

USING ENVIRONMENTAL PERMITS FOR BOOSTING THE ENVIRONMENTAL PERFORMANCE OF LARGE-SCALE LIGNITE SURFACE MINING ACTIVITIES IN GREECE¹

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Abstract. More than 350 Mm³ of materials are excavated annually from the mines of the Ptolemais basin which produce about 50 Mt of lignite. This lignite is subsequently supplied to Thermal Power Plants located in the vicinity of the mines. Mining activities currently occupy a total of 16,000 ha. Unless appropriate preventive and mitigation measures are applied, environmental conditions will deteriorate in numerous ways due to the scale of the operations and the applied surface mining method.

From calendar year 2002, it is required that the Ptolemais mining complex complies with environmental permits set by Ministerial Decisions signed in common by the Ministers of Environment, Development, Culture and Agriculture. For the core mining activity, which consists of four pits with an annual lignite production of more than 35 Mt, the permits were signed eight years after the submission of the relevant Environmental Impact Assessment study. During this long period of negotiations, the mine operator was called many times to submit supplementary information that was deemed necessary in order to agree to the terms and conditions that were finally included in the permit.

This paper presents the main terms and conditions of these permits, which provide a framework for developing and implementing an integrated environmental management system. This system comprises several preventive and mitigation measures related to waste management and monitoring of environmental quality, which are applicable from the early stages of mine operation. The implementation of this system is completed after the mine closure with a series of site-specific land rehabilitation and post-mining monitoring activities.

Based on the experience gained so far from the implementation of the terms and conditions prescribed in the permits, this paper also presents some critical aspects regarding the benefits of this process, the regular implementation of auditing procedures and the effective settlement of conflicts between mining companies, supervising authorities and other stakeholders.

Additional Key Words: Impact assessment, land reclamation, rehabilitation

¹ Paper was presented at the 2008 National Meeting of the American Society of Mining and Reclamation, Richmond VA, *New Opportunities to Apply Our Science* June 14-19, 2008. R.I. Barnhisel (Ed.) Published by ASMR, 3134 Montavesta Rd., Lexington, KY 40502.

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Proceedings America Society of Mining and Reclamation, 2008 pp 785-806

DOI: 10.21000/JASMR08010785

<http://dx.doi.org/10.21000/JASMR08010785>

Introduction

Environmental protection is a significant priority for society. The citizens expect their governments, local authorities and the industry to take all necessary measures for protecting the environment and for keeping them informed about the impacts of every project that affects the environment. This is particularly true for communities located in the vicinity of surface mining operations. Thus, environmental management has become a major issue for all mining companies, which try to assess the potential impacts of their operation, to improve their environmental performance and to meet the standards specified by the laws and regulations that are in force (Pavloudakis and Roumpos, 2004).

In this context, Environmental Impact Assessment (EIA) is a key process for environmental management. It has a preventive rather than a corrective nature and is oriented towards providing the necessary elements for informed decision-making by the authority in charge and the owner of the project. The EIA must identify and evaluate the potential impacts to the physical, chemical, biological, cultural and socioeconomic environment and to plan the measures to prevent, decrease, mitigate or eliminate those impacts. For this purpose, numerous issues regarding the landscape, land uses, aesthetic values, conservation of wildlife, archaeological sites, rational exploitation of natural resources, energy use, safety, etc must be investigated thoroughly. The EIA is fundamentally a timely, adequate and sufficient information tool for all involved stakeholders to understand the environmental and social features of a proposed project and to be consulted about their concerns in this regard (Canter, 1996, de Sadeleer et al., 2002, Vidal and Aurazo, 2004, Pavloudakis et al., 2006).

The Environmental Impact Assessment leads either to the rejection of a proposed project or to its approval. In case of project approval the EIA implementation and follow up is based on an environmental permit. This permit is an official document (in Greece it has the form of a Decision signed in common by all involved Ministries), which consists of a series of terms and conditions that must be fulfilled in order to ensure that:

- the environmental impacts are within the predicted or permitted limits,
- the described preventive and mitigation measures are implemented according to the best known practices, and
- actions are taken to manage unanticipated impacts or other unforeseen changes.

The main objective of the present paper is to demonstrate how the environmental permits serve as a framework for developing an environmental management system and for assisting a mine operator to make the right decisions regarding the preventive and mitigation measures

that must be applied. In addition, it points out all issues that must be thoroughly examined in order to avoid conflicts with the public and the supervising authorities.

