

A model for environmental impact assessment of oil refinery in Iran a case study: Tehran oil refinery

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Abstract—In present project, attempts have been made to consider oil general issues in addition to oil refinery environmental impact assessment because the oil general issues have direct and close connection oil refinery environmental impact assessment issues. In oil refineries environmental impact assessment, initially the oil general issues shall be considered in order achieves the desirable results. In this project oil general issues are taken into consideration along with environmental impact assessment of oil refinery in different section in order to achieve the final and desirable result through comparing and incorporating these two issues. With considering oil refining process and studying the approaches necessary for upgrading efficiency of model for oil refinery impact assessment in the framework of oil general issues and incorporating this model along with various issues of oil industry. TEHRAN oil refinery has chosen for case study to review of its environmental status and ability of this software.

Keywords—component; oil refinery, petroleum, environmental impact assessment, environmental improvement, TEHRAN oil refinery

I. INTRODUCTION

In scientific viewpoint the environment comprises of renewable and non-renewable resources. Nowadays, the environment is suffering from severe deterioration, degradation, damages and numerous pollutions in which several agents are involved. In fact, what always attracts the attention of all experts and officials of oil industries and environmental issues as "the environmental pollution problems" specially oil pollutions now requires more and deeper attention [19]. Environmental impact assessment (EIA) is being used globally, either as a planning or management tool, in order to minimize the harmful consequences of development [1]. In Iran, there is no formal system monitoring in the legislation or Guidelines. However, some limited informal system monitoring by the environmental agencies has taken place to improve the EIA system by incorporating feedback from experience [2]. Setting priorities for new projects is a complex task, since there is generally not enough available information to assess or forecast resulting environmental problems and their impact on the economy or society. Therefore, strategic decisions have to be made with high levels of uncertainty [5]. The impact of environmental regulation on macroeconomic performance has been studied in some depth over the last 15

years. Similarly, impact on profit performance, investment intention and location decisions of firms has also been studied, although in less depth. There has been less academic interest, however, in the impact that environmental regulation has on the strategic objectives of companies. A significant majority of firms indicated that the environmental approvals process should be considered to be an important determinant of investment strategy. An initial reaction to these figures might suggest that the majority of respondents believed the environmental approvals process to be a negative influence. However, this is not necessarily the case. The phrase 'important determinant of investment' could be read by respondents to mean either an impediment to investment, or an encouragement to good development [7]. The development and implementation of a three-stage EIA process involving: (1) preliminary screening of proposed undertakings; (2) environmental assessment of those proposed developments deemed to have potentially significant effects during the initial screening stage; and (3) environmental impact review in those circumstances in which large-scale public consultation and detailed technical reviews are required to determine impacts and project suitability [9]. In today world, the there is a huge amount of findings and advances in various aspects of environment to which they conducted researches on the exploitation of findings of environmental impact assessment shall be added too. Currently, environmental impact assessment for oil refineries is taking in to consideration and improving the natural resources via environmental assessment is seen as the best available method for environment protection [32]. At present, a large number of people see the environment protection aligned with sustainable development and finally consider advance as one of their principal needs. Although huge oil and gas reserves in land and marine areas bring noticeable wealth for the countries with oil resources but imposes pollutions deriving from reserves' extraction. In land areas, drilling, big petrochemical compounds, refineries and numerous oil dependent factories, create oil pollutions particularly during oil wells drilling in the oil fields [18]. Different issues such as importance of financial competition and rapid advance of various industries and rising of people living level demands higher energy resources consumption rate ,particularly fossil fuels mainly comprises of oil derivatives [4]. This fact along with significance of environment protection and sustainable development and due to insufficient attention to the environment and negligence in

