Eilbek 059

IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM (IC

CORROSION
CORROSION & ANTI-CORROSION

CORROSION & WATER-CONTROL

INSTALLATION & OPERATION

MANUAL

IMPRESSED CURRENT
ANTI-FOULING

ICCP

Corrosion & Water-Control b.v.
The Netherlands
Tel. (+31) 79 - 5931295
Fax (+31) 79 – 5931871
Email: info@corrosion.nl

Dönneweg GmbH & Co
Germany
Tel. (+49) 49163583
Fax (+49) 49166491
Email: h.brands@doenneweg.com

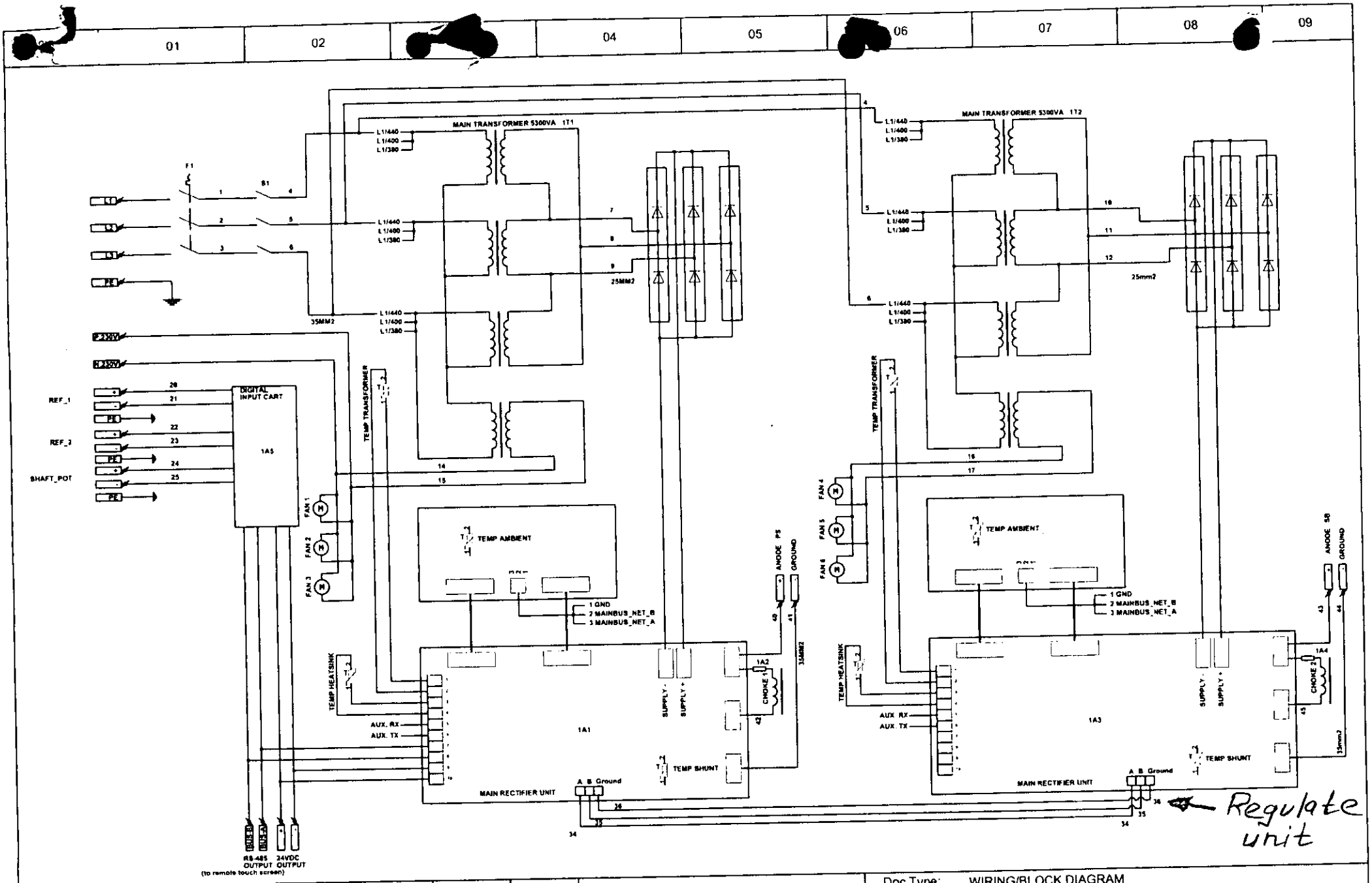
Shipyard	*: Meyer Werft Papenburg*
Owner	*: --*
YN	*: NB671*
Date	*: July 7th 2004*
Project number	*: CWC 1296*
Version	*: 001*

21 APPENDIX D PARTLIST

PS2A-400V/300/24/ DI

Make	Type	Description	Number
Rittal	AE1213	CABINET 1000*1200*300	1
Hager	Inst. Auto fuse	MC640E	1
Rittal	Ventilator	AE	2
Silema	24V/300A, consist of:	Main Rectifier	2
	-regulate unit -Choke + ampère measuring -transformer (400V)		2 2 2
Alflex	ME	Dig. Input Cart	1
Alflex	DPI **	Microprocessor/Touch display	1
Phoenix	EIAL-NS35		2
Phoenix	UKH150	terminals	4
Phoenix	UK5N	terminals	10
Phoenix	USLKG5	earth terminals	5
Phoenix	Clipfix35	Gauge clamp	2
Phoenix	U5LKG16	earth terminals	1
KN	KG41B T103/NLB522E	Mainswitch	1
TM	ZB4BV5	Signal lamp 400V	1

** Touchscreen display is located in ECR



Customer Meyer Werft	inst. no.: 380-440/300/DI	Drawn	W.L.	25-03-03	CORROSION PROTECTION SYSTEMS CORROSION & WATER CONTROL bv	Doc Type:	WIRING/BLOCK DIAGRAM
		Revised	A.T.P.	21-04-03		Product:	ICCP
Latest revision description: Terminal ID	rev: 02	Checked	A.T.P.	27-06-03		Part:	CONTROL UNIT 300 A.
		Yard.no.:	671/672/673/674				
Project: 1269		Scale:		Size: A4		Doc no.: St.380-440.300.DI	Sheet: 02

1 INTRODUCTION.

1.1 REMARKS.

- Read this instruction manual before proceeding.

Please note that on request Corrosion & Water-Control bv, or one of its official world wide agents, can inspect the installed ICCP installation prior to first use. Please check with Corrosion & Water-Control bv for more information regarding this commissioning.

1.2 GUARANTEE AND LIABILITY.

The "General conditions" of Corrosion & Water-Control bv are applicable. Also refer to the confirmation of the order for possible additions.

Not covered by the guarantee is improper functioning as a result of:
- Incorrect installation.
- Not following the instructions in this manual.
- Replacement with non-original parts.

1.3 ENVIRONMENT.

- The environmental laws and rules of the area where the ICCP system is installed, always have to be respected.
- The rules of the classification societies – if applicable – have to be respected.
- Always be alert to the possibility of dangerous voltages.

1.4 SAFETY.

Pay attention: touching some parts may result in hazardous voltages.

The secondary voltage to the anodes (0-24 VDC) and current (0 – 1000A) used in this ICCP system is at such a level, that it can be hazardous to humans:
installation and maintenance must only be done with the main power disconnected and by knowledgeable and authorised personnel only.

The primary voltage in the power supply can be hazardous to humans:
installation and maintenance must only be done with the main power disconnected and by knowledgeable and authorised personnel only.

2 PRINCIPLE OF CATHODIC PROTECTION.

Depending on the type of environment, metallic corrosion is normally an electrochemical reaction in which a metal combines with a non-metal like oxygen. A metal oxide is formed.

Every metal, when submerged in an electrolyte like sea water, will build up a natural potential difference, by sending positive ions into the solution, leaving negative loaded electrons behind. Now the metal is negative and the surrounding sea water is positive loaded. This potential difference can be measured in mV. All metals has an unique potential difference. The more negative this value, the more tendency this metal has to corrode. These potentials can be tabulated and form the Electro-chemical series, showing magnesium as one of the most negative (active) metal.

The following example is an practical approach of the ***galvanic series.***

If two metals are submerged in an electrolyte like sea water or damp soil and are in direct electrical contact, a current will pass through the electrolyte from the more active metal to the least active metal. The least active metal does not corrode and is termed the ***cathode***. The more active metal, the ***anode***, dissolve and the flow of electrical current increases. This is a metal ion and electron transfer process - it ***corrodes***.
Corrosion only can occur at an anode and never at a cathode. At the cathode only reduction is taken place.

A typical simple cell as described is shown in Figure AA below:

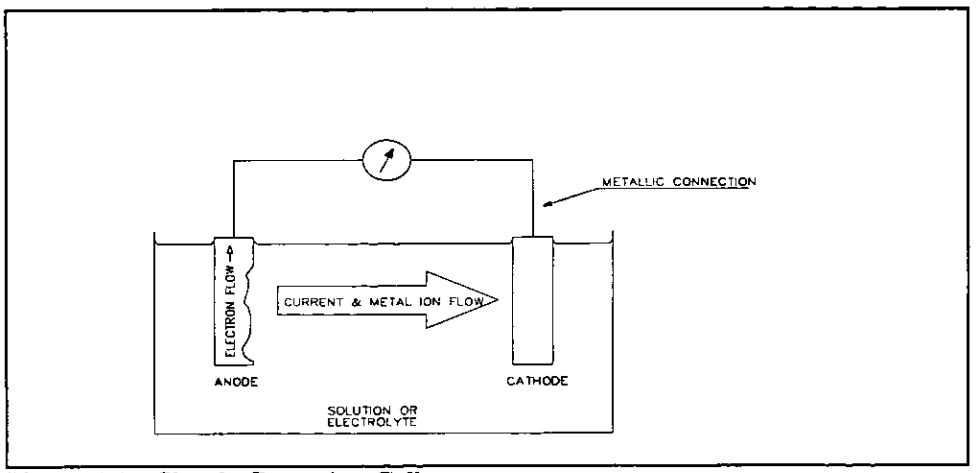


Figure AA - Simple Corrosion Cell

The anodic and cathodic areas in a corrosion cell may be due to electrical contact of two dissimilar metals, termed ***galvanic corrosion.*** Large currents can occur at small anodic areas and lead to rapid corrosion. This can effect marine structures such as ships internal tanks and external hull plates, sheet steel piling in harbours and tubular structures common in jetties and drilling or production platforms.

Cathodic Protection is a system of preventing corrosion by forcing all surfaces of a structure to be cathodic, by providing it with extra electron generated by external anodes.

The galvanic corrosion current available from an anode to electrolyte, structure combination should be sufficient to overcome the local surface corrosion currents on the structure until no current flows from anodic areas of the structure. Hence the structure is ***entirely cathodic*** or under ***cathodic protection***.

The potential or measure of activity, between a structure and an electrolyte when measured, gives an indication of whether the structure is anodic or cathodic. For steel under normal non-anaerobic conditions it can be shown that steel to electrolyte potential more negative than 0.85 volts measured against a copper/copper sulphate electrode indicates that complete cathodic protection is achieved. This is equivalent to negative 0.80 volts measured against a silver/silver chloride electrode and positive 0.24 volts against a zinc electrode.

These values are further explained by Figure BB below:

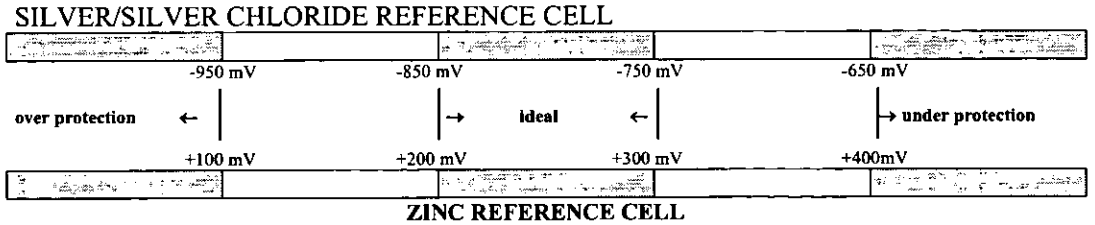


Figure BB - Comparison of Reference Electrodes

3 PRINCIPLE OF IMPRESSED CURRENT CATHODIC PROTECTION.

As previously explained a metal can be made cathodic by electrically connecting it to a more anodic material within the electrolyte. The most commonly used anodic metals are alloys of aluminium, zinc and magnesium. Anodes of these metals corrode preferentially to the structure to which they are connected. The anodes deteriorate as an essential part of their function and are therefore termed as being ***sacrificial anodes***.

Another method of making a metal cathodic is by electrically connecting it to another metallic component. This in the same electrolyte through a source of direct current, directing the current flow to occur of the surface of the added metallic component, ***the anode***, into the electrolyte and into the metal, ***the cathode***.

