Initial Environmental Examination

Project No: 46455

July 2014

Nauru: Electricity Supply Security and Stability Project

Prepared by the Nauru Utilities Corporation

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ABBREVIATIONS AND UNITS

ACM	Asbestos containing material
ADB	Asian Development Bank
CIE	Ministry of Commerce, Industry, and Environment
dB(A)	Decibel acoustic (a measure of noise level)
EHS	Environmental health and safety
EMP	Environmental management plan
GRM	Grievance redress mechanism
GWh	Giga-watt hour (a measure of energy output)
IEE	Initial Environmental Examination
km	kilometer
kV	kiloVolt
kWh	Kilo-watt hour
m	meter
MCIE	Ministry of Commerce, Industry and Environment
MW	megawatt
NO_2	Nitrogen dioxide
NRC	Nauru Rehabilitation Corporation
NUC	Nauru Utilities Corporation
PCB	Poly-chlorinated biphenyls
PMU	Project management unit
RONPHOS	Republic of Nauru Phosphate Corporation
SO_2	Sulfur dioxide
tCO_2e	tons carbon dioxide equivalent

I. INTRODUCTION

1. Nauru is an island country in Micronesia in the South Pacific. **Figure 1** shows Nauru as a small, single, oval-shaped equatorial island, located about 40 kilometers (km) south of the equator, and some 2,000 km east-north-east of Papua New Guinea. Its nearest neighbor is Banaba Island in Kiribati, 300 kilometers (km) to the east. The Although Nauru has an exclusive economic zone of 320,000 square kilometers (km^2), its total land area is only 21 km^2 making it the smallest state in the South Pacific and second smallest state by population (<10,000) in the world. Figure 1 shows Nauru's location in the western South Pacific.

Figure 1 – Location of Nauru

2. **The project**. The proposed Nauru Electricity Supply Security and Stability Project (the project) will improve the quality and reliability of electricity service provided by Nauru Utilities Corporation (NUC). This will be achieved through the delivery and installation of new diesel-fired generation to provide reliable base-load power for NUC, allowing NUC to retire older generation assets and perform scheduled refurbishment of existing units to extend their service lives. The project will also include improvements to the existing structure housing NUC's generation units.

3. Nauru's current diesel-fired generation fleet is dilapidated, unreliable, and extremely inefficient. All of NUC's installed generators are operating at far below their nameplate capacity, and are nearing the end of their useful lives or are out of service. The powerhouse (physical structure) is likewise in poor condition, which represents a vulnerability to Nauru's supply security.

4. While Nauru is virtually 100% electrified, service reliability is extremely poor. Unscheduled – and often prolonged – interruptions are frequent. As in other parts of the Pacific where significant intermittent renewable generation sources are being introduced into legacy diesel-based systems (e.g. Yap), Nauru will remain reliant on thermal generation (i.e. diesel) for its base-load and for system stability and reliability for the foreseeable future. High-priority investment requirements have been identified to improve service reliability and mitigate the risk of catastrophic failure of NUC's power generation system. Among NUC's investment priorities is the introduction of 2.6-3.0 megawatt (MW) (nominally 2.8MW) of new diesel-fired generation to replace existing generation, improve reliability, and reduce fuel costs.

5. NUC estimates that this will result in a 20% improvement in generation efficiency from the current 3.4 kiloWatt hour (kWh) to 4.1 kWh generated per liter of diesel consumed.

6. The feasibility assessments and due diligence for the project are being conducted through project preparatory technical assistance which is intended to: (i) determine the scope for necessary powerhouse repairs; (ii) identify safeguards issues and develop impact mitigation measures and plans as required; (iii) prepare a comprehensive generation rehabilitation and investment plan; (iv) prepare specifications for procurement of new generator unit(s) and for installation of new generator(s) and associated auxiliary equipment; and (v) assess current tariff policy, tariff-setting procedures, and options for provision of subsidy support for low-income households' electricity consumption.

7. **Objectives of the IEE**. As part of the due diligence, this initial environmental examination (IEE) identifies and assesses the environmental impacts associated with the project. The IEE describes the proposed project, its location, potential impacts, and mitigation measures to lessen any adverse environmental impacts during the construction and operation of the project. In the absence of an environmental assessment framework in Nauru, the IEE complies with the Asian Development Bank (ADB) *Safeguard Policy Statement 2009* (SPS). The objectives of the IEE are to:

(i) Conduct an environmental audit of existing facilities and operations;

(ii) Conduct environmental assessment for each element of the proposed project: (a) delivery and installation of replacement diesel generator(s), (b) decommissioning and disposal of generators to be retired, (c) rehabilitation of existing generators, (d) repair and/or demolition of existing structures at NUC's generation site;

(iii) Develop environmental impact mitigation measures for incorporation into structural rehabilitation of the powerhouse which is envisaged under the project;

(iv) Develop specific scopes for the management, handling, and disposal of any identified hazardous materials (e.g. asbestos-containing materials) in accordance with relevant national legislation and SPS;

8. **Approach and methodology**. This IEE provides an assessment of existing environmental conditions in the project area including the identification of environmentally sensitive areas; identifies and evaluates potential impacts and their significance; and includes an environmental management plan (EMP) that will prevent or minimize adverse environmental impacts to acceptable levels. The IEE has been prepared in the context of SPS, noting that the level of detail and comprehensiveness are commensurate with the significance of potential impacts and risks.

9. The information in the IEE was acquired from site visits, secondary sources, and information gathered from stakeholder consultations undertaken for the project. Information about the project components and configuration were provided by NUC. The environmental impacts of the proposed project have been analyzed within the primary impact zone encompassed by and adjacent to the main project site (the existing powerhouse) and adjacent properties, and the broader environs of the island of Nauru.

II. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

A. Nauru Environmental Policies

10. Since Nauru's independence from Australia in 1968, its laws are derived primarily from English and Australian common law, though it also integrates indigenous customary law to a limited extent. Nauruan common law is founded mainly on statute law enacted by the Parliament of Nauru, and on precedents set by judicial interpretations of statutes, customs and prior precedents.

11. Nauru's environmental regulatory framework is based largely on legislation prior to becoming an independent nation in 1968. The Constitution of Nauru, adopted in 1968, establishes itself as the supreme law of the country.

12. There is no comprehensive environmental management law, but there are a series of legislative acts covering various ecological and public health issues, which are summarized in Table 1, and discussed below. There are no formal regulatory requirements for environmental impact assessment.

Table 1 - Nauru Environment Regulatory Framework

Item	Scope
The Constitution of Nauru 1968	Supreme law of the country
Criminal Procedure Act 1972	Provides for criminal prosecution for offenses against any environmental law.
Nauru Rehabilitation Corporation (NRC) Act 1997	Establishes NRC as lead organization for rehabilitation of phosphate mining areas
Nauru Fisheries and Marine Resources Authority Act 1997	Includes provision for conservation and protection of fisheries and marine resources
Litter Prohibition Act 1983	May be broadly interpreted to cover most solid waste disposal
Marine Pollution Prevention Bill (proposed)	Drafted in 2000 but not passed
Public Health Ordinance 1925, Amended 1967	Focus on public health and control of potential nuisances to human health
Lands Act 1976	Defines land ownership rights, limitations on transfer of ownership and leasing. This act would cover any acquisition of land, e.g., for new power plant locations or a new landfill.

Source: SPREP. Government of Nauru: Review of Environment Related Laws. [Undated]

13. Nauru does not have specific regulations or emissions standards applicable to diesel–based electricity generation. In the absence of such national standards, the standards of the World Bank Group standards for thermal power projects ranging from 3 – 50 megawatt (MW) thermal input, presented in Table 2 are applicable to the project. World Health Organization ambient air quality standards are presented in Table 3.

Table 2 - World Bank's General Environmental, Health, and Safety Standards

Parameter	Indicative Standard	Comment
Stack emissions		Dry gas, excess O_2 content 15%
Particulate Matter (PM) (mg/m3)	100	Upper limit based on economic viability
Sulfur dioxide (SO_2) (% in fuel)	1.5 – 3.0	Sulfur concentration in fuel can be monitored
Nitrogen oxides (NOx)	1600 – 1850	Lower limit applies to engines with bore size < 400 mm; upper limit applies to bore size = or > 400 mm
Wastewater (mg/L except as noted)		Standards are for industrial wastewater treated for discharge to sanitary sewage systems. Project wastewater is storm water, for which World Bank guidelines do not include quantitative standards. Therefore, these standards are presented as benchmarks for reference and not for strict compliance purposes. Monitoring capacity in Nauru is very limited; simple field kits and portable instruments are recommended for pH, BOD or COD, TSS, and oil and grease.
pH	6 – 9	
Biochemical oxygen demand (BOD)	30	
Chemical oxygen demand (COD)	125	
Total Nitrogen (N)	10	
Total Phosphorous (P)	2	
Oil and grease	10	
Total suspended solids (TSS)	50	
Total coliform bacteria (Most probable number / 100 ml)	400	

Source: World Bank Group. Environmental Health and Safety Guidelines (2007)

Table 3 - World Health Organization Ambient Air Quality Guidelines

Parameter	Averaging Period	Guideline (microgram/m^3)
Sulfur dioxide (SO_2)	24 hour 10 minute	125 (Interim target-1) 50 (Interim target-2) 20 (guideline) 500 (guideline)
Nitrogen dioxide (NO_2)	1 year 1 hour	40 (guideline) 200 (guideline)
Particulate Matter (PM10)	1 year 24 hour	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline) 150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter (PM2.5)	1 year 24 hour	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline) 75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone (O_3)	8-hour daily maximum	160 (Interim target-1) 100 (guideline)
Note: PM 24-hour value is the 99th percentile. Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.		

Source: World Health Organization. Air Quality Guidelines Global Update (2005)

14. **International environmental agreements**. A number of international environmental conventions/treaties and protocols related to environmental management and protection were also signed, accessed and ratified by the government of Nauru. These conventions/treaties and protocols are listed in Appendix 1.

B. ADB Safeguard Policy

15. The SPS requires that all ADB financed or administered projects undergo an environmental assessment to ensure the environmental soundness and sustainability of projects. It also aims to support the integration of environmental considerations in the project decision-making process by developing safeguards to avoid adverse impacts of projects on the environment and affected people, minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible, and to help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

16. Environmental assessments are required at different levels of detail depending on the complexity, scale, and degree of impact, ranging from the largest and most complex, category A, to the smallest and least complex, category C. For all the categories, the environmental assessment should take into account the global environmental aspects on biodiversity and institutional capabilities related to environmental and social aspects. The environmental assessment process requires an initial screening of a project to determine, at the early stage, the level of assessment that is required so that appropriate studies are undertaken commensurate with the significance of potential impacts and risks.

17. The project will improve generation efficiency and reduce the intensity of emissions, with minimal long-term irreversible impact on the environment. The potential adverse environmental impacts of the project will occur during the construction stage, and are site-specific, temporary, and most can be managed and/or mitigated. Based on these considerations the project has been classified as environment category B with this IEE being the appropriate level of assessment.

III. DESCRIPTION OF THE PROJECT

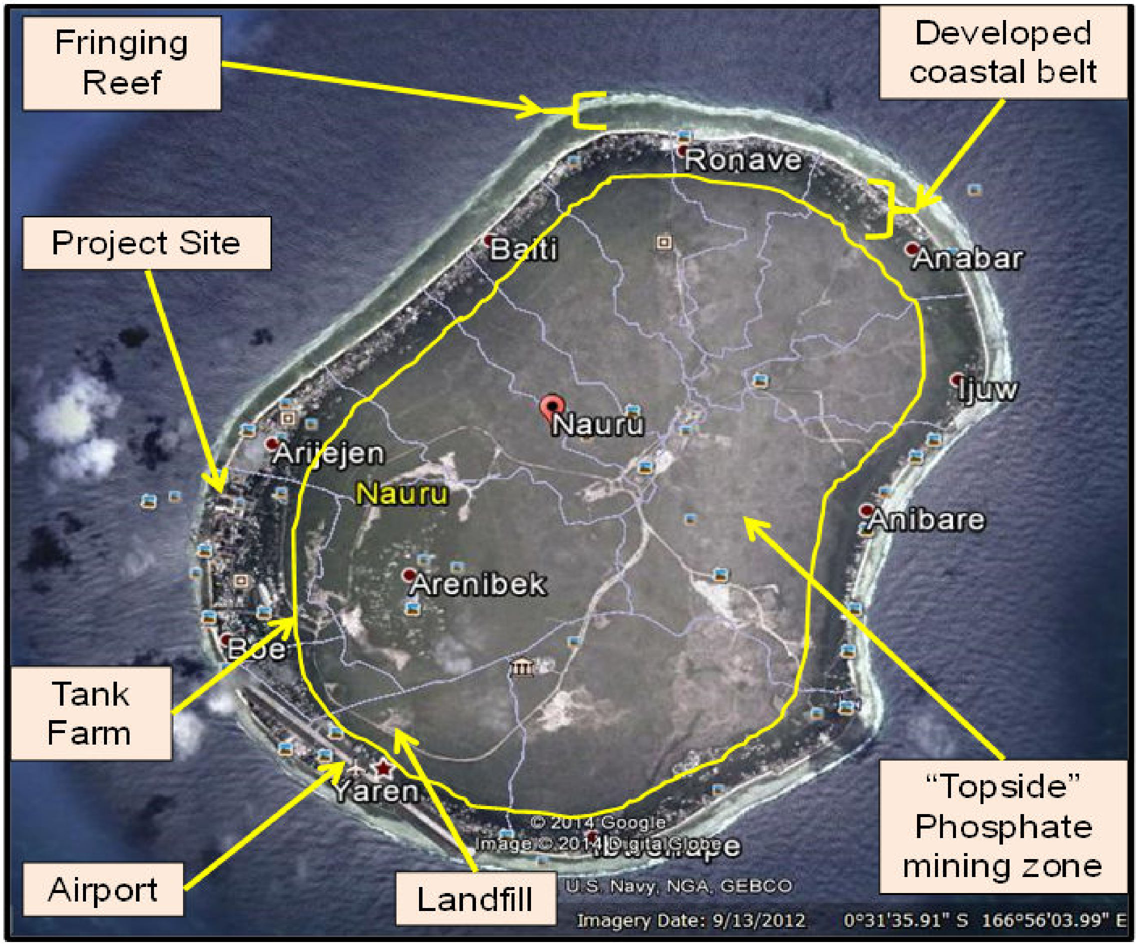
A. Project Proponent and Location

18. **Project proponent**. NUC will be the executing agency and owner of the project, with overall responsibility for Project design, preparation and evaluation of tenders, construction supervision, and operations. ADB will manage procurement activities, as well as project implementation consultants.

