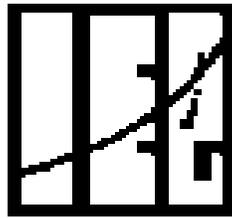


Economics of Environmental Management System in Oil
India Limited: An Environmental Economics
Perspective Case Study of Oil, Duliajan

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ECONOMICS OF ENVIRONMENTAL MANAGEMENT SYSTEM IN OIL INDIA LIMITED: AN ENVIRONMENTAL ECONOMICS PERSPECTIVE CASE STUDY OF OIL, DULIAJAN*

-Devashis Bose

INTRODUCTION- THE RESEARCH PROBLEM

Oil India Limited (OIL) is a major public sector organization in India that explores and produces mineral oil and natural gas. This is a research study based on OIL's Duliajan Central Industrial Complex. The Environmental implications of the exploration and production of mineral oil and natural gas are well known. Global problems like "enhanced greenhouse effect" to locally increased incidence of respiratory disorders are attributed to such operations. So are other forms of pollution, which adversely affect the flora, fauna, humans, domesticated animals and all other forms of life. In the theory and practice of environmental management, a paradigm shift is taking place from 'end-of-the-pipe treatment' of pollution or negative environmental externalities, to 'Preventive Environmental Management'. OIL and its operations have sufficient scope for attracting attention as far as externalities are concerned for it is the biochemical and physical nature of the fossil fuels that may make the life of human, flora, fauna and all other forms of life unsustainable on earth. But then, the need of economic development, which is essentially energy intensive, cannot be denied. The issue becomes pertinent in the context of a developing economy like India. The role of OIL and similar industries forms the core in rapid economic growth, through industrialization and a subsequent expansion of the services sector. Preventive Environmental Management (PEM) can mitigate the potential environmental damage. Therefore, it is essential to explore the pragmatic integration of the externalities into the marginal private cost (MPC) of production of the operations of the OIL and arrive at a nearly true Marginal Social Cost (MSC) of production. Whether, the environmental performance of OIL with special reference to its operations under the Duliajan Central Industrial Complex, is optimum, has to be examined. The examination and related studies requires integration of the enforceability of the Environmental Management System (EMS), eco-efficiency and application of the grant of property rights, for an efficient solution to the problems faced in environmental economics. There is a pressing need to resolve the contradictions between rapid development through poverty alleviation via unsustainable energy exploration/production/use, and sustainable development through efficient environmental management. Therefore, the research problem is to explore the possibility of implementing an efficient EMS in the OIL.

Paper presented in the Workshop on Trade, Environmental and Rural Poverty held at the Institute of Economic Growth, University Enclave, Delhi, during 18-19 August, 2006.

STUDY GOAL OF THE PAPER

The paper attempts to analyse compatibility of the existing environmental management practices with the principles of EMS.

THE ECONOMICS OF ENVIRONMENTAL MANAGEMENT SYSTEM IN OIL

Corporate Environmental Management (CEM) is referred to as Environmental Management System when the later is incorporated as a management policy and practice of a firm or a corporate body. EMS is defined¹ as a comprehensive management policy and includes practices undertaken by a corporate body or firm or an institution that include the operations, organization, financial planning and overall strategies for meeting the goal of sustainable development through deliberate modifications in the context of its interactions with the environment. The concepts and ideas related to CEM took concrete shape during the 1960s and some sequence of events² [a comprehensive list can be referred in Appendix I] across the developed nations gave shape to a kind of awakening in this field.

Levels of EMS in OIL

In order to find the levels of Environmental Management System (EMS), during the course of study questionnaires were administered to the officials of OIL, information and data were collected on objective indicators of EMS and officials were also interviewed over a period of two years. At the beginning of the study, OIL did not have a comprehensive certification like the ISO 9000 or ISO 14000 but during the course of the study, OIL gradually adopted certain certification processes and at the conclusion of the study it has undertaken certification under ISO 14000 for certain facilities.

