



## ASSESSING OF ENVIRONMENTAL IMPACT FOR THE COAL-FIRED POWER PLANT BASED ON EXPERT SYSTEM

Ikhlas Kitta, Salama Manjang and Zahir Zainuddin

Department of Electrical Engineering, Hasanuddin University, Makassar, Indonesia

E-Mail: [ikhaskitta@gmail.com](mailto:ikhaskitta@gmail.com)

### ABSTRACT

Environmental impact assessment based on expert systems caused by construction of the coal-fired power plants necessary because of the need for people to be able to advocate for environmental issues around the power plant. As well as in the preparation of environmental impact analysis report of power plants need a lot of expert opinions from various fields of science so that it requires substantial investment. This research aims to design and develop an environmental impact assessment system in the coal-fired power plant that has adopted the mind an expert on the environment based on expert system in order to minimize the presence of environmental experts.

**Keywords:** coal-fired power plant, environmental impact assessment, expert system.

### INTRODUCTION

The level of pollution in water, air and soil increased along with the increasing development of the industry, both oil and gas industry, as well as non-oil and non-gas. To prevent such contamination, there should be efforts to control environmental pollution, one of them by applying the analysis of the impact on the environment.

The electricity industry, particularly in the coal-fired power plant which uses coal as a fuel, it has a huge potential for polluting our air and water [1]. To control the level of environmental pollution generated by the power plant waste disposal need a system that can assess the quality of the environment in the form of an environmental impact assessment.

An environmental impact assessment report prepared for analysing the significant environmental impact of an activity. In Indonesia, the environmental impact report is a prerequisite permitting operational continuity of a project or power plant. The report was prepared at the planning and operation of power plants by doing everything possible observations on the environmental impact of the power plant. Basis of preparation of environmental impact statements in Indonesia is Law No. 32 of 2009.

In the preparation of impact analysis, an environmental impact report for the power plant needs a lot of expert opinions from a variety of disciplines. An environmental impact assessment is a very broad application of science and interdisciplinary. It requires a large investment.

For economical and practical reasons, a maker of power plant environmental impact statements may use expert system as an alternative to environmental experts. This system does not have the ability to write an environmental impact report as a whole. However, the system is able to provide assistance, preparation of environmental impact statements. The system is able to resolve the problem by applying expert knowledge which has been contained in the database system.

Because it is difficult to remember all of the data required in the assessment of the environmental impact of the coal-fired power plant such as the quality of raw

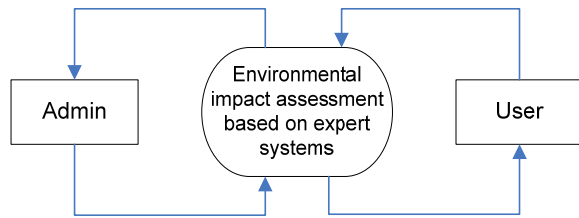
materials that exist in one location, the associated processes and mitigation. Therefore, for that matter, needed an expert system that is able to predict the contamination material from observation data of physical, chemical and biological environment. So the system can provide suggestions for investigating and mitigating the pollution to the environment experts. Therefore the complexity in making an environmental impact assessment then this article is a summary of research activities that have been made in the development of environmental impact assessment applications of the coal-fired power plant located in South Sulawesi (Indonesia) by using an expert system.

### METHODS

#### Design and manufacture of application software

The execution of this research is conducted with the following steps: 1) Phase literature study to collect theories and literature that support and relate to achieving the goals of this research; 2) The design phase of the system that are stages of system development plan into a form design that is used to facilitate the user in understanding the system to be developed; 3) Stage of the program is the stage to process the data into an application program; 4) Phase of testing and data retrieval application program to check whether the program works well or not; and 5) The stages of data analysis is the stage of data processing by analysing and comparing each of the test data to be able to know the level of success.