19. Nauru is 100% electrified, but service quality and reliability are poor in large part due to aging generation units which have not been adequately maintained. The proposed project includes the following components: (i) delivery and installation of replacement diesel generator(s); (ii) replacement of the NUC powerhouse roof; (iii) environmental monitoring; and (iv) decommissioning and disposal of generators to be retired (by NUC).

20. The project is located at NUC's existing power generation facility on the west coast of Nauru. Figure 2 shows the project location and other key infrastructure.

Figure 2 – Location of Project Site



B. Project Components

21. **Delivery and installation of replacement diesel generator**. The project will finance up to 3 MW of new diesel generation capacity. The exact configuration and size of unit is still to be confirmed and will depend on the results of tendering and available budget.

22. **Decommissioning and disposal of generators to be retired**. Some of the existing generation units are inoperable or are well beyond the end of their economic operating lifetime, and after installation of new generation units, some of these will be retired. The units to be retired have not been confirmed as of late June 2014.

23. **Rehabilitation of existing generators**. Some existing units are in need of major overhaul, but have kept in operation with only limited maintenance, to provide basic electricity service. After installation of new units, major overhauls will be performed if those units can be brought back in to regular service economically.

24. **Repair and/or demolition of existing structures at NUC's generation site**. The existing powerhouse is in poor condition. The roof, which is partly made of asbestos-containing material (ACM), requires replacement as soon as possible. An asbestos survey conducted in 2007 identified appropriate procedures to ensure that the asbestos does not pose a public health threat during roof rehabilitation or removal, as long as best practices are employed during removal, storage and final disposal (see Appendix 2).

C. Implementation Phases

25. **Design.** The design of the project is based on projected electricity demand and reserve generation capacity requirements in the event that the largest, and first and second largest, generation units are off-line (referred to as N-1 and N-2 conditions). The existing generation units still operational, have a nominal or nameplate capacity of 8 MW but due to deferred maintenance these have been de-rated to a total of 3.5 MW at present.[1]

26. NUC is intending to order an additional 3 MW of new containerized high speed generating capacity,[2] which will bring nominal capacity to about 6.5 MW; this is sufficient for projected demand and N-1 conditions before any self-generators, such as the Refugee Processing Centre are connected. The proposed project will deliver up to 3 MW of additional capacity which is expected to meet near-term demand growth from existing consumers but is unlikely to satisfy N-2 conditions, particularly if existing self-generators are connected.

27. **Construction**. The overall construction and installation works are scheduled to be implemented within a period of less than 12 months. The entire construction activities will employ only a limited number of qualified workers with specific experience in setting up diesel generation units. It is anticipated that 10 to 15 local workers may be engaged in asbestos removal and roof replacement, under the supervision of foreign personnel with expertise and appropriate qualifications or certifications in asbestos management.

28. Construction camps will not be needed. All of the proposed work will take place on the existing NUC premises. New transformers will be installed to connect new generation units to the grid. These will be specified as containing no polychlorinated biphenyls (PCBs).[3]

29. **Operations**. During the operational phase, routine monitoring and maintenance activities will be performed to ensure that the generation units are operated as designed. As noted above, after the new generation units are installed the existing units will undergo major overhauls or decommissioning.

30. **Project proponent**. NUC will be the executing agency, and will participate in project preparation, design of project components, and in evaluation of tenders. ADB will manage procurement activities, as well as the project implementation consultants.

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1 Daka, Andrew D. 2013. *Technical Evaluation and Assessment Study of NUC Power Generation and Distribution Systems*. SPC-GIZ Coping with Climate Change in the Pacific Island Region Programme (CCCPIR) Energy Component. Suva, Fiji. 5 June 2013

2 These units are being funded by the Governments of Nauru and Australia.

3 PCBs were phased out of use globally beginning in the late 1970s, and it is actually quite difficult to acquire new transformers with PCBs. Decommissioning of transformers is not included in the project scope. However, at NUC's request, PCB Best Management Guidelines are presented in Appendix 4.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Physical Resources

1. Topography and Geology

31. Nauru is an uplifted limestone island, initially covered in guano that had accumulated over centuries. Nauru's 'guano' made for the richest and purest source of phosphate in the world, which was primarily used in fertilizer.[4] The land area consists of a narrow coastal plain or "Bottomside", ranging from 100 to 300 meters wide, which encircles a limestone escarpment rising some 30 meters to a central plateau, known locally as "Topside" (as shown on Figure 2).

32. The maximum height above sea level is approximately 70 meters. The island is surrounded by a fringing coral reef between 120 and 300 meters wide. The reef drops away sharply on the seaward edge, at an angle of about 40^{o}, to a depth of about 4,000 meters. [5]

33. The coastal plain comprises a zone of sandy or rocky beach on the seaward edge, and a beach ridge/fore-dune behind which is either relatively flat ground or, in some places, low lying depressions or small lagoons filled by brackish water. Scattered limestone outcrops or pinnacles can also be found on both the coastal plain and on the inter-tidal flats of the fringing reef.

34. The raised central plateau or Topside consists of a matrix of coral-limestone pinnacles and limestone outcrops, between which lie extensive deposits of soil and high-grade tricalcic phosphate. This area covers approximately 1600 ha (over 70% of the island) and has been the focus of phosphate mining for over 80 years. Relative elevations on Topside vary generally between 20 and 45 meters above sea-level, with occasional pinnacle outcrops reaching elevations of 50 to a maximum of 70 meters above sea-level. The topography remaining after completion of primary phosphate mining is a pinnacle-and-pit relief varying between 2 and 10 meters.

35. The highest point on the island is Command Ridge in the west at an elevation of 71 meters above sea- level. Buada Lagoon, a landlocked, slightly brackish, freshwater lake, and its associated fertile depression (about 12 ha in area), is located in the low-lying southwest-central portion of the island at an elevation of about 5 meters above sea- level.

2. Temperature and Rainfall

36. The climate is equatorial and maritime in nature. There have been no cyclones on record. Nauru is located in the dry belt of the equatorial oceanic zone, with diurnal temperatures ranging from 26^{o} to 35^{o} Celsius, and nocturnal temperatures between 22^{o} and 28^{o} Celsius.

37. Annual rainfall is extremely variable, averaging 2,126 mm per year but with a range of 280 to 4,590 mm. Monthly rainfall data available for the period 1977 to 1993 indicate a range of 0 to 746 mm, with 62 months out of 204 months (for which data were available) having less than 100 mm of rain. Rain tends to be more frequent during the months of December to April. Prolonged droughts are common and place severe stress on the natural species and lead to the death of non-coastal exotics and fruit trees (such as breadfruit).

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[4] Guano comprises droppings by seabirds mixed with decaying microorganisms from the ocean floor and with the natural coral and limestone that formed the island.

[5] Government of Nauru. 2004. *National Assessment Report: Ten Year Review of the Barbados Program of Action*

3. Water Resources

38. Surface water resources are limited to the fresh water Buada Lagoon in the southwest part of the topside, which is not used for drinking water. Potable water is supplied by limited rainwater collection and reverse osmosis desalination plants. The desalination plants used around 30% of the energy generated by NUC in 2008. Since 2008 and the reinstatement of the Australian Government funded Refugee Processing Centre, additional desalination capacity has been added on the island, each with its own high speed diesel power supply.

39. Groundwater is not used for drinking water. Septic tanks may be poorly maintained, with some contribution to groundwater contamination. Until a few years ago, sewage from a centralized treatment plant was dumped into the ocean just beyond the reef; this outlet is location between the active phosphate loading facilities and the NUC site.

4. Air and Noise Quality

40. There are no air quality and noise monitoring networks on the island, and no quantitative baseline data are available. Phosphate mining is the major industrial activity, which generates particulate matter from mining and milling operations, and other emissions from furnaces. In addition to NUC's generation capacity, backup generators running on diesel or gasoline (petrol) are common.

41. The main sources of air pollutants are the phosphate mining operations, vehicle emissions, dust from roads, burning of household solid wastes, and power generation including NUC's powerhouse and an unknown number of backup generators.

42. Given the age and condition of NUC's generation units, the stack emissions probably do not meet guidelines for new diesel generation units. The visibility of stack emissions varies during the day, but the emissions plumes are not readily visible beyond the NUC site boundaries. Airborne dust is visible around some of the phosphate processing buildings and is highly visible during loading onto ships. The NUC site, phosphate mill, and phosphate loading facilities are all located on the downwind side of the island, which minimizes the direct potential impacts of emissions.

B. Biological Resources

43. Development in the coastal belt and a century of mining activity in the interior has severely degraded the island's ecosystems. Mining operations have damaged both terrestrial and marine biodiversity. Mining has caused runoff and of large quantities of silt and soil onto the surrounding reefs, which has greatly reduced the productivity and diversity of reef life.

44. On land the mining has removed much of the vegetation. Of the 467 plant species found on Nauru, most are either native or introduced weed species. Exotic weed species predominate in primary succession, but they are rapidly replaced by native plants such as *Dodonea viscosa* and *Ficus prolixa*, and by pantropical strand plants such as *Scaevola taccada*, *Morinda citrifolia*, *Premna obtusifolia*, *Guettarda speciosa*, and *Calophyllum inophyllum*.

45. These species are scattered and stunted, however, when compared to their growth habitat in the unmined areas. Centuries will be needed for the vegetation to reestablish naturally, even in a modified form, and most likely it will be composed primarily of *Calophyllum inophyllum* and other native coastal strand trees as dominants, with *Ficus prolixa* on the exposed coral—limestone pinnacles that remain after mining. Figure 3 shows vegetation patterns on the island.

46. The project site was cleared of vegetation decades ago and remains devoid of vegetation and animal life. The surrounding area to the north, west, and south of the site has been developed for industrial use. The area to the east is vegetated, but is not pristine. On Figure 3, the project site is located in disturbed area category 1c ("cultural") which represents most of the urbanized areas.

C. Socio-Economic Conditions

1. Land Ownership and Use

47. Land law of Nauru is to be found primarily in the Lands Act 1976 and, by and large, continues the regime in force previously with the exception that if three quarters in number of the joint owners of a property agree to lease it for public purposes then the Minister may override the refusal of the minority. Ownership of land included such things as rights to grant life interests and profits and extends to ownership of wells, the reef, fishing rights and lagoons. Nauruan customs concerning title to land (other than by lease), rights to transfer or by will or other testamentary disposition and succession are given statutory recognition and have full force and effect of law.

48. Traditional Nauruan society was divided into 12 tribes, with the land shared between them and passed down through the female line (matrilineal). Land ownership remains very important to Nauruans, and no activities can take place on any piece of land without the consent of the traditional owners.

49. The ownership of the phosphate has been recognized, more by default and implication than by design. The constitution provides in Article 83 (1) "Except as otherwise provided by law, the right to mine phosphate is vested in the Republic of Nauru." The Republic became, thereby, the successor to the BPC, but only in respect of the right to mine. The right has been given by law to the Nauru Phosphate Corporation which still mines the phosphate.

50. The island is divided into two plateau areas: "bottomside" a few meters above sea level, and "topside" typically 30 meters higher. The bottomside area is generally less than 1 km wide, has been heavily developed, and is considered to be urban as it is home to most of the population. For administrative purposes the island is divided into 14 districts.

51. The topside area is dominated by pinnacles and outcrops of limestone, the result of nearly a century of mining of the high-grade phosphate rock. About 70% - 80% of the total area has been disturbed by mining.[6] Phosphate production peaked at 1.5 million tons in 1975, decreasing to 250,000 tons in 2001 and to almost zero in 2004. Production resumed in 2005, and amounted to 41,549 tons in 2009. The topside area also hosts a refugee processing center operated by the Australian government.

