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ENVIRONMENTAL IMPACT ASSESSMENT OF THE AWIBENGKOK GEOTHERMAL FIELD DEVELOPMENT, GUNUNG SALAK, INDONESIA

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ABSTRACT

Like many geothermal prospects around the world, the Awibengkok Geothermal Field, currently being developed by Unocal and Pertamina about 100 km south of Jakarta, is in an environmentally sensitive area. The development is mostly within a protected tropical forest area with a nature reserve and two tea plantations on its margins. Few people will be displaced by the development since there are no permanent residents in the planned field but, because of the low population density in adjacent areas, effects on neighbouring residents will be particularly noticeable. The environmental impact study prepared for the project concludes, however. that the project will have a very positive social impact and that the environmental management and monitoring programs should both minimize the ecological impact of the geothermal development and provide data needed to improve the security of much of the surrounding natural habitat.

INTRODUCTION

In 1982, Unocal Geothermal of Indonesia, Ltd (UGI) entered into a Joint operating Contract (JOC) with the Indonesian National Oil Company (PERTAMINA) to operate the Gunung Salak Geothermal Contract area located about 100 km south of Jakarta. At the same time UGI also entered into an Energy Sales Contract (ESC) with the Indonesian National Electrical Utility (PLN). Subsequent exploration including geological, geophysical and geochemical surveys and 11 exploration wells discovered two fields, the Awibengkok Field (8 wells) and the Ratu Field (3 wells). Further studies have shown that the Awibengkok Field has proven reserves of 230 MWe for 30 years. UGI has committed to supply steam to a two 55 MW unit PLN Power Plant during the first stage of development. Later plans call for expansion of plant capacity with an additional 55 MW unit during a second stage of field development, bringing total installed capacity to 165 MW.

Environmental concerns are of particular interest at Awibengkok because of the ecological and social sensitivity of the immediate area. The area to be utilized for the first 110 MW development (Figures 1 and 2) is entirely within the Gunung Salak protected forest with the Halimun nature reserve and the Cianten tea plantation adjacent to the west and the Jayanegara tea plantation bordering on the south. The population of the neighbouring villages is relatively small so social and economic impacts will be particularly noticeable. Forest areas are allocated to the "protected" category in order to stabilize hydrology and control erosion in important watersheds, whereas nature reserves are designed to protect natural habitats and endangered species. The Awibengkok development is a sufficient distance from the Halimun Nature Reserve to produce a minimal impact on it but the impact on the protected forest and the local population must be considered more thoroughly.

Soon after Unocal began its initial exploration program at Awibengkok in 1982, the government of Indonesia enacted new laws outlining basic provisions for environmental management, but the relevant regulations were not implemented until 1986. In order to get an initial project activity and location permit in the interim, Unocal prepared a preliminary environmental baseline and impact report that was not specifically required by the 1936 regulations. Subsequently however, the Awibengkok Geothermal Field became the first energy resource project in Indonesia to complete the newly instituted environmental review process and acquire a developme and operation permit.

The most important stages of the environmental regulation process consisted of the preparation, review and approval of two sets of documents, an Environmental Impact analysis (EIA) and an Environmental Management and Monitoring Plan (EMMP). The EIA has five sections: 1) an introduction, 2) a project description, 3) an environmental baseline study of existing conditions 4) a project impact identification and prediction and 5) significant impact evaluation and a proposed EMMP outline. The EMMP provides the approved guide-lines for operating and monitoring the field in an environmentally sound and sustainable way taking into account technology, economy and institutions.

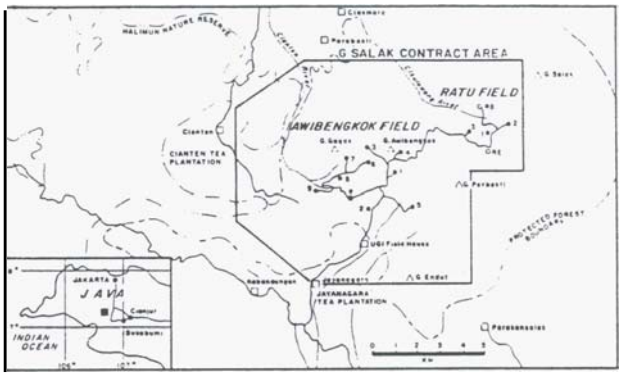

Fig. 1. Location of Gunung Salak contract area and protected forest boundary.

