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20075

DP/ID/SER.A/1628  
16 February 1993  
ORIGINAL: ENGLISH

i, 28 p  
Tables

ASSISTANCE TO THE ESSENTIAL OIL INDUSTRY, ZANZIBAR

DP/URT/86/026/11-51

UNITED REPUBLIC OF TANZANIA

Technical report: Maximizing the capacity utilization of the  
clove stem oil distillery, Chake Chake\*

Prepared for the Government of the United Republic of Tanzania  
by the United Nations Industrial Development Organization  
acting as executing agency for the United Nations Development Programme

Based on the work of S. Ahmed, pilot plant engineer

Backstopping Officer: T. De Silva, Chemical Industries Branch

United Nations Industrial Development Organization  
Vienna

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\* This document has not been edited.

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**A B S T R A C T.**  
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The expert's mission DP/UTR/86/026 was for 17 days from 30th April.'92 to 17th May.'92. During this stay the expert spent some days in Zanzibar and rest in Pemba. All the proposed activities were performed.

- Preventive maintenance system has been designed.
- Safety aspects in the distillery at Chake Chake have been reviewed.
- The processing equipment in Malindi distillery at Malindi Zanzibar was evaluated and repair / modification have been suggested.
- Appropriate layout for distillery setup at the new site in Zanzibar including equipment inputs of suitable capacity, economic feasibility have been worked out and presented in a separate report.

I N T R O D U C T I O N .  
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Zanzibar State Trading Corporation (ZSTC) is responsible of export cloves and produce of Zanzibar. In this regard ZSTC performs functions of purchasing, warehouseing, grading, processing, packaging and marketing.

Export of essential oils particularly from clove stem and clove buds provide major share in export earning. Two distilleries one each in Unguja and Pemba process cloves to produce oils Distillation centre in Unguja (Zanzibar) was set up in 1930. This centre is not functioning these days due to physical breakdown of boiler and other major equipment although some units and components can give useful service.

Distillation centre in Pemba has been set up in 1982 and regular distillation started from December 1983. The plant was formally inaugurated on 12 Jan.'1984 by then President Mr. J. K. Nyerere. This plant housed all French equipment mainly from La Tournaire SA and technical know now was also provided by French consultants. The plant was run for initial five years by them. After their departure the plant is being operated by the national staff.

The Government of Tanzania requested UNIDO to help out to overcome certain shortcomings in operation and to broaden the product range by conducting research and developing technology for the production of plant derived pharmaceuticals. The expert was fielded from 30th. April.'92 to 17th. May.'92 under the project DP/UTR/86/026 with following objectives.

- i) Preparation and implementation of preventive maintenance programme.
- ii) Evaluate safety aspects in the distillery.
- iii) Evaluate existing processing equipment in Malindi distillery, Zanzibar.
- iv) Design appropriate layout for distillery setup at the new site.

## A C T I V I T I E S.

-----

The activities in this project has been devided into three broad portions:-

- i) Activities relating to Chake-Chake distillery.
- ii) Activities relating Malindi distillery.
- iii) Activities relating to proposed distillery at new location in Unguja (Zanzibar)

The expert spent about two weeks at Chake-Chake distillery. This distillery has well planned layout using one of the best set of equipment in the world. All the equipment are kept in good working condition and despite of very low inventory of the spare parts and maintenance supplies the plant has been kept running. Although there exist a preventive maintenance programme but due to shortage of trained staff and engineering supplies maintenance activities are restricated to breakdown maintenance.

A preventive maintenance programme is written and is attached as annexure. List of spare parts has been compiled and attached as annexure.

The plant layout has built in saftey aspects and the staff generally practice it. Some steps, however, should be taken additionally to make the distillery safer.

An enironmental hazard is the dust and splint from the boiler flue. Due to low height of the chimney this dust is not only spread in the distillery premises but its sufficient quantity falls in vicinity. The matter has been discussed with national counterparts and as an immediate step a new stack has already been ordered. Suitability of an air washer was also discussed and found worth further probing.

