PN-ABR-973
89245

# NATURAL RESOURCES MANAGEMENT PROJECT

BAPPENAS – Ministry of Forestry
Assisted by
USAID

# BUKIT BAKA MINI–HYDROELECTRIC SYSTEM IMPLEMENTATION PLAN

Michael Johnson
Engineering Consultant

Associates in Rural Development
for
Office of Agro–Enterprise and Environment
USAID – Jakarta

AID Contract No. 497 – 0362

June 1992

REPORT NO. 7

/

Contents

Page 1. Proposed implementation schedule / scope of work

2. Supervisor / work force

3. - 7. Equipment specification

8. System hydraulic parameters

Graph - hydraulic profile

Drawings - overall site plan - 1
Intake / diversion structure - 2
Powerhouse / discharge pit - 4
Penstock installation - 1
Distribution system - 1

Proposed implementation schedule - Bukit Baka Mini-hydro project
June, 1992 Schedule for year 1992

| Task | estimated time reqd | start | finish |
|---|---|---|---|
| Site preparation (access, accommodation) | 6 weeks | 15 Sept | 30 Oct |
| Local labor/material acquisition | 2 weeks | 1 Sept | 15 Sept |
| Manufacture of equipment (turbine/generator/control unit) | 8 weeks | 1 Sept | 30 Oct |
| Ship generating equipment (Irian Jaya to W. Kalimantan) | 4 weeks | 1 Nov | 30 Nov |
| Procure and ship materials (pipeline, cable, const material) | 8 weeks | 1 Sept | 30 Oct |
| Construction start (Powerhouse, diversion structure) | 4 weeks | 1 Nov | 30 Nov |
| Penstock installation | 4 weeks | 1 Nov | 30 Nov |
| Distribution system installation | 4 weeks | 1 Nov | 30 Nov |
| Generating equipment installation, plant commissioning and operator training. | 2 weeks | 1 Dec | 15 Dec |

Estimated time to complete project - 14 weeks

**Proposed supervisor/work force - Bukit Baka Mini-hydro project.**

| On site tasks: | | No. | skill | man/days |
|---|---|---|---|---|
| 1. Local labor/material procurement | - | 1 | Mini-hydro specialist (expat) | 10 |
| | | 1 | National counterpart | 10 |
| 2. Site preparation | - | 1 | Mini-hydro specialist (expat) | 10 |
| | | 1 | Mini-hydro technician (national) | 30 |
| | | 2 | labor supervisor | 30 |
| | | 20 | laborers | 30 |
| 3. Construction of powerhouse and diversion structure. | - | 1 | mini-hydro technician (national) | 20 |
| | | 4 | carpenters | 20 |
| | | 8 | laborers | 20 |
| 4. Penstock installation | - | 1 | Mini-hydro technician (national) | 20 |
| | | 2 | labor supervisor | 20 |
| | | 20 | Laborers | 20 |
| 5. Distribution system installation | - | 1 | Mini-hydro technician (national) to overlap with task #3 above | |
| | | 1 | labor supervisor | 15 |
| | | 10 | laborers | 15 |
| 6. Generating equipment installation, commissioning training of station operator. | - | 1 | Mini-hydro specialist (expat) | 10 |
| | | 2 | Mini-hydro technicians (national) | 10 |
| | | 1 | labor supervisor | 10 |
| | | 5 | laborers | 10 |

| Skill | Total man/days |
|---|---|
| Engineer - 1 | 20 |
| Technician - 2 | 100 |
| Supervisor - 2 | 125 |
| Carpenters - 4 | 80 |
| Laborers - 38 | 1360 |

**Bukit Baka mini-hydro project**

**Equipment and material specification**

**Turbine model/type - Hydro-tech P-16.250**

**Turbine type** - Pelton impulse turbine, horizontal shaft.

1. Pitch diameter of impulse turbine runner - 41.27 centimeters
2. Turbine runner - monolithic casting of manganese bronze
3. Inside diameter of turbine buckets - 165 millimeters
4. Hub diameter of casting - 180 millimeters
5. Hub width of casting - 200 millimeters
6. Inside diameter of shaft bore - 80 millimeters
7. Shaft attachment method - .5" keyway through hub
8. Method of runner balance - static with shaft and attachments
9. Shaft material - stressproof stainless steel
10. Shaft diameter - 80 MM (on runner) 75 MM on bearings
11. Turbine bearings - SKF FY-75 flange, ball bearings
12. Turbine seals - slinger (no contact) type
13. Turbine housing - steel weldment, 7 MM
14. Turbine frame - 75 X 150 MM U-channel
15. Turbine nozzle - Needle nozzle with handwheel operator
16. Needle nozzle diameter (maximum jet diameter) - 50 MM
17. Orfice diameter of nozzle - 57 MM
18. Inlet diameter of nozzle - 8 inches
19. Body diameter of nozzle - 8 inches
20. Nozzle flange type/diameter - ASME 8 inch standard
21. Nozzle to be equipped with 125 PSI / 1000 Kilopascal pressure gage
22. Turbine deflector - 7 MM stainless steel / 30 MM shaft diameter

23. Fasteners - (water contact areas) stainless steel
(non-contact areas) standard grade, galvanized

24. Coatings - 2 coats of zinc primer, 2 coats industrial enamel

25. Turbine performance data:

Percent mechanical efficiency----------75.0
Mechanical power output in horsepower--------44.0
Unit discharge in liter per second----------70.0
Design head in meters----------68.0
Diameter of nozzle in centimeters----------4.75
Jet velocity in meters per second----------36.7
Pitch diameter of turbine runner in CM-------41.27
Runaway speed in RPM----------1700.0
Load speed in RPM----------800.0
Weight in KG----------456.0

**Generator model/type - AVK DKBN 32/40-4**
**(may substitute Stanford 40KVA brushless gen)**

1. Output rating in KVA - 40
2. Output rating in Kilowatts - 32
3. Full load efficiency rating 85.0
4. Frequency - 50 HZ
5. Voltage - 400 / 230 VAC
6. Phase - 3
7. Brushless self regulated
8. Speed - 1500 RPM
9. Powerfactor - .8
10. Shaft diameter - 60 MM
11. Weight 250 KG

**Turbine controls model/type - Hydro-tech J-3**

1. Control method - electronic load controller
2. Phase - 3
3. Voltage - 400 volts at 50 HZ
4. Capacity in watts - 30,000 watts
5. Load dump - water cooled from penstock, 30KW rated
6. Metering - 3 ampmeters, 1 voltmeter, 1 frequency meter
   1 hour meter
7. Breakers - automatic trip, thermal type, 75 amp
8. Overspeed/underspeed protection - frequency monitoring
   to trip turbine deflector. Bandwidth - 10 HZ
9. Turbine control cabinets 2 @ 50cm X 75cm X 25cm, wall mounted
10. Weight of turbine controls - 125 KG

**enstock/pipeline system**

1. Total length of penstock - 1230 M

2. Penstock material and manufacturer - PVC (Pralon)

3. PVC Pipeline diameter, type and length:

| iameter | pressure rated | | type end | lengths | length |
|---|---|---|---|---|---|
| 10" | S-16 | 8 kg/cm sq | T.S. glue | 75 X 6 M | 450 M |
| 10" | S-12.5 | 10 kg/cm sq | T.S. glue | 130 X 6 M | 780 M |

total length 1230 M

see hydraulic profile for position of pipe according to pressure)

4. Penstock to be reduced to 8" for turbine nozzle connection at powerhouse. Terminate with 8" ASME flange socket.

5. Penstock to be covered with a minimum of 30 cm of backfill and bedded in rock-free soil at least 10 cm surrounding and below the pipeline.

6. Penstock to be equipped with a 2" vent/breather not more than 10 meters from the pipeline inlet. Breather to be screened with .5 inch steel expanded metal screen.

7. Manufacturers recommended solvent/glue joining procedure to be followed in pipeline installation.

8. Final grade for access roads and facilities to be completed prior to penstock installation in areas where the penstock may run beneath access roads or facilities.

9. position of buried penstock to be indicated at 20 meter intervals with permanent, painted steel markers.

10. Thrust blocking of sweeps/bends to be provided in areas of poor soil compaction.

**Electrical distribution system:**

1. Primary 3 phase cable - 3X70 / 1X50 sq.MM. twisted aluminum, insulated, overhead low voltage distribution cable. Total length of cable required - 2000 M.

2. Secondary 1 phase cable - 2x10 sq. MM. twisted copper, insulated, overhead distribution cable. Total length of cable required - 500 M.

3. Distribution poles - 2" X 6M (2.5MM wall thickness) galvanized steel pipe installed in 100cm deep X 50 cm diameter holes. All poles to have installed end caps on top of pole to prevent water entering. Poles to be asphalt coated bottom 2 meters prior to burying. Total poles required at 20M intervals - 100

4. Method of cable attachment - steel "J" hangers with neutral wire installed in hanger.

5. Method of cable splicing - Steel crimp sleeve, covered with insulating electrical tape.

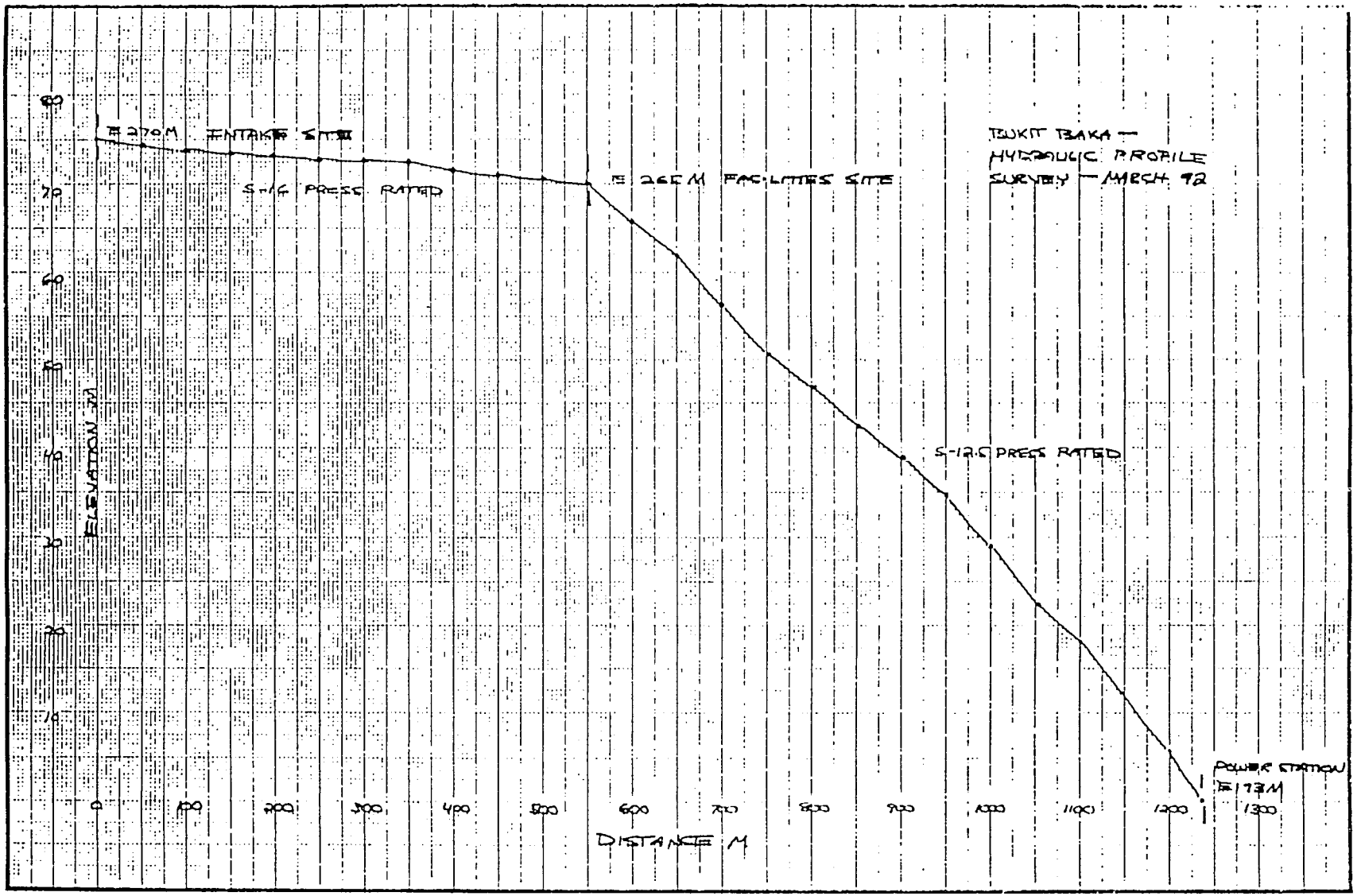
6. Termination poles and poles carrying converging cable angles greater than 10 degrees to be anchored with 10 sq MM galvanized steel wire from cable hanger support to buried ground anchor.