compliance with principles of environment protection and restoration during natural resource exploitation is noticeable and for the said reasons different studies are carried out in the countries to restore the environment [23]. To this end and in order to remove the challenges deriving of oil pollutions and environment improvement using latest scientific development which is the offering the oil refinery impact assessment model, this research was carried out to be employed as a model for other oil rich and oil industries areas [26]. On the other hand, this method of oil refinery impact assessment is compatible to the environment and imposes no harm to the environment and therefore this method was employed in this study. Environmental knowledge and information is and will always be incomplete, particularly with infinitely complex ecosystems considered at various scales. Impact analysis, by its very nature, is predictive and requires a look out into the future [11]. The enforcement of legislation can help in implementing and monitoring EIA effectively and successfully [6]. Impact assessment (IA) is an instrument that is gradually making inroads into European Union policy making. Great ambitions are tied to the introduction of a compulsory system of IA as a way to achieve better regulation but also as a tool to improve legitimacy of government and increase unity in European politics. In order to raise the quality of the assessments, which has been questioned, there is a call for application of more evidence based methods. As a result, there might be a window of opportunity for greater use of scientific support in impact assessment work. However, the EC's IA system has several overlapping and partly contradictory objectives to produce estimates about possible future impacts are only one of them. The IA system should be understood as a political instrument shaped by its multiple objectives and the political context of permanent negotiations in which it is situated. Impact assessment systems have been employed in European Union politics for a long time. The Environmental Impact Assessments (EIA) Directive introduced in 1985, followed by the regulation known as the Strategic Environmental Assessment (SEA) Directive introduced systematic assessment of environmental effects of political measures. Assessments of environmental impacts were followed by other sectoral assessment. But single sector assessments have only covered certain sets of impacts and only applied for plans and programs, not policies. The impact assessment's character of continuous negotiation can further induce the leader to maximize the flexibility of the work process. In an example regarding selection of indicators for modeling it was said that the optimal situation would be to have completely free choice. The reason for this being that the objectives might change under way. If selection of indicators were overly fixed this could hamper a flexible adjustment to changes in the evolving IA process. The insights revealed about the Commission's IA work are somewhat surprising and apparently contradictory. The Commission has in several ways demonstrated its political will to introduce a "better regulation". Implementation of an evidence-based IA system based on the three pillars of sustainability, seemed to be the cornerstone in the governance of better regulation. However, IA procedures also have the objectives to ensure

transparency and cohesion in the policy process. When the analytical work has been done and strategies negotiated the IA is used as a tool to disseminate the rationale for a policy proposal, inside and outside the Commission. The impact assessment is at the core of this negotiation process and is therefore a political balancing act. Consequently, the IA process cannot be regarded solely as a knowledge instrument. Since 2003 an integrated (between sectors and levels) system for impact assessment (IA) of policy proposals has been implemented in the European Commission. According to the requirements this new policy-driven IA system should be guided by sustainability principles (economic, social and ecological) and carried out in open interaction with society at large. However, the introduction of this system has an aim that is wider than merely providing a knowledge base for decision making. It is also a tool for communication, improved legitimacy of government and increased unity in European politics. When the IA system is appraised, its multiple objectives – to provide accurate estimates of impacts, integrate policy sectors, serve as a communication tool and provide a basis for decision making – should be accounted for. The European Union is a complex, transnational construction, in which politicians, officials and interest groups across national states interact to shape shared policy outcomes. In this complicated political system for European integration, negotiation plays a central role. The impact assessment is at the core of this negotiation process and is therefore a political balancing act. Consequently, the IA process cannot be regarded solely as a knowledge instrument. The accurate estimate of future impacts is only one dimension of a successful IA process. It shall also contribute to integration between the Commission services and serve as a tool for internal and external negotiation. Seen this way the IA is primarily used to gather knowledge that supports the outcome of the continuous negotiations of the Commission's proposals [10]. Environmental impact assessment can be defined as the process of predicting and evaluating the effects of an action or series of actions on the environment [13]. Natural resources are in general considered the "inputs" to impact assessment studies [14]. The Guidelines include a standardized approach to evaluating social impacts that might occur throughout the 4-phase life cycle of a typical industrial or hazardous facility, including: (1) planning/policy development, (2) construction implementation, (3) operation/maintenance, and (4) decommissioning/abandonment [15]. Human activity has an inevitable impact on the environment and this is generally negative. It is undeniable that society is increasingly aware of the state of the surrounding environment, since it forms the basis for all human activity [16]. In Thailand, Indonesia, and Malaysia, political and business support for environmental impact assessment (EIA) is low, and environmental agencies are virtually powerless compared with economic development agencies. Western style democratic principles are weakly supported, the public is effectively excluded from project planning and decision-making, mission agencies are relatively isolated from public demands for environmental protection, and environmental agencies have difficulty enforcing EIA requirements.