This can easily be visualised by the extended simple cell as shown by Figure CC below:

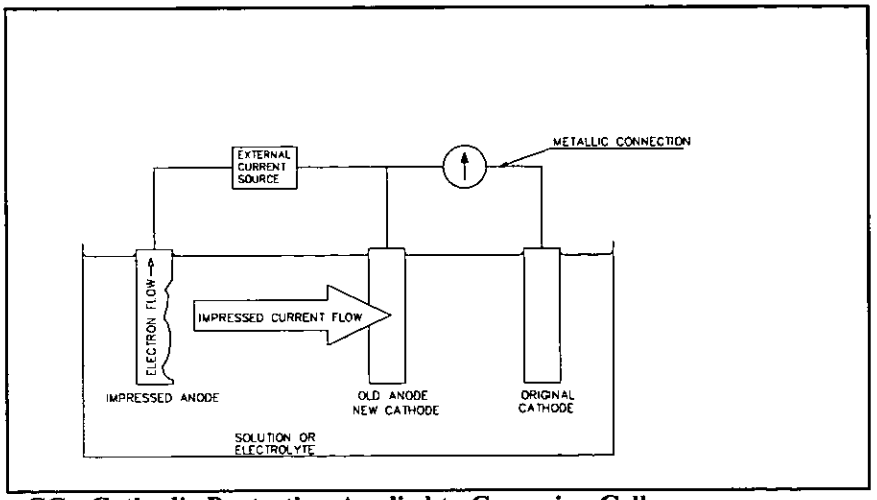


Figure CC - Cathodic Protection Applied to Corrosion Cell

As an internal current source is employed, this type of protection is termed *IMPRESSED CURRENT CATHODIC PROTECTION* or *ICCP.*
This type of system requires a direct source of current usually obtained from the mains power due to a transformer rectifier.

The impressed current anode material is ideally non-consumed by the passage of current from it into the electrolyte. In practice the materials used are a compromise between this ideal and the cost of available materials. Impressed current anodes are traditionally made from graphite, silicon iron, lead alloys, mixed metal oxide coated or
platinised titanium and platinised niobium. The selection of the correct anode material is critical in the formulation of an effective and economic cathodic protection scheme.

4 COMPONENTS OF THE ICCP SYSTEM.

The Corrosion & Water-Control (CWC) ***ICCP*** System comprises equipment as described below.
A diagram for a typical impressed current system layout is shown at Appendix B PRINCIPLE CONNECTION DIAGRAM..

4.1 IMPRESSED CURRENT ANODES:

The function of the anode is to conduct DC protective current in seawater. **ICCP** anodes have been designed to perform this function whilst maintaining a low electrical resistance contact with the seawater. Surface linear type anodes are available with 50 to 200 Ampere ratings while recessed type anodes are available with up to 200-Ampere ratings.

All ***ICCP*** anodes are constructed from specialist coated titanium anode elements encapsulated in a tough, flexible, chlorine resistant plastic resin-insulating carrier. They are designed to run from 12 or 24 volt systems and are less than half the size and a quarter of the weight of conventional lead silver anodes. Typical lifetimes for these anodes are in excess of 15 years. Appendix G TECHNICAL DRAWINGS RECESSED ANODE.

4.2 IMPRESSED CURRENT REFERENCE ELECTRODES:

The high purity ***ICCP*** Zinc reference electrodes are designed to give stable reference potentials, zinc against the hull. The construction of the cells is similar to the anodes. A typical reference cell should be able to last up to 15 years without maintenance or replacement. The reference cell gives a mV signal to the DPU. Appendix H TECHNICAL DRAWINGS RECESSED REFERENCE ELECTRODE.

The minimum number of reference cells used per power supply is one although usually two are used.

4.3 IMPRESSED CURRENT DIGITAL PROCESSING UNIT:

This ICCP Digital Processing Unit (DPU) is build for reliability and offers, due to the use of the latest technologies, a lot of benefits for both the user and the shipyard. The DPU is designed for controlling, monitoring and processing Impressed Current Anti-Fouling (ICAF) systems as well as Impressed Current Cathodic Protection (ICCP) systems.

An ICCP DPU consists of:

- A coated steel cabinet with a door mounted Microprocessor Print.
- A Touch Screen Display for operation the system.
- A Galvanic Isolated Rectifier. Primary input 380-440V/50-60Hz, secondary 24VDC output up to 700 amp.
- Two exchange contacts (NO/NC) for external alarm functions.
- 8 galvanic isolated digital inputs 4-30V
- Two propeller shaft potential read-outs, with alarm functions.
- A front mounted main switch.
- Terminals for all necessary connections.

On the inside of the cabinet a galvanic isolated current supply and necessary ME-prints are installed. These are all controlled and monitored by a processor print.

The fully automatic DPU has a touch display operation for showing hull potentials PS and SB, output voltage, current to the anodes, and diverse alarm functions. Also the DPU contains a data-logger were all potentials, output voltage and current will be saved. It is also possible to connect an external modem so Corrosion & Water-Control b.v. can check the system on long distance. Appendix E TECHNICAL DATA CASING POWER UNIT.
For a complete description of this DPU, see chapter THE TOUCH SCREEN DISPLAY.

4.4 IMPRESSED CURRENT PROPELLER AND RUDDER GROUNDING:

To enable the rudder to receive impressed current protection a dedicated electrical bond in the form of flexible cable is provided. The cable is typically fixed from the rudderstock to the main ship structure. In the same way, any stabilisers may be bonded also.

To allow protection of the bare propeller and exposed shafting and to prevent spark erosion in the shaft bearings, the propeller shaft is fitted with a shaft grounding system

The ICCP shaft grounding system comprises a high content silver alloy band, fixed in place with stainless steel clips and a set of high content silver graphite brushes with a holder. The brushes complete a low resistant path from the ring assembled on the shaft to earth, allowing current flow from the propeller. Appendix I SHAFT GROUNDING MANUAL.

5 INSTALLATION OF THE ICCP SYSTEM.

01 The ***ICCP*** system comprises anodes and electrodes for installation through the ships hull using penetration and cofferdam arrangements, a power unit for location internally and bonding equipment for the propeller and rudder. Ensure all equipment is identified from the drawings and part list showing in appendices of this manual before starting any installation work.

02 The locations for all components are usually described in the specific drawings made for this vessel.

03 It is very important that the installation instructions are followed and fully understood. Incorrect installation is the biggest cause of failures found in the running of impressed current systems. Should any problem occur during installation or any instruction appear unclear do not hesitate to contact:
Corrosion & Water-Control b.v.

Tel: +31 (0) 79 5931295
Email: info@cwcontrol.com

5.1 RECESSED MMO-ANODE.

The anodes should be installed in the positions indicated by CWC in consultant with the shipyard. If, for some reason it is found impractical to fit any component in the specified positions the **CWC** representative will advise on the necessary re-location.

6 DESCRIPTION

The ICCP System consists of anodes and electrodes for installation through the hull using penetration/cofferdam arrangements, a power unit for location internally and bonding/grounding arrangements for appendages such as

propeller and rudder. The system uses identical cofferdams for both surface mount linear and recessed anodes. The cofferdams for the reference electrodes are longer as for the anodes, so that there is a necessity to differentiate between cofferdams before starting assembly.
Locations for components are shown on the **CWC** drawings supplied for the particular vessel, but are normally subject to final confirmation between the **CWC** engineer and the yard/owner.

Recessed anode – fitting instructions see drawing in appendix G.

- Cut a hole in the hull at each anode location with a diameter corresponding with the diameter of the anode bottom plate.

- Grind off any surplus metal to ensure a smooth surface around the hole inside and out, so that the anode housing body will locate centrally inside the hole in the shell plating at the inboard side of the hole. Profile the inner and outer edges for welding.

- Locate the anode housing centrally in the hole, from the inside of the hull in such position that the exit cable gland is orientated to suit the installation.

- Secure the anode housing in the position by a continuous fillet weld internally and externally to give a weld section at least equal to the plating thickness.

- Clean off all weld splatter from all surfaces, including the anode and cofferdam recess, and grind flat the external weld area. Before proceeding further, ensure that ALL other welding work, either inboard or outboard, has been completed for the entire area to be covered by a dielectric shield (e.g. Hempadur Multistrenght 35530). Any welding carried out after application of the dielectric shield will damage the shield material even if the welding is not associated with the cathodic protection.

- Apply thread tape or sealing compound to one anode cable gland, making sure that this is fitted with a neoprene "O"ring. Fit the gland to the inside of the anode mounting plate within the cofferdam recess and fully tighten the main body of the gland, but fully slacken the compression ring.

- Abrasive blast clean the entire shield area to near white metal according the technical data sheet of the used dielectric shield material (e.g. Hempadur Multistrenght 35530).

- Remove residual dust with a dry clean brush. Remove the plug from the hull boss hole.

- Form the shield by applying the well mixed material in a radius of 2000 mm according the technical data sheet. Apply the shield before 4 hours have elapsed from the time of blasting or before a visible rust bloom has developed.

- Apply filler "Puraflex" lute (VIBA 6001) coating of spare mastic to the back of the anode. Keep the anode mounting holes clean.

- Install the anode whilst the lute is still soft. Remove all the protection from the mounting plate studs.

- Pass the anode connection pin through the hole in the hull, and fit the anode in position using the 8 head cap screws. Ensure the connection pin is not damaged.

- Fit the washers and head cap screws provided and tighten the anode fixings evenly until the lute on the mounting plate is squeezed out and the anode becomes flush or just recessed in the hull plate. Ensure the anode is fixed securely.

- Smooth finish the squeezed lute into the anode edge and fill the stud holes in the anode with Puraflex lute until level with the anode top to give a smooth uniform surface. Ensure the double recess and the edge are completely filled and that all bare steel is covered over.

- Inside the vessel apply LOCTITE BEARING 243 (or Versachem 245) to one anode gland and fit into the hull boss over the connection pin. Fit the second gland to the outside of the exit pipe over the cable and connect the cable to the anode connection pin. Leave some slack cable between inner and outer glands.

- The anode cable may now be connected direct to the Transformer Power Unit or into a suitable junction box provided by the Yard or Owner.

- Make a final check of all connections and finally fit the blind flange and gasket seal to the cofferdam.

- Note 1: All welds should meet vessels classification society rules.

- Note 2: Ensure the anode surface is not painted when covering the di-electric shield area.

- Note 3: For systems fitted in submerged tanks, all external cables running in these tanks should be housed in heavy wall

conduit pipe.

6.1 RECESSED ZINC REFERENCE ELECTRODE.

The electrodes should be installed in the positions indicated by CWC in consultant with the shipyard. If, for some reason it is found impractical to fit any component in the specified positions the **CWC** representative will advise on the necessary re-location.

Recessed electrode – fitting instructions see drawing in appendix H.

- Cut a 133mm diameter hole in the hull at each reference cell location.
- Grind off any surplus metal to ensure a smooth surface around the hole inside and out, so that the reference cell housing body will locate centrally inside the hole in the shell plating at the inboard side of the hole. Profile the inner and outer edges for welding.
- Locate the reference cell housing centrally in the hole, from the inside of the hull in such position that the exit cable gland is orientated to suit the installation.
- Secure the reference cell housing in the position by a continuous fillet weld internally and externally to give a weld section at least equal to the plating thickness.
- Clean off all weld splatter from all surfaces, including the reference cell and cofferdam recess, and grind flat the external weld area.
- Apply thread tape or sealing compound to one reference cell cable gland, making sure that this is fitted with a neoprene "O"ring. Fit the gland to the inside of the reference cell mounting plate within the cofferdam recess and fully tighten the main body of the gland, but fully slacken the compression ring.
- Abrasive blast clean the recessed area to near white metal to SSPC-SP10 or SA2.5 Swedish standard SIS 05 5900. The steel profile should not be more than 75 microns.
- Apply filler "Puraflex" lute (VIBA 6001) to the back of the reference cell. Keep the reference cell mounting holes clean.
- Install the reference cell whilst the lute is still soft. Remove all

the protection from the mounting plate studs.

- Pass the reference cell connection pin through the hole in the hull, and fit the reference cell in position using the 4 head cap screws. Ensure the connection pin is not damaged.

- Fit the washers and head cap screws provided and tighten the reference cell fixings evenly until the lute on the mounting plate is squeezed out and the reference cell becomes flush or just recessed in the hull plate. Ensure the reference cell is fixed securely.

- Smooth finish the squeezed lute into the reference cell edge and fill the stud holes in the anode with Puraflex lute until level with the reference cell top to give a smooth uniform surface. Ensure the doubler recess and the edge are completely filled and that all bare steel is covered over.

- Inside the vessel apply thread tape to one reference cell gland and fit into the hull boss over the connection pin. Fit the second gland to the outside of the exit pipe over the cable and connect the cable to the reference cell connection pin. Leave some slack cable between inner and outer glands.

- The reference cell cable may now be connected direct to the Transformer Power Unit or into a suitable junction box provided by the Yard or Owner.

- Make a final check of all connections and finally fit the blind flange and gasket seal to the cofferdam.

- Note 1: All welds should meet vessels classification society rules.