The Malindi distillery was visited several times with the possibility of its reinstatment. Most of the services equipment like boiler, cooling tower, pumps etc have already through their physical lives and there seems to be no possibility of their putting back to work. There are twelve distillation units with copper stills having six condensors made of stainless steel.

All twelve florantine vessel are made of stainless steel. These condensers and florantine vessels are in good conditions and could be used if the supplier of the proposed equipment incorporates these components and reduces the prices accordingly.

Visits of different engineering concerns were made in Zanzibar and Mainland. There exists potential for local fabrication provided know how on materials and workshop techniques are made available. The people responsible in these concern are found willing and keen to undertake such jobs if properly guided but could not assure the delivery dates due to constraints of availability of engineering supplies. It is however worth considering the local offers before importing any plant and equipment.

The proposed distillery in Unguja has been discussed in considerable details in the feasibility, study titled "Establishment of a processing facility for Essential Oils in Unguja Zanzibar". This report was submitted to UNIDO and ZSTC. A brief summary of that report is reproduced hereunder.

Zanzibar comprising of islands of Unguja and Pemba is known the world over for quality production of cloves. Cloves stems, a by-product of clove buds being rich in essential oil were processed on large scale in the past in a distillery located at Malinidi in Zanzibar Town. The production of stem oil in the past touched a peak of 200 tons. However due to various factors including depleted condition of the distillery production stopped from 1980 onwards till a new distillery was established in 1983. Export of clove stem oil reached a level of 61 tons in 1990-91 with increasing export potential. Simultaneously production of clove bud oil also picked up. As the Pemba distillery has limitations of production a new distillery has been proposed for Unguja to process a) Clove stems produced there b) Clove buds which are transported to Zanzibar for grading and packing prior to export c) Limes for their oil and juice.

As per recommendation of the TPR project UTR/86/026 a Techno-economic Feasibility Study for establishing a processing Facility in Unguja was undertaken by the CTA and the Engineer of the project involving national personnel.

The Processing Facility is to be located in Zanzibar Industrial Estate or a plot measuring 10620 SqM. Considering the average availability the raw materials, processing of 200 tons of Clove buds (Gd iv) and 30-100 tons (1994-98) of limes is proposed. Except for limes, increase in Clove stems and buds is not visualised. Increase in availability of limes is expected from 30 tons in 1994 to 100 tons by 1998.

The distillery buildings are planned to cover an area of 834 sqM. About 650 tons of raw materials would be processed in 1997 and onwards to produce 60 tons of oil and 30 tons of lime juice. Total investment works out to be US \$ 690,920 made up of.

Building.	: US \$ 303,440/=
Processing Equipment.	: US \$ 163,400/=
Utilities & Services.	: US \$ 163,500/=
Quality Control Laboratory.	: US \$ 21,080/=
Automobiles.	: US \$ 24,500/=
Furniture & Fixtures.	: US \$ 10,000/=
Office Equipment.	: US \$ 5,000/=

Projected net profit in millions of TSh. has been estimated as under:-

	1994	1995	1996	1997	1998
	----	----	----	----	----
Sales.	70.21	105.11	140.42	175.60	176.41
Net Profit.	6.39	18.51	30.47	41.86	41.02

A working capital of 4 million shillings is estimated in first year which reaches to 10 millions in 4th year of operation.

Payback Period for Plant & Equipment is 2.9 years whereas this period for entire investment is 4.9 years. Internal Rate of Return (IRR) is 20 percent while Return on Investment (ROI) is above 18 per cent. All the foreign exchange investment is recovered in the second year of operation.



The project is feasible even if the sale price of oil is reduced by 25% and prices of raw material increased by 25 per cent.

The proposed distillery will have a profound effect on the economy of Zanzibar, 40 technical and other personnel will be employed, the clove and lime cultivators will have regular income and the country will earn more than half a million US Dollars annually. The benefit will increase substantially further when other essential oils mentioned the study are also produced for export at a later stage .