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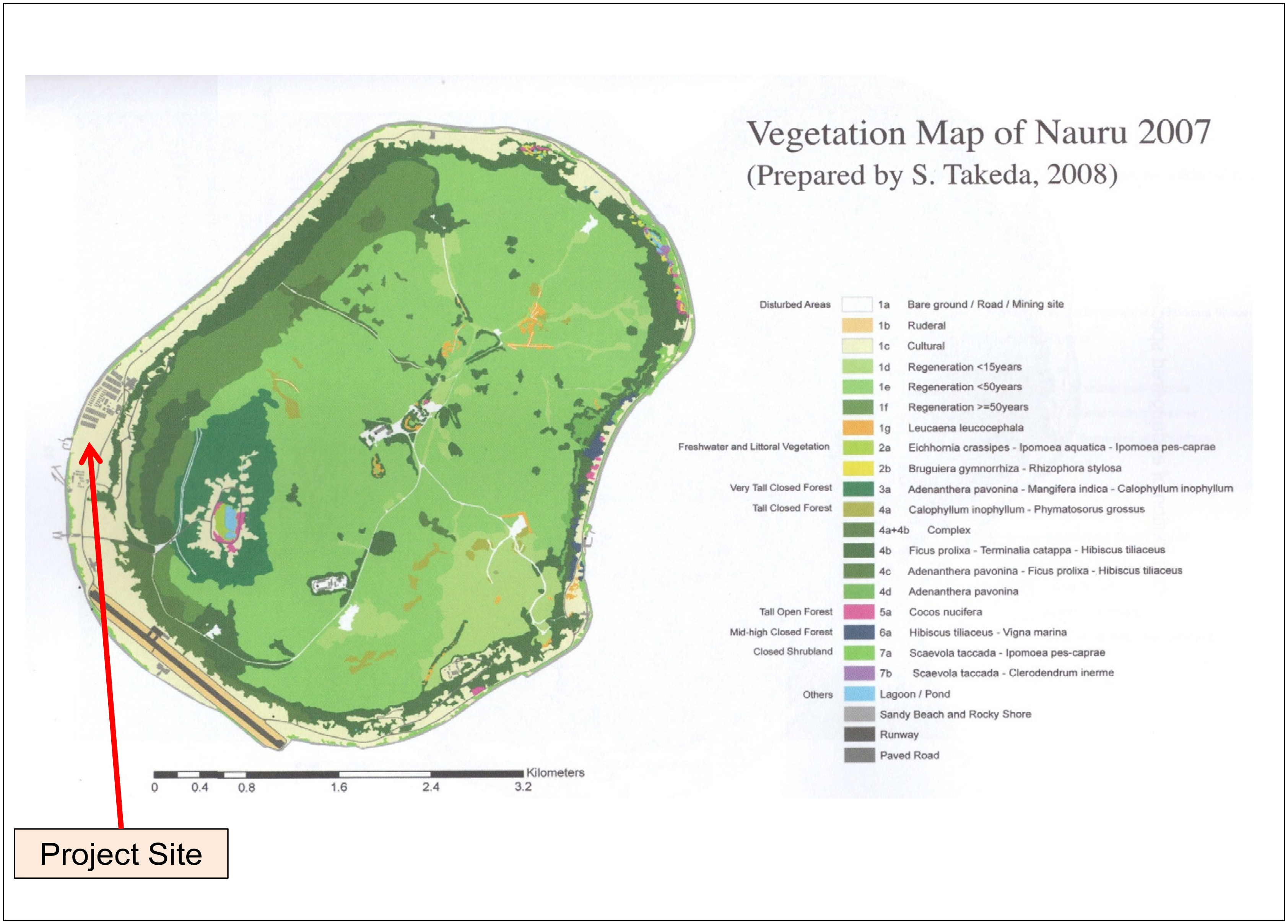
[6] M. Nazzal. 2005. An Environment Destroyed and International Law http://www.lawanddevelopment.org/articles/nauru.html

Figure 3 – Vegetation Map of Nauru



Source: SPC. *The Vegetation and Flora of Nauru – 2007* (2009)

2. Population

52. **Demographics**. The 2011 census shows a population of 10,084 persons with 5,105 males and 4,979 females and indicated a crude birth rate of 27.2 and crude death rate of 7.5 (for period 2007 – 2011). The median age is 25.3 years with 92% of the population being 54 years or younger. The ethnicity of the population is Nauruan 58%, other Pacific Islander 26%, Chinese 8%, and European 8%.[7]

53. **Health and education status**. Adult obesity was 71% in 2008, the second highest in the world after American Samoa. Health expenditures accounted for 9.8% of gross domestic product in 2011. Life expectancy is 59.7 years (56.8 years for men and 62.7 years for women), ranking 169th in the world. Public education is available; the average period of school attendance is nine years for males and ten years for females. There is one general hospital for the island.[8]

54. **Living standards and wellbeing**. Nauru became independent in 1968, and took control of mining operations in 1970. From that time onwards all profits were retained by Nauru, and until the early 1990s Nauruans derived one of the highest average per capita incomes in the world from the export of phosphate rock. Mining extended across a large part of the island, so the royalties received as payment for mining rights were shared among many families in proportion to the amount of land they owned. During the peak years of phosphate mining virtually all Nauruans enjoyed a high standard of living and had plenty of opportunities for education and personal development. Virtually all household needs, including food and drinking water, were imported from overseas. Although residual mining continues, both government revenue and average household income have been reduced dramatically. Insufficient revenue now limits capacity to maintain public and private buildings, and sometimes, even capacity to pay public service salaries. Slow growth in the public and private sectors means few opportunities for young people entering the labour market.

55. Some Nauruan families that were once highly privileged in comparison with much of the world's population are now finding it difficult to provide for their day-to-day needs. Food security is a significant issue, as very little land is suitable or available for agricultural production, and most food is imported. Social surveys conducted for the poverty and social assessment noted that only 13% of households kept a kitchen garden and livestock production was low. Most households rely on imported frozen poultry for protein needs and this is supplemented by marine resources. About half (51%) of households undertake fishing, with "own consumption" reported as the primary objective.

3. Infrastructure

56. **Power supply and electricity use**. For residential and normal commercial activities, Nauru is 100% electrified, with electricity provided by NUC when sufficient generating capacity is available. The majority of households and commercial consumers receive electricity supply via a pre-paid meter. NUC provides a subsidized residential tariff of US$0.10 per kWh[9] for the first 300 kWh per month, with the tariff increasing to US$0.25 per KWh above that.

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7 Government of Naru. 2012. *Census of Population and Housing 2011*

8 UNICEF. 2005, *Nauru: A Situational Analysis of Children, Women and Youth*

9 This compares with the estimated production cost of US$0.60 / kWh (based on discussions with NUC).

57. The phosphate mining operations, Refugee Processing Centre, some contractors' bases and new accommodation blocks, have captive generation units. Backup generators are common. The majority of the households use liquefied petroleum gas or electricity for cooking, with some preference for gas due to the unreliability of electricity. Freezers and refrigerators are common, as is home ownership of fans and air conditioners.

58. **Water supply**. As noted above, drinking water is supplied by desalination plants and some rainwater harvesting. Groundwater is generally not utilized, although some wells may be present.[10] Most people have access to improved water supply (96% of the population) and sanitation (65.6%).

59. **Transport and access**. A road encircles the island, with a limited network of roads and trails into the topside area. An airport with a single 2 km runway is located on the south coast. There are no natural harbors. Two harbors have been created; a small-boat harbor on on the east side of the island at Anibare Bay, and a larger facility which handles container shipments and other bulk cargo adjacent to the NUC project site on the western side of the island.[11] Two phosphate loading facilities have been constructed on the west coast. One of these units is no longer operational; the operating facility is just south of the harbor adjacent to NUC. Beyond the fringing reef, water depth increases rapidly, allowing deep-water ships to moor within a short distance of its edge.

60. The project site is within NUC's power station and existing facilities as shown in Figure 4. Industrial facilities are present on the west and south sides of the site, and the main ring road is present on the east side. The north side was formerly a golf course and is now occupied by storage containers and a staging area for prefabricated housing units.[12] Fuel for power generation and other purposes is imported and conveyed to a tank farm on Topside, southeast of the NUC powerhouse. A non-engineered solid waste landfill is located further to the southeast.

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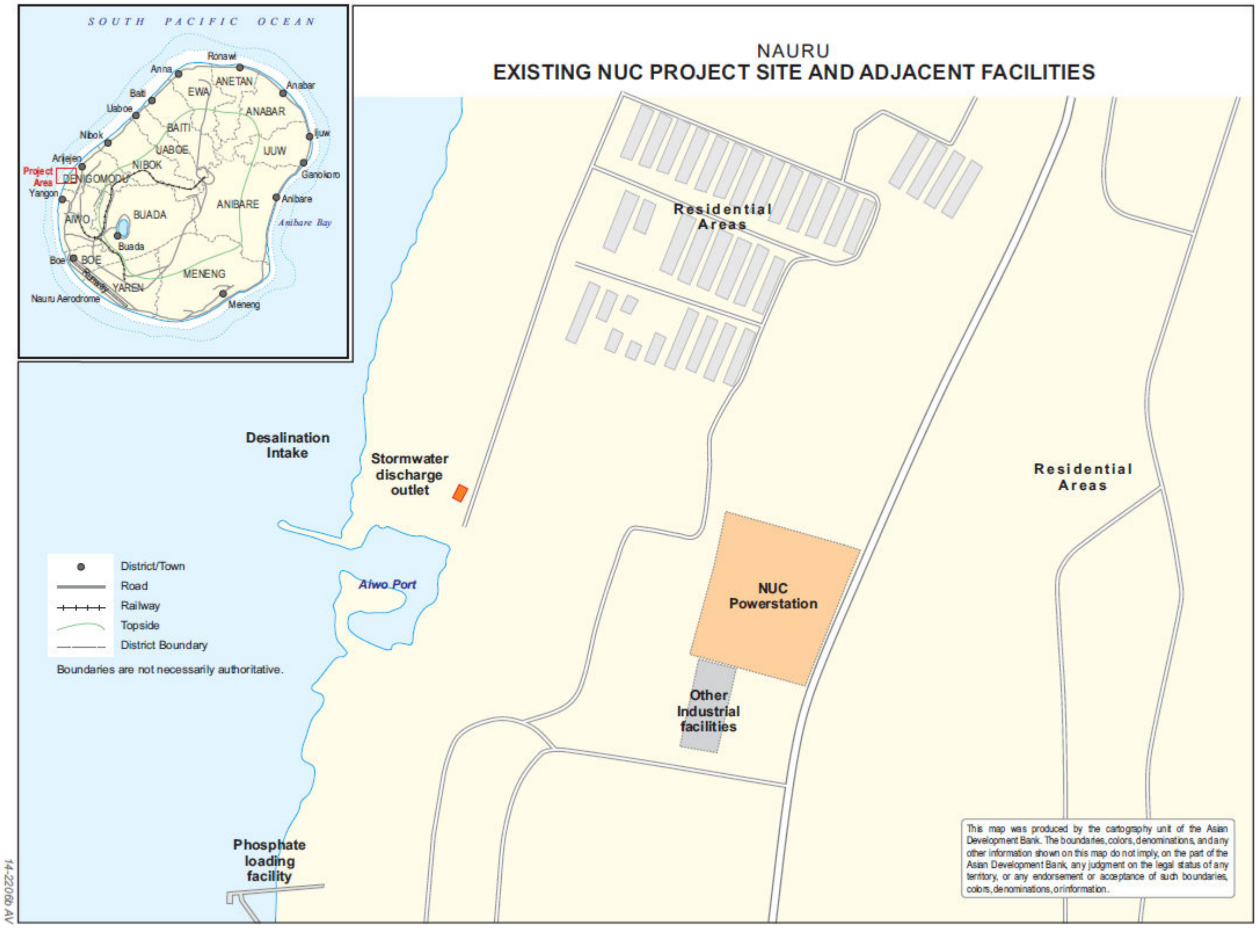
[10] Anecdotal reports note that groundwater has significant odor and is not fit for human consumption.

[11] The harbor and phosphate loading facilities were constructed on the leeward (downwind side) of the island to avail of calmer seas during loading and off-loading operations.

[12] Adjacent to the area occupied by storage containers is the "Location" district, which comprises a series of dilapidated apartment blocks which were built by the former Phosphate Commissioners to house overseas workers. Many of these dwellings were claimed by traditional landowners when the company was purchased by the government and the Nauru Phosphate Commission was set up in 1970.

Figure 4 – Existing NUC Project Site and Adjacent Facilities



V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

61. Environmental impacts have been delineated into three phases: (i) ongoing operations, (ii) design and construction phase; and (iii) operation phase. Mitigating measures are recommended to avoid or minimize adverse environmental impacts. Potential impacts during construction arise mainly from waste generated during refurbishment of the powerhouse and decommissioning of old generation units. The potential impacts are mainly associated with oily wastes which might be discharged to the sea or which could contaminate groundwater. As groundwater is not used for drinking water, there is essentially no potential exposure risk to human health. Potential impacts during operations arise from continuous air emissions from generation units, periodic discharge of storm water to the sea, and potential groundwater contamination.

A. Audit of Existing Operations and Facilities

62. The ongoing operations were audited via walk-around inspections, meetings with NUC management and staff, and a meeting with the chief environmental officer at the Ministry of Commerce, Industry, and Environment (MCIE). The existing operations present essentially the same potential impacts as the proposed project (as summarized in Table 4). The existing power generation units are diesel fired internal combustion generator sets which are in need of

overhaul and major maintenance. Some of the existing units may be decommissioned after new units are installed, depending on system peak demand and the availability of NUC's relatively new high speed diesel generating sets and implementation progress with an additional Australian government funded generating set.