7. If possible, all trees within a fall radius of the distribution system should be removed.

**Note:** **As of June 1, a facility site plan has not been submitted. The electrical distribution system plan can be provided after the site plan is finalized.**

SMALL HYDROELECTRIC SYSTEM PARAMETERS 05-19-1992 BUKIT BAKA · ARD

| | |
|---|---|
| SLOPE IN DEGREES FROM THE HORIZONTAL | 0.00 |
| SLOPE AS PERCENTAGE (PERCENT RISE PER UNIT OF RUN) | 0.00 |
| SLOPE DISTANCE AS MEASURED ALONG THE SURFACE | 0.00 |
| HORIZONTAL OR MAP DISTANCE | 0.00 |
| VERTICAL DISTANCE (CHANGE IN HEIGHT) | 0.00 |
| ACCUMULATED SLOPE DISTANCE OF PREVIOUS ENTRIES | 0.00 |
| ACCUMULATED HORIZONTAL DISTANCE OF PREVIOUS ENTRIES | 0.00 |
| ACCUMULATED VERTICAL DISTANCE OF PREVIOUS ENTRIES | 0.00 |
| STATIC OR GROSS HEAD OF WATER IN FEET | 246.06 |
| STATIC OR GROSS HEAD OF WATER IN METERS | 75.00 |
| STATIC OR GROSS HEAD OF WATER IN POUNDS PER SQUARE INCH | 106.55 |
| STATIC OR GROSS HEAD OF WATER IN KILOPASCALS | 735.16 |
| FLOW OF WATER IN AMERICAN GALLONS PER MINUTE | 1032.68 |
| FLOW OF WATER IN CUBIC FEET PER MINUTE | 138.06 |
| FLOW OF WATER IN CUBIC FEET PER SECOND | 2.30 |
| FLOW OF WATER IN CUBIC METERS PER SECOND | 0.07 |
| HEAD LOSS DUE TO FRICTION, IN FEET | 20.78 |
| HEAD LOSS DUE TO FRICTION, IN METERS | 6.33 |
| HEAD LOSS DUE TO FRICTION, IN POUNDS PER SQUARE INCH | 9.00 |
| HEAD LOSS DUE TO FRICTION, IN KILOPASCALS | 62.07 |
| HEAD LOSS DUE TO FRICTION, AS PERCENTAGE OF STATIC OR GROSS HEAD | 8.44 |
| INSIDE DIAMETER OF PENSTOCK IN INCHES | 10.00 |
| INSIDE DIAMETER OF PENSTOCK IN CENTIMETRES | 25.40 |
| HAZEN - WILLIAMS COEFFICIENT OF FRICTION FOR PIPE BEING CONSIDERED | 150.00 |
| DYNAMIC OR WORKING HEAD OF WATER IN FEET | 225.29 |
| DYNAMIC OR WORKING HEAD OF WATER IN METERS | 68.67 |
| DYNAMIC OR WORKING HEAD OF WATER IN POUNDS PER SQUARE INCH | 97.55 |
| DYNAMIC OR WORKING HEAD OF WATER IN KILOPASCALS | 673.09 |
| TOTAL LENGTH OF PENSTOCK IN FEET | 4035.43 |
| TOTAL LENGTH OF PENSTOCK IN METERS | 1230.00 |
| VELOCITY OF WATER IN PENSTOCK, FEET PER SECOND | 4.25 |
| VELOCITY OF WATER IN PENSTOCK, METERS PER SECOND | 1.30 |
| PERCENT EFFICIENCY OF PENSTOCK | 91.56 |
| PERCENT EFFICIENCY OF TURBINE | 75.00 |
| PERCENT EFFICIENCY OF GENERATOR | 85.00 |
| OVERALL EFFICIENCY OF WHOLE SYSTEM, AS A PERCENTAGE | 58.37 |
| MECHANICAL POWER OUTPUT OF TURBINE IN HORSEPOWER | 44.06 |
| ELECTRICAL POWER OUTPUT OF SYSTEM IN KILOWATTS | 27.94 |
| AMOUNT OF ELECTRICAL ENERGY PRODUCED IN ONE DAY, IN KILOWATT HOURS | 670.53 |
| AMOUNT OF ELECTRICAL ENERGY PRODUCED IN ONE YEAR, IN MEGAWATT HOURS | 244.74 |
| INSIDE DIAMETER OF NOZZLE IN A SINGLE-NOZZLE IMPULSE TURBINE, INCHES | 1.87 |
| INSIDE DIAMETER OF NOZZLE, SINGLE-NOZZLE IMPULSE TURBINE, CENTIMETERS | 4.75 |
| FREE-SPOUTING VELOCITY OF WATER ISSUING FROM NOZZLE, FEET PER SECOND | 120.45 |
| FREE-SPOUTING VELOCITY OF WATER ISSUING FROM NOZZLE, METERS / SECOND | 36.71 |
| MOST EFFICIENT RIM SPEED OF IMPULSE TURBINE, FEET PER SECOND | 57.82 |
| MOST EFFICIENT RIM SPEED OF IMPULSE TURBINE, METERS PER SECOND | 17.62 |
| EFFECTIVE DIAMETER OF IMPULSE TURBINE RUNNER, INCHES | 16.25 |
| EFFECTIVE DIAMETER OF IMPULSE TURBINE RUNNER, CENTIMETRES | 41.27 |
| MAXIMUM OR RUNAWAY SPEED OF IMPULSE TURBINE IN REVOLUTIONS PER MINUTE | 1698.79 |
| MOST EFFICIENT SPEED OF IMPULSE TURBINE IN REVOLUTIONS PER MINUTE | 815.42 |
| EFFECTIVE DIAMETER OF DRIVE PULLEY ON TURBINE, INCHES OR CENTIMETERS | 14.00 |
| EFFECTIVE DIAMETER, DRIVEN PULLEY ON GENERATOR, INCHES OR CENTIMETERS | 7.61 |
| SIZE RATIO, DRIVING/DRIVEN PULLEY; SPEED RATIO, DRIVEN/DRIVING SHAFT | 1.84 |
| RUNAWAY SPEED OF GENERATOR IN REVOLUTIONS PER MINUTE | 3125.00 |
| WORKING SPEED OF GENERATOR IN REVOLUTIONS PER MINUTE | 1500.00 |
| SUGGESTED GENERATOR SIZE, IN KILOVOLT-AMPERES CONTINUOUS RATING | 50.00 |




BEST AVAILABLE DOCUMENT

11

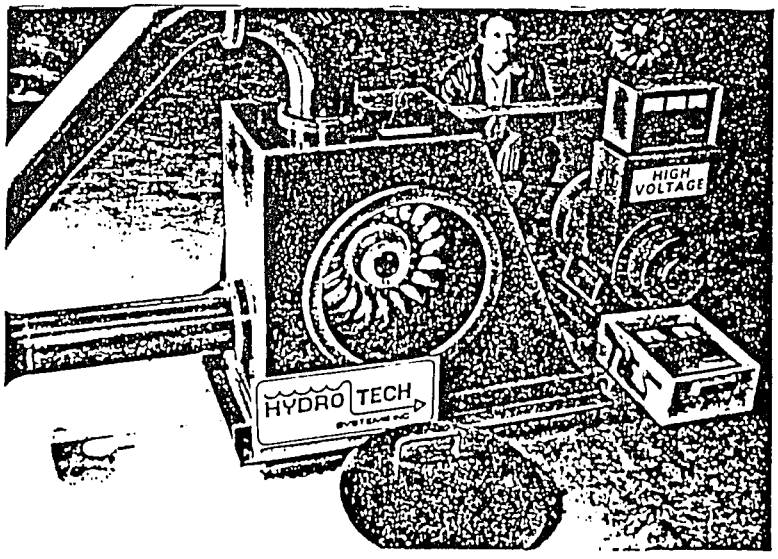
# HYDRO TECHNOLOGY SYSTEMS

*introduces*

# HYDROMOTOR READY TO RUN PELTON TURBINES

Hydro Technology Systems has received numerous requests for a well designed, basic impulse turbine, cost effective, yet efficient and standardized. A water turbine which can be utilized to drive a generator or a variety of mechanical requirements such as pumps, agriculture process machinery or saw mills in remote areas or developing nations.

The result is HYDROMOTOR, a basic impulse turbine backed by years of turbine building experience with plenty of standard features, good efficiency and adaptability to perform a variety of work with falling water. Options such as flow regulating needle nozzles and hydraulic jet deflectors can be added to meet special requirements. HYDROMOTOR performance data is included with this information.




Model 75 with optional needle nozzle shown above

HYDROMOTOR STANDARD FEATURES:

- Unit cast bronze pelton wheels, precision ground, balanced.
- Stressproof stainless steel shafting.
- Industrial long life bearings and seals.
- Efficient contoured epoxy coated steel housings.
- Corrosion resistant fasteners throughout.
- Fixed nozzles provided with quick change jet rings for flow regulation.

HYDROMOTOR OPTIONAL FEATURES:

- Flow regulating needle nozzles with handwheel operators.
- Positive, gravity type jet deflectors.
- Hydraulic actuators for deflectors and needle nozzles.

HYDRO-TECHNOLOGY SYSTEMS •

BEST AVAILABLE DOCUMENT

## MODEL 75
Turbine Nominal
Output in H.P.

FLOW IN C.F.M.

| Head in Feet | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | LOAD SPEED R.P.M. | Head in Meters |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 2 | 2.5 | 3.5 | | | | | | | | 1100 | 30.4 |
| 150 | 3 | 4 | 5.5 | 7 | | | | | | | 1350 | 45.7 |
| 200 | 4 | 5.5 | 7.5 | 9 | 11 | | | | | | 1550 | 60.9 |
| 250 | 5 | 7 | 9 | 11.5 | 14 | 16 | | | | | 1750 | 76.2 |
| 300 | 6 | 9 | 11 | 13.5 | 16.5 | 19 | 21.5 | | | | 1900 | 91.5 |
| 350 | 7.5 | 10 | 13 | 16 | 19 | 22 | 25 | 28 | | | 2060 | 106.7 |
| 400 | 8 | 11 | 14 | 18 | 21 | 25 | 29 | 32 | 35 | | 2200 | 122 |
| 450 | 9 | 12 | 16 | 20 | 23 | 28 | 31 | 36 | 39 | 43 | 2340 | 137.2 |
| | 7.1 | 9.5 | 11.9 | 14.2 | 16.6 | 19 | 21.4 | 23.8 | 26 | 28.5 | | |

FLOW IN LITERS PER SECOND

## MODEL 95
Turbine Nominal
Output in H.P.

FLOW IN C.F.M.

| Head in Feet | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | LOAD SPEED R.P.M. | Head in Meters |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 4 | 6 | 7.5 | 9.5 | | | | | | | 870 | 30.4 |
| 150 | 6 | 9 | 11 | 14 | 16.5 | | | | | | 1064 | 45.7 |
| 200 | 8 | 12 | 15 | 19 | 22 | 26 | | | | | 1230 | 60.9 |
| 250 | 10 | 15 | 19 | 23 | 28 | 32 | 36 | | | | 1373 | 76.2 |
| 300 | 12 | 17 | 22 | 27 | 33 | 38 | 43 | 48 | | | 1505 | 91.5 |
| 350 | 14 | 20 | 26 | 32 | 38 | 43 | 51 | 56 | | | 1625 | 106.7 |
| 400 | 16 | 23 | 30 | 36 | 43 | 50 | 56 | 64 | 71 | | 1737 | 122 |
| 450 | 18 | 25 | 32 | 39 | 48 | 54 | 64 | 71 | 79 | 86 | 1843 | 137.2 |
| | 14.3 | 19 | 23 | 28.5 | 33.3 | 38 | 42.9 | 47.6 | 52.4 | 57 | | |