**R E C O M M E N D A T I O N S .**  
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**CHAKE-CHAKE DISTILLERY.**  
-----

- i) Inventory of critical spare parts and engineering supplies should be built in .
- ii) Preventive maintenance schedule should be adhered to.
- iii) Training should be arranged for maintenance staff to plan and execute schedules. Modern techniques/tools on trouble shooting should be introduced.
- iv) The distillery should have facilities and arrangement for fire fighting. Periodic drills should be done to apprise people of the system and keeping them aware and fit to combat any type of fire hazard.
- v) The factory staff handling heavy loads should be provided proper shoes and head covers.
- vi) Arrangement should be made to test and stamp all wire ropes used to handle heavy loads to avoid any probable accident due to rope breaking.
- vii) Boiler stack should be replaced.
- viii) A wet scrubber should be introduced to wash and take away the solids from the boilers flue to overcome the pollution and environmental hazards.
- ix) All loose electric wiring should be removed and all external electric fitting should be examined and replaced by totally enclosed damp proof enclosures.

**MALINDI DISTILLERY.**  
-----

- i) Six stainless steel condensers, twelve florantine receiver and six storage tanks are in good condition and should be used in proposed distillery to reduce the total investment in plant & equipment.

ii) Proper drawing should be prepared for all serviceable equipment so that suppliers of the new equipment incorporate these component with their supply.

iii) The remaining plant components should be salvaged and the proceeds from this sale would further reduce the investment in new plant .

**NEW DISTILLERY.**

=====

i) A new distillery should be set up at a new site as proposed. A decision in should immediately be taken considering the feasibility report in this regard.

ii) The feasibility report should be given for appraisal to the banks and other investors.

iii) A coordinated effort should be made to develop the products other than clove in marketable quantities for possible diversification.

Annexure I.

A B B R E V I A T I O N S .  
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T. Sh or Sh.	Tanzania shillings.
US \$.	United States Dollars.
GOZ.	Government Of Zanzibar.
ZSTC.	Zanzibar State Trading Corp.
UNDP.	United Nations Development Programme.
UNIDO.	United Nations Industrial Development Organization.
DISTILLERY.	The Clove Oil Distillery, Chake Chake Pemba,
FOREX.	Foreign Exchange

Conversion Rate One US \$ = Tsh 385  
(May 92)

Annexure II.

L I S T O F P E R S O N S M E T .  
-----

- 1- Government of Zanzibar.  
Ministry of Trade & Industry.  
  
Mr. Issa S. Machano. Principal Secretary.  
Mr. Kamis K. Songoro. Director, Industry.  
Mr. Samira Said Salim. Industrial Officer.
  
- 2- Zanzibar State Trading Corporation.  
  
Mr. Abdul Rehman Rashid. General Manager.  
Mr. Shaib Ali Mossi. Economic Advisor.  
Mr. Mohammad Ali Muombwa. Chief Engineer  
Mr. Abedi. Supervisor.
  
- 3- Mr. Harub S. Nassor. General Manager.  
TRW Corporation Mbweni.
  
- 4- Mr. Said Amir Said. Vice Principal.  
Karume Technical  
College - Zanzibar.
  
- 5- Mr. Ali. T. Fatawi. Head Workshop Kara-  
kana Kuu Chumbuni -  
Zanzibar.

RECOMMENDED LIST OF SPARE PARTS.

=====

A. BOILER:-

-----

S. NO.	PART NO.	DESCRIPTION.	QTY.
-----			
1.		Repair kit for steam trap.	6
2.		Pressure Gauge 0-40 psi.	2
3.		Dosing pump.	1
4.		Reflex glass for water level Indicator.	2
5.		Mercury switch-Water cutout.	2
6.		Stop valve welded type for pipe NW 1 1/4" (O.D 42.2mm)	2
7.		Vent valve DN 15.	2
8.		Indicator Lamps.	6
9.		Fuses Control Panel A	6
10.		Timer Motor.	1
11.		Main Contactor-Blower.	1
12.		ON-OFF Push Button.	4
13.	P6TQ	Pressure switch-Georgin.	2
14.		Non-return valve feed pump.	2

B. SCREW CONVEYORS:-

-----

1.		Chain with lock & half links.	15M
2.		Variable drive pulley with 2 drive belts.	1
3.		Conveyor side pillow bearings.	6
4.		Gear box bearings (Comablock)	1set.
5.		Variable pulley bearings OZC2 SB3.	1 "
6.		Gear box bearings (PS 1220 R1/20) SN 510454.	1 "
7.		Star-Delta Relay. LC3-D403.	1
8.		Over load Relay. LR1-D4.	1
9.		Push button. ZB-2-8E.	2
10.		Fuse (LT Legrand)	6each
		1A, 2A, 8A, 10A, 12A, 16A,	

C. HOIST:-

-----

Model. ND2N.  
 Type. 109038.  
 Brake Type. FAH.

