METANOL DE ORIENTE PLANT EXPANSION PROJECT

Environmental and Social - Cultural Impact Assessment

Executive Summary

Oil and Petrochemical Complex
General Jose Antonio Anzoategui

Anzoategui State, Venezuela

June, 2006

Ingenieria CAURA, S. A.

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1. INTRODUCTION

This is the Executive Summary of the Environmental and Social-Cultural Impact Assessment (EsIASC) for the Metanol de Oriente Plant, Expansion Project on behalf of the Project Sponsor, Metanol de Oriente, METOR, S. A., a joint venture company conformed by national capital: Petroquímica de Venezuela S. A., (PEQUIVEN) and Empresas Polar, and foreign capital: Mitsubishi Gas Chemical, Mitsubishi Corporation and International Finance Corporation (IFC).

The EsIASC was developed to evaluate the environmental and social impacts of the Expansion Project so as to minimize or avoid negative impacts and to comply the Decree 1.257 for Environmental Assessment (MARN, 1996)[1] as required by Venezuelan Regulation. In addition, it was designed in conformity to good international practices, including guidelines and standards of international institutions that have adopted the "Equator Principles".

This EsIASC study intends to provide detailed and comprehensive information about the key environmental and social-cultural aspects of the Expansion Project, including how the Project Sponsor plans to manage related opportunities, challenges, and impacts. The technology to convert natural gas into methanol, with some improvements tending to diminish raw materials requirements and wastes generation, is licensed by Mitsubishi Gas Chemical (MGC), which will also provide the catalyst to be used in the process. METOR, S. A., has committed to apply monitoring, management and mitigation measures that are in line with good international processing practice and Best Available Technology Not Involving Excessive Cost (BATNIEC) to reduce or eliminate potential impacts from the Project.

An integrated team of environmental and social science experts under the direction of Ingeniería CAURA, S. A., Venezuelan consulting firm, developed EsIASC of Expansion Project. Additionally, technical support was received from the Expansion Project Management. The EsIASC is based on secondary information of key physical, biological, and social-cultural attributes of the Expansion Project site and its environs. Environmental baseline studies and direct wastewater discharges to surface waters, air emissions and noise issue were intensely reviewed.

(1) Ministry of Environment and Natural Resources. Decree N° 1.257: Standard Concerning Environmental Assessment of Activities Capable of Degrading the Environment. Official Gazette of the Republic of Venezuela N° 35.946. 1996

2. PROJECT DESCRIPTION

METOR, S. A., Expansion Project looks upon the construction of a new plant on a 2.26 hectares (5.59 acres) lot, adjacent to the existing plant located at the Oil and Petrochemical Complex "General José Antonio Anzoátegui", Bolívar county jurisdiction, Anzoátegui State, Venezuela. It shall be capable to produce 850,000 metric tons of methanol annually (2,500 tons/day), using natural gas as a raw material. An investment of approximately 425 millions dollars will allow METOR S. A., to increase the current nominal capacity to 1.6 millions metric tones per year of high purity methanol in the existing[2] plant (built in 1993), which has a production capacity of 750.000 metric tones. This places METOR S. A., as one of the important methanol producers in the world.

The materialization of the METOR, S. A., Expansion Project represents an important intensification of the rhythm of direct and indirect integration of the petrochemical activities to the spectrum of investments within the Venezuelan economy; and may result in the extension of the international market of the petrochemical products manufactured in the country (Ministry of Energy and Petroleum, 2005)[3]

In order to attend the plant global needs, Metanol de Oriente, METOR, S. A., will take advantage of the facilities that the Oil and Petrochemical Complex "General José Antonio Anzoátegui" provides to satisfy the needs of the whole condominium. These facilities include water, electricity, natural gas, administrative offices, emergency response, intercommunication system, industrial clinic, surveillance, industrial effluents disposition system, liquids platform, maintenance, etc.

2.1 GEOGRAPHICAL LOCATION

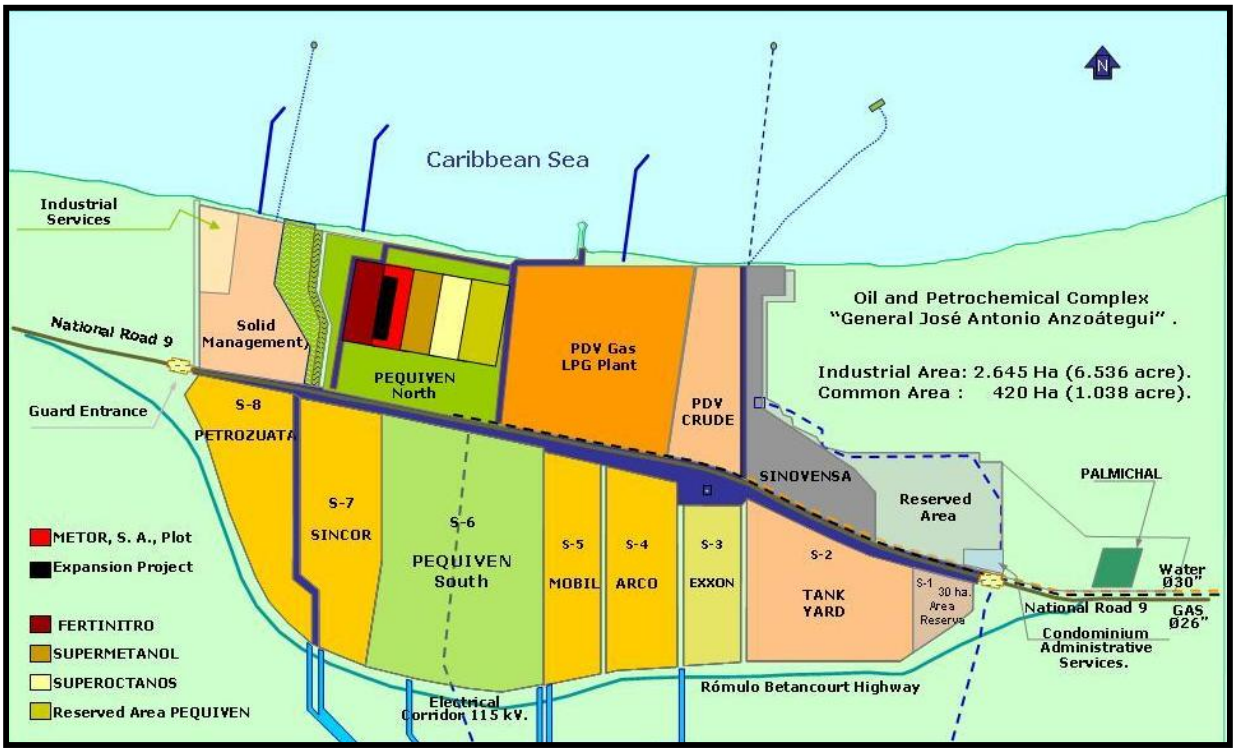
Metanol de Oriente, METOR, S. A., Expansion Project will be built inside the existing Metanol de Oriente, METOR, S. A., assigned area, at the Oil and Petrochemical Complex "General José Antonio Anzoátegui" (Figure N° 1), declared as a Security Zone for the Basic National Industry (Presidential Decree N° 1.527, 1996)[4]. The Oil

(2) The existing plant, once fulfilled the requirements specified by the quality standards received a DET NORSKE VERITAS" ISO 9001: 2000 certification, as a methanol grade "AA" producer.

(3) Ministry of Energy and Petroleum. *Resolution N° 338: Basis for the Formulation of the Price of Methane Gas to be Provided by PDVSA Gas, S.A. to the Petrochemical Project for the Extension of Production of Methanol, Called "Metor II"*. Office of the Minister. Official Gazette of the Bolivarian Republic of Venezuela N° 1.962. 2005.

