Environmental Audit at AA. Kandholhudhoo for the Registration of Existing Desalination Plant and Powerhouse

Proposed by

Kandholhu Cruise & Spa

Prepared by

For Water Solutions Pvt. Ltd., Maldives

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1 Introduction

The Ministry of Housing and Environment requires that desalination plants and powerhouse in the Maldives be registered. In order to carry out the registration process, environmental clearance is required from EPA. A decision statement regarding the Environmental Impact Assessment of the power and water infrastructure needs to be obtained from EPA. In order to provide such clearance, EPA requires that an environmental audit be done for existing facilities.

Environmental Protection Agency has decided that an Environmental Audit Environmental is required for the registration of desalination plant under the Desalination Regulation of the Maldives and Guidelines for Power System Approval issued by the Maldives Energy Authority.

1.1 Aims and Objectives

The objectives of the report are:

- to assess the environmental performance of the existing powerhouse and desalination plant at Kandholhudhoo
- to facilitate the application to register the existing powerhouse and desalination plant according to the requirements of the Environmental Protection Agency and the Maldives Energy Authority.
- To demonstrate the commitment by the proponent to undertaken environmental monitoring.
- To fulfill the obligations of the proponent to undertake an EIA under Clause 5 of the Environmental Protection and Preservation Act of the Maldives and requirements of the Tourism Regulations.

1.2 Environmental Audit Implementation

This audit has been undertaken by a local environmental consulting firm, Water Solutions. Water Solutions have been chosen by the proponent as the environmental consultants for this project. The team members were:

- Ahmed Jameel, Environmental Engineer (EIA Registration No: EIA 07/07)
- Abdul Aleem, MPH, BSc. Environmental Health (EIA Registration No: EIA 09/07)
- Mohamed Riyaz, Assistant Surveyor

1.3 Terms of Reference

The terms of reference for this audit have been attached as an annex. This audit has been prepared based on these terms of reference.

The scope for this environmental audit is to focus the environmental compliance and performance of the existing power system and desalination plant.

2 Project Description

2.1 Location and Study Area

The study is focused on the existing power and desalination plant at AA Kandholhudhoo. The specific areas includes the powerhouse, powerhouse stacks, the desalination plant, surrounding areas of powerhouse and desalination plant house for noise and emission, seawater intake and brine discharge outfall of the desalination plant and fuel tanks and oil handing areas. This report focuses only on the powerhouse and the desalination plant and no other operations of the resort are incorporated within the context of this report.

2.2 Methodology

Existing environment was studied using standard methods used in EIA studies. Field visit was undertaken on 6th January2010.

2.3 Mapping and Location identification

The island, including shore line including the low tide line, mid tide line and high tide line and vegetation lines were mapped for the assessment. Mapping was undertaken using hand held differential GPS and available satellite photos. The location of data collection sites were marked using handheld GPS.

2.4 Water Quality

Groundwater and marine water quality was assessed using water quality logger, which was calibrated at National Health Laboratory. Water samples were collected, as outlined in the TOR, at about 1m below from the surface Desalinated water quality was tested at the Coco Cola laboratory. BOD and COD of marine water were not tested as its tests were not able to be carried out at the National Health Laboratory.

2.5 Marine Environment surveys

Marine environmental surveys were conducted to collect data and establish marine environmental baseline conditions for impact evaluation.

2.6 Noise

Noise level was measured using a digital sound level meter Q 1362 from Dick Smith Electronics. The noise level was measured using A weighting, 'A' weighting was used as this enables sound level meter to respond in the same manner as the human ear, which increases and decreases amplitude over the frequency spectrum. The sound level meter that was used for the part of the assessment had an accuracy of ±2 dB.

2.7 Uncertainties in impact prediction

Environmental impact prediction involves a certain degree of uncertainty as the natural and anthropogenic impacts can vary from place to place due to even slight differences in ecological or social conditions in a particular place. There is also limited data and information regarding the particular site under consideration, which makes it difficult to predict impacts.