S. NO.	PART NO.	DESCRIPTION.	QTY.
1.	14	Rope.	1
2.	18	Ball bearing. (Drum)	1
3.	19	Ball bearing. (Drum)	1
4.	20	Ball bearing.	1
5.	21	Ball bearing.	1
6.	24	Ball bearing.	1
7.	25	Ball bearing.	1
8.	28	Ball bearing.	1
9.	29	Ball bearing.	1
10.	31	Limit switch.	1
		Brake spares type FAH.	
11.	3	Compression spring.	3
12.	4	Pressure plate.	1
13.	5	Yoke plate with brake coil.	1
14.	6	Guide rod.	1

D. DISTILLATION STILL:-

-----

1.	DN100	Drain valve Gate type.	3
2.		Capillary type thermometer with pressure Calibration.	3
3.	DN25 PN16	Valve.	3
4.		Lid Gasket.	3
5.		3 way valve for Gasket.	3
6.		Pressure Gauge in st. steel for condensor.	3
7.		Glass for Florantine Flask.	6
8.		PTFE Gasket for item 7	12

E. STEAM LINE:-

-----

1.	Samson PN40	Repair kit PRV.	3
----	-------------	-----------------	---

F. WATER TREATMENT:-  
-----

1.	Repair kit Dosing pump.	1
2.	Solenoid valve 25mm.	1

G. GENERATOR ROLLS ROYCE:-  
-----

1.	Cylinder sleeves.	1set
2.	Starter motor.	1
3.	Air filter.	3
4.	Lub. Oil filter.	3
5.	Fuel Filter.	3
6.	Priming pump.	1

H. COOLING TOWER:-  
-----

1.	Pump bearings.	1set
2.	PTFE glands.	2set
3.	V-Belt Blower.	6

I. VACUUM DISTILLATION:-  
-----

1.	Pump bearings.	1set
2.	Pump seal.	3
3.	Level glass. for s.s.tank.	3
4.	Sight glass. for boiler.	3
5.	Sight glass. for receiver.	3



**PREVENTIVE MAINTENANCE SCHEDULES.**  
=====

MECHANICAL MAINTENANCE	BOILER	DAY	SIG.
D	<ol style="list-style-type: none"><li>1. Check water level functions.</li><li>2. Check steam pressure.</li><li>3. Regulate feed water temperature and maintain required conditions.</li><li>4. Analyse feed water and maintain water treatment at required conditions</li><li>5. Blowdown deposit after every 8 hour of operation.</li><li>6. Check steam or water leaks from hand holes or manhole.</li><li>7. Check smoke leaks.</li></ol>		
W	<ol style="list-style-type: none"><li>1. Clean the furnace, Inspect bars on the furnace grid for distortion or missing. Replace all damage bars.</li><li>2. Lubricate all access doors hinges registers and air flaps with H.T. grease.</li></ol>		
M	<ol style="list-style-type: none"><li>1. Perform daily &amp; weekly checks.</li><li>2. Check smoke tubes, combustion chamber bricks and repair if necessary.</li></ol>		
A	<ol style="list-style-type: none"><li>1. Perform daily, weekly &amp; monthly checks.</li><li>2. Wash out water side. Clean, inspect corrosion and repair.</li><li>3. Repair insulation, if damaged</li><li>4. Clean outside and repaint.</li></ol>		