At the same time, the paper tries to promote the idea of using environmental permits as a basis for auditing procedures, for resolving any conflicts between mining companies, supervising authorities and other stakeholders, as well as for providing the public with an opportunity of active involvement in environmental decision-making procedures that may affect considerably the sustainable and environmentally sound development.

Description of mining activities

Lignite is a solid fuel of poor quality characteristics which is found in great abundance in the Greek subsoil. In terms of lignite production Greece, ranks second in the European Union and sixth worldwide. Based on total deposits and the anticipated future rate of consumption, it is estimated that the domestic lignite reserves will last for more than 45 years. To date, a total of 1.3 billion tons of lignite have already been mined, while remaining exploitable reserves are approximately 3.1 billion tons. In 2006, 62.5 million tons of lignite were mined, a record since the commencement of lignite mining operations in Greece.

About 80% of the lignite quantity used for power generation purposes is produced from the mines located in the basin of Ptolemais. Most of these mines belong to the Greek Public Power Corporation (Fig. 1). Since the establishment of this company, 50 years ago, the exploitation of these mines provided a low-cost fuel, whereupon the electrification program and the economic development of the country were based. The lignite deposits of Ptolemais are still the most important domestic energy source for Greece.

Today, the total annual excavations of Ptolemais mines are 350 Mm³ and the lignite production is 50 Mt. The six thermal power plants that are fuelled by the mines of Ptolemais basin have an installed capacity of 4,378MW, representing 41.4% of the country's total installed capacity and meeting nearly 55% of the country's electrical energy demand.

The exploitation method applied at the mines is based on continuous excavation, transport and stacking systems. The so-called German method is based on 42 bucket-wheel excavators, 16 spreaders / stackers and 250 km of belt conveyors, which have been installed in six mine pits. Conventional earth moving equipment is used mainly for the excavation of the hard-rock formations that are present within the overburden layers of South Field, the largest mine of the area. In addition, such equipment is used in small pits of limited production, around the main lignite deposits. The total area occupied by mining activities is currently 16,000 ha. Up to now, about 3,700 ha, most of them on already abandoned mine

dumps, have been reclaimed: 2,700 ha have been reforested and 1,000 ha have been developed to land for agricultural purposes (Figures 2 & 3).

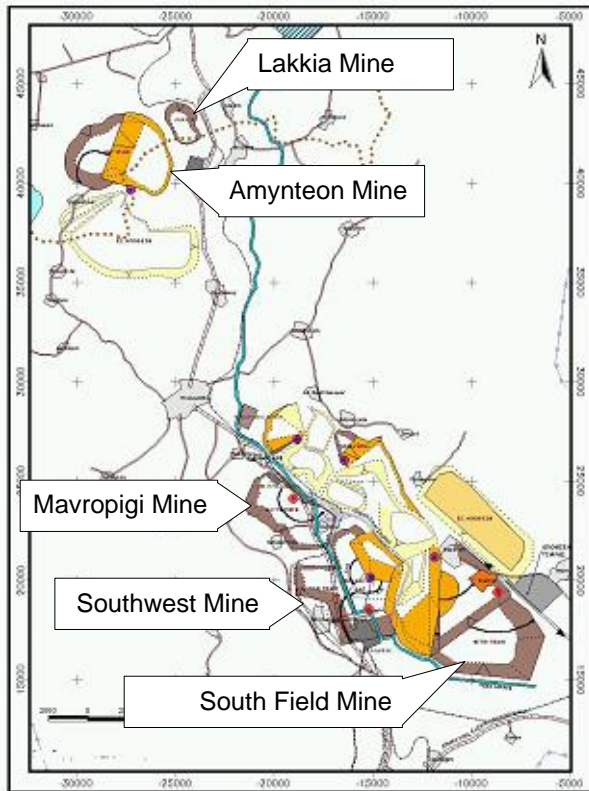


Figure 1. Mines in the Ptolemais basin. The mines of Kleidi and Ahlada are further north.



Figure 2. Reforestation of a waste heap slope.



Figure 3. Cultivation of reclaimed mine land by local farmers.