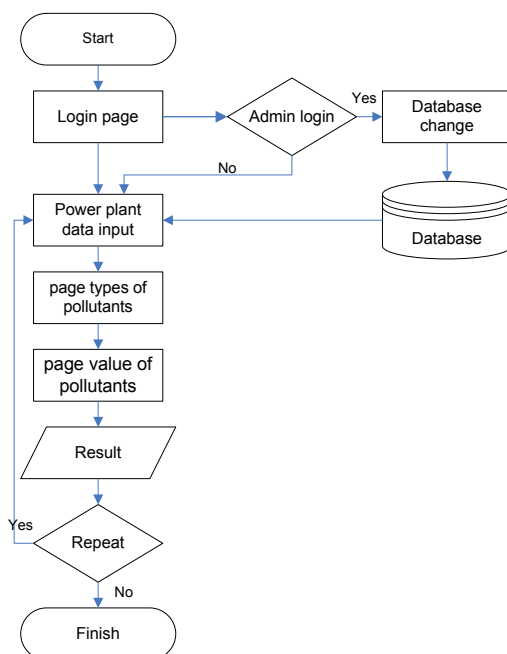
Stages of system design include a description of the system structure design software such as context diagram and flowchart. This context diagram describes the system in general and simple (Figure-1).



**Figure-1.** Design diagram of environmental impact assessment based on expert systems.

Assessment of the coal-fired power plant is divided into two, namely the admin and user. The admin is the user who has the right to manage the data and knowledge base in an expert system to add, modify and delete data. While the user is a user who can only access certain menus in the system, such as running a program analyser for environmental assessment of the coal-fired power plant.

Flowchart of application program can be seen from the picture presented in Figure-2 below



**Figure-2.** Flowchart of application program.

Coal-fired power plant has potential to cause air pollution. Air pollution due to power generation in the form of CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>x</sub>, and dust containing heavy metals [2]. Air pollution by substances that have an adverse impact in the form of health reduction of air, which have a negative impact on human health.

Therefore, to make it easier to analyze the environmental impact power plant, used methods of expert systems. The expert system is a system that tried to adopt an environmental expert knowledge to the computer model, so that the computer can solve environmental problems as is commonly done by environmental experts. Components of an expert system for the analysis of

environmental impacts are divided into four sections, namely: Knowledge Base, Working Memory, Inference Engine and User Interface [3] [4] [5] [6].

## RESULTS AND ANALYSIS

### Model on environmental impact assessment of the coal-fired power plant

Forecasts major and significant impact on the environmental analysis will consider the experience and knowledge of environmental experts in related disciplines. The use of this method is well suited to the parameters that have data and information availability is very limited. Impacts that will arise as a result of development activities and operation of coal-fired power plant will be assessed through the forecast value / magnitude of environmental impact and significance of environmental impacts.

Determination of the magnitude based on a scale changes in environmental quality will be grouped into the value of small, medium and large. Criteria minor impact, the impact or changes will occur in the low intensity and the change can be eliminated from the local environment, while moderate impact criteria indicate that the intensity of the impact will occur at the maximum limit in which the impact can still be tolerated. A criterion huge impact shows that the impact will occur with considerable intensity exceeds the maximum value that can be tolerated by a particular environment.

To determine the impact that occurs requires knowledge of environmental issues in power plant, environmental components to be assessed, and the potential impact [7]. In the environmental assessment on coal-fired power plant, several components that must be considered, namely:

- Spatial components. Locations should be in accordance with the designation of local spatial plans, attach Bylaw Spatial district or city
- Physical components
- Biological components
- Components of Social, Economic, and Cultural

In the environmental impact assessment, should undertake impact analysis process which refers to:

- Change Functions and Land Use.
- Decrease Air Quality.
- Decreased Water Quality.
- Potential of Heavy Metal Waste

### Analysis model with expert system

#### Environmental impact assessment methods

In the design of impact assessments used methods of assessment / predicted impacts that would occur by comparing the value of the coal-fired power plant environmental parameters with the value of environmental



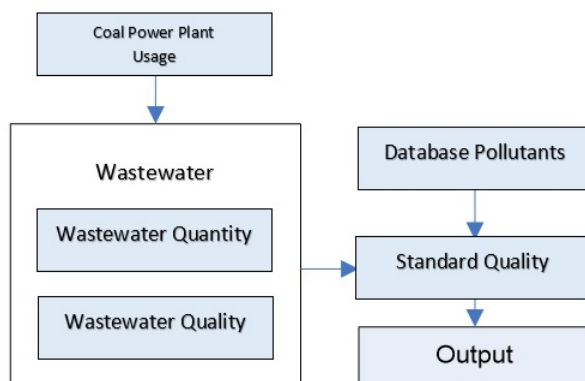
quality standards that have been agreed. The criteria used in this design refers to the environmental quality standards based on legislation in force include clean water quality standards according the Minister of Health No. 416 / Menkes / IX / 1990 and the consideration of environmental standards set by local governments such as South Sulawesi Governor Decree No. 14 Year 2003 on the Management, Water Pollution Control, Air, Determination of Waste Quality, Ambient Air Quality Standards and Emission Levels and Standard in Operation Disruption Event in South Sulawesi (Indonesia).