The key elements of EMS include the following:³

- Environmental Policy
- Environmental Standards
- Legal Requirements and Compliance
- Setting of Environmental Targets
- Organizational Structure and Responsibility
- Training, Awareness and Development of Competence
- Establishment of Communication
- Operational Control
- Monitoring and Measurement
- Non-Compliance and Non-Conformation for Subsequent Corrective and Preventive Action

¹ Welford, Richard (1996), "Corporate Environmental Management", Stylus Publications, VA, USA.

² Jain, Deepak and Mukta Kumra (2001), "Market and Environment" as a Part of the Joint Education Programme of Center for Preventive Environmental Management (CPEM), Nagpur.

³ Netherwood, A. (1996), "Environmental Management Systems-The Tools of Corporate Environmental Management", Earthscan Publications, London, UK.

- Maintenance of Records
- EMS Audit
- Management Review.

A detailed study of the aforesaid key elements in the context of the operations of OIL was done and the methodology consisted in use of questionnaires; interviews and official documents and records of the management sections of OIL; as well as records of SPCB. A Check-list on EMS was prepared and information was recorded for this specific purpose. The study found that as per the official version of OIL, the organization is committed to Environmental Management (EM) and this is validated by two important aspects. OIL appointed O'Connor Associates Environment Insurance of Canada to carry out an Environmental Study⁴ in the year 1995. This study was a voluntary initiative and there was no legal, public, global, market or any other requisition for carrying out such a study.

OIL has succeeded in the continual cycle approach to a great extent. OIL has a well organized Safety & Environment (S & E) department functioning with an allocation of top level executives and is manned by 20 full-time employees. The S & E department is responsible for overseeing the environmental aspects and implications of the operations of OIL and is the core group behind the Environmental Policy adopted, implemented, and practiced. It also ensures an efficient overall EMS. According to the S & E department officials, the budgetary allocation made to it does not reflect the entire expenditure on environmental management. The individual departments of OIL additionally budget for environmental management matters and compliance in their respective departments. For example, the Production Department of OIL maintains a Treatment Plant and hence incurs the related expenditure. However, a mere amount of Rs 4 to 5 lakh is kept aside for the payment of compensation related to pollution and externality damages.

Environmental Policy and OIL

An Environmental Policy is a key element of an efficient EMS and in the absence of such a policy, only partial environmental management (EM) can be practiced. OIL did not have an EM till late 2003. The 'Safety, Health and Environment (SHE) Policy' of the OIL was approved and adopted in the 344th Board Meeting of the Board of Directors held at New Delhi on 17 Nov, 2003. According to this policy, the following measures have been adopted-

- Ensure a safe and sound working environment at all our work places.
- Comply with all the Rules and Regulations on Safety, Occupational Health and Environment Protection stipulated by statutes besides our own policies and manuals.

⁴ O'Connor Associates Environment Insurance (1995), "Environmental Study", OIL.

- Adopt and promote safe and eco-friendly technology and review the performance of the systems in line with changing needs.
- Continuously work towards mitigation of adverse environmental impacts, if any of our operations on air, water and land.
- Prevent mishaps, minimize risks and hazards and remain trained, equipped and ready for an effective and prompt response to emergencies including disasters and accidents.
- Promote resource conservation and recycle options.
- Prevent occupational diseases and accord due concern for the employees health as well as community around our operational areas.
- Encourage external audit of our S, H & E standards so that the confidence of stakeholders and the public is safeguarded.
- Encourage knowledge upgradation and promote safety, health and environmental awareness amongst all the employees.
- Remain committed to continual improvement and the achievement of highest safety, health and environmental protection standards of the company leading towards sustainable development.
- Work towards preserving the ecological balance and heritage in operational areas.

OIL has taken a major step towards ensuring an efficient EMS in its operations by adopting the stated Environmental Policy. The statements of this policy are in line with, and correspond to, the standard practices in EMS of CEM at the global level. OIL has affected measures to ensure a safe and sound working environment at its sites and all other work places.