The exploitation of these lignite mines has a strategic importance for the Greek energy portfolio. It provides significant advantages, such as low cost of extraction and relatively stable and easily predictable fuel prices. It also contributes to a significant saving of foreign currency reserves (approximately 1 billion dollars annually) and offers both stability and security in the availability of fuel supplies. At the same time, the utilization of lignite provides thousands of jobs throughout the Greek countryside, where high rates of

unemployment prevail. Therefore, lignite has contributed significantly to the growth of the Greek National Product.

Unless appropriate preventive and mitigation measures are applied, environmental conditions will deteriorate in numerous ways due to the scale of the operations and the applied surface mining method (Kavouridis et al., 2002, Public Power Corporation, 2005).

The evolution of environmental permitting procedure

In Greece, the era of systematic environmental protection started in 1986, when the first Environmental Protection Act was voted by the Parliament. However, the implementation of Environmental Impact Assessment (EIA) started after 1990, when the Ministers of Environment, Development, Culture and Agriculture signed in common a Decision that a) regulated issues regarding classification of public and private projects according to their potential to cause adverse impacts to the environment and human health, and b) specified the contents of EIA studies and the procedure for receiving an environmental permit. Apart from the requirement for carrying out an EIA for every new project, at that time it was obligatory for all existing private and public projects to submit an EIA report and to start operating with project-specific environmental terms and conditions.

In this context, the EIA study referring to the mining activities at the Ptolemais lignite mining complex was submitted to the Ministry of Environment in 1993 (Fig. 4). After a long period of negotiations and the submission of supplementary information by the mines' operator, the relevant environmental permit, in the form of a Ministerial Decision, was signed in October 2001. Using the know-how and the experience gained during the above long-lasting process a new permit for the lignite mining activities in the Amynteon area (close to the Ptolemais mining complex) was signed by the Ministry of Environment, after only a period of three months. This area is located about 10 km from the Ptolemais mines and it was considered for the purposes of EIA and permitting procedure, as a separate activity.

However, the first ever lignite mining activity to receive an environmental permit is the Mavropigi mine. This is a relatively new mine that began operations in 2001 in anticipation of a lignite production deficiency due to the closure of the old mines at Komanos and the North Sector (Ptolemais complex). According to the legal framework that was already in force, the approval of a permit was a prerequisite for the beginning of mine exploitation works. As a consequence, a separate EIA and permitting procedure was carried out for the Mavropigi Mine, even though this operation was located very close to the existing mines of Ptolemais. This procedure was of high priority, in order to avoid decreased lignite production

and to meet the electricity demand. Finally, the first permit of the Mavropigi mine was signed in September 2001. In June 2003 this permit was modified in order to include some new provisions that had already been listed in the permits of Ptolemais and Amynteon mines, which were signed in the meantime.

Year			
1985		1997	
1986	- Environmental Protection Act is voted	1998	
1987		1999	
1988		2000	- Submission of EIA for Mavropigi mine
1989		2001	- Permit approval for Mavropigi mine
1990	- Ministerial decision for EIA / Permits	2001	- Permit approval for Ptolemais mine
1991		2002	- Permit approval for Amynteon mine
1992		2002	- Permit approval for Meliti power plant waste disposal site
1993	- Submission of EIA for the core mining activities in Ptolemais and Amynteon	2003	- Permit approval for asbestos cement disposal site
1994		2004	- Permit approval for Kleidi and Ahlada mines
1995		2005	- Approval for Lakkia mine (review of Amynteon mine permit)
1996		2006	
		2007	

Figure 4. Schematic representation of the environmental permitting evolution.

The 2003 permit was modified once more in 2004 in order to add the requirement of constructing a noise barrier between the mine pit and the community of Mavropigi. In April 2004, the Council of State decided to repeal the permit, mainly because the relevant EIA report did not investigate the pit's expansion to the west margin of the lignite deposit as an alternative to the current mine development. It should be noted that the lignite deposit runs underneath the village of Mavropigi and under current plans, no relocation of the village would be needed. However, the proposed alternative, which was proposed by the citizens and the local authorities, made imperative the resettlement of the village with expenses totally covered by the mining company.

Finally, the mine operates with a new permit signed in 2005. The new permit does not refer to the community resettlement, but recent decisions by the mining company reflect that such resettlement is included in the development plan of the Mavropigi mine.