Table 4 – Audit of Existing Facilities and Operations

Parameter	Activity and/or Potential Impacts	Nature [a]	Magnitude [b]	Extent [c]	Duration [d]	Mitigation Measures
Physical and cultural resources	Disturbance of adjacent houses, public facilities, and main road	D	SS	SS	LT	On-going operations are contained within the existing NUC site, which is surrounded on 3 sides by other industrial facilities and on the 4th side by the main road. Impacts are minimal. Long-term objective is to install new power generation units at new sites which would not have any direct impact on physical and cultural resources.
Waste generation	Stockpiling and removal of solid wastes	D	L	ST	ST	Disused equipment and materials to are stockpiled on-site and are to be recycled off-site or disposed at existing off-site landfill.
Water quality	Discharge of oily storm water to surrounding surface.	D	L	SS	LT	Rehabilitation of powerhouse drainage system and installation of oil-water separator; to be implemented in parallel with the proposed project. [13]
Air quality, noise, and vibration	Dust and exhaust gases	D	L	SS	LT	Dust control with water sprays as necessary. Contractor's equipment to meet ADB/World Bank guidelines for equipment and vehicle emissions and noise standards
Occupational Health and Safety	Worker safety and protection	D	L	SS	LT	NUC management is implementing use of personal protective equipment (PPE) and better housekeeping measures. NUC to develop corporate EHS program in parallel with the proposed project.

dB(A) = decibel acoustic, EHS = environment, health, and safety, MW = megawatts, NUC = Nauru Utilities Corporation

Notes: [a] Nature: D=direct, IN=indirect, R=reversible, IR=irreversible
[b] Magnitude: H=high, M=medium, L=low
[c] Extent: SS=site-specific, L=local, R=regional
[d] Duration: LT=long-term, MT=medium term, ST=short-term

[13] It is not clear whether NUC has engaged specialist expertise to design drainage and separation facilities or what the project timeframe is.

63. The NUC facility is surrounded by other industrial facilities and non-residential activities on three sides, and the remaining side is bounded by the main road. Thus, there is an effective buffer between the facility and the nearest residential areas, minimizing potential impacts (including possible health and safety impacts) on the nearby community. The powerhouse roof is mostly non-friable asbestos containing material (ACM), which poses a potential health threat if the material is not properly managed. The project includes replacement of the roof. A detailed asbestos survey conducted in 2007 and which included air monitoring, concluded: “There is no evidence that there are any health risks associated with the asbestos containing materials present at the power station under current circumstances.” The survey identified appropriate procedures for ACM management which are presented in Appendix 2.

64. A more immediate issue is occasional discharge of oily wastewater to the surface which runs off onto the adjacent land to the north which is occupied by shipping containers used for storage. The oily wastewater results from a leaky roof and inadequate storm water drainage and control. The powerhouse roof will be replaced as part of the project. The new roof will be designed to minimize run-off water into the powerhouse, and may include rainwater harvesting (design details are to be confirmed).

65. Independently of the ADB-funded project, NUC is refurbishing the powerhouse drainage system to control run-on and run-off water, waste lubricating oil, and other fluids. NUC will repurpose an existing water storage facility for storm water retention and oil-water separation. The recovered waste oil will be used as supplemental fuel at the phosphate mill furnaces. The recovered water will be used on-site for dust control or discharged through the existing marine outlet. The marine outlet was plugged sometime around 2006 at the direction of government in response to complaints about oily fluid discharges to the sea. [14] This had the adverse effect of causing flooding in the powerhouse, which resulted in oily fluids being spilled on the surface and extensive seepage onto adjacent low-lying areas. Upgrading the run-on and run-off control with a new roof with rainwater harvesting, a retention pond, and an oil-water separator will resolve the oily fluid discharge problem and reduce flooding risk in the powerhouse proper. If necessary to manage storm water during high-rainfall events, the marine outlet will be reopened after the oil-water separator is installed. When and if the outlet is put back into normal use, there will be a one-time flushing event that will discharge oily fluid into the sea. This discharge can be mitigated by deploying spill control booms and application of dispersants.

66. As discussed in Section II, Nauru does not have a robust environmental regulatory framework. There is no routine ambient environmental monitoring conducted by government agencies or third parties. Routine environmental monitoring of air and water emissions at the project site is not conducted because there are no specific requirements for NUC to conduct such monitoring. Monitoring of air and water emissions at the project site will be conducted as part of the proposed project. Storm water monitoring will be conducted by NUC as part of its ongoing operations. Solid wastes stored on site do not pose an immediate environmental threat, but NUC is planning to recycle or dispose of these wastes offsite to allow further refurbishment of its facilities, including demolition of some unused structures.

67. NUC is implementing basic environment, health, and safety (EHS) practices including use of personal protective equipment (PPE) such as hard hats, safety gloves, and hearing protection, and improved housekeeping. NUC has designated a senior employee to be responsible for EHS issues, and is in early stage development of an EHS program. This will include emergency preparedness and response plan covering fire, explosion, and other related situations.

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[14] The exact date of this action is unknown but was reported by NUC to be “about 8 years ago.”

68. Workers will be trained on emergency preparedness and response procedures and a manual on safety and emergency procedures should be prepared and disseminated to workers like fighting fuel and oil fires, e.g. from leaking fuel lines and transformers. The EHS procedures will outline the system to identify potential emergency situations and potential accidents that can have an impact to the health and safety of the workers and adjacent facilities, and surrounding community. In the absence of national regulatory guidance, NUC's EHS program will be consistent with the World Bank Environmental, Health, and Safety Guidelines for Thermal Power Plants (2008) and the General Environmental, Health, and Safety Guidelines (2007).

B. Design and Construction Phase

69. The potential impacts during the design and construction phase of the project are related to the optimization of new generation capacity, type, and efficiency; and refurbishment of the existing powerhouse and facilities. The project will improve the overall efficiency of power generation, reducing the overall emissions intensity, and providing overall net environmental benefits. Alternatively stated, the proposed investments comprise an environmental improvement project. Table 5 presents the summary of the anticipated impacts from this phase.

70. The configuration and design of the new generation unit(s) have not been finalized as of June 2014, there may be three 1 MW units, or one 3 MW unit; either configuration presents fairly simple construction requirements with minimal physical impacts. If 1 MW units are selected, then three containerized generator sets would be delivered via the adjacent port, dropped in to the NUC site, and set up in a "plug and play" fashion, with imperceptible environmental impacts.

71. A single 3 MW unit entails more complicated set-up and assembly, but also with minimal environmental impacts. A 3 MW unit will weigh about 60 to 70 metric tons, and will be about 7 meters long overall, on a large steel base frame. For shipping, the generator and engine may be separated, and shipped as "deck cargo," with the balance of equipment (piping, radiator, etc.) in two or three standard shipping containers. Assembly will be required on site: the engine and generator will be rolled into the powerhouse, and subsequent construction will be virtually all within or adjacent to the powerhouse. Environmental impacts will be minimal and imperceptible outside of the NUC site.

1. Physical Resources

72. **Pollution and waste management issues**. The existing power house will undergo refurbishment including replacement of the roof and upgrading of the drainage control system. The existing roof is partly composed on ACM, which is also the case for many other buildings on Nauru. An asbestos survey conducted in 2007 confirmed the asbestos is non-friable and poses minimal health and environmental risks as long as best practices are employed during roof removal.[15] The asbestos wastes will be stored securely on-site, or taken off-site for secure storage or disposal. The 2007 survey recommended secure disposal at the existing landfill, following the best management practices and specific procedures for asbestos waste containment (see Appendix 2). Other off-site disposal options include transport to a licensed facility in Australia or possible deep-sea disposal.[16]

[15] AusAID. 2007. *Report for Nauru Asbestos Project: Power Station Asbestos Survey*. Prepared by GHD consultants; Melbourne, Australia. March 2007.

[16] According to CIE Environment Director [Bryan Star], asbestos removed from a school in Nauru was transported for disposal in Australia. Deep sea disposal may be inconsistent with international conventions to which Nauru is a signatory.

73. A maximum of three new transformers will be required to connect the new generation unit(s) to the grid. The bid packages will include a specification that transformers must not contain PCBs. Decommissioning of transformers is not included in the project scope; however, at NUC's request, PCB Best Management Guidelines are presented in Appendix 3. Other solid wastes include used equipment such as piping, pumps, and valves, which can be stored on-site. Most of these wastes have residual metal value and can be recycled off-site. Other construction debris can be disposed off-site at the existing landfill near the airport.

74. **Water quality**. As noted above the powerhouse roof will be replaced as part of the project. A temporary cover will be erected over the existing roof, which will have the immediate effect of eliminating most rainwater leakage into the powerhouse and minimizing run-on water; this will reduce the amount of storm water to be managed. NUC's plans for upgrading the storm water control system will minimize wastewater discharge and allow for waste oil to be recovered and utilized as a supplemental fuel offsite.

75. **Air quality, noise and vibration**. Construction activities will have minimal incremental air emissions, noise, and vibration, associated with refurbishment of the powerhouse and installation of the new generation units. Dust can be controlled with water sprays. Contractors' equipment should meet the ADB and World Bank guidelines for emissions standards.

2. Biological Resources

76. The project will include minor civil that will be wholly contained within the NUC site. There will be no impacts on ecological impacts.

3. Socio-economic Resources

77. **Land issues**. The project will be located on the existing NUC site and will not require additional land acquisition. There will be no land use changes associated with the project. The project will not impinge on any historical or culturally significant site. There are no protected areas or other ecologically significant areas adjacent to the project site, other than the nearby coast and fringing reefs.

78. **Traffic management**. The equipment and materials for the project will be imported by ship and offloaded at the port which is adjacent to the NUC site. Therefore, delivery of equipment and materials will not have any negative impact on traffic or nearby residential areas.

79. **Workforce related issues**. The project will require an estimated crew of about 20 people for the roof replacement and about 10 people for the generation unit(s) installation and commissioning. The construction period is expected to take nine months. This workforce represents a manageable increase in the personnel who will be working at the NUC site, and does not pose an imminent threat with respect to communicable diseases or other public health issues.[17]

80. **Health and safety**. Potential impacts related to asbestos roofing material are also minimal, as the asbestos is non-friable and would present health risk only if the material were deliberately crumbled and inhaled. NUC does not have an environment, health, and safety (EHS) system, but is beginning to develop and implement basic EHS practices including use of personal protective equipment (PPE) such as hard hats, safety gloves, and hearing protection. Equipment suppliers and construction contractors should have corporate EHS policies in place and should follow appropriate EHS procedures for the powerhouse refurbishment (including asbestos management) and installation of the new generation units.

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[17] This is estimated as 5% of the workforce employed on a rotating basis at the Nauru Processing Center.

Table 5 - Potential Construction Impacts and Mitigation Measures

Parameter	Activity and/or Potential Impacts	Nature [a]	Magnitude [b]	Extent [c]	Duration [d]	Mitigation Measures
Potential Impacts During Design and Construction Phases						
Physical and cultural resources	Disturbance of adjacent houses, public facilities, and main road	D	SS	SS	ST	Construction is limited to inside-the-fence activities on NUC's existing site, with import of a small number of standard shipping containers coming directly to the port adjacent to project site. Imported equipment can be moved directly to the site without disturbing adjacent industrial facilities, housing, or the main road.
Waste generation	Replacement / repair of roof: management of asbestos-containing material Decommissioning of old generation units, and removal of solid wastes	D	L	ST	ST	Contain asbestos waste on-site or dispose off-site following best management practices. Off-site recycling and disposal of solid wastes. Construction debris can be disposed off-site at landfill. Decommissioned generation units can be stored on-site indefinitely, recycled off-site, or possibly disposed at existing landfill.
Water quality	Rehabilitation of powerhouse drainage system and installation of oil-water separator: wastewater discharge through marine outlet	D	L	SS	ST	Install run-on / run-off control including rainwater harvesting, retention basin, and oil water separator. Waste oil to be used as supplemental fuel phosphorous mill furnace. Deploy spill control booms and dispersant at marine discharge point to control oily wastewater discharge when marine outlet is re-opened.
Air quality, noise, and vibration	Construction dust and exhaust gases	D	L	SS	ST	Dust control with water sprays as necessary. Contractor's equipment to meet ADB/World Bank guidelines for equipment and vehicle emissions and noise standards
Occupational Health and Safety	Worker safety and protection during construction	D	L	SS	ST	NUC to develop corporate EHS program. Contractors to implement EHS plan in accordance with good practice.

dB(A) = decibel acoustic, EHS = environment, health, and safety, MW = megawatts, NUC = Nauru Utilities Corporation

Notes: [a] Nature: D=direct, IN=indirect, R=reversible, IR=irreversible
[b] Magnitude: H=high, M=medium, L=low
[c] Extent: SS=site-specific, L=local, R=regional
[d] Duration: LT=long-term, MT=medium term, ST=short-term

C. Operation Phase

1. Physical Resources

81. **Waste generation and management**. NUC will implement improved housekeeping to clear accumulated wastes and debris, and contain solid wastes on-site prior to off-site recycling and/or disposal. Routine solid wastes can be disposed of off-site at the existing landfill.

