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Bilateral project between Cabo Verde and the Netherlands:
"Renewable Energies"

Report VII: Progress July-September 1982

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Steering Committee
Wind energy
Developing Countries
DHV Consulting Engineers

Divisão de Energias Renováveis
Ministério do Desenvolvimento Rural

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1. INTRODUCTION

The Division of Renewable Energies (DER) is a department within the Ministry of Rural Development of Cape Verde. Its main activities are the installation, maintenance and administration of water pumping windmills. At present, the two principal donors to DER are USAID and SWD. USAID is delivering equipment and material for a new, renewable energy, workshop. SWD, represented by DHV Consulting Engineers, carries out a three years project financed by the Dutch Ministry of Development Cooperation, from 1 July 1981 onwards.

Two consultants of SWD are working as cooperants to DER.

The present report deals with the activities of DER during the third trimester of 1982.

The progress has been rather slow during this period; generally speaking this was due to:

- the vacancy of chief of DER was temporary appointed to the electrical technician, which left DER with one staff member less
- August and September is the period of holidays in Cape Verde

2. WATER PUMPING WINDMILLS WITH MECHANICAL TRANSMISSION

2.1. Installations

The installations of three Southern Crosses 25' in Santo Antão were completed. However, the pumps have not yet been installed because the necessary tubes, to be delivered by DGIS, did not arrive in time. The installation equipment is being shipped back to Praia. A technical note dealing with these installations, was written, reference 1.

When tubes of 2½" became available on the market, the pump of the Southern Cross 25' on Acheda de São Filipe, was installed.

A Dempster 14' was installed on tubewell FT5, Ribeira de Flamengos, Santiago. The manometric head is 22 m, of which 12 above the tubewell, upto a water tank. So, the mill was equipped with a Southern Cross packing box (see report IV, annex F). The pump diameter is 3", stroke 12". Predicted water yield is maximally 30 m³/day in May, minimally 14 m³/day in August, see reference 2. The mill serves the drinking water supply in this part of the Ribeira.

2.2. Maintenance

The monthly maintenance of the mills on Santiago was done as usual. The Southern Cross 25' on the Achada Baleia is still out of operation, awaiting a decision of the Groundwater Department. The Dempster 8' in Santa Cruz, which was still without a water tank, was equipped with a cistern, borrowed from the Tarrafal project.

The Dempster 8' at Lem Duque was painted.

A persistent problem is the turning loose of pump rods; this happened in this period with the Dempsters in Monte Vaca and Granja. A probable reason is the non-verticalness of the tube wells. The problem can be solved by making a guidance of the pump rod close above the pump. The pump rod of the Dempster 14' in Ponta Furna, broke. Here the static forces are quite high (water level 60 m, 3" pump). To be improved by placing a pump of smaller diameter.

2.3. Site selections and other preparations

A preparatory study was made on the equipment of tubewell FT-5, Flamengo; see reference 2.

A field visit was made, together with Rural Improvements, to Salineiro, in the western part of Santiago. Here, the tubewell FBE-2 could be equipped with a Southern Cross 25'.

To further investigate this, it is necessary to measure the properties of the wind regime here, during some time, with a MS 778 data logger. See reference 3.

*old design
Southern Cross
has 25' diameter pump*

A proposal was made (reference 4) to equip tubewell MF-2, on Maio, with a windmill to supply drinking water to the vila, Porto Inglês. Here, also wind measurements are necessary (mean wind speed).

Together with the Director of the department of Soil and Water Conservation, an identification visit was made to the Watershed Management Project, i.c. the Ribeiras Saltos, Flamengos, and São Miguel. Some 8 possible sites for water pumping windmills were identified and several for hand pumps. A technical note on this visit is being prepared.

In July 4 Dempsters and installation tools were sent to Maio. Installation works were envisaged to start in August, but as MDR's funds to pay travels and board and lodgings had been exhausted by that time, nothing was done yet.

2.4. Performance

A technical note (reference 5) was written on the methodology of performance measurements on Dempsters 8' and 14'.

Report VI became available (reference 7); this report predicts the monthly yields of Dempsters 8' and 14' in Achada and Ribeira wind regimes; to this aim the hourly wind data of Praia from 1975 through 1981 were elaborated and also reported in report VI.

*American
Fan type*

3. WATER PUMPING WINDMILLS WITH ELECTRICAL TRANSMISSION

3.1. Aerowatts on São Nicolau

No developments in this period.

