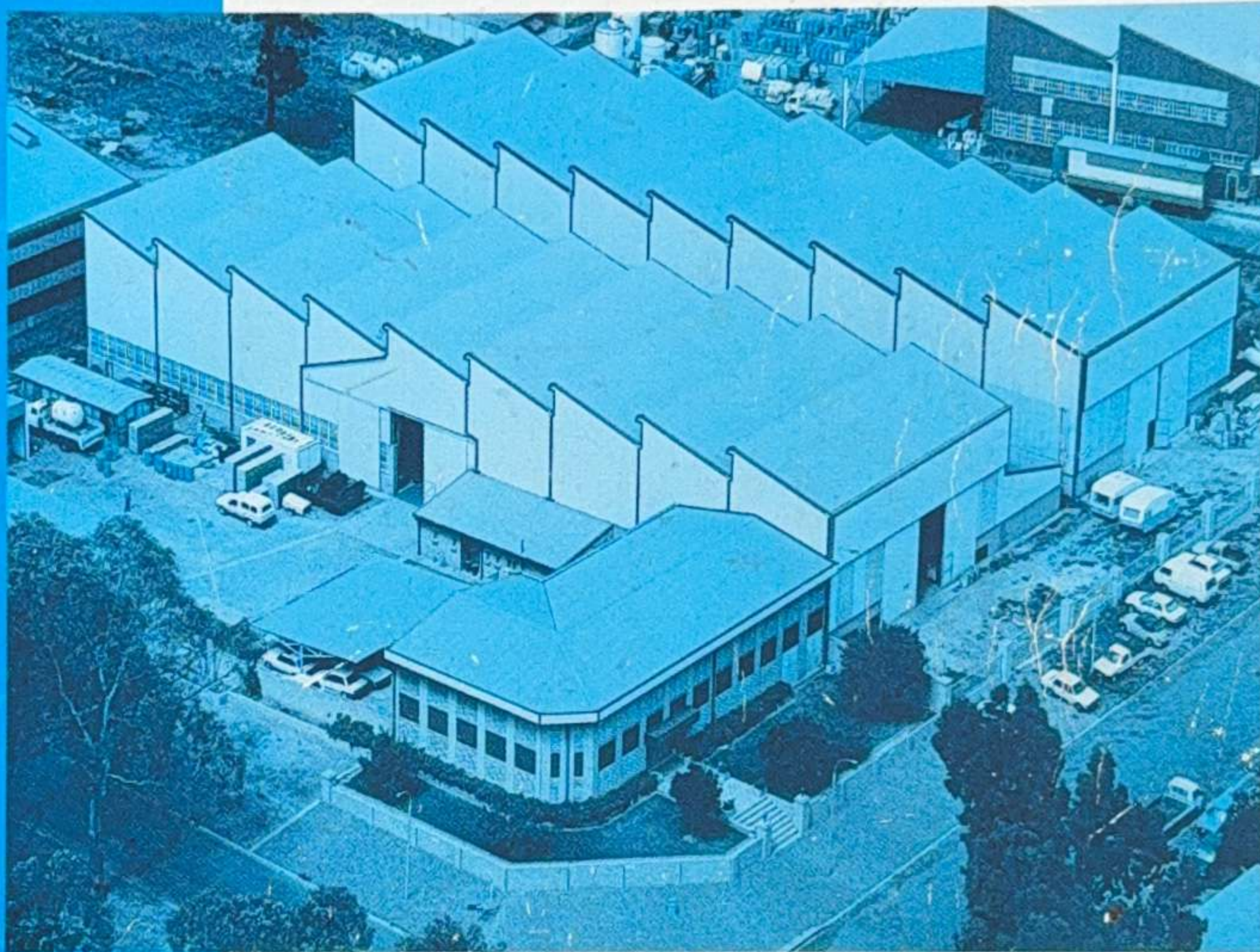


PRENTEC

CONSULTING AND CONTRACTING CHEMICAL ENGINEERS
IN
WATER, SEWAGE & INDUSTRIAL EFFLUENT TREATMENT



FOUNDED IN 1974, PRENTEC ARE AN INDIGENOUS
SOUTH AFRICAN COMPANY OFFERING TOTAL IN-HOUSE
ENGINEERING RESOURCES.

PRENTEC (PTY) LTD.


P. O. Box 12181, Chloorkop 1624. South Africa.

Tel: +27 (0) 11 976-5234 Fax: +27 (0) 11 976-2802

OPERATING AND MAINTENANCE INSTRUCTION MANUAL

CONTENTS

TYPE OF PLANT : SEWAGE TREATMENT PLANT
ADVANTAGES OF PRENTEC'S BATCH TREATMENT SYSTEMS
CLIENT OF TREATMENT : CLEARWATER
FOR TREATMENT
PLANT LOCATION : KNYSNA
PROCESS DESIGN PARAMETERS
CLIENT'S ORDER NUMBER : DATED 11 APRIL 1997
IMPORTANT OPERATING NOTES
PRENTEC REFERENCE ANY OPERATING NOTE J-0549-SA
MECHANICAL EQUIPMENT
DATE OF COMMISSIONING : OCTOBER 1997
SWITCHES / PUSHBUTTONS / INDICATORS ON CONTROL PANEL
PLC UNIT
CIVIL WORKS
CORROSION PROTECTION
PROCESS GUARANTEE
PRENTEC (PTY) LIMITED : TELEPHONE NUMBER (011) 976-5234
P O BOX 12181 : TELEFAX NUMBER (011) 976-2802
CHLOORKOP
1624

 PRENTEC REFERENCE	TITLE	DATE	NAME	P.O. BOX 12181 CHLOORKOP 1624 SOUTH AFRICA Reg. No. 74 / 03306 / 07
		DRAWN		
		CHKD		
		APPR'D		

MECHANICAL MAINTENANCE SHEETS **CONTENTS**

1. **PROCESS SYSTEMS** (CLEARED UNIT) MODEL No. BCF 44325/1100 L201-05 RATED
2. **ELECTRICAL** (300 V, 3 PHASE IP55 BRUCE CROXTON MOTOR)

GENERAL (PORTABLE PUMP MODEL KW 73-17 300V RATED @ 100% EFFICIENCY)

ADVANTAGES OF PRENTEC'S BATCH TREATMENT SYSTEMS

CONCEPT OF TREATMENT (PUMP MODEL C03 0300 PPT RATED @ 6.9 KW)

SBR TREATMENT

PROCESS DESCRIPTION

PROCESS DESIGN PARAMETERS

OPERATION & CONTROL (ARRANGEMENT OF SEWAGE TREATMENT PLANT)

IMPORTANT OPERATING NOTES (TRUNG DIAGRAM FOR SEWAGE PLANT)

SUMMARY OF IMPORTANT OPERATING NOTES (IM FOR PLC)

MECHANICAL EQUIPMENT

ELECTRICAL EQUIPMENT

SWITCHES / PUSHBUTTONS / INDICATORS ON CONTROL PANEL

PLC UNIT

CIVIL WORKS

CORROSION PROTECTION

PROCESS GUARANTEE

PLANT GUARANTEE

EXCLUSIONS & DEVIATIONS



PRENTEC REFERENCE

TITLE

	DATE	NAME
DRAWN		
CHKD		
APPR'D		

Reg. No. 74 / 03306 / 07

P.O. BOX 12181
CHLOORKOP
1624
SOUTH AFRICA

ENCLOSURES

GENERAL

TECHNICAL MAINTENANCE SHEETS FOR PROPRIETARY EQUIPMENT:-

1. BROOK HANSEN GEARED UNIT MODEL No. SCF 44B25-D100 LBH-4G RATED @ 57RPM C/W 3KW, 380 V, 3 PHASE IP55 BROOK CROMPTON MOTOR.
2. SUBMERSIBLE PUMP MODEL KW 75-4T 380V RATED @ 3l/s @ 8MWC.
3. KEYS 28 FLOAT LEVEL REGULATORS.
4. CHEMICAL DOSING PUMP MODEL CC3 0306 PPI RATED @ 6,0 l/hr

DRAWINGS

- A1-J-049-SA-01 - GENERAL ARRANGEMENT OF SEWAGE TREATMENT PLANT.
- A3-J-0549-SA-16a ELECTRICAL WIRING DIAGRAM FOR SEWAGE PLANT.
- A4-J-0549-SA-16b ELECTRICAL WIRING DIAGRAM FOR PLC.

The PENTEC scope of supply is limited to :-

- reinforced concrete raw sewage sump ;
- inlet bar screen ;
- reinforced concrete aeration tanks complete with baffles ;
- floating aeration structures c/w gearbox, access walkway, motor, and a K-aerator ;
- chlorine contact tank and chlorine dosing unit;
- sludge drying beds complete with piping and valves .

PENTEC treatment plants are fully fledged treatment plants conforming to the requirements of the Department of Water Affairs.

	DATE	NAME
DRAWN		
CHKD		
APPR'D		

ADVANTAGES OF PRENTEC GENERAL TREATMENT SYSTEM

The treatment plant has been designed on the sequencing batch reactor (SBR) principle. The plant operates on a batch principle and is based on total oxidisation employing the extended aeration principle of the activated sludge process.

The plant shall produce an acceptable effluent subject to:

- it being operated and maintained in accordance with Prentec's operating and maintenance instructions.

- it being operated within the design parameters as defined in the instruction

2. PLANT

- the raw sewage being free from all matter which may have detrimental effects e.g. toxic material, oil, disinfectants, etc.

The PRENTEC scope of supply is limited to :-

- reinforced concrete raw sewage sump ;
- inlet bar screen ;
- reinforced concrete aeration tanks complete with baffles ;
- floating aeration structures c/w gearbox, access walkway, motor, and a K-aerator ;
- chlorine contact tank and chlorine dosing unit;
- sludge drying beds complete with piping and valves .

PRENTEC treatment plants are fully fledged treatment plants conforming to the requirements of the Department of Water Affairs.



TITLE

DATE

NAME

DRAWN

CHKD

APPR'D

Reg. No. 74 / 03306 / 07

P.O. BOX 12181
CHLOORKOP
1624
SOUTH AFRICA

ADVANTAGES OF PRENTEC'S BATCH TREATMENT SYSTEM

1. TOTAL CAPITAL COSTS -

are reduced by the elimination of the settling tanks and the sludge recirculation facilities, together with a reduction in the sludge drying beds area. PRENTEC's mode of construction of the civil works by employing precast, reinforced concrete panels also reduces the total capital costs.