According to standard environmental policies, mitigation of the environmental effects of the operations of a producer must take place within a span of two to three years. The annual reports of the firm too must reflect the changes that have been effected in the environmental aspects. The annual reports of OIL for the years 2002-05, 2003-04, 2004-05 were scrutinized and analysed to assess whether the changes and mitigation efforts had been documented or not. It was found that OIL meticulously documents all the preventive, mitigating measures, certification, compliance and any other related activities in the context of environmental aspects in all its annual reports of the OIL. For example, OIL has undertaken certification of certain facilities like the Power House, LPG Bottling Plant, Hospital and Medical Services, etc. and three of these have been already approved under ISO 14000. Efforts to bring the facilities of OIL under the purview of ISO 14000

certification and its subsequent documentation in its Annual Reports are validation of its initiating establishment of an efficient EMS.

Environmental Standards

Environmental standards can be defined in the context of national or sub-national and international requirements, legislations, treaties and other practiced and enforceable systems. At the national and sub-national level, OIL has to compulsorily adhere to the legislations enforced by the Government of India and those that are regulated by the MoEF and implemented and enforced by the CPCB and SPCBs at the central and state levels, respectively. Only three (3) departments of OIL have been certified under the ISO 14000 standards. Information on the various departments and facilities and the certification levels has been shown in Table 1-

Table 1: Status of ISO Certification in OIL's Departments and Facilities

SL. NO.	NAMES OF DEPARTMENT	ISO CERTIFIED (& YEAR)	CERTIFICATION PROCESS INITIATED (& YEAR)	CERTIFICATION PROCESS NOT INITIATED	REMARKS
1	Production Oil	2005-06	2005-06	NA	-
2	LPG Plant	2005-06	2005-06	NA	-
3	Power House	2005-06	2005-06	NA	-
4	Chemical	NA	2006	NA	
5	Research and Development (R & D)	NA	2006	NA	
6	Medical	NA	2006	NA	
7	Drilling	NA	NA	Not Initiated	Require urgent initiation for establishment of an efficient EMS
8	Production-Gas	NA	NA	Not Initiated	-do-
9	Materials	NA	NA	Not Initiated	
10	Field Engineering	NA	NA	Not Initiated	

Source: Safety and Environment Department, OIL, Duliajan.

Legal Compliance

OIL's compliance with the law of the land in the context of environmental aspects was studied and analysed by scrutinizing documents, information and data and by interviews of officials of the SPCB and also of the OIL. The status of compliance of OIL with the State Pollution Control Board (SPCB) under the provisions of:

- Air Act – (a) Consent to establish- Obtained up to 31 March 2006.
(b) Consent to operate- Obtained up to 31 March 2006.
(c) Compliance- Obtained up to 31 March 2006.
- Water Act- (a) Consent to establish- Obtained up to 31 March 2006.
(b) Consent to operate- Obtained up to 31 March 2006.
(c) Compliance- Obtained up to 31 March 2006.
- Environment Act- (a) Submission of Environmental Statement- Submitted up to 30 September 2005.
(b) Obtaining of Environmental Clearance- Obtained up to 30 September 2005.
(c) Compliance by not discharging/emitting environmental pollutants in excess of prescribed limits- Complied.

It may be noted that the consents and/or compliances are as per the SPCB rules and regulations.

Environmental Objectives in Operations of OIL

Environmental targets are of prime importance for implementing a successful EMS in any organization. ISO 14000 standards define environmental objective as overall environmental goal arising from the environmental policy that an organization sets itself to achieve, and quantified where practicable and environmental target as detailed performance requirement, quantified where practicable, applicable to the organization or parts thereof that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives. The setting of environmental objectives and targets turns organizational goals into reality. In the case of OIL, the management has some no time-bound set objectives and targets for turning its environmental policy into concrete results. This aspect is one of the major shortcomings as far as the EMS is concerned. Still, OIL is striving for zero-flaring and compared to 20 percent 10 years back, now the level of flaring has come down to 7 percent.

