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KENYA

ENVIRONMENTAL ASSESSMENT SUMMARY

KIPEVU 75 MW DIESEL PLANT
(SECOND PLANT ADDENDUM)

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A REPORT ON THE ENVIRONMENTAL IMPACT ASSESSMENT OF THE 75MW MEDIUM SPEED DIESEL PLANT AT AT KIPEVU, MOMBASA (THE SECOND PLANT ADDENDUM)
KENYA

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EXECUTIVE SUMMARY

BACKGROUND

Demand for power has been increasing in Mombasa, and in the middle of a national effort to use alternative power sources for electricity (hydro and geothermal), The Kenya Power Company has found a need for a 75 MW generating plant at Kipevu to fill the 33 month "dry" time that exists in the hydro cycle. The present 1954 plant has serious generating problems. Coupled with a highly increased demand, a rapid initiation of the new plant was necessary. A second 75 MW plant is now being planned to supplement the first 75 MW. The purpose of the second plant is to meet projected demand shortfall in dry hydrological years.

The second 75 MW diesel generator is designed to be located on a hill next to the present 75 MW plant. The new plant will have a self-contained cooling system and be either slow or fast depending on design. This fuel-generating building will utilize an imported generator insulated in metal sheets, active fuel storage tanks with water storage tanks for radiator use, and a new transformer area with facilities for roads, drainage, store rooms, repair rooms, sanitary and washing areas, and petroleum holding areas. The site favored is next to the old power plant and directly next to the new 75 MW plant. The site had been formerly used as a British military site. The present plant has been operating since 1954 and its design does not reflect environmental sensitivity. In addition, the 5 generators equalling over 100 MW total, have serious repair problems so that they will not be operable for more than another 6 or so years, during which time the new plant and hydro facilities can come on line. Environmental problems of the existing plant include air emissions, once-through cooling from Kilindini Creek to Makupa Creek with 100 degree Fahrenheit (38 degree centigrade) water emitted, leakage of small amounts of petroleum from the plant on a regular basis, and excessive use of fresh water, some of which comes from rivers and springs in national parks. Fire and oil spills have occurred. The environmental assessment for the first 75 MW plant has already been submitted.

The present plant and future site is located at the western edge of Mombasa in the center of one of the largest industrial areas (port, oil refineries, sewage treatment, several industrial zone dump sites) in coastal East Africa. The winds blow WSW for a part of the year and ENE a second part. The prevailing wind speed is 6-9 knots. The hill is approximately 141 M above the adjacent land and is shale with some "floating" baserock, formed in the post-Jurassic period. The site is located on a spit of land previously occupied by the British for a fortification in the 20th century with 11 buildings and a clearing. Thus, it is not a virgin wilderness site. With the withdrawal of the British, the site has returned to an "old field" on its secondary successional stage from grass-dominated
(Cenchrus ciliaris, a common Kenya grass) to a mixed shrub (Acacia dominated) and grass system. A series of birds "visit" the site in their daily scanning for food. The food web is grasses and grass detritus with insects (grasshoppers, butterflies, moths, etc.), reptiles, and birds at the top of the food web. Many seed-eating birds are also present. The list of species does not include any endangered species, even though our field study carefully looked for the potentially endangered birds and two endangered mammals possibly inhabiting the site. The proposed site was not a nesting or chick-rearing area. Nests were seen in other places with larger more mature trees. The shrubs and bush produced food, but not habitat.

Below the hill is Makupa Creek which has been cut off for at least a century from two broad tidal creeks which come from the ocean (Tudor Creek to the north, and Kilindini creek to the south) which form major channels around Mombasa. The flow into Makupa Creek is tidal and from the port area of Kilindini Creek, past two branches of the port. The Creek has large mud flats on the west side which function as a wading bird feeding area. The present productivity is based largely on blue-green algae and red algae. Crabs, annelid worms, univalves of a variety of types, and nursery fish inhabit these shores at present.