It is worth noting that since the first permit was signed, numerous other activities have been planned and relevant EIA procedures have been carried out in order to receive permits. Today, additional permits have been signed for the ash disposal site of Meliti (2002), the asbestos cement disposal site (2004), the Kleidi mine (2006), the Ahlada mine (2006), the expansion of the Amynteon mine in the area of Lakkia (2007). In addition, procedures are

progressing for receiving permits for the development of the Southwest mine, the diversion of the Soulou stream, the diversion of the railway, and the operation of auxiliary facilities within the mines (e.g. wastewater treatment plans, petrol stations, equipment maintenance stations).

Today, the Ministry of Environment and the mining company, recognize the problems that arise from the separate monitoring and auditing of activities that take place in the same geographic area and cause cumulative impacts to the environment. Consequently, the possibility of developing new permits, which should cover all the earth moving and auxiliary works, at least for the core activity of the Ptolemais mining complex, is currently being investigated. This holistic approach will provide the mining company and all involved stakeholders with an effective mechanism for assessing environmental impacts, planning preventive and mitigation measures and implementing monitoring and auditing schemes. Moreover, this approach will not complicate further the already bureaucratic system of environmental management and inspection.

The contents of environmental permits

The environmental permits of lignite mining activities consist of a series of terms and conditions that reflect the National policy for environmental protection in the minerals extraction industry, as this is described in laws (mainly the Regulation of Mining and Quarrying Works of Greece), presidential decrees, ministerial decisions and European directives (Table 1). Moreover, guidelines of international organizations that promote the implementation of best available techniques in environmental protection have also been taken into consideration, together with know-how and experience coming from abroad and from the implementation of similar environmental protection strategies in other sectors of the Greek economy.

Table 1. Typical contents of an environmental permit referred to a lignite surface mine

Paragraph	Description
A	Type and size of mining activity
B1	Emission limits
B2	Maximum allowable concentrations of pollutants
C	Noise and vibration limits
D	Measures for preventing pollution and environmental degradation
D1	General terms
D2	Monitoring of environmental quality
D3	Cost
E1	Sensitive environmental components
E2	Measures for the protection of sensitive environmental components
F	Permit expiration date
G1	Withdrawal of permit
G2	Fines
G3	Amendments in case of conflicts between the mining study and the environmental permit

More specifically, the main issues introduced by the terms and conditions of the lignite mines environmental permits are the following:

Type and size of mining activity

This section contains a brief description of the activity under question as well as a list of coordinates that determine the polygon within which the mining activity takes place. In case of the Ptolemais mines, this polygon is defined by 574 points, which surround an area of 11,089 ha. The permit for the Amynteon mine includes an area of 5,837 ha.

Emission limits and maximum allowable concentrations of pollutants

This section contains a list of references to legal documents and regulations that set limit values for various environmental parameters that must be met during mine development and operation. These regulations refer to the concentration of certain pollutants in the air and in the aquatic receivers of wastewater pumped from the mines as well as to limit values for noise emitted from the operating mines in general, or from certain types of excavation and haulage equipment.

Land reclamation

The terms and conditions listed in this section of the permits introduce some critical aspects of environmental management in surface mining sites:

- Development and implementation of a reforestation program, according to specific guidelines that determine the type of trees, spacing, etc., and at the same time, try to minimize the gap between completion of mining works and beginning of land reclamation.
- Submission of technical studies that describe in detail the land reclamation works planned for various parts of the disturbed area as well as for the final pit that will remain after mine closure.
- Implementation of supplementary rehabilitation works in areas where the initial rehabilitation - reforestation projects did not prove efficient (a 80% efficiency in reforestation is considered a limit value for adopting supplementary works).
- Development of optical barriers by planting trees around the disturbed areas.
- Construction of mine waste heaps that follow the topography of the greater mining area and result in limited visual impacts.
- Implementation of certain measures for preventing landslides and other types of soil deformation.
- Management of topsoil in a way that minimizes loss of fertile agricultural land such as topsoil removal prior to mine pit excavation works, temporary storage (if necessary) and spreading on the final surfaces of waste heaps.
- Realization of a rehabilitation plan even if the mine operation might stop suddenly due to economic problems or reasons of other nature. For this purpose a bonding system is applied. According to this, the mine operator commits a certain amount of money, which is considered enough for financing the basic mine decommissioning and land rehabilitation works. This amount is gradually reduced as rehabilitation proceeds on waste heaps that have reached the specified elevations and will not be further utilized during mining works.