2. PLANT RELIABILITY -

the proposed installation offers greater flexibility and reliability in operation and ease of extending.

3. OPERATIONAL CONTROL -

the system completely eliminates the operating problems and housekeeping requirements normally associated with the day to day control of activated sludge plants e.g.. sludge bulking/ recirculation, wash down clarifiers, etc., etc. The operation of the batch treatment tanks are fully automatic.

4. PLANT PERFORMANCE -

is not sensitive either to the large daily or seasonal fluctuations on organic or hydraulic loads applied to the plant thus guaranteeing a consistent high quality effluent.

5. WASTE EXCESS SLUDGE

- the total volume of excess sludge produced is reduced due to the longer average sludge age and the higher recommended operating level of the mixed liquor suspended solids. The sludge bed requirements are therefore reduced and the sludge produced is more readily treated.

6. FLOW MEASUREMENT

- the measurement of the sewage plant through put is measured in a batch fashion and hence offers a much greater accuracy.

7. LABOUR/MAINTENANCE

- is greatly reduced due to the plant's automatic mode of operation and the simplicity of plant construction.

8. ENVIRONMENTAL

FRIENDLY

- the total oxidation process eliminates the formation of obnoxious odours thus enabling batch reactors to become more environmentally acceptable. The longer average sludge age and retention time also minimises fly odour nuisance.

CONCEPT OF TREATMENT

GENERAL

The sewage shall be treated by a single SBR batch system incorporating the following treatment steps:

1. Raw sewage dumping and storage in a raw sewage sump ;
2. Raw sewage screening and flow distribution ;
3. Aeration by surface aerator ;
4. Settling ;
5. Decanting of the settled effluent ;
6. Retention of the waste sludge in the aeration tank ;
7. Wasting of excess sludge on drying beds ;
8. Flow measurement of the treated effluent by batch counting ;
9. Chlorination of the final effluent ;
10. Retention of final effluent in a chlorine contact tank ;
11. Disposal of final effluent to an environmental pond.

The steps are all carried out in a conventional manner except for steps, 3, 4 and 5 which are executed in a single tank.

Because there is no continuous separation and recycling of the activated sludge in the batch treatment plant, there is no necessity to provide separate facilities to store and aerate the excess sludge.

Additional capacity has been built into the aeration basins to enable the sludge to build up until it is convenient to waste sludge onto the drying beds or some other method.



PRENTEC REFERENCE

TITLE

	DATE	NAME
DRAWN		
CHKD		
APPR'D		

Reg. No. 74 / 03306 / 07

P.O. BOX 12181
CHLOORKOP
1624
SOUTH AFRICA

The treated effluent from the SBR plant is chlorinated in the chlorine contact tank prior to discharge to the environmental pool. PROCESS DESCRIPTION oils, and other floating matter

Refer to A1-J-0549-SA-01 General arrangement of sewage treatment plant.

Unscreened raw sewage is gravity fed through the barscreen located at the treatment plant. The barscreen is designed for a flow of 300m³ /day.

The screened raw sewage will gravitate into the raw sewage sump where the raw sewage will be pumped up into the splitter box. It will then be gravity fed into the aeration tanks. The organic constituents are biologically oxidised by the micro-organisms present in the activated sludge.

The operation of the aeration tanks are of a batch type system i.e. the tanks contents are aerated until the volume reaches a predetermined level when the fully automatic control system shuts down the aerators, allows a quiescent settling period, and then commences the treated effluent discharge cycle. Since the decanting cone is submerged, scum and floating matter are not discharged with the final effluent.

The effluent discharge cycle is automatically stopped by means of a low-level switch, which is positioned in the tanks to prevent the discharge of sludge, and the next aeration cycle is recommenced. From time to time stabilised excess sludge must be discharged to the sludge drying beds.

Because there is no continuous separation and recycling of the activated sludge in the batch treatment plant, there is no necessity to provide separate facilities to store and aerate the excess sludge.

Additional capacity has been built into the aeration basins to enable the sludge to build up until it is convenient to waste sludge onto the drying beds or some other method.

The treated effluent from the SBR plant is chlorinated in the chlorine contact tank prior to discharge to the environmental pond. Facilities for removing fats, oils, and other floating matter from the aeration tank are provided.

PROCESS DESIGN PARAMETERS

The SBR treatment plant was designed in accordance with the following parameters:

1.1 BARSCREEN / FLOW SPLITTER BOX

1.1.1. The barscreen is sized to handle a flow of 300m³/day. The unit shall be provided with a 33mm opening screen followed by a 13mm screen. The barscreen will be provided with an emergency bypass which shall form an integrated part of the barscreen.

Aeration Tanks

Feed to aeration tanks, (average dry weather flow) 75,0m³/d per tank

Number of tanks 2

Each aeration tank will have the following properties:

- diameter 6,7 m
- water operating depth 2,8 to 3,5 m
- operating volume - average 111,0 m³
- hydraulic retention period - average 35,5 hrs
- organic loading 26,25 kg BOD/d
- volumetric loading 236,5 gmBOD/m³
- oxygen requirements 2,3 kgO₂/kgBOD
- oxygen input rate over 16,8 h 3,6 kgO₂/hr
- minimum aeration efficiency 1,8 kgO₂/kWh
- minimum oxygen requirements 60,4 kg O₂/d
- maximum absorbed power 2,0 kW
- installed power (aerator) 3,0 kW
- absorbed power 2,5 kW
- number of decant cycles 24 hrs 3

PROCESS DESIGN PARAMETERS

The SBR treatment plant was designed in accordance with the following parameters.

1.1 BARSCREEN / FLOW SPLITTER BOX

1.1.1 The barscreen is sized to handle a flow of 300m³/day

The unit shall be provided with a 35mm opening screen followed by a 15mm screen. The barscreen will be provided with an emergency bypass which shall form an integrated part of the barscreen.

1.2 Aeration Tanks

Feed to aeration tanks, (average dry weather flow) 75,0m³/d per tank

Number of tanks

Each aeration tank will have the following properties

- diameter 6,7 m
- water operating depth 2,8 to 3,5 m
- operating volume - average 111,0 m³
- hydraulic retention period - average 35,5 hrs
- organic loading 26,25 kg BOD/d
- volumetric loading 236,5 gmBOD/m³
- oxygen requirements 2,3 kgO₂/kgBOD
- oxygen input rate over 16,8 h 3,6 kgO₂/hr
- minimum aeration efficiency 1,8 kgO₂/kWh
- minimum oxygen requirements 60,4 kg O₂/d
- maximum absorbed power 2,0 kW
- installed power (aerator) 3,0 kW
- absorbed power 2,5 kW
- number of decant cycles/24 hrs 3

- decant flow rate $\pm 55,0 \text{ m}^3 / \text{h}$
- volume of each discharge $25,0 \text{ m}^3$
- gearbox $96,0 \%$
- energy density $22,5 \text{ watts/m}^3$

1.3 Chlorine Contact Tank

- Number of tanks 1
- Diameter of tank $3,0 \text{ m}$
- Water depth $1,85 \text{ m}$
- Volume $13,1 \text{ m}^3$
- Dump volume 25 m^3
- Dump period $30,0 \text{ min}$
- Retention time at $55 \text{ m}^3/\text{h}$ 15 min

1.4 Sludge Drying Beds - Quick Drain Matting

- Number of Beds 3
- Type of bed Sand media with quick drain matting
- Specified bed area 48 m^2
- Dimensions of beds $4 \times 4 \text{ m}$

1.5 Plant Controls

The biological treatment shall be automatically controlled via a Telemecanique PLC unit.

PRENTEC's standard, software shall be provided.

1.6 Environmental ponds

- Dimensions and approximately $30 \times 15 \text{ m}$
- Water depth average 1000 mm
- Volume approximately 450 m^3

1.7

Design loadings

The proposed treatment plant is based on the following design parameters:

1.7.1 Hydraulic loadings

Average Dry Weather Flow	150.00 m ³ /day
	6.25 m ³ /hour
	1.74 l/sec
Peak Dry Weather Factor	3.50
PDWF	6.10 l/sec
Peak Wet Weather Flow	7.0 l/sec

1.7.2 Organic loadings

COD concentration of raw sewage	700 mg/l
BOD concentration of raw sewage	350 mg/l
Ammonia as N	40 mg/l
Phosphate as P	6 mg/l

Based on the above assumptions the anticipated loadings are:

COD	105.0 kg/day
BOD	52.50 kg/day
Ammonia	60 kg/day
Phosphate	0.9 kg/day

PLC LOGIC CONTROLLER

The system shall be controlled via a PLC unit and PRENTEC's standard software which provides complete flexibility of operation including:

- Putting the SBR unit into the manual mode.
- Select plant loading which to optimise plant operating efficiency.
- Each discharge counter to provide accurate measurement of treated wastewater.
- Means of changing the treatment process from total nutrient removal to total nitrification as and when required by a process selection switch.

IMPORTANT OPERATING NOTES

OPERATION & CONTROL

The operation of the effluent treatment plant is basically automatic and the plant demands little attention. However, there are aspects of the plant operation which demand rigid discipline.

1 **SBR UNIT**

The aeration tanks shall be designed to treat an average daily flow of 150 m³/d.

The commencement and termination of the decanting cycles are initiated from level float switches with time back-up switching.

During the treatment service cycle, the nitrification/denitrification process steps are controlled from the PLC which has pre-programmed software.

Over and above automatic control of the aeration process, the surface aeration units offer individual control by being provided with readily adjustable immersion depth facilities. Further inherent aeration flexibility is provided by the aerator turbine arms being adjustable in length.

2 **PROGRAMMABLE LOGIC CONTROLLER**

The plant operation shall be controlled via a PLC unit and PRENTEC's standard software package which provides complete flexibility of operation including:-

- placing the SBR unit into the manual mode;
- preset plant loading switch to optimise plant operating efficiency;
- batch discharge counter to provide accurate measurement of treated wastewater;
- means of changing the treatment process from total nutrient removal to total nitrification as and when required by a process selection switch.

allowed to settle for a 45 minutes. The volume of settled sludge is then read as a percentage of the cone.

IMPORTANT OPERATING NOTES

When the volume of settled sludge reaches 35% in the test cone, the sludge should be wasted into a drying bed. Wasting of sludge must only take place towards the end of the

The operation of the effluent treatment plant is basically automatic and the plant demands must relatively little labour. However, there are aspects of the plant operation which demand rigid supervision:-

either excessive sludge present in the aeration tank or the automatic effluent discharge valve is not closing properly.