82. **Water quality**. After refurbishment, the storm water drainage and retention system will contain run-off water and waste fluids from the power house. The recovered waste oil will be used as supplemental fuel at the phosphate mill furnaces. Recovered water will be used on-site for dust control or discharged through the reopened marine outlet if necessary.

83. **Air quality, noise and vibration**. The refurbished powerhouse and generation units will be designed in accordance with World Bank guidelines for air emissions and noise standards (see Table 2). Vibration is unavoidable, but is limited to the immediate area around the existing powerhouse.

84. The project is expected to improve generation efficiency by about 20%, from 3.4 kWh/liter of fuel to 4.1 kWh/liter of fuel. This represents a greenhouse gas offset of about 4,352 tons carbon dioxide equivalent per year (tCO_2e/y), from the current estimated 21,760 tCO_2e/y.[18]

2. Socio-economic Resources

85. **Land issues**. As noted above, the Project will be located on the existing NUC site and will not require additional land. There will be no land use changes associated with the project, and after construction there will be no impacts on physical and cultural resources. The project will have positive benefits in the form of improved power quality and reliability, improved fuel efficiency per unit of electricity output, and reduction in emissions intensity.

86. **Health and safety**. As noted above, NUC does not have an environment, health, and safety (EHS) system, but is beginning to develop and implement basic EHS practices including use of personal protective equipment (PPE) such as hard hats, safety gloves, and hearing protection. In the absence of national regulatory guidance, NUC's EHS program will be consistent with the World Bank group Environmental, Health, and Safety Guidelines for Thermal Power Plants (2008) and the General Environmental, Health, and Safety Guidelines (2007).

87. Table 6 presents the summary of the potential impacts expected during the operations phase of the project.

[18] This estimate is based on approximately 8 million liters per year fuel consumption, current efficiency of 3.4 L/kWh, and an emissions factor of 0.8 tCO_2e/MWh.

Table 6 - Potential Impacts during Operation Stage and Mitigation Measures

Parameter	Activity and/or Potential Impacts	Nature [a]	Magnitude [b]	Extent [c]	Duration [d]	Mitigation Measures
Potential Impacts During Operation Phase						
Waste generation	Used equipment and materials	D	L	SS	ST	Temporary on-site storage or off-site disposal at landfill. Used equipment may be refurbished and reused at other sites if possible. Scrap metal may be sold into recycling markets.
Water quality	Run-off water from powerhouse	D	L	SS	LT	Operation and maintenance of storm water runoff control and oil-water separator system. Waste oil to be used as supplemental fuel at phosphorous mill furnace.
Air quality, noise, and vibration	Air emissions and noise from new generation units	D	L	SS	ST	Technical specifications on generation units to meet established emissions guidelines for small thermal power generation (3MW – World Bank guidance). Overall generation efficiency will be improved, reducing emissions intensity. Technical specifications on generation units and powerhouse to limit noise to 55 dB(A) at nearest receptor.
Land	No ongoing impacts after construction	L	L	SS	ST	Generation units will be operated within existing NUC site: no direct impact on surrounding physical resources.
Occupational Health and Safety	Worker safety and protection during operations	D	L	SS	ST	NUC to implement corporate EHS program in accordance with good practice.
Community	Improved power supply	D	P	L	LT	None required. Benefits from improved supply quality and reliability for all consumers.

Source: ADB / PPTA consultants
dB(A) = decibel acoustic, EHS = environment, health, and safety, MW = megawatts, NUC = Nauru Utilities Corporation
Notes: [a] Nature: D=direct, I=indirect, R=reversible, IR=irreversible
[b] Magnitude: H=high, M=medium, L=low, P=positive
[c] Extent: SS=site-specific, L=local, R=regional
[d] Duration: LT=long-term, MT=medium term, ST=short-term

VI. ANALYSIS OF ALTERNATIVES

88. **No project alternative**. A 'no project' alternative is not acceptable because the proposed project is required to provide basic electricity supplies. In the "no project" scenario, electricity supply would decline relative to demand, resulting in degradation of service quality and reliability. Without the project, demand growth could not be accommodated, which would constrain economic recovery and growth. The present situation will not improve and the reliability and safety of power supply will not be attained.

89. **Selection of generators**. Specifications for the new generation units are being evaluated. The exact configuration and type of units are still to be confirmed, and may consist of one 3MW unit or up to three 1MW units. NUC estimates that this will result in a 20% improvement in generation efficiency from the current 3.4 kWh to 4.1 kWh generated per liter of diesel consumed. The actual efficiencies will vary with configuration, engine speed, and tuning for maximum efficiency. The air-shed is not considered to be degraded; therefore the engines can be specified for maximum efficiency rather than minimum nitrogen oxide emissions.

90. **Expansion of renewable energy**. Nauru's renewable energy resources are limited. Biomass, geothermal, and hydropower resources are non-existent.[19] The potential wind resource is not well known although, based on airport and National Aeronautics and Space Administration wind data, it is probably only marginally cost-effective at present fuel prices. Data collection, funded by the European Union indicates an annual average wind resource of 4.22 m/s at 30 meters (about 4.7 m/s if extrapolated to 50 meters) for 2009–2011. These figures are at the low end of practicality for wind energy generation.

91. There is some potential for waste-to-energy given that the existing landfill accepts wastes with biodegradable organic carbon (e.g. food and paper wastes), and other energy content (e.g. used tires). A recent report estimated that 6MW of capacity could be developed and would require advanced technology and likely capital investment on the order of $3 million per MW.[20] This is well beyond the scope of current NUC and government budget capacity. A detailed feasibility study would be required before further consideration of this concept.

92. Solar energy is the most abundant resource providing an average 6 kWh/m^2 per day and with a seasonal variation of around 10% - 15%. Solar photovoltaic cells could supplement the existing diesel generation, but the variable nature of solar energy will require energy storage systems for it to be connected to the grid at high levels of penetration, i.e. above 20% penetration. A dynamic model of the power system is needed to confirm the maximum possible level of solar penetration before grid stability issues occur, but it is likely to be limited to around 20–30% of mid-day demand. Above this threshold, storage and control systems will have to be introduced to ensure grid stability. It appears theoretically and technically possible to construct about 10MW of solar generation with storage, but with recent cost estimates of about $7 million per MW, and the current fiscal health of NUC, such a system is not a financially or economically viable option at present.[21]

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[19] Mirei. I, Mofor. L, & Wade, H. 2013. *Pacific Lighthouses: Renewable Energy Opportunities and challenges in the Pacific Islands region; Nauru*. International Renewable Energy Agency, Abu Dhabi

[20] Zimin, D. 2014. *Environmental Situation and Issues on Island of Nauru*. Auckland, New Zealand

[21] A back-of-the-envelope estimate suggests that based on current fuel consumption of 7 - 8 million liters per year at a cost of up to $2/liter, the 10MW solar plant would have a simple pay-pack period of 5 - 10 years. Upfront capital costs pose a significant barrier, and at present there are no donor or private sector proposals for financing the solar concept. The status of land acquisition, actual land availability, and readiness of a site is also unclear.

93. Cultivation of indigenous flora such as *jatropha* for bio-diesel production may be technically possible, but would require several years lead time before production at scale would be viable. A bio-diesel plantation could be included as part of the Topside rehabilitation efforts. Assuming that yields of 540 – 680 liter per ha could be achieved on a 1000 ha plantation, total biodiesel production could provide about 6-7% of current fuel consumption.[22]

94. A pure renewable energy option is not economically viable as a near-term solution, but solar power concepts are being pursued with other development partners, and in the foreseeable future the Nauru power system is expected to become a diesel-solar hybrid. In the longer term (10 years or more), as system and operating and maintenance costs decline, solar energy is expected to provide a progressively greater share of Nauru's electricity supply.

VII. INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

95. This section presents the public consultation process that was undertaken for the project, the results of the surveys and consultation meetings, and the concerns raised by the stakeholders. Field investigations were undertaken from 14-22 May 2014 and involved a series of interviews with residents in order to identify issues surrounding power supply and use and to solicit views on the project, including how poor consumers could benefit. The list of people interviewed is presented in Appendix 4.

96. The majority of households receive their electricity supply through pre-paid meters. NUC provides a lifeline (subsidized) residential tariff of $0.10 per kWh for the first 300 kWh per month ($30/month), above which the cost increases to $0.25 per kWh.[23] The lifeline tariff and consumption level is sufficient for the basic household requirement of lights, fans, and fridge/freezer. Payment for electricity does not feature as a major item in overall household expenditure. Food and non-alcoholic beverages account for 43% of average household expenditure and transport accounts for a further 14.5% while housing and utilities account for only 4.2% of average household expenditure. Given that most Nauruan families own their own home, it can be assumed that the majority of this expenditure is on 'utilities' and is attributable to purchasing electricity.

97. The subsided $30 per month tariff is the psychological cut-off point for most Nauruan householders interviewed. Most families are acutely aware of the cost of electricity and pursue energy saving strategies, such as switching off lights and fans when rooms are not occupied. A significant number of household have air conditioners, but residents are aware of running costs and report energy conservation measures such as only running the air conditioners while sleeping. All families have deep freezers and these provide food security through preserving fish when catches are good and storing frozen meat (particularly chickens) in anticipation of periodic shortages which occur when supply ships fail to arrive. A number of respondents stated that they turn their freezers off when there is no food to store.

98. Electricity usage patterns must be evaluated against the unpredictable supply. There has been a major shift away from electricity to gas as a means of cooking, and most families report that they now rely on single burner gas rings powered by disposable camping gas canisters priced at about $8 for 14 kg canisters. Respondents stressed that gas is reliable and not subject to cuts like electricity and is in fact cheaper for cooking. The use of electric rice cookers is common because this is felt to be an efficient way of cooking the staple.

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[22] This is a best-case estimate assuming theoretical yields. Domestic biodiesel production at this rate would be economically attractive, but achieving these yields from jatropha has not been demonstrated on a routine commercial basis anywhere in the world.

[23] This compares with the estimated production cost of $0.60 per kWh (NUC pers. comm.).

99. There is low level of awareness on the proposed project, but electricity consumers in Nauru are aware of the problematic nature of electricity supply and implicitly understand the need for improved generation capacity. The major issue for consumers is potential revisions to the tariff structure and impacts on affordability.

100. Local NGOs have voiced concerns over asbestos roofing materials, which are present on many buildings on the island including houses and churches.

101. This IEE will be disclosed on the ADB website in accordance with the ADB Public Communications Policy 2011 and will also be disclosed locally. NUC will make information about the project to the public by posting a notice at its retail service window, and making copies of the IEE available on request.

VIII. GRIEVANCE REDRESS MECHANISM

102. A grievance redress mechanism (GRM) will be established to address concerns of the stakeholders about the project in compliance with requirements of SPS for addressing people's concerns and complaints promptly and in a transparent manner. Given the nature of this project, which is essentially an efficiency upgrade with a short construction schedule and limited impact outside of NUC's facilities, the GRM should be based on NUC's existing service and public communications portals for receiving complaints.

103. During the design and construction phase of the project, the most likely grievances are expected to relate to the poor quality of electricity service. Grievances during construction may also include impacts related to refurbishment of the powerhouse and waste disposal activities. During the operational phase of the project, the complaints that may be anticipated are related to electricity service and possibly air emissions and waste management activities.

104. The following steps describe the grievance redress procedure during the construction and operational phases of the project:

105. **Step 1:** A complainant may send his/her concerns about the construction or operation of the project to NUC or the construction contractor.

106. **Step 2:** A meeting will be held among the complainant, contractor and NUC to discuss the whereabouts of the complaint. Immediate action on the complaint is expected from the contractor or the NUC on the concern raised by the complainant. The resolution of the complaint should be done within one week.

107. **Step 3:** When the complainant is not satisfied with the action or decision of the NUC or the contractor, the complainant can inform the head of the district about the matter. The district head will then call a meeting of the complainant, NUC, and contractor to resolve the complainant.

108. **Step 4:** If the complainant does not receive any response or action from the NUC or the contractor within twenty (20) days from the meeting with the district head, the complainant will have the right to submit the complaint to the next higher level of the grievance redress mechanism or mediating bodies such as the MCIE.

IX. ENVIRONMENTAL MANAGEMENT PLAN

A. Mitigation and Monitoring

109. The construction and operation phase mitigation measures identified in Section V are summarized in Table 7, together with the proposed monitoring activities, schedule, estimated cost and responsible entity for implementation. Additional details of proposed monitoring are presented in Table 8, and additional details on preliminary EMP cost estimates are presented in Table 9. The EMP is site-specific.

B. Environmental Management Responsibilities

110. **Nauru Utilities Corporation**. NUC will implement the project with support with support from project implementation consultants. ADB will manage the procurement process. The EMP will be incorporated into bid packages so that suppliers have a clear understanding of responsibilities and obligations. NUC will be responsible for implementation and monitoring of the EMP, and will be responsible for coordination with other government agencies and any affected persons throughout the project cycle.