Environmental protection

The relevant terms and conditions regulate issues concerning the management of various waste 'streams' and the control of emissions that can deteriorate the quality of certain environmental components (e.g. air, surface water, groundwater, soil). In particular, these terms and conditions refer to the following issues:

- Control of particulate emissions during haulage of excavated material
- Disposal of waste that is not produced from the excavation process within the mine site

- Control of access in active mining areas
- Monitoring of radioactivity
- Management of used spare-parts and equipment beyond further repair in collaboration with recycling companies that hold all necessary approvals
- Treatment and discharge of water in aquatic receivers
- Mapping of all streams and diversion of those crossing the mining area
- Determination of the water balance in the greater mining area, after elaborating the necessary studies, and implementation of measures aiming at a rational use of water sources
- Operation of equipment repair facilities in a way that minimizes the release of dangerous substances to the environment (including development of required infrastructure for this purpose)
- Limitations for carrying out repair and maintenance works in-situ
- Implementation of programs for the collection, temporary storage and disposal of used lubricants, tires, batteries, etc., in collaboration with recycling companies that hold all necessary approvals
- Operation of wastewater treatment plans at the end of sewerage pipelines of buildings, equipment repair facilities, etc.
- Operation of auxiliary facilities (e.g. petrol stations) under the terms and conditions referred to permits of activities of this type.

Monitoring of environmental quality

Monitoring and record keeping are vital procedures for assessing the effectiveness of the applied environmental management practices. Monitoring methods must meet international standards, national regulations or best practices while records keeping papers and electronic devices must be approved by local authorities that are responsible for the inspection of mining operations. Access to all collected data must be free to all interested authorities.

The environmental parameters that must be monitored either continuously or on a regular basis include:

- Soil quality in rehabilitated areas
- Characteristics of waste materials that are co-excavated with lignite and are dumped in the mine waste heaps
- Quality it is monitored in ten stations located in selected points within the greater mining area. The installation points of these monitoring stations should be

determined in collaboration with university laboratories in order to give a representative view of air pollution dispersion under various weather conditions.

This section also establishes the obligation of the mining company to develop action plans in case of emergency situations that may cause severe environmental damage and to name the persons who have the responsibility by law to organize the company's response in the above cases.

Cost

Environmental permits refer to the costs of implementing the above-mentioned terms and conditions for the permitting period and until mine closure / rehabilitation. This cost includes all the activities required for environmental management during mining operations and land rehabilitation according to the plans that have been approved by the authorities. However, this cost excludes direct or indirect payments given as compensation to local communities or individuals for problems caused by the mining activities as well as the financing of projects that were agreed between the mining company and stakeholders for promoting the economic development and the welfare of local communities.

Expiration of the permit

The environmental permits of the Greek lignite surface mines are valid for a certain period (usually 10 years). When this period elapses, the Ministry of Environment must re-examine the terms and conditions of the permit and must suggest certain amendments, if necessary. This procedure is considered necessary because mining operations normally last a few decades, a period long enough for the development of new technologies and legal and administrative tools that guarantee a more effective protection of the environment.

Remarks about mines operation under the terms and conditions of the environmental permits

Mobilizing citizens and local authorities

The operation of the mines under the terms and conditions of the relevant permits provides the supervising authorities with a baseline for on-site inspections and the local communities and NGOs with an opportunity to trace and assess easily (i.e. with no need of technical expertise) the problems that threaten the quality of environment. At the same time, requests can be placed to the mining operator and the supervising authorities to take action in order to protect the living standards of the community. Up to now, numerous deficiencies or ineffective practices have been pointed out during on-site inspections or through the

submission of written complaints by local authorities and citizens. These issues are summarized in the following list:

- improper management of topsoil
- inadequate measures for dust control during ash transport
- limited use of covers on trucks
- discharge of wastewater without written approval from local authorities
- improper measures for controlling access to the mining sites
- absence of signs that delineate the mining area
- lack of measurements for radioactivity
- inadequate mapping of streams
- lack of elaboration of on-line measurements of wastewater quality
- delays in the reforestation program
- absence of covers on belt conveyors that transport ash
- absence of water sprinkling systems for reducing dust emissions along roads
- depression of water table and reduction of groundwater available for irrigation purposes
- improper management of waste tires, belt-conveyors and used lubricants
- dust dispersion from ash disposal site
- fractures on the land in the vicinity of mine pits
- operation of crushers without written permission

The aforementioned complaints are not characterized of equal importance in terms of intensity or frequency. In some cases they do not reflect reality. In other cases they have been resolved by providing the involved parties with all the necessary information. In some situations they have been overcome by the immediate response of the mining operator (Fig. 5-8) and only in a few cases have they led to the imposition of a fine by the Environmental Control Group of the Prefecture.