(4) Presidential Decree, Nº 1.527. *Security Zone for the Basic National Industry: Oil and Petrochemical Complex "General José Antonio Anzoátegui"*. December, 1996.

and Petrochemical Complex is located at Bolívar county jurisdiction, Anzoátegui State



SOURCE: METOR, S. A

Figure N° 1: Oil and Petrochemical Complex "General José Antonio Anzoátegui"

Metanol de Oriente, METOR, S. A., geographical limits are:

North: Caribbean Sea
South: National Road 9
East: SUPERMETANOL plot
West: FERTINITRO plot

The Expansion Project will cover an area of 2.26 hectares (5.59 acres) inside the METOR, S. A., plot and geographical limits are as follows:

North: Existing Methanol Storage Tank Area
South: Existing Warehouse and Maintenance Building

East: Existing Synthesis and Distillation Sections
West: FERTINITRO plant

The Expansion Project plot is located within the following UTM coordinates:

POINT	COORDINATES	
	NORTH (m.)	EAST (m.)
A	1.114.740	294.123
B	1.114.910	294.133
C	1.114.950	294.010
D	1.114.780	293.990

Source: METOR, S. A

It is important to mention that the plot where the Expansion Project is to be located was already included as a future expansion area in the original project of the existing Methanol Plant, therefore it already has access ways, lightening system and other services. Both services and infrastructures already available at the existing plant and Norm IR-M-02: Equipment and Installations Locations Regarding Third Parties (PDVSA, 1995)[5]; have been considered in order to allocate the installations required for the Expansion Project, inside the existing plant, in a safe and economical way.

Likewise the existing plant, the Expansion Project will be built under Mitsubishi Gas Chemical (MGC) license as a project executed by Mitsubishi Heavy Industries and INELECTRA, which includes basic and detailed engineering development, as well as the procurement, construction, performance test and early production phase.

Metanol de Oriente, METOR S. A., a joint venture company of Petrochemical of Venezuela, S. A., (PEQUIVEN), will execute expansion Project with the following shareholders:

HOLDER	PARTICIPATION %
Petroquímica de Venezuela, S. A. (PEQUIVEN)	37,50
Mitsubishi Corporation	23,75
Mitsubishi Gas Chemical, Inc.	23,75
Empresa Polar Uno, C A	10,00
International Finance Corporation (IFC)	5,00

(5) Petróleos de Venezuela, S. A. (PDVSA). *Norm IR-M-02: Equipment and Installations Location of third Parties".* 1995

The construction phase will start during the first half of September 2006, and it will end by March 2009. Operations will be initiated with a performance test in June 2009. Commercial operation is expected to start three (03) months later.

The new methanol plant design is based upon a production rate of 2.500 tons/day, with a factor of 8,000 hours operation per year (340 days) and a programmed turn around of 25 days after the first year operation is over. Later on, turn around will be executed every three (3) years, in order to allow appropriated maintenance to all equipments and production units.

The execution of the project will be in agreement with a schedule of activities summarized in Figure N° 2.

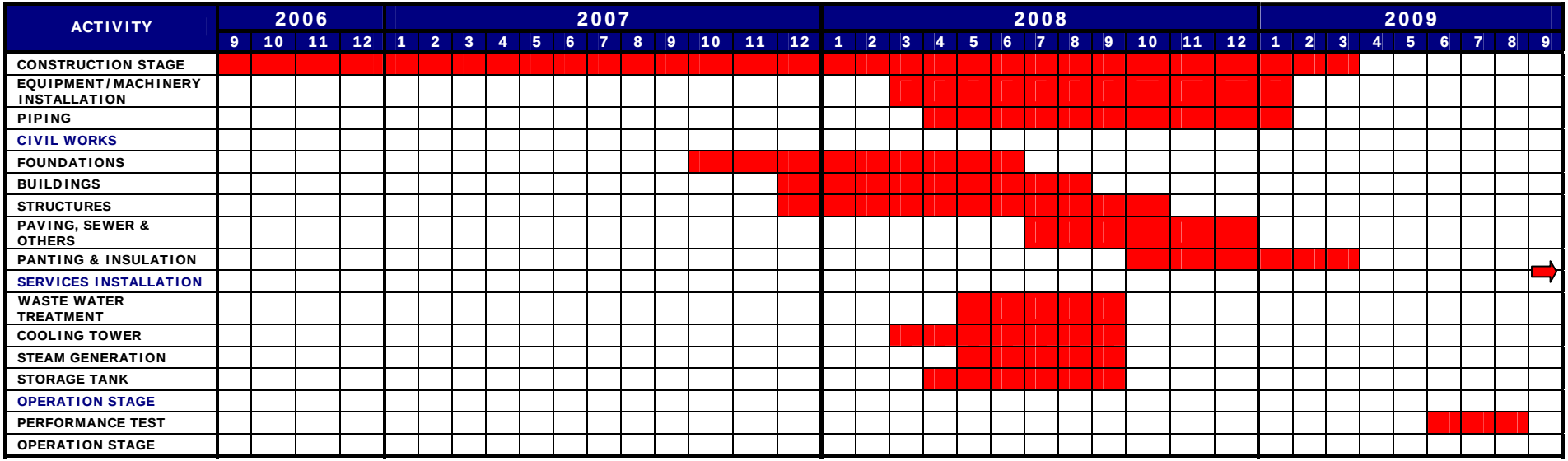
2.2 PROJECT EXPANSION STAGES

2.2.1 Pre-Construction Stage

During this stage, all the activities to assist the construction of the new facilities of the Expansion Project will be carried out. Among these activities, the following can be mentioned:

- Request of all permits and/or necessary authorizations.
- Review of the Basic Engineering and beginning of the Detail Engineering, Procurement and Construction (EPC) of the plant.
- Signing of EPC Contracts with the favored construction and services companies.
- Completion of the Detail Engineering.
- Project Hazard and Operability Risk Analysis (HAZOP)
- Procurement, purchasing and Transportation of the machineries, equipment and personnel required to carry out the construction activities.
- Construction of temporary facilities for contractors office; storage of machineries, equipment, tools and inputs; dressing room; portable restrooms; etc., in unoccupied parcel of PEQUIVEN located to the east of the project (Figure N°1).
- Cleaning and adaptation of the land of the construction area, currently occupied by stored equipment and materials. Only a small area located in a plot outside battery limits (OSBL) at north side of the existing plant, will be deforested in order to install flare stack and facilities.

Figure N° 2: Expansion Project. Master Schedule



2.2.2 Construction Stage

The following activities are involved:

- Civil works, such as construction of foundations and pedestals, support structures, walls, flagstones and bases of pavements, and others; drainage system; accesses interconnection to the area of the project and their internal facilities with the existent roads; and the waterproofing, forge, masonry, carpentry, painting, etc. Construction of buildings is also included.
- Mechanical works, such as transportation of materials and execution of works of structural steel; cleaning, covering, and insulation of pipes, valves and accessories; protection of steel structures and metals; installation of compressors and pumps, and connection to their respective process lines.
- Installation of auxiliary facilities or services required by the process as wastewater treatment, cooling tower, storage tank, etc.,
- Electrical and instrumentation works related to the installation of equipments, interconnections and power distribution to the systems, and control equipment and monitoring of different processes and services.
- Cleaning, insulation, painting and identification of equipments and pipes, internal roads and process areas
- Hydrostatic tests (vessels, equipments and tanks).
- X-Rays test to the pipes in order to verify the quality of the welding works and to ensure these do not have defects. This will be carried out by companies properly registered in the Permanent National Registration of Ionizing Radiations Sources and Generating Equipments (RNPFEGRI, in Spanish) of the Ministry of Energy and Petroleum (MEP), and the Registration of Susceptible Activities of Degrading the Environment (RASDA), of the Ministry of the Environment and the Natural Resources (MARN).
- Dismantlement of the temporary facilities once concluded the construction activities, leaving the area in perfect condition.

2.2.3 Operation Stage

Generally, the actions will be related to methanol production at the expected capacity. Nevertheless, once concluded the construction phase and before the operation phase, it will be carried out an overall inspection and test of the different equipments and systems. Later on, the start up activity will begin, which includes

the placement of catalysts and chemicals, starting the plant normal operation and the execution of the necessary adjustments.

2.2.3.1 General Services Description[6]

Project components will be located in four (4) areas (Figure N° 3) identified as:

- Process area,
- industrial services area,
- storage and shipping area, and
- flare area.

