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AMENDMENT 4

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ނަންބަރު **No:**	**TES/2015/W-76**	
ޕްރޮޖެކްޓް Project:	Design and Build Basis for Water Supply Network, Water Storage Tanks and Reverse Osmosis Plant and Allied Works based on Integrated Water Resources Management approach in Th. Thimarafushi, Maldives.	
ތާރީޚް Issued Date	Thursday, June 25, 2015	
ސަފްހާގެ އަދަދު No. of Pages: 10	ބީ.އޯ.ކިއު BOQ: 00	ޑްރޯއިންގް Drawings: 00

Please include this amendment when submitting the bid. ބީލަން ހުށަހަޅާއިރު މި އެމެންޑްމަންޓް ބީލަމާއެކު ހުށަހަޅަންވާނެއެވެ.

1. Attached with this amendment is the answers to clarifications received for the subjected project.

2. Bid submission date is as follows.

   Date: **Tuesday, June 30, 2015**

   Time: **1400 Hours Maldives Time**

   Venue: **Meeting Room, Tender Evaluation Section, Ministry of Finance and Treasury**

ނަން **Name: Abdullah Ali**	ސޮއި **Signature:**

Project Name: Design and Build Water Network System in Th.Thimarafushi, Maldives
Interested Bidder: MWSC
Subject: Clarifications
Date:

S.No	Reference	Reference Details	Clarifications
1		Attached herewith is a regulation from Ministry of Environment and Energy for water and sewerage connections. Please clarify the categories of house connections that should be provided under this project as this would affect the bid price.	All categories indicated in the point 1 of the the Usool for the Water and Sewerage House Connections should be addressed.
2		According to ITB 7.4 states that no pre-bid meeting, so please provide us with list of parties who have purchased the bids.	1. MWSC 2. Puritas Pvt Ltd 3. Sierra Maldives Pvt Ltd 4. Static Company Pvt Ltd 5. Aima Construction Company Pvt Ltd & Haway International Pte Ltd (Joint Venture) 6. HISSS
3		With reference to Appendix to Tender 1.1.3.3 Time for Completion of the Works is 9 months (3 months for design and 6 months for construction). Based on our experience from previous projects and size of the island 9 months is not sufficient for project completion. For design and build water network, on average project duration will be 18 months (5 months for design , 13 months for construction). Design and material order (major materials are not available locally) would take up to 5 months taking consideration of complying with EPA guidelines, EPA approval of design and island council cooperation. So we request for time extension for the Time for Completion of the Works.	Reference Appendix to Tender 1.1.3.3. Please find the amended version of the Time of Completion of the Works below. Total 12 Months = (03 Months Design + 09 Months Construction)
4		The subjected project scope includes Integrated Water Resource Management (IWRM) approach. EPA has mentioned in the comments for one our design and build water project that "According to the IWRM (Integrated Water Resources Management) guideline provided by EPA renewable energy power source should provide 50% of the local power supply ". We would like to request to provide us IWRM guideline by EPA and whether renewable power source would be required for these island. If renewable Power source such as solar panel is to be installed, this should be separately mentioned in the BOQ and it should be very clear to all contractors as this is a very high cost item. In previous tenders of Integrated Water Resource Management projects that we have tendered renewable Power Source are not in the scope and tenders on Renewable Power Sources are usually a separated tender.	Please find attached the IWRM Guideline. Please add and item to the BOQ addressing the Renewable Energy component that could be negotiated later.

Guideline for IWRM Projects

Design Standards

It is appropriate to design a water supply system for a midterm period of about 30 years with the option to expand it in the future.

Water Supply

The water supply system shall be designed in a manner to provide sustained potable water to the consumers within the supply area on a continuous basis under normal situation. The system is in general shall comply with the under listed parameters complying particularly to EPA requirements and generally with other international standards.

- All inclusive water consumption rates per person from house connection should be between 50 and 70litres per day.
- Minimum water quantity of 20litres for drinking and cooking only shall be guaranteed during emergency and extreme climatic conditions.
- Non-Revenue Water (NRW) shall be limited to 5% for this new water supply scheme.
- No public standpipes would be provided as 100% house connections are envisaged.
- Suitable standpipes would be installed at waterfront area to easily fill water to fishing vessels and other consumers in nearby islands during emergency or extreme climatic conditions.
- Commercial and industrial demand shall be determined for each scheme individually as a percentage of population water demand in conjunction with local trend, development pattern and historical records. Large scale water demand for commercial and industrial use cannot be supplied from desalination plant.
- Service coverage ratio to the project area shall be 100% on completion of the project.
- Pumping efficiency shall be in the region of 50% to 75%.
- Bulk water meters shall be installed at all strategic locations including for raw water, treated water and reservoir outlets.
- Residual pressure head at connections to individual premises shall be a minimum of 10m and maximum of 30m. An average of 20m head is envisaged in the service area.