ELECTRICAL MAINTENANCE	BOILER	DAY	SIG.
D	<ol style="list-style-type: none"><li>1. Check motors of feed pump, induced draft fan and forced draft fan for any abnormal sound. Feel temperature for any abnormal increase.</li><li>2. Check all circuit breakers, contactors, overloads for any abnormal humming sound.</li><li>3. Ensure functioning of water level switch.</li></ol>		
W	<ol style="list-style-type: none"><li>1. Perform all daily checks.</li></ol>		
6M	<ol style="list-style-type: none"><li>1. Check amperage of all motors and compare it with rated.</li><li>2. Back trip the motors by readjusting thermal overloads.</li><li>3. Reset thermal overloads.</li><li>4. Clean contacts of contactors to remove carbon deposits.</li></ol>		
A	<ol style="list-style-type: none"><li>1. Perform daily, weekly &amp; 6M checks.</li><li>2. Repack electrical motors with general purpose grease (Alvania R3)</li></ol>		

MECHANICAL	COOLING TOWER	DAY	SIG.
D	<ol style="list-style-type: none"><li>1. Check water level in the sump every 30 minutes.</li><li>2. Check for any leakage from the body/casing.</li><li>3. Check float valve for leakage.</li><li>4. Check water flow on top of cooling tower.</li></ol>		
W	<ol style="list-style-type: none"><li>1. Perform daily maintenance check.</li><li>2. Check belt tension of cooling tower fan.</li></ol>		
M	<ol style="list-style-type: none"><li>1. Perform daily &amp; weekly maintenance check.</li><li>2. Lubricate fan bearing housing.</li></ol>		
A	<ol style="list-style-type: none"><li>1. Perform daily weekly &amp; monthly maintenance checks.</li><li>2. Thoroughly clean the blower.</li><li>3. Remove fills and clean it thoroughly from algae.</li><li>4. Repaint all metallic surfaces.</li></ol>		

ELECTRICAL	COOLING TOWER	DAY.	SIG.
D	<ol style="list-style-type: none"><li>1. Check fan motor temperature by touching the body.</li><li>2. Check for any abnormal sound of the motor.</li><li>3. Check switch gear for any abnormal sound.</li></ol>		
M	<ol style="list-style-type: none"><li>1. Check motor amperage with tongue tester.</li></ol>		
A	<ol style="list-style-type: none"><li>1. Perform daily, monthly checks.</li><li>2. Back trip fan motor and readjust thermal overload relay.</li><li>3. Clean contacts of the contactor with CTC.</li><li>4. Repack motor with greasse(Alvania R3)</li></ol>		

MECHANICAL MAINTENANCE	COOLING TOWER PUMP	DAY	SIG.
D	<ol style="list-style-type: none"><li>1. Check water discharge pressure.</li><li>2. Check water leakage along the shaft through stuffing box.</li><li>3. Check bearing temperature by hand.</li><li>4. Check for any other pipe line leakage.</li></ol>		
M	<ol style="list-style-type: none"><li>1. Perform daily maintenance check.</li><li>2. Check and replenish lubricant in the bearing housing.</li><li>3. Check anchor bolts and nuts.</li><li>4. Check pump coupling.</li></ol>		
A	<ol style="list-style-type: none"><li>1. Perform daily &amp; monthly maintenance checks.</li><li>2. Inspect pump bearings and change if necessary.</li><li>3. Clean outside and repaint.</li></ol>		

ELECTRICAL MAINTENANCE	COOLING TOWER PUMP	DAY	SIG.
D	<ol style="list-style-type: none"><li>1. Check pump motor temperature by touching its body.</li><li>2. Check for any abnormal sound.</li><li>3. Check switch gear for any abnormal sound.</li></ol>		
M	<ol style="list-style-type: none"><li>1. Check motor current with tongue tester.</li></ol>		
A	<ol style="list-style-type: none"><li>1. Perform daily &amp; monthly checks.</li><li>2. Overhaul motor by repacking motor bearings, varnishing its winding and repainting.</li><li>3. Check functioning of thermal overload relay and recalibrate.</li><li>4. Clean contacts of the contactor with CTC.</li></ol>		