Organizational Structure and Responsibility

According to the guidelines of ISO 14000, evidence of an efficient EMS in an organization can be verified in the context of allocation of human resources and use of specialized skills, technology and financial resources. OIL has in place a well organized

Department for Safety and Environment (S & E) that basically deals with all the safety and environmental issues relating to the operations of OIL. However, emphasis on the environmental aspects is a recent phenomenon and the approach of OIL to environmental issues were more of an 'end of the pipe treatment' rather than Preventive Environmental Management (PEM). Prior to adoption of an Environmental Policy and the initiation of the ISO certification process, OIL's environmental management centered around managing externalities after they have been created and paying compensation to the affected parties. For example, in the case of leakage of formation water or sludge into the nearby agricultural fields, action is taken to prevent the flow by strengthening bunds, sealing the points/s of leakage and if necessary, temporary closure of operations. This may be followed by payment of compensation to the affected party/parties in case such external effects are reported. This practice was the standard management policy and partially this policy still is an important constituent of the current overall management policy of OIL. Such policies definitely offer some kind of solace and help to the affected parties, but then do not however add up to the requirement of a strong EMS. In the post Environmental Policy adoption period, the aforesaid policies are in use but have been complemented by strong EMS elements. As discussed earlier in this chapter, initiation of the ISO certification process is one of the most important aspects of the objectives and targets of putting in place an efficient EMS. The S & E department is currently more equipped to handle and manage environmental issues that are critical to ensure efficiency in EMS.

Establishment of Communication

Communication on environmental performance and all other aspects of environment relating to internal as well as external agencies and institutions, is a core element in the process of establishing a good EMS in an organization. Moreover there is also the necessity for EMS documentation to ensure the practice of 'document control'. Document Control means maintenance of EMS documents in such an organized manner that makes them easy to locate and control resulting in efficiency in operations. EMS cannot be established in absence of 'document control'. OIL has a very systematic way of document control and the S & E department maintains all the documents relating to the environmental aspects and is gradually being opened for external communication. Internal communication is an established practice in the operations of OIL and subject to approval from its Group General Manager (GGM), the management head. All departments are gradually being sensitized and are communicated with, regarding the environmental aspects. By means of verification of the documents of the S & E department that is responsible for environmental management in OIL, and through the interview of the officials of the Departments of Safety and Environment (S & E), Training & Development (T & D), Public Relations (PR), Materials, Geology, Liquefied Petroleum Gas and Technical Audit (TA), as also by canvassing of questionnaires, etc. it was found that internal communication to each department has been initiated. The form of communication adopted is the holding of departmental, inter-departmental and other seminars, conferences, meetings and training programmes.

Communication Programmes on Environmental Aspects:

The Safety and Environment (S & E) department of OIL conducts a 3-day programme every month for the officials of the OIL. This programme entails three and half hours on environmental sensitization and related aspects and trains a maximum of 60 employees.

Another essential constituent of EMS is the communication of environmental performance and all other environmental aspects to 'External Agencies and Institutions'. OIL took the initiative in the preparation of an Environmental Report and it engaged an external and Canada based agency namely O'Connor Associates Environmental Insurance for the same in 1995. OIL's decision to appoint the said agency and the subsequent undertaking of the preparation of the Environmental Report was a policy decision that marked a change in its management philosophy. Moreover, the decision was not due to any regulatory or legislative reason. Prior to the initiative taken in the preparation of the Environmental Report, OIL has been routinely communicating to the SPCB as per the MoEF and other government directives, regulations and legislations. OIL has a system of reporting all kinds of leakage, accidents and any other event or incident to the SPCB in case they have environmental implications. Preparation of monthly reports on the environmental aspects and submission of the same to the SPCB is a normal management practice and this responsibility lies with the S & E department. Another important step that is a prerequisite for establishment of an efficient EMS is ISO certification.

Operational Control⁵

Operational Control with respect to Environmental Management is an essential part of an efficient EMS.