Conveyance System

Water convergence system in general covers works associated with raw water pipeline, transmission mains, distribution network, storage facilities, individual house connections, etc. Pipes manufactured from PE materials with a nominal pressure of PE80 PN6 shall be generally used for all pipelines including for house connections.

Pipelines

- Velocity of liquid flow in pumping main shall be limited to 1.5m/s with a targeted average velocity of 1.2m/s
- Losses at fittings and specials should be computed separately item by item or allowed as an overall percentage of 10 for DI, PVC and PE pipe materials
- Size of washout pipe shall be between 1/3 and 1/6 of the diameter of the main transmission pipe
- Air valves and washout valves shall be provided as required
- Normal depth of earth cover for the pipeline shall be maintained at a minimum of 0.6m
- Transmission pipeline capacity shall be 1.50 times the daily average production capacity for the year 2030
- Distribution pipeline capacity shall be 3.0 times the daily hourly average flow capacity for the year 2050 to take care of the peak hourly flow
- Minimum pipe diameter for distribution system shall be 63mm
- All large valves shall be made of DI material
- Sand beddings of 100mm thick shall be provided for pipelines
- House connections shall be with a minimum of 19mm diameter pipeline incorporated with water meter

Storage Reservoirs

- The storage tanks are normally above-ground storage cistern are below-ground storage vessel. The typical maximum size for a domestic system should be 20 or 30 cubic meters with appropriate calculations.
- Clear water tank of storage capacity not less than seven (7) days production capacity of the RO plant shall be erected at ground level in the vicinity of the treatment plant prior to delivery to the consumers through conveyance system. Should be shown with appropriate calculations
- The following possible options have been evaluated before deciding on the type of storage tanks and proper justifications should be provided.
  1. Reinforced concrete tank with covered roof
  2. PE tanks of 10cum capacity each
  3. Reinforced fiber-glass circular tanks
- The 7 days stored water should be recalculated within the network with 24 hours to prevent stagnation.

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Collection Pit

A small pit is dug in the ground, beneath the tap of the storage tank and constructed in brick masonry to make a chamber, so that a vessel could be conveniently placed beneath the tap for collecting water from the storage tank. A small hole is left at the bottom of the chamber, to allow the excess water to drain-out without stagnation. Size of collection pit shall be 60 cm x 60 cm x 60 cm.

Roof Rainwater Harvesting

The project shall advocate for rainwater harvesting system as a primary option with a desalination plant to ensure potable water security.

Catchment Area

Improved household rainwater harvesting system would be used exclusively by the islanders during the rainy season and rainwater harvesting from the centralized system is needed for only during the dry period supplemented with the desalinated water.
The roof area required to capture rainwater for the dry period consumption could be estimated from the formulae Q = CIA, where,
Q = Total rainfall volume
I = Rainfall
A = Roof area
C = Run off coefficient, (this is taken as between 0.60 and 0.85)

- The excess overflow water from the rainwater harvesting must be channeled through the ground water recharging system (filtered pits/well/infiltration) which should improve the ground water quality and enhance quantity to prevent saline water intrusion.

- Suitable public buildings belong to the center and island community with large roof catchment area should be identified for collection of rain water during the site visits and data collection process. These buildings should be grouped in to clusters to divert water to a common storage tank and the locations for construction of storage tanks within the island should be identified and shown in a map. These collection points shall be interconnected and water pumped to the central treatment plant for further treatment and disinfection. Both desalination and community based rainwater treatment systems shall be located at the same place.

- The rain water collected from roof will contain some finer suspended solid matters with an average turbidity level in the range of 5 NTU and it has to be removed prior to disinfection. The post-storage rainwater should be subjected to filtration process at the treatment plant location before diverting in to the clear water tank.

Transmission System

Potable water transmission system to the consumers generally consists of conveyance main pipe, storage reservoirs both ground level and elevated, distribution pipe network and house connections.
Direct pumping to distribution system should be used for the distribution of water to the consumers any other system or options should be justified accordingly.

For direct pumping to distribution system the following components required

- High lift pump with installation of VSD/VFD of about 10cum/hour capacity and 30m head
- Distribution network with necessary valves and fittings (common to both options)
- House connections with water meters (common to both options)
- Standpipes at harbor area to supply water to fishing boats and neighboring islands (common to both options)
- A standby transmission pump should be provided in case of transmission pump break down interrupting water supply
- Power supply must be provided continuously to ensure persistent water supply at all times, connection to island power supply would ensure that requirement with a standby generator.
- Energy requiredfor the water supply should be estimated on demand basis.
- In the event of transmission pump breakdown, a standby transmission pump should be provided.