A. BARSCREEN

The barscreen must be raked regularly.

Since the bulk of the sewage is fed to the plant during the daytime, it is suggested that at full load conditions, the barscreen is raked three times per day, i.e. 07h00, 13h00 and 17h00. The frequency of raking may be reduced during low load conditions. The actual raking operation takes only five (5) minutes.

The mixed liquor is run onto the bed to give a maximum

B. CHLORINATION

Chlorination of the final effluent is executed by injecting sodium hypochlorite solution into the effluent as it enters in to the chlorine contact tank. The hypochlorite solution must be prepared daily since it loses its activity on standing.


It is suggested that the operator makes sure that there is a minimum of 40 litres solution available in the plastic drum (sufficient to cover two discharge cycles).

Preparation of the sodium hypochlorite solution is executed by mixing the sodium hypochlorite concentration with an equal amount of water. The dosing pump should be set at 100% frequency (lower knob) and 40% stroke (upper knob) to give a delivery output \pm 6 liters per hour.

The floating structure automatically raises and lowers the aeration unit, within the guide rails

C. SLUDGE WASTING

While the aerator is operating and the aeration tank almost full, a sample of the aeration tank liquor should be drawn and poured into the test settling cone and

	TITLE	DATE	NAME	P.O. BOX 12181 CHLOORKOP 1624 SOUTH AFRICA Reg. No. 74 / 03306 / 07
		DRAWN		
		CHKD		
		APPR'D		

allowed to settle for ± 45 minutes. The volume of settled sludge is then read as a percentage of the cone contents.

When the volume of settled sludge reaches 35% in the test cone, the sludge should be wasted onto a drying bed. Wasting of sludge must only take place towards the end of the aeration tank decanting period, i.e. after the sludge has settled in the tank. Sludge must never enter the chlorine contact tank. The presence of sludge in the chlorine contact tank indicates either excessive sludge present in the aeration tank or the automatic effluent discharge valve is not closing properly.

D. SLUDGE DRYING BEDS

Wasting excess concentrated MLSS sludge to the drying beds should be conducted during the same period as when the final effluent is being discharged, viz, after the settling period. The velocity of the waste liquor being applied to the bed should be broken by the concrete slab at each discharge to prevent the top surface of the sand from being disturbed. The mixed liquor is run onto the bed to give a maximum depth of 150mm.

After 1 to 2 hours, the sludge layer will have settled and a supernatant layer of effluent will be visible above the sludge. After 24 hours the supernatant layer shall have fully drained off leaving a thin layer of sludge. The sludge should then be left to dry to a "cracked" cake before removing. When the sludge has dried to a "cracked" cake, it must be removed immediately by raking the top of the bed and the dried sludge stored under cover for use as fertilizer or compost.

E. PLANT OPERATION

In the aeration tank, the aerator is mounted on a floating structure. The floating structure automatically raises and lowers the aeration unit, within the guide rails depending on the change in water level.

The decanting unit is suspended from the floating structure and is connected to the discharge pipe by means of a flexible hose.

 PRENTEC REFERENCE	TITLE	DATE	NAME	P.O. BOX 12181 CHLOORKOP 1624 SOUTH AFRICA Reg. No. 74 / 03306 / 07
		DRAWN		
		CHKD		
		APPR'D		

The operation of the plant is controlled by the automatic process control board. The aerator shall stop and start as controlled by the high and low levels switches. As the tank fills, the aerator will operate until the water level reaches the high level float switch. When this switch is activated, the aerator automatically stops and the settling period commences.

At the end of the pre-set settling period, the automatic dump valve will open for a period of 120 seconds to clear the flexible hose of any sludge, thereafter the automatic discharge valve is opened and the final effluent is discharged into the chlorine contact tank.

When the low level switch is activated by the fall in the water level, the effluent discharge is automatically stopped and the aerator starts up again. Under no circumstances should the aerator and effluent discharge system be operated simultaneously.

Since the incoming raw sewage is discharged into the aeration tank towards the bottom of the tank and the effluent discharge is taken from a point approximately 100mm below the top level, raw inflow and effluent discharge can take place simultaneously without being detrimental to the plant operation.

The immersion depth of the aerator can be varied by using the adjusting bolts situated on the float. Increasing the immersion depth increases oxygen input and also increases the power absorbed.

Decreasing the immersion depth has the opposite effect. The aerator must always turn in a clockwise direction when viewed from the access platform.

During erection and commissioning of the plant, the floating structure and aerator levels have been preset and should not be altered. If for any reason (maintenance of otherwise), a level is changed, it is important to ensure that the vertical axis of the aerator is located at 90 degrees to the top water level after all adjustments have been made, i.e. the aerator arms must be parallel with the top water level.

overflow can, switching off the aerator and decommissioning the floating structure into the

For ease of reference, the automatic control of the aeration tank unit operates as follows:-

CHLORINE CONTACT TANK


- a) Low Level Switch
Stops the effluent discharge cycle and starts the aerator.
- b) High Level Switch *new system in progress 27/2/99. PD*
Stops the aerator and starts the settling period. *aerator continues to run for 20 min then stops and settling process starts.*
- c) Settling period
The length of the settling period prior to the opening of the effluent discharge valve has been pre-programmed for 45 minutes.
1 min 20 sec outlet flush.
Discharge
- d) Duty Selector *approximately every three weeks depending on the sludge build-up*
The duty selector in the panel is provided to control the total period of aeration by stop/starting the aerator during the aeration cycle thus optimising the plant performance at various loading to the plant.

OPERATING CONTROL TESTS

- e) Night Time Discharge
The plant controls are pre-set to discharge effluent from the aeration tanks at 03h00.

From time to time, excessive amounts of oil, fat, floating matter shall accumulate in the aeration tank thus causing sludge bulking and the formation of nocardia scum.

All floating matter from the aeration tanks must be periodically removed by placing the tank in the manual mode and allowing the tank to fill up to the level of the overflow cone, switching off the aerator and decanting the floating matter onto the

 RENTEC REFERENCE	TITLE	DATE	NAME	P.O. BOX 12181 CHLOORKOP 1624 SOUTH AFRICA Reg. No. 74 / 03306 / 07
		DRAWN		
		CHKD		
		APPR'D		

sludge drying beds. The use of a water hose spray shall facilitate the decanting of the floating scum.

F. CHLORINE CONTACT TANK

During normal operation of the plant, small amounts of sludge shall be carried over to the chlorine contact tank. These solids shall slowly accumulate on the tank floor and shall from time to time rise to the top of the tank and be carried away with the final effluent.

In the event of sludge build-up in the chlorine contact tank, the chlorine contact tank may be drained by opening the valve and draining all of the tanks contents into the return sump whereby the submersible pump will discharge the contents back into the aeration tank.

This has to be done approximately every three weeks depending on the sludge build-up in the tank, this will minimise the accumulation of solids and improve the quality of the final effluent.

G. OPERATING CONTROL TESTS

Once a week, or more often if the plant is not operating satisfactorily, the plant operator should check the pH of the effluent in the aeration tank. If the pH drops below 6,8 steps must be taken to neutralise the effluent by adding lime. The quantity of lime to be added can only be determined on site. We recommend that two 50kg bags be kept in the stores as a precautionary measure. Twice a week the mixed liquor suspended solids (MLSS) should be measured. A simple but acceptable means of measuring the MLSS is carried out in a settling cone.

While the aerator is operating and the aeration tank almost full, a sample of aeration tank liquor should be drawn and poured into the test settling cone and allowed to

settle for ± 45 minutes. The volume of the settled sludge is then read as a percentage of the cone contents.

When the volume of settled sludge reaches 35% in the test cone, sludge should be wasted onto a drying bed. Wasting of the sludge must only take place towards the end of the aeration tank decanting period, i.e. after the sludge has settled in the tank. Sludge must never enter the chlorine tank.

H. FINAL EFFLUENT ANALYSIS


The Department of Water Affairs demand that regular tests on the influent and effluent are carried out by a laboratory set up for the analysis in question.

These tests include:-

- Oxygen absorbs value (4 hours)
- Chemical oxygen demand
- Total suspended solids
- Free and saline ammonia (as N)
- Nitrates and pH

In the event of sludge build-up in the chlorine contact tank, the chlorine tank may be drained by opening the valve and draining all the contents back into the return sump. This is to be done every three weeks. (See "F")

If the pH drops below 6,8 steps must be taken to neutralize the effluent by adding lime. The plant operator should check the pH of the effluent in the aeration tank. (See "G")