A large portion of this north side of the Creek is being used as the major municipal land-fill. A wide variety of substances are being drained into this creek from the land-fill. Consequently, the wading bird productivity of the intertidal population is far lower in the northern shore. The Mombasa (east side) is also being used as a dump site for the port and a land-fill. Substances also enter from this side. The Makupa Creek into which the present plant has emptied up to 3000 gal./minute from the existing 110 MW generators in once-through cooling, is not pristine, but rather has been used for at least 400 years for depositing sewage and garbage, and heavily used for 100 years. The long-term plan by the city of Mombasa is to continue the land-fill and the use of these two sites. Plans by the national government include an Economic Free Zone between the power plant and the dump site (just upland from the wading bird feeding area). The bottom of Makupa Creek is mostly mud. There are red and green macro-algae attached to rock. The original seagrass which forms an important part of the lower intertidal and benthic community has been removed by siltation, filling and frequent oil spill from the port some time ago. To summarize, the bay immediately adjacent to the existing and new sites is highly impacted. One area of productivity at the west end remains productive and is worth protecting. The largest polluter in the area is the municipal dump.

One of the oldest cities in Kenya, probably dating back to the second century A.D., Mombasa provides countless tourists with an exotic flavor that blends local, Arab, Portuguese and British traditions. The tourist community is a prime energy user in Mombasa today (10 times more energy per person than citizen-use). Although Mombasa
was the most important trading town on Africa’s east Coast for many centuries, its tremendously rapid recent growth has put a heavy strain on its infrastructure. A reliable power supply is one of the major constraints to a high quality of life for its residents and to the factors that make for successful industrial ventures in Changamwe, (its industrial sector and the area in which the Kipevu power plant is located). The cultural heritage at the site was examined by an archeologist expert in the Mombasa periods. Pre-World War I British military remains were the only cultural property found. Three armament bases will be preserved.

There are no residents, squatters or hawkers on the present or proposed sites of the power plant in Kipevu, so no resettlement is necessary. The socio-economic composition of the nearest settlement Changamwe (one mile west) parallels that of industrial sectors in many of Africa’s rapidly growing cities. Most of the inhabitants are male, though some have brought their families to them after establishing a home or a job. About half of the inhabitants earn less than $20 US per month. Another 25% earn $100 US a month or less and about 24% earn somewhat more. One third of the residents live in squatters colonies in mud and wattle housing. Half of the people in Changamwe now have water and electricity and half are without. Almost all the people who live in Changamwe are either workers at the many industries located in Changamwe or are self-employed as hawkers or in some menial capacity. People interviewed claim that those who are able work at two, or even as many as three jobs at one time. As much land as is available is devoted to subsistence vegetable and fruit production.

Industries in the area include automobile assemblage, a large brewery, lumberyards, a soap factory, bakeries, brick and block manufacturers, furniture manufacturers, many wholesalers and many cottage industries as well as a wide variety of trades represented in the informal sectors. There are about 10,000 residents and workers in Changamwe. The workers and residents are positive about the project. They feel jobs and more electric power for their homes will improve their lives.

ENVIRONMENTAL IMPACT

The apparent environmental impact of the second power plant can be separated into site-specific impacts, construction impacts, and operating impacts (including hazards). The site-specific impacts include: i) removal of the grassy habitat with loss of feeding area of about two hectares; ii) loss of brush area for drain and other structures; iii) outflow of storm water wastes into Makupa Creek; iv) air emissions; v) potential hazards to the port, and road to the port by petroleum and potential threat to a sensitive wetland from the petroleum tanks; vi) geological perturbation by erosion of the edge of the hill. The construction risks include: i) run-off of silt down the hill in all directions into estuarine water; ii) potential accidents or fires that will spread materials into the water
or air; iii) removal of adjacent areas' ecosystems beyond the site by siltation due to construction; iv) dumping of hazardous and toxic substances. The operating impacts include: i) use of large amounts of water per day (the choice of the source of which is a factor in potential impact); ii) the potential spillage or fire hazard due to many tons of stored petroleum; iii) storm water run-off that contains heavy metals, silt and oil; iv) creation of hazardous and toxic wastes which need to be disposed of; v) vibrational activity of the generator in the shale (a partially metamorphosed clay); vi) the electromagnetic field of the transformers; vii) from each of six machines release of sulfuric oxides of 10 million cubic meters, nitrates of 11 million cubic meters, and 126 tons of dust; viii) disposal of hazardous and toxic wastes; ix) erosion, and x) sewage. Section 1.9 outlines solutions for all of these impacts.