Figure 5. Temporary storage of tires delivered to contractors specialized in recap and recycling.



Figure 6. Installation of covers on belt conveyors that transport ash from the thermal power plants to the mines.



Figure 7. Temporary storage of used lubricants



Figure 8. Spreading of topsoil on horizontal surfaces of waste heaps designated for farming

In any case, the environmental permits make easier the participation of the public and all involved stakeholders in environmental impact assessment and environmental auditing procedures. In this way the development of innovative technical and administrative activities, which aim at improved environmental protection, is promoted.

The disputes of mine operators with supervising authorities

Often, the mine operators face many practical problems with the implementation of certain terms or conditions that are mentioned in an environmental permit. In such cases, the operator, in order to avoid conflicts with supervising authorities and imposition of fines, is allowed to submit to the Ministry of Environment an official request for modification of the permit.

In the case of lignite mining activities that are carried out in Greece the mine operators suggested (and the Ministry of Environment approved) a more flexible practice for topsoil management than the those described a) in the National Regulation of Mining and Quarrying Works and b) in the permit that was initially signed. According to the relevant provisions of

the legislation that is in force in other economically developed countries, the mine operator can use earthen materials excavated in deeper horizons, instead of topsoil excavated during mine pit opening, after proving through sampling and laboratory analysis that such material can support the quick grow of vegetation. Moreover, the new terms correlate the requirement of topsoil spreading on final mine surfaces with the planned land uses, after mine closure, and the results of sampling and laboratory analysis that are indicative of the fertility of mine waste materials.

Other points that are raised by the mine operators are related to the excavation of topsoil during mine pit opening, the construction of fences, the construction of noise control barriers and the position of signs. All these activities are carried out in areas, which have already been expropriated, but are usually cultivated by the initial land-owners as one of the compensations for the development of the mine. The farmers, however, protest against any action, which may result to loss of income from agricultural activities.

Communities' resettlement as the main cause of conflicts during permit development

Before the approval of an environmental permit and during the EIA procedure a major problem that usually arises between local communities and the mining company is the resettlement of villages. Up to now, the resettlement of communities was considered an alternative for surface mine development only if lignite deposits were located in inhabited areas. In these cases the mining company is obliged to pay compensation for every private property and for public buildings and infrastructure (churches, streets, utility networks, etc). Moreover, the company must cooperate with local authorities for the selection of the site, where the community will be resettled, and for the development of new infrastructure that will allow a timely resettlement of community members to the new village.

Furthermore, there is a continuously growing pressure from communities which demand resettlement due to the decline in their life quality caused by the various impacts of surface mining. Even if the mining operator meets the regulatory standards as far as the minimum distance from inhabited area is concerned, local communities demand their resettlement arguing that the large size of coal surface mining operations, which unavoidably spreads pollutants over a wide area, reduces the availability of land for activities other than mining. Until now, these claims have been opposed by the mining companies. However, there is still an increased uncertainty regarding additional costs that may arise in the future (Pavloudakis et al, 2006:1, Pavloudakis et al, 2006:2).

Advantages and disadvantages of the development of a corporate environmental management strategy based on the terms and conditions of the permits

From an environmental perspective, the main benefits resulting from the implementation of an environmental management strategy based on the terms and conditions listed in the relevant permits are related to the following two factors:

- The applied measures target a number of environmental issues of equal significance. The importance of this development can be fully understood when considering the belief of many mining companies that environmental protection is nothing but reforestation.
- The applied measures start from the early stages of mine development and operation. In this way, it is more likely to prevent irreversible damage to the environment and to minimize the risk of abandoning the mining site without having completed a proper rehabilitation program.