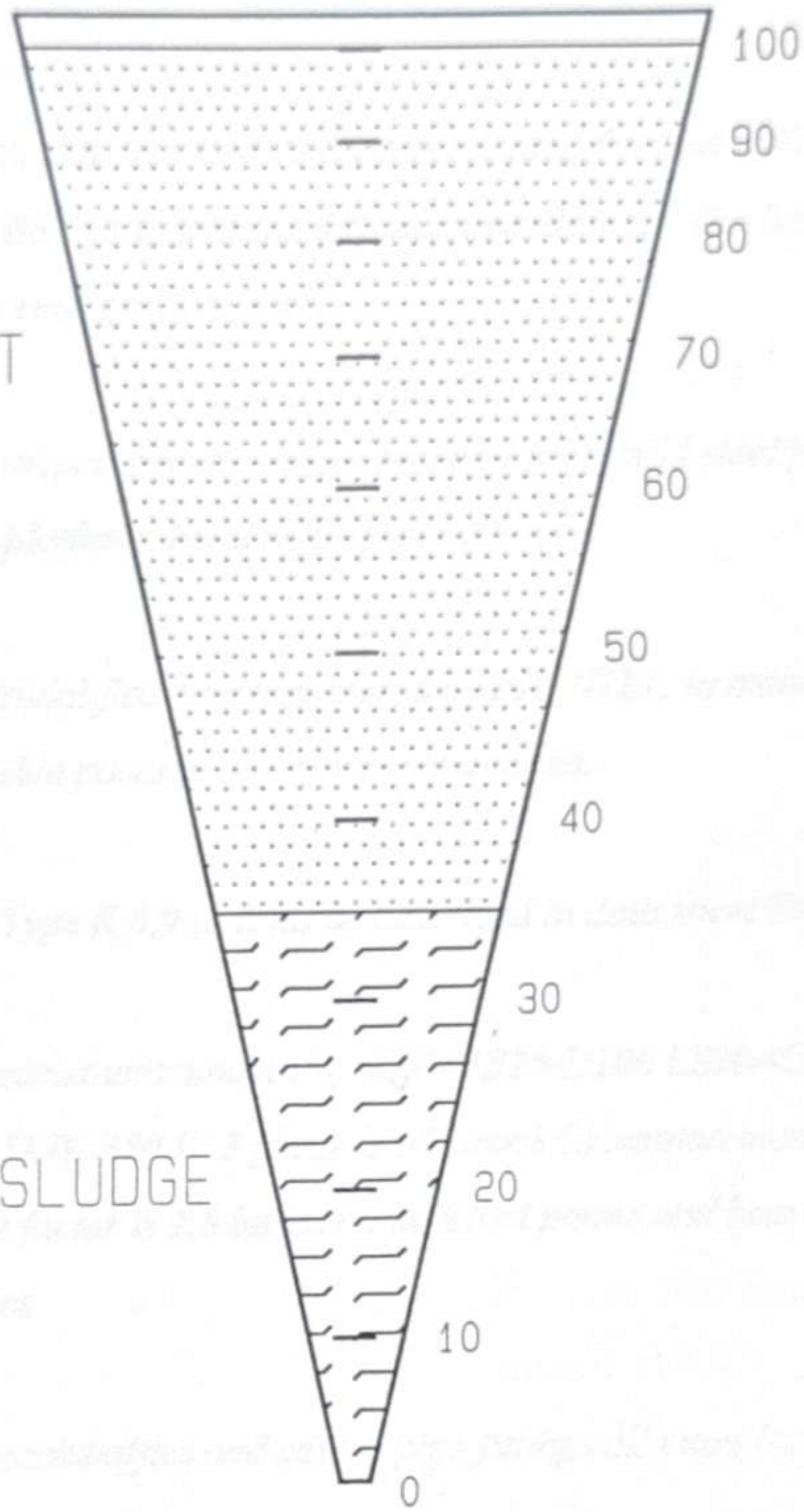
 PRENTEC REFERENCE	TITLE	DATE	NAME	P.O. BOX 12181 CHLOORKOP 1624 SOUTH AFRICA Reg. No. 74 / 03306 / 07
		DRAWN		
		CHKD		
		APPR'D		

SUMMARY OF IMPORTANT OPERATING NOTES

- The barscreen must be raked regularly. (See "A").
- The sodium hyperchlorite solution must be prepared daily since it loses its activity on standing. (See "B")
- Wasting of sludge must only take place towards the end of the aeration tank decanting period, i.e. after the sludge has settled in the tank. Sludge must never enter the chlorine contact tank. (See "C")
- When the sludge had dried, to a "cracked" cake on the sludge drying beds, it must be removed immediately by raking the top of the bed and stored under cover for use as fertilizer or compost. (See "D")
- Under no circumstances should the aerator and effluent discharge system be operated simultaneously. (See "E")
- In the event of sludge build-up in the chlorine contact tank, the chlorine tank may be drained by opening the valve and draining all the contents back into the return sump. This is to be done every three weeks. (See "F")
- If the pH drops below 6,8 steps must be taken to neutralize the effluent by adding lime. The plant operator should check the pH of the effluent in the aeration tank. (See "G")

SLUDGE SETTLING
CONE

CLEAR
SUPERNATANT



SLUDGE

SLUDGE SETTLING
CONE

PRENTEC REFERENCE

TITLE

	DATE	NAME
DRAWN		
CHKD		
APPR'D		

Reg. No. 74 / 03306 / 07
P.O. BOX 12181
CHLOORKOP
1624
SOUTH AFRICA

ELECTRICAL EQUIPMENT

MECHANICAL EQUIPMENT

The treatment process shall be fully automated for the wasting of excess activated

Scope of supply: The actual control of the aeration tanks shall be via a Telemechanics PLC which shall accept the plant inputs and provide the control outputs to the operators

1 - off Double barscreen, drip tray and rake all fabricated from welded steel, hot dipped galvanised to SABS 763 to provide a robust installation, The barscreen shall be provided with an emergency bypass.

Control panel 380Volt. The manufacturer of our wall mounted dust and vermin

2 - off Floating aerator tripod structure manufactured from mild steel piping and plate c/w access platform, hand railing and guides. and equipped as follows:-

6 - off Fibreglass ellipsoidal floats manufactured by PRENTEC in moulds c/w internal sleeves and variable position adjusting mechanisms.

b) 2 x 3 kW DOL. aerator starter complete with circuit-breaker.

2 - off Surface aerator Type K 0,9 (3 arm) as described in data sheet SA01/02. with current transformer.

2 - off Brook Hansen geared unit model No. SCF 44B25-D100 LBH-4G rated @ 57RPM C/W 3KW, 380 V, 3 phase IP55 Brook Crompton motor.. The minimum service factor is 2,8 based on installed power and bearing lifetime (B10) 100 000 hrs.

8 led indicator lights, 220V transformer with circuit breaker for PLC supply, 1 discharge counters and 3 control fuses.

2 - off Sets of aeration tank baffles and cast in pipe fittings all manufactured in mild steel. 2 SP circuit breakers for compressor and lights and 1 SP earth leakage relay for industrial switch plug mounted on control panel.

1 - off Sodium hypo-chlorite dosing pump complete with mixing/dosing tank and associated piping rated @ 6.0l/hr.

Site cabling shall be PVC SWA 600 / 1000 V copper cables to SABS 130-70 galvanised at

2 - off Submersible pump model KW 75-4T 380V 0.75 kW rated @ 3l/s @ 8MWC.

All equipment shall be effectively earthed from the client's power supply.



TITLE

	DATE	NAME
DRAWN		
CHKD		
APPR'D		

Reg. No. 74 / 03306 / 07

P.O. BOX 12181
CHLOORKOP
1624
SOUTH AFRICA

ELECTRICAL EQUIPMENT

SWITCHES / PUSHBUTTONS / INDICATORS ON CONTROL PANEL

The treatment process shall be fully automated for the wasting of excess activated sludge. The actual control of the aeration tanks shall be via a Telemecanique PLC which shall accept the plant inputs and provide the control outputs to the operating equipment. The PLC shall be programmed to provide complete flexibility of operation but shall yet retain reliability of the process treatment control. The control board shall comprise the following:

Control panel 380Volt. The manufacture of one wall mounted dust and vermin proof control panel with glass window and of the approximate size:-

Height - 800 mm, Width - 600 mm, DEPTH - 260 mm, and equipped as follows:-

- a) 1 x incoming circuit- breaker "Mitsubischi" interlocked and panel door and 1 X phase failure relay with HRS fuses.
- b) 2 x 3 kW DOL. aerator starter complete with circuit-breaker, contactor and overload protection "Telemecanique" and ammeter with current transformer.
- c) 2 X 0,75 kW dol Sewage pump starters complete with circuit-breaker, contactor and overload protection, overload light and running hour meter.
- d) Auto control c/w plc, plant hand/auto selector switch. 4 selector switches 1 pushbutton, 8 led indicator lights, 220V transformer with with circuit breaker for PLC supply, 2 discharge counters and 3 control fuses.
- e) 2 dosing pump starters with SP circuit breaker and contactor.
- f) 2 SP circuit breakers for compressor and lights and 1 SP earth leakage relay for industrial switch plug mounted on control panel.
- g) Solenoids, tubing and fittings supplied by PRENTEC.

Site cabling shall be PVC SWA 600 / 1000 V copper cables to SABS 150/70 glanced at both ends and suitably current rated for the associated equipment and the voltage drops. All equipment shall be effectively earthed from the client's power supply.

PRENTEC REFERENCE	TITLE	DATE	NAME	P.O. BOX 12181 CHLOORKOP 1624 SOUTH AFRICA Reg. No. 74 / 03306 / 07
		DRAWN		
		CHKD		
		APPR'D		

SWITCHES / PUSHBUTTONS / INDICATORS ON CONTROL PANEL

On front door

1. Aerator duty / selector 4 positions

1. **Full** : aerator running all the time. -total nitrification
2. **$\frac{3}{4}$** : aerator runs 90 minutes and stands 30 minutes. -denitrification
3. **$\frac{1}{2}$** : aerator runs 60 minutes and stands 60 minutes. -denitrification
4. **$\frac{1}{4}$** : aerator runs 30 minutes and stands 90 minutes. -denitrification

2. On / off duty (For tank A & B).

The aeration tank can be put out of duty, for maintenance, etc.

The aerator and valves are now blocked. (Except in manual mode).

3. Plant Mode - manual - auto

In the manual mode all the automatic functions are disabled, and each plant component is switched on/off by means of an on/off switch.

In the automatic mode, the manual on/off switches are disabled, and each electrical component is now controlled from the PLC.

4. On/off Switches

These switches are only active in the manual mode. Each switch is linked to an individual component:

1. **Aerator A**
2. **Aerator B**
3. **Chlorine dosing pump**
4. **Tank A inlet valve**
5. **Tank A outlet valve**

- 6. Tank B inlet valve
- 7. Tank B inlet valve
- 8. Tank "A" dump valve
- 9. Tank "B" dump valve

5. Discharge Selector - 3 position

- 1. Off
- 2. Tank A
- 3. Tank B

After selecting "on", a discharge cycle (settling / decanting) will immediately start when pressing the pushbutton once. Continuously pressing the pushbutton will cause the selected tank to move from step to step i.e.:

service settle decant service
 press press press

10. LED Indicating Light

The above does not work if the reactor already in a discharge phase. However, one can switch the selector if this reactor is in discharge mode and bring that reactor to service by pressing the pushbutton.

6. Pushbutton

This button works together with the discharge selector switch. This pushbutton is there to cause the aerator to advance stepwise through the process,

7. Door-handle Switch

This is merely a safety switch which takes the power away from the internal of the panel so that safe access to the components is now possible.

	DATE	NAME
DRAWN		
CHKD		
APPR'D		

PLC UNIT

8. Discharge Counters

Each reactor has its own counter. This counter is non resetable and counts the number of tank discharges. A normal tank discharge is activated by the high and low level switches in the tank. The discharge volume between the high and low level signals is calculated as follows:-

$$V = (\text{dia tank})^2 \times \pi \times (\text{distance high - low}) = 25 \text{ m}^3$$

9. Amp Meters

Only the amperage on the aerator motor(s) is measured, as this constitute at least 90% of the power consumption of the sewage plant.

The aeration process is based on basically two parameters:

1. Absorbed oxygen (surface)
2. Mechanical agitation (mixing)

The process description explains this relation better and should be consulted.

10. LED Indicating Lights

The various process steps are indicated by means of a LED. This makes it possible by simply watching the panel lights to know the status of the plant.