The apparent social impacts on the adjacent community do not include resettlement of any people. Also, no livelihood will be interrupted or taken away. In fact a very positive effect on livelihood for Changamwe residents will occur.

The solutions for these problems have been examined in some detail with various experts and with the planning and management of Kenya Power Company. The appropriate solutions seem feasible and relatively cost effective:

a) The petroleum hazard problem (spill or fire) is not easily solved on top of the hill due to proximity to generators and transformers and due to potential releases down the hill to the existing plant, port, sewage plant, restaurants or sensitive wetlands. The relatively fragile substrate of shale may not support the massive weight of the tanks and may erode rapidly. The optimum solution is to immediately expand and upgrade the petroleum holding facilities next to the present generating facilities by building a large earthen wall containing 105% of tank volume at a 3 to 4 m distance from the tanks to act as a safety wall for leaks, accidents or fires. (Employees will obviously enter by stairs up and down the wall.) The tanks themselves might be expanded and rebuilt for a much larger facility at the same petroleum site.

b) Construction of a dyke parallel to the shore line, which will contain plant effluent and storm water and potentially act as a barrier to heavy metals or petroleum as well as extensive silt from the construction phase flowing towards the biologically productive western edge of Makupa Creek, is recommended.

c) The removal of the grasses and habitat is absolutely necessary before placing the foundation and for fire hazard removal. In almost any site a certain amount of vegetation would be removed, including the alternative site Rabai. There is also a mitigation program recommended and described below which will purchase virgin forest land adjacent to Shimba National Park or Abedare National Park.
d) The plant effluent and storm water problem is best solved by having a large drainage system capable of handling maximum storm water, and 3 drain traps, 2 for sediment, and a final oil trap. The storm water drain would circle the plant and the final drain would be next to the present cooling water. Many problems of the construction phase can be overcome by building this drain system along with the roads and foundations first. The alternative to the dyke system is to have the "sanitary water" emissions (baths, drains, toilets) treated by the not-yet functioning sewage plant to the west.

e) Site construction should be conducted in accordance with a construction erosion and sediment transport control plan. The plan should ensure that appropriate control measures are installed to include, but not to be limited to: settling ponds, swales and ditches (to reduce stormwater velocity and allow for sedimentation); loose rock barriers across ditches (to reduce water velocity/turbulence and filter silt from the stormwater); hay bales staked in ditches (to reduce velocity and provide filtration); and hay bales and silt curtains along unprotected slopes to reduce velocity and turbulence and provide filtration. All construction areas adjacent to water bodies and existing creeks should have hay bales and/or silt curtains staked in place to assure that silt laden stormwater does not enter natural water bodies. Inspection of these facilities should occur weekly to ensure that devices remain in place and are working effectively. Final sedimentation and oil removal will be accomplished in the pond system prior to discharge. Additionally, ditches alongside the roadway down the bluff should be concrete or asphalt lined. If the above procedures are not implemented, significant erosion will occur during construction and over the life of the plant. Significant amounts of silt will be deposited in the final sedimentation pond(s) and inhibit their usefulness as a treatment device. The final sedimentation pond itself will not provide adequate protection for the aquatic environment and minimize erosion to an acceptable level.

f) The water source problem is best handled by drilling a well so as not to use water from the National Parks. The alternatives are Tiwi well water, which is not now available at the site except mixed with Shimba Park Water, and river water from tens of miles away, which is delivered sporadically. A supplementary water source could be created by building catchments and cisterns. Potentially, water from the sewage treatment plant could also be a non-potable supplement. A mixed source is most likely the best plan.

g) Safety and workers' health and safety solutions are outlined in the text.

ALTERNATIVE SITES

A. No Action Alternative: The no action alternative does not seem feasible since there is enormous citizen, industry, commercial and infrastructure pressure to have
secure, regular and sufficient power. This second 75 MW plant will allow for expanded commerce, industry and tourism. The 40 year old plant cannot provide this. The hydro and geothermal programs will not be in place in sufficiently short time to provide the power. In short, the second largest city in Kenya with the largest port in East Africa and the largest oil refineries and largest tourism business in coastal East Africa must have a power source adequate to its future.