FLOW IN LITERS PER SECOND

## MODEL 120
Turbine Nominal
Output in H.P.

FLOW IN C.F.M.

| Head in Feet | 40 | 60 | 80 | 100 | 120 | 140 | 160 | 180 | 200 | 220 | LOAD SPEED R.P.M. | Head in Meters |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 5.5 | 9 | 12.5 | 15.5 | | | | | | | 680 | 30.4 |
| 150 | 8.5 | 13.5 | 19 | 23.5 | 28 | | | | | | 840 | 45.7 |
| 200 | 11 | 18 | 25 | 32 | 39 | 45 | | | | | 970 | 60.9 |
| 250 | 14 | 23 | 31 | 39 | 48 | 56.5 | 64 | | | | 1080 | 76.2 |
| 300 | 16.5 | 26.5 | 36 | 47 | 56 | 67 | 77 | 86 | | | 1190 | 91.5 |
| 350 | 19.5 | 30 | 42 | 53 | 66 | 76 | 90 | 101 | | | 1285 | 106.7 |
| 400 | 22 | 33 | 47 | 59 | 72 | 85 | 100 | 116 | 129 | | 1375 | 122 |
| 450 | 24 | 37 | 53 | 66 | 82 | 99 | 113 | 130 | 145 | 159 | 1460 | 137.2 |
| | 19 | 28.5 | 38 | 47.6 | 57 | 66.6 | 76 | 85.7 | 95.2 | 104.8 | | |

FLOW IN LITERS PER SECOND

## MODEL 160
Turbine Nominal
Output in H.P.

FLOW IN C.F.M.

| Head in Feet | 30 | 60 | 90 | 120 | 150 | 180 | 210 | 240 | 270 | 300 | 330 | LOAD SPEED R.P.M. | Head in Meters |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 4 | 9 | 14 | 18.5 | 24 | | | | | | | 516 | 30.4 |
| 150 | 6 | 13.5 | 21 | 28 | 36 | 43 | | | | | | 630 | 45.7 |
| 200 | 8.5 | 18 | 27 | 37 | 47 | 58 | 67 | | | | | 730 | 60.9 |
| 250 | 10.5 | 22.5 | 34 | 46 | 60 | 72 | 84 | 96 | | | | 816 | 76.2 |
| 300 | 12.5 | 26 | 40 | 55 | 70 | 86 | 101 | 115 | 130 | | | 890 | 91.5 |
| 350 | 14 | 31 | 47 | 63 | 82 | 99 | 118 | 135 | 151 | | | 965 | 106.7 |
| 400 | 16.5 | 35 | 54 | 73 | 93 | 111 | 132 | 154 | 173 | 193 | | 1030 | 122 |
| 450 | 19 | 40 | 60 | 82 | 102 | 122 | 140 | 169 | 195 | 217 | 238 | 1100 | 137.2 |
| | 14.2 | 28.5 | 42.9 | 57.1 | 71.4 | 85.7 | 100 | 114.3 | 128.6 | 142.9 | | | |

FLOW IN LITERS PER SECOND

NOTE – To determine K.W. output: H.P. X .746 X Generator efficiency = K.W. output.
Example – 65 H.P. X .746 X .85 (generator eff.) = 41 K.W.

BEST AVAILABLE DOCUMENT

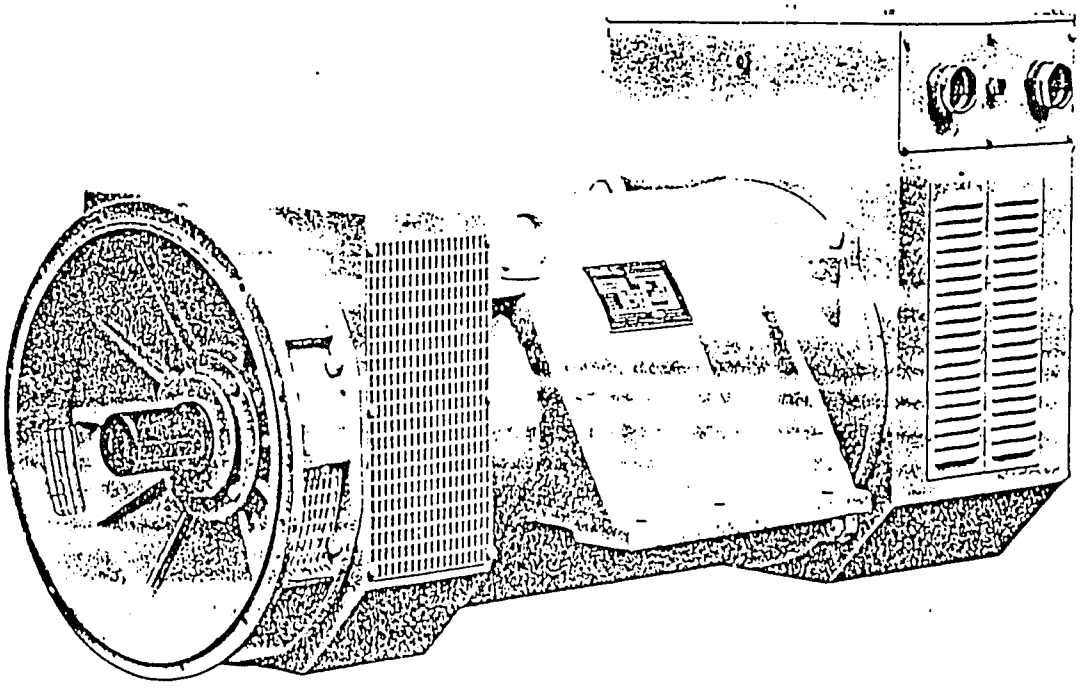
A. van Kaick

# Technische Daten
# Technical Data

# Typenreihe/Series
# DKBN 25-120

Selbstregelnde Generatoren
bürstenlos

Self-regulating
brushless alternators



BEST AVAILABLE DOCUMENT

1/1

## Leistungsreihen und technische Daten der bürstenlosen DKBN-Generatoren
## Ratings and technical data of brushless DKBN-alternators

**Wirkungsgrade, Antriebsleistungen, Kühlluftmengen, Trägheitsmomente, Gewichte**
**Efficiencies, power inputs, cooling air volumes, moments of inertia, weights**

50 Hz Niederspannung 400 V — 50 Hz low voltage 400 V

| Polzahl | Typ DKBN | Leistung $S_N$ kVA | Leistung $P_N$ kW | Wirkungsgrad bei cos phi = 0,8 mit $S/S_N$: ¼ | ¾ | ¾ | 4/4 | 5/4 | Wirkungsgrad bei cos phi = 1 mit $P/P_N$: ¼ | ¾ | ¾ | 4/4 | 5/4 | Antriebsleistung bei $S_N$ kW | Kühlluftmenge m³/min | Trägheitsmoment J kgm² | Gewicht kg | Schwerp. Abstand x mm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2-polig 3000 min⁻¹ · 2-pole 3000 rev/min | 25/5-2 | 5,0 | 4 | 68,0 | 71,0 | 75,0 | 74,0 | 73,0 | 69,3 | 76,4 | 79,8 | 80,1 | 78,3 | 5,40 | 3,5 | 0,021 | 60 | siehe Maßtabelle / see table of dimension |
| | 25/7,5-2 | 7,5 | 6 | 69,8 | 73,1 | 76,9 | 76,0 | 75,2 | 71,0 | 78,1 | 81,6 | 82,0 | 80,2 | 7,90 | 5,0 | 0,026 | 65 | |
| | 25/10-2 | 10,0 | 8 | 70,2 | 74,0 | 78,0 | 77,0 | 76,3 | 72,5 | 79,5 | 83,0 | 83,3 | 81,4 | 10,40 | 6,5 | 0,029 | 75 | |
| | 25/12,5-2 | 12,5 | 10 | 71,6 | 75,6 | 79,5 | 78,5 | 77,9 | 73,8 | 80,7 | 84,5 | 84,7 | 83,0 | 12,70 | 7,5 | 0,038 | 85 | |
| | 25/15-2 | 15,0 | 12 | 72,9 | 77,0 | 81,2 | 80,0 | 79,5 | 75,2 | 82,0 | 85,8 | 86,0 | 84,6 | 15,00 | 8,5 | 0,042 | 98 | |
| | 25/17,5-2 | 17,5 | 14 | 73,4 | 77,5 | 81,6 | 80,3 | 80,0 | 75,4 | 82,3 | 86,0 | 86,4 | 85,0 | 17,40 | 10,0 | 0,050 | 110 | |
| | 32/20-2 | 20 | 16 | 75,4 | 76,7 | 79,0 | 79,8 | 79,2 | 76,3 | 80,2 | 83,6 | 84,5 | 84,8 | 20,00 | 11,5 | 0,089 | 180 | |
| | 32/25-2 | 25 | 20 | 75,8 | 77,0 | 79,2 | 80,0 | 79,5 | 77,0 | 80,8 | 84,0 | 84,8 | 85,1 | 25,00 | 14,0 | 0,110 | 198 | |
| | 32/30-2 | 30 | 24 | 76,9 | 78,4 | 80,8 | 81,5 | 80,9 | 78,0 | 81,5 | 84,4 | 85,6 | 86,0 | 29,50 | 15,5 | 0,132 | 217 | |
| | 32/35-2 | 35 | 28 | 77,2 | 78,6 | 81,0 | 81,0 | 80,8 | 78,0 | 81,5 | 84,6 | 85,6 | 86,2 | 34,60 | 17,0 | 0,170 | 230 | |
| | 32/40-2 | 40 | 32 | 77,5 | 79,0 | 81,4 | 82,0 | 81,6 | 78,3 | 81,9 | 85,0 | 86,0 | 86,6 | 39,00 | 20,0 | 0,200 | 240 | |
| | 32/50-2 | 50 | 40 | 78,2 | 80,1 | 82,5 | 83,0 | 82,1 | 79,5 | 83,0 | 85,9 | 86,9 | 87,3 | 48,20 | 24,0 | 0,270 | 280 | |
| | 32/60-2 | 60 | 48 | 78,3 | 81,0 | 83,0 | 84,5 | 83,9 | 80,2 | 87,0 | 87,5 | 87,8 | 87,8 | 56,80 | 28,0 | 0,360 | 320 | |
| | 38/75-2 | 75 | 60 | 79,2 | 82,5 | 84,3 | 86,0 | 85,0 | 85,0 | 88,3 | 90,0 | 91,1 | 91,4 | 69,80 | 30,0 | 0,540 | 402 | |
| | 38/100-2 | 100 | 80 | 83,3 | 86,6 | 87,6 | 88,0 | 87,0 | 87,1 | 90,4 | 92,2 | 93,2 | 93,6 | 90,90 | 33,5 | 0,620 | 465 | |
| | 38/125-2 | 125 | 100 | 85,5 | 88,7 | 89,7 | 90,0 | 89,2 | 89,2 | 92,4 | 94,3 | 95,2 | 95,7 | 111,00 | 35,0 | 0,720 | 530 | |
| 4-polig 1500 min⁻¹ · 4-pole 1500 rev/min | 25/5-4 | 5,0 | 4 | 71,3 | 75,0 | 76,0 | 75,0 | 73,2 | 82,5 | 85,6 | 85,0 | 85,0 | 80,1 | 5,35 | 3,4 | 0,028 | 61 | siehe Maßtabelle / see table of dimension |
| | 25/7,5-4 | 7,5 | 6 | 72,0 | 76,2 | 77,0 | 76,5 | 75,2 | 83,2 | 87,0 | 86,2 | 85,8 | 80,9 | 7,85 | 5,0 | 0,038 | 67 | |
| | 25/10-4 | 10,0 | 8 | 73,6 | 77,2 | 79,0 | 78,0 | 76,6 | 84,0 | 88,5 | 87,4 | 86,7 | 81,3 | 10,25 | 6,0 | 0,052 | 78 | |
| | 25/12,5-4 | 12,5 | 10 | 79,8 | 81,5 | 82,9 | 80,7 | 79,0 | 84,2 | 88,9 | 87,7 | 87,2 | 85,0 | 12,40 | 7,0 | 0,061 | 88 | |
| | 25/15-4 | 15,0 | 12 | 80,0 | 82,0 | 83,5 | 81,2 | 79,6 | 84,5 | 89,5 | 87,9 | 88,6 | 87,4 | 14,80 | 8,0 | 0,072 | 95 | |
| | 25/17,5-4 | 17,5 | 14 | 81,0 | 82,5 | 84,0 | 82,0 | 81,0 | 85,0 | 90,4 | 90,0 | 90,4 | 89,5 | 17,00 | 9,0 | 0,081 | 114 | |
| | 32/20-4 | 20 | 16 | 79,4 | 81,8 | 82,8 | 83,0 | 81,6 | 83,9 | 86,8 | 87,4 | 87,4 | 87,0 | 19,30 | 9,5 | 0,163 | 176 | |
| | 32/25-4 | 25 | 20 | 79,5 | 82,0 | 82,9 | 83,0 | 81,7 | 84,0 | 87,0 | 87,5 | 87,4 | 87,2 | 24,10 | 12,0 | 0,210 | 195 | |
| | 32/30-4 | 30 | 24 | 79,8 | 82,4 | 83,2 | 83,5 | 82,1 | 84,3 | 87,5 | 87,9 | 87,6 | 87,3 | 28,75 | 14,0 | 0,330 | 214 | |
| | 32/35-4 | 35 | 28 | 80,2 | 83,0 | 83,5 | 84,0 | 82,5 | 84,7 | 87,9 | 88,2 | 88,0 | 87,5 | 33,35 | 15,5 | 0,380 | 227 | |
| | 32/40-4 | 40 | 32 | 80,7 | 84,0 | 84,6 | 85,0 | 84,0 | 86,0 | 88,6 | 89,0 | 89,5 | 87,8 | 37,65 | 17,0 | 0,475 | 250 | |
| | 32/50-4 | 50 | 40 | 81,5 | 84,9 | 85,7 | 86,0 | 84,8 | 86,8 | 89,0 | 89,8 | 90,5 | 90,0 | 46,50 | 20,0 | 0,620 | 288 | |
| | 38/60-4 | 60 | 48 | 83,0 | 86,2 | 87,6 | 88,0 | 87,0 | 87,9 | 90,8 | 91,8 | 92,0 | 91,2 | 54,55 | 21,0 | 0,870 | 358 | |
| | 38/75-4 | 75 | 60 | 85,0 | 88,3 | 89,5 | 89,7 | 88,8 | 89,9 | 92,9 | 93,8 | 93,9 | 93,1 | 66,90 | 22,0 | 1,110 | 395 | |
| | 38/100-4 | 100 | 80 | 86,2 | 89,4 | 90,5 | 90,6 | 89,5 | 90,9 | 93,8 | 94,8 | 95,0 | 94,2 | 97,70 | 26,0 | 1,210 | 456 | |
| | 38/125-4 | 125 | 100 | 87,2 | 90,5 | 91,4 | 91,6 | 90,6 | 92,0 | 95,0 | 95,9 | 96,0 | 95,2 | 109,20 | 30,0 | 1,320 | 518 | |