The production units will form the process area where the following sections are included:

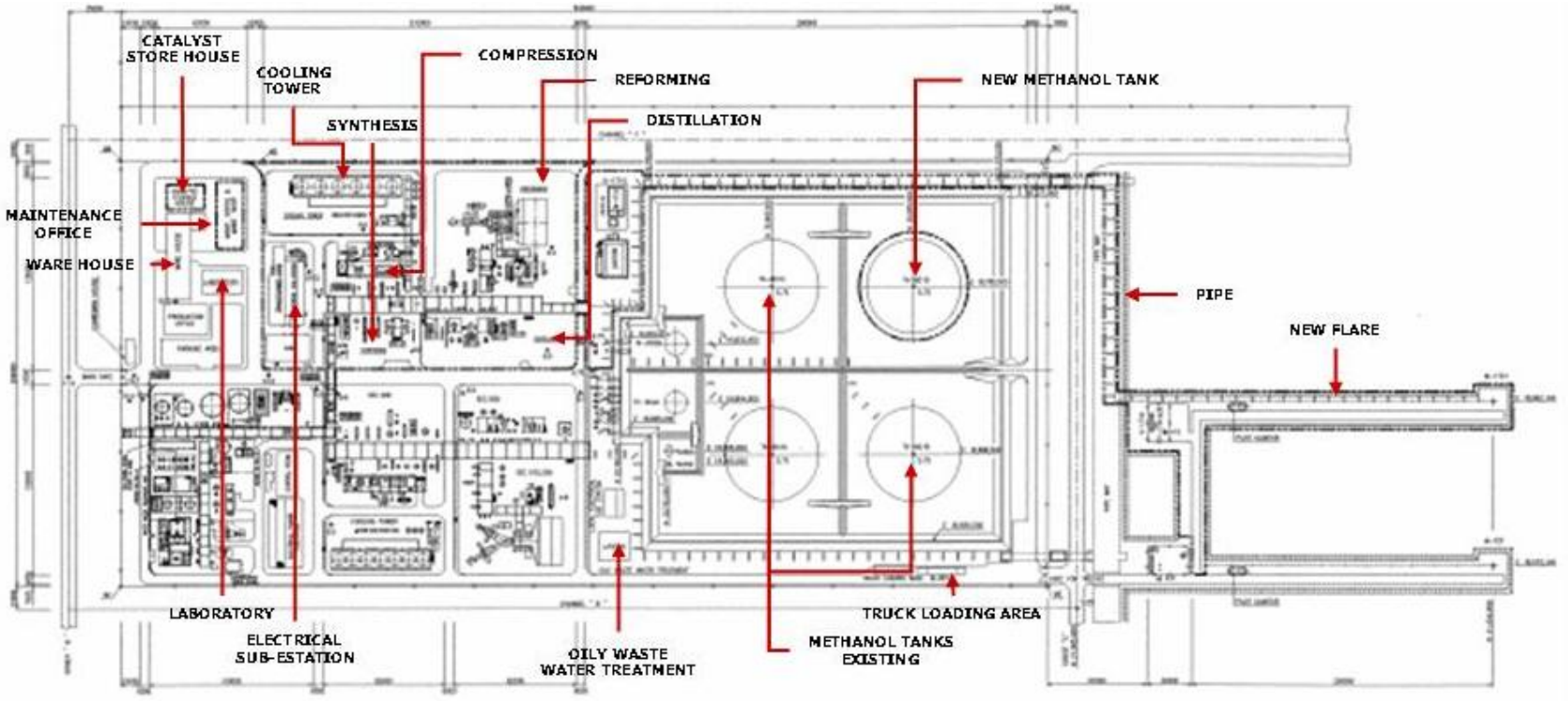
- Reception and treatment of natural gas, Hydrodesulphurization
- Natural gas reforming and heat recovery
- Reformed gas compression
- Methanol synthesis of the reformed gas
- Crude methanol distillation to remove impurities

The units and systems needed for plant operation integrate industrial services. These are:

- **Filtered Water:** the main source of industrial water is the Neverí River, at 32 Km to the east of JIC. Then, after being filtered and treated at PEQUIVEN Common Facilities (currently operated by the Contractor Aguas Industriales de Jose) it is distributed to the users.
- **Cooling Water:** The Cooling Water Unit is fed by Filtered Water, as make up. The warm water returned from the plant (214 ton/h) to the Cooling Tower where the absorbed heat is dissipated to atmosphere.
- **Demineralized Water**: The facilities shall produce the deaerator feed water and the process make-up water (180 m^3/h) for the process plant.
- **Potable Water:** It will come from PEQUIVEN Common Facilities (2.8 m^3/h). There will be potable water available at approx., 300 m., from the plant location at 3.5 kg/cm^2G and temperature ambient.

(6) Mitsubishi Heavy Industries, LTD. MCEC. *General Description for Utility & Offsite.* METOR-Expansion Project. Dec. 2005.

Figure N° 3: Project Components



- **Waste Water Treatment Facilities:** The wastewater from the whole plant shall be treated in the facilities. It will be in accordance with the Venezuelan regulations and sent to PEQUIVEN collecting system outside of the battery limit.

Figure N° 4 shows the overall water balance for expansion project only and for both expansion project and existing plant.

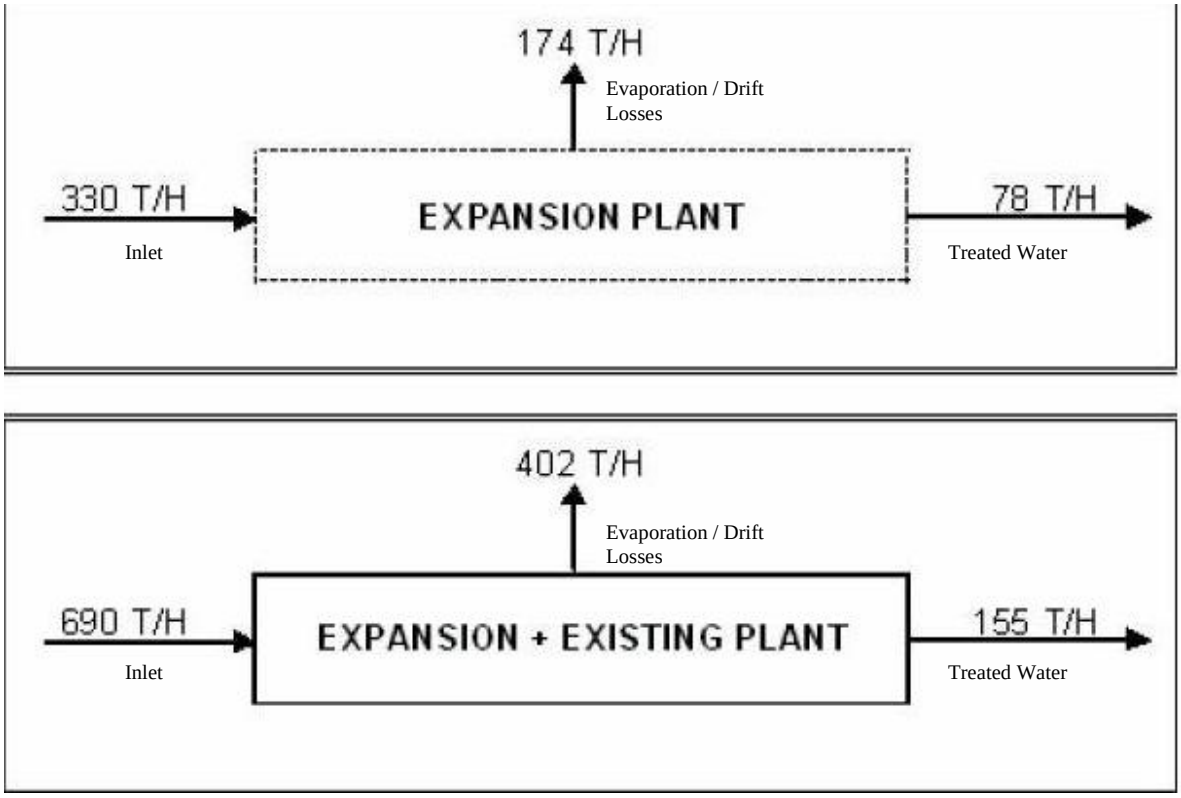


Figure N° 4: Overall Water Balance

- **Instrument Air Unit.** Instrument Air from the unit shall be connected to the distribution header that shall supply to the whole Plant including Expansion Project and the existing plant.
- **Steam System**. High Pressure Steam (105 kg/cm^{2}G Level) to be consumed in Expansion Plant shall be generated from Reformed Gas Waste Heat Boiler. It shall be used for Syn Gas Compressor Turbine during normal operation.