111. As noted in Section V, NUC is developing an EHS program and is already implementing good practices (including PPE for powerhouse employees) and better housekeeping. The EHS will be further developed for consistency with ADB safeguards requirements. NUC have assigned staff to a project management unit (PMU) which will be responsible for overall project implementation including the EMP and social safeguards. Project implementation consultants will support the PMU as the owner's engineer, and will also assist in EMP implementation. The PMU will ensure that bidding documents include criteria for bidders' EHS policy and environmental certification criteria (if any). On behalf of NUC, the PMU will also consult with the landfill operators, asbestos management experts (to be included in the roof replacement contract), and MCIE on the ultimate disposition of asbestos wastes.[24]

112. The PMU will prepare monitoring reports twice during construction and once during the first year of operations, and submit these to ADB for review. The reports will cover EMP implementation with attention to compliance and any needed corrective actions.

113. **Project implementation consultants**. Project implementation consultants will support the PMU as the owner's engineer, and will also assist in EMP implementation including procurement and delivery of monitoring equipment, and conducting routine emissions monitoring during construction and operations. The scope of work for EMP implementation is outlined below:

- Update the project EMP based on detailed design considerations including the generation units configuration and contract arrangements (EPC contracts or separate supply and installation contracts);
- Review contractors' EHS plans and EMP(s), and recommended revisions as necessary;
- Procure field-portable equipment for air quality monitoring (PM_{10}, NO_2, SO_2, and O_3,as outlined in Table 8) and arrange for its delivery to the NUC site;

[24] As noted elsewhere in the IEE, asbestos materials are quite common in Nauru, and the total amount of asbestos containing materials is much larger than that at NUC's powerhouse. As buildings age and roofs require repair and replacement, a much larger volume of asbestos materials will require proper management, which will require intervention of MCIE and possibly other government agencies.

Table 7 – Environmental Management Plan

Activity and/or Potential Impacts	Mitigation and/or Enhancement Measures				Monitoring Plan			
	Measures / Actions	**Schedule / Timing**	**Estimated Cost ($)**	**Responsibility**	**Parameters / Actions**	**Schedule / Timing**	**Estimated Cost ($)**	**Responsibility**
Design and Construction Phase								
Project disclosure	ADB-approved IEE and other project documents to be disclosed in accordance with ADB Communications Policy 2011.	Disclosure Prior to ADB project approval	Included in NUC operational costs	ADB, NUC	Project information notice posted at NUC retail service window.	Prior to ADB Board approval	n/a	NUC
Environmentally responsible procurement	EMP included in tender documents to ensure that mitigation measures are included in contract budgets and that contractors fully anticipate environmental responsibilities including special requirements for asbestos management during roof replacement	During bid document preparation	Included in bid costs	NUC, project implementation consultants, and contractors	Appropriate provisions in bid documents	Bid preparation stage	Included in NUC operational costs and project implementation consultants budgets	ADB, NUC, project implementation consultants, and contractors
Physical and cultural resources: Disturbance of adjacent houses, public facilities, and main road	Construction is limited to inside-the-fence activities on NUC existing site, with import of a small number of standard shipping containers coming directly to the port adjacent to project site. The containers and any other imported equipment can be moved directly to the site without disturbing adjacent properties, the main road, or nearby residential areas.	n/a	n/a	NUC	NUC to coordinate with port officials and operations crew prior to receiving shipment(s)	After contract signing and prior to shipping	n/a	NUC Project Management Unit (PMU)
Waste generation: Replacement / repair of roof: management of asbestos-containing material (See Appendix 2) Decommissioning of old generation units, and removal of solid wastes	1. Off-site recycling and disposal of solid wastes. Non-hazardous construction debris can be disposed off-site at landfill. 2. Decommissioned generation units can be stored on-site indefinitely, recycled off-site, or possibly disposed at existing landfill. 3. Contain asbestos waste, and dispose off-site at landfill, or securely store on-site following best management practices. Asbestos waste can be stored indefinitely onsite in a standard shipping container which is secured from public access (i.e., locked and labeled appropriately).	1 & 2: Waste disposal is part of ongoing operations 3: Asbestos roofing to be contained and secured daily during roof replacement	1 & 2: Waste disposal is part of ongoing operational costs. 3: Roof replacement including asbestos management is included in project cost (EPC contract cost): $409,000 (to be updated)	NUC to coordinate waste disposal with NRC landfill operations unit.	Roof replacement contractor to document asbestos control on a daily basis during construction. NUC and NRC to agree on disposal of asbestos wastes at landfill prior to drafting EPC contract specifications.	1 & 2: Ongoing 3: Asbestos disposal agreed to prior to EPC contract tender	1 & 2: included in NUC ongoing operational costs 3: Included in project management costs	NUC PMU

Activity and/or Potential Impacts	Mitigation and/or Enhancement Measures				Monitoring Plan			
	Measures / Actions	**Schedule / Timing**	**Estimated Cost ($)**	**Responsibility**	**Parameters / Actions**	**Schedule / Timing**	**Estimated Cost ($)**	**Responsibility**
Water quality: Rehabilitation of powerhouse drainage system and installation of oil-water separator; wastewater discharge through marine outlet	1. Install run-on / run-off control including rainwater harvesting, retention basin, and new oil water separator. Waste oil to be used as supplemental fuel at phosphorous mill furnace. 2. Water quality monitoring prior to construction to establish baseline; quarterly monitoring during construction (see Table 8) 3. Deploy spill control booms and dispersant at marine discharge point to control oily wastewater discharge.	Throughout construction stage	1: included in project cost 2: Water Quality: See Table 9 3: including in NUC operational cost	NUC, with support from project implementation consultants	Recommended storm water parameters: pH BOD COD Oil & grease TSS	1 event prior to construction to establish baseline Quarterly during construction and first 3 years of operations	Included in NUC operational costs	NUC and CIE to agree on reopening of marine outlet prior to any storm water discharge
Air quality, noise, and vibration: Construction dust and exhaust gases	1. Contractor's equipment to meet ADB/World Bank emissions standards for thermal power plants 2. Air quality and noise monitoring prior to construction to establish baseline; quarterly monitoring during construction (see Table 8) 3. Dust control with water sprays as necessary.	Throughout construction stage	1. Included in contractors' costs 2. Air monitoring: (see Table 9) 3. Included in NUC ongoing costs	NUC, with support from, project implementation consultants	Noise: dB(a) Recommended Air parameters: PM_{10} NO_2 SO_2 O_3	1 event prior to construction to establish baseline Quarterly during construction and first 3 years of operations	Air monitoring: $50,000 (see Table 9)	NUC PMU with support from Project Implementation Consultants
Occupational Health and Safety: Worker safety and protection during construction	1. NUC to implement corporate EHS program including emergency response plan. 2. Contractors to implement EHS plan in accordance with good practice, including personal protective equipment for workers. 3. Roof replacement contractor to implement mitigation and monitoring in accordance with international best practices	Prior to construction	Included in ongoing operational cost and contractors' cost	NUC, with support from project implementation consultants	1. ADB loan covenants 2 & 3: tender documents	Prior to start of construction and during construction phase	Included in NUC and contractors costs	NUC and contractors

Activity and/or Potential Impacts	Mitigation and/or Enhancement Measures				Monitoring Plan			
	Measures / Actions	Schedule / Timing	Estimated Cost ($)	Responsibility	Parameters / Actions	Schedule / Timing	Estimated Cost ($)	Responsibility
Operational Phase								
Physical and cultural resources: No ongoing impacts after construction	Generation units will be operated within existing NUC site: no direct impact on surrounding physical resources and no imminent health and safety risks due to the project. Benefits include improved power supply quality and reliability for all consumers.	Throughout operational period	n/a	NUC	NUC to maintain fencing and other access controls	Ongoing	Included in ongoing operational costs	NUC
Waste generation: Used equipment and materials	Temporary on-site storage or off-site disposal at landfill. Used equipment may be refurbished and reused at other sites if possible. Scrap metal may be sold into recycling markets.	Throughout operational period	Included in ongoing operational costs	NUC	Timely removal of wastes including off-site disposal and recycling as appropriate	Ongoing	Included in ongoing operational costs	NUC
Water quality: Storm water runoff from powerhouse	Operation and maintenance of storm water runoff control and oil-water separator system: (i) Recovered waste oil to be used as supplemental fuel at phosphorous mill furnace; (ii) Recovered storm water used for dust control on sire and/or disposed through marine outlet. Quarterly monitoring during first 3 years of operations (see Table 8); frequency may be reduced after year 1 if results are satisfactory.	Throughout operational period	Included in ongoing operational costs	NUC, with 3rd party support, transferring to CIE by end of year 1	Recommended storm water parameters: pH BOD COD Oil & grease TSS	Quarterly during first 3 years of operations	Included in NUC operational costs	NUC and CIE to agree on reopening of marine outlet prior to any storm water discharge
Air quality, noise, and vibration: Air emissions and noise from new generation units	Generation units to meet established emissions guidelines for small thermal power generation (3 MW – World Bank guidance). Overall generation efficiency will be improved, reducing emissions intensity. Noise limit of 55 dB(A) at NUC site boundary or nearest off-site receptor. Quarterly air quality and noise monitoring during first 3 years of operations (see Table 8); frequency may be reduced after year 1 if results are satisfactory.	During operational period	Monitoring to be included in ongoing operational costs	Air quality by project implementation consultants; transferring to NUC or CIE by end of year 1	Noise: dB(a) Recommended Air parameters: PM_{10} NO_2 SO_2 O_3	Quarterly during first 3 years of operations	Included in NUC operational costs	NUC

Activity and/or Potential Impacts	Mitigation and/or Enhancement Measures				Monitoring Plan			
	Measures / Actions	Schedule / Timing	Estimated Cost ($)	Responsibility	Parameters / Actions	Schedule / Timing	Estimated Cost ($)	Responsibility
Occupational Health and Safety: Worker safety and protection during operations	NUC to implement corporate EHS program in accordance with best practices.	Throughout operational period	Included in ongoing operational costs	NUC	ADB / World Bank guidelines for electric utility operations	Ongoing	Included in NUC operational costs	NUC

Source: ADB / PPTA consultants

BOD = biochemical oxygen demand, CFC=chlorofluorocarbons, dB(A) = decibel acoustic, NUC = Nauru Utilities Corporation, NO_2 = nitrogen dioxide, NO_x = nitrogen oxides, PMU = Project Implementation Unit, ROW=right-of-way, SO_2 = sulfur dioxide, SPM = suspended particulate matter.

Table 8 - Proposed Environmental Monitoring Plan

Parameter and Standard [a]	Location	Method [b]	Timing and Frequency	Responsibility [c]
Asbestos	NUC powerhouse	Visual	Daily during removal	NUC, roof replacement contractors including asbestos management specialist(s)
Noise	NUC site boundary and nearest receptor	Portable noise meter	At least 1 event prior to construction to establish baseline	NUC with support from project implementation consultants (and/or CIE)
Ambient Air Quality: PM_{10} NO_2 SO_2 O_3	Five (5) stations – Three stations at NUC powerhouse site: (i) retail service window on north side, (ii) east side powerhouse entrance, and (iii) south or west side of the powerhouse; and a designated upwind/background station (e.g., Menen Hotel), and a designated downwind station (e.g., the residential area to north-northwest of the NUC powerhouse)	Portable air monitoring devices Sulfur content in fuel from NUC's suppliers	At least 1 event prior to construction to establish baseline Semi-annually during construction Semi-annually during first 3 years of operations (frequency may be reduced if results are satisfactory)	NUC with support from project implementation consultants Responsibility should transfer to CIE or 3rd party with sufficient monitoring capacity and expertise at end of project.
Storm water quality: [d] pH BOD COD Oil & grease TSS	Storm water retention basin and marine discharge outlet	Field monitoring kits	At least 1 event prior to construction to establish baseline Semi-annually during construction Semi-annually during first 3 years of operations (frequency may be reduced if results are satisfactory)	NUC with support from project implementation consultants Responsibility should transfer to CIE or 3rd party with sufficient monitoring capacity and expertise by end of year 1 of operational period
Solid waste	NUC powerhouse and surrounding premises	Visual	Daily / weekly during construction and routine operations	NUC

Source: ADB / PPTA consultants
BOD = biochemical oxygen demand, CIE = Ministry of Commerce, Industry, and Environment, COD = chemical oxygen demand, dB(A) = decibel acoustic, NUC = Nauru Utilities Corporation, NO_2 = nitrogen dioxide, O_3 = ozone PM_{10} = 10 micron particulate matter SO_2 = sulfur dioxide, SPM = suspended particulate matter.
Notes:
[a] Refer to Table 2 and 3 for environmental standards.
[b] Portable / handheld / field monitoring equipment should be readily available for the parameters listed except for O_3. Contractors for asbestos removal will be responsible for air monitoring and other EHS requirements during removal.
[c] NUC will have overall responsibility for the monitoring program until CIE or a 3rd party can take over.
[d] Storm water management and water quality monitoring is outside the scope of the ADB project, and will be included in NUC's ongoing operational costs.

- Conduct air monitoring at five stations [three stations around NUC site, one designated upwind station, and one designated downwind station]; three rounds of monitoring to be conducted (a) prior to, (b) during, and (c) after construction as outlined in Tables 7 and 8;
- provide training for designated NUC and CIE personnel on air monitoring, with the objective of transferring monitoring responsibility to NUC and/or CIE within the first year of operations;
- Assist PMU in preparation and delivery of Safeguards Monitoring Report two times per year.