| No. of poles | Model DKBN | kVA $S_N$ Rating | kW $P_N$ Rating | ¼ | ¾ | ¾ | 4/4 | 5/4 | ¼ | ¾ | ¾ | 4/4 | 5/4 | kW $S_N$ Power input at | m³/min Cooling air volume | J kgm² Moment of inertia | kg Weight | x mm Distance to centre of gravity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | cos phi = 0,8 with $S/S_N$ | | | | | cos phi = 1 with $P/P_N$ | | | | | | | | | |
| | | | | EFFICIENCY | | | | | | | | | | | | | | |

BEST AVAILABLE DOCUMENT

BEST AVAILABLE DOCUMENT

# SPESIFIKASI PIPA uPVC

## DIAMETER LUAR NORMAL/TEBAL DINDING MINIMAL

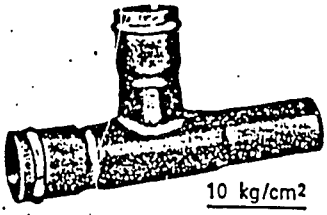
SATUAN : mm.

| | SII 0344 – 82 / ISO – 4065 * | | | | | | JIS K 6741 – 1975 K 6742 – 1978 | | | | ASTM D 1785 : 1976 | | | B. S. 3505 : 1968 | | | | | DIN 8061 / 8062 / 19532 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inch – mm | Dia. Luar | S–6.3 | S–8 | S–10 | S–12.5 | S–16 | Dia. Luar | VP | AZ* | VU | Dia. Luar | Schedule 40 | Schedule 80 | Dia. Luar | Class B | Class C | Class D | Class E | Dia. Luar | Series 2 | Series 3 | Series 4 | Series 5 |
| 3/8" – 13 | • 16 | 1.2 | 1.0 | 0.8 | 0.7 | 0.5 | 18 | 2.3 | – | – | 17.15 | 2.31 | 3.20 | 17.15 | – | – | – | 1.5 | – | – | – | – | – |
| 1/2" – 16 | • 20 | 1.5 | 1.2 | 1.0 | 0.8 | 0.7 | 22 | 2.7 | 2.25 | – | 21.34 | 2.77 | 3.73 | 21.35 | – | – | – | 1.7 | – | – | – | – | – |
| 3/4" – 20 | • 25 | 1.9 | 1.5 | 1.2 | 1.0 | 0.8 | 26 | 2.7 | 2.25 | – | 26.67 | 2.87 | 3.91 | 26.75 | – | – | – | 1.9 | 25 | – | – | 1.5 | 1.9 |
| 1" – 25 | • 32 | 2.4 | 1.9 | 1.6 | 1.3 | 1.0 | 32 | 3.2 | 2.70 | – | 33.40 | 3.38 | 4.55 | 33.55 | – | – | – | 2.2 | 32 | – | – | 1.8 | 2.4 |
| 1¼" – 30 | • 40 | 3.0 | 2.4 | 1.9 | 1.6 | 1.3 | 38 | 3.2 | 2.70 | – | 42.16 | 3.56 | 4.85 | 42.25 | – | – | 2.2 | 2.7 | 40 | – | 1.8 | 1.9 | 3.0 |
| 1½" – 40 | • 50 | 3.7 | 3.0 | 2.4 | 2.0 | 1.6 | 48 | 3.6 | 2.70 | 1.8 | 48.26 | 3.68 | 5.08 | 48.25 | – | – | 2.5 | 3.1 | 50 | – | 1.8 | 2.4 | 3.7 |
| 2" – 50 | 63 | 4.7 | 3.8 | 3.0 | 2.4 | 2.0 | 60 | 4.1 | 3.15 | 1.8 | 60.33 | 3.91 | 5.54 | 60.35 | – | 2.5 | 3.1 | 3.9 | 63 | 1.8 | 1.9 | 3.0 | 4.7 |
| 2½" – 65 | 75 | 5.5 | 4.5 | 3.6 | 2.9 | 2.3 | 76 | 4.1 | 3.15 | 2.2 | 73.03 | 5.16 | 7.01 | 75.15 | – | 3.0 | 3.9 | 4.8 | 75 | 1.8 | 2.2 | 3.6 | 5.6 |
| 3" – 75 | 90 | 6.6 | 5.4 | 4.3 | 3.5 | 2.8 | 89 | 5.5 | 4.05 | 2.7 | 88.90 | 5.49 | 7.60 | 88.90 | 2.9 | 3.5 | 4.6 | 5.7 | 90 | 1.8 | 2.7 | 4.3 | 6.7 |
| 4" – 100 | 110 | 8.1 | 6.6 | 5.3 | 4.2 | 3.4 | 114 | 6.6 | 4.50 | 3.1 | 114.30 | 6.02 | 8.56 | 114.30 | 3.4 | 4.5 | 6.0 | 7.3 | 110 | 2.2 | 3.2 | 5.3 | 8.2 |
| 5" – 125 | 1.5 | 9.2 | 7.4 | 6.0 | 4.8 | 3.9 | – | – | – | – | – | – | – | – | – | – | – | – | 125 | 2.5 | 3.7 | 6.0 | 9.3 |
| 6" – 125 | 140 | 10.3 | 8.3 | 6.7 | 5.4 | 4.3 | 140 | 7.0 | 5.40 | 4.1 | 141.30 | 6.55 | 9.53 | 140.20 | 3.8 | 5.5 | 7.3 | 9.0 | 140 | 2.8 | 4.1 | 6.7 | 10.4 |
| 6" – 150 | 160 | 11.8 | 9.5 | 7.7 | 6.2 | 4.9 | 165 | 8.9 | 6.40 | 6.1 | 168.28 | 7.11 | 10.97 | 168.25 | 4.5 | 6.6 | 8.8 | 10.8 | 160 | 3.2 | 4.7 | 7.7 | 11.9 |
| 7" – 175 | 180 | 13.3 | 10.7 | 8.6 | 6.9 | 5.5 | – | – | – | – | – | – | – | 193.75 | 5.2 | 7.7 | 10.1 | 12.4 | 180 | 3.6 | 5.3 | 8.8 | 13.4 |
| 8" – 200 | 200 | 14.7 | 11.9 | 9.6 | 7.7 | 6.2 | 216 | 10.3 | 8.40 | 6.5 | 219.08 | 8.18 | 12.70 | 219.00 | 5.3 | 7.8 | 10.3 | 12.6 | 200 | 4.0 | 5.9 | 9.8 | 14.9 |
| 9" – 225 | 225 | 16.6 | 13.4 | 10.8 | 8.6 | 6.9 | – | – | – | – | – | – | – | 244.45 | 5.9 | 8.7 | 11.5 | 14.1 | 225 | 4.5 | 6.6 | 10.8 | – |
| 10" – 250 | 250 | 18.4 | 14.8 | 11.9 | 9.6 | 7.7 | 267 | 12.7 | 10.30 | 7.8 | 273.05 | 9.27 | 15.06 | 273.00 | 6.6 | 9.7 | 12.8 | 15.7 | 250 | 4.9 | 7.3 | 11.8 | – |
| 10" – 250 | 280 | 20.6 | 16.6 | 13.4 | 10.7 | 8.6 | – | – | – | – | – | – | – | – | – | – | – | – | 280 | 5.5 | 8.2 | 13.4 | – |
| 12" – 300 | 315 | 23.2 | 18.7 | 15.0 | 12.1 | 9.7 | 318 | 15.1 | 12.7 | 9.2 | 323.85 | 10.31 | 17.45 | 323.85 | 7.8 | 11.6 | 15.2 | 18.7 | 315 | 6.2 | 9.2 | 15.0 | – |
| 14" – 350 | 355 | 26.1 | 21.1 | 16.9 | 13.6 | 10.9 | 370 | – | – | 10.5 | – | – | – | – | – | – | – | – | 355 | 7.0 | 10.4 | 16.9 | – |
| Tekanan Kerja (kg/cm²) | 0 – 25°C | 20 | 16 | 12 | 10 | 8 | 5–35°C | 10 | 8 | 5 | 20°C | 10 | 15 | 20°C | 6 | 9 | 12 | 15 | 20°C | 4 | 6 | 10 | 16 |
| | 25° – 35°C | 16 | 12 | 10 | 8 | 6 | | | | | – | – | – | – | – | – | – | – | – | – | – | – | – |
| * | 0 – 25°C | 16 | 12 | 10 | 8 | 6 | | | | | | | | | | | | | | | | | |
| | 25° – 35°C | 12 | 10 | 8 | 6 | 5 | | | | | | | | | | | | | | | | | |

AZ* Spesifikasi Pralon.