#### Development of expert system for air quality assessment of coal-fired power plant

This section describes about the problems the implementation of observations of the power plant have been standardized, types of pollutants contained in the legislation (Regulation No. 82 of 2001 concerning the quality of water) along with its effects and how to handle. Domain on this issue has the following characteristics:

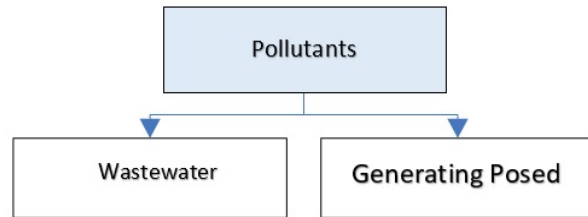
- Classification of pollutants will continue to grow given the growth of the technology that will generate the kind of new industry and new chemicals.
- Mitigation and its effects will continue to grow along with research in the field of environment.
- To conduct an investigation can not be generally applicable, given the characteristics of water flow at each location of the power plant is not generally applicable.
- Knowledge of power plants, pollution, solution and the effect is very dependent on the knowledge and experience of experts Environmental Power Plant.

Water quality parameters in power plant environment to be assessed is covering BOD, COD, DO, and temperature. Thus making these applications-oriented database established on the type of power plant to see what kind of contaminants. The databases that are created are, among others: Database Pollutants, Mitigation Database and Database disease (Figure-3).



**Figure-3.** Process of water quality assessment of coal based power plant.

In addition to an assessment based on applicable standards for water quality, then the expert system is made anyway mitigation processes to reduce the environmental impact. If there is contamination, the application will explain about the diseases caused by pollutants (Figure-4).



**Figure-4.** Flow of mitigation and diseases caused by pollutants.

Preparation of a mitigation plan on the various impacts that will arise is done by considering a number of policy instruments for environmental management implemented in Indonesia, namely regulatory instruments, institutional, economic participation, education, information and conflict resolution. Some instruments are disseminated in the form of technological approaches, and institutional approaches.

Technological approach as a mitigation alternative is an approach which employs a method or technology in the form of program / project to manage large and important impact. The scope of the technology being considered is the technology that is available, either already known and used, as well as those brought in from the outside and ready to use so it does not have to affect the operational schedule or implementation of power plant construction.

Institutional approach as an alternative of mitigation is an approach that involves institutional management. This approach is used to consider the function of formal and informal institutional services.

#### Development of expert systems of air quality in coal-fired power plant

Parameters of air quality to be assessed is the content of the gases in the air that include CO, CO<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub> and dust and noise as shown in Table-1. Assessment of parameter of air quality based on the decree of the Governor of South Sulawesi No. 14, 2003. The locations were considered representation of areas suspected to be affected and not affected with regard to the direction and wind speed. Based on these considerations, the air quality measurements carried out on site locations and settlements activities in the vicinity of the power plant activities. Measured air quality data used as a basis to forecast changes and impacts to air quality.

**Table-1.** Components assessed air quality.

No.	Environmental component / Parameter	Unit
1.	Total Ash/Particle	$\mu \text{ g/Nm}^3$
2.	Carbon Monoxide (CO)	$\mu \text{ g/Nm}^3$
3.	Nitrogen Dioxide (NO <sub>2</sub> )	ppm
4.	Sulfur Dioxide (SO <sub>2</sub> )	$\mu \text{ g/Nm}^3$
5.	Oxidant (O <sup>3</sup> )	$\mu \text{ g/Nm}^3$
6.	Lead (Pb)	$\mu \text{ g/Nm}^3$
7.	Noisy	dBA

### Some supporting data for modelling the environmental assessment expert system

#### a) Climate data

Establishment of an environmental assessment based on expert system supported by environment data of around the coal-fired power plant, so for these survey activities is climate data that includes rainfall and rainy days, temperature, humidity, solar radiation, wind speed and direction, and lightning. Historical data was made in the form of climate database of power plant (Table-2).