114. The EMP scope may be divided into two individual assignments for a specialist covering the EHS/EMP activities and an air monitoring specialist.

115. **Ministry of Commerce, Industry and Environment**. MCIE is the designated regulatory authority to oversee NUC, but has limited capacity for environmental monitoring. Therefore, NUC will have primary responsibility for implementing the EMP. MCIE will participate in monitoring activities, availing of training by the project implementation consultants and any other third party service providers, with the objective of taking responsibility for routine monitoring and oversight after the first year of operations.

116. **Construction contractors and suppliers**. The project involves two significant operations requiring third party contractors: (i) roof replacement, and (ii) delivery and installation of new generation capacity. The roof replacement is expected to be implemented via an engineering, procurement, and construction (EPC) contract mode, and will include qualified asbestos removal works and supervisors. The new generation capacity may also be implemented via an EPC contract or separate supply and installation contracts.

117. Construction contractors and other suppliers will be required to have a corporate EHS policy; environmental management certifications such as ISO 14001 (or equivalent) would be an additional qualification. Contractors will adopt the EMP and may revise the EMP in consultation with NUC and ADB if necessary. Contractors will have primary responsibility for worker health and safety, including provision of appropriate personal protective equipment (e.g., hard hats, safety boots, and hearing protection), and controlled management and disposal of construction-related wastes. NUC will provide sanitary facilities.

118. The contractor for roof replacement will provide a crew which is qualified to manage asbestos wastes in accordance with international best practices. The new generation unit(s) will require some assembly on-site including connections to new control systems, transformers, etc.; the suppliers' team will require skilled labor such as welders and pipe fitters.

119. **Asian Development Bank**. ADB will (i) review and clear the IEE and EMP before contracts are finalized and construction commences; (ii) review progress reports, quarterly progress reports and safeguards monitoring reports; and (iii) officially disclose environmental safeguards documents in accordance with the ADB Public Communications Policy 2011.

C. EMP Cost Estimates

120. Preliminary cost estimates for the EMP are shown in Table 9. These estimates cover the estimated roof replacement costs including asbestos management costs and the basic monitoring activities for the first year of the implementation period.

121. The estimates also include provision for two international specialists to support EMP implementation and air monitoring as discussed above. The basic EMP cost will be funded by the Project or from government counterpart funds as noted in Table 9.[25] The estimates are subject to revision.

Table 9 - Preliminary EMP Cost Estimates (US$)

A. Activities (funded by the project)	**Unit**	**Unit Cost ($)**	**Total ($)**
Asbestos management (cost to be updated at design/bidding stage) [a]	LS	$409,000	$409,000
International Professional for EHS/EMP support [assumes 3 visits, 1 week per visit (plus travel time), during first year of implementation/construction]	1 p-m	25,000	25,000
International Consultant – Travel (3 RT airfare @ $5000/RT; 30 days per diem @ $200/day)	LS	21,000	21,000
Air Quality and Noise Monitoring Equipment [a]	LS	5,00	5,000
International Professional for Monitoring and Training of NUC and/or CIE Personnel [assumes 3 visits, 1 week per visit (plus travel time), during first year of implementation/construction]	1 p-m	25,000	25,000
International Consultant – Travel (3 RT airfare @ $5000/RT; 30 days per diem @ $200/day)	LS	21,000	21,000
Subtotal			***506,000***
Contingencies (~ 9%)	LS	4,000	44,000
A. TOTAL			**550,000**
B. Other Activities (not funded by the project)			
Water Quality Monitoring Equipment [b]	LS	5,000	5,000
International Professional for Monitoring and Training of NUC and/or CIE Personnel [assumes 2 visits, 2 weeks per visit, during first year of implementation/construction]	1 p-m	25,000	25,000
International Consultant – Travel (2 RT airfare @ $5000/RT; 30 days per diem @ $200/day)	LS	16,000	16,000
Subtotal			**46,000**
Contingencies (~ 9%)		4,000	4,000
B. TOTAL			**50,000**
Grant Total (A + B)			**600,000**

Source: TA 8524-NAU consultant estimates.
Note: [a] The asbestos management estimate is from the 2007 survey and includes asbestos removal, roof replacement, and off-site disposal; includes 10% contingency (see Appendix 1 for additional details). The estimate is subject to revision during design and bidding stages.
[b] Storm water management and water quality monitoring is outside the scope of the ADB project, and will be included in NUC's ongoing operational costs.

[25] NUC staff costs are not known and are not included.

X. CONCLUSIONS AND RECOMMENDATION

122. The proposed project will have minimal environmental impacts that can be readily mitigated by appropriate design specifications and implementation of practical mitigation measures associated with internationally accepted good engineering practices.

123. There are no significant sensitive areas that will be affected by the proposed project. The project site is in a developed industrial zone, with some nearby urban community. Land acquisition is not required.

124. Any impacts of the project during the construction phase are temporary and limited to the surrounding area and can be readily mitigated through proper design and construction. These impacts are primarily due to refurbishment of the powerhouse, in particular removal and management of asbestos-containing roofing materials and decommissioning of old generation units. The new generation units and other materials will be delivered via the port adjacent to the project site; there will be no disruption to traffic or to adjacent communities.

125. The potential impacts during the operational phase are due to air emissions from the new generation units. The new units will be more efficient than the existing generation units, therefore emissions will be lower relative to business as usual, and the overall emissions intensity will decline.

126. An EMP has been prepared and will be implemented during all phases of the project cycle. The EMP identifies the environmental mitigating measures as well as the institutional arrangements for its implementation.

127. The project will provide positive impacts to all electricity consumers in Nauru due to improved reliability and quality of electricity service. The project will facilitate future integration of renewable energy into electricity supplies.

128. Based on this assessment, it is concluded that overall, the project will result in significant positive socio-economic benefits, and any potential negative environmental impacts are small-scale and localized, few if any are irreversible, and can be minimized adequately through good design and implementation of appropriate mitigation measures. This IEE is the appropriate level of assessment and no further assessment is warranted.

XI. REFERENCES

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APPENDIX 1: INTERNATIONAL CONVENTIONS AND TREATIES

- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, entered into force on 5 May 1992 (accessed on 12 November 2001)
- United Nations Framework Convention on Climate Change (ratified 11 November 1993)
- Kyoto Protocol (ratified 16 August 2001)
- Convention on Hazardous & Toxic Wastes (Waigani Convention)
- South Pacific Regional Environment Programme (SPREP Convention)
- Convention for the Protection of the Natural Resources & Environment of the South Pacific Region & Related Protocol
- United Nations Convention on Law of the Sea (UNCLOS)
- United Nations Convention on Rights of the Child
- Agreement Establishing the South Pacific Forum Secretariat Treaty on Cooperation in Fisheries Surveillance & Law Enforcement in the South Pacific Region (Niue Treaty)
- United Nations Convention on Biological Diversity
- Basic Agreement between Nauru and World Health Organization (WHO)
- Asian-Pacific Postal Convention & General Regulations of the Asian-Pacific Agreement for the Implementation of the Provisions of the UN Law of the Sea of 10 December 1982 Relating to the Conservation & Management of Straddling Fish Stocks & Highly Migratory Fish Stocks adopted on 4 August 1995 by the UN Conference on Straddling Fish Stocks & Migratory Fish Stocks
- Nauru Agreement on Fisheries
- Pacific Island Countries Trade Agreement (PICTA)
- Pacific Agreement on Closer Economic Arrangement (PACER)
- Convention on the Prohibition for the Stockpiling, Transportation & Use of Chemical Weapons
- Treaty on Non-Proliferation of Nuclear Weapons (NPT)
- United Nations Educational, Scientific and Cultural Organization (UNESCO)
- Vienna Conventions on Diplomatic Relations 1961 & Consular Relations 1963
- South Pacific Nuclear Free Zone Treaty (SPNFZ)
- Convention of the Prohibition of Fishing with Long Driftnets in the South Pacific (Wellington Convention)
- Multilateral Treaty on Fisheries between Government of certain Pacific Island Countries and the Government of the United States of America
- Convention on the Prevention of Marine Pollution, Dumping of Wastes and other Matters (London Convention 1972)
- United Nations Convention to Combat Desertification and Drought (CCDD)

APPENDIX 2: BEST MANAGEMENT PRACTICES FOR ASBESTOS

1. Workplace Safety and Management

When working with asbestos, it is important to reduce exposure risks and ensure the safety of everyone involved.

> "Both friable and non-friable asbestos pose a significant health risk to all workers and others if the materials are not properly maintained or removed carefully…Asbestos is a known carcinogen, and the inhalation of asbestos fibres is associated with increased incidences of a number of diseases including pleural disease, asbestosis, lung cancer and mesothelioma. Even limited or short-term exposure to asbestos fibres can be dangerous" (National Strategic Plan).

The risks of asbestos exposure can be managed and reduced by following proper safety standards and following an asbestos management plan.

A clear asbestos management plan helps identify workplace risks and sets clear safety guidelines for management and removal. A management lays out clear course of action including timeline, safety, and emergency guidelines, to ensure projects are carried out safely and efficiently. An asbestos management plan should include the following:

- Identification and labeling of all asbestos material on the site
- Standards for measuring exposure (air monitoring procedures, etc)
- Outline of procedures to manage risks, including proper dress, equipment, and handling*
- Emergency procedures for accidents involving asbestos
- A timeline of project goals, and responsible parties for each deliverable
- Disposal plan for asbestos waste

Personal safety equipment is essential for safely working with asbestos materials. Clear guidelines and standards for safety equipment can be found in Section 4.5 of *The How to Safely Remove Asbestos Code of Practice*, from pages 29-32. Proper safety equipment includes well fitting coveralls, gloves, boots, and most importantly, respiratory protective equipment. When friable asbestos is being removed, respiratory equipment should include air-line respirators.

Following removal, all equipment must be either decontaminated or disposed of. Decontamination units must be set up for workers, with all external clothing/equipment being properly disposed of along with the asbestos waste or decontaminated. There are two types of site decontamination: wet and dry. Wet decontamination involves using damp rags to wipe all contaminated areas. Rags should only be used once, and used rags should not be re-wetted in a water bucket to avoid contaminating water. If electrical equipment is involved, wet decontamination may be a higher risk option due to electrical shock. Dry decontamination involved rolling or folding up all plastic sheeting used and sealing it in clean plastic. The contaminated area should also be vacuumed with an asbestos vacuum cleaner. This method should be used only when wet decontamination is not an option. Further guidelines for decontamination can be found in Section 4.6 of *The How to Safely Remove Asbestos Code of Practice (pp* 32-42).

2. Removal of Asbestos

Enclosure. The first step of asbestos removal is to set up an enclosed space for removal, to limit contamination and reduce the risk of fibers becoming airborne. The enclosure design should be based on the scale of removal taking place.

Large-scale removal. Large-scale removal includes projects of long duration, frequent removal, and those that generate a significant amount of airborne fibers. For large-scale projects, an enclosure space should be constructed. When friable asbestos is removed on a large scale, a negative pressure workspace is ideal, using negative air pressure units. For non-friable asbestos projects, the use of an enclosure can be determined by risk assessment based on the contamination potential of the site and chance of airborne fibers.

Enclosure design should take into consideration: precautions to minimize the spread of asbestos access to decontamination areas, air quality within the enclosure, lighting, temperature, and any other hazards in the area. Enclosures should be constructed of heavy duty plastic sheeting that is at least 200 µm thick. All walls, floors, doors, and windows should be enclosed, but viewing panels may be used when appropriate so the work area can be seen from outside the enclosure. Seals should be airtight wherever air may pass through, to prevent asbestos from contaminating non-enclosed areas. Airlocks should be placed at entry points and decontamination areas. Where plastic layers overlap, the overlap should be at least 30 centimeters (cm), and both layers should be double taped. All persons must wear appropriate gear during work and deconstruction of the enclosure, and all plastic should be disposed of as asbestos waste.

Small scale removal. Small scale asbestos removal is often only short term maintenance work, and involves the use of three different options: small scale enclosure, glove bags, and wrap and cut techniques. Small scale enclosure should be used in limited access areas and emergency removals. These enclosures can be framed with wood or other materials, and should use the same plastic sheeting and format as large scale enclosures. The enclosure should be large enough to allow work to take place and accommodate any equipment. All seals in the enclosure should be secure to reduce the risk of contamination. When work is completed, materials that cannot be decontaminated should be disposed of as asbestos waste.

Glove bag work is best for asbestos from individual fixtures such as piping and valves. A glove bag is a single-use bag made from clear, heavy-duty polyethylene with built-in arms and access ports. All waste is contained within the bag, reducing decontamination needs. The bag should be cut and arranged to completely enclose the asbestos-containing object, with all needed tools inside the bag, and then sealed with heavy-duty tape. For safety, coveralls and respirators should still be worn when using glove bags. Once removal is complete, asbestos should be sealed in the bag. Then the bag is vacuumed out with an asbestos vacuum, removed, and disposed of as asbestos waste.

The wrap and cut asbestos removal method produces very low levels of airborne fibers, and can be used instead of the enclosure method in certain circumstances. If the asbestos present is a small level of non-friable asbestos, and is in good condition, this method can be used. This works best when an entire component is to be removed and disposed of. First, the equipment being removed should be vacuumed with an asbestos vacuum and wiped down with rags that should be treated as asbestos waste. The equipment being removed should then be double wrapped in heavy-duty plastic (at least 200 µm thick) and completely sealed with heavy duty tape. Exposed surfaces can then be disconnected, cut, etc. to remove the equipment, ensuring the plastic is not punctured. Once the equipment is removed, exposed surfaces should also be wrapped, and the entire thing disposed of as asbestos waste. For safety, coveralls and respirators should be worn when using this method.