- Note 2: Ensure the reference cell surface is not painted when covering the hull area.

- Note 3: For systems fitted in submerged tanks, all external cables running in these tanks should be housed in heavy wall conduit pipe.

6.2 RUDDER STOCK CABLE.

The rudder stock cable provides an earth return for current flow from the hull so protecting the rudder from corrosion. Drawing in appendix I shows the rudder cable arrangement.

Weld or bolt one end of the cable to the rudder stock and the other end to the ships structure.

6.3 SHAFT GROUDING SYSTEM.

A special manual for the installation of this system is enclosed in Appendix I SHAFT GROUNDING MANUAL..

6.4 DIGITAL PROCESSING UNIT.

Always read these instructions in conjunction with the items drawings in the appendices section of this manual. The power unit drawings are shown in Appendix F TECHNICAL DRAWINGS POWER UNIT.

The power units are designed for wall mounting for units up to 700 AMPS, or to be free standing for units bigger than 700 AMPS, with bolting available through the bottom plinth and back section via the mounting holes provided. To ensure adequate ventilation it is recommended that an air gap be maintained all around the unit.

The power unit must be mounted in the engine room near the anodes to ensure a minimal voltage drop.

The following cables must be provided and installed:

01	1 cable for the power supply of the power unit.	(5 x 2,5 mm^2)
02	1 cable from the anode to the power unit for each anode.	(see figure DD)
03	1 cable from the ref. electrode to the power unit.	(2x1,5mm^2 shielded)
04	1 cable from the shaftgrounding to the power unit.	(2x1,5mm^2 shielded)
05	1 earth cable.	(see figure DD)

50A	75A	100A	150A	200A	Cable thickness
45M					16mm²
70M	47M				25mm²
98M	67M	49M			35mm²
125M	83M	61M	41M		50mm²
178M	120M	88M	60M	45M	70mm²
250M	165M	125M	83M	61M	95mm²

Provide and install all cables according Appendix B PRINCIPLE CONNECTION DIAGRAM., other specifications you will find in Appendix C ELECTRICAL CONNECTION DIAGRAM..

-Note 1: The cable shielding of the reference electrodes should be mounted with 1 side to earth.

-Note 2: The earth cable of the anodes should be able to conduct the maximum current of the system.

-Note 3: If the system alarm outputs are connected with the central alarm system of the vessel the maximum capacity should be less than 230V/2 Amp.

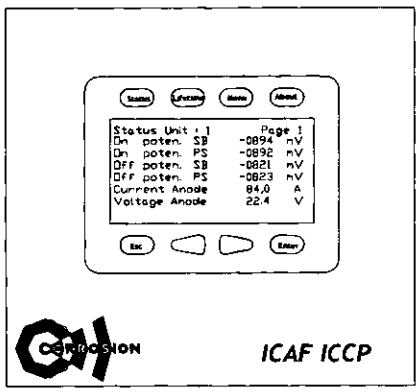
ONCE THE SYSTEM IS COMPLETELY INSTALLED, PLEASE READ:SYSTEM COMMISSIONING LIST.

7 THE TOUCH SCREEN DISPLAY.

The design of this display assures simple, fast and clear operation and is therefore equipped with a few standard "SMART" control buttons.
Four "SMART" buttons are located on the topside of the touch screen: STATUS, LIFETIME, MENU and ABOUT, used as shortcuts for fast accessing to different menu options. On the lower side of the touch screen the following buttons are located, ESC, BACKWARD/FORWARD and ENTER.

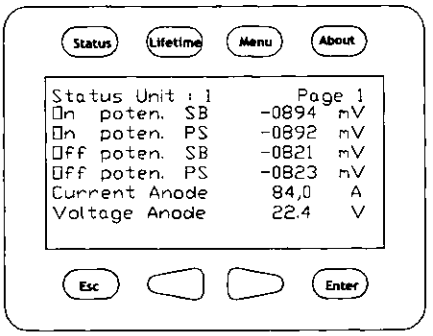
The operation of this ICAF unit is divided in three different USER levels:

- Level 1 : read-out only, no system adjustments can be made. access for everyone.
- Level 2 : system adjustments are possible, to access this level a password is needed (see chapter HOW TO ACCESS DIFFERENT USER LEVELS.).
- Level 3 : only for engineers of Corrosion & Water-Control bv. To access this level another password is required.



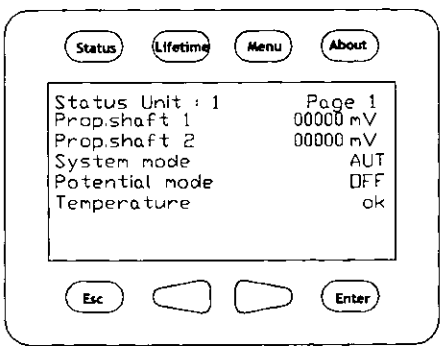
8 STATUS DISPLAYED.

When pressing the STATUS button, the following information will be displayed.



- On potential SB/PS:
  This is the actual potential level of the vessel, measured when the ICCP anodes are active and are disturbing the reference electrodes.
- Off potential SB/PS:
  This is the actual potential level of the vessel, measured when the ICCP anodes are inactive, so called " Off Potential Controlled".
- Current anode:
  This value shows the actual total current (Ampere) which is running via the anodes.
- Voltage anode:
  This value shows the actual running voltage.

When pressing the forward button, the following additional information will be displayed:



- Propeller shaft 1/2:
  This value shows the potential difference of the propeller/shaft and indicates if the necessary grounding is function well. Value may not be higher as 50mV, otherwise an alarm will be generated.

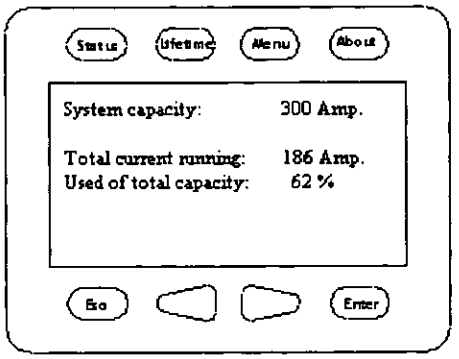
- System mode:
  This indicate if the system is running in automatic function (aut) or manual (man).

- Potential mode:
  Indicates how the system is measuring the potential. OFF- or ON potential controlled.

- Temperature:
  Indicates the temperature inside the cabinet.

9 LIFETIME DISPLAYED.

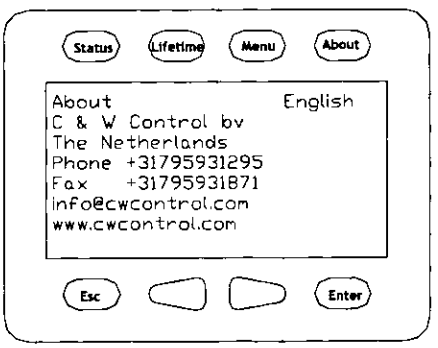
When pressing the LIFETIME button, the following information will be displayed:



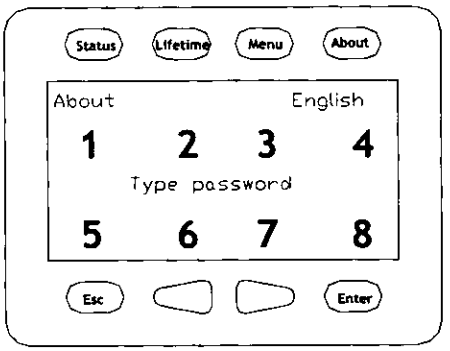
Besides the total system capacity and the actual current with is running, this screen displays an indication of the used total capacity. This value will reach 100% in time and gives an indication of your coating condition. Before it will reach 100% the vessel should be dry docked and the coating should be repaired.

10 HOW TO ACCESS DIFFERENT USER LEVELS WITH THE PASSWORD.

If system adjustments must be made, a password is required to access the specific menu.
First the ABOUT button should be pressed. The following screen will appear.



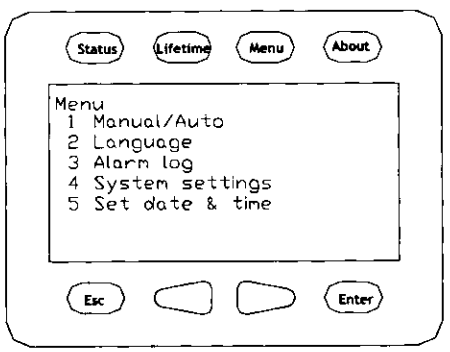
Next the ENTER button must be pressed. The following screen will appear.



In this screen the required password can be entered by pressing the specific numbers on the screen.
The password to access user level 2 is **5274.**
Please be aware of the changes which can be made in the main system settings when entering user level 2!
The password to access user level 3 is not mentioned in this manual and can only be supplied by Corrosion & Water-Control bv.

Only when the correct password is entered, the followng menu will appear:

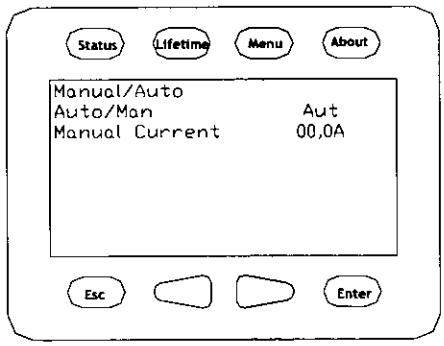
11 USING THE MENU FOR MAKING SYSTEM ADJUSTEMENTS.



With this menu revisions of the basic settings can be made, by pressing the required sub division.

1 Manual/Auto
2 Language
3 Alarm log
4 System settings
5 Set date and time

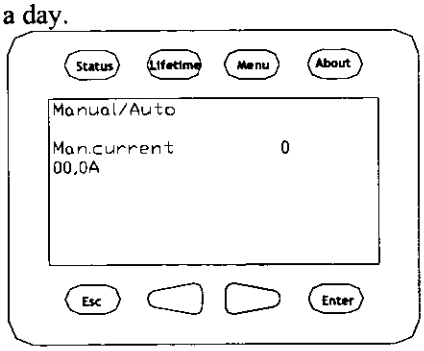
11.1 MANUAL/AUTO



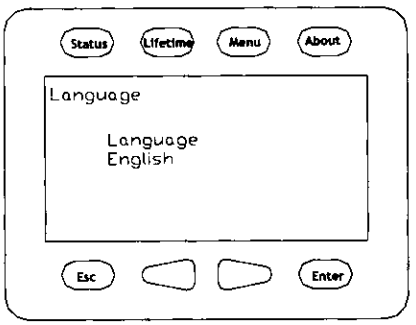
System can be set to manual or automatic operation. In normal situations the system will run in automatic.
Manual operation is only reserved for testing the system anode outputs against the reference cells, or is a temporary back up system should the automatic system fail. The manual control when set will provide the chosen current output constantly regardless of the actual hull potential. Use only this manual operation after consulting **Corrosion & Water-Control b.v.!**

11.2 MANUAL OPERATION:

Increase the required current by steps of 0,5 Amps using the arrow keys until the potential difference is set to **-800 to –850mV**.
Check for the first 12 our, every our the potential difference if it is still between –800 and –850mV., after 12 our it is recommended to check the potential difference once a day.

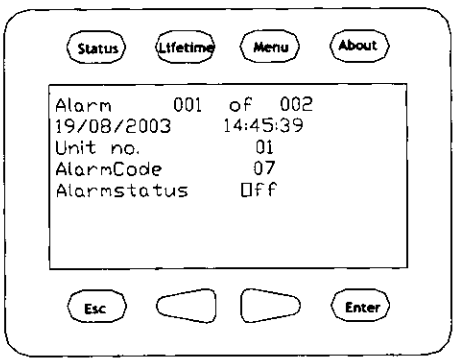


11.3 LANGUAGE.



Different languages may be chosen by pressing the backward/forward buttons.
Standard the English, German and Dutch languages are available, other languages are optional. Confirm by pressing Enter.

11.4 ALARM LOG.



All generated system alarms will be saved in the alarm log. All alarms receive a unique notification number. The following information is available for every single saved alarm.

- Alarm notification number. (above example shows alarm 1 of the total 2 alarms)
- Date and time of the specific alarm.
- Specific unit for which the alarm is/was valid.
- Alarm code which indicates the reason. (see below for the different alarm codes)
- Alarm status.

It is possible that an alarm is generated the first hour because of low potentials. This is a normal situation, accept the alarm by pressing the ESC button. The alarm will disappear within 24 hours.

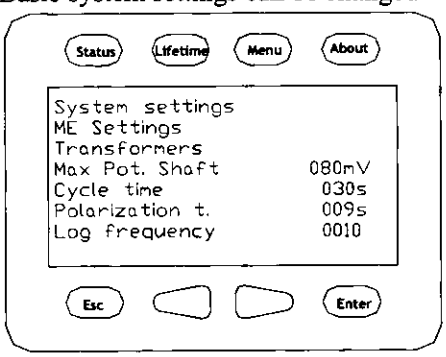
Alarm codes	Description
01	Max potential SB, check if system is running in automatic. Vessel might be sailing from fresh to salt water. Please check if current is decreasing.