Environmental advocacy is growing but is still new and largely unappreciated by government. Whereas technical factors contribute to the consequent ineffectiveness of EIA, cultural factors provide complementary explanations [21]. A reliance on paternalistic authority, hierarchy, and status as principles of social organization; a dependence on patron-client relationships for ensuring loyalty and advancement among political, bureaucratic, and private-sector actors; and a strong desire to avoid conflict and maintain face all reinforce the power of political and business elites and circumscribe that of individuals and communities [17].

II. MATERIAL AND METHODS

The environment is a more time-consuming process because it has more dependant and independent variables which have to be taken into account. There needs to be a tool or support system. The challenge of collecting, processing, analyzing and reporting information can be partially met by use of various computer and information technologies (computer-assisted systems) [30]. Result and some consequences of such actions are incidence of environmental pollution. Therefore, refineries can also among the plans and projects can be considered the long-term effects of short-term environmental effects [27]. Present goal of applying this model evaluation software environmental impact assessment of oil refinery is in order to achieve environmental protection for receiving to sustainable development in economic program coordinator with the principles of environmental protection and prevent the destruction and depletion of renewable non-renewable resources [28]. Therefore, environmental problems must be large perspectives and infrastructure development with environmental protection design rule of law and policy makers and economic development planning, social and cultural future of Iran with more focus on the environment, resources using and efficiency of intellectual resources with more attitude balance and proportion between the rules of law, environmental and sustainable development occurs [31].

III. TEHRAN OIL REFINERY

As mentioned earlier the oil refinery and environment interactions were studied given the size of the job and environmental features in the framework of different units of oil refinery (executive, constructional, operational and processing) and different environmental (physical, biological, socio-economical and cultural) parameters. The major environmental impacts and consequences of oil refineries include gas emissions, effluents, solid wastes, noise, odor and visional and aesthetic impacts [8]. Tehran Oil refining Company discussion is: Date of establishment: 1965-1968, Date of operating: 1969 (South refinery)-1973 (North refinery), Nominal capacity: 220,000 barrels per day, Operational capacity: 240,000 barrels per day, Feed: Light crude oil of Ahvaz –Asmari oil field, crude oil of Maroon/Shadgan, Middle Asia, Production units: crude oil distillation, viscosity, liquid gas recovery, gasoline hydrogenated refining and gasoline conversion, hydrocracker, Hydrogen, Nitrogen, Sulfur recovery, Amine gas treatment [25].

All researches and studies about this issue entail three kinds of operations:

- 1- Detailed investigations and studies about environment.
- 2- Investigations and studies about oil refinery.
- 3- Investigations and studies about oil refinery environmental impact assessment.

Regarding the first item, studies about environment, the studies were conducted given the refinery neighboring lands suitability and surrounding environment and necessity to consider the soil and environment protection by the vegetation. Regarding the second item, studies about crude oil refinery, the studies were carried out given the main agents in production and interference in area oil industry and as the major agent of oil pollution in the area. In this respect, oil refinery different units were focused. Regarding the third item, studies about oil refinery environmental impact assessment, given the diversity in crude oil and creation of severe environmental pollution by all oil refineries upon refinery technical default (in all stages including design, execution and operating).