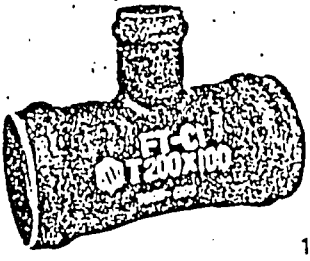
16

## 27. BELL TEE BELL BRANCH (FRP Cover)



| | 10 kg/cm² | Pembuangan |
|---|---|---|
| 8" x 3" = | Rp. 174.450,– | Rp. 148.650,– |
| 8" x 4" = | Rp. 192.650,– | Rp. 163.800,– |
| 8" x 5" = | Rp. 222.950,– | Rp. 189.600,– |
| 8" x 6" = | Rp. 247.250,– | Rp. 209.300,– |
| 8" x 8" = | Rp. 306.400,– | Rp. 260.900,– |
| 10" x 3" = | Rp. 265.450,– | Rp. 226.000,– |
| 10" x 4" = | Rp. 301.850,– | Rp. 256.350,– |
| 10" x 6" = | Rp. 354.900,– | Rp. 300.300,– |
| 10" x 8" = | Rp. 408.000,– | Rp. 347.350,– |
| 10" x 10" = | Rp. 483.850,– | Rp. 411.100,– |

## 28. ALL-BELL TEE (ALL-FRP)



| | 10 kg/cm² |
|---|---|
| 8" x 4" = | Rp. 459.550,– |
| 8" = | Rp. 611.250,– |
| 10" x 6" = | Rp. 681.000,– |
| 10" = | Rp. 823.550,– |
| 12" x 6" = | Rp. 856.950,– |
| 12" = | Rp. 1.151.150,– |

## 29. BELL S-BEND (Heat Process)

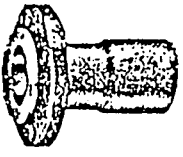
| | 10 kg/cm² |
|---|---|
| 3" = | Rp. 30.350,– |
| 4" = | Rp. 54.600,– |
| 6" = | Rp. 159.250,– |

## 30. FLANGE SPIGOT – W (Heat Process)

(tidak termasuk Flange)

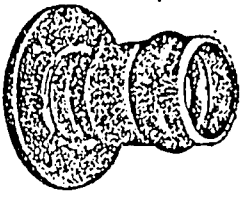
| | 10 kg/cm² |
|---|---|
| 2" = | Rp. 3.500,– |
| 2½ = | Rp. 4.900,– |
| 3" = | Rp. 8.850,– |
| 4" = | Rp. 15.600,– |
| 5" = | Rp. 23.400,– |
| 6" = | Rp. 44.200,– |
| 8" = | Rp. 73.150,– |
| 10" = | Rp. 116.150,– |

## 31. FLANGE SOCKET-W (Heat Process)



| | 10 kg/cm² |
|---|---|
| 2" = | Rp. 19.100,– |
| 2½" = | Rp. 22.550,– |
| 3" = | Rp. 27.750,– |
| 4" = | Rp. 40.750,– |
| 5" = | Rp. 54.600,– |
| 6" = | Rp. 73.700,– |
| 8" = | Rp. 110.950,– |
| 10" = | Rp. 175.100,– |

## 32. FLANGE BELL END (Heat Process)



| | 10 kg/cm² |
|---|---|
| 2" = | Rp. 19.750,– |
| 3" = | Rp. 30.350,– |
| 4" = | Rp. 41.750,– |
| 5" = | Rp. 57.650,– |
| 6" = | Rp. 83.450,– |
| 8" = | Rp. 131.950,– |
| 10" = | Rp. 201.750,– |

## 33. TS FLANGE SOCKET (Inj)

| | 10 kg/cm² |
|---|---|
| ½" = | Rp. 9.050,– |
| ¾" = | Rp. 10.400,– |
| 1" = | Rp. 15.600,– |
| 1¼" = | Rp. 19.950,– |
| 1½" = | Rp. 20.500,– |
| 2" = | Rp. 27.250,– |
| 2½" = | Rp. 34.700,– |
| 3" = | Rp. 41.150,– |
| 4" = | Rp. 61.400,– |
| 6" = | Rp. 123.100,– |



BEST AVAILABLE DOCUMENT

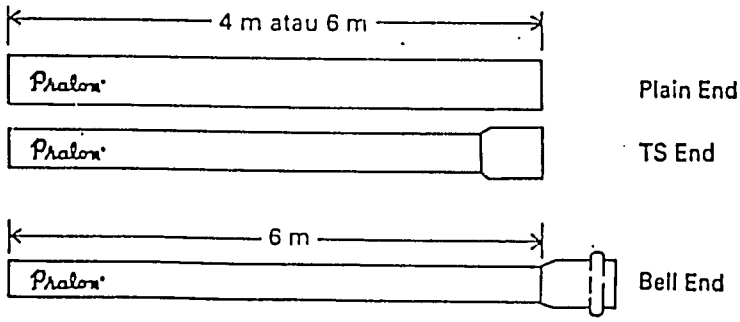
# HARGA PER METER

| Nominal Diameter | | Nominal O.D. | S – 10 | | S – 12.5 | |
|---|---|---|---|---|---|---|
| Inch | mm | mm | Plain End/TS End | Bell End | Plain End/TS End | Bell End |
| ½" | 16 | 20 | Rp. 460,– | — | — | — |
| ¾" | 20 | 25 | Rp. 700,– | — | — | — |
| 1" | 25 | 32 | Rp. 1.200,– | — | — | — |
| 1¼" | 30 | 40 | Rp. 1.750,– | — | — | — |
| 1½" | 40 | 50 | Rp. 2.800,– | — | — | — |
| 2" | 50 | 63 | Rp. 4.350,– | Rp. 4.700,– | Rp. 3.550,– | Rp. 3.850,– |
| 2½" | 65 | 75 | — | — | — | — |
| 3" | 75 | 90 | Rp. 8.800,– | Rp. 9.550,– | Rp. 7.100,– | Rp. 7.900,– |
| 4" | 100 | 110 | Rp. 13.100,– | Rp. 14.400,– | Rp. 10.500,– | Rp. 11.600,– |
| 5" | 125 | 140 | Rp. 21.200,– | Rp. 23.500,– | Rp. 16.850,– | Rp. 19.200,– |
| 6" | 150 | 160 | Rp. 27.000,– | Rp. 30.200,– | Rp. 22.100,– | Rp. 24.550,– |
| 8" | 200 | 200 | Rp. 42.600,– | Rp. 47.200,– | Rp. 34.000,– | Rp. 39.550,– |
| 10" | 250 | 250 | Rp. 66.400,– | Rp. 80.250,– | Rp. 53.150,– | Rp. 67.000,– |
| 12" | 300 | 315 | Rp. 105.500,– | Rp. 127.650,– | Rp. 84.550,– | Rp. 106.500,– |
| 14" | 350 | 355 | Rp. 132.100,– | Rp. 168.000,– | — | — |

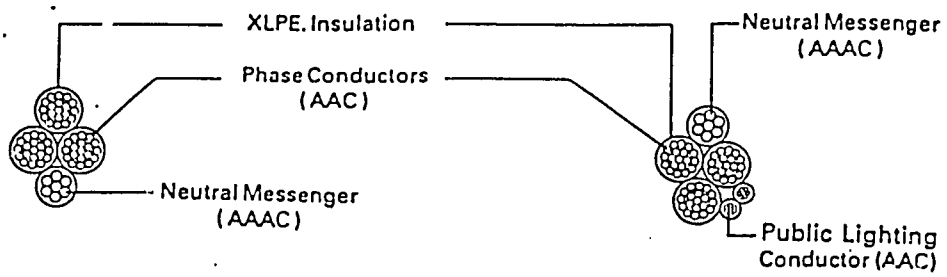
Standard : SII 0344 - 82 ISO 4065.

Harga : Franco Jakarta.
Belum termasuk 10% PPN.
Harga dapat berubah sewaktu-waktu tanpa pemberitahuan terlebih dahulu.

Panjang : 4 meter atau 6 meter.



## CONDUCTORS FOR L.V. OVERHEAD LINE




BLE : 31.

### MECHANICAL CHARACTERISTICS

| NOMINAL SECTIONS | | | Approx. Twisted Diameter | Weight of Cable | DELIVERY | | |
|---|---|---|---|---|---|---|---|
| Phase | Neutral | Public Lighting | | | Standard Reel Length | Approx. Weight of Loaded Reel | Type of Reel |
| mm² | mm² | mm² | mm | kg/km | m | kg | |
| 3x70 | 1x50 | - | 37.0 | 985 | 500 | 915 | DRUM |
| 3x50 | 1x35 | - | 32.4 | 707 | 500 | 580 | DRUM |
| 3x35 | 1x25 | - | 29.4 | 554 | 500 | 570 | DRUM |
| 3x25 | 1x25 | - | 22.5 | 433 | 500 | 360 | DRUM |
| | | | | | | | |
| 3x70 | 1x50 | 2x16 | 37.0 | 1125 | 500 | 980 | DRUM |
| 3x50 | 1x35 | 2x16 | 33.3 | 848 | 500 | 780 | DRUM |
| 3x35 | 1x25 | 2x16 | 31.9 | 695 | 500 | 570 | DRUM |
| 3x25 | 1x25 | 2x16 | 29.4 | 574 | 500 | 560 | DRUM |

## INSULATED ALUMINIUM TWISTED CONDUCTORS FOR L.V. OVERHEAD LINE

### ELECTRICAL CHARACTERISTICS

| Nominal Sectional Area of Phase | Resistance of Conductor at 20°C | Permissible Currents Ambient Temperature | | |
|---|---|---|---|---|
| | | 20°C | 30°C | 40°C |
| mm² | Ohm/km | A | A | A |
| 25 | 1.20 | 110 | 100 | 95 |
| 35 | 0.868 | 135 | 125 | 110 |
| 50 | 0.641 | 160 | 145 | 135 |
| 70 | 0.443 | 200 | 185 | 170 |