11. Telemechanique PLC (TSX 17 - 20)

The in and output numbers on the PLC are visible through the front door window. A separate schedule gives the allocation of inputs and outputs. The PLC is only effective in the automatic mode.

TITLE	DATE	NAME	P.O. BOX 12181 CHLOORKOP 1624 SOUTH AFRICA
	DRAWN		
	CHKD		
	APPR'D		
	Reg. No. 74 / 03306 / 07		

PLC UNIT

PLC OUTPUTS

The PLC consist of the following components:-

1. **Main Unit:** code TSX 17 - 20
22 Inputs / 12 outputs
220V AC relay outputs
24V DC inputs
Spare
2. **Eprom:** TSX MC 70 E 524, which is a 24 KB Eprom cartridge to hold the main program.
3. **Language cartridge:** TSX P 17 - 20 FD2, which is Telemecanique's interpreter cartridge and which also has the real time clock function.
Spare
4. **Lithium battery:** TSX 17 ACC.
This battery keeps the real time clock active and lasts for a minimum of one year. The battery should be renewed every year, while the power is switched on.

 PENTEC REFERENCE	TITLE	DATE	NAME	P.O. BOX 12181 CHLOORKOP 1624 SOUTH AFRICA Reg. No. 74 / 03306 / 07
		DRAWN		
		CHKD		
		APPR'D		

PLC OUTPUTS

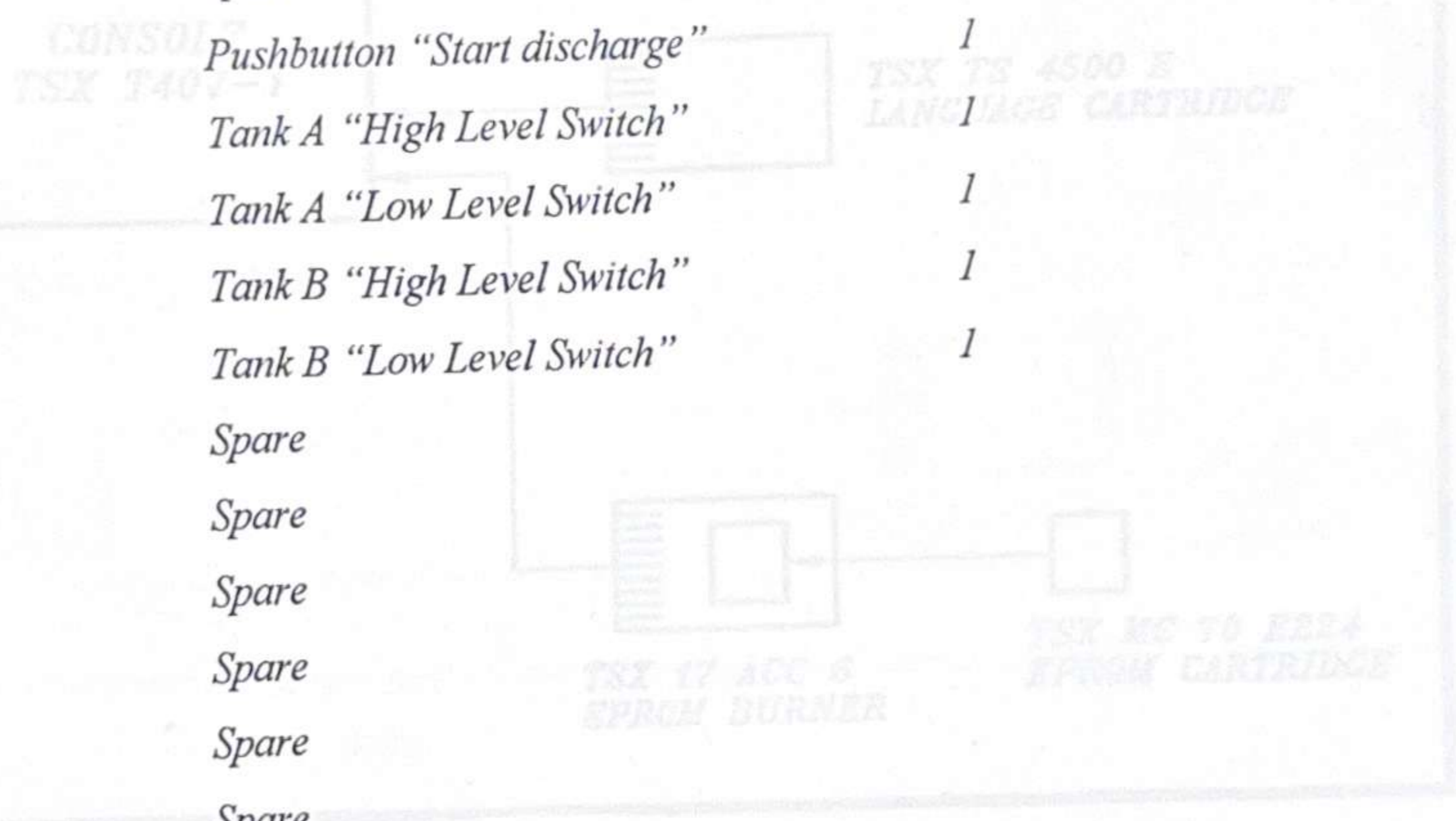
<u>NUMBER</u>	<u>ALLOCATION</u>	<u>BIT STATUS</u>
0 0,0	Aerator Tank A	1
0 0,1	Aerator Tank B	1
0 0,2	Spare	1
0 0,3	Tank A outlet solenoid valve	1
0 0,4	Tank B inlet solenoid valve	1
0 0,5	Tank B outlet solenoid valve	1
0 0,6	Spare Tank "A" dump valve	1
0 0,7	Tank "B" dump valve	1
0 0,8	Tank Chlorine dosing pump	1
0 0,9	Spare	1
0 0,10	Pusher Spare Start discharge	1
1 0,11	Tank A "High Level Switch"	1
1 0,12	Tank A "Low Level Switch"	1
1 0,13	Tank B "High Level Switch"	1
1 0,14	Tank B "Low Level Switch"	1
1 0,15	Spare	
1 0,16	Spare	
1 0,17	Spare	
1 0,18	Spare	
1 0,19	Spare	
1 0,20	Spare	
1 0,21	Night discharge reflector	

MAIN CUSTOM PROGRAM

This program is developed with the help of PLC INPUTS using the TSX 4500 E, using the TSX 0437-7 programming console.

NUMBER ALLOCATION BIT STATUS

I 0,0	Aerator duty - full	1
I 0,1	Aerator duty - 3/4	1
I 0,2	Aerator duty - 1/2	1
I 0,3	Aerator duty - 1/4	1
I 0,4	Tank A - In order	1
I 0,5	Tank B - In order	1
I 0,6	Spare	
I 0,7	Tank A - discharge selector	1
I 0,8	Tank B - discharge selector	1
I 0,9	Spare	
I 0,10	Pushbutton "Start discharge"	1
I 0,11	Tank A "High Level Switch"	1
I 0,12	Tank A "Low Level Switch"	1
I 0,13	Tank B "High Level Switch"	1
I 0,14	Tank B "Low Level Switch"	1
I 0,15	Spare	
I 0,16	Spare	
I 0,17	Spare	
I 0,18	Spare	
I 0,19	Spare	
I 0,20	Spare	
I 0,21	Night discharge selector	



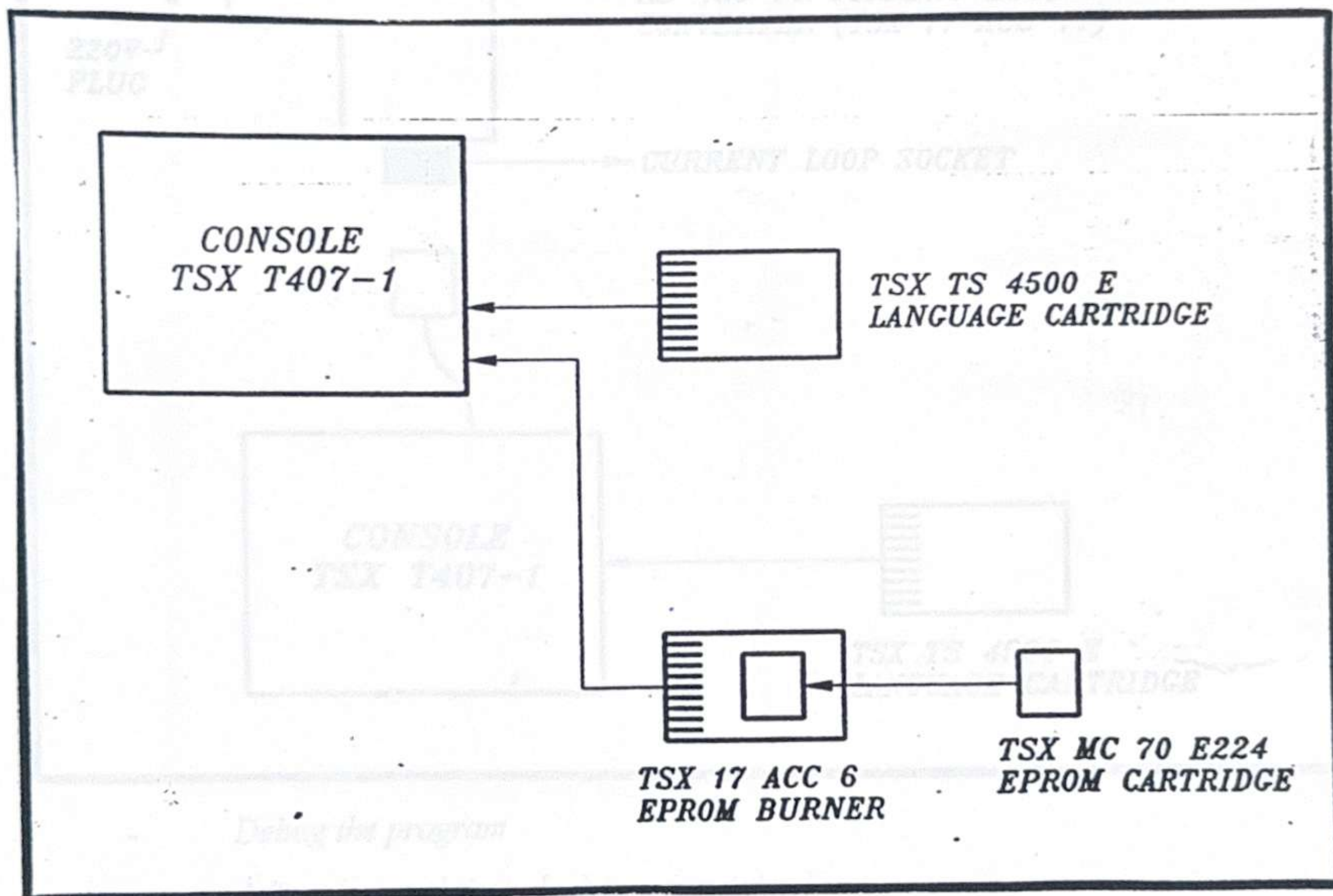
MAIN CUSTOM PROGRAM

This program is developed with the help of the Telemechanique PL 7 - 2 language version TSX TS 4500 E, using the TSX O407-1 programming console.