Furthermore, there are some secondary benefits, which are related to strictly environmental performance parameters as well as to more generalized performance criteria applicable to the minerals extraction industry (Canter, 1996, Vidal & Aurazo, 2004):

- Efficient and equitable project planning
- Increase of favorable environmental aspects
- Selection of cost-effective environmental alternatives
- Rational exploitation of human and financial resources
- Possibility of incorporating a life-cycle-analysis approach, which can be further used as a tool for integrating economic, environmental and social matters in a way that promotes sustainable development
- Provision of an opportunity to local communities to exercise their choice of rights
- Distinction between a) measures deriving from the terms and conditions referred in the permits and b) commitments of the mining company deriving from other agreements (e.g. in compensation for affected communities and groups of people)
- Improved information flow between proponents and different stakeholder groups; improved understanding of a project
- Determination of all important issues, including those perceived as being important by sectoral agencies, public bodies, local communities, affected groups, and others

- Distinction between legal requirements, technical expertise, as it is expressed by academic people, arbitration processes or manuals of best available techniques, and traditional knowledge
- Proper assessment of the magnitude and significance of impacts
- Better response of project proponents to different stakeholders' needs; identification of important environmental characteristics or preventive and mitigation measures that otherwise might be overlooked
- Improved acceptability and quality of mitigation and monitoring processes

In spite of the above mentioned potential benefits, the development of an environmental management plan that is focused on the compliance with terms and conditions mentioned in the permits receives criticism, which is usually related to lack of necessity, increased costs, delays, rise of conflicts, mistrust and excessive formalism (Pring, 2001, Donnelly et al, 1998).

In particular, some potential costs are:

- Adherence to the terms and conditions of the permits and overlooking or ignoring of other, usually locally-specific, social, environmental and health issues of equal importance
- Failure to draw on the feedback of local communities due to the blinkered compliance to the terms and conditions; probable loss of an opportunity for further enhancing the project benefits
- Failure to tailor rehabilitation projects to local needs and priorities due to the adopting of generally applied terms and conditions
- Failure to draw public support
- Emergence of conflicts between supervising authorities, local communities and the mine operator due to the strict procedural framework of resolving issues of minor importance

The integrated approach of environmental management

Nevertheless, the main advantage of the above-presented environmental management plan is the fact that it covers the entire range of activities, which take place in a large-scale surface mining operation, allowing a systematic and integrated control of all adverse impacts. The control or even the elimination of these impacts is achieved by continuously applying the following procedure (partially based on work by UNEP (1994) and Sadler & McCabe, 2002):

Supervision. Simple and effective surveillance by regulatory authorities to monitor adherence to and implementation of the terms and conditions of the project.

Monitoring. Improved monitoring of adverse impacts, based on certain qualitative and quantitative criteria that allow continuous check of environmental changes, and measurement of the effectiveness of any mitigation measures. Monitoring can be useful either for assessing the changes of certain environmental parameters due to the development and operation of mining activities or for ensuring that regulatory requirements and standards are being met.

Compliance with regulatory standards. Simplified check for the compliance with regulatory standards that are in force and other terms and conditions that must be met, relevant to pollutants' emissions, waste discharge, etc. No need to refer to the legal framework, which is continuously modified.

Auditing. Verification of the accuracy of EIA predictions regarding the environmental impacts and the effectiveness of mitigation measures that were proposed. Audits are systematic and documented verification procedures that must evaluate objectively the conformation of the EMS to specific criteria set by the company. The results of the evaluation must be communicated to the hierarchy and must be also linked to mitigation and preventive action processes. An effective auditing process is based on (a) the development of audit protocols, (b) the determination of appropriate audit frequency, usually once per year, (c) the selection and training of auditors, who must be independent of the activities being audited, and (d) the maintenance of audit records, which must cover laws and regulations, products, processes, suppliers, contractors, important environmental management issues, emergency situations and readiness for response, complaints, training programs, inspections, reviews, etc.

Decision-making. The hierarchy of the company has a stable basis of making decisions taking into consideration a variety of unbiased parameters that allow an equitable distribution of project benefits to all stakeholders, satisfying at the same time various objectives: increase of company's profits, welfare of local communities, economic prosperity of the country, etc.

Public involvement. All involved parties are kept informed and are capable of participating in a constructive dialog with the local authorities and the mine operator, having an opportunity to present their opinions and to claim the implementation of measures that ameliorate their life standards.

**A possible development: the certification of Environmental Management System
according to international standards**

Based on the terms and conditions prescribed in the permits of mining activities, a mining company can develop and implement an Environmental Management System (EMS). This system will be the basis of every environmental management action and performance review during the entire mine lifetime, starting from mine development, continuing during mining operations and ending after mine closure. The system will include a series of actions for continuous monitoring of various environmental components and control of all adverse impacts by applying certain preventive and mitigation measures (Vlachantonis & Pavloudakis, 2003).