3.2. Aerowatt on Achada Baleia

Shortly after the change of oil (end of June) the generator bearings broke down, effecting a short circuit and thus a partly burnt out generator. The supplier, Aerowatt, sent two new generators (the other for the also burnt-out generator in São Nicolau, see previous reports). The generators arrived only at the end of August; the wind generator on Achada Baleia pumps water again, since 8 September.

An analysis was made of the performance of the Aerowatt/Guinard system after one year of operation (reference 6). Th conclusion is that the overall system efficiency is rather low (power of pumped water/power in the wind $\leq 0,035$) and that the operation is still far from fail-safe.

4. WIND GENERATORS WITH OTHER END USES

Aeropower

The component to be substituted was returned by the company, after reparation, beginning of July; however, without the required documentation to regulate the safety mechanism. Reclamations remained without success, until at the end of August it became known that Aeropower since July does not exist anymore. Given this, it is doubtful whether DER's Aeropower will ever operate again.

Wesp

No developments in this period.

Darrieus

Via SWD, Holland, a pro forma invoice was received from Grenco, to deliver suited cooling equipment for the Darrieus. A proposal was forwarded to MDR.

Elektro

5013 Rump
DER's plea to purchase an Elektro wind generator from the USAID project for the new workshop, was evaluated by a VITA-expert. Although he agreed with all of DER's arguments and could not come up with acceptable alternatives, he suggested to reconsider the North Wind Power option. DER has refused this and is urging USAID to have a decision taken on short notice.

5. ANEMOMETRY

5.1. Equipment

A MS 778 data logger was installed on Achada Lem, council of Santa Catarina, Santiago. The purpose to measure at this site is two-fold: to get general insight in the characteristics of the wind in the wake of the central mountains and to evaluate the possibility of a future wind generator on this site. This wind generator would substitute or back-up an existing diesel driven electrical water pump.

The Stewart wind run odometer was installed near a tubewell at Ribeirão Manuel, in the same region as Achada Lem and very probably having the same frequency distribution. This measurement aims to investigate whether the tubewell can be equipped with a "mechanically" water pumping wind-mill.

Measurements with other equipment (MS 778 on Achada de São Filipe, WP-4000's on Achada de São Filipe, Casella on Achada Baleia) have been continued as usual.

Preparations (towers, foundations, guy ropes) were made to install the third MS 778 in Salineiro and a WP 4000 on Maio (at the site of tubewell MF 2); see section 2.3.

5.2. Elaboration of data

Report VI (reference 7) was completed in this period; it contains frequency and time duration curves for each month, based on the hourly wind speeds of Praia from 1975 through 1981. Together with power curves of wind machines, it is thus possible to predict the outputs for each month of the year.

Correlation analyses are being carried out between the various wind meters; results will be presented in technical notes.

6. OTHER PROJECTS

6.1. The guard's house

The glass of the solar distillator was destroyed when a woman, tired from a hard day's work, wanted to use this as a chair. This was repaired. No further developments in this period.

6.2. The biogas plant

No developments in this period.

6.3. Solar pump

A proposal was made by DER to install a solar pump (with photovoltaic cells) at Mendes Faleiro, Santiago, to pump drinking water from a tube well. Preparations were made to install a heliograph there.

7. ORGANIZATIONAL AND TECHNICAL BACK-UP

7.1. Personnel

The electrotechnical technician, Manuel da Graça Teixeira, formerly already staff member of DER, was appointed interim chief of DER. The transfer of knowledge activities take at the moment only place at the level of the training of staff at the workshop and installation level. Important items like planning, electrical engineering, mechanical engineering anemometry and site selection cannot be taken up sufficiently for want of qualified counterparts.

7.2. Workshop, equipment and materials

The construction of the new workshop is running satisfactorily. However, the Cooperativa de Construção Civil encounters difficulties in having their bills timely paid by the Ministry of Finances. The flow of finances originating from the Netherlands and destined to the Cooperativa has been interrupted several times, which may have serious consequences for the progress of work.

The arrival of equipment and materials, both of the USAID and the SWD project, continued. See Annexes I and II for updated lists.

7.3. Transport

The gearbox of the jeep ran broken. So, for the time being, DER has only the Ford pick-up and Ford lorry at its disposal.

7.4. Planning

Was continued as usual.

7.5. Training of mechanics

DER is still waiting for the funds of Church World Service.