After trial runs and debugging the program, the latter was loaded onto a 24K Bytes Eprom cartridge (TSX MC 70 E 544), with the help of a TSX 17 Acc 6 EPROM burner.

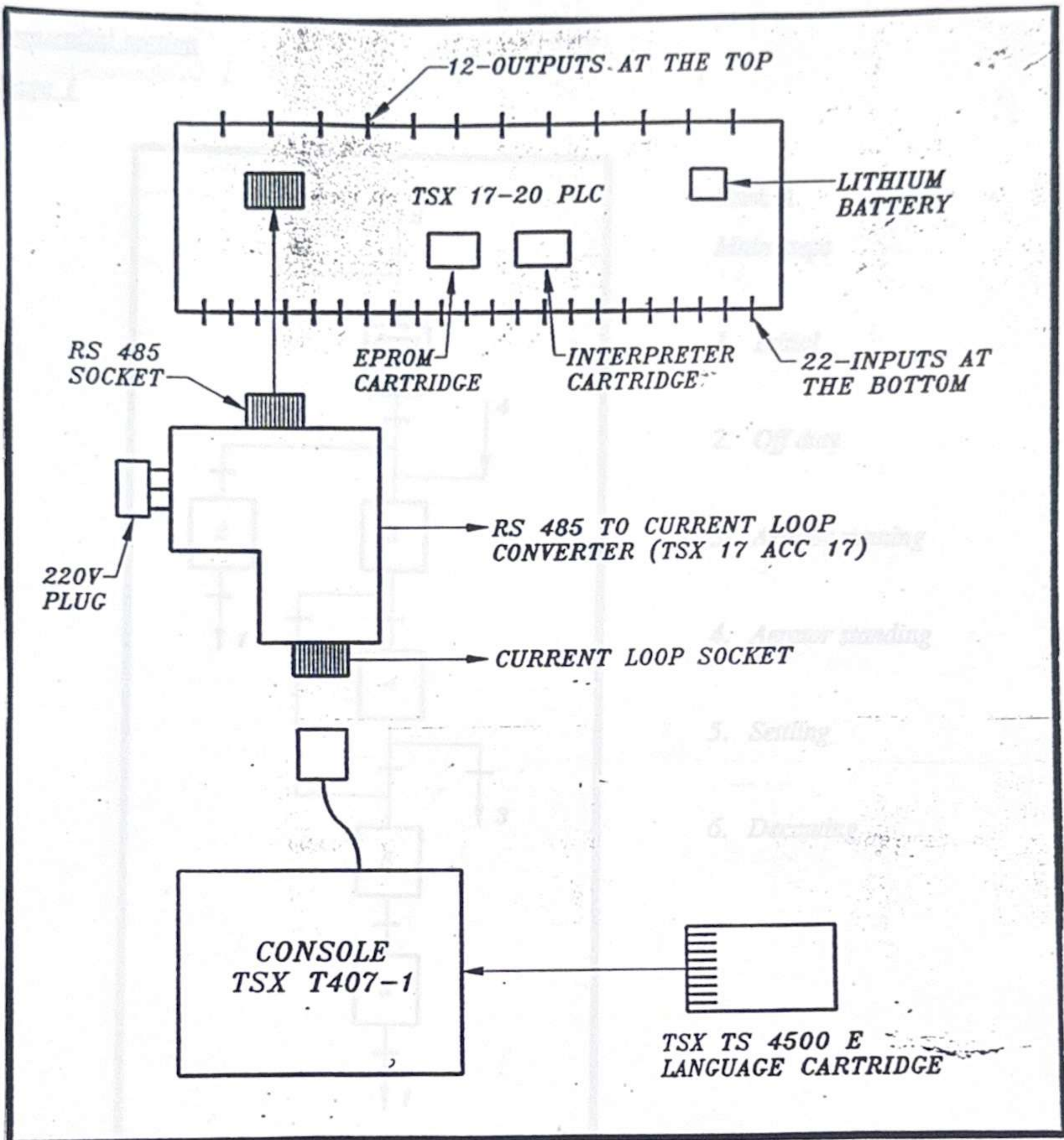
Schematic:-

1. Loading the program



The program is written using the GRAFCET language. This is Telemechanique's own sequential programming / development tool.

2) Communication with PLC



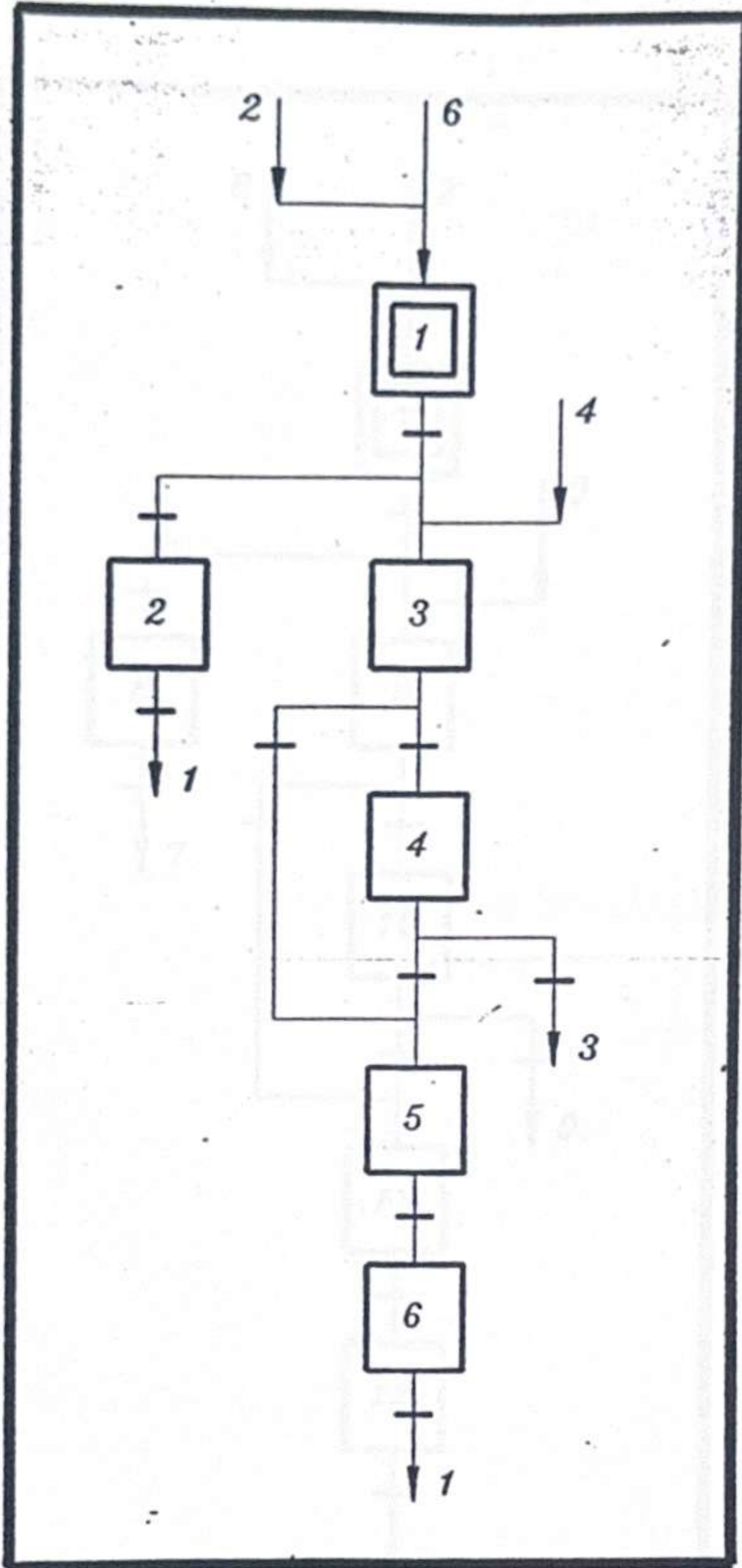
- Debug the program
- Adjust (set real time clock to current time)
- Force inputs and outputs
- Diagnostics.

The program is written using the GRAFCET language. This is Telemecanique's own sequential programming / development tool.