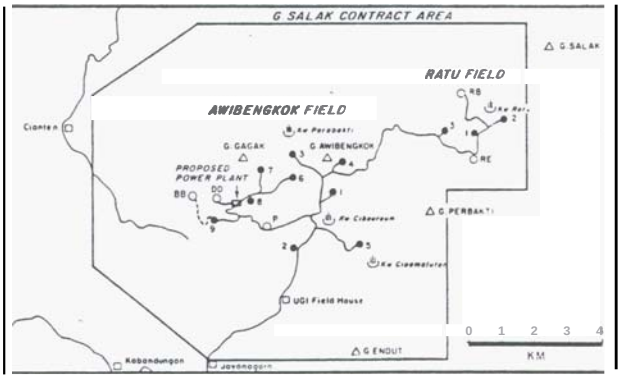

Fig. 2. Location of Awibengkok field and thermal features.

THE EIA REPORT

1) Environmental Baseline

Geomorphology

The Gunung Salak Contract area (Figure 1) is located on very rugged Quaternary volcanic massif consisting of three main volcanic centres, Gunung Salak (2311 m), Gunung Parabakti (1699 m) and Gunung Gagak (1511 m). The predominantly andesitic volcanics are deposited on a "basement" of Miocene calcareous sediments. The most recent volcanism is a 2000 year old rhyolite tuff that was erupted from Gunung Awibengkok. Relatively minor hydrothermal mud eruptions have been reported at several of the numerous hot spring and fumarolic complexes (Kawah Parabakti, Kawah Cibeureum, Kawah Cipamatutan and Kawah Ratu, See Figure 2). The Awibengkok field lies over and to the west of the principal thermal manifestations in the vicinity of the Gagak and Parabakti cones.

Climate

The Gunung Salak climate is typical of moderately high altitude wet tropical areas and is classified as Type A Koppen. Temperatures range from 15 to 28°C, average humidity is 90% and annual rainfall ranges from 3800 mm to 5300 mm. Winds usually average 0.8 m/s with a recorded maximum of 4.5 d s , and are predominantly easterly in January through April and southerly in September though November. Air quality measurements show unusual readings only within the Kawah Cibeureum fumarolic complex (Figure 2) where H_2S of .04 to .12 ppm was detected.

Hydrology

Given the very steep topography and heavy rainfall drainage consists of deeply incised streams in a radial pattern on the volcanic cones feeding a dendritic valley drainage. The Cisakati and Cianten Rivers drain from the current development area to the west, the Cikuluwung Rivers drain from the ridgeline just east of field area towards the north and the Cibeureum River flows to the south. Shallow ground water aquifers occur in colluvial deposits, lava flows and pumice tuff deposits.

Vegetation

Most of the Gunung Salak Contract area is covered by a mixed tropical forest, 5% of which is primary, 75% old secondary and 18% young secondary growth. About 2% is covered by tea plantations. No endangered flora were detected. Fifty-nine species of trees were identified, the most dominant being Altingia Excelsa (Local name: Rasamala). The mature trees are about 30 m tall with diameters commonly greater than 30 cm. The commercial timber potential in the development area of the Awibengkok Field would be about 288 cubic m/Ha, although this timber is protected from harvest by current conservation legislation.

Wild Life Habitat

Wild life population surveys were conducted over two periods, during a dry season (March-August) and a wet season (September-February). These surveys identified 16 species of mammals, 6 species of reptiles or amphibians, and 8 species of birds that are protected and inhabit the region. One of the species identified, spotted Leopard (Panthera Pardus) is a rare and endangered species in Indonesia, evidence of which was found during the dry season. Other protected species that were found in this area included the Black Monkey (Hylobates Moloch), the Jungle Cat (Felis Bengalensis), Small Java Deer (Munitiacus Muncak) and the Scaly Anteater (Manis Javanica).

The protected ornithological species that were found in this area included, Rhypidura Javanica, Spilornis Colopakdis, Spizaetus Malayensis, and Callus Varius. Interviews with local villagers led to the suspected presence of Anthinoptes Alacencis, Rhyticeros sp, D. Remifer, and Ketupa Ketupu.

The streams and rivers of the Gunung Salak region are also characterized by a fair diversity and abundance of phytoplankton and some 20 species of fish, none of which are endangered.

Social Economics and Culture

At the time of the survey the population of the villages near the project site totaled some 106,410 people. The average population density in the villages surveyed was 9 people per Ha, and individual village populations ranged from 3,945 to 8,150.

The majority of the populace near the tea plantations was employed by the plantations, whereas the populace of the area north of the contract area were generally rice paddy, clove, or fish cultivators. Besides plantation workers and other cultivators, many other farmers were found in the villages engaged in goat, lamb, chicken, and duck farming, both as main occupations and as side earnings.

The majority of the population has had some primary education with decreasing proportions having progressed through junior and senior high schools. Local opportunities for utilizing more advanced education are limited, underemployment is common, and young educated villagers frequently move permanently from the community because of the lack of opportunity. Almost the entire population was identified as being Moslem. The general attitude of the population to the Awibengkok development was very positive.

The transportation infrastructure included paved main arteries with serviceable cobbled secondary roads that were regularly reached by public transport.