A. Air pollution

Air pollution due to the refineries' operation mainly derives in operating stage according to the facilities' age and employing processes by firing, steam boilers, furnaces, pumps, compressors, reserve tanks and distillation towers. The most important air pollutants are sulfur oxides, nitrogen oxides, carbon monoxide, aldehydes, ammonia, particles and hydrocarbons [24]. The emitted hydrocarbons from the refinery are the most important source of pollution. Emitted hydrocarbons from the exhausting pipes and reserve tanks are the major air pollutants deriving from a refinery operation. Part of hydrocarbons is produced via evaporation [29]. During combustion process, nitrogen oxides are formed particularly in facilities such as boilers, compressors, catalytic reducers and introduced into the environment. The particles are produced by turbines and boilers directly related to consuming fuel.

B. Water pollution

Discharging effluents into the environment can contaminate surface waters, soil and underground water due to leak or oozing of raw materials or products [20]. Such a condition could be occurred due to tanks' or pipelines' leak [22].

C. Solid wastes

Refineries produce noticeable amounts of solid wastes [3]. The largest amount of solid wastes originate from cracking, coke production, sludge production and treatment (sludge deriving from cleaning tanks), water and oil separators and effluent treatment system.

D. Ecosystem demolition

In recent years, oil and gas prospecting and extraction operations imposed some damages to the marine and land environments in the areas that are under oil industries operations due to lack of a definite description for studying

and investigating environmental impact assessment services [12].

IV. RESULT AND DISCUSSION

The model for environmental impact assessment of oil refinery and analysis of the results were established based on the interactions matrixes in which the interactions of two stages of oil refinery construction and operating activities on all environmental parameters were studied under the three general categories of soil physical and chemical properties, water quality, air quality, land usage and future development plans and economical, social and cultural aspects integrating all involved agents.

V. CONCLUSION

Function of this method is on the base of environmental impact assessment matrix and environmental risk assessment that they modified and mix together to making the best result of environmental impact assessment of oil refinery. Summing up and analysis of the results of matrix of the interactions reveals all impacts of establishing refinery in both design - constructing and exploiting stages. Software has special design that every items of environmental parameters, design-construction and operation phases with consideration of operational needs, particularly financial (financial costs - economic) based on costs and benefits can change. All cases can be removed and added are based on business need. The overall result of software is available in Fig. 1 & 2.

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With assistance of offered model given operational need and other parameters particularly oil refinery financial affairs (financial-economical expenses level) the following items can be achieved:

- Possibility of full investigating and studying the project before execution.
- Possibility of planning and managing required for harmonizing refinery operations with environment.
- Possibility to provide incorporated planning for oil refinery future development plan.
- Possibility of studying plan and project for potential changes in oil refinery and impacts.