7.6. Short missions

In preparation of the short mission on the possibilities of irrigation with windmills, SWD had talks in September, in Holland, with Jean-Pierre Egger, Swiss agricultural expert, at present cooperant to MDR. The preparation of the cooperative study of "water prices" of various water lifting devices, is pending at the moment.

8. REFERENCES

1. Nota Técnica E.R. 20/08/82:
"Progresso do trabalho em Santo Antão"
Kees versteegh
2. Nota Técnica E.R. 13/07/82:
"Equipamento do furo FT-5, Flamengos, Santiago"
Niko Pieterse
3. Nota Técnica E.R. 07/07/82:
"Equipamento do furo FBE-2, Salineiro, Santiago"
Niko Pieterse
4. Nota Técnica E.R. 26/07/82:
"Equipamento do furo MF-2 em Figueira da Horta, Maio, para o
abastecimento de água à vila Porto Inglês"
Niko Pieterse
5. Nota Técnica E.R. 01/06/82:
"Metodologia de medições do rendimento das aerobombas"
Niko Pieterse
6. Nota Técnica E.R. 11/09/82:
"Funcionamento do sistema Aerowatt/Guinard na Achada Baleia,
Santiago"
Niko Pieterse
7. Report VI:
"Caudais estimados das aerobombas baseando-se nos dados do vento da
Praia 1975-1981"
Niko Pieterse

Bilateral project between Cape Verde and the Netherlands "Renewable
Energies".

ANNEX 1

Equipment received from USAID upto September 15, 1982A. Bought locally

- typewriter Olympia SG 35
- typewriter Olympia SKM
- 2 typist's desks
- 1 oval table
- 4 chairs
- 1 drafting table
- 2 desks
- 1 butane heater

B. Arrived from USA

item	description	quantity
A.1	Mercurial thermometers	10
A.2	Set of precision thermometers	2
A.3	Min./max. thermometers	4
A.4	Sling psychometer	1
A.5	Pocket sling psychometer	1
A.6	Psychometric slide rules	2
A.7	Hydrothermograph	2
A.8	Charts for above	8
A.9	Charts for above	2
A.10	Dial hygrometer	2
A.11	Sum duration recorder	2
A.12	Carts for above	2
A.13	Silicon cell radiometer	2
A.13a	Cable for above, 20 ft	2
A.14		
A.15		
A.15a		
A.15b	20 ft of cable for above	2
A.16	Shadow band for A.13	1
A.17		
A.17a	Portable solar radiometer	1
A.18	Pocket thermometer 10-100°	5
A.18a		
A.18b		
A.18c		
A.18d		
A.19	MCJ-T Electronic Ice point	2
A.20	Batteries for above	5

item	description	quantity
A.21	Omni-thermocouple + amplifier	1
A.22	Batteries for above	1
A.23	Digital thermocouple 2176 A	1
A.24	Thermocouple wire	1000 ft
A.25	Reference junction	1
A.26	Connections	20
A.27	Digital thermocouple 2160 A-T	1
A.28	Thermocouple kit	1
B.1	Windrun odometers	6
B.2	Parts for above	6
B.3	Extra anemometer heads	6
B.4	Wire conductors	1500 ft
B.5	Waterproof field kits with batteries	6
B.6	Spare parts	1 lot
B.7	Hand-held anemometers	2
B.8		
B.9		
B.10		
B.11		
B.12	Digital data records MS 778	3
B.13	Miscroprocessor AIM 65	1
B.14	Paper rolls for above	60
B.15	Data cassettes for above	12
B.15a	2-conductor skilles cable	200 ft
B.15b	9-conductor skilled cable	200 ft
B.16	Windicator	1
B.17	Battery eliminator for above	1
CA 18	Hard steel blades for power hack saw	6
D.1	Power factor meter	1
D.5	Megger insulation tester	1
D.7	Wire spools	6
D.8	Electricians pliers	2
D.9	Assortment of electrical connectors	2 kits
D.10	Assortment of alligators	1 kit
D.11	"Electrical" storage cabinets	3
D.12	Assortment of nuts, bolts, etc	1 kit
D.13	Soldering gun	2
D.14	Assortment of welding rods	
D.15a	Timing light	1
D.15b	Dwell meter	1
D.18	Electricians pliers	2
D.19	Electrical tapes	25 rolls
D.20	Resin core solder	20 rolls