Distribution Network

- The potable water produced at the treatment plant (desalination and/or rainwater harvesting) should be transmitted to the consumers by direct pumping to the distribution network.
- Pipes made of PE materials should be used to cover the entire developed area of the island.
- Provision would be allowed in the distribution system for future expansion.
- WatCad software should be used for the sizing of various pipelines identified for the system.
- A minimum pipe diameter of 75mm should be used for all major roads within the supply area and 63mm diameter for minor roads.
- The piping system should be incorporated with air valves and washout valves to improve pumping efficiency and cleaning of pipelines respectively.
- Isolation valves should be used in all important points of pipelines in order to isolate a particular section of pipeline during repair and/or maintenance without affecting other areas of the network.

House Connections

- Individual house connection with 25mm diameter pipe should be used from the water main to the household incorporating water meters.
- The properties with internal plumbing for potable water supply shall be connected directly with the incoming service pipeline.
- The properties without installation of internal plumbing shall be provided with a standpipe outside the house but within the compound.

Power Supply

- A power supply integrated with renewable energy sources like wind, solar panel and combined with dieselgeneration powered systems should be considered which would be economicallyfeasible within the limited resources available for the project.
- Possible power source options are should be considered for securing energy requirement.
    1. Diesel generator
    2. Solar panel
    3. Wind power
    4. Combination of any two any two or all three
- Renewable energy power source should provide minimum 50% of the local power supply.
- The electricity cost should drop down by a minimum of 25% and this should be shown with cost analysis study of the electricity cost.

Desalination Plant

- Should be designed according to Technical Specifications of Water Supply
- Minimum plant capacity should be 10 tonns / day and maximum should be 30 tonns /day.
- Only a maximum of 25% of water should be supplied from the Desalination plant with compliance to the water consumption rates.

Water Treatment

Before making a decision about what type of water treatment methods to use, water should be tested by anapproved laboratory and determine whether the water could be used for potable or non-potable uses. The typesof treatment that can be used are filtration, disinfection, and buffering for pH control. Dirt, rust, scale, siltand other suspended particles, bird and rodent feces, airborne bacteria and cysts will inadvertently find theirway into the cistern or storage tank even when design features such as roof washers, screens and tight-fittinglids are properly installed. Water can be unsatisfactory without being unsafe; therefore, filtration and someform of disinfection is the minimum recommended treatment if the water is to be used for human consumption(drinking, brushing teeth, or cooking). The types of treatment units most commonly used by rainwater systemsare filters that remove sediment, in consort with either ultraviolet light or chemical disinfection.

- **Filters**
  A filter is an important part of the inflow structure of a RWH System. Once screens and roof washers removelarge debris, other filters are available which help improve rainwater quality.

Keep in mind that most filtersavailable in the market are designed to treat municipal water or well water. Therefore, filter selection requirescareful consideration. Screening, sedimentation, and pre-filtering occur between catchment and storage orwithin the tank.
A cartridge sediment filter, which traps and removes particles of five microns or larger filter should be used for rainwater harvesting.
Sediment filters used in series, referred to as multi-cartridge or inline filters, sieve the particles from increasing to decreasing size.
These sediment filters are often used as a pre-filter for other treatment techniques such as ultra-violet light orreverse osmosis filters which can become clogged with large particles. Unless something is added to rainwater,there is no need to filter out something that is not present. When a disinfectant such as chlorine is added torainwater, an activated carbon filter at the tap may be used to remove the chlorine prior to use. It should beremembered that activated carbon filters are subject to becoming sites of bacterial growth. Chemical disinfectantssuch as chlorine or iodine must be added to the water prior to the activated carbon filter. If ultraviolet light orozone is used for disinfection, the system should be placed after the activated carbon filter. Many watertreatment standards require some type of disinfection after filtration with activated carbon. Ultraviolet lightdisinfection and Ozonation is not recommended since it is expensive.

Following are the recommended types of filters that can be used;

1. Gravity based filter

   This consists of construction of an underground / above ground filtration chamber consisting of layers of finesand / coarse sand and gravel. The ideal depths from below are 60 cm thick coarse gravel layer, 40 cm coarsesand and 40 cm fine sand. Alternatively only fine sand can also be used along with the gravel layer. Furtherdeepening of the filter media shall not result in an appreciable increase in the rate of recharge and the rateof filtration is proportional to the surface area of the filter media. A unit sq.m. surface areaof such a filter shall facilitate approx. 60litres./hr of filtration of rainwater runoff.
   A systemof coarse and fine screen is essential to be putup before the rainwater runoff is allowed toflow into the filtration pit. A simple charcoalcan be made in a drum or an earthen pot. Thefilter is made of gravel, sand and charcoal, allof which are easily available.