The climate data base is used for comparison purposes in the short-term climate data obtained through direct measurement of the parameters, especially temperature, humidity and wind speed.

**Table-2.** Climate components assessed.

No.	Environmental component / Parameter	Unit
1.	Rainfall	mm
2.	Rainy Days	mm/day
3.	Temperature	°C
4.	Humidity	%
5.	Solar Irradiation	hour/day
6.	Wind Velocity	km/hour

#### b) Data physiographic

Other data used to support the environmental impact assessment based on expert system is a picture physiographic of power plant location and surroundings covering the landscape as well as the slope is collected through the interpretation of topographic maps are available and / or direct measurement.

#### Application software

The environmental impact assessment application using the Indonesian language as the language of the user. When the user runs the application of environmental impact assessment of power plant, the main page will appear. Furthermore, it would be on the login page for the system to know the active user and what he wanted to do. Next, will be confronted with the main menu the user to

enter data that is power plant name and location Figure-5. Then the user will be prompted to choose the type of contaminants, namely water, air and electricity.

**Figure-5.** The data page of power plant name and location.

**Figure-6.** Parameters types of air pollutants.

On page types of pollutants, the user will be given a choice about what this parameter is to be calculated air, water or electricity. If the user selects the type of water pollutant, that it will show a page of parameters consisting of pH, copper, zinc, iron, TSS and temperature. If the user selects the type of gas / air pollutants (Figure-6), that it will show a page of parameters consisting of total particulate matter, sulfur dioxide, nitrogen oxides and opacity, while if the user selects the type of electricity pollutant, that it will show a page of parameters consisting of an electric field and a magnetic field. Then users are welcome to fill out the value of each parameter for the next application will compare the value of standard input and standard quality raw or value.

#### CONCLUSIONS

Based on the results of the implementation and application of systems analysis in the environmental assessment of the coal-fired power plant, then the environmental assessment based on expert system of this power plant is able to provide the level of pollution information contained in the scope of the power plant.



Environmental assessment expert system application of this power plant is able to provide guidance to the user in terms of environmental pollution that has been caused power plant waste.

#### ACKNOWLEDGEMENT

The authors gratefully acknowledge Indonesia Government of ministry of research and higher education for financial support of this research.

#### REFERENCES

- [1] Ikhlas Kitta, Salama Manjang, Wihardi Tjaronge, Rita Irmawaty. 2016. Effect of Fly Ash Filler Quantity on Electrical Properties of Silicone Rubber Insulator Material. ARPN Journal of Engineering and Applied Sciences. 11(7): 4689-4695.
- [2] Gang XU, Shiyuan LU, Yongping YANG, Liqiang Duan, Ji LI, Le LI and Xiaona SONG. 2010. New Environmental Friendly Evaluation Criterion for Coal-Fired Power Plant Comprehensive Performance. 2010 International Conference on Electrical and Control Engineering, IEEE, 25-27. June.
- [3] Mohammad Iqbal, Sigit Widiyanto, Haydan Mardhi Fadlillah and Herry Susanto. 2014. Pakar-UKM - Expert System for SMEs Using Dynamic Knowledge Base. ARPN Journal of Engineering and Applied Sciences. 9(12): 2441-2447.
- [4] Marouane El Mabrouk, Mostafa Ezziyyani, Mohammad Essaaidi. New Expert System for Short, Medium and Longterm Flood Forecasting and Warning. Journal of Theoretical and Applied Information Technology. 78(2): 286-302.
- [5] Andrey Vladimirovich Ostroukh, Dmitry Ivanovich Popov, Dmitry Grigorievich Demidov and Nataliya Evgenievna Surkova. 2015. Development of the Rules Base for an Expert System Choice Adaptive Learning Strategy. ARPN Journal of Engineering and Applied Sciences. 10(10): 4430-4435.
- [6] Ikhlas Kitta, Salama Manjang, Wihardi Tjaronge, Rita Irmawaty. 2016. Effect Of Coal Fly Ash Filler In Silicone Rubber and Epoxy Resin As Insulating Material in Wet Environmental Conditions. International Journal of Mechanical & Mechatronics Engineering. 16(02): 48-53.
- [7] Assistant Deputy for Environmental Impact Assessment. 2007. Free Assessment AMDAL or UKL/UPL for Coal Power Plant Development Activities. Ministry of Environment, 2007, Indonesia.