02	Max potential PS, see 01.
03	Min potential SB, check if there is current running or if total capacity is used in lifetime screen. When the Vessel is stationary close to an other object, the system will adjust itself when this object is gone.
04	Min potential PS, see 03.
05	Anode current alarm, check the connections and cables.
06	Max voltage alarm, when the vessel is not operating on fresh water, check if total capacity is used in lifetime screen.
07	Shaft grounding alarm, assembly might be dirt, not installed correctly or brushes might be worn. Clean, reinstall or change brushes.
08	Temperature alarm, check and clean, if necessary, the ventilators.
10	RS485 alarm, please check all relevant connections.
25	System was shut OFF during a specific but known and saved period of time (system will restart automatically).

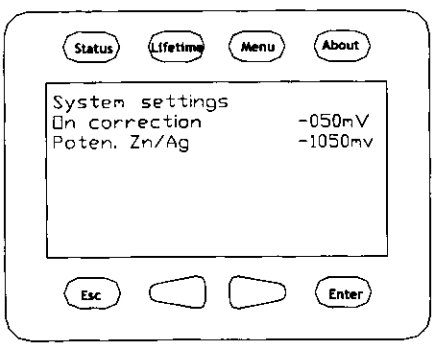
See chapter ELECTRICAL TESTING BEFORE SWITCHING ON for manual checking parts of the ICCP system.

11.5 SYSTEM SETTINGS.

Basic system settings can be changed if required.



Press forward button for next screen.

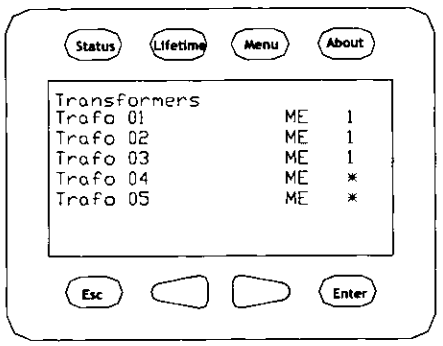


The following system settings might be changed.

1 ME settings Please see ME Settings

2	Transformers	Transformers can be linked to ME-prints
3	Max. pot. Shaft	Adjustment for shaft potential limit.
4	Cycle time	Frequency "Off potential" measurements.
5	Polarisation time	Time which is needed for polarization.
6	Log frequency	Log frequency can be changed.
7	On correction	Correction factor for on potential.
8	Potent. Zn/Ag	Factor for showing the value as an Ag/AgCl reference electrode when measured in zinc.

11.5.1 ME Settings

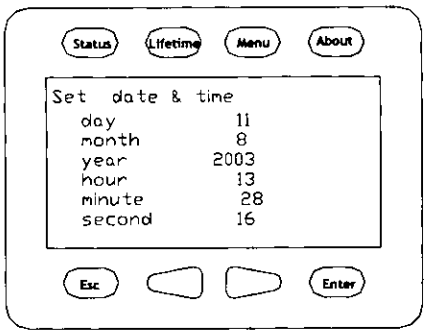


Following ME settings might be changed by pressing the specific line and using the forward/backward buttons.

1	Set point.
2	On _ off _ dead band.
3	Al. Max. Poten PS, adjustment of the maximum allowable potential.
4	Al. Max. Poten SB, adjustment of the maximum potential.
5	Al. Min. Poten PS, adjustment of the minimum potential.
6	Al. Min. Poten SB, adjustment of the minimum potential.
7	Max. Current, adjustment of the maximum current.
8	Max. Voltage, adjustment of the maximum voltage.
9	Temp. Alarm, adjustment of the maximum allowable inside temperature.
10	pFaktor.
11	iFaktor.

11.6 DATE AND TIME.

Standard time is set according UTC.
For changing the day, month, year, hour, minute or second, the specific sub division should be pressed and adjusted with the backward and forward button.
Settings should be confirmed by pressing the enter button.



12 CONNECTION TO AN EXTERNAL COMPUTER.

Besides manual modifications of this ICCP system, which is described above, modifications can be done via an external computer using the standard windows program "HyperTerminal". The ICCP unit can be connected with an external computer with a standard COM-cable (RS232). The data will be displayed in a standard text format and may be imported in a spreadsheet program.
All main system settings, values and logged data will than be displayed. Of course this data can be send by email to Corrosion & Water-Control bv for checking or revision as well.

Figure 1 shows the HyperTerminal menu screen as displayed.

```
========================================
****** CORROSION & WATER-CONTROL *******
========================================
1:Data-Log read-out
2:Delete Data-Log
3:
4:Read Alarm-Log
5:Delete Alarm-Log
6:
7:Read Parameters
8:Overwrite Parameters

Make your choice >
```

12.1 SYSTEM MODIFICATIONS VIA AN EXTERNAL COMPUTER.

If necessary and when the data is downloaded in a spreadsheet program, system settings may be changed (as described above) and finally uploaded to the ICCP unit. Besides it is possible to send the downloaded file to Corrosion & Water-Control bv via email. After the required revisions done by Corrosion & Water-Control bv, the file will be returned by email and is ready for uploading to the ICCP system.
When revisions are made, immediately save this changed file under a different name, so the original file will not be lost.

12.1.1 SYSTEM MODIFICATIONS VIA THE MICROPROCESSOR PRINT.

All settings and logged data is saved in the memory of the microprocessor, located on a separate print. It is possible and very easy to exchange this print with all settings and data in case revisions of the basic system settings should be made.
However the special designed software for this ICCP system is well protected and not accessible nor can be downloaded or displayed without authorization from Corrosion & Water-Control bv in the Netherlands.

12.1.2 DELETING LOGGED DATA.

Please be aware of the possibility of deleting the logged data with HyperTerminal.

12.1.3 READING ALARM LOG.

See chapter 7.

12.1.4 DELETING ALARM LOG.

Please be aware of the possibility of deleting the logged data with HyperTerminal.

12.1.5 DISPLAYING PARAMETERS.

In the following table an example is displayed of the ICCP system parameters, when downloaded to an external computer.
This table shows the system settings.
Following parameters are shown:

Channel	=	anode control print exit.
Anode	=	anode identification number
Set	=	the anode current set point
Vmax	=	maximum allowed voltage
Low	=	minimum anode current when using the high-low function
On	=	status of anode ON/OFF
Life	=	remaining anode lifetime

Table: Example of exported parameters (settings)

LOCAL DATE:	16/ 4/2003 19:17:58					
System ID	123456790					
Slave Units	1					
Alarm_A	10	per cent				
Alarm_V	15	per cent				
Alarm_L	3	weeks				

SystemType	1					
Log_Freq	30	days				
Language	0					
Parameters of the channels						
Channel	Anode	Set	VMax	Low	On	Life
1	1	0.51	0.2	0.25	1	53
2	2	0.52	0.2	0.25	1	53
3	3	0.53	0.2	0.25	1	53
4	4	0.54	0.2	0.25	1	53
5	5	0.55	0.2	0.25	1	53
6	6	0.56	0.2	0.25	1	53

13 ROUTINE SYSTEM OPERATION.

The **ICCP** system once running is completely automatic with little maintenance being required. The system should require no adjustments during routine operation of the vessel. However to ensure the system operates at maximum efficiency at all times the following advice should be followed:

13.1 EVERY DAY:

Check the touch screen if the screen saver it displayed (SYSTEM OK), or if an alarm was generated. Then record the readings from the display by pressing the STATUS button, see. STATUS displayed. Enter these readings into the log sheets provided in Appendix J LOG SHEETS.

13.2 EVERY WEEK:

It is important to maintain the efficiency of the slip ring, so deposits from the brushes should be regularly cleaned away with a soft cloth. If the propeller grounding system is not functioning proper an alarm will be generated. For the same reasons the rudder cable should be checked for fraying of the conductors.

13.3 EVERY MONTH:

Each log sheet provided for the vessel has spaces for one month 's entries. Once completed a copy of the log sheet should be sent to **Corrosion & Water-Control b.v.** for comments on the system operation.

13.4 30 DAYS PRIOR TO DRY-DOCK:

One month before dry-dock it is essential that daily log sheets have been maintained and are forwarded to **Corrosion & Water-Control b.v.**. This will ensure any spares, needed for the

system despatched in time. It is advised that an engineer from **Corrosion & Water-Control b.v.** be in attendance during dry-docking to check and service the ***ICCP*** System.

14 SYSTEM COMMISSIONING LIST.

Once the system installation is completed and the vessel again enters the water, the system can be checked for correct function.

A competent electrician or an engineer from CWC should complete the following checklist. Remember readings taken from the power units may vary depending on the conductivity of the water where the tests are carried out. It is preferred that salt content is as near true deep seawater as possible.

When the list is completed it is suggested a copy of the sheets be transmitted to our offices. The address is on the front manual cover.

Vessel Name & Owner: _____

Date and place: _____

14.1 PHYSICAL CHECKS OF HULL EQUIPMENT

Checks to be carried out whilst vessel is dry-docked !

a) Inspection of Port Side Anodes:
- Check Anodes are not damaged _____
- Mounting bolds secure & filled _____
- Check Anodes stud points are secure & filled _____
- Check Anode Elements are clear from dirt _____
- Check di-electric Shields are complete _____
- Connections accordance E-diagram _____

b) Inspection of Starboard Side Anodes:
- Check Anodes are not damaged _____
- Mounting bolds secure & filled _____
- Check Anodes stud points are secure & filled _____
- Check Anode Elements are clear from dirt _____
- Check di-electric Shields are complete _____
- Connections accordance E-diagram _____

c) Inspection of Port Side Electrodes:
- Check Electrode Cells are not damaged _____

Mounting bolds secure & filled _____
Check Cell stud points are secure & filled _____
Check Cell Elements are clear from dirt _____
Connections accordance E-diagram _____

d) Inspection of Starboard Side Electrodes:
Check Electrode Cells are not damaged _____
Mounting bolds secure & filled _____
Check Cell stud points are secure & filled _____
Check Cell Elements are clear from dirt _____
Connections accordance E-diagram _____

14.2 PHYSICAL CHECKS OF EARTHING SETS

Checks can be carried out with vessel dry or in water !

e) Inspection of Shaft Slip-Ring Assembly:
Any visual damaging _____
Distance between Brush Holder pin
and propeller shaft according manual _____
Check Installation of Slip-Ring & Cleanliness _____
Check Installation of Brush Holder _____
Check connection of Brushes _____
Check all earthing cables are connected _____

f) Inspection of Rudder Bonding Cable:
Check Installation of Rudder Cable _____
Check Rudder Cable is not Frayed _____
Any visual damaging _____

14.3 PHYSICAL CHECKS AT POWER UNIT

Checks to be carried out with vessel at sea!

g) Check Unit Body for Transit Damage: _____

h) Check Unit Bolting is Rigid & Sufficient _____

i) Check all Shipyard Cables to Terminal Board: _____

j) Any visual damaging _____

k) All cable diameters according manual _____

15 AUTOMATIC CORRECT INSTALLATION CHECK.

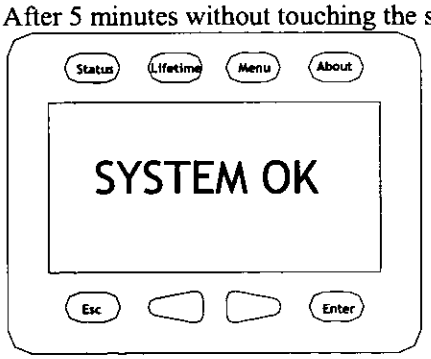
After switching on the ICCP unit and every time the primary power is reconnected, the ICCP system will check itself on correct installation automatically. When no mall function is detected in all connected components the system will switch to operation. Otherwise it will generate an alarm code on the screen. All possible alarms should be accepted by pressing the ESC button. The displayed alarm codes are mentioned and explained in ALARM LOG. to assure a fast trouble shooting and solution of the occurred mall function.
For this reason it is not possible that damage will occur on the vessel or ICCP system, due to wrong anode connections etc.
Depending on the quantity of anodes connected, this test will take several minutes, visualized by a countdown function.

15.1 VISUAL TESTING BEFORE SWITCHING ON

Assure that all cables are connected before switching the power "ON".

It is possible that an alarm is generated the first hour because of low potentials. This is a normal situation, accept the alarm by pressing the ESC button. The alarm will disappear within 24 hours.

When the system is functioning properly the following screensaver will be displayed continuously, until the screen is touched and the status of the system is shown.
After 5 minutes without touching the screen it will return to the screen saver.



If an alarm is generated, please see chapter: ALARM LOG.