Medium Pressure Steam (26.5 kg/cm^{2}G Level) shall be supplied by the extraction of Syn Gas Compressor Turbine and generated in Methanol Superconverter it shall be used for other steam turbines and the process steam for the reforming reaction. Let Down from Medium Pressure Steam Header and exhaust of backpressure turbines shall supply Low Pressure Steam (5.0 kg /cm2G Level). It shall be used for the steam reboilers in the Distillation Section and deaeration of Boiler Feed Water.

- **Inert Gas System**: Nitrogen (850 Nm^3/h) is used as inert gas and it shall be imported by road tanker or by pipeline property of third parties.
- **Fuel System:** Two kinds of fuel are supplied from outside battery limit: fuel gas based on natural gas and fuel oil. Natural gas is used for fuel gas and is supplied mainly for Reformer Burners (78.402 Nm^3/h) and Flare Stacks (29 Nm^3/h) and diesel oil is used as fuel oil (267 l/h), only for the emergency generator running at maximum capacity. As a consequence of the combustion of these fuels, the amount of Carbon Dioxide generated is estimated in 400.000 MT per year.
- **Electrical Power**: Electrical power will be imported from the existing 34,5 kV Complex main substation, located at approx. 1.500 m., from Methanol Plant battery limit. An emergency power generator shall be provided to supply the power for the critical equipments that secures the safe shutdown of the Plant in case of power failure.
- **Storage and Shipping System**: Product methanol synthesized and purified in Process Unit is once stored in Product Methanol Tanks, existing (3) and new (1), prior to loading to ocean cargo, tank lorry, etc. Storage tanks shall be capable of storing minimum 30 days of nominal production capacity.

2.2.3.2 General Process Description[7]

The process consists in allowing natural gas to react with water steam in the presence of a catalyst and under established conditions of pressure and temperature (Figure N° 5). It divides into five (5) sections:

1. Natural gas desulphurization
2. Reforming the natural gas feedstock with steam
3. Compression of the reformed gas
4. Methanol synthesis of the reformed gas
5. Distillation of the crude methanol to remove the impurities

(7) Mitsubishi Heavy Industries, LTD. MCEC. *General Process Description.* METOR-Expansion Project. Dec. 2005.

Any sulfur compound in the natural gas must be removed to the trace level prior to the introduction into the reforming catalyst, as well as in the methanol synthesis catalyst. The process natural gas is pressurized to a suitable pressure. Then it is mixed with a part of the purge gas from the Synthesis Section, used as hydrogen source for the hydrogenation in the Hydrogenator.

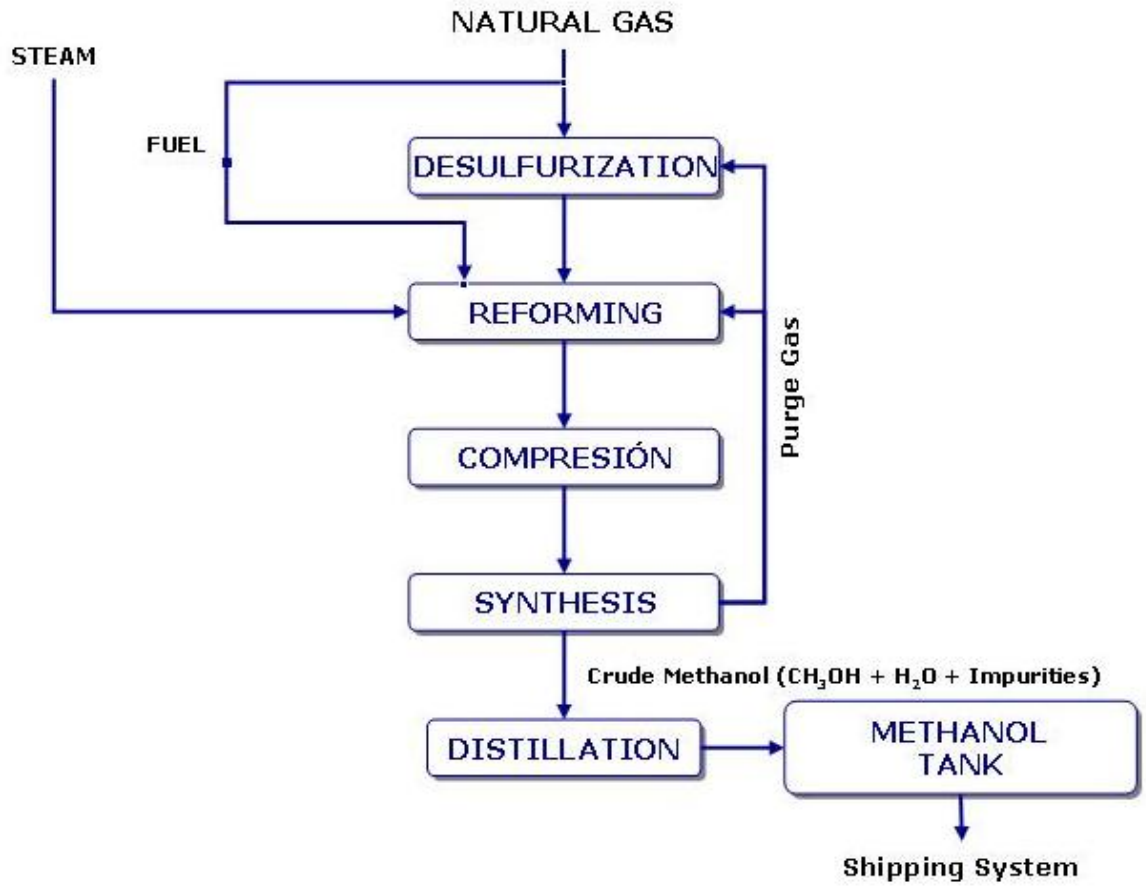


Figure N° 5: Overall Block Flow Diagram

In the Hydrogenator, organic sulfur compounds from the natural gas are converted to hydrogen sulfide, which is adsorbed in the Sulfur Adsorber as follows:

In Hydrogenator: $R\text{-}SH + H_2 = R\text{-}H + H_2S$

In Sulfur Adsorber: $H_2S + ZnO = ZnS + H_2O$

The desulfurized process natural gas is saturated by contacting with the circulating water and the circulating process condensate. After mixed with the medium pressure steam, the mixed gas is heated to a suitable temperature and then it is introduced into the Reformer.

The reforming reactions take place over the nickel-base catalyst filled as follows:

$$CH_4 + H_20 = CO + 3H_2 - 49.2 \text{ kcal/mol}$$

$$CO + H_20 = CO_2 + H_2 + 9.8 \text{ kcal/mol}$$

The reformed gas is compressed to the required pressure and then is fed to the synthesis section as the make-up syn gas.

The make-up syn gas is mixed with the recycle gas and the mixture (synthesis gas) is preheated. The main reaction for methanol synthesis is as follows:

$$CO + 2H_2 = CH_3OH + 21.6 \text{ kcal/mol} \quad (1)$$

In addition, carbon dioxide (CO_2) in the make-up syn gas is converted to carbon monoxide (CO) by following reaction (2). The formed carbon monoxide produces methanol by the reaction (1).

$$CO_2 + H_2 = CO + H_2O - 9.8 \text{ kcal/mol} \quad (2)$$

In case of MGC cooper-zinc catalyst (with very high selectivity to methanol), carbon dioxide (CO_2) is directly converted to methanol by the reaction (3):

$$CO_2 + 3H_2 = CH_3OH + H_2O + 11.8 \text{ kcal/mol} \quad (3)$$

In this way, all the carbon oxides are converted to methanol so there is not any emission to the atmosphere from the process side.

Methanol and water formed in the synthesis reaction is condensed and cooled to approximately 45°C and separated from the non-condensable gas. The gas dissolved in the liquid are flashed off at reduced pressure (3.5 kg/cm^2G) and crude methanol is sent to Distillation Section for purification.

Crude methanol contains about 80% of methanol, about 20% of water, small quantities of dissolved gas and a small quantity of organic impurities (di-methyl

ether, methyl formate, acetone, various ketones, ethanol, higher alcohol, paraffin and other complexes) which are produced simultaneously with methanol synthesis.