MECHANICAL MAINTENANCE	GENERATOR	DAY	SIG.
ENGINE.			
-----			
D	<ol style="list-style-type: none"> <li>1. Check cooling water temperature.</li> <li>2. Check for any oil/water leakage.</li> <li>3. Clean the exterior of the engine.</li> <li>4. Keep engine running at no load for at least 1 hour when started.</li> <li>5. Test run without load once a week.</li> <li>6. Check temperature of injector by hand.</li> <li>7. Check oil level and water level.</li> </ol>		
M	<ol style="list-style-type: none"> <li>1. Clean each one of the filter for fuel, lubricating oil and air.</li> </ol>		
A	<ol style="list-style-type: none"> <li>1. Perform daily &amp; monthly checks.</li> <li>2. Change oil.</li> <li>3. Check clearance of suction and exhaust valves.</li> <li>4. Check lapping of suction &amp; exhaust valves.</li> <li>5. Check crank shaft.</li> <li>6. Check piston oil pressure rings.</li> <li>7. Check pistons.</li> <li>8. Check piston pin metals.</li> <li>9. Check crank pin metals.</li> <li>10. Check crank shaft deflections.</li> <li>11. Check main bearing metals.</li> <li>12. Check oil supply lines.</li> <li>13. Check moving parts of valve driving mechanism.</li> <li>14. Check inside of governor.</li> <li>15. Check cylinder liner.</li> <li>16. Check and clean lubrication piping.</li> <li>17. Clean cooling water piping.</li> <li>18. Check fan belts for wear, replace if required.</li> </ol>		

MECHANICAL MAINTENANCE	ROTARY DRIER	DAY	SIG.
D	<ol style="list-style-type: none"> <li>1. Check the rotary motion for smoothness.</li> <li>2. Check the vibration of turbine, clean if vibrate.</li> <li>3. Oil drum drive pinion.</li> <li>4. Grease fan bearings with high temperature grease.</li> <li>5. Check for any abnormal sound.</li> </ol>		
W	<ol style="list-style-type: none"> <li>1. Perform daily maintenanc checks.</li> <li>2. Grease drier's rollers (8 nos.)</li> <li>3. Grease lateral thrust bearings.</li> <li>4. Grease tie rod between rollers.</li> <li>5. Oil valves and linkage.</li> </ol>		
M	<ol style="list-style-type: none"> <li>1. Perform daily and weekly maintenance checks.</li> <li>2. Check drive belts for slackness</li> <li>3. Check oil level in transmission gear boxes.</li> <li>4. Clean interior and inspect for corrosion.</li> </ol>		
A	<ol style="list-style-type: none"> <li>1. Perform daily, weekly &amp; monthly checks.</li> <li>2. Replace oil in transmission gear boxes.</li> </ol>		



ELECTRICAL MAINTENANCE	ROTARY DRIER	DAY	SIG.
D	<ol style="list-style-type: none"><li>1. Check fan motor and roller drive motor for temperature or abnormal sound.</li><li>2. Check switchgears for smooth change over from star to delta and any other abnormality.</li></ol>		
M	<ol style="list-style-type: none"><li>1. Perform daily checks.</li><li>2. Check both motors current.</li></ol>		
A	<ol style="list-style-type: none"><li>1. Perform daily &amp; monthly checks.</li><li>2. Overhaul motors by checking bearings and repacking with fresh lubricant.</li><li>3. Check the insulation of the motor winding. If below 1000 ohm per volt, revarnish and dry before reassemblying.</li><li>4. Check functioning of thermal overloads and recaliberate.</li><li>5. Clean contacts of relays with CTC.</li><li>6. Repaint the motors.</li></ol>		

MECHANICAL MAINTENANCE	SCREW CONVEYOR	DAY	SIG.
D	<ol style="list-style-type: none"><li>1. Check for any abrasion sound.</li><li>2. Check for bearings heating.</li><li>3. Check gear box for heating or abnormal sound.</li></ol>		
M	<ol style="list-style-type: none"><li>1. Perform daily checks.</li><li>2. Check oil level in gear box.</li><li>3. Check belt tension.</li><li>4. Grease flanged bearings.</li></ol>		
Y	<ol style="list-style-type: none"><li>1. Perform daily &amp; monthly checks.</li><li>2. Inspect all flanged bearings and replace if slight friction is observed.</li><li>3. Completely dismantle screw and inspect trough and screw for corrosion and abnormal wear .</li><li>4. Repaint and assemble.</li></ol>		