15.2 TAKING THE SYSTEM IN OPERATION:

Take the following readings over a 24-hour period:

Record Readings immediately after switching "ON":

Reference Cell PS	_____
Reference Cell SB	_____
Voltage to anodes	_____
Current to anodes	_____

Record Readings after 30 minutes:

Reference Cells PS	_____
Reference Cells SB	_____
Voltage to anodes	_____
Current to anodes	_____

Record Readings after 1 hour:

Reference Cells PS	_____
Reference Cells SB	_____
Voltage to anodes	_____
Current to anodes	_____

Record Readings after 2 hours:

Reference Cells PS	_____
Reference Cells SB	_____
Voltage to anodes	_____
Current to anodes	_____

Record Readings after 6 hours:

Reference Cells PS	_____
Reference Cells SB	_____
Voltage to anodes	_____
Current to anodes	_____

Record Readings after 24 hours:

Reference Cells PS	_____
Reference Cells SB	_____
Voltage to anodes	_____
Current to anodes	_____

NOTE****: These tests establish the correct working of Automatic mode. Over the 24 hour period the readings should be seen to settle with very little variation.

15.3 POST TEST SYSTEM NOTES.

After all tests are completed the system should be left permanently to automatic mode. Should any problems occur whilst carrying out these tests refer to the Power unit section in the ***ICCP*** Manual. If this does not solve the problem please contact **Corrosion & Water-Control b.v.** directly on:

Telephone: **+31 (0)79 5931295**
Facsimile: **+31 (0)79 5931871**
E-mail: **info@cwcontrol.com**

Once this sheet is completed is suggested that a copy be sent to the address shown below

Corrosion & Water-Control b.v.
P.O. Box 47
2750 AA Moerkapelle
The Netherlands

Test Completed by (Print): _____

Test Completed by (Sign): _____

Test Dates and place: _____

16 SYSTEM LOG SHEETS.

In Appendix J LOG SHEETS. there are **ICCP** system log sheets for completion each day. Once a sheet is full (or once a month) a copy should be sent to **Corrosion & Water-Control b.v.** for study to confirm correct system operation.

17 TROUBLE SHOUTING.

17.1 ICCP ANODES

Disconnect Shipyard Cables from Anode terminal connections and measure open circuit potential*. Reconnect Cables after tests are finished:

Anode PS	_____mV.	value should be ±1000 mV.
Anode SB	_____mV.	value should be ±1000 mV.

17.2 ICCP REFERENCE ELECTRODES

Disconnect Shipyard Cables from reference electrode terminal connections and measure open circuit potential*. Reconnect Cables after tests are finished:

Reference electrode PS	_____mV.	value should be between –400 and +200 but not **0** mV.
Reference electrode SB	_____mV.	value should be between –400 and +200 but not **0** mV.

NOTE*: Measure the (DC) voltage between the anode-connection stud/reference electrode and the hull with a mV meter. Put the + at the anode and the – at the hull. Assure a good connection.

18 APPENDIX A ICCP SPECIFICATION SHEET.

CORROSION & WATER-CONTROL BV

Date	:	July 7th 2004
Client	:	Meyer Werft Papenburg
Client reference	:	3082/04 671/147 NB671
Corrosion & Water-Control bv reference	:	1269/02461
Total nr of MMO-anodes	:	4
Total nr of reference electrodes	:	2
Number of power supplies	:	1
Number of shaft grounding systems	:	1
Number of rudder grounding cables	:	1

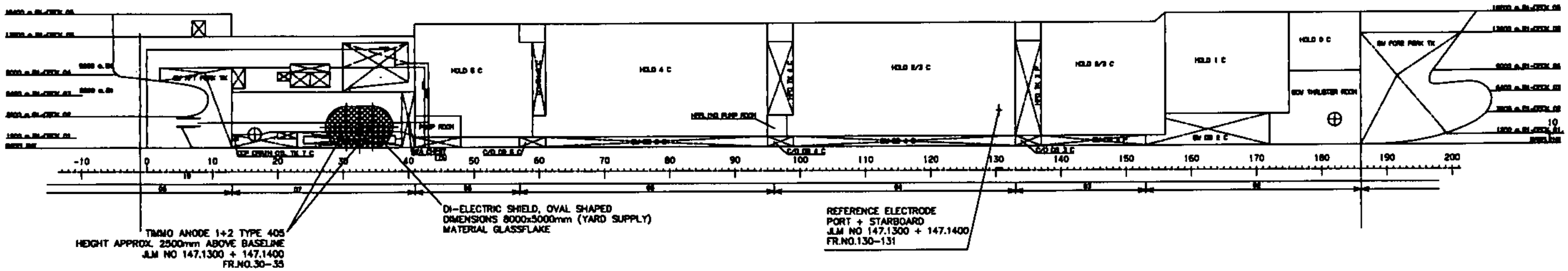
Power supply:
Suitable for tropical conditions.

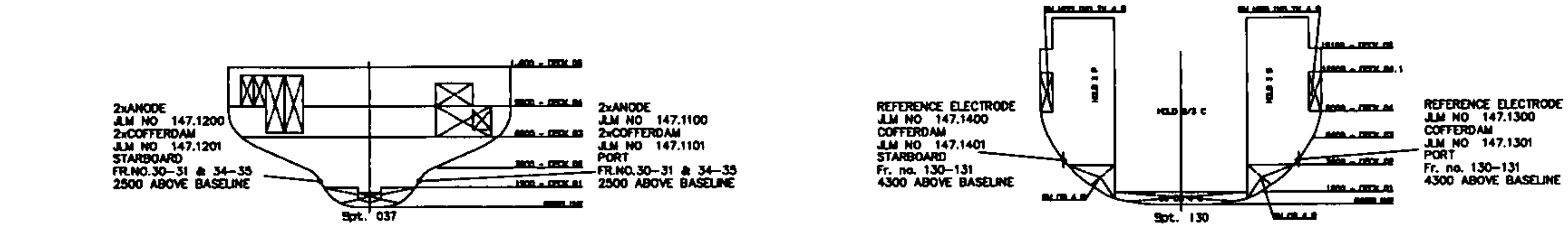
Type of power supply	:	PS2A/400V/300DI
Outside dimensions	:	BxHxD = 1000x1200x300 mm
Primary	:	400V/50Hz/3pH
Secondary	:	300A/24VDC
Nr. of outputs	:	2

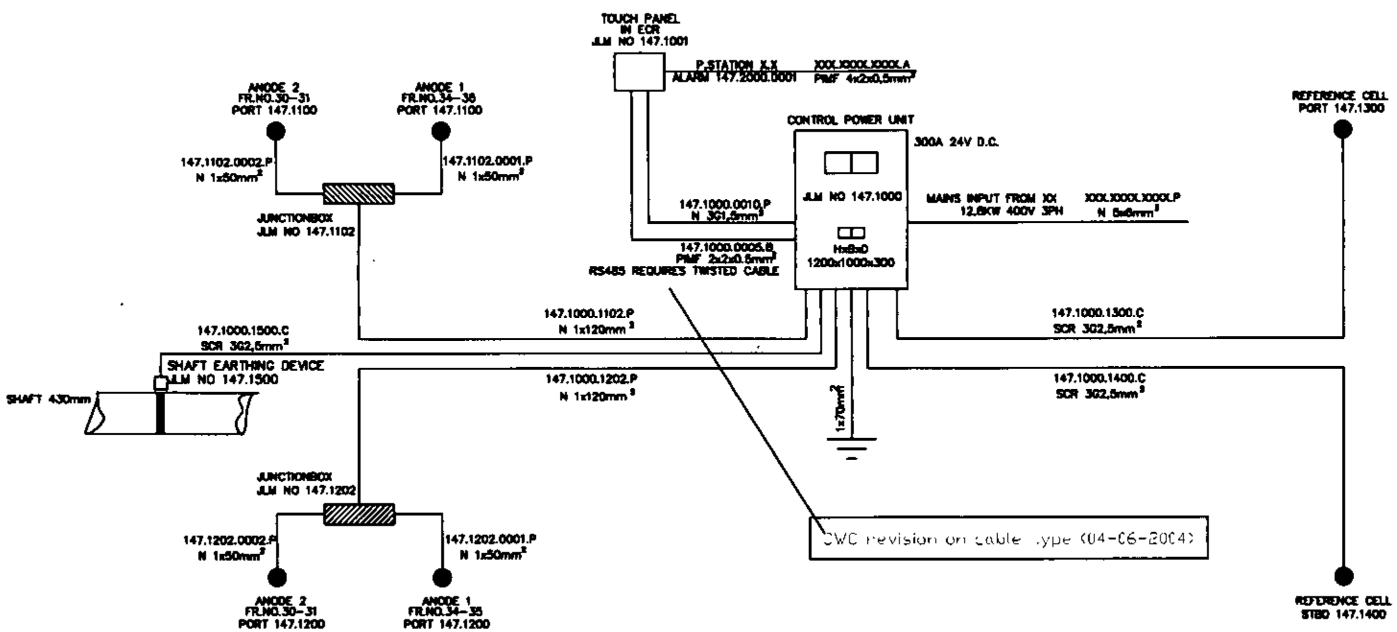
Anode division per power unit:

Power unit type	:	PS2A/400V/300DI
Number of MMO-anodes	:	4
Number of reference electrodes	:	2
MMO-anode type	:	405

19 APPENDIX B PRINCIPLE CONNECTION DIAGRAM.







No.	Art der letzten Änderung / Kind of last Alteration

Ausgeführte Pausen/Prints Issued

Änderung/Alteration: 0 A B C D E F G H I J K L

Gesamt/Total :
Datum/Date :