The crude methanol is purified for the production of Federal Grade AA Methanol with three columns system: one Topping Column and two (2) refining columns. 35% of the total capacity of methanol production rate will be refined in HP Refining Column and 65% of that will be refined in LP Refining Column.

2.2.4 Waste Streams

2.2.4.1 Air Emissions

Fumes from vehicles, machinery and equipment and dust from the construction of infrastructure and earth transportation are the major sources of emissions from the construction stage.

Operation stage shall generate air emissions from several sources. The major sources are the natural gas (PNG) at the outlet of the Sulfur Adsorber located upstream of the Reformer, the reformed gas at the suction of the Syn Gas Compressor / Circulator, and the synthesis gas at the discharge of Syn Gas Compressor / Circulator and Syn Loop. The major pollutants are carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and total suspended particulates (TSP).

2.2.4.2 Waste Water (Liquid Effluents)

Table 1 lists major sources of wastewater to be generated by the Expansion Project. The wastewater to be released from the Expansion Project shall be sent to the Waste Water Treatment Facility.

Table N° 1: Expansion Project, Source of Waste Water

SOURCE	Vol. (m^3/h)
Demineralized Water Treatment Unit	16
Blown down Water from Heat Boiler	4
Blown down + Backwash Water from Cooling Tower	41
Oily Water from Process Area	11
Blowdown Water from Saturators	6

Source: Mitsubishi Heavy Industries, LTD. General Description for Utility & Offsite. Waste Water Balance. Dec. 2005

2.2.4.3 Noise

Occupational noise is the one that is generated and measured in the working area, and have been measured and reported by METOR according the annual Integral Protection plan. The last result is shown in Figure N° 6., and it indicates some process areas in the existing facility where the noise level is higher than the equivalent level for eight hours of exposition required by the Venezuelan Regulations and the IFC Guidelines (85 dB(A)). The use of hearing protection is actively enforced in those areas. For the new Plant, the design basis was set at 85 dB(A) as maximum. So it is not expected any area exceeding this level, during normal operation.

Ambient noise is the one measured at the boundaries of the Plant area, and it may or may not be generated in the Plant. There are not recent records of such environmental noise level data in METOR. However, based on the occupational noise data and some internal monitoring exercises, it is expected to have values below 70 dB(A), according the World Bank Group Policies and Guidelines (World Bank Group, 1998)(9)

During the construction phase of the new Plant, if there were any specific activity that generates high level of noise during short period of time, effective mitigation methods will be applied

After commissioning of the new plant, the noise level is expected to be within the international acceptable range.

2.2.4.4 Solid Wastes

Domestic solid wastes to be generated by the 2,000 workers during plant construction, are estimated in around 7.0 t/week (0.5 kg./person/day). Additionally, construction waste generated is equivalent to 5,652.50 m^3 (0.25 m x 22,610 m^2).

Solid wastes generated during plant operations include both industrial waste generated from processes such as catalyst fines and spent catalyst, wastewater treatment sludge, contaminated container and packing, etc., and domestic solid waste generated from operators and administrative facilities.

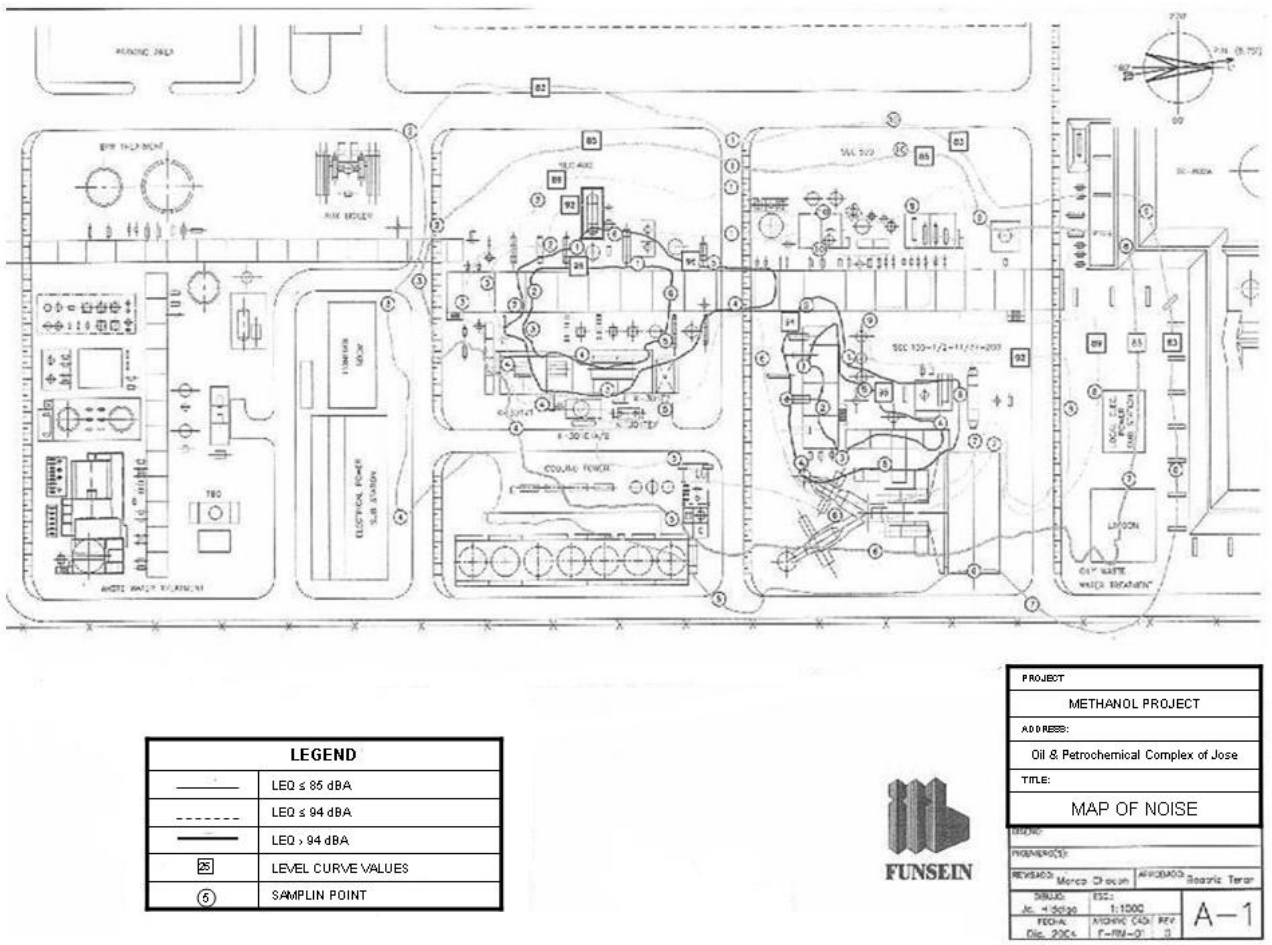


Figure N° 6Map of Noise

2.2.5 Environmental Control Systems

In the design of the Expansion Project, the following controls have been developed to control pollution, both for plant specific sources and for general source categories.

2.2.5.1 Air Emissions

The dust control methods shall be depending on the proximity of the Expansion Project Plant to established plants, local weather conditions, the humidity or moisture content of the earth, the mode of transportation of the equipment, machinery and earth, etc. It shall include spraying of road with water depending on the background levels of dust be established by this environmental impact assessment study. Health hazards will be controlled by wearing of respirators and eye protection devices in critical weather conditions.

The Flare Stack shall burn the effluent gas such as the natural gas, the reformed gas and synthesis gas released from Expansion Plant. It shall handle the steady gas release during star-up and the instantaneous gas at the emergency shut down. The steam released to the atmosphere for certain time, shall be released through the Steam Silencer.

All these actions will be executed in order to satisfy the limits and parameters settled down in the Rules on Air Quality and Control of Atmospheric Contamination (Presidency of the Republic, 1995)[8] that regulate the emission of gases and suspended particulate matter that are considered potentially damaging to the environment or human health. Similarly, the Expansion Project shall comply with the emissions limits settled down by World Bank Group Policies and Guidelines (World Bank Group, 1998)[9].