BEST AVAILABLE DOCUMENT

## INSULATED ALUMINIUM TWISTED CONDUCTORS FOR L.V. OVERHEAD LINE

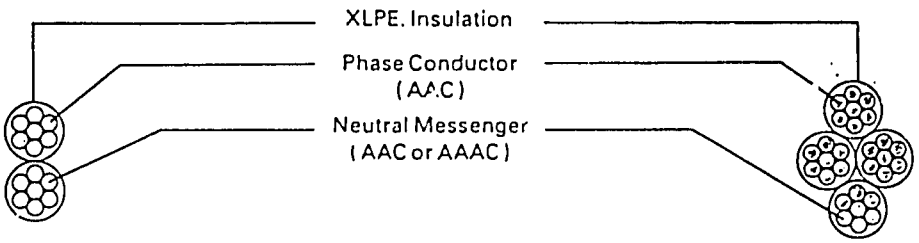



TABLE : 30. MECHANICAL CHARACTERISTICS

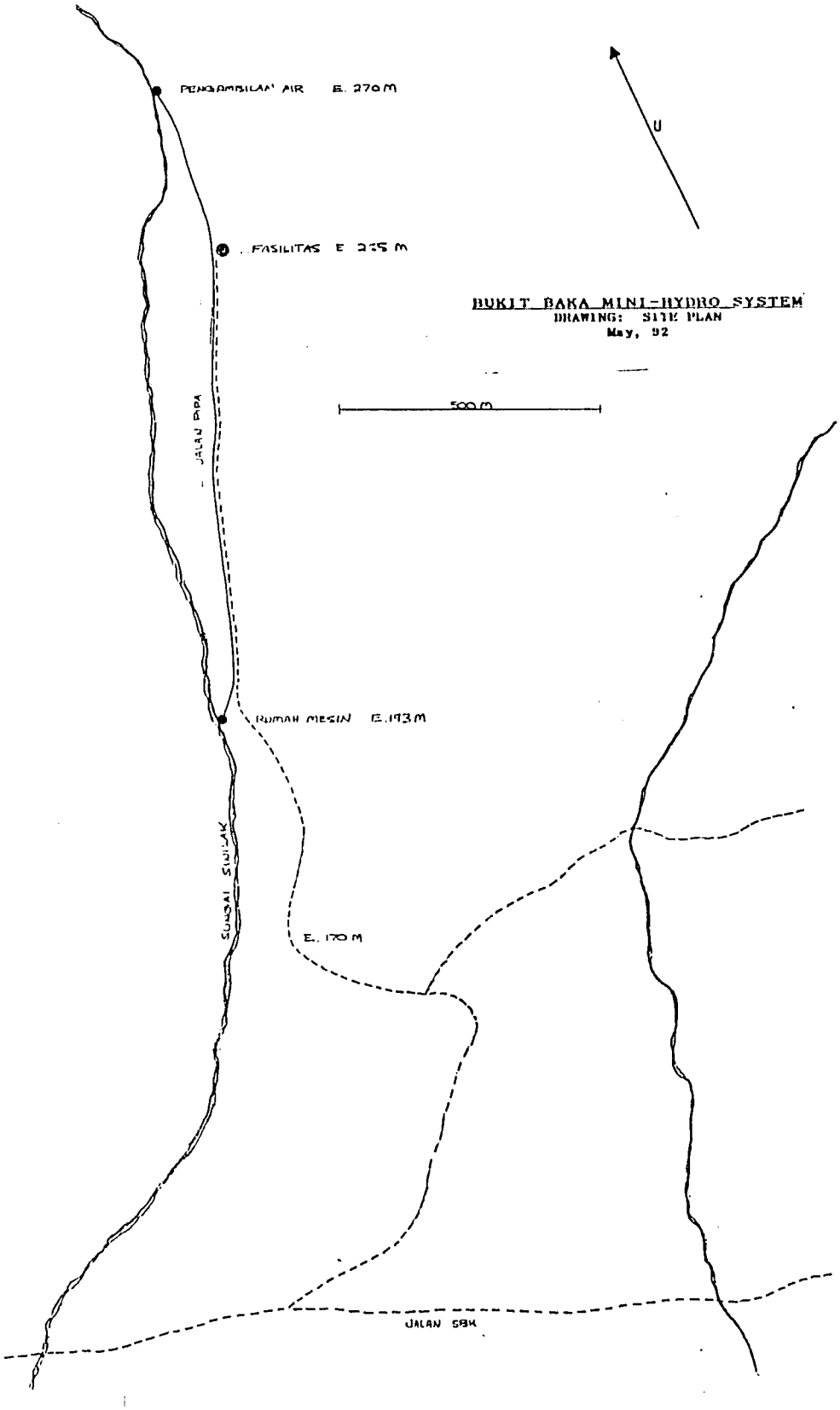
| NOMINAL SECTIONS | | | Approx. Twisted Diameter | Weight of Cable | DELIVERY | | |
|---|---|---|---|---|---|---|---|
| Phase | Neutral | Public Lighting | | | Standard Reel Length | Approx. Weight of Loaded Reel | Type of Reel |
| $mm^2$ | $mm^2$ | $mm^2$ | mm | kg/km | m | kg | |
| 2 x 16 | - | - | 15.0 | 141 | 500 | 145 | DRUM |
| 3 x 16 | 1 x 16 | - | 18.1 | 282 | 500 | 235 | DRUM |
| 2 x 25 | - | - | 18.6 | 216 | 500 | 200 | DRUM |
| 3 x 25 | 1 x 25 | - | 22.5 | 433 | 500 | 370 | DRUM |

## INSULATED ALUMINIUM TWISTED CONDUCTORS FOR L.V. OVERHEAD LINE

### ELECTRICAL CHARACTERISTICS

| Nominal Sectional Area of Phase | Resistance of Conductor at 20°C | Permissible Currents Ambient Temperature | | |
|---|---|---|---|---|
| | | 20°C | 30°C | 40°C |
| $mm^2$ | Ohm/km | A | A | A |
| 10 | 3.02 | 65 | 60 | 50 |
| 16 | 1.91 | 85 | 80 | 70 |
| 25 | 1.20 | 110 | 100 | 90 |

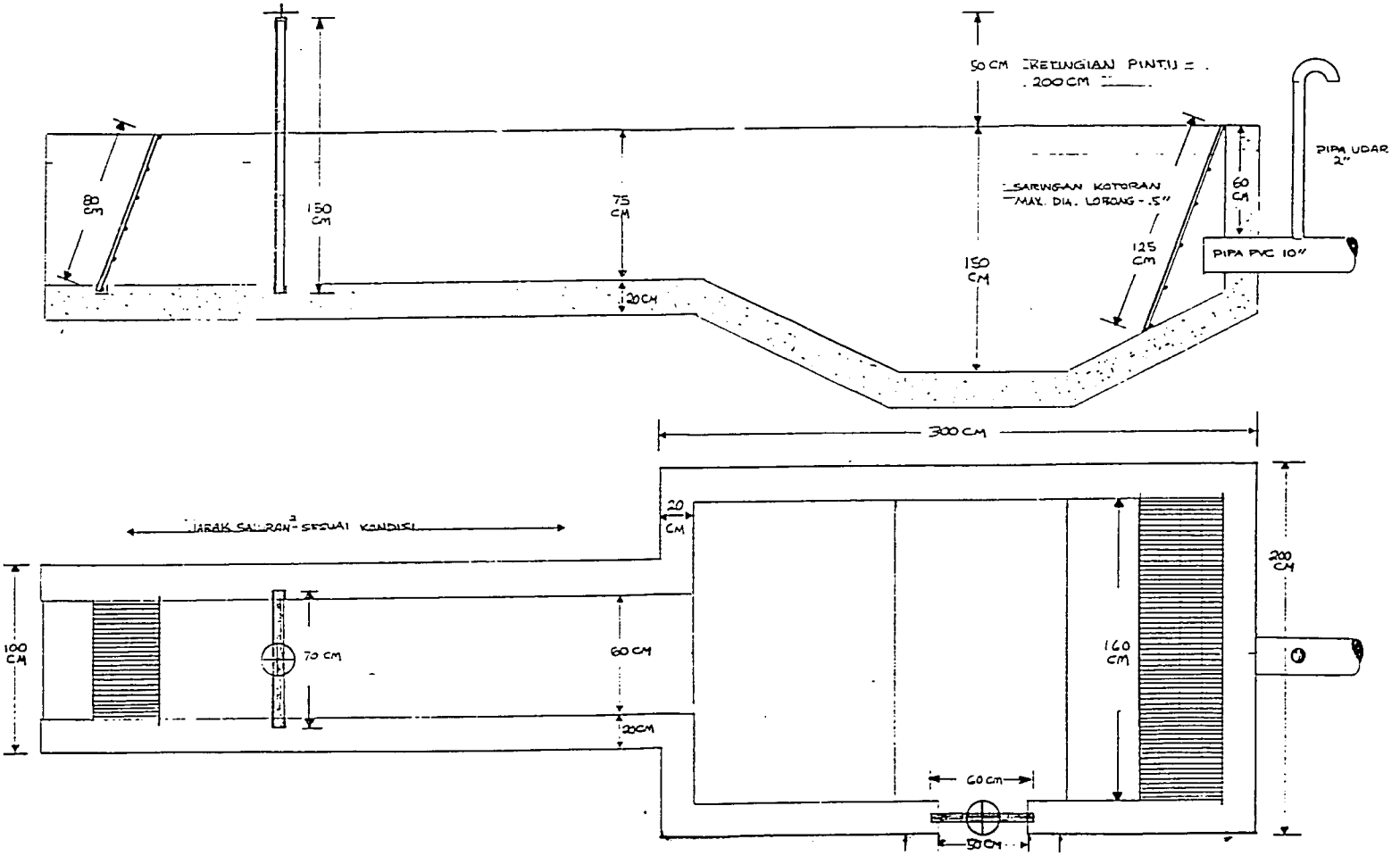
BEST AVAILABLE DOCUMENT

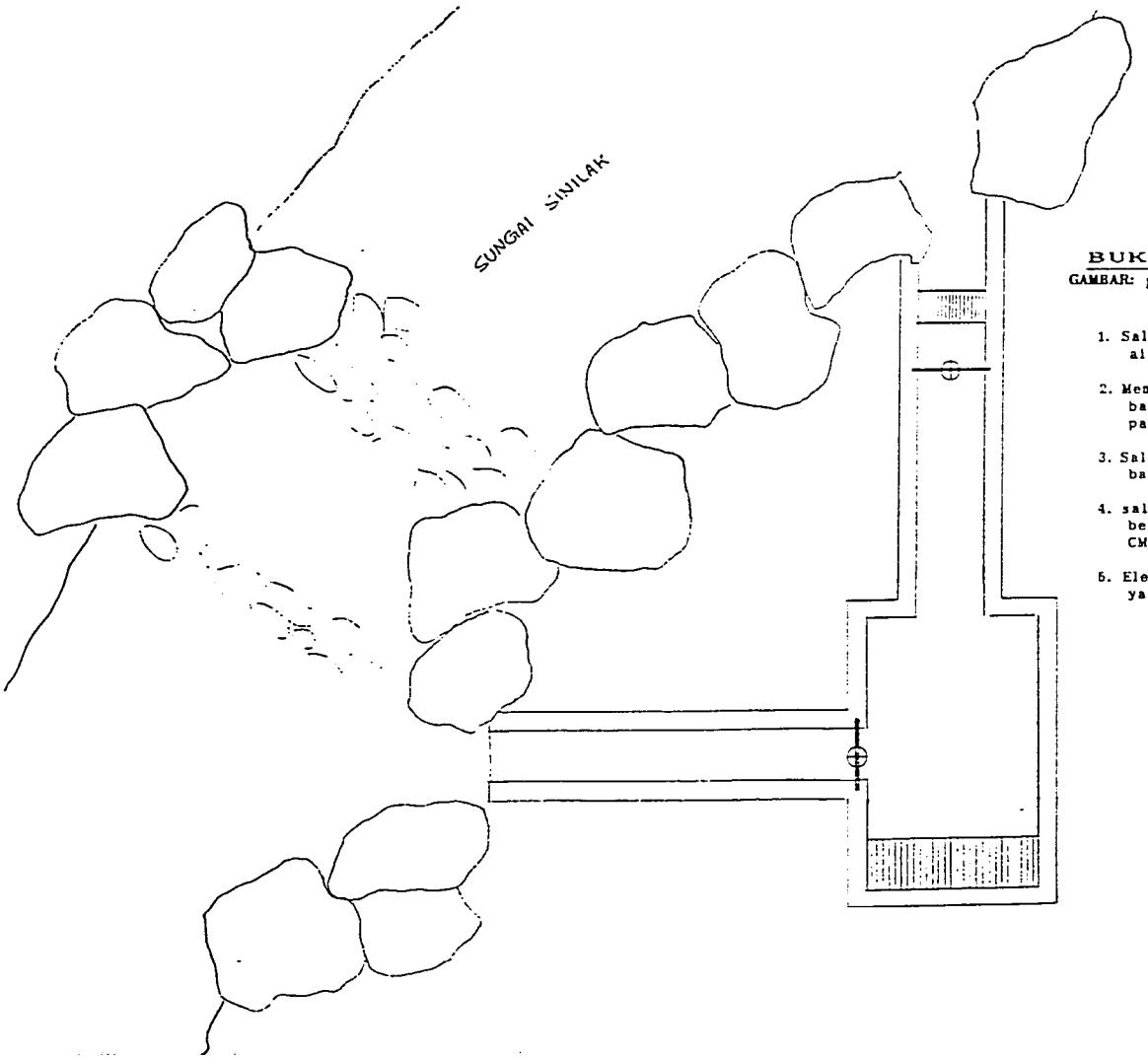

PENGAMBILAN AIR E. 270 M
U
FASILITAS E 235 M
BUKIT BAKA MINI-HYDRO SYSTEM
DRAWING: SITE PLAN
May, 92
500 M
JALAN PPA
RUMAH MESIN E.193 M
SUNGAI SINILAK
E. 170 M
JALAN SBK