Genehmigung/Approvals

Geprüft durch/Approved by	1st	2nd	3rd

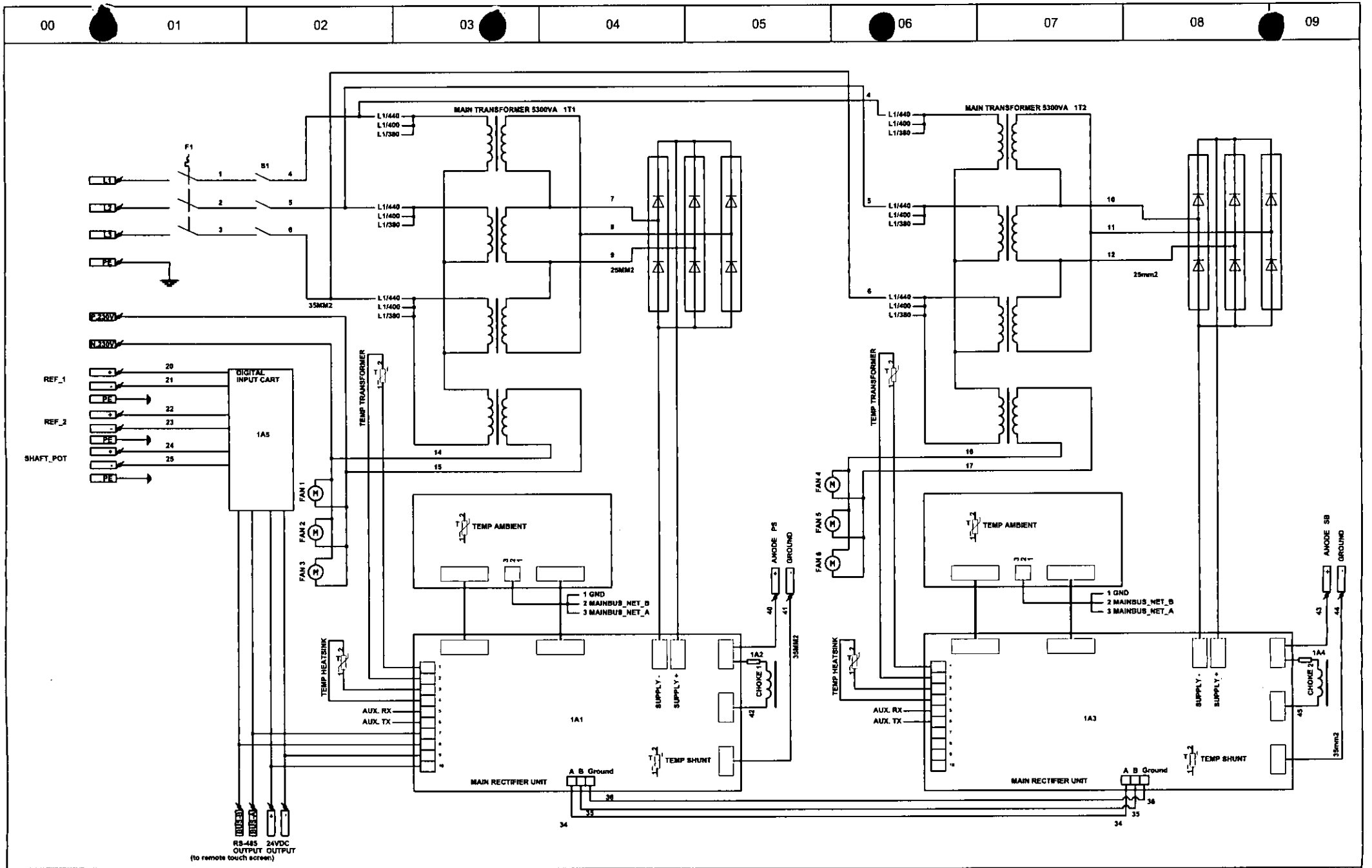
MEYER WERFT
PAPENBURG SEIT 1795

ARRANGEMENT OF ICCP PLANT
ANORDNUNG DES FREMDSTROM SYSTEMS

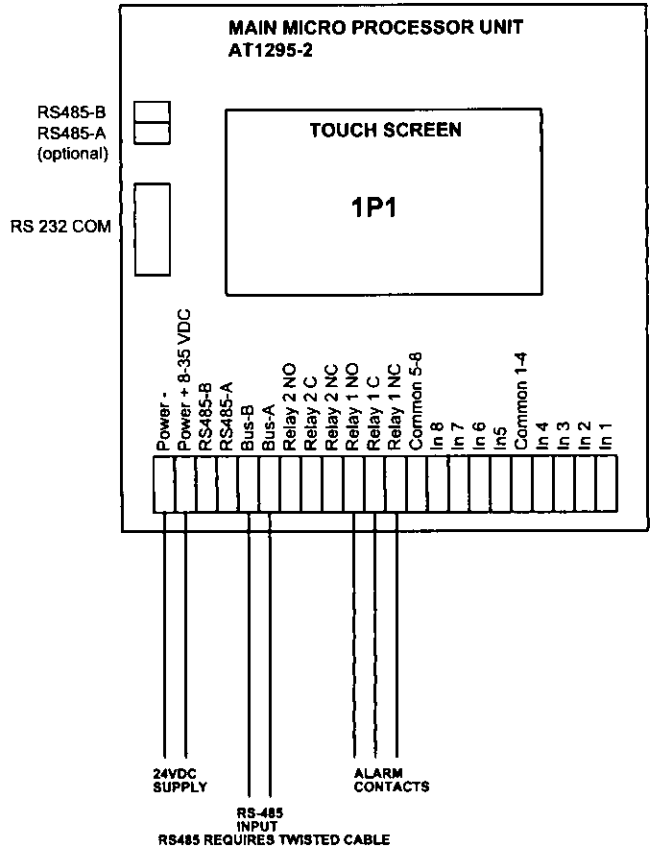
15.03.04

167 147 E --- --- - --- --- 300. 0

20 APPENDIX C ELECTRICAL CONNECTION DIAGRAM.



Customer Meyer Werft	inst. no.: 380-440/300/DI	Drawn	W.L.	25-03-03	CORROSION PROTECTION SYSTEMS CORROSION & WATER-CONTROL bv	Doc Type:	WIRING/BLOCK DIAGRAM
		Revised	A.T.P.	21-04-03		Product:	ICCP
Latest revision description: Terminal ID	rev: 02	Checked	A.T.P.	27-06-03		Part:	CONTROL UNIT 300 A.
		Yard.no.:	671/672/673/674			Doc no.: St.380-440.300.DI	Sheet: 02
Project: 1269		Scale:		Size: A4			



Customer Meyer Werft	inst. no.: 380-440/300/DI	Drawn	W.L.	25-03-03	PROTECTION SYSTEMS	Doc Type: REMOTE TOUCH SCREEN Product: ICCP Part: CONTROL UNIT 300 A.
Latest revision description: connections	rev: 02	Revised	A.T.P.	21-04-03		
		Checked	A.T.P.	27-06-03		Doc no.: St.380-440.300.DI / Sheet: 04
		Yard.no.:	671/672/673/674			
Project: 1269		Scale:		Size: A4		

21 APPENDIX D PARTLIST

PS2A-400V/300/24/ DI

Make	Type	Description	Number
Rittal	AE1213	CABINET 1000*1200*300	1
Hager	Inst. Auto fuse	MC640E	1
Rittal	Ventilator	AE	2
Silema	24V/300A, consist of:	Main Rectifier	2
	-regulate unit -Choke + ampère measuring -transformer (400V)		2 2 2
Alflex	ME	Dig. Input Cart	1
Alflex	DPI **	Microprocessor/Touch display	1
Phoenix	EIAL-NS35		2
Phoenix	UKH150	terminals	4
Phoenix	UK5N	terminals	10
Phoenix	USLKG5	earth terminals	5
Phoenix	Clipfix35	Gauge clamp	2
Phoenix	U5LKG16	earth terminals	1
KN	KG41B T103/NLB522E	Mainswitch	1
TM	ZB4BV5	Signal lamp 400V	1

** Touchscreen display is located in ECR

22 APPENDIX E TECHNICAL DATA CASING POWER UNIT.

Technical data casing power supply ICCP system.

Make	:	Rittal
Type	:	AE 1213.600
Number	:	1
Type	:	PS2A-400V/300/24/DI
Primary	:	400V/50Hz/3pH
Secondary	:	24 VDC
Nr. of outputs	:	2
Width	:	1000 mm
Height	:	1200 mm
Depth	:	300 mm
Weight	:	215 kg
Material	:	Steel
Coating	:	Enamelled
Colour	:	RAL 7032
Protection	:	IP 66 acc. to EN 60529/10.91
Design	:	acc. to NEMA-4

Technical data fixation lugs:

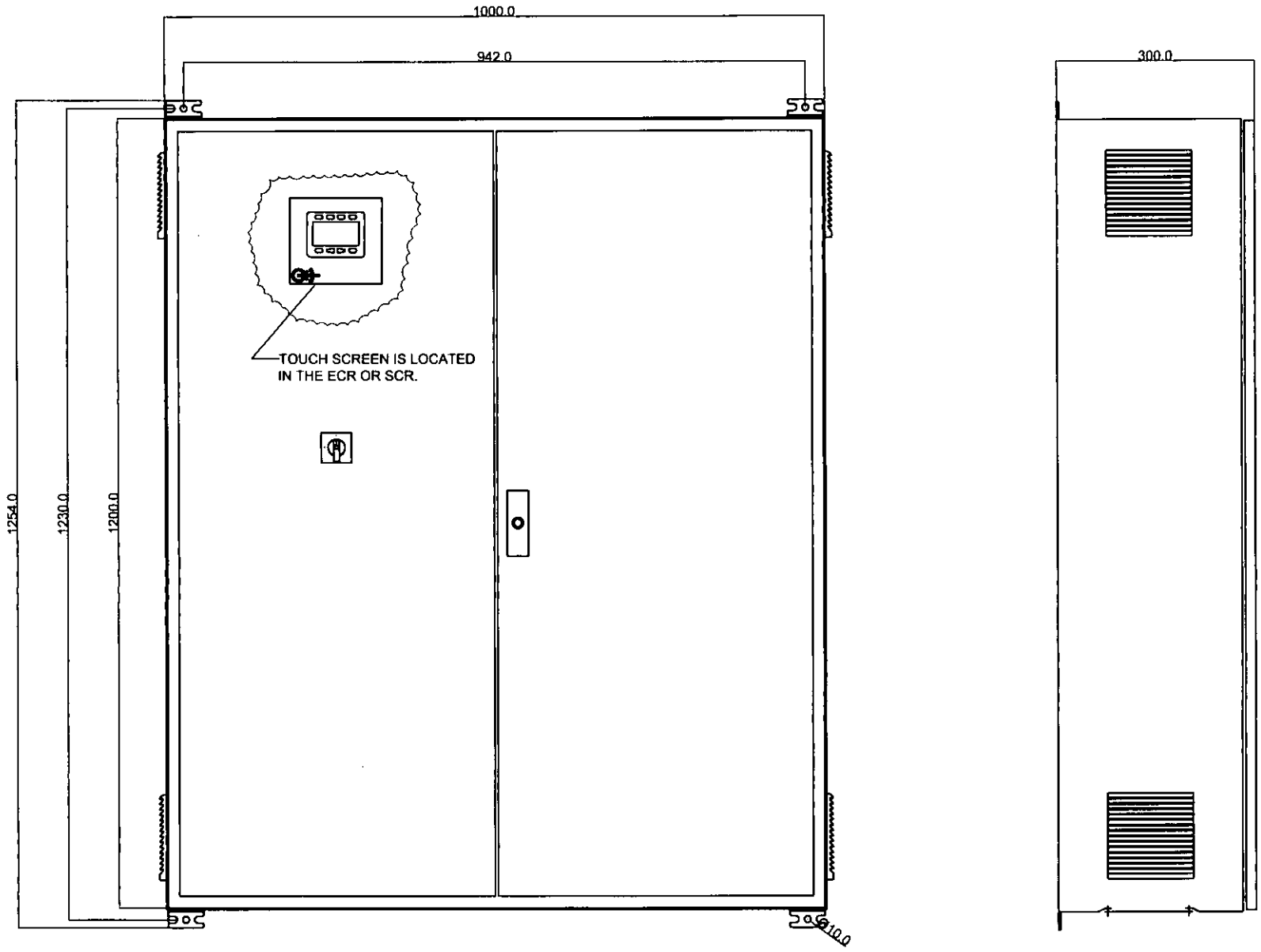
Make	:	Rittal
Type	:	KL 1502 (200x200x120mm)

2 chromed steel fixation strips at each side.

The power supply is supplied with:

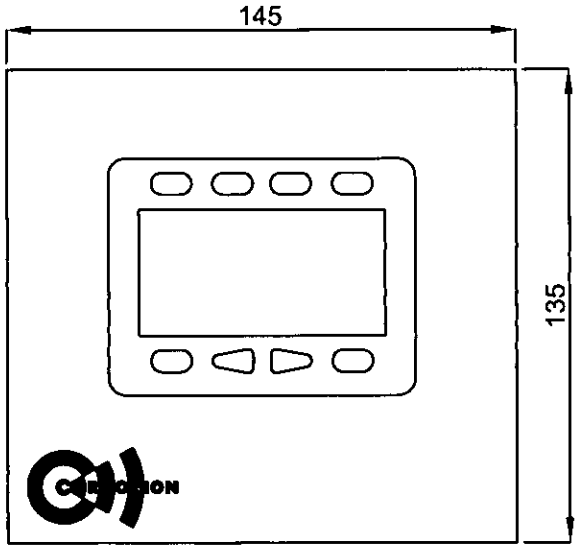
- 1 cable gland for each output.
- 1 cable gland for primary cable.
- 1 cable gland for ground connection.
- 1 cable gland for data output.

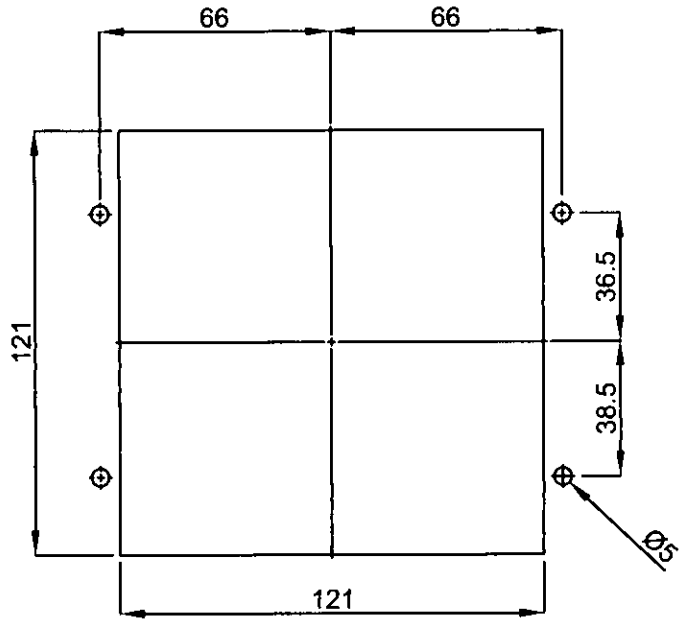
23 APPENDIX F TECHNICAL DRAWINGS POWER UNIT.