2.8 Water Supply Infrastructure

2.8.1 Water Demand at the island

On average the plant produces 5.0 – 6.0 m^3 of water per day. It was found that on average the island consumes 4 - 5 m^3 of water per day.

2.8.2 The source and methods of obtaining feed water

The source of the feed water for the desalination plant is from a seawater intake located on western side of the island. The intake is a 4 inch pipe which is located 120 m from the shoreline. The location of the boreholes are marked in the island map attached as Annex 1

2.8.3 Circulation of water

The feed water to the desalination plant is sourced through the intake. The pump at the plant house, pumps the water from the intake to the sedimentation tank. Then the water is flown through the filters. The filtered water is passed through the membranes with help of High Pressure pumps. The permeate water produced at the desalination plant is sent to the holding tank before it is pumped to the main storage tanks.

Figure 1: Sedimentation tank

The concentrated seawater which is produced as by product is collected and then pumped to the sea through the brine outfall.

2.8.4 Desalination Plant

Kandholhudhoo has 1 reverse osmosis plant with a capacity 6 MT/Day. The plants can produce fresh water from sea water with TDS of 375,000 ppm at 25 °C. The water produced from the plants have a quality TDS<500 ppm at a pressure of less than 2 Bar. The system efficiency is rated not less than 35%.

Type of plant	Reverse osmosis
Manufactured Country	Singapore
Date of Manufactured	1995
Plant Serial No	2531-6-K
Plant Model No	2531
Number of Plants	1
Total Capacity	6 m3/day

Table 1: details of the desalination plants

Figure 2: The RO plant at Kandholhudhoo

2.8.4.1 Desalination Process

The feed water for the desalination is sourced through the boreholes. The water from the boreholes is connected to a sedimentation tank through a pump well. The intake water passes through a sedimentation tank to minimize clogging of the membranes from silt present in the water. The sedimentation tank is about 8 tons.

Then seawater flows through a sand filter and a check filter by the filtration pump after storing in the sedimentation tank.

Figure 3: one set of sand filters and check filters at RO plant house

The filtered water is then passed through the reverse osmosis system. The reverse osmosis membrane reduces the salt content producing freshwater. Freshwater is pumped into the storage tank which is located outside the plant house. The existing desalination plant does not have a disinfection unit.

The hyper brine which is produced by the desalination process is discharged to the ocean through the brine outfall which is located 50 m from the shoreline on western side of the island.