B. Rabai Site Alternative: Lack of cost-effectiveness, zoning problems, resettlement of substantial number of farmers and other citizens, lack of land ownership, and a worse set of environmental problems due to similar sources, water and emissions factors does not justify this site which was considered in detail.

C. The proposed Kipevu Site: The cost-effectiveness of the Kipevu site due to the usefulness of many facilities including transformers, power lines, administrative building and present petroleum holding tanks is clear. Also the area is zoned industrial. Most of the highest volume electrical customers (the oil refinery 7 MW; the port 5 MW; the other industries in Kipevu and West Mombasa 12MW) are immediately next to the present site making transmission simple and cost effective. Also all the environmental and social potential problems have feasible solutions in this location.

MITIGATION ALTERNATIVES

Mitigation Plans:

a) For the energy conservation and efficiency program, already established with citizens and industry in Mombasa, a new program appealing to tourists (a major energy and water user in Mombasa) to participate in energy conservation measures for Mombasa will be carried out by KPC. Our recommendation is for a conservation videotape and slide show to be placed in hotel lobbies on a continuous basis emphasizing the alternative energy program through geothermal and hydro sources, to educate tourists to energy conservation measures. The focus would be on how the tourist could participate in saving electricity by using less hot water and air-conditioning. Participation by hotels in providing window and door screens so that tourists could choose not to use air-conditioning at night and still feel safe from mosquitos carrying malaria will be explored by KPC with hoteliers.

b) A program to direct storm run-off, waste water, oil, heavy metals and other substances away from the only productive feeding ground of Makupa Creek via an earth dyke will be implemented in this program:
c) Three sets of important structures from the old British installation (as designated by the coastal archeologist) will be saved in the design of the plant as cultural heritage mitigation for cultural property.

d) Triple drains are recommended to be installed for the combined storm water and existing plant waste water as mitigation.

e) Safety walls will be built around existing oil tanks as well as any new tanks as a type of mitigation for preventing oil spills and fires.

f) Also, the present position of the petroleum tanks will be moved down the hill as safety and mitigation measures. Either existing tanks will be made much larger, or new ones will be placed west of them. An assembly area for safety will be established on the present tank pad area.

g) Safety equipment, especially for fires but also for oil spills will be purchased as a part of this loan. These will already be on site and functioning when the crew arrives.

h) Oil spill equipment, training, a contingency plan and operational and structural safety measures will all be put into place.

i) The productivity of the grassland habitat which will be removed for the power plant site is recommended to be replaced by the purchase of 6.5 hectares of forest land immediately adjacent to Shimba Park. The site will be Shimba National Park or Abedare National Park where through carelessness of people over the years, many hectares of vegetation were removed but other perturbances or pollutants are not present or are minimal.

ALTERNATIVE GENERATING OPTIONS

KPC has considered in depth the alternate energy generating options. A large scale energy program using local energy sources is underway throughout Kenya with KPC utilizing chiefly geothermal and hydro energy. Detailed considerations in which this petroleum-based unit was the most optimal, given rapid timing for construction needs, and cost for Mombasa, are available through KPC.

CONCLUSION

Given KPC's agreement on the above mitigation, design, acceptable alternatives and construction and operation hazard and safety measures, the plant should be a strong
positive benefit to those citizens of central coastal Kenya, especially Mombasa and surroundings.

The overpowering needs for the plant voiced by all interviewed was striking. The series of easily facilitated, low cost remedies to the environmental problems are outlined herein:

a) The major petroleum holding tanks now designed for the north crest of the hill will be transferred to lower level and surrounded with a safety dyke with one or two small temporary petroleum storage/equalization tanks on the top of the hill.

b) The wildlands taken for the plants are recommended to be replaced by a purchase of 6.5 hectares of virgin forest next to Shimba National Forest.

c) Workers safety measures are to be introduced.

d) Safety from fire and petroleum measures must be introduced.

e) A set of alternative water sources, the use of which will not do harm to a National Park, have been recommended: wells, Tíwi water, Sabaki River water, rainwater (as supplement for "make-up" water), and desalinized water. A combination of several sources is also discussed.

f) Hazardous, toxic, and organic wastes are addressed and solutions outlined.

g) Emissions into the air and water are addressed in detail and the solutions given as necessary. Water emissions through siltation and accident are particularly emphasized.