Concentrations of contaminants emitted from sources of Existing Plant have meet specified emissions limits over the period 1995-2005.

2.2.5.2 Water Wastes (Liquid Effluents)

The first element of the waste water system shall be the collection system. The Expansion Project shall have separate sewer systems to handle the different types

(8) Presidency of the Republic. *Decree N° 638. Rules on Air Quality and Control of Atmospheric Contamination*. Official Gazette Ext. N° 4,889. May 1995.

(9) World Bank Group. *Pollution Prevention and Abatement Handbook.* July, 1998

of wastewater. Run off, for example, shall be separated from contaminated storm water and oily water from the ground installed various rotating machines in the process area and the utility area. This shall reduce the volume of wastewater that has to be treated.

Waste Water Treatment Facility shall treat any wastewater released from the Expansion Project, to remove contaminants and purify it prior to send to PEQUIVEN Collecting System outside of the battery limit. The unit shall be new, separated and independent from the Waste Water Treatment Facility of the Existing Plant.

Domestic sewage, coming from the administrative areas and from the Expansion Project, will incorporate to the existing internal net of METOR and they will be sent to the Domestic Wastewater Treatment Plant of the Petrochemical Complex.

The condensate water from Recovery Area shall be recovered. Then, it will be partially sent to the Saturator, where the condensate shall be evaporated. The rest of the condensate shall be recycled to demineralized water.

All wastewater of the Expansion Project shall have to meet maximum limits specified in the Water Quality Regulations (Presidency of the Republic) [10]. These regulations establish maximum limits for components that can be discharged either directly or indirectly into rivers, estuaries, coastal areas, lakes and dams. In addition, the process wastewater, domestic sewage and contaminated runoff must meet the maximum limits specified by World Bank Group Policies and Guidelines (World Bank Group, 1998) [11]

2.2.5.3 Noise Control

In the case of the working environment, the noise intensity may constitute a health hazard. To ensure compliance with noise level regulation (Presidency of the Republic, 1992) [12] and occupational health and safety (IFC, 2003) [13] it shall be necessary to monitor noise levels in the working environment and to ensure that workers wear appropriate personal protective equipment. In addition, it shall be necessary the periodic examination of workers to detect occupational deafness. No

(10) Presidency of the Republic. *Decree N° 883: "Rules for the Classification and Control of Water Bodies and Wastewater or Liquid Effluents"*. Official Gazette Ext. 5021, December 18, 1995.

(11) Op., cited, pp. 438

(12) Presidency of the Republic. Decree N° 2.217: "Rules for Control Generated Contamination by Noise" Official Gazette Nº 2.519, April 27, 1992.

(13) IFC. Environmental and Social Guidelines for Occupational Health & Safety. June 24, 2003.

employee shall be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day. In addition no unprotected ear should be exposed to a maximum fast noise level of 110 dB(A).

Working environment with high noise level shall be appropriately marked. Signals shall be according to the international standards, as well known and easily understood by workers, visitors and the public.

However, the first and most important control options will be appropriate plant design, maintenance and operating practices. During operation monitoring, high noise carrying equipment will be gradually removed or improved. For new equipment, solutions to noise problems are in most instances available.

2.2.5.4 Solids Waste Management

The design and management of the Expansion Project facilities and the planning of associated activities incorporate pollution prevention principle.

Domestic solid waste generated during the construction and operation phases of the Expansion Project, will be stored in recipients with a capacity not more than 40 kg., and then transported regularly to the Sanitary Landfill Cerro de Piedra, for their final disposal. Units adapted to the existing conditions in the area will be used in the transportation of such waste.

Spent catalysts and used oils will be separated and stored temporarily under controlled conditions and in an environmentally safe manner until their commercialization with companies properly qualified and certified for their regeneration, reuse, recycling or any other use. Final disposal certification is submitted to METOR by the certified company, according to the Venezuelan regulation.

Wastewater treatment sludge will be land filled. To prevent contamination, leachates from sediments and sludge, will be sampled and tested frequently. The parameters to be tested will depend on the nature of the potential leachates.

All solid wastes generated and listed as non hazardous waste will be handled according to the Non Hazardous Solid Waste Standard (Presidency of Republic, 1992)(14) and specific law (National Assembly, 2004)(15). All hazardous solid wastes

(14) Presidency of the Republic. *Decree N° 2.216: Norms for the Handling the Non Hazardous Waste Solids come from Domestic Commercial, Industrial or Other Sources".* April 27, 1992.

will be handled according to the Hazardous Materials and Hazardous Wastes Management Standard (Presidency of Venezuela, 1998)[16], and specific law (National Assembly, 2001)[17].

In addition, the Expansion Project shall comply with the Hazardous Materials Management Guidelines (IFC, 2001)[18] and Occupational Health & Safety (IFC, 2003)[19]

2.2.5.5 Fire Fighting System

This system is similar to the existing one in METOR, with some modifications in order to integrate it. The ordinary equipment includes hydrants, portable extinguishers and alarms. Design and installation shall be in accordance with Venezuelan Standard COVENIN, Fire Protection Design Standards of PDVSA. Fire fighting water (1,181 ton/h) is available along the north coordinate at 8.5 Kg/cm^{2}G and fire-fighting tie-in and it shall be provided with isolation valves, according to PEQUIVEN existing facilities.

2.2.6 Expansion Project Requirements

The construction stage is estimated in 30 months with a work force peak of 2.000 men approximately. The operation stage will generate 32 direct jobs, distributed among supervisory personal, plant operators and maintenance staff.

The Plant Operations will require the following industrial services of the Complejo Industrial Petroquímico y Petrolero General José Antonio Anzoátegui facilities:

Industrial water:	112	L/sec.
Electricity (34,5 kW)	8	MW
Potable water	0.78	L/sec.
Sewage water treatment	0.78	L/sec.
Waste water treatment facilities	25	L/sec.

(15) National Assembly. "*Law for Residue and Solid Wastes"* November 2004.

(16) Presidency of the Republic. *Decree, Nº 2.635: Norms for the Control of Recovery of Hazardous Materials and Handling of Hazardous Wastes"* August 03, 1998.

(17) National Assembly. "*Law about Substance, Materials and Hazardous Wastes"* November 2001.

(18) IFC. "*Hazardous Materials Management Guidelines*". Environmental, Health and safety Guidelines. December 2001.

(19) IFC. "*Environmental and Social Guidelines for Occupational Health & Safety*". June 24, 2003.

PDVSA Gas will supply the natural gas required as row material, at 34°C (93.2ºF) ambient temperature, 17.5 kg/cm² normal pressure, 21.0 kg/cm² maximum pressure, and a caloric value of 9,401 Kcal/Nm³.

Natural gas consumption, for both, process requirements and fuel, it has been estimated at a maximum of 34.3 MMBTU per ton, of produced methanol. Considering the natural gas caloric value consumption will be 919 N m³/ton of methanol.

2.2.7 Project Hazard and Operability Risk Analysis

METOR expansion project basic engineering, was inittialy developed in 1998. As part of its HSE policy and in compliance with Venezuelan petrochemical and oil industry regulations, a HAZOP study was done at that time, and the resulting recommendations were considered.

At the beginning of 2006, during the revision of the basic engineering package, a second HAZOP study was performed.

The resulting recommendations from this study are mainly related to the operation of the common facilities that interconnect new and existing plant. Besides, some actions related to instrumentation and operational procedures were decided. Therefore, the HAZOP team concluded that the design of Metor Expansion Project not only fulfill technological and safety requirements but also it assures a safely and reliable operation if all of the HAZOP recommendations are implemented.

A new HAZOP study during the detail engineering stage will be done to evaluate the risks involved in the construction and operation stages.

2.3 ACTIVITIES THAT MIGHT GENERATE POTENTIAL IMPACTS

Even though Expansion Project will be built up in an intervened area, lacking of vegetation, excepting the sector where flare is to be located, performance of some activities -associated to construction and operation stages- will generate affectations to physical and social-economical environment.