	TITLE	DATE	NAME	P.O. BOX 12181 CHLOORKOP 1624 SOUTH AFRICA Reg. No. 74 / 03306 / 07
		DRAWN		
		CHKD		
		APPR'D		

Sequential section

Page 1



Tank A

Main steps

1. Initial

2. Off duty

3. Aerator running

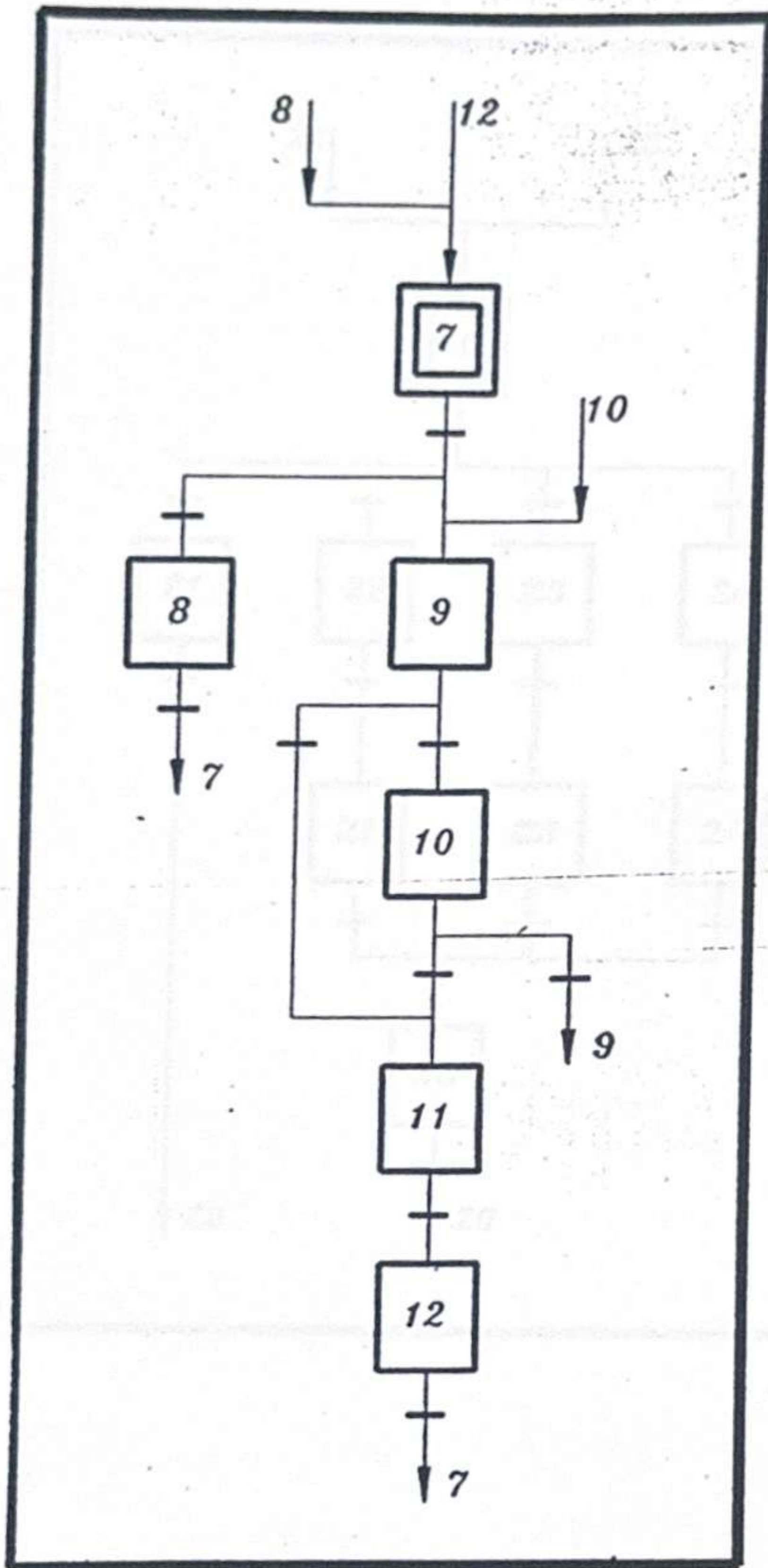
4. Aerator standing

5. Settling

6. Decanting

Sequential section

Page 2



Tank B (future)

Main steps

7. Initial

8. Off duty

9. Aerator running

10. Aerator standing

11. Settling

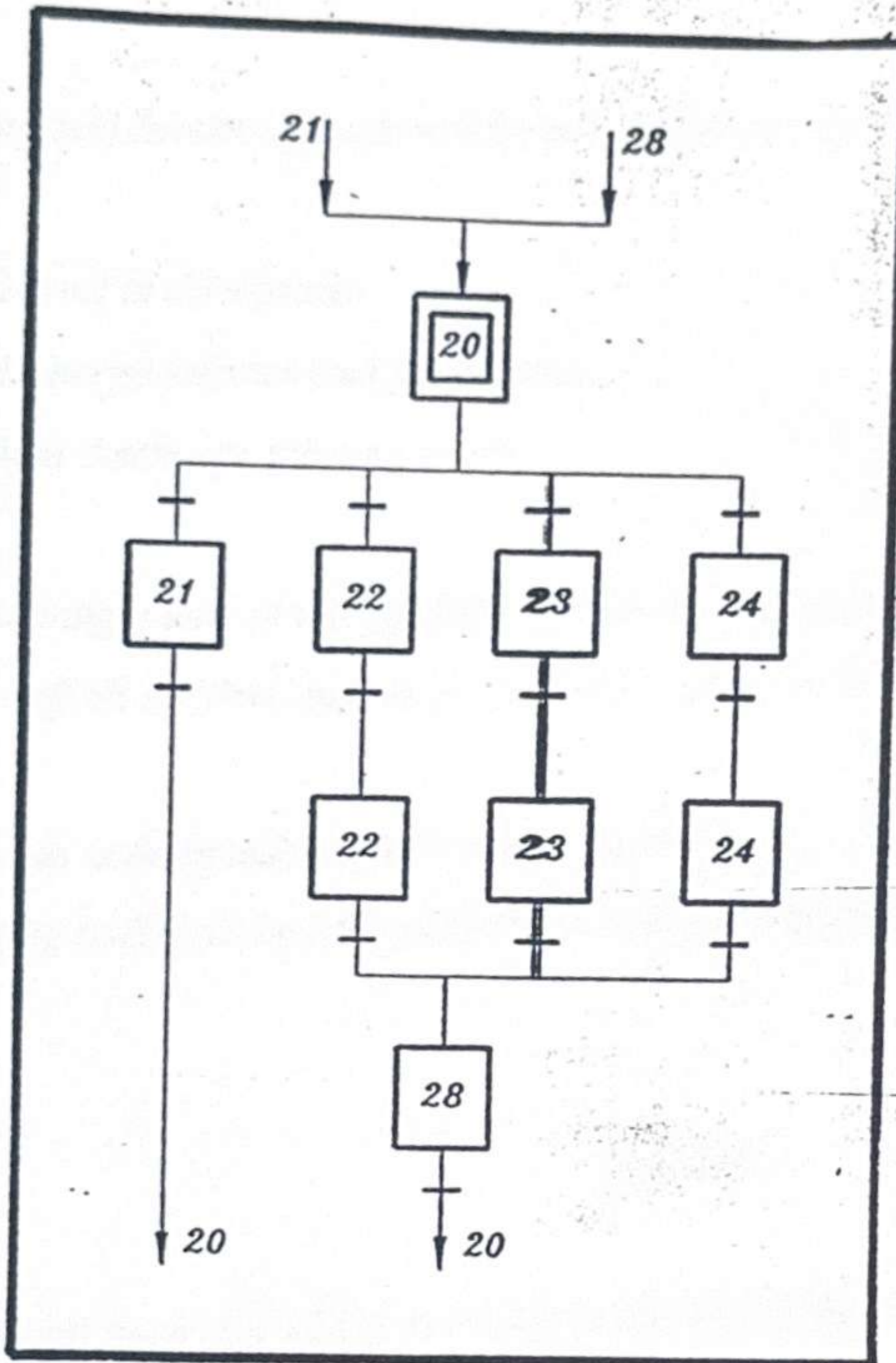
12. Decanting

Step 11, 12 and 14 are running from

Step 11, 12 and 14 are standing from

Aerator Duty

Page 3



- 20. Initial
- 21. 120 minute step
- 22. 90 minute step
- 23. 60 minute step
- 24. 30 minute step

28. Intermediate step

- 25. 30 minute step
- 26. 60 minute step
- 27. 90 minute step

Steps 21, 22, 23 and 24 are running times.

Steps 25, 26 and 27 are standing times.

AUTOMATIC

When switching to on-duty the programme will consider the reactor as being operational. The aerator running/not running status will be subjected to the pre-programmed on-off times as per duty selector position.

The settling and decanting cycle will be introduced by 3 possible conditions:-

1. Hi-level in the reactor
2. Discharge selector and push button
3. Night discharge selector switch

When switching a tank to the off-duty position, the tank goes to rest in the off-duty step. The aerator is off all the time and the in and outlet valves are kept closed.

The program is designed around 2 tanks maximum.

Non existing tanks will be considered by the program as if they are in the off-duty position.

MANUAL

In the manual mode, the PLC's is totally isolated from the plant components.

However, each the motor or valve is now individually controlled by on-off switches.

Even both tanks can be decanting at the same time.



PRENTEC REFERENCE

TITLE

	DATE	NAME
DRAWN		
CHKD		
APPR'D		

Reg. No. 74 / 03306 / 07

P.O. BOX 12181
CHLOORKOP
1624
SOUTH AFRICA

All water retaining structures are constructed in material which offers resistance to corrosion, e.g. reinforced concrete, high density polythene, etc.

CIVIL WORKS

PROCESS GUARANTEE

1. **Aeration Tank**

The aeration tanks both 6,7 meter diameter by 4 m wall height shall be constructed by assembling and linking together of reinforced precast panel slabs such that a hoop stress on ring tension is created.

The plant being operated in accordance with the operating manual.

The precast components are placed on a ring beam foundation and are linked together with an interlocking steel pin. At each joint between the panels, a column is cast in situ to form a water tight joint. The floor is then cast in sections.

Sealing of the floor joints is then carried out employing a bitumen/ mastic substance. All puddle flanges and steel attachments are cast into the slabs during slab manufacture.

PLANT GUARANTEE

2. **SLUDGE DRYING BEDS**


Three drying beds, each 4 x 4 m, shall be constructed by mounting precast concrete walls on concrete foundation and casting a sloping floor to the central run-off drain.

EXCLUSIONS AND DEVIATIONS

3. **CHLORINE CONTACT TANK**

The chlorine contact tank 3,0 diameter shall be constructed from Prentec standard two meter panels and all internal piping galvanised to SABS 763 - this being the only protective coating guaranteed in sewage treatment plants.

The aeration tank floats are fabricated in fibreglass thus again offering non corrosive surfaces.

 PRENTEC REFERENCE	TITLE	DATE	NAME	P.O. BOX 12181 CHLOORKOP 1624 SOUTH AFRICA Reg. No. 74 / 03306 / 07
		DRAWN		
		CHKD		
		APPR'D		

All water retaining structures are constructed in material which offers resistance to corrosion, e.g. reinforced concrete, high density polythene, etc., etc.

Any extra time required to complete the works, due to delays beyond our control will be subject to reimbursement of additional cost, including P & U costs.

PROCESS GUARANTEE

PRENTEC retain the right to change a make of proprietary equipment, or substituted. The quality of the effluent leaving the plant shall comply with the general standards (Government Gazette) subject to:-

Drawings A1-J-4349-SA-01.

- The plant being operated in accordance with the operating manual.
- The plant being operated within the tender design criteria.
- The raw sewage being free from all matter which may have a toxic or detrimental effect to the biological process and operating efficiency of the plant ie. normal waterborne domestic sewage, being fed into the plant.