Customer Meyer Werft	inst. no.: 380-440/300/DI	Drawn	W.L.	25-03-03	PROTECTION SYSTEMS	Doc Type:	LAYOUT CABINET
		Revised	A.T.P.	22-04-03		Product:	ICCP
Latest revision description: FAN	rev: 02	Checked	A.T.P.	27-06-03		Part:	CONTROL UNIT 300 A.
		Yard.no.:	671/672/673/674			Doc no.: St.380-440.300.DI	Sheet: 01
Project: 1269		Scale:		Size: A4			

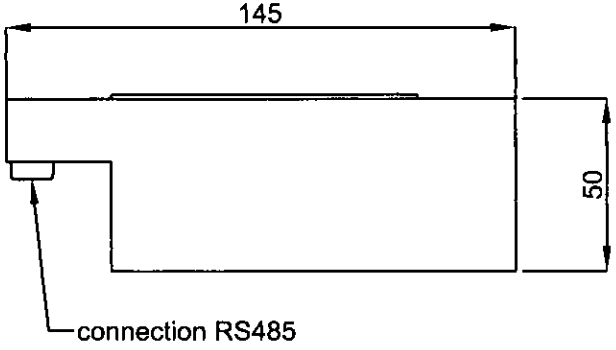
TOP VIEW





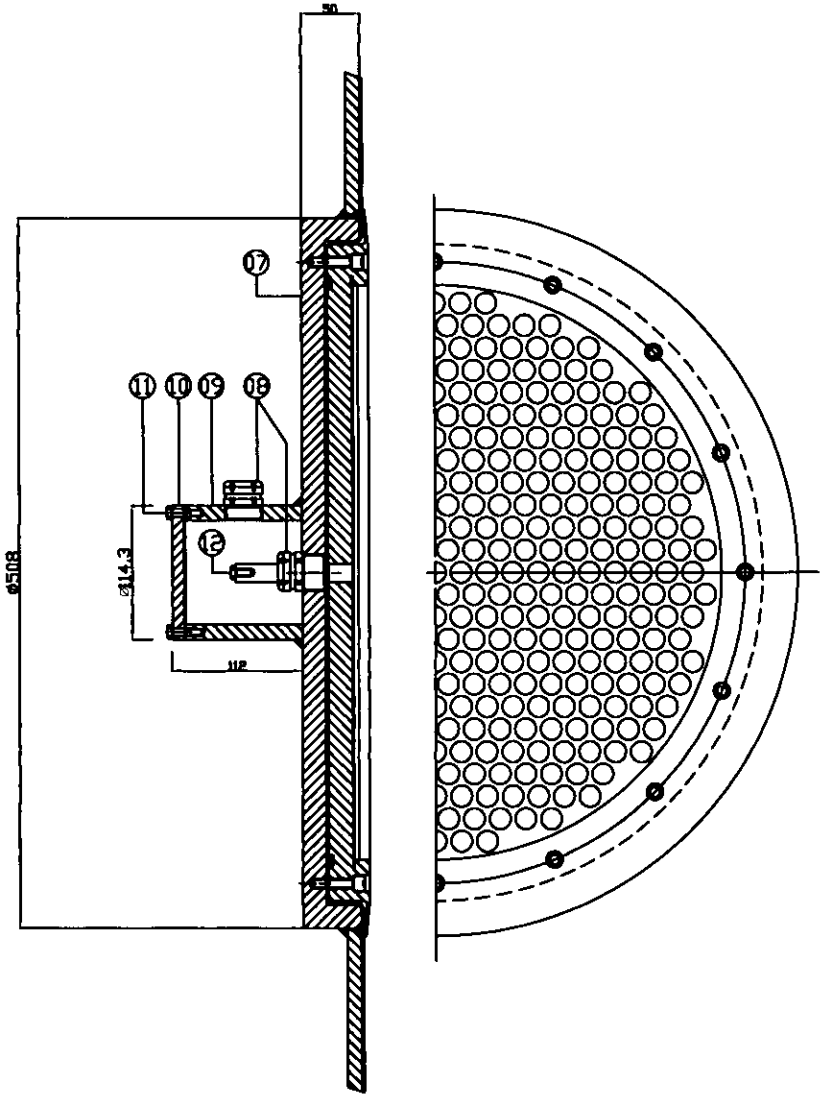
DRILLING/HOLE PATTERN

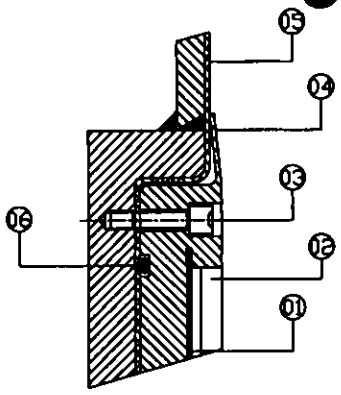
SIDE VIEW



Customer Meyer werft	Drawn	JdL	25-03-03	PROTECTION SYSTEMS	Doc Type: REMOTE TOUCH SCREEN Product: ICCP/ICAF Part: POWER UNIT
	Revised	A.T.P.	21-04-03		
Latest revision description: drilling/hole pattern	Checked	A.T.P.	27-06-03		
	Yard.no.: NB 671/672/673/674				Doc no.: St.POWER UNIT - DI Dwg nr. 8T045 Rev: 00
Project nr. 1296	Scale: n.t.s.		Size: A4		

24 APPENDIX G TECHNICAL DRAWINGS RECESSED ANODE.





Weights:
Steel cofferdam : 47,0 kg
HDPE anode holder : 7,0 kg
Ti/MMO anode : 1,5 kg
Total weight : 55,5 kg

Item	Description	Material	Number
01	MMO-Ti Anode	MMO-Ti	1
02	Perforated protection plate	HPPE	1
03	Hexacon bolt M8x35	AISI A4	12
04	Ridged Di-electric shield	HDPE	1
05	Di-electric shield	Epoxy	1
06	O-Ring	Rubber	1
07	Cofferdam	St.52.3	1
08	Cable gland M32x1,5	CuZn39pb3	2
09	Pipe ø114,3x12,5	St.52.3	1
10	Cover ø114x10	St.52.3	1
11	Bolt M6x25	St.8.8	8
12			

Description ICCP

Project: 1269
Yardno. NB671/674

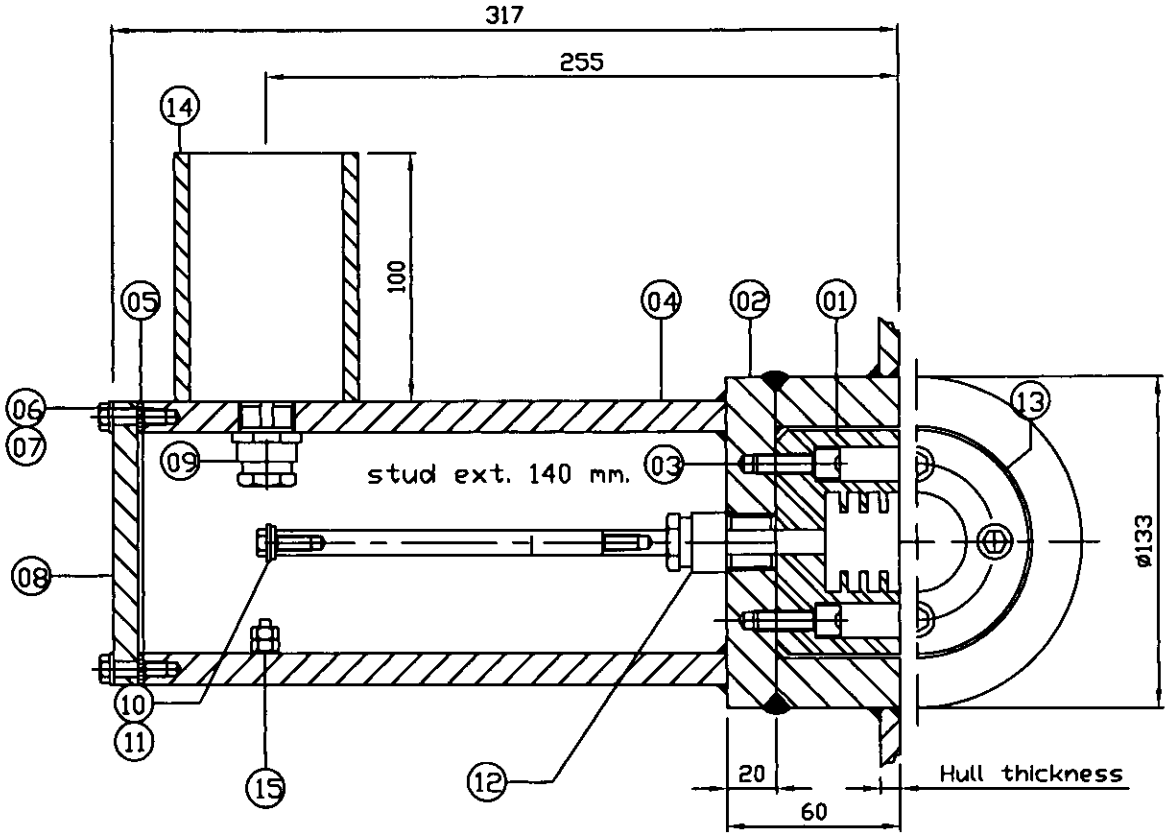
TITLE RECESSED MMO ANODE 405 mm.

rev. description date

Drawn AtP
Checked RS
scale 1:3
date 15/05/'04
Tagno.

CORROSION & WATER-CONTROL bv PROTECTION SYSTEMS

Size A4 Drwg.no. 8T040



Weights:
Steel cofferdam: 17,5 kg
HDPE anode holder: 0,5 kg
Zinc ref cell: 0,5 kg
Total weight 18,5 kg

Item	Description	Material	Number
01	Electrode holder	Hdpe	1
02	Bottom plate	st.52	1
03	Hexagonnut	R.v.s. A4	4
04	Pipeø114.3x12.5	st.52	1
05	Sealing	Neoprene	1
06	Bolt M6x20	8.8	6
07	Bolt M6x20	8.8	6
08	Coverø114x10	st.52	1
09	Cable plug PG 16	CuZn39pb3	1
10	Extension stud	st.52	1
11	Bolt M6x20	8.8	1
12	Cable plug PG 16	CuZn39pb3	1
13	Reference cel	Zn	1
14	Pipe ø76,1x12,2	st.52	1
15	Ground M6x16	8.8	1
Item	Description	Material	Number

Description ICCP

Project: 1269
Yardno. NB 671/672/673/674
Drawn M.Q.
Checked AtP
scale
date 24-04-2003
Tagno.

TITLE RECESSED REFFERENCE ELECTRODE SPECIAL

Rev. description date by

PROTECTION SYSTEMS

Size A4 Drwg.no. SP.001-000

25 APPENDIX H TECHNICAL DRAWINGS RECESSED REFERENCE ELECTRODE.

26 APPENDIX I SHAFT GROUNDING MANUAL.

PROPELLER EARTHING SYSTEM

Do not attempt to service or readjust the system without first reading and understanding this manual.

Read this manual before carrying out any test.

Should any information be required, which is not covered by this manual, please contact:

Corrosion & Water-Control b.v.
Herenweg 58, 2751 DB Moerkapelle
P.O. Box 47, 2750 AA Moerkapelle
Tel.: + 31 (0) 79-593 1295
Fax: + 31 (0) 79-593 1871
E-mail: info@cwcontrol.com

26.1 INTRODUCTION

When steel immersed in sea water (e.g. a ships hull) small galvanic currents are initiated at anodic areas of the metal surface, causing corrosion. Such corrosion predominates at the stern of a ship, where the combined effects of increased turbulence and differential metals results in accelerated corrosion rates.
For more details of this process we refer you to our manual "Impressed Current Cathodic Protection" system, **ICCP**.

The application of Cathodic Protection effectively suppresses these corrosion cells by applying an opposing current from external anodes and if the propeller is to receive the benefits of cathodic protection then there must be a continuous electrical circuit between the propeller and the ships structure.

This circuit usually exists when the propeller is at rest, where a metal to metal contact is made between the shaft and the stern tube liners, or main engine bearings and journals.

However, whilst the shaft is turning the bearing lubrication creates an intermittent high resistance which effectively insulates the propeller from the hull structure. Since the propeller presents a relatively large surface area of bare metal, it attracts cathodic protection currents, which tend to flow by arcing across the lubrication film and in so doing, results in spark erosion which eventually leads to pitting and "stripping" of white metal bearing surfaces. It is generally accepted that the effects of arcing are minimised when the potential across the shaft/hull interface is less than 50mV.

To overcome this undesirable condition of arcing, and ensuring that cathodic protection is extended to the propeller, it is good practice to install Shaft bonding equipment as an integral component of a ships Cathodic Protection System it is applicable to both sacrificial anode and Impressed current schemes. Furthermore, where such bonding is installed it is recommended that the capacity of the cathodic protection system should include an allowance for the propeller.

Various combinations of slip ring and carbon brush materials are available but experience has shown that only high silver composition brushes running to a silver track, can provide an effective and sustained low resistance path.

This assembly consist out of silver brushes which will make electrical contact with a silver slip ring by special brush holders. It is designed for ease of assembly by proficient technical personnel. When running properly the shaft earthing system voltage should be 50 millivolt or less. This value will be monitored continue by the integrated mill voltmeter in the power supply. When the system is not working properly it will give an alarm signal.

26.2 GENERAL

1) The system comprise a single slip ring arrangement, silver brushes, brush holders and brush holder pins.
2) The slip ring is supplied as a single open coil whose diameter suits the shaft approximately. However, to allow a tolerance for variations in shaft diameter the slip ring is cut slightly oversize and should be dressed to fit, on site. This involves removing small amounts of metal at the slip ring mating joint until an exact fit is achieved and the slip ring conforms to the shaft diameter without unevenness. Failure to remove excess slip ring material before securing with the band tensioning, or to finish with a badly fitted joint will result in an uneven track surface with consequent rapid brush wear.
3) Under normal circumstances, a correctly fitted slip ring and associated brush gear can be expected to perform for many years. Under these conditions and subject to the vessels trading/operational pattern, the anticipated brush life is one year, although smaller diameter shafts turning at higher brush contact speeds will inevitably result in increased brush wear rates.