REFERENCES

- [1] Ahammed A.K.M. R., & Nixon B.M., 2006. Environmental impact monitoring in the EIA process of South Australia, *Journal of Environmental Impact Assessment Review*, 26, 426–447.
- [2] Ahmadvand M., & Karami E., & Zamani G.H., & Vanclay F., 2009. Evaluating the use of Social Impact Assessment in the context of agricultural development projects in Iran, *Journal of Environmental Impact Assessment Review*, 29, 399–407.
- [3] Aghaie, sh., 1986. Environmental impact assessment of oil refinery, azad publication, p. 77.
- [4] Alian, T., 2001. A guidance to environmental impact assessment, andisheh publication, p45.
- [5] Al-Rashdan D., & Al-Kloub B., & Dean A., & Al-Shemmeri T., 1999. Theory and Methodology Environmental impact assessment and ranking the environmental projects in Jordan, *European Journal of Operational Research*, 118, 30-45.
- [6] Alshuwaikhat H. B., 2005. Strategic environmental assessment can help solve environmental impact assessment failures in developing countries, *Journal of Environmental Impact Assessment Review*, 25, 307–317.
- [7] Annandale D., & Taplin R., 2003. Is environmental impact assessment regulation a 'burden' to private firms?, *Journal of Environmental Impact Assessment Review*, 23, 383–397.
- [8] Ardalanie, E., 1989. Environmental policy in Iran, Safi Alisha publication, pp. 63-65.
- [9] Armitage D.R., 2005. Collaborative environmental assessment in the Northwest Territories, Canada, *Environmental Impact Assessment Review*, 25, 239–258.
- [10] Atkinson S.F., & Canter L.W., & Ravan M. D., 2006. The influence of incomplete or unavailable information on environmental impact assessment in the USA, *Environmental Impact Assessment Review*, 26, 448–467.
- [11] Backlund A., 2009. Impact assessment in the European Commission – a system with multiple objectives, *Journal of science and policy*, 12, 1077-1087.
- [12] Bahoush, A., 1991. Environmental protection in oil industry, Ney publication, pp. 84-90.
- [13] Baratto F., Diwekar U. M., & Manca D., 2005. Impacts assessment and tradeoffs of fuel cell based auxiliary power units Part II. Environmental and health impacts, LCA, and multi-objective optimization, *Journal of Power Sources*, 139, 214–222.
- [14] Bare J. C., & Gloria T. P., 2008. Environmental impact assessment taxonomy providing comprehensive coverage of midpoints, endpoints, damages, and areas of protection, *Journal of Cleaner Production* 16, 1021-1035.
- [15] Bass R., 1998. Evaluating environmental justice under the national environmental policy act, *Journal of Environ Impact Asses rev*, 18, 83–92.
- [16] Blanco Moron A., & Delgado Calvo-Flores M., Martín Ramos J.M., & Polo Almohano M.P., 2009. AIEIA: Software for fuzzy environmental impact assessment. *Journal of Expert Systems with Applications*, 36, 9135–9149.
- [17] Boyle J., 1998. Cultural influence on implementing environmental impact assessment: insights from Thailand, Indonesia, and Malaysia, *Journal of environ impact asses rev*, 18, 95-116.
- [18] Dabirie, F., 1994. Environmental regulations in Iran, ghoghnuh publication, pp. 35-55.
- [19] Daryalal, M.J., 2002. Health, safety and environment in oil terminals, nioc publication, p. 33.
- [20] Ghanizadeh, Gh., 2001. Health, safety and environment in oil industry, nioc publication, pp. 69- 72.
- [21] Ghizhazadeh, S., 2005. Environmental protection in oil terminals, nioc publication, p. 67.
- [22] Golestan, M., 1985. Environmental protection, vaziri publication, p. 37.
- [23] Houshyar, R., 1991. Environmental engineering, aboureihan publication, p. 92.
- [24] Jaafarzadeh, M.T., 2001. Health, safety and environment in oil refinery, nioc publication, pp. 97- 102.
- [25] Khosravanie, Sh., 2001. A guidance to environmental engineering in oil refinery, nioc publication, p. 78
- [26] Kianie, M., 1991. Environmental policy review in oil industry, danesh publication, pp. 54-58.
- [27] Momenzadeh, D., 2006. Environmental protection in oil and gas refineries, oioc publication, pp.37-41.

- [28] Monavarie, M., 2001. Environmental impact assessment, department of environmental protection, pp .67-70.
- [29] Monavarie, M., 1999. Environmental impact assessment, Islamic azad university, p. 23
- [30] Muthusamy, N., Rahmalingam, M, 2003. Environmental impact assessment for urban planning and development using GIS. In: Proceedings of the Third International Conference on Environment and Health, Chennai, India.
- [31] Shariat, M., 1999. Environmental impact assessment, green publication, pp . 81-84
- [32] Shariat, M., 2001. Environmental impact assessment, Islamic azad university, p. 29.