Management and Disposal of Wastes: Disposal Wells are used for pumping waste or formation water and are constructed with depths of more than 1000 meters. Often old oil wells are converted into disposal wells. According to the officials of OIL, the Environmental Audit Report of the O'Connor Associates Environmental Insurance, officials of the SPCB and the R & D department of OIL, the disposal wells are properly constructed with constructed screens on the bottom of the tubing string and do not have packers. Open-Hall logs in unconsolidated forms are never used by OIL. However, experts of the Geology Department of OIL and those from the SPCB conceive migration of pumped-in water leading to contamination of surface water bodies, shallow aquifers, local water wells, flora and other forms of vegetation. They also felt that such migration of pumped-in water can take place during the whole lifetime of the OCS and the subsequent adverse effects can take in the future periods to come.

Status of Operational Control

I. Treatment and Disposal of Formation Water: The OIL maintains 2 (two) Volumes of Safe Operating Procedures (SOP) that include all the environmental and safety

⁵ Kuhre, W. Lee (1998), "Environmental Performance Evolution", Prentice Hall Insurance, USA.

management issues relating to its operations. As per the provisions and guidelines of the SOP, the following procedures are used for the treatment of Formation Water. The history of oil formation in the earth's crust dates back to the Jurassic age. The compressions, impressions and the remains of the past zoological era, i.e., the fossil fuels are the mother of generation of hydrocarbons in the earth's sub-surface. Oil, water (H₂O) and gas remain in the oil bearing strata according to their specific gravity. While producing crude oil, the water that is inherent to the crude oil also comes out along with the crude oil produced. This water is called formation water (produced or connate water). This formation water is highly rich in minerals, hot and highly saline and hence, unsuitable for human use. The formation water is termed as a pollutant in the oil field. The formation water needs to be treated as per the specified parameters. OIL treats the formation water and disposes it 1000 meters into the ground as per the *environment protection guidelines* of the *Environment (Protection) Act*. The treatment and disposal of formation water is the responsibility of the operating departments i.e. the production department. The Safety and Environment (S & E) department monitors the environment friendly disposal⁶ system relating to formation water. It was also reported by the S & E officials that samples of treated formation water are also collected and analysed by the OIL laboratory, and also sent to external bodies like the State Pollution Control Board (SPCB) to ensure quality and impartial analysis.

II. Volume (Amount) of Formation Water: The volume of Formation Water produced during extraction of crude oil and natural gas differs in different oilfields and also from installation to installation. The general observation is that the more ageing the field, the greater the production of formation water. As the OIL is a public sector company, in correspondence with its social commitment to the strategic need of the nation, the break-even ratio of formation water to crude oil and/or natural gas is kept as high as 9:1 implying that even if 10 percent of the total extraction is crude oil and/or natural gas and the rest is formation water, still production shall be executed. However, the production ratio of oil to water may be as high as 9:1 at times and occasionally even 100 percent. Currently OIL is producing approximately 4000 kilolitres of Formation Water per day in all the areas of Assam. After treatment of the Formation Water, it is disposed off in underground wells meant specifically for this purpose.

III. Chemical Characteristics of the Formation Water: The chemical characteristics of the pre-treated and post-treated Formation Water are given below along with the specified requirements of the Environment (Protection) Act.

⁶ This is based on the provisions and/or requirements of the environmental regulations/laws.

Table 2: Chemical characteristics of Formation Water

Matter/Elements/Compounds present in Formation Water	Pre-Treatment (in parts per million litre of Formation Water)	Post-Treatment (in parts per million litre of Formation Water)
Oil and Grease	3000 ppm	less than 10 ppm
Dissolved Solids	5000 ppm	less than 100 ppm
Salinity	3000 to 4000 ppm	remains unchanged

Source: Safety and Environment Department, OIL, Duliajan

As per the Environment (Protection) Act of the MoEF, the specified requirements are given below in the table-

Table 3: Requirements of Environment Act for Water

Matter/Elements/Compounds present in Formation Water	Environment (Protection) Act specification (in parts per million litre of Formation Water)
Oil and Grease	less than 10 ppm
Dissolved Solids	less than 100 ppm

Note: Other parameters do not change.