item	description	quantity
E.1	Die sets for threading ½"-3"	1
E.2	Manual pipe threader ½"-3"	1
E.3		
E.4	Adjustable pipe wrenches	6
E.5	Chain-type pipe wrench	2
E.6	Mobile pipe cutters	2
E.7		
E.8	Pipe reamers for 3/8"-3"	3
E.9	Hand-operated hydraulic pipe bender	2
E.10	Pipe vises upto 3"	2
F.1	Plywood ½", 4' x 8'	50
F.3	Black iron pipe ½", 2'	15
F.4	Black iron pipe ¾", 21'	8
F.5	Black iron pipe, 1", 21'	4
F.6	GI pipe fittings, tees, nipples, unions, couplings, els	
F.7	Black iron pipe fittings, tees, nipples, unions, couplings, els	
F.8	Globe valves, brass, ½"	10
F.9	Globe valves, brass, ¾"	10
F.10	Globe valves, brass, 1"	5
F.11	Gate valves, brass ½"	15
F.12	Gate valves, brass ¾"	15
F.13	Gate valves, brass 1"	5
F.14	Check valves, brass ½"	6
F.15	Check valves, brass, ¾"	6
F.16	Check valves, brass, 1"	4
F.17	Teflon tapes, ½" wide	10 rolls
F.18		
F.19	Copper tubing, ½", 10'	30
F.20	Copper tubing, ¾", 10'	2
F.21	Copper els, 90°, ½"	20
F.22	Copper els, 45°, ½"	20
F.23	Copper tees ½"	10
F.24	Copper couplings, ½"	10
F.25	Copper crosses, ½"	5
F.26	Copper els, 90°, ¾"	15
F.27	Copper els, 45°, ¾"	15
F.28	Copper tees, ¾"	5
F.29	Copper couplings, ¾"	8
F.30	Copper crosses, ¾"	5
F.31	Solder bars	20
F.32	Acid flux (tins)	20
F.33	Gate valves, brass, ½", sweat ends	6
F.34	Gate valves, brass, ¾", sweat ends	4
F.35	Globe valves, brass ½", sweat ends	6

item	description	quantity
F.36	Globe valves, brass, $\frac{3}{4}$ ", sweat ends	4
F.37	Copper tube pipe adapters $\frac{1}{2}$ "	10
F.38	Copper tube pipe adapters, $\frac{3}{4}$ "	10
F.39		
F.40		
F.41	4' x 8' - 26 gauge galvanised iron sheet	30
F.42	4' x 8' - 22 gauge galvanised iron sheet	30
F.43	4' x 8' - 24 gauge soft copper sheet	10
F.44	4' x 8' - 22 gauge aluminium sheet	10
F.45	Glass wool insulation batts, $5\frac{1}{2}$ " x 23", 70'	5 rolls
F.46		
F.47	Window glass 3' x 7'	400'
F.48	Polyethylene film, 10' x 100'	10 rolls
F.49	Polyvinyl sheet (clear), 10' x 100'	30 rolls
F.50	54" x 100 yards aluminized mylar roll	1
F.51	Reinforced polyethylene plastic, 12' x 100'	2 rolls
F.52		
F.53		
F.54		
F.55	Assorted wood screws	1 lb
F.56	Nails (assorted sizes), common	15 lbs
F.57	Nails (assorted sizes), galvanized	10 lbs
F.58		
F.59		
F.60		
F.61		
F.62		
F.63		
F.64		
F.65	Silicone sealant	24 tubes
F.66		
F.67		
F.68	$\frac{1}{2}$ " plastic tubing PVC	300 ft
F.69	heating duct pressure-sensitive tape	10 rolls
F.70		
F.71		
F.72	Parts cleaner (gunk), gallon	8
F.73		
F.74	$\frac{1}{4}$ " turnbuckles for wire rope, galvanised	10
F.75	$\frac{1}{4}$ ", 7 x 10 galvanised, wire rope	500 ft
F.76	Miscellaneous steel:	
F.76a	Angle iron 4" x 4" x $\frac{5}{16}$ " x 20'	5 legs
F.76b	Angle iron $1\frac{1}{2}$ " x $1\frac{1}{2}$ " x $\frac{1}{8}$ " x 20'	10 legs
F.76c	Angle iron 1" x 1" x $\frac{1}{8}$ " x 20'	10 legs
F.76d	Broad flanged girder 4"	5 legs
F.76e	Broad flanged girder 8"	5 legs
F.76f	Plates 6 x 3 x $\frac{3}{8}$	5 sht