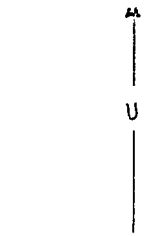
BUKIT BAKA MINI-HYDRO SYSTEM

GAMBAR: Pengambilan air dan bak Penampung

May, 1992



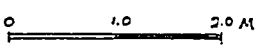


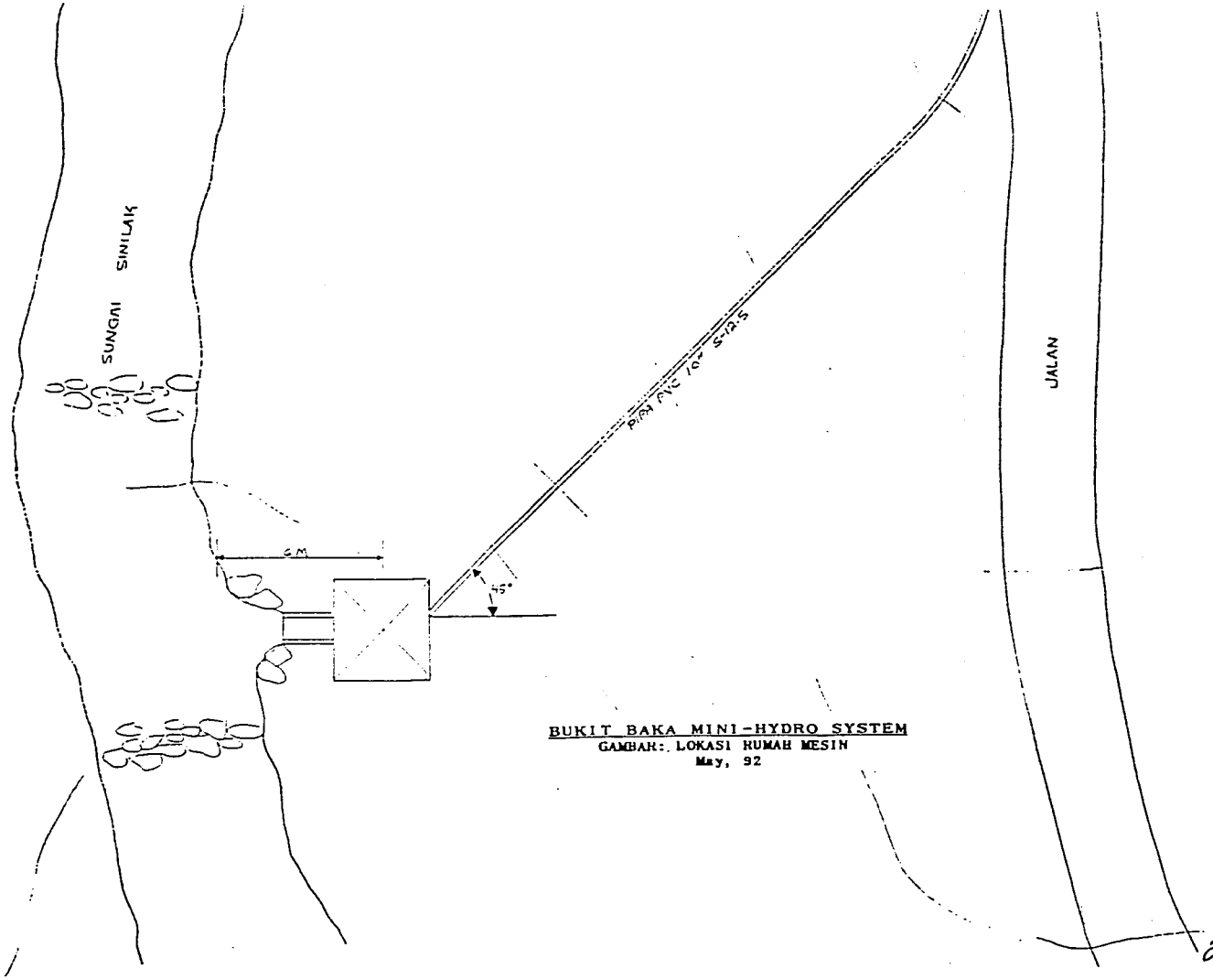




## BUKIT BAKA MINI-HYDRO SYSTEM

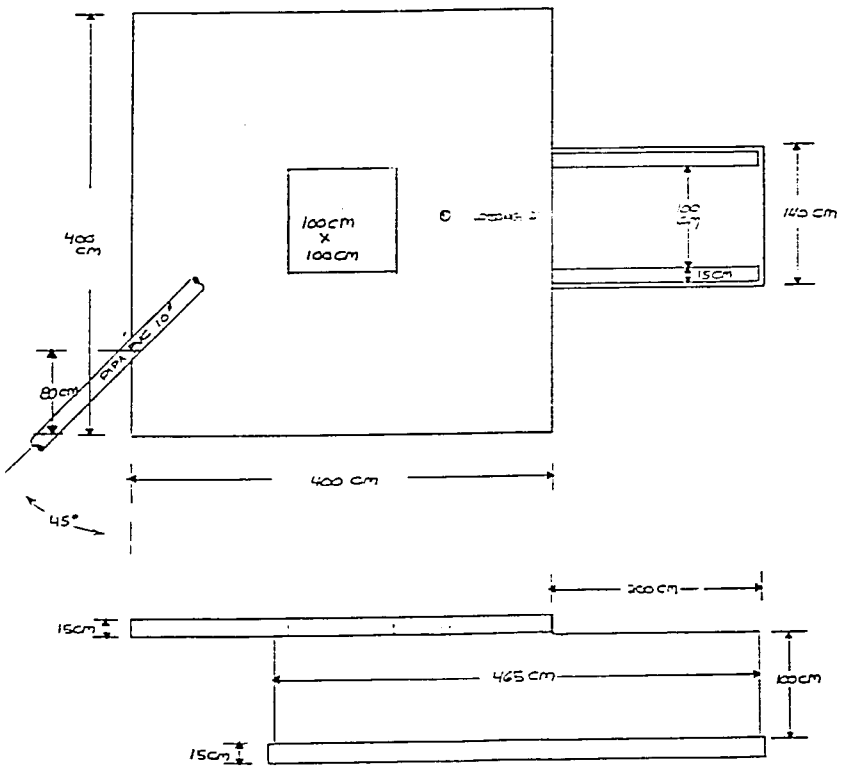
**GAMBAR:** Pengambilan air dan bak penampung
May, 92

1. Saluran pengambilan air dan saluran pembuangan air harus mengatur jarak sesuai kondisi lokasi.
2. Membuat saluran-saluran dan bak penampung dengan batu kali dan semen. Ratio semen = kerikil - 3 pasir - 2 semen - 1.
3. Saluran-saluran dan bak penampung harus diplester bagaian dalam saja.
4. saluran-saluran dan bak penampung membuat dengan besi beton .5 " (reinforcing rod .5") setiap 25 CM bagian dalam semen.
5. Elevasi bak penampung sesuai tanda (bencbmark) yang sudah depasang di tempat dengan surfay.



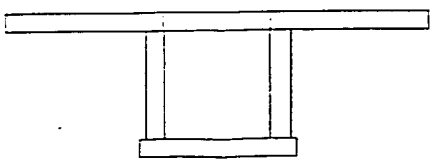


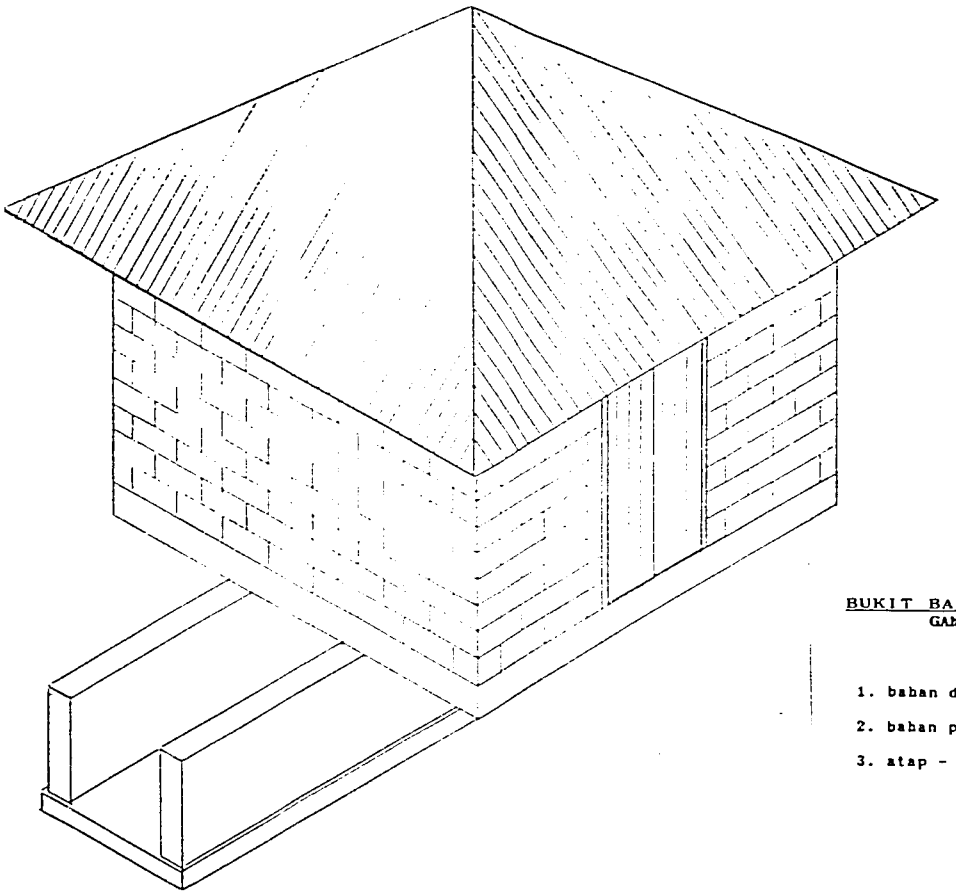

BUKIT BAKA MINI-HYDRO SYSTEM
GAMBAR: LOKASI RUMAH MESIN
May, 92




**BUKIT BAKA MINI-HYDRO SYSTEM**
**GAMBAR: FONDASI RUMAH MESIN**
**May, 92**

1. Tebal semen lantai dan dinding - 15 cm.
2. Ratio semen - 3 kerikil / 2 pasir / 1 semen.
3. Memakai .5" besi beton setiap 25 cm dalam lantai dan dinding.
4. lokasi pembuangan air di tengah lantai 100 cm X 100 cm., atau sesuai kaki turbine.
5. Orientasi rumah mesin dan pipa sesuai site plan dengan drajat (45 degrees).