Removal options. There are three main methods of asbestos removal; two wet, and one dry. Technique should be chosen based on what will lead to the least amount of airborne fibers and contamination. The three methods, in preferred order, are the wet spray method, the saturation and water injection method, and the dry method. It is important to note that with all methods, safety equipment, including coveralls and respiratory protective equipment should always be used.

Wet spray. This method is the preferred method of asbestos material and can be used to remove asbestos from plants, buildings, and other structures. This method requires constant use of low-pressure water. A fine spray is used to constantly wet down asbestos and related materials to suppress fibers. This is often achieved with garden hose-type fixtures, but can also be done with a pressurized vessel, if no pressurized water supply is available. The size and supply of water should also be based on the amount of asbestos being removed.

As removal begins, an asbestos vacuum cleaner may be used before spraying down with water to remove any airborne fibers. Once this is complete, water is directed at cuts in the material, and used to fully saturate the asbestos. A wetting agent, such as detergent, may be added to the water to speed up the process. It is also possible to use a PVA emulsion, which may be more effective than water at preventing airborne fibers. A PVA emulsion can be allowed to dry before removal begins to prevent slipping hazards. If using water or water and detergent, as the material is fully wetted, it can be removed, and new exposed surfaces should be sprayed down. Removed sections should be immediately sealed and labeled for disposal.

Saturation and water injection. This technique for asbestos removal is to be used when friable asbestos is so thick that the spraying method will not sufficiently suppress fibers. This method is done by directly injecting water or a water-based solution into the asbestos, using a specialized applicator and injection head. To speed up the process, holes may be cut in outer layers. This also ensures full saturation of the asbestos. Once materials are completely saturated, they can be removed, packaged, labeled, and disposed of. This method requires specific training for the equipment and process used, to ensure materials are fully saturated and contamination risks are reduced.

Dry removal. This method is the least preferred of the three, and should only be used when wet methods are not viable, usually due to risks of electrical shock or water damage to equipment. This method has the highest risk of fibers becoming airborne, and requires additional safety precautions. For non-friable asbestos, it is important to enclose the removal area as much as is reasonably possible. With friable asbestos, the removal area mush be fully enclosed and maintained at negative pressure using negative air pressure units. Workers must also wear full-face positive-pressure supplied air-line respirators. Regardless of what type of asbestos is being removed, material should be taken out in small sections in an effort to reduce any airborne fibers. Asbestos vacuum cleaners are very important when using the dry technique, and should be employed whenever possible. All waste should be directly moved to wetting containers to suppress dust. After waste has been wetted, it can be packaged for disposal.

3. Disposal Options

The preferred disposal method for asbestos is for all waste (including plastic sheeting and any other materials that cannot be decontaminated) to be sealed in heavy-duty plastic that is at least 200 μm thick, and sealed with heavy-duty tape. These packages should be of a manageable size, and can then be taken to a licensed disposal facility that will ensure they are properly labeled and buried in an allowed location. If waste is significant, large-scale tarps that meet packaging requirements can be used, if the package is still appropriately sealed. This can also be disposed of in the same way.

For on-site disposal, any and all asbestos waste material should be packaged in heavy-duty plastic and sealed with tape, in accordance with standard asbestos disposal. All packages should then be clearly labeled that they contain asbestos waste material. If a location is available, these packages can be buried in an area that is clearly marked as containing asbestos waste. If proper packing procedures are followed and all materials are labeled, the risks of contamination should be very low. This is a low-cost option, and will only require duct tape, heavy-duty plastic sheeting, and labor (person-hours) to pack and bury the waste. The challenge with this option is to find appropriate land where the asbestos can be buried, and ensure that it is clearly marked.

4. Key Findings and Recommendations from 2007 Asbestos Survey

The roof of the power station is composed of corrugated asbestos (chrysotile) cement sheeting that is likely to be 50 years old. It is, in this instance, at the end of its useful life and is in very poor structural condition. By this it is meant that although it looks intact from a distance, and may not be leaking too badly at present, the actual integral strength of the asbestos cement has almost disappeared from weathering, i.e. the gradual dissolution of the cement matrix over time by the action of rainfall and biological activity.

Rainwater is always slightly acidic (unless passing through a cloud of volcanic ash), and cement is an alkaline substance. Therefore over time the acid in the rain eats away at the alkaline cement material. Asbestos itself is entirely inert and safely bound up in the cement matrix, but over time as the cement slowly washes away the asbestos cement has the appearance of becoming 'furry', i.e. it is possible to see the bundles of fibers of asbestos protruding from the cement, and fiber shedding begins to occur. It has been documented that fiber shedding most often occurs with heavy rainfall and that gutters and storm water outlets can accumulate asbestos fibers as a result of this.

As the cement dissolves away over the decades the product becomes thinner and can become brittle, and no longer safe to walk on in the case of roofs. In the case of the power station roof the highly moist climate of Nauru and the power station being on the coast has meant that the external face of the asbestos cement has become porous and sponge-like, encouraging some biological activity within it that has further deteriorated the material and further weakened its structural strength. This was demonstrated by instead of having to apply considerable pressure to snap off a sample of the asbestos cement product at an edge (as is usually the case), the material sampled from the edge of the power station roof was soft and almost fell apart as gentle pressure was applied from a set of pliers. Three areas were investigated and all had the same soft texture with no integral strength left in the product.

The asbestos cement roof is therefore gradually becoming friable, and may be difficult to remove as intact sheets during any removal exercise. The roof therefore should not be walked on without proper fall restraint systems in place, and preferably a 'cherry picker' or crane should be used for any work on the roof.

It is expected that the roof has little life left in it after 50 years in the Nauruan climate, and this general statement is probably applicable to all asbestos cement-roofing products that are of this age in Nauru. If the roof had been in generally good structural condition then cleaning it with alkaline water based biocides and then painting it with special silicaeous paints to preserve it for another 10 years or so would have been an option. In its current condition it is recommended that the roof be replaced with a non-asbestos containing alternative such as galvanized iron or color-bond cladding. The estimated quantity of ACM in the roof is 980 m^2.

The front (eastern) gable of the Power Station has asbestos (chrysotile, amosite and crocidolite) cement moldings fitted to provide ventilation. This product has also begun to deteriorate, and is cracked and broken in places. It is recommended that the asbestos cement ventilation moldings be removed and replaced with a non-asbestos containing alternative. The estimated quantity of ACM in the ventilation moldings is 42 m^2.

It is recommended that all identified asbestos containing materials be removed by an appropriately licensed asbestos removalist prior to any refurbishment or demolition works that may impact on the identified materials. The cost to remove and replace one square meter of asbestos containing material in Nauru is approximately $400. This price is an estimate inclusive of crane hire, labor costs, transport of the material and its disposal in an appropriate landfill facility. The quantity estimates and associated costs are considered to be within + 30% of actual quantities and costs. The total estimated cost is therefore (980 m^2 + 42 m^2) = 1022 m^2 x $400 = $408,800. A contingency of approximately 20% is assumed for a total estimated cost of $500,000 (as shown in Table 7 of the EMP).

APPENDIX 3: BEST MANAGEMENT PRACTICES FOR POLYCHLORINATED BIPHENYLS

1. Workplace Safety and Management

Until the late 1970s, polychlorinated biphenyls (PCBs) were a common component in many products such as transformers and capacitors, as they do not degrade significantly over time or due to temperature. However, due to this characteristic, PCBs do not break down in the environment, and can accumulate in the fatty tissues of animals, and become concentrated in the food chain. PCBs may also become concentrated in soils and contaminate the area. Wherever PCBs have concentrated in the environment, there is an exposure risk. The most commonly observed symptom in people exposed to high levels of PCBs is a condition known as chlor-acne. It is a severe, persistent, acne-like rash. Very high exposure to PCBs may also cause liver damage and damage to the nervous system, resulting in numbness, weakness and tingling in the arms and legs. It is possible that PCBs may cause cancers" (Managing PCBs).

Because of the health risks of PCB, it has been banned in most developed countries, and is being removed, treated, and recycled when possible. While concentrated PCB exposure has clear health risks, "PCB containing equipment is unlikely to pose a health risk, unless it becomes damaged and leaks" (Managing PCBs). If workers will not have any direct contact with PCBs, no special precautions are needed. If contact does occur, immediately wash any body part exposed to PCB, and consult a medical professional.

For projects that may lead to PCB contact, such as draining PCB from electrical components, workers should wear protective clothing that is impervious to PCBs. Protective clothing should include gloves, coveralls or aprons, and shoe covers. Workers should also wear protective eyewear, such as safety goggles or face shields. "Impervious coveralls made of butyl rubber, neoprene, nitrile rubber, polyvinyl alcohol, viton, saranex or teflon (**not** ordinary rubber) should be worn when handling PCB liquids" (Safe Management of PCBs). If PCBs are being handled hot, or there is significant air exposure, personal respiratory protective devices should also be worn.

After projects are completed, reusable equipment and gear should be thoroughly washed with soapy water. Reusable equipment must be either impervious to PCB contamination or able to be completely cleaned. Equipment should be tested to ensure that it has not been contaminated by PCB exposure before it is used for any other projects. Contaminated clothing should not be cleaned or reused. Contaminated clothing and equipment should be immediately disposed of as PCB waste.

2. Removal of PCBs

If PCB-containing components are simply being removed, and are in good condition, the risk is low. Components can simply be removed and packaged for disposal. If components are being drained or may be in poor condition and vulnerable to leaks, additional safety precautions should be taken, including wearing appropriate gear as discussed above.

Removal procedures will vary depending on what components are being taken apart, but generally do not require special techniques or setup. Equipment should be safely dismantled, with PCB-containing components either disposed of as PCB waste, or drained, with contaminated parts and PCBs disposed of properly, and remaining materials recycled or disposed of normally.

3. Disposal Options

The preferred disposal method for PCBs is to treat and recycle PCBs and PCB contaminated material. Components can be drained of PCBs, and if "the PCB-contaminated metal in the equipment does not have a coverage of PCBs on its surface area of more than 1mg/m2," it can be considered PCB free and recycled or disposed of normally. Any PCBs or material that is contaminated above this threshold should be properly packaged and taken to an appropriate facility where it can be treated and recycled.

On-site disposal and long-term storage will depend largely on budget and amount of waste produced. If space is available, PCB waste can be stored safely, with proper packaging. Any equipment containing PCBs should be put in a polyethylene bag, and then stored in a dangerous goods approved drum. Drums should be "sealable, open-head, epoxy-lined, export-quality steel drums" (Managing PCBs). If components are leaking, drums should be partially filled with an absorbent (kitty litter, diatomaceous earth), and then bags of PCB containing equipment. Liquid PCBs should be stored in separate drums from those containing components. PCBs from different sources should be stored in separate drums to prevent mixing of concentrations. All drums of PCB waste should be clearly labeled, with a label that includes if it is liquid PBCs or PCB-containing components, [i.e., that the waste is equivalent to class 9 in the Australian waste classification system], and an indication of concentration.

Once drums, are sealed, PCBS can be stored, as long as the storage meets certain requirements. All containers must be labeled and stored to prevent any possible discharge to the environment. PCBs have a very low vapor pressure, so may be stored in occupied buildings if conditions are appropriate. All storage for PCBs should meet the following requirements:

- Impermeable floor (concrete)
- Away from heat sources, flammable liquids, electrical hazards, chemicals, batteries, food storage
- No drainage outlets
- Inside, roofed area- protected from weathering and external agents
- Area cannot be prone to flooding
- Limited access- no access by unauthorized individuals
- Adequate space for all drums and access for inspection

Under these circumstances, PCBs, PCB-containing materials, and other PCB wastes can be stored on site. The viability of this option will largely depend on available space for the amount of waste produced, and the affordability of storage materials (these materials would also be needed for transport, so this should not be an issue).

APPENDIX 4: LIST OF PEOPLE INTERVIEWED DURING MAY 2014 CONSULTATIONS

Name of Respondent	**District**
Takenebu Anatete.	Denig
Taakung Teruru.	Denig
Ifiaua Ititaake.	Denig
Ateti Akerita.	Denig
John Mitek Kaliwa.	Denig
Biit Ioane.	Denig
Tiria Boata.	Denig
Atic.	Denig
Kaibeau.	Denig
Tetino Kaibeaw.	Denig
Robert Amasia.	Denig
Teitea Anefefe.	Denig
Tettibwi Utiera.	Denig
Tekoba Kamonki.	Denig
Gordon Tozaka.	Denig
Nat Takai Raieta	Denig
Arro Raieta.	Denig
Tibuia kokia.	Denig
Aaron Koria.	Aiwa
Elvis Spanner.	Uaboe
Victor Soriano.	Denig
Sabeta Cain.	Nibok
Ditrond Tom	Aiwo
Bernsdowoum Buada.	Buada
Doke Cecil.	Denig
Tupe Tagamum	Ijuw
David Dowiyogo.	Baitsi
Bernard Akubor.	Yaren