ELECTRICAL MAINTENANC	SCREW CONVEYOR	DAY	SIG.
D	<ol style="list-style-type: none"><li>1. Check drive motor for temperature &amp; abnormal sound.</li><li>2. Check switch gears for any humming sound.</li></ol>		
M	<ol style="list-style-type: none"><li>1. Perform daily checks.</li><li>2. Check all motor currents.</li></ol>		
A	<ol style="list-style-type: none"><li>1. Perform daily and monthly checks.</li><li>2. Overhaul motors by checking bearings and repacking with fresh lubricant.</li><li>3. Checks insulation of motors winding. If below 1000 ohm per volt, rewanish and dry before reassembling.</li><li>4. Check functioning of thermal overloads and recaliberate.</li><li>5. Clean contacts of relays with CTC.</li></ol>		

MECHANICAL MAINTENANCE	STEAM DISTILLATION UNIT	DAY	SIG.
D	<ol style="list-style-type: none"> <li>1. Check for steam leakage from the lip seal (Lid gasket)</li> <li>2. Check leakage from the florantine receiver.</li> <li>3. Check line leakage.</li> </ol>		
W	<ol style="list-style-type: none"> <li>1. Perform daily check.</li> <li>2. Lubricate lip seal with silicone grease.</li> <li>3. Inspect still from inside for any corrosion, dent or any other irregularity.</li> <li>4. Inspect insulation for any water seepage.</li> </ol>		
M	<ol style="list-style-type: none"> <li>1. Perform daily &amp; weekly checks.</li> <li>2. Lubricate lid bearings with high temperature grease.</li> </ol>		
Y	<ol style="list-style-type: none"> <li>1. Perform daily weekly &amp; monthly checks</li> <li>2. Clean the entire plant thoroughly and repaint.</li> </ol>		

MECHANICAL MAINTENANCE	HOIST	DAY	SIG.
D	1. Observe smooth functioning of the hoist. If should run without jerks.		
M	1. Visually inspect the rope. If certain parts have worn out or have frayed. Peplace the rope. 2. Lower the hook as far as possible and lubricate the rope over entire lenght. 3. Adjust brakes.		
Y	1. Perform daily & monthly checks. 2. Completely overhaul the drive replace the bearings if slight play is observed, reassembly & repaint.		

VACUUM DISTILLATION		DAY	SIG.
D	<ol style="list-style-type: none"><li>1. Check for steam and water leakage.</li><li>2. Check for vacuum leakage.</li><li>3. Check functioning of thermostat valve of the vacuum pump.</li></ol>		
W	<ol style="list-style-type: none"><li>1. Perform daily checks.</li><li>2. Inspect still from inside for any corrosion, dent or any other irregularities.</li><li>3. Inspect insulation for any water seepage.</li></ol>		
Y	<ol style="list-style-type: none"><li>1. Perform daily &amp; weekly checks.</li><li>2. Completely overhaul the pump and its motor and repaint.</li></ol>		

**Backstopping Officer's Technical Comments  
based on the work of Mr. S. Ahmed  
DP/URT/86/026/11-51**

The report clearly describes the important activities carried out by the expert during his short mission of two weeks. He has made very useful recommendations for the improvement of safety at the distillery, particularly with regard to the boiler. The spare parts recommended by him should be procured to keep the distillery functioning without interruption.

He has also prepared preventive maintenance schedules for all the major units and it is expected that the project authorities would follow-up the procedures regularly in order to prolong the use of equipment without damage.

The expert's recommendations for the Malindi distillery will enable its rehabilitation to be carried out with minimum costs. The findings of the techno-economic feasibility study carried out by him and the Chief Technical Adviser have been further elaborated in recommending the initiation of a project in Unguja. UNIDO would be willing to share its vast experience in this area in executing such a project.

The expert has very successfully carried out his duties and obligations for the benefit of the project.