item	description	quantity
F.76g	Plates 6 x 3 x 5/16	5 sht
F.76h	Plates 6 x 3 x 3/16	5 sht
F.76i	Plates 12 x 3 x 0,075	5 sht
F.76j	Plates 8 x 3 x 0,04	10 sht
F.76k	bar 5/8"	10 legs
F.76l	Bar 3/4"	10 legs
F.76m	Bar 1"	10 legs
F.76n	Bar 1 1/4"	10 legs
F.76o	Bar 2"	5 legs
F.76p	Bar 2 3/4"	5 legs
F.76q	Box 3/4"	10 legs
F.76r	Box 2"	10 legs
G.1.		
H.1	Legal filing cabinets	8
H.2	Visible Index card file	2
H.3	Card holders and cards for above	1000
H.4	Desk lamp	4
H.5	Drafting table, 42" x 60"	1
H.6	Drafting machine	1
H.7	Drafting instruments, set	1
H.10	Texas Instruments TI-59, calculator and printer	1
I.1	Ford truck LN-7000	1
I.2	Ford pick-up F 250	1
J.1		
J.2	Compressor system appurtenances	
J.3		

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ANNEX II

Equipment and books received from SWD upto September 15, 1982

A. Equipment

- English language course
- hand-held angleometer
- photocopier, Olympia Omega 303
- various electrical components to repair the control unit of the Darrieus
- 15 overalls
- 5 caps
- 5 stroke counters
- 5 water meters
- 2 hand-held conductivity meters
- 35 watermeters M-TRM 7/10
- 15 watermeters M-TRM 20
- 6 Suzuki off the road motors, 125 cc
- 1 winch, type Verlinde, 1,500 kos
- 1 winch, type Verlinde, 2,000 kos
- 2 pulley, cap. 2,000 kos
- 1 pulley, cap. 1,500 kos
- 6 cable clips \emptyset 7.5 mm
- 6 cable clips \emptyset 12.6 mm
- 6 cable clips \emptyset 14.7 mm
- 6 cable lockings, galvanized
- 4 winch ropes, 2 meters
- 4 winch ropes, 4 meters
- 8 cable shoes
- 1 Renault 4 TL
- 2 conductivity meters H&C
- 1 camping tent
- 2 water level meters, length 100 meters
- 23 adaptors, galvanized
- 14 T-pieces, galvanized
- 21 nippels, galvanized
- 1 20" container

B. Books

- "Appropriate building materials", SKAT
- "Manual technique pour l'approvisionnement en eau des zones rurales", SKAT
- "Aspects of irrigation with windmills", SWD
- "Irrigation water storage tanks made of brickwork", SWD
- Mémento de l'adjoint technique des travaux ruraux", Ministère de la Coopération

- Mémento de l'agronome, idem
- "Energies Renouvelables et Développement", idem
- "Manual de l'adjoint technique du génie rural", idem
- "Les pompes et les petites stations de pompages", idem
- "Formation à l'exploitation de l'énergie solaire", idem
- "Energies renouvelables et réseaux de communication", idem
- "Les microcentrales hydrauliques", idem
- "Les ouvrages d'un petit réseau d'irrigation", idem,
- "Hydraulique pastorale", idem
- "Evaluation des energies renouvelables pour les pays en développement", idem
- "Des éoliennes pour Djibouti, SWD
- "Linear integrated circuits", Motorola
- "The European CMOS selection", Motorola
- "Village Technology Handbook", VITA
- "Irrigation design and practice", Withers, Vipond
- "Small scale irrigation with windmills in Sri Lanka, vol. 1 and 2", WEU/SWD
- "Biomass for energy in the developing countries", Hall, Barnard & Moss
- "Solar distillation", Pergamon Press
- "Standard Handbook for electrical engineers", Fink & Beaty
- "Energie éolienne", D. le Gourières
- "Groundwater Hydrology", David K. Todd
- "Eoliennes & Aerogénérateurs", G. Cuntly
- "Solar energy calculated", Solarcon
- "Solar energy engineering"
- "A manual of building construction", Intermediate Technology
- "L'Energie solaire"
- "+GF+"
- "Programmer soi-même, bibliothèque de base", (instructions for TI-59)
- "Wind Energy system", proceedings BHRA conference, Stockholm, September 1982
- "Applications of solar energy for heating and cooling of buildings", Jordan & Liu
- "Pompes à main", OMS