2. Sand Filters.

   Sand filters are commonly available, easy andinexpensive to construct. These filters can beemployed for treatment of water to effectivelyremove turbidity (suspended particles like silt andclay), colour and microorganisms.
   A simple sandfilter that can be constructed domestically, the toplayer comprises of coarse sand followed by a 5-10mm layer of gravel followed by another 5-25 cmlayer of gravel and boulders. These filters are manufactured commercially on a wide scale. Most of the waterpurifiers available in the market are of this type.

3. Pressure Based Filter

Pressure based filters facilitate a higher rate of filtration in a pressurized system. It requires a siltation pit ofabout 6-15 cu.m. in capacity so as to facilitate sedimentation before it is pumped through the filter into theground.

Being a pressure based system it involves a pump of capacity 0.5-1 hp. The rate of filtration is evidentlyhigh and the quality of water is also claimed to be as per WHO guidelines.

They are successful for areas withlarger rainwater runoff (>6 cu.m./hr) and limited space availability. Also these filters can be put in combinationwith an existing tube well so as to recharge water into the same bore.

Disinfection

The need to disinfect the final treated water before distributing to the consumers cannot be overemphasized. Some of the current technical approaches available to provide effective drinking water disinfection techniques are highlighted below:

1. Chlorination:

Chlorination is most appropriately used to treat rainwater if contamination is suspected due to the rainwater being coloured or smelling bad. It should only be done if the rainwater is the sole source of supply and the tank should first be thoroughly inspected to try to ascertain the cause of any contamination.

Chlorination is done with stabilised bleaching powder (calcium hypochlorite - CaOCl2) which is a mixture of chlorine and lime. Chlorination can kill all types of bacteria and make water safe for drinking purposes. About 1 gm (approximately 1/4 tea spoon) of bleaching powder is sufficient to treat 200 litres of water.

2. Chlorine tablets:

Chlorine tablets are easily available in the market. One tablet of 0.5 g is enough to disinfect 20 litres (a bucketful) of water.

3. UV Radiation:

Ultra violet (UV) light can be used to kill bacteria, viruses and cysts by exposure to UV light. Turbidity or the suspended particles in water should be removed before treatment otherwise pathogens can hide in the particles and the treatment will not be effective. UV lights do not leave any residue or bye product so problem of smell or taste like chlorine can be eliminated. They use minimum power for operation. The operation manual will be provided by the manufacturer.

Groundwater Recharge Systems

- Various options have been available for recharging of coastal plain aquifers by utilizing overflow water from rainwater harvesting systems, salinity control measures and seawater intrusion.

- Some of these measures are highlighted below and considered for implementation under this program.
    1. Modification of ground water pumping and extraction pattern
    2. Artificial recharge
    3. Injection barrier
    4. Extraction barrier
- Artificial recharging of the aquifer is the most appropriate solution and economically viable option for the project islands in addition to natural groundwater replenishment and recharging occurring during each rainy season as at present.
- The artificial groundwater recharging could possibly be carried out by adopting two simple techniques as listed below and this program would concentrate mainly on the first option of diverting the excess rainwater for this purpose.
    1. Diverting excess (overflow) from household and community rainwater harvestingsystems into selected pits, trenches, dug wells, etc.
    2. Recycling the wastewater after appropriate treatment to reach the desired water quality level
- Some of the methods available for recharging of shallow aquifers are highlighted below.
    1. **Trenches** of 0.5 to 1m width and 10 to 20m length, filled with filter materials
    2. Existing **household dug wells** combined with open pits filled with filter materials and filtered water diverted to existing household well.
    3. **Recharging dug well** (1 to 1.5m diameter and 2 to 3m depth) system with cover, inter connected and excess water dispersed in the periphery of the island
    4. **Soakaway**is a bored hole of up to 30 cm diameter drilled in the ground to a depth of 3 to 10 m. the soakaway should be filled up with a filter media like brickbats and should be lined with a PVC or MSpipe to prevent collapse of the vertical sides. The pipe may be slotted/perforated to promote percolation through the sides
    5. **Mini Artificial Aquifer System (MAAS)** is a unique artificial recharge structure, which is ideally suitable foropen areas particularly low-lying areas. This structure is also suitable for junctions of roads, street corners,parks, stadiums, play grounds, bus terminus, theatres, open area of public buildings, schools, colleges etc.In open areas, the topsoil and clayey portion of sub-surface should be excavated and the excavated portion should be filled with locally available boulders of various sizes in ascending order from the top. The top portion may befilled with sand.Two or three recharge shafts may be constructed at the bottom of the excavated portion. These recharge shaftsof site-specific dimensions can be constructed penetrating through the layers of impermeable horizon to thepotential to prevent clogging.

NOTE: Out of the above points 2 and 3 can be used only for community wells not for household wells

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