During construction stage, the activities that might affect environment are the following:

- Installation of facilities
- Site clearing

- Construction of structures and preparative works
- Construction of asphalted pavements ands access ways
- Construction of drainage systems
- Architectonic works performance
- Transportation of equipments, people/staff and machineries to the installation site
- Structural steel works.
- Process lines coating/cleaning and installation of compressors and pumps
- Installation of service systems and facilities
- Finishing operations
- Hydrostatic testing of pipes and valves
- X-rays testing
- Dismantling and clearing of temporary installations.
- Setting out and commercial testing

During operation and maintenance stage, activities susceptible to produce environmental perturbation are:

- Combustion and eventual burning of gases
- Emergency venting
- Equipment cleansing
- Handling of chemicals and catalysts
- Water treatment
- Maintenance of pavement, pipelines, equipments, drainage works, etc.
- Replacement of light fixtures
- Activities of periodical maintenance on equipments and pipelines
- Activities of grassland maintenance

3. ENVIRONMENTAL AND SOCIAL BASELINE

Project will be performed on a 22.610 m² parcel totally intervened and prepared for industrial development. It is located inside the battery limits of the area occupied by the existing methanol plant and other METOR, S. A. facilities, at the Petrochemical Complex General José Antonio Anzoátegui.

Similarly to the existing plant, the environmental area of influence for the Expansion Project was determined by the territorial extension susceptible to be affected in a direct or indirect manner by the activities associated to its implementation.

In general, the direct influence area of the Expansion Project is totally intervened as established during the conception of the company in 1992. The new flare stack will be allocated in the same classified area as the existing one.

Environmental and social characterization was performed starting from basic information obtained in field, particularly for the variables geology and geotechnics, hydrography, vegetation and fauna; data update and basic information reported in environmental studies carried out in the influence area.

3.1 GEOLOGY

The study area is part of the Venezuelan eastern littoral inside the geological surroundings of the Eastern Interior Sierra and Unare Depression occidental extreme, in a zone generally characterized, by presenting a typical sinking topography, dominated by plain with extensive beaches interrupted by the Interior Sierra.

3.2 SISMICITY

The Northeastern region of Venezuela presents seismicity from medium to high, which increases from East to West. It has generated 5 to 7.8 Richter earthquakes. Santa Ines. Although in the region are located different fault systems, the fault of highest interest is Santa Ines Fault, because of its proximity to Industrial Complex of Jose.

3.3 GEOMORPHOLOGY

Previous studies (CORPOVEN and Ingeniería CAURA, S. A)[20], indicated that land shapes present in the study area belongs to a morphogenetically active environment, characterized by the presence of erosion processes and accumulation at the drainages bottoms, that eventually discharge in “El Juncal” Lagoon, situated at the East of the plot/parcel, adjacent to coast.

3.4 SOILS

Dry climate ad high slopes in these ranges had originated thin soils, rocky or stony, with low contents of organic matter. In general, soil in the plot/parcel present a

[20] CORPOVEN and Ingeniería Caura, S. A. *NRO Oil Refinery. Environmental Impact Assessment.* Caracas, 1992.

good capacity of support, with firm, very firm and hard consistencies, and materials that compose them do no present corrosive characteristics (Geohidra, 1998)[21].

3.5 DRAINAGE PATTERN AND GROUNDWATER

Plot/Parcel presents a superficial drainage pattern with water displacement from Southeast to Northwest. The ground water table oscillates between 8,82 y 7,00 m and measures performed clearly show that subsoil ground water table is leaded by the sea level. Groundwater conductivity varies from 6.250 to 74.200 μmhos/cm; Chlorides concentration varies from 0.23 to 1.85 %; and Sulfate concentration vary from 0.070 to 0.355 %.

3.6 CLIMATE

The area is classified as Very Dry Tropical Forest (Ewel y Madriz, 1976)[22].

In general, the area is under the Intertropical Convergence (ITC) and Northeast trade winds. There are not significant variations of temperature. Precipitation produces the major significant changes to the environmental conditions.

The water balance is negative. There is not a rainy season (PP > ETP); instead, there is an intermediate period where precipitation exceeds 50% the monthly evapotranspiration (PP ≥ ETP/2).

The thermal regime of the area is:

a)	Monthly average temperature	26.6 ºC
b)	Monthly maximum average Temperature	32.2 ºC
c)	Monthly maximum average Temperature	22.4 ºC
d)	Monthly average oscillation amplitude	9.8 ºC

The annual average velocity is 2.7 m/sec. March as 6.6 m/sec., and April and February 6.1 m/sec register the higher values; minimum values are 2.2 m/sec., and 2.6 m/sec., in July and August respectively. Maximum velocity is between October and November with 22.9 m/sec.

(21) GEOHIDRA. *Geotechnical and Topographic Study for Expansion Project*. September, 1998.

(22) Ewel y Madriz. *Life Zone of Venezuela*. 1976.

The prevailing wind direction is NNE, from the sea to the mountain. However, in July –October, direction changes from the mountain to the sea, prevailing east.

The average relative humidity is 77%, having the highest value (80%) in August, and the lowest value (72%) in March and April. The highest average value 80% is from July to September. The maximum value is 96% and the minimum is 52%.

As the area is in a marine environment, these values indicated the need to consider its corrosive effects in pipes, chimneys and installations in general.

3.7 WATER QUALITY

Results obtained from several studies by authorized laboratories since 1995 up to 2005, in the marine-costal area next to the Project area, allowed to conclude that the liquid effluents discharges from the companies located at the Petrochemical Complex, have not altered the physical-chemical and bacteriological quality of the marine-costal environment.

The METOR existing plant discharges fulfill maximum ranks and limits established in the Norms for the Classification and Quality Control of Water Corps and Discharges or Liquid Effluents. (Presidency of the Republic, 1995)[23]

3.8 AIR QUALITY

Results obtained from several studies by authorized laboratories since 1995 up to 2005, in the air quality of the area next to the Project area, allowed to conclude that the emission discharges from the companies located at the Petrochemical Complex, have not altered the air quality.

Emissions studies of fixed sources of METOR existing plant by authorized laboratories since 1995 up to 2005, showed that the emission levels has always been under the maximum limits established in the Norms on Air Quality and Atmospheric Contamination Control (Presidency of the Republic, 1995)[24].

3.9 VEGETATION

The plot where the Expansion Project is to be located is completely intervened, without vegetation, except some gardens kept in the surroundings and a short

(23) Op., cit.

(24) Op., cit.

chaparral / coastal hawthorn, of low height and covering, in the plot/parcel North sector whose components are adapted to drought and poor soils rigorous conditions.

Nevertheless, in the Project indirect influence area there is a fringing forest zone and shore mangrove and outfalls of Hoces stream and some mall sectors of coastal grassland (Ingeniería Caura, S. A. 1997)[25].

3.10 FAUNA

There is not critical habitat near the area of expansion project. A coastal-marine zone is located 10 kilometers to the northeast of the Petrochemical Complex, out of the influence area of Metor expansion project. It corresponds to a wetland called Los Mesones o Boca de Caiman that houses birds, fishes, crustacean and microorganisms highly inter-related with physical-chemical balances of water and migratory cycles of species.

3.11 SOCIAL-ECONOMICAL AND CULTURAL CHARACTERISTICS OF THE PROJECT AREA

Expansion Project of METOR, S. A. Metanol Plant, similar to the existing plant, is located within an Area Under Regulated Environmental Administration Regime: Security Zone of the National Basic Industry of the Industrial Petrochemical and Petroleum "José Antonio Anzoátegui" (Presidency of the Republic, 1996)[26]. Their directives and guidelines establish a land-zoning scheme based on both operational and functional requirements and security and environmental considerations of the Industrial Complex that open up 47,363.86 hectares (116,947.8 acres) to industrial, petrochemical, oil and industrial support uses, and onshore and offshore terminal facilities.

The breakdown of the zoning scheme prohibits settlements and related uses (recreational, residential, commercial, and industrial), arable cropping, livestock production, production forestry, fishing, etc. Therefore, there are not some rural or fishing populations around the influence area of METOR plant.

The economical activities localized in the Piritu and Barcelona Cities, around 20 km from Metor plant, are tourism, fishery, industrial and petroleum. Industrial and petroleum activities are concentrated mainly in the Industrial Complex and

(25) Ingeniería Caura, S. A. *Environmental Impact Assessment Study of SINCOR Project*. 1997

(26) Op., cit.

surrounded areas; the fishery activity is based in Piritu and Puerto La Cruz and continental platform, outside of the Security Zone polygon; the tourism take place all over the costal line, except on the area where Industrial Complex is located.