4) To ensure effective bonding, the slip ring should be installed on the intermediate shaft, astern of any insulating couplings or flanges and preferably clear of water spray or oil and grease contamination from stern gland lubrication.

5) SHAFT BONDING CONDITION MONITORING:
The condition monitoring system integrated in the power unit provides a permanent and readily available indication of the condition and therefore, effectiveness of the shaft bonding system.
To ensure a continuous cathode bond and freedom from shaft bearing damage the Condition Monitor should display a shaft potential not exceeding 50mV. Reading in excess of this value are indicative of worn bonding brushes or dirty brushes or poorly maintained brush gear and/or slip rings.
Measurement of shaft potentials is achieved by installation of a single Monitoring Brush, which runs on the main shaft bonding slip ring, but has its brush gear mounted on a separate and insulated spindle. The brush gear is connected direct to the Power Unit with a 1 x 2,5mm^2 cable (see ICCP manual for connection diagram).

26.3 INSTALLATION

1) Select a convenient and suitable location on the intermediate shaft (see 4 above) and thoroughly clean to remove all grease and debris to ensure a good contact between shaft and slipring.

2) Loosely fit two stainless steel securing bands and tensioners to provide temporary support whilst trimming slip ring to size. (see 2 above)

3) Temporarily slide the single strip slip ring beneath the edge securing bands to determine amount of trimming required in order to match slip ring to the shaft diameter.

4) Withdraw slip ring and remove excess material by filing at the butt joint and repeating 3 as necessary, until the slip ring exactly matches the shaft diameter and the butt joint meet squarely.

5) Once the slip ring has been prepared, finally secure in position by adjusting the slotted tensioners with a screwdriver until a close fitting and tight grip is made around the entire shaft circumference.

6) To avoid excessive brush wear, it is essential that the mating butt joint forms a smooth track profile. Any gap at this joint can be in filled by slackening of the tensioners and inserting a small amount of soft solder (It is not necessary nor advisable to apply heat.) then readjusting the tensioners to squeeze the solder between the joint faces, carefully scraping away any excess without damage to silver plate surface.

7) The double box brush holder should be mounted on a steel support spindle. The centre line of support spindles for both double and single brush holders should be 32,5 mm above the slip ring surface.

8) Install the brush holder on the spindle, align centrally on the slurping track. Before finally clamping the brush holder to its spindle, check it will not be fouled by the tensioning clamps during rotation.

9) To ensure a continuous low resistance contact between the brush gear and ship structure, attach the 1 meter length of 35mm^2 cable to a convenient structure earth, routed and supported to minimum strain on the brush holder assembly.

10) Fit the two brushes in their holders and connect leads to the brush holder before adjusting and locking the brush holder in position so that each brush makes a good contact with the slip ring. When correctly fitted the brushes will protrude 2-3mm beyond the edges of the brush boxes.

11) The single, spring loaded monitoring brush is similarly installed, but should be mounted on the insulated spindle provided. The centre line of the insulated spindle should be 32,5 mm above the slip ring surface.

12) Install the brush holder on the spindle, align centrally on the slip ring track and check the brush gear will not foul the tensioning clamps during subsequent rotation of the shaft.

13) Connect a 1 x 2.5mm^2 cable between the monitoring brush holder and the Power unit (see ICCP manual for connection diagram).

14) On completion check:

    a) All items secured and fitted properly to drawing and instructions.

    b) Slip ring contact surface is free of grease/oil contamination.

    c) Ensure slip ring track is smooth and true, with particular attention to the butt joints.

d) Brushes free to move in their boxes, and run soundlessly on the slip ring.

e) When the shaft is rotating at normal operating speed, confirm electrical continuity between shaft and hull by measuring mill volts with switch able voltmeter.

26.4 MAINTENANCE

1) Examine the slip ring and brush gear every 7 days for cleanliness and security.

2) Any build up of oil or grease deposits on the slip ring and brush holder should be removed with a degreasing solution.

3) Inspect brush holder and brushes for freedom of movement and ensure brush connection leads are secure and not damaged or corroded. Worn or damaged brush holders can lead to uneven and wasteful brush wear.

4) Brush wear should be noted, replacing the brushes or adjusting tension arms as necessary to maintain integrity of electrical continuity between slip ring and brush holder.

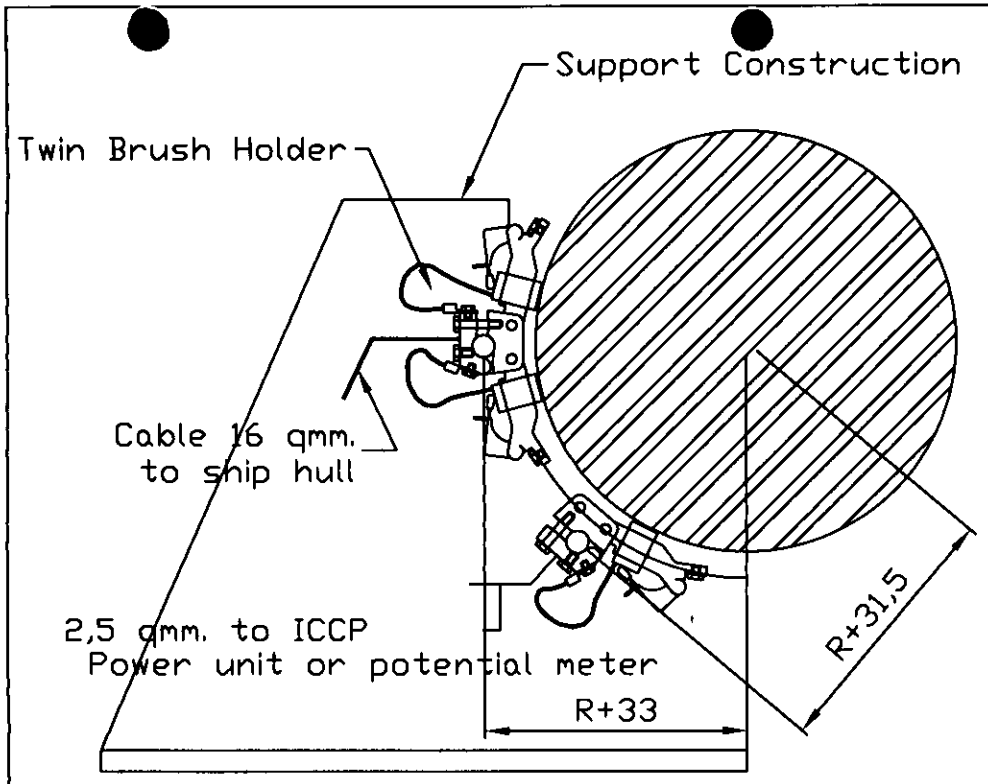
5) Check regularly the value on the power unit.

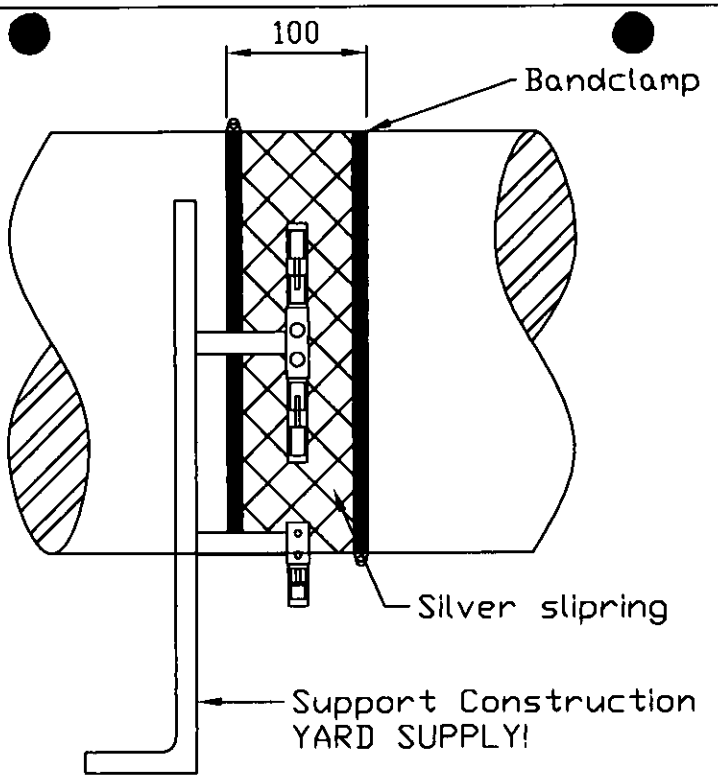
NOTE:

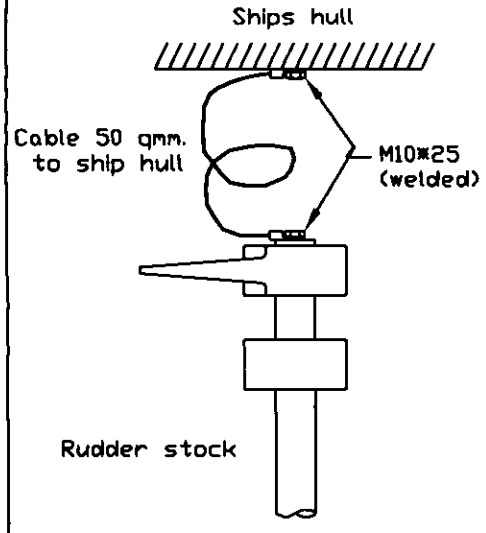
The ideal brush pressure will be obtained at the lowest possible mill volt readout at the power unit.
But the pressure has to be as low as possible to prevent excessive tearing of the brushes.

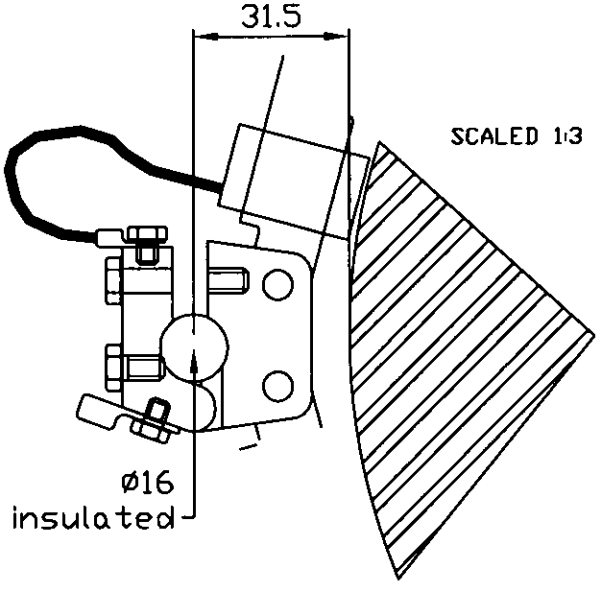
26.5 PART LIST

ITEM	QUANTITY	CHECKED
SILVER PLATED SLIP RING TO SUIT **430 mm** SHAFT DIAM.	1	
STEEL CLAMPS BANDS TO SUIT **430 mm** DIAMETER SHAFT	2	
1 BRUSH HOLDER + 2 BRUSHES FOR SILVER PLATED SLIP RING	1	
SLIPRING CONDITION MILLIVOLTMETER POWER UNIT	1	
1 BRUS HOLDER + 1 BRUSH FOR SLIPRING MILLIVOLTMETER	1	
2,5 sqmm CABLE FOR CONNECTION TO MONITORING BRUSH MILLIVOLTMETER (3 m long)	-	









Description	ICCP	Project	1269
		Yardno.	671/672/673/674
rev. description date	TITLE Slip-Ring Arangement Propeller Shaft	Drawn	MQ
		Checked	AtP
		scale	1:
		date	12-02-02
		Tagno.	
CORROSION & WATER-CONTROL bv PROTECTION SYSTEMS		Size A4	Drwg.no. T407.003

27 APPENDIX J LOG SHEETS.

AUTO HULL ICCP LOG SHEET

VESSEL OR PROJECT

LOG DATES

MV SETPOINT	
ps	sb

Date	Sea Temp.	Water F/B/S*	Pot Ps"on"	Pot SB "on"	Volts	Amps	Pot. PS "off"	Pot. SB "off"	Status (0-1)	Alarm Y/N

28 APPENDIX K MAINTENANCE PLAN ICCP.

MAINTENANCE PLAN.

System: ICCP
(Component:) Anodes, power unit, shaft grounding
Manufacturer: Corrosion & Water-Control bv
Date: 2004-

NR:	1. Maintenance Task	2. Maintenance Intervals		3. Reference to Manuals	4. Parts Required 2,5 years
		Running Hrs:	Time Period:		
1	Screen Saver is shown		Daily	VISUAL TESTING BEFORE SWITCHING ON	
2	Record readings		Daily	Appendix J LOG SHEETS.	
3	Check and clean propeller shaft grounding		Weekly	Appendix I SHAFT GROUNDING MANUAL.	Set of silver brushes
4	Fax log-sheets to Corrosion & Water-Control bv		Monthly	ROUTINE SYSTEM OPERATION.	
5					
6					
7					
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11					
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