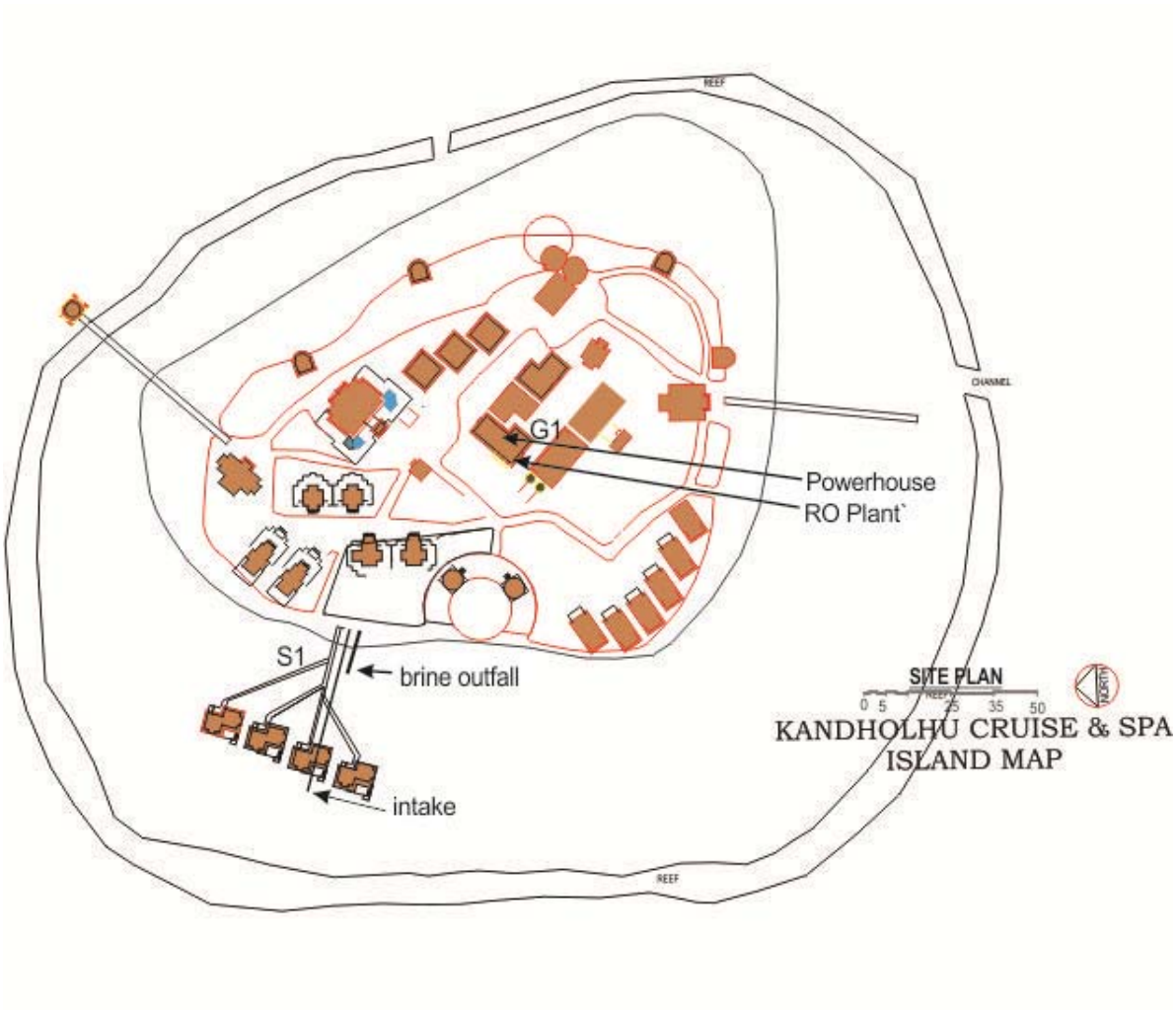

Figure 6: Groundwater and sea water sampling locations

3.1 Safe Groundwater availability

The size of the natural island is about 1.2 hectares. The ratio of the freshwater lens to the island area is estimated to be about 0.42. The groundwater recharge from rainfall is estimated to be 0.8 m/year and sustainable yield from the groundwater aquifer is estimated to be 3 cubic meters per day. Same amount of water is produced by the desalination process at the island

Item	Island
Island area (ha)	1.2
Estimated freshwater lens area (ha)	0.5
Ratio of freshwater lens area to island area	0.42
Estimated recharge from rainfall (m/year)	0.8
Estimated sustainable yield (m/year)	0.24
Estimated sustainable yield (m3/day)	3

Figure 7: Sustainable Yield of groundwater for Kandholhudhoo (after Falkland, 2002)

3.2 Marine Environment

Existing Marine Environment

3.3 Existing marine environment at outfall site

The marine environment of Kandholhudhoo consisted of shallow, reef-flat and the reef. Kandholhudhoo island is situated within atoll system of Ari atoll. The reef system of Kandholhudhoo is a very alive with abundant live coral cover. One of the main reason for the high percentage of live corals is attributed to the fact that the management is extremely careful in educating and ensuring that the reef is in good health.

3.4 Biotic Marine Environment

Biotic marine of Kandholhudhoo can be categorized into two major components. They are the coral reef system and the lagoon system. Quantitative assessment of the status of the reef in the island was conducted by adapting photo-quadrate transects at the outfall location. Semi-quantitative assessment of the reef was conducted by time-swims and visual observations. Status of the lagoon was assessed by visual observations. Status of the reef is excellent in Kandholhudhoo.

The following graph shows the benthic cover of the coral reef at the outfall location.

