern with respect to agriculture, forestry, etc. due to proposed developments
- Quantification of non-hazardous and hazardous wastes (solid/semi-solid/liquid) likely to be generated during proposed operations and suggestions on proper collection, treatment and disposal methods and delineation of environmentally compatible options for value added utilisation
- Studies on methods of collection, management and top soil reclamation for laying of pipelines
- Landuse pattern along the pipeline routes (1 km wide corridor on either side) and around valve/booster/ compressor stations along the pipeline routes
- Collection of information on intersections with roads, railway lines, drinking water mains, sewage pipelines, crude oil and gas pipelines, river and effluent discharge pipelines
- Collection of information on lakes/reservoirs/dams, historical/archaeological important monuments within 1 km on either side of pipeline route
- Study of topographic features of pipeline corridor
- Analysis of toposheets published by Survey of India/ National Bureau of Soil

Survey and Landuse Planning related to proposed pipeline corridor

- Assessment of impacts on landuse pattern with respect to agriculture and forestry
- Recommendations on landuse / soil conservation measures, solid waste management and overall mitigation measures of impacts on land environment

1.8.3.5 Biological Environment

- Collection of information on flora and fauna including rare and endangered species around the project site and along the pipeline routes
- Assessment of species diversity, density, abundance etc., in the study region
- Assessment of likely changes on flora and fauna due to proposed facilities
- Delineation of conservation measures for the protection of flora and fauna around the project site

1.8.3.6 Socio-economic and Health Environment

- Collation of baseline data including demographic details, such as households, population, literacy, employment pattern, general health, tribals, transport, communication and welfare facilities such as hospitals, educational institutions, project awareness amongst the public, infrastructure facilities, economic resources, cultural and aesthetic attributes etc.
- Projection of anticipated changes with respect to above parameters and delineation of guidelines to minimise the impacts
- Review of rehabilitation and resettlement plan, if any, prepared for the proposed developments
- Assessment of economic benefits to local community.

1.8.4 Methodology for EIA

Keeping in view the nature of activities proposed to be undertaken in the RJ-ON-90/1 block and environmental guidelines of MoEF, EIA has been done based on the baseline data gathered for the entire block. The impact assessment for the various field development and its environmental attributes has been considered. The work carried out is briefly reported below and has been described in detail in subsequent sections.

1.8.4.1 Air Environment

As stated earlier, the prevailing ambient air quality status was established through a network of stations monitored by other agencies in summer season, 2004. The air quality data w.r.t. suspended particulate matter (SPM), sulphur dioxide (SO₂), nitrogen oxides (NO_x), CO, hydrocarbons were collected.

Micro-meteorological parameters such as wind speed, wind direction, temperature and humidity were continuously recorded during the study period. The recorded data were used to determine predominant meteorological conditions, characterizing baseline status and in prediction of impacts on the air environment.

Prediction of impacts on air quality due to proposed operations is carried out through application of air quality models as stipulated in "Assessment of Impacts on Air Environment: Guidelines for conducting Air Quality Modeling" - a publication of Central Pollution Control Board.

1.8.4.2 Noise Environment

Noise level measurements were carried out by other agencies around the proposed development area, hospitals, highways, schools, commercial centers located within the region. The data available were analysed for establishing baseline status of noise.

Increase in noise levels due to project activities was predicted using wave divergence and Federal Highway Administration (FHWA) model.

1.8.4.3 Water Environment

The ground water quality data related to physical, chemical (inorganic and organic), and nutrient and heavy metals category were analysed to establish baseline water quality. There is no perennial surface water body in the development area.

The impacts on ground water quantity and quality are predicted based on the available information.

1.8.4.4 Land Environment

In the study area, data available on characterization of soil samples were used in this EIA report. The landuse/land cover classification was carried out based on the analysis undertaken by Regional Remote Sensing Agency, Jodhpur - ISRO.

1.8.4.5 Socio-economic Environment

Data on the demographic pattern, population density, educational facilities, agriculture, income, fuel, medical facilities were collected and analysed for all the study villages.

1.9 Environmental Management Plan

- Evaluation of adequacy of existing pollution control devices and suggest modifications
- Propose appropriate additional mitigation measures to reduce adverse impacts due to proposed developmental activities on:
 - Air quality
 - Water quality
- Design of solid/hazardous waste storage & disposal facilities
- Design of greenbelt
- Propose appropriate control measures for mitigation of adverse impacts due to developmental activities
- Delineation of detailed post-project environmental quality monitoring programme

1.10 Content of EIA Report

The EIA Report is based on the primary field data generated at the project site and data collected from secondary sources.

Chapter 1.0 – Introduction

This chapter provides purpose of the EIA report, background information of the project, scope, methodology and brief outline of EIA report.

Chapter 2.0 – Description of the Project

This chapter provides the following details:

- Type of project
- Need for the project
- Project location
- Project details including associated activities required for the project

Chapter 3.0 – Baseline Environmental Status

This chapter presents the information on study area, information on existing environmental resources, findings of field studies undertaken to establish the baseline environmental status and has been organized into the following environmental components:

- Air

- Noise
- Water
- Land
- Biological
- Socio-economic

Chapter 4.0 – Anticipated Environmental Impacts

This chapter details the identification, prediction and evaluation of impacts on each resource. The impacts of “the project” are predicted using available computer models during construction and operational phase. The significance of impacts is determined based on applicable environmental guidelines. It describes the overall impacts of the proposed project and identifies the areas of concern, which need mitigation measures.