4. ENVIRONMENTAL ASSESSMENT RESULTS

4.1 IDENTIFICATION OF ENVIRONMENTAL EFFECTS

Table N° 2 summarizes the effects on the physical, biological and social-economics environments.

Table N° 2: Expansion Project Identified Environmental Effects

PROJECT STAGE	IDENTIFIED ENVIRONMENTAL EFFECTS	
	PHYSICAL – NATURAL ENVIRONMENT	SOCIAL-ECONOMICAL ENVIRONMENT
Construction	❑ Direct vegetation removal from new flare area. ❑ Wildlife habitats affected during the clearing vegetation. ❑ Potential contamination of the marine - costal water for improperly treated water waste. ❑ Potential changes in air quality for fugitive dust from road and transportation of personal, equipment and machineries.	❑ Employment expectative generated during construction stage. ❑ Road system damaged for transportation of machinery, equipment and personal. ❑ Road accidents risk increase. ❑ Nuisance increased for noise from machinery and equipment. ❑ Safety and health increased by operating heavy equipment and machinery
Operation and maintenance	❑ Wildlife habitats affected level noise. ❑ Potential contamination of the marine - costal water for improperly treated water waste. ❑ Potential changes in air quality for emissions from process.	❑ Employment expectative generated. ❑ Public services pressured. ❑ Near by communities' discomfort. ❑ Nuisance increased for noise from machinery and equipment. ❑ Safety and health increased for exposure to heat and noise

Source: Ingeniería Caura, S. A.

4.2 EVALUATION OF ENVIRONMENTAL IMPACTS

The environmental impacts was performed with the Modified Method of Integrated Relevant Criteria (Lopez & Senior, 1998)[27], which is based in obtaining a numerical value for each environmental impact "Environmental Impact Value" (VIA in Spanish)

[27] López J &C. T. Senior, *Modified Method of Integrated Relevant Criteria for Environmental Impact Evaluation*. Memorias del IV Congreso Interamericano sobre el Medio Ambiente (1997). Universidad Simón Bolívar y Fundación Polar. Caracas. 1998.

that might be generated by the Project, starting from its evaluation using indicators of Intensity (I), Extension (E), Development (D), Duration (T) and Reversibility (R)..

Table N° 3 lists the evaluated, hierarchzed / ranked and classified environmental impacts.

Table N° 3: Project Expansion, Classification of the Environmental Impacts Assessed According to its Relevance.

CODE	IMPACT NAME	OCCURRENCE PROBABILITY	STAGE	VIA
MEDIUM RELEVANCE IMPACTS (4,0 <VIA < 5,9)				
ISE-3	Road accidents risk increase due to machinery, equipment and personnel transportation.	High	Construction	5.7
ISE-1	Employment expectative increases due to man power and service demands and the existing region unemployment ratio	High	Construction	5.2
IF-5	Noise level increased due to machinery, equipment and tools used during construction stage.	High	Construction	4.4
IF-6	Noise level increases due to rotary equipment (pumps, compressors, etc.), operation and maintenance.	Medium	Operation	4.2
IF-3	Air quality affectation due to combustion gases emissions and blows, etc.	Low	Operation	4.2
ISE-2	Roads system damage due to machinery, equipment, row transportation, etc.	Medium	Construction	4.1
LOW RELEVANCE IMPACTS (VIA <4,0)				
IB-1	Direct vegetation removal from new flare area	Alta	Construction	3.8
IF-2	Quality affectation of the marine - costal water environment due to the generation of residual, domestic waters and liquid effluents	Medium	Construction and Operation	3.9
IF-4	Air quality affectation due to combustion gases emissions from plant fixed and mobile sources (furnaces, boilers, flare, etc.)	Medium	Construction and Operation	3.8
IF-1	Soil erosion increases for wind and water	Media	Construction	2.3

4.3 ENVIRONMENTAL MEASURES PROPOSAL

Environmental measures proposed were designed and characterized in function of the impact to which they are addressed, analyzing its application feasibility, from technical, legal and economic points of view, and its moment and place of application, according to impact generation activities.

Table N° 4 summarizes the selected environmental measures in order to prevent the occurrence of the environmental impact evaluated.

Table N° 4: Project Expansion, Recommended Environmental Measures

STAGE	ENVIRONMENTAL MEASURE	ENVIRONMENTAL IMPACT
PHYSICAL NATURAL ENVIRONMENT		
Construction	Erosion and sediment control plan. Concurrent, continuous reclamation of all disturbed sites	IF-1: Soil erosion IF-2: Quality affectation of the marine -costal water environment
Construction and Operation	Erosion and sediment controls Operation stage and Waste Water Treatment Unit routinely monitored and adjusted to meet discharge standards	IF-2: Quality affectation of the marine -costal water environment
Operation	Routine maintenance of equipments and process Emissions and air quality routinely monitored	IF-3: Air quality affectation
Construction	Irrigation for dust suppression and combustion gas control Routine maintenance of machinery and equipments	IF-4: Air quality affectation
Construction Operation	Routine maintenance of machinery and equipments OHSMS	IF-5: Noise level increased IF-6: Noise level increased
SOCIAL-ECONOMICAL AND CULTURAL ENVIRONMENT		
Pre-construction Construction	Project Information and Divulgation Program	ISE-1: Employment expectative generation ISE-2: Roads system damage ISE-3: Road accidents risk increase
Pre-construction Construction	Priority to local employment	ISE1: Increase of Employment expectative.

Source: Ingeniería Caura, S. A

4.4 ENVIRONMENTAL SUPERVISION PLAN AND MONITORING PROGRAM

The Environmental Supervision Plan and Monitoring Program become the final stage of the environmental variable incorporation process in the Expansion Project and it is a requirement demanded in the Article 28 of the Decree N° 1,257: "Norms on Environmental Evaluation in Activities Susceptible to Environmental Degradation", published in the Official Gazette N° 35,946, dated April 25, 1996.

Environmental Supervision Plan allows planning and coordination of necessary technical actions to grant the fulfillment of legal dispositions and regulations of environmental character, the execution of environmental measures incorporated to the Expansion Project, and monitoring relevant or critic activities to identify the apparition of new impacts and encourage pertinent environmental measures. The plan presents:

- Activities to be supervised in pre-construction and construction stages, as well as operation and maintenance.
- Measures or obligations to be supervised which include: disposition established in the Venezuelan environmental normative and international norms that may apply considerations or environmental measures incorporated to the project design and proposed in this study, and obligations established in the environmental authorizations received by the project.
- Environmental supervision actions, referring to methods and procedures employed for accomplishment verification or instrumentation of obligations or measures that shape Environmental Supervision elements.
- Chronogram for Environmental Supervision will be closely related with the sequence of activities foreseen for Project redevelopment.

Monitoring Program as part of the Environmental Supervision Plan, is addressed to grant the fulfillment of legal normative on the part of the Expansion Project Management in order to prevent degradation, contamination and other actions or activities that may cause harm to resources.

In general, in function of variables, the Environmental Monitoring Program comprehends the following monitoring specific subprograms for each variable:

- Monitoring Program for Quality of Waters to be discharged into Sea. It is proposed to continue with quarterly characterization of generated effluents,

at the exit of the Industrial Liquid Effluents Treatment Units and in the sea discharge sump of PEQUIVEN channel.

- Monitoring Program for Air Quality: It is proposed to continue with the following annual official characterization in the project influence area:
  - Fix sources emissions.
  - Studies of air quality under JIC coordination,
  - Noise level emissions.
- Hazardous Materials Management Program to manage the risk associated with all Hazmat facilities and activities.

Reports to be presented monthly at the Ministry of Environment and Natural Resources (MARN) shall also contain all material that support results and established recommendations in such, as well as meeting rough drafts, photos, in site supervision formats, laboratory results, etc., and they shall contain, at least, the following:

- Report issue date
- Supervision Period
- Supervised activities:
  - Project Phase
  - Activity advance
- Supervision actions
- Results
- Measures to be implemented
- Recommendations
- Supports:
  - Meeting rough drafts,
  - Photographs,
  - Analysis carried out, and
  - Supervision formats.

The internal monitoring program, included in the Integral Protection plan, will complement the above environmental measures. Frequency of this program will be evaluated periodically.