3.4.2.1 Water Quality

Water quality was collected during the field trip from two locations. Sea water samples were collected from outfall location

Parameter	S1
GPS coordinate	4°00'11" N 72°52'51" E
Air temperature	29.8°C
Water temperature (at Surface)	27.2°C
Water depth of the sampling locations	1.0 m
pH	7.9
Salinity (conductivity)	55,000µS/cm
DO (% Saturation)	85
Turbidity	0
Suspended solids (mg/l)	35
Total Coliform	0
Feacal Coliform	0

3.5 Power Generation and Distribution Infrastructure

The power system at the island includes the power generation equipments and distribution Equipment. The power generation equipment includes a power house building, a fuel storage facility and diesel engine generator sets having the capacity of 250 kW x 02 as the installed capacity of the generator sets. The emission stack is about 10 meter tall which installed at the powerhouse. On average the power house plant produced 130 Kwh of electricity per day.

Figure 10: Diesel Generators at Kandholhudhoo

The powerhouse has installed secondary residential silencer with attenuation of better than 85 dB (A) at 1 meter. The soundproofing ensure a total free field sound level of not more than 85 dB (A) at full load outside the power house.

3.5.1 Fuel

A fuel storage tank of capacity 45,000 litres storage the diesel for the powerhouse. The storage tank does not have a bund around the tank to control the accidental spillage.

Figure 11: Storage tanks at Kandholhudhoo

3.5.2 Noise

Noise levels from the powerhouse are well within acceptable levels. The powerhouse has secondary residential silencer which attenuates the noise to 85 dB (A) at 1 meter and 75 db(A) at 5 m. Hence the powerhouse does not cause significant noise pollution. Noise is in compliance.

3.5.3 Air Quality

The stack at power house does not produce visible smoke and not cause any significant concern to the staff and guest at the island.

Figure 12: smoke staff at the powerhouse

3.5.4 Fire and Safety Measures

Fire protection and prevention measures had been taken at the powerhouse and the surrounding areas. In order to protect the powerhouse from the fire accidents the proponent has installed fire extinguishers.

3.5.5 Management of waste and waste oil

The waste lube oil area generated from the generators after every 200 hours of operation. Each changing of lube oil from a generator would generate 50 litres of waste oil. These waste lube oil is collected in 200 litre drums. These are collected and transported to Kuramati Island Resort for final treatment and disposal.

4 Environmental Performance and Compliance

4.1 Identification

Environmental performance of the powerhouse and desalination plant has been measured by considering the impact of the existing power house and desalinated plant on the island environment. As such, the following areas would be considered for evaluating the environmental performance:

- operational impact of powerhouse and desalination plant
- Identify if the brine is discharged in appropriate location and if exhaust emissions are appropriately discharged.
- Discuss the short term as well as long term effects of any emissions or discharges on the environment, especially the health of the staff.
- Identify any information gaps and evaluate their importance for decision-making.
- Determine how well the existing infrastructure complies with existing environmental policies and regulations

4.2 Desalination Plant

4.2.1 Impact on Groundwater

The RO plant use seawater from the seawater intake and the brine that is generated from the RO process is disposed to the sea via the brine outfall. Hence the ground water is not impacted due to the operation of the resort.

4.3 Sedimentation tank

Water from the seawater intake is pumped to the sedimentation tank in the desalinated plant house. The capacity of tank is around 9 m3. The tank has a depth of 2m. The sedimentation tank is observed to be function as it removes the larger particles before feed water is fed to the filters.

4.4 Filters

The filter system installed in the RO plant consists of Sand Filter, check filter and micron filters. Visual inspection was made and leaks were observed in filters in the filtration system.

4.5 Reverse Osmosis Units

The reverse osmosis units installed at the island is very old but had been properly maintained. Hence the unit is producing water at an acceptable efficiency.

4.6 Storage Tanks

The total capacity of the storage tanks is 50,000 litres which is equal to island need for over 10 days.

4.6.1 Noise form desalination plant

The desalination plant does not produce significant level of noise and is located away from sensitive area. Hence it does not have an impact on the island's environment

4.6.2 Impact on Marine environment due to discharge of Brine from RO Plants

The outfall of the RO plant is located on western of the island and discharges the brine into the sea.