Monitoring-Measurement

Environmental performances can be measured by maintaining an ‘Environment Effects Register’ that book-keeps the environmental inventory of all the instruments used for measuring the compliance. As discussed earlier, checking of environmental performance indicators is essential for ensuring an efficient EMS. Maintenance of an ‘Environmental Regulations Register (ERR)’ is critical to the functioning of EMS. In case of the operations of OIL, maintenance of ‘ERR’ is not observed. Although the S & E department maintains a record of all accidents and incidents related to environmental issues and those which may have adverse environmental effects, a specific ‘environmental inventory’ is not maintained. In standard EMS practices, the incorporation of the environmental costs in the form of external cost is very important. The records of the Finance department of OIL and the Annual Reports questionnaire fed to the Management staff reveal that there is no provision and practice of calculating and subsequently incorporating the External Costs of production of crude oil and natural gas in the Private Costs of production. It can hence be concluded that OIL has not initiated any measure to incorporate external costs in its production costs. This reveals that steps have not been incorporated to control the environmental implications of OIL’s operations with the help of economic tools in its overall management practices. However, OIL has initiated many other steps like ISO certification, formulation of Environmental Policy, etc. those now constitute a major portion of the overall management policy and correspond to an efficient EMS.

Environmental Management System (EMS) Audit

EMS Audit is one of the key elements in ensuring initiation, implementation and practice of an efficient EMS in the overall management of any organization. EMS Audit in relation to industries like oil and coal is imperative because of the bio-chemical interactions of its products with the environment. This study prepared a check-list concerning the EMS Audit in order to find the propriety of the said audit in relation to OIL. The EMS Audit check-list is given below in Table 5-

Table 4: CHECK LIST ON EMS AUDIT IN OIL

SL. NO.	EMS AUDIT EFFICIENCY INDICATORS	STATUS	REMARKS
1	Whether Audit Procedures and Protocols have been developed?	Developed/Partially Developed/Not Developed	Not Developed
2	Whether Appropriate Audit Frequency has been Established?	Established/Partially Established/Not Established	Not Established
3	Whether Internal Auditors are Trained?	Trained/Partially Trained/Not Trained	NA
4	Whether Audit Records are Maintained?	Maintained/Partially Maintained/Not Maintained	NA
5	Whether External Audit is Conducted?	Regularly Conducted/Irregularly Conducted/Not Conducted	Irregularly (Once in 2004)
6	Whether External Auditing Agency/Agencies are Certified?	Internationally Certified/Nationally Certified/Regionally Certified	Internationally Certified

(Derived from) Jain, Deepak and Mukta Kumra (2001), "Systems Approach to Environment" as a Part of the Joint Education Programme of Center for Preventive Environmental Management (CPEM), Nagpur.

It can thus be concluded that OIL does not have an established EMS Audit system in its place currently.

FINDINGS ON EMS

OIL has initiated its compliance with an efficient EMS and is striving to meet all the regulatory (sub-national, national and international) requirements. Yet, it has a long way to go in meeting the standard of apportioning the goal of sustainable development. OIL has established compliance with the regulatory aspects of the SPCB and CPCB and scores satisfactorily. However, though the process of ISO-14000 certification has been initiated and concluded for some OIL facilities, a majority of the installations require

immediate certification. As far as the internal communication programmes are concerned, it seems that the time allocated and the content is not sufficient to instill amongst the employees such environmental managerial/practical skills as shall be effective in changing the organizational sustainable development orientation. Communication to external agencies too is lacking in the sense that OIL is more concerned about regulatory communication than otherwise and hence may be treated as a case of end-of-the-pipe externality control rather than preventive measure. Another important aspect of EMS that seems to have been not taken care of is the External Audit. Till date, EMS Audit has not been conducted by any external agency and only one Environmental Report was prepared by an international external agency. Hence, on the one hand, non-conduction of EMS Audit is a shortcoming in the EMS, and on the other, inviting an external environmental reporting despite absence of any regulation speaks of environmental concern. OIL has ample potential to meet all the requirements in establishing an efficient EMS as its managerial practices are in tune with TQM and hence needs to go only a step further to meet the environmental economics concerns. Currently, OIL needs to incorporate the negative externalities in its private cost of production in order to reflect the real social cost of production. This measure shall ensure that incorporation of negative externality in the private costs shall ensure the establishment of an efficient EMS and thus meet the broader goals of sustainable development.