In this context, the development of an EMS can be based on the principles and procedures of ISO14001. Taking into account the facts and conditions presented in the above sections, which rule every large-scale surface mining operation, the development and certification of an EMS is a feasible investment that can pay back the relevant cost in several ways.

Since June 2007, the Public Power Corporation SA, the company that exploits the vast majority of the lignite deposits located in Ptolemais basin, holds an ISO14001 certification for the EMS that applies to four surface mines. The key element in the implementation of this EMS is the formal and documented procedure that is followed for keeping the different levels of the company's hierarchy informed about the overall effectiveness and the potential 'weaknesses' of the applied environmental protection and land reclamation practices. Taking advantage of this critical characteristic, the hierarchy is capable of participating in the decision-making and of setting the priorities of the environmental protection policy. Although this is expected to be common practice in every company, it is also true that in complex production activities, such as surface mining operations, the environmental issues are not the primary concern of the upper hierarchy.

Another critical advantage of the certified EMS derives from the requirement of active participation of all the company's personnel to environmental protection actions (e.g. waste recycling). This participation is achieved through the entrusting of specific responsibilities and the realization of seminars and other training programs.

Furthermore, the mitigation measures which are selected based on the EMS are part of a uniform and long-term strategy with unambiguous objectives, which does not favor spending money on remedial actions not included in the specified conditions. It also minimizes the

risk of severe ecological damages that may result in an adverse publicity to the company (Cascio et al., 1996, Arvanitogiannis et al., 2000, Vlachantonis & Pavloudakis, 2003).

PLAN Package

- Commitment of hierarchy
- Initial environmental review
- Documentation / dissemination of company's environmental policy
- Recording of environmental laws and regulations
- Realization of impact assessment studies and recording of significant environmental issues
- Development of an organization chart (allocation of responsibilities)
- Determination of tangible and measurable targets
- Development of an environmental management program

DO Package

- Control of mining operations
- Implementation of environmental protection measures
- Education, training and sensitization of personnel
- Implementation of the public relations strategy
- Dissemination of information
- Publishing / dissemination to the company's personnel of guidelines for the implementation of the EMS

CHECK Package

- Monitoring / comparison with standards, targets and performance criteria (indicators)
- Recording of monitored parameters and environmental quality results connected to indicators
- Audits of processes and proposal of corrective measures for achieving compliance with standards

REVIEW Package

- Internal review of the entire EMS conducted by the management
- Customers review (non-mandatory)
- Review conducted by an accredited third-party (non-mandatory)
- Technical certification

- Corporate sign-off of review (corporate endorsement)
- Management commitment to EMS improvement

Conclusions

Coal and lignite surface mining operations can cause adverse impacts to the natural and socioeconomic environment due to the type of the activities and the enormous scale of the affected area. As a consequence, activities of this type are considered a potential threat for the health, quality of life and economic development of communities located in the vicinity of mining sites.

The legal framework that is now in force sets as a prerequisite for obtaining a permit for the development of a new surface mine, the thorough investigation of the related environmental impacts. Based on this analysis a series of terms and conditions are determined, which regulate the implementation of preventive and mitigation measures for monitoring and protecting the environment during mine development, operation and decommissioning.

For the mining complex of Ptolemais, Greece, where the exploitation of the lignite deposit started in the 1950s, the first environmental permits were signed in 2001, after completing a long-lasting process of negotiations with all the involved Ministries and local authorities. The experience gained so far from the operation of the mines under the terms and conditions specified in the permits shows that this process can boost the overall environmental performance of the mining company. This enhancement is achieved through the implementation of an integrated environmental management strategy that covers all potential impacts and is not solely focused on reforestation and measures applicable after mine closure.

On the other hand, the only weaknesses of this approach are delays and misunderstandings, which are due to interpreting the terms and conditions in a formal and inflexible way that does not leave space for a constructive dialog in favor of the equal distribution of the project benefits.

The development and certification of an Environmental Management System, according to the standards set by ISO or other international organizations, which will incorporate the terms and conditions of the relevant permits, is an opportunity that further improves the corporate environmental performance. Furthermore, this provides the company's hierarchy with a tool for evaluating the effectiveness and predicting the feasibility of various land reclamation and environmental management plans.

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