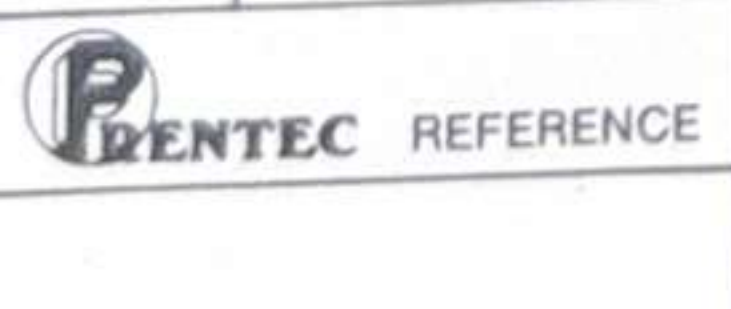
PLANT GUARANTEE

The complete plant shall be guaranteed against faulty workmanship or material for a period of 12 months from date of completion of construction, fair wear and tear excluded.

EXCLUSIONS AND DEVIATIONS

The tender scope of supply has been clearly detailed, but for ease of reference, we would list the following exclusions and deviations

1. All soil testing and reports are excluded.
2. Bulk earthworks, back filling and platform for the treatment plant.



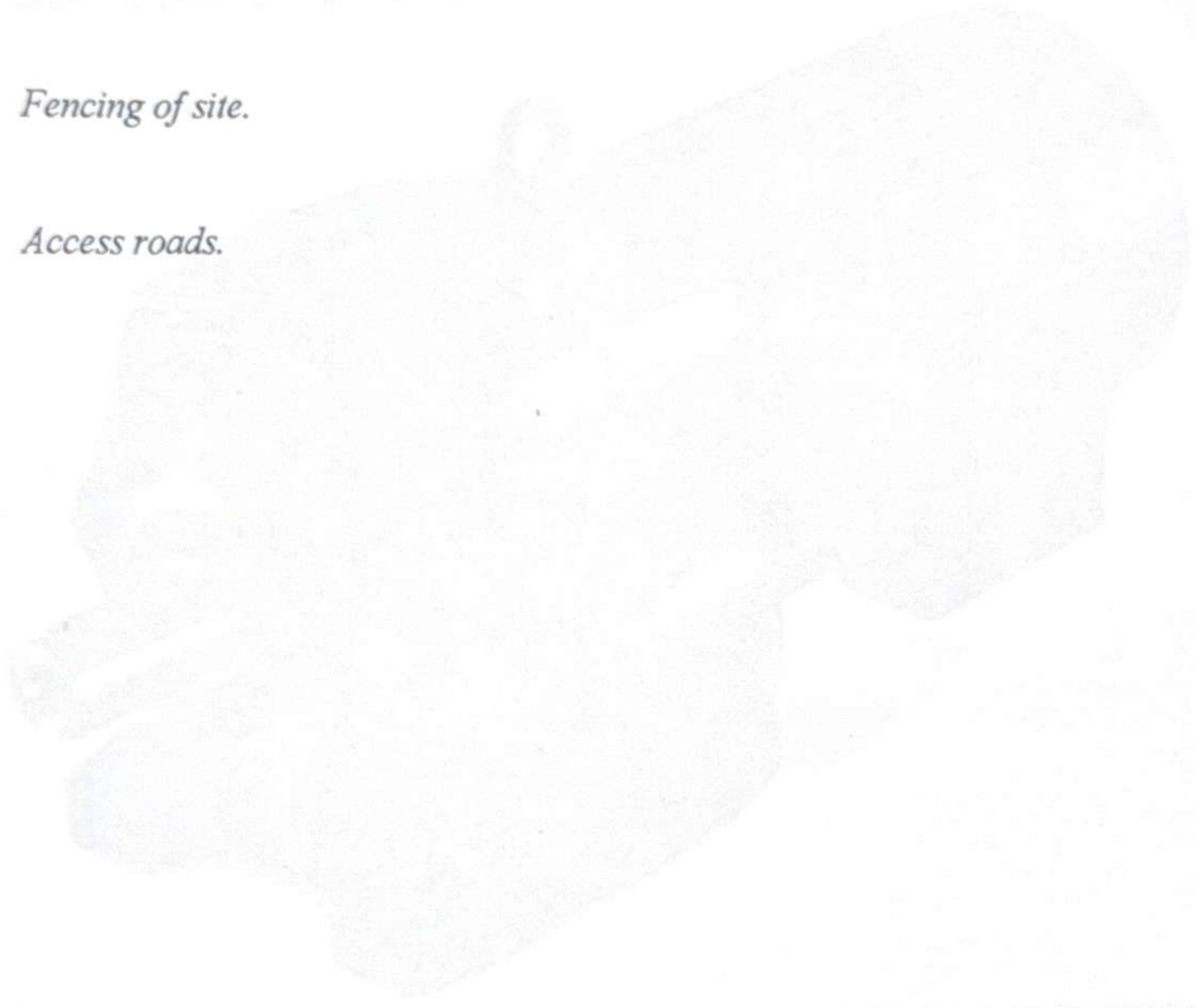
TITLE

	DATE	NAME
DRAWN		
CHKD		
APPR'D		

Reg. No. 74 / 03306 / 07
 P.O. BOX 12181
 CHLOORKOP
 1624
 SOUTH AFRICA

BROOK HANSEN 53

3. Any laboratory equipment required by the client is excluded.
4. Any extra time required to complete the works due to delays beyond our control will be subject to reimbursement of additional cost, including P & G costs.
5. PRENTEC retain the right to change a make of propriety equipment, or nominated subcontractor.
6. The battery limits of the offered plant is as indicated on General Arrangement Drawings A1-J-0549-SA-01.
7. Fencing of site.
8. Access roads.



 PRENTEC REFERENCE

TITLE

	DATE	NAME
DRAWN		
CHKD		
APPR'D		

Reg. No. 74 / 03306 / 07

P.O. BOX 12181
CHLOORKOP
1624
SOUTH AFRICA

REVISION

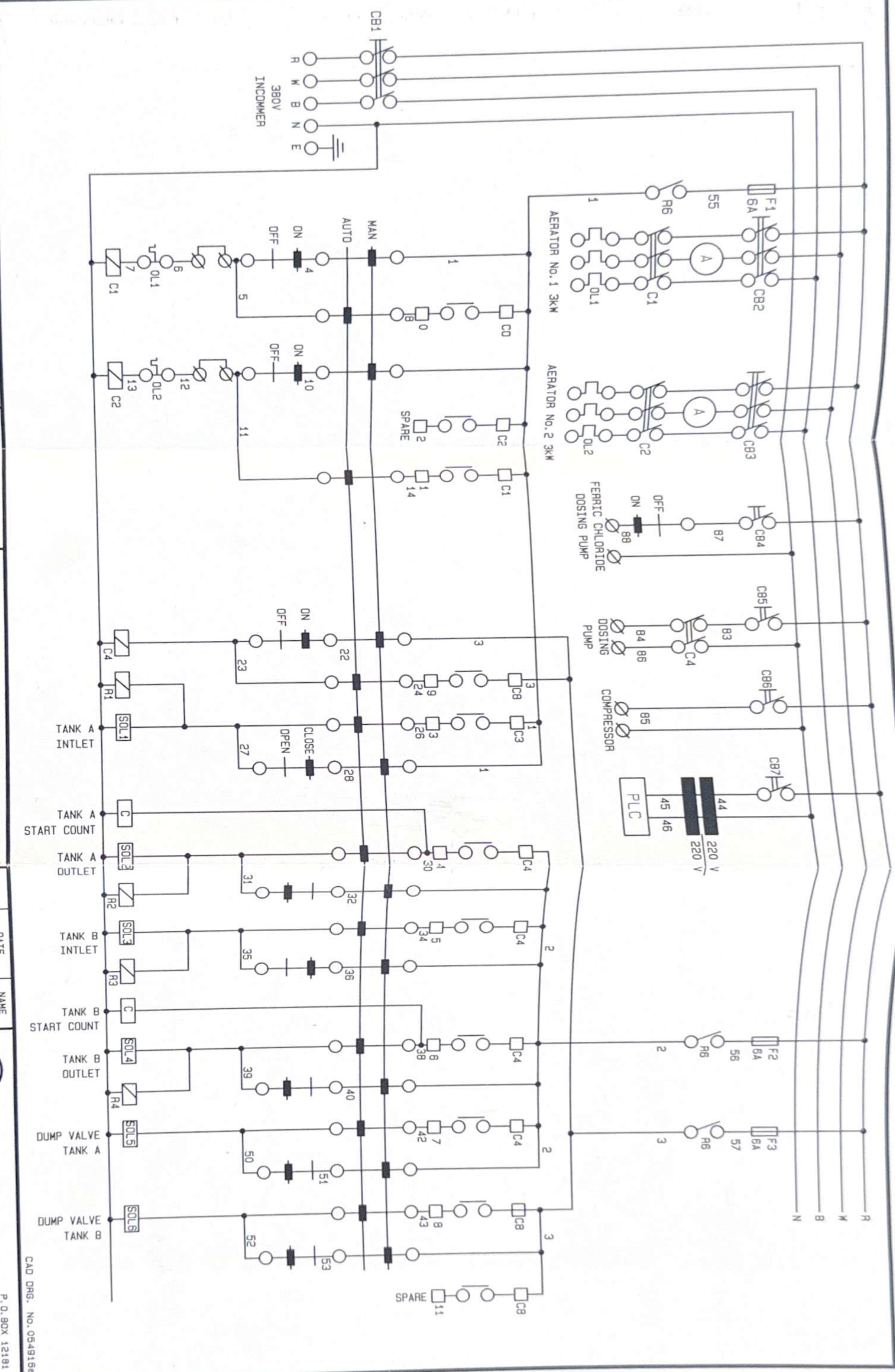
CLIENT	CLEARWATER KNYNSNA
ENGINEER/ORDER NO.	
CLIENT	
PRENTEC	0549/SA
SCALE	N/A

TITLE
**ELECTRICAL WIRING
 DIAGRAM FOR SEWAGE
 TREATMENT PLANT**

DRAWN	10-10-1998	NAME	T.J.
CHECKED			
APPROVED			

DRAWING No. **A3-J-0549-SA-16**

PRENTEC (PTY) LTD
 SHEET 1 OF 2
 P.O. BOX 12181
 CHLOROKOP
 1624
 PROJECTION
 REV. 0



CAD DRG. NO. 054916A