CORPORATE LIABILITY FOR SUSTAINABLE DEVELOPMENT: POLICY PRESCRIPTION

OIL and its operations are a major source of environmental externalities in the areas of study that is more or less representative. The study of oilfields and as well as of the central industrial complex, found some lacunae in the application of EMS. In this context, some policy prescriptions may be made so that compatibility between corporate liability and the principles of sustainable development is reached. The following policy changes may be made with reference to the overall study of this paper.

1. The SPCB seems to be at loss as far as prevention of environmental externalities is concerned. According to the official records, OIL complies with all the environment related laws and is up-to-date. Interestingly, as the newspaper reports suggest, the SPCB officials (especially from the state headquarters) barge into the oilfields and issue press statements regarding criminal non-compliance by OIL. Besides making some news it hardly changes much as the consent and or compliance letters are issued on time that in itself is contradictory to the claims of SPCB brass. Therefore, it is essential that the SPCB ensures that the consent and compliances are rigorously met and letters are subsequently issued or otherwise, instead of issuing press statements on the one hand and issuing compliance documents to OIL on the other.
2. OIL must take up soil permeability testing at the time of the flare pit construction and estimates of potential seepage losses needs to be made.

3. Although OIL has completed ISO 14000 certification for three important departments and the process has been initiated for another three, the need of the same for another 4 departments at the earliest, is urgent. The departments of Drilling, Production-Gas, Field Engineering and Materials are all likely to be the producers of negative environmental externalities. Therefore, it is prescribed that ISO certification of all these installations are done at the earliest and the costs thereof incurred are incorporated into the total costs⁷ of production.
4. The OIL management must set time-bound and quantified environmental objectives and/or targets for giving practical shape to its Environmental Policy.
5. The time allocated for environmental sensitization of OIL employees is not only insufficient, it seems to be doing some kind of lip service. Even if the quality and content of the three and half hours allocated during the 3-day internal training programme is excellent, it may fail to create the atmosphere of seriousness that should be attached to Environmental management.
6. OIL can initiate maintenance of an 'Environment Effects Register' for the purpose of book-keeping the environmental inventory.
7. OIL cannot achieve application of an efficient EMS and meet the needs of sustainable development in absence of EMS Audit. OIL should conduct regular EMS Audit conducted by reputed and competent external agencies.
8. Estimation of the external costs of production of oil and natural gas needs to be done. Of course such a measure is not the sole responsibility of OIL. All the stakeholders and research institutions can come together to carry out such an exercise that shall bring out approximate estimates of the external costs as practically it is not possible to find the actual costs. Incorporation of these external costs to the private costs of OIL can ensure sustainability as a voluntary corporate liability.

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⁷ OIL calls these raising costs.

named here as the list is exhaustive, too contributed to this work. Local population of various field areas exhibited strong scientific temper and extended support as well as local hospitality whenever required. It is pertinent to mention that the author received training in Environmental Economics from the Department of Economics of University of Hyderabad and especially is thankful to Professor V. B. N. S. Madduri and his team for instilling the sound concepts and theories necessary for this kind of work.]