4.7 Power house

4.7.1 Location

The power house is located away from the noise sensitive areas on the island

4.7.2 Emission

The powerhouse has tuned generators and hence the emission from the powerhouse stack does not cause any significant visible impact on the visual environment of the island.

4.7.3 Fuel, oil handling and management

The fuel for the generators is stored in the fuel storage tank located near the powerhouse. The fuel storage tank does not have a bunded to prevent accidental leakage of fuel to the ground. Hence, the storage of fuel at the island has a risk to the ground water contamination at the island by an accidental leak.

The waste oil from the generators is recovered from the generators and stored separately in barrels. The waste oil is send to Kuramati Island Resort for final treatment and disposal.

4.7.4 Audit Summary

Parameter	Compliance		Performance			Observation	recommendation
	Yes	No	Low	Fair	Good		
Impact on ground water	X				X		
RO Plant	X			X		The filters are leaking	Leaks need to repaired
Storage tank	X				X	Storage tank can store up to 10 days of water for the island	
Chlorination		X		X		No chlorination	Need to disinfect the produced water
Noise & Emission	X				X		
Water quality	X				X		
Marine water quality	X				X		
Fuel handling and management	X			X		Fuel tanks need to bunded	
Water demand	X		X			The demand for water is reasonable	
Energy demand	X		X			The demand for energy is acceptable	

5 Mitigating and management of Negative Impacts

This section identifies measures to mitigate significant negative impacts to acceptable levels. The main issues that were identified during the audit were high demand for water and energy at the island. The RO system and the power system on the island has been recently upgraded and modernized. Hence the RO system and power system are performing to levels that it does not have any significant impact on the environment.

5.1 Installing a disinfection system at the desalination plant

Presently the RO plant does not have a chlorination system to disinfect the produced water. Hence it is recommended to install a disinfection system at the RO Plant house as such that the produced water could be disinfected before it is pumped to the storage tank for storage and distribution.

5.2 Bunding the fuel tank

The fuel storage tank does not have a bund to retain 110% of its content if there is an accidental spillage. Hence it is proposed to construct a bund around the fuel storage tank as to contain 110% of the volume which is stored in the storage tank.

5.3 Fixing the leaks at the filters

At the time of inspection for the environment audit, it was observed that RO plant was leaking at different areas due to lose connection. This kind of leaks would reduce the efficiency of the RO process. Hence, it is recommended to fix the leaks in the RO process from the filters to the product water tank.

6 Environmental management and monitoring plan

This section covers the monitoring needs of the powerhouse and desalination plant facilities at Island.

6.1 Cost of Monitoring

The proponent has committed fully for the monitoring programme outlined in this report.

6.2 Aspects of monitoring

Monitoring will only include groundwater, RO water and marine water quality. Summary monitoring reports will be provided when such is required.

6.3 Methods of monitoring

Environmental monitoring will be undertaken using standard methods described in the Methodology section.

Table 4: Aspects of the environmental monitoring program with cost breakdown

Monitoring Attribute	Indicator	Methodology	Monitoring Frequency	Estimated Cost (US$)
Marine water quality	pH, temp, DO and Salinity	Onsite or Lab analysis	Quarterly	250 per quarter
Ground water quality	pH, temp , BOD, DO, Salinity, nitrates, phosphates,	Onsite or Lab analysis	Quarterly	250 per quarter
RO water quality	suspended solids, TDS, pH, temp, Salinity, turbidity, Ecoli	Onsite or Lab analysis	Quarterly	250 per quarter

6.4 Monitoring responsibility

Monitoring responsibility will be with the client and financial provisions will be made to undertake the monitoring.

6.5 Monitoring Report

Monitoring report will be compiled based on the baseline data collected for monitoring the parameters included in the monitoring program. This report will be submitted to the relevant government agencies for compliance, if requested. The report will include details of the site, data collection and analysis, quality control measures, sampling frequency and monitoring analysis and details of methodologies and protocols followed.

7 References

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9 TOR

10 Floor plan of Powerhouse and RO Plant