Chapter 5.0 – Environmental Management Plan (EMP)

This chapter provides recommendations for Environmental Management Plan (EMP) including mitigation measure for minimizing the negative environmental impacts of the project

Environmental monitoring requirements for effective implementation of mitigation measures during construction as well as operation of the project have also been delineated along with required institutional arrangements for their implementation. Budgetary cost proposed for pollution mitigation and environmental management are also provided.

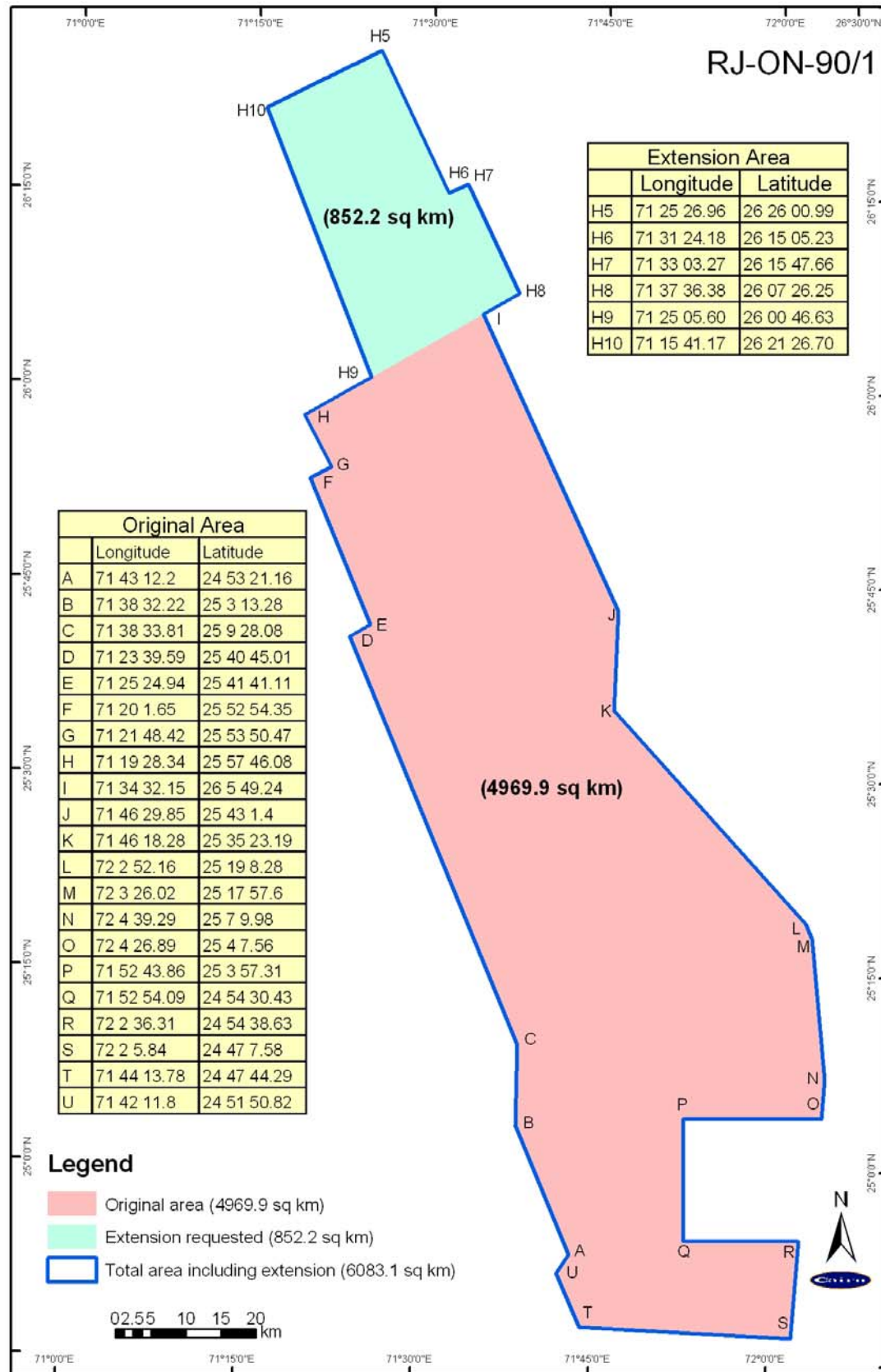


Fig. 1.1 : RJ-ON-90/1 Block Boundaries – Total Study Area

Table 1.1
Capacities of Field Developments

Field	Max. No. of Wells Pads	Max. No. of wells		Total Crude Oil Production (BOPD)	Total Gas Production (MMSCFD)
		Production	Injection		
Mangala Field development	15	195	195	1,00,000	17
NA Field development	8	40	40	20,000	3.4
Saraswati Field development	4	24	-	6,000	0.07
Raageshwari Field development	6	36	-	2,000	0.28
Raageswari Gas Field	2	8	-	-	20