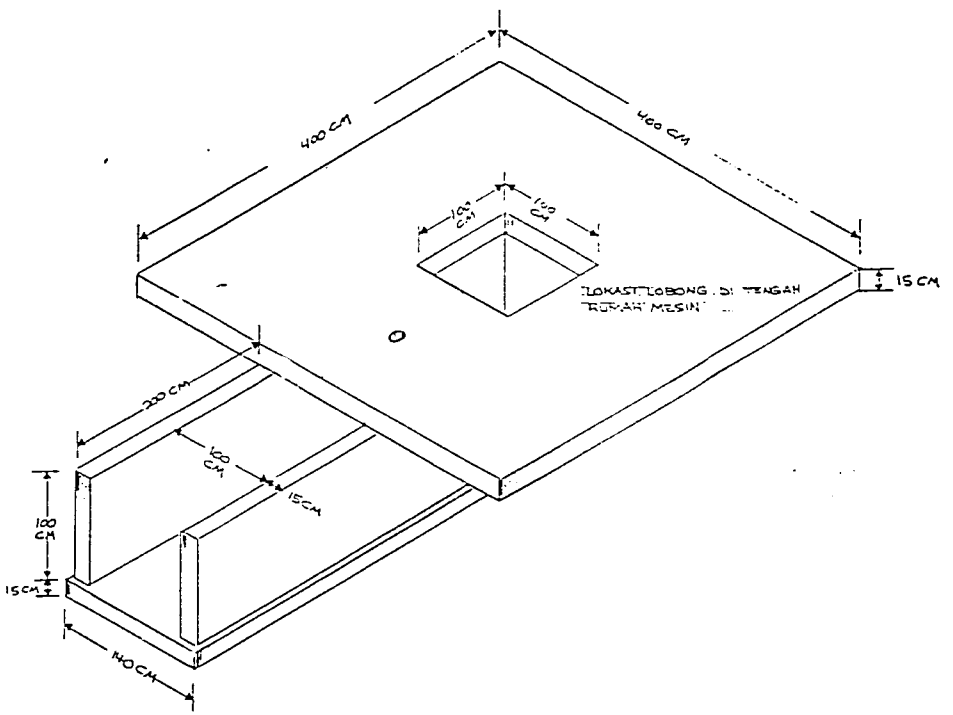


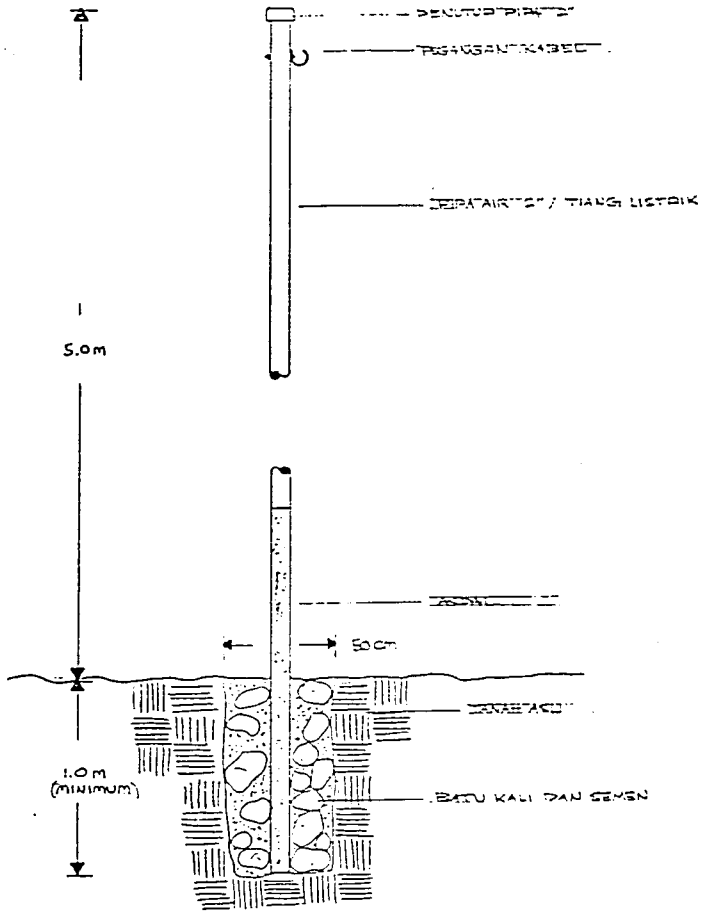


**BUKIT BAKA MINI-HYDRO SYSTEM**
**GAMBAR: RUMAH MESIN**
**May, 92**

1. bahan dinding - batu tela, plester dalam saja.
2. bahan pintu dan gorden atap - kayu besi.
3. atap - seng atap .45 mm.

**BUKIT BAKA MINI-HYDRO SYSTEM**
**GAMBAR: FUNDASI RUMAH MESIN**
**May, 92**

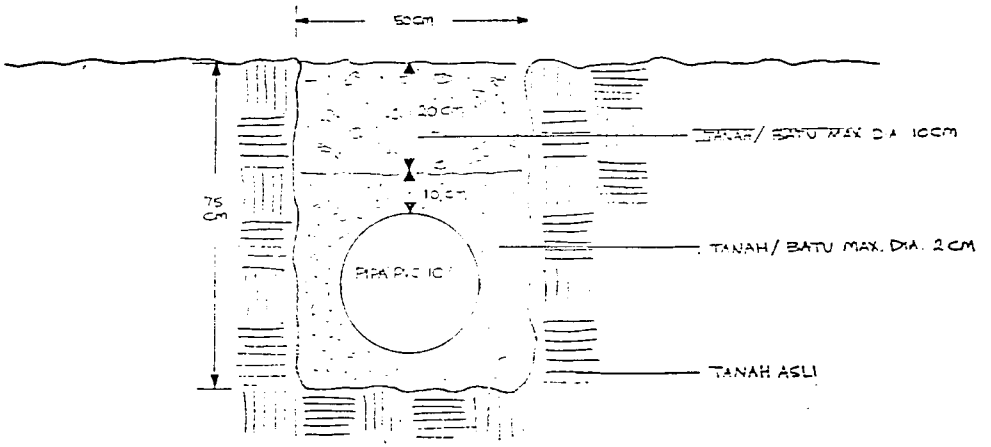


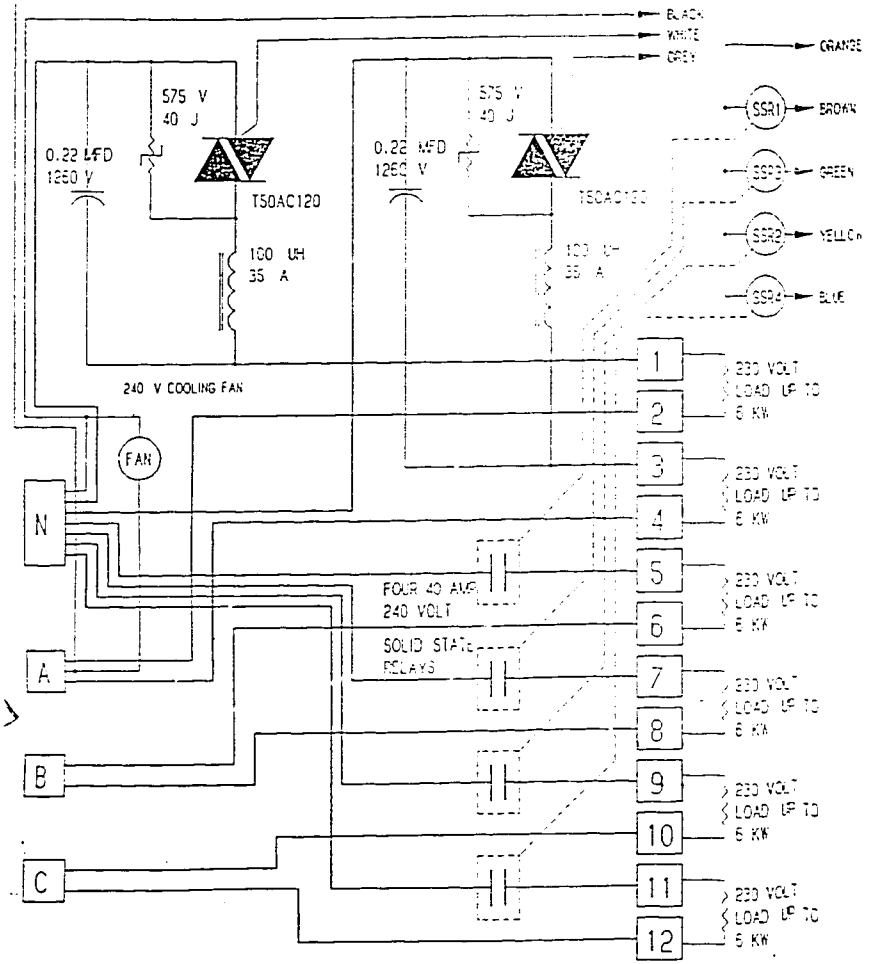


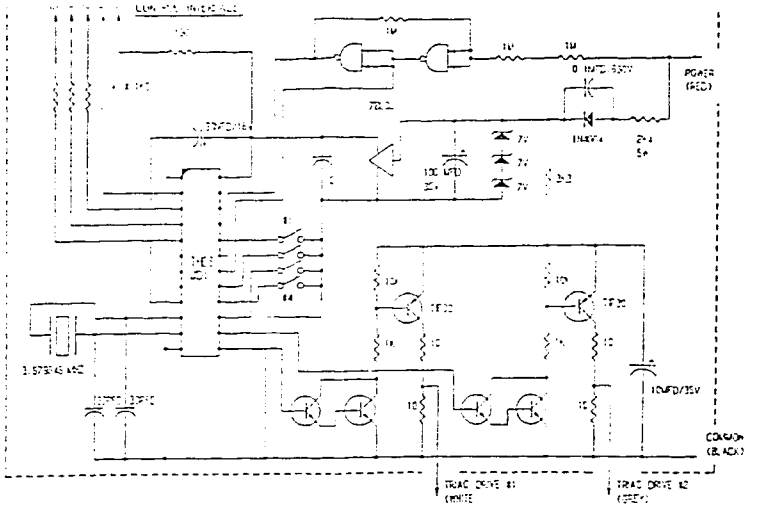

BUKIT BAKA MINI-HYDRO SYSTEM
GAMBAR: Tiang listrik / sistem distribusi
May, 1992

1. Tiang listrik - pipa air (galvinized) 2" X 6 M
2. Tutup pipa di atas dengan penutup pipa 2"
3. Memasang tiang dengan 1 M dalam tanah
4. Memasang tiang dengan batu kali dan semen
5. Aspal bagaian pipa yang pasang dibawah tanah

BUKIT BAKA MINI-HYDRO SYSTEM
GAMBAR: Instalasi pipa PVC 10"
May, 1992






## NOTES:

1. ALL SIX LOADS MUST BE CONNECTED FOR CORRECT OPERATION
2. MODULE SWITCHES #1 AND #2 MUST BE TURNED ON
3. LOADS MAY BE AS SMALL AS DESIRED.
4. LOADS MUST NOT EXCEED A MAXIMUM OF 6 KW EACH AT 240 V
5. LOADS SHOULD ALL BE IDENTICAL, OR AT LEAST VERY CLOSE IN SIZE FOR CORRECT OPERATION.
6. A NEUTRAL MUST BE SUPPLIED.
7. LOADS ARE ALWAYS ELECTRICALLY HOT, REGARDLESS OF LOADING
8. IF WATER COOLED LOADS ARE USED, INTERLOCK A THERMOSTAT AND LEVEL SWITCH TO SHUT DOWN THE TURBINE UPON INTERRUPTION OF WATER FLOW.

THES THOMSON AND HOWE ENERGY SYSTEMS INC.
BOX 2.S.S. #1, KIMBERLEY, BRITISH COLUMBIA, CANADA
(604) 427 4326 DRAWING COPYRIGHTED 1991 T.H.E.S.

SCHEMATIC FOR 3 PHASE "JUNIOR" GOVERNORS OF THE "J3" TYPE CONFIGURED FOR USE ON 400 VOLT 4 WIRE SYSTEMS

| Rev#: | Date: | By: | | | |
|---|---|---|---|---|---|
| 1 | Mar20/91 | WRT | Design by: W. R. Thomson | Nov05/90 | Dr'g No. GJS - 040 |
| | | | Drawn by: W. R. Thomson | Nov05/90 | |
| | | | Approved by: W.R.Thomson | Mar20/91 | |
| | | | Date of issue: March 20th 1991 | Rev: 1 | File# J Job# |

NRM/ARD CONSULTANCY REPORTS

| NO. | TITLE | AUTHOR |
|---|---|---|
| 1. | Procurement Plan For Research Equipment at Bukit Baka and Equipment Installation at Samarinda Forestry Research Station | Roy Voss |
| 2. | Agroforestry in Bukit Baka/ Bukit Raya | W.G. Granert |
| 3. | Pengukuran dan Pemetaan Topografi Sebagian Daerah Taman Nasional Bukit Baka/Bukit Raya | Sahri Denny, cs |
| 4. | Applied Research Recommendations for Production Forest Management An Economic and Ecological Review of the Indonesian Selective Cutting and Replanting System (TPTI) * | Lisa Curran & Monica Kusneti |
| 5. | Balancing Forest and Marine Conservation with Local Livelihoods in Kalimantan and North Sulawesi | Jill M. Belsky |
| 6. | Proposal to the GOI and USAID for the Development of Comprehensive Environmental and Natural Resources Accounts (CENRA) for Economic Planning and Management | Henry Peskin & Joy Hecht |

* Confidential – Not for circulation