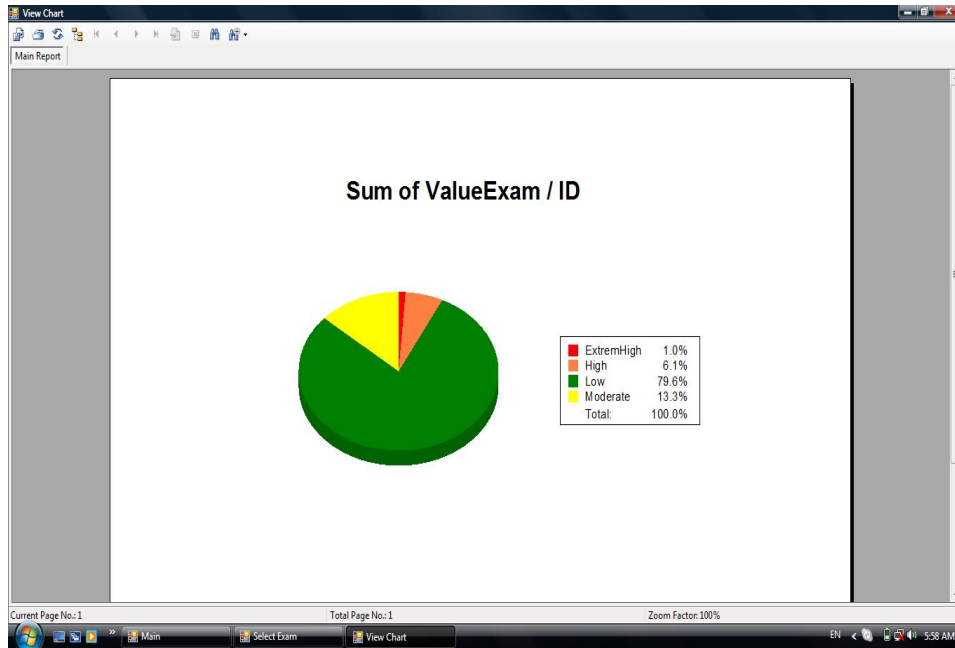


Figure 1. the result report (design-construction phase)

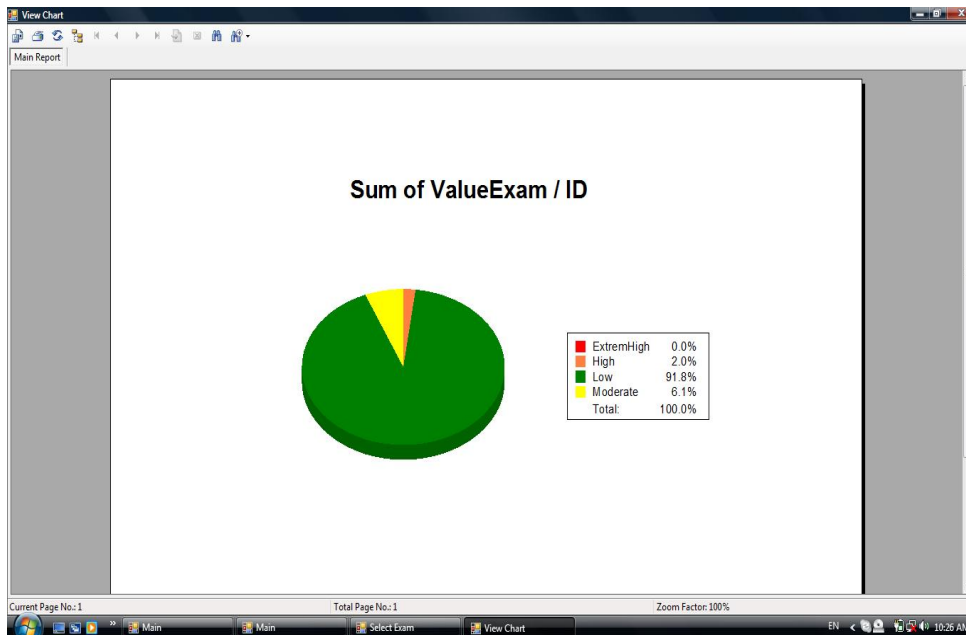


Figure 2. the result report (operation phase)