2) Project Description

For the purposes of environmental regulation, Awibengkok field development activities were considered in three groups: 1) site layout and construction, 2) drilling and well testing and 3) operation.

Site Layout and Construction

During the exploration of the field, approximately 85 Ha of land was utilized by UGI from the protected forest. Development will use an additional 25 Ha of land for a total of 110 Ha. Land usage bill be minimized by clustering directionally drilled large bore wells on a few large pads. All of the production and injection system will be within the protected forest but there will be no permanent residence facilities built within the ptected forest.

Drilling and well-Testing

Development drilling will be carried out using a conventional oil rig equipped to safely handle geothermal conditions to 3000 m based on previous experience with other wells in this area. The wells will be directionally drilled and will be completed with larger than standard casing to minimize the number of production bells. Only six productions wells will be needed for 110MW startup including spare capacity. About seven injection wells bill be needed. Each well is expected to take about two months to complete, Drilling water will be pumped from the Cisaketi River but drilling fluids will be disposed by settling out solids in the lined drill sumps and then injecting excess fluid down a well into the geothermal reservoir. Similarly, after steam separation, well test fluids will either be directly injected or held in a sump and then pumped down a well. Non-condensible gas (NCG) produced during well testing, will be vented, but this does not present an environmental problem since NCG is less than 1% of steam produced.

The proposed layout for the initial 110MW field operation is shown in Figure 2. Most of the production will come from six wells on pads AWI-7 and AWI-8. Each well will have a dedicated separator. Produced steam and brine will be sent through separate steam and brine lines. Insulated lines will connect wells to the power plant located about 500 m best of the AWI-8 pad. Most of the injected brine will be piped further westward to the planned injection pads at AWI-9 and two new locations. Most cooling water condensate will also be injected into a dedicated well but some will be injected into the steam feed upstream of the steam scrubber to ensure good quality steam. Using condensate for steam cleaning greatly reduces the amount of river water required to operate the field. In case of power plant upsets and for startups, steam will be temporarily piped to a rock muffler. Temporary wellhead relief of two-phase fluid will be provided through an atmospheric flash tank vented to a storage sump fur later injection.

3) Anticipated Environmental Impacts

The most serious environmental risks identified were related to noise, H_2S emissions, the possibility of brine spills from the injection system, decreased flowrate of streams due to drilling rig withdrawals, disturbance to the hydrology due to land clearance and related erosion and distortions of the structure and composition of flora in the vicinity of the development.

The most obvious environmental benefit would be social. There will be not only increased direct employment in the area but also the general improvement in local opportunities that this would bring. In particular, the serious under employment of better educated residents and the tendency of many of the most promising young people to emigrate permanently from the area should be alleviated. There are, however, dangers associated with increased road traffic and potential social problems related to inter-community competition, disruption of long established social and economic hierarchies and the anticipated local economic slump that may follow the completion of the construction phase of Units 1 and 2.

THE ENVXRONMENT MANAGEMENT AND MONITORING PLANEMMP)

The most serious environmental problem, the loss of the protected forest area, will be addressed by the purchase of an equal area of non-forestry land to add to existing protected forest. Also the developers will pay for the trees being cut and those funds will be applied to reforestation. Damaged but unutilized forest area will be reclaimed using original species where appropriate.

In order to protect drainage areas and erosion prone areas, all unpaved open spaces will be vegetated and steep slopes terraced and planted. Areas around H_2S emitting facilities will be planted with H_2S tolerant (and, in some cases, absorbent) plants such as species of rhododendron. A thorough air quality monitoring program will identify any excessive emissions. Water quality monitoring will be done in all drainage areas that could be affected by a brine spill and the field will have sufficient lined sump capacity to handle anticipated upsets.

The impact of the project roed traffic will be managed by coordinating major transportation efforts with local authorities and by implementing a prominent road safety awareness program directed at both project personnel and the general public. Temporary bachelor quarters for construction workers wili be maintained in the forest close to the site in order to minimize commuting and the social strain of a major influx of temporary workers in small villages.

Other programs directed at alleviating social concerns will include support for community projects and events and an effort to hire locally when possible. Local training and education will be supported tc steadily increase the skill level of local workers.

CONCLUSION

The long term plan of the government of Indonesia is to increase the total of protected forest plus Nature Reserve lands to 30% of Java's area. The Halimun Nature Reserve is not directly affected by the current development and its security should be improved by increased funding for local forestry monitoring. The environmental management plan should adequately protect Salak hydrology, erosion should not be a significant problem, and the net amount of protected forest on Java will be maintained by land purchases. Since the principal purposes for the protection forest will be ensured, the project was judged to meet the Department of Forestry's environmental requirements. The EMMP appeared to adequately mitigate the drawbacks of the project and great social benefit was expected so a permit has been issued to proceed with the construction and operation at Awibengkok.

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