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APPENDIX I

A list of events and legislations/treaties are given below. The exploration of CEM and the subsequent adoption and practice of EMS can be sourced to these-

1. The United States (US) National Environmental Policy Act⁸ of 1969.
2. Swedish Environmental Protection Law of 1969.
3. Enactment of Comprehensive Environment Protection Laws in Denmark (1973), Canada (1973), Australia (1974), The Netherlands (1981), Japan (1984) and the European Union (EU-1985).
4. The Stockholm United Nations Conference on Environment⁹ of 1972.
5. Presentation Report of the World Commission on Environment and Development (chaired by Gro Harlem Brundtland¹⁰) in 1987.
6. The Montreal Protocol¹¹ (on phasing out of Chlorofluorocarbons (CFCs¹²) of 1987.
7. The Earth Summit held in Rio de Janeiro (Brazil) in 1992 leading to the enactment of Agenda 21.¹³
8. Many accidents relating to industry that caused severe damage and posed alarming threat to human beings, other living things and the overall environment enhanced global and local consciousness towards the need for adoption of practices in industry that subsequently led to evolution of CEM and EMS. Those accidents were-
 - (a.) Wrecking of the oil-tanker ship Torrey Canyon in the Sicily Isles in 1967.¹⁴
 - (b.) The Bhopal Gas Tragedy of 1984, in which thousands died and were adversely impaired and/or affected due to accidental (and criminal negligence) leakage of Methyl Isocyanide gas.
 - (c.) Spillage of huge quantities of pesticides by MNC Sandoz in the Rhine river.
 - (d.) In 1989, a Russian oil tanker named Exxon Valdez wrecked at Sea and spilled huge quantities of oil.

⁸ This legislation was enacted by the US government that made carrying out of Environmental Impact Assessment (EIA) for some specific categories of large and medium projects (those could cause potential environmental damage) mandatory.

⁹ The Stockholm Conference was the first global meet on Environment that led to output of the “Stockholm Declaration”.

¹⁰ Gro Harlem Brundtland was former Prime Minister of The Netherlands and is credited as a pioneer of sustainable development.

¹¹ The first global Environment Policy for elimination of CFCs in a phased manner that was signed by almost all the nations of this world.

¹² CFCs is a compound used in aerosols, refrigerators, etc. that damages the atmospheric ozone layer that filters the harmful; ultraviolet rays emitted by the Sun.

¹³ Agenda 21 was a action plan to be adopted by nations across the world.

¹⁴ Grove, Richard and Vinita Damodaran (14 October, 2006), “Imperialism, Intellectual Networks, and Environment Change”, Economic and Political Weekly, Mumbai.

- Adoption of Total Quality Management (TQM)¹⁵ as an overall strategy across global corporate bodies and institutions was another step towards evolution of an overall environmental management policy. Adoption of TQM led to formulation of industry standards like the ISO 9000, BS 5000, ISO 14000 Standards, etc.

The enactment of Legislations in India also has helped in acceptance of EMS amongst the companies and other institutions. The legislations enacted in India in relation to the environment are-

- The Water (Prevention and Control of Pollution) Act, 1974.
- The Water (Prevention and Control of Pollution) Rules, 1975.
- The Water (Prevention and Control of Pollution) Cess (usage) Act, 1977.
- The Water (Prevention and Control of Pollution) Cess Rules, 1978.
- The Air (Prevention and Control of Pollution) Act, 1981.
- The Air (Prevention and Control of Pollution) Rules, 1982/83.
- The Environment (Protection) Act, 1986.
- The Environment (Protection) Rules, 1986.
- The Hazardous Wastes (Management and Handling) Rules, 1989.
- Manufacture, Storage and Import of Hazardous Chemical Rules/Amendment Rules of 1994.
- Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms or Cells Rules, 1989.
- The Public Liability Insurance Act, 1991.
- The Public Liability Insurance Rules, 1991.
- Environmental (Protection) Rules-“Environmental Statement”, 1992/1993.
- Environmental (Protection) Rules-“Environmental Standards”, 1993.
- Environmental (Protection) Rules-“Environmental Clearance”, 1994.

¹⁵ TQM does not necessarily entail environmental quality but is a prerequisite to it, as in absence of total quality in products and processes it is not possible to endeavour for environmental quality.