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# CORROSION CONTROL TECHNOLOGIES & PRODUCTS

SUNRUI MARINE ENVIRONMENT ENGINEERING CO., LTD



# **Contents**





Sunrui Marine Environment Engineering Co., Ltd is a subsidiary of China Shipbuilding Industry Company Limited. It was founded in 2003. The registered capital of the company is 260 million China Yuan. The company headquarter is located in Laoshan district of Qingdao, with departments of R & D center, Corrosion control department, Water treatment department, Shipping department, Product center, Shanghai branch, offices in Tokyo of Japan and in Singapore and so on. The company is a professional high-tech engineering company which is engaged in the research and development, design, manufacture, engineering and project contacting of corrosion control and water treatment technologies.

Corrosion and protection professional is one of the earliest established professional of the company. After more than 50 years development, it has become the strongest pillar industry of Sunrui. Nowadays, Sunrui is the most famous comprehensive economic entity in the field of corrosion and protection. It has a very excellent team to do research, design, development, manufacture, and engineering contraction. It also has many advantages and high reputation in the anti-corrosion technology field at home and abroad.

# **Company Introduction**





## Comprehensive Strength

## **Major Customers**



There are 253 people in Sunrui in 2014, where all kinds of technical personnel of the company are 167 people, including 9 professors, 51 senior engineers, 9 first-grade project managers and national first-class construction engineer, 4 cathodic protection experts and designers certified by NACE, 2 Qingdao outstanding technical personnel, 1 expert of IMO ballast water treatment evaluation committee, and 1 Taishan scholar.

Sunrui has R & D center to develop new technologies and products. There are more than 40 professional technical personnel, and all of them has the master degree or above. Sunrui also has the first-class research and testing equipment for anticorrosion and antifouling technology with the base for developing new technologies and products, testing products, and training talents.

#### Sunrui began to study cathodic protection technology from 1961. It is engaged in the research, development and manufacture of technologies and products in corrosion and protection field. It has more than 50 years of scientific research results accumulation and has more than 2000 large-scale project performance.

Human

Resource

Sunrui has received national and provincial scientific and technological achievements more than 40, edited in chief national standards, the national military standards and ministerial standards more than 20 in anticorrosion and antifouling field.

## Comprehensive Strength

## **Production Capacity**

Sunrui has modern workshops of 26000 square meters, highly qualified and skilled workers, advanced production technology and equipment, standardized management system and first-class testing conditions.

Sunrui has produced 15000 ton sacrificial anodes each year of aluminum alloy, zinc alloy, magnesium alloy and iron alloy. The annual output of transform-rectifiers, auxiliary anodes and reference electrodes is 400 sets. The annual output of coating products is 15000<sup>2</sup> m. The annual output of corrosion detection device is 50 sets. Sunrui is the largest production base of cathodic protection products in Asia. The product quality of Sunrui is very reliable and in the leading position in domestic due to advanced equipment and technology.

Sunrui has Quality and Safety Department to test products' quality and manage safety and environment-protection of the company. It also depends on four marine experiment stations of Qingdao, Xiamen, Sanya and Deep-sea to do experiments such as simulation and accelerated corrosion test in marine environment, corrosion & electrochemical test, coating layer performance research etc. State Key Laboratory for Marine corrosion and protection built in 2001, which is depending by the company, is the only national key laboratory in the field of metal corrosion research and anticorrosion technology in marine environment.

Sunrui has more than 30 advanced equipment and instrument such as environment scanning electron microscopy (ESEM), Kelvin probe microscope, electrochemical workstation, A30 alloy analyzer, PCM-7X field corrosion detector, etc.

In addition, China corrosion and protection test center of ship material and CCS (China classification society) corrosion and protection validation test center of ship material is affiliated to Sunrui. The company has further improved the detection means and testing technology with the measurement certification of State Bureau of Technical Supervision to become one of the most advanced and authoritative enterprises in testing instruments and testing technology.

## Technology Strength



# **Main Qualification**

Sunrui has adopted the certification of GB/T19001 cathodic protection products, GB/T50430 quality management system certification of anticorrosion engineering construction, GB/T24001 environmental management system certification, GB/T28001 management system certification of occupational health and safety.

Sunrui was accredited as the high and new technology enterprise by the Chinese government since 2008, and the key high-tech enterprises of China Torch Program since 2013.

Sunrui obtains and keeps main qualifications of large state-own enterprises suppliers such as State Power Corporation, Sinopec, CNPC (China National Petroleum Corporation), CNOOC (China National Offshore Oil Corporation) and so on.

## **Testing and Experiment**





# **Qualification & Honor**

\*:-

安全生产许可证

Certification of safety production

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## Qualification



Enterprise business license



Highest contracting certificate in anti-corrosion area

**供应商名称**, 金品发现防腐跌行工程有能

准入证编号, 01001001482 Certificate No.

发证单位。 中国石油大热气氛: hausu Unit 由供采的使型系

The supplier

准入章.



China anticorrosion construction qualification



Work safety standardization two grade enterprise of Shandong province



The enterprises record table of national import and export



Management system certification of quality, environment and occupational health and safety



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The qualified supplier of Saudi Aramco





Honor

#### High tech enterprise certification



Scientific and technological

progress second prize

of Shandong province

単位名称:青岛双城洋洋环境工作 股份寬且公司

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A-class tax credit rating enterprise of Qingdao



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**SUNRUI** 

反量管理体系认证证书

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Observing contracts and keeping promise enterprise of Shandong province



Good contract unit in the Panyu to Huizhou gas development project of CNOOC

AAA credit rating enterprise of Shandong province



**Observing contract &** keeping promises unit in Nan'ao bridge project



# **Technologies & Products**

## Cathodic Protection Technology

Cathodic protection is one of the most efficient methods to prevent metal from electrochemical corrosion. It impresses certain cathodic current to the protected metals and makes the produce cathodic polarization. When their potentials are lower than certain values, the anode dissolving process of corrosion will be effectively controlled. According to the different manners of providing cathodic current, cathodic protection will be divided into two types, including sacrificial anodes and impressed current system.

Sacrificial anode method is to connect the protected metallic structures with a more active metal or alloy, through their dissolving. The protected structures shall get the necessary current and will be protected effectively. Impressed current method is to convert the AC into low voltage DC and then transmit the protection current to the protected metallic structure through auxiliary anodes. The system will measure the potential with reference electrode and return the controlling signals to the auto-control rectifier to regulate the output current, thus keeping the metallic structures in excellent protection condition.

Usually, the cost of cathodic protection just takes  $1\% \sim 3\%$  of the total cost of protected metallic structures, however their life can be extend several folds or ever several tens of folds. Since it has many advantages such as simple facility, easy engineering, and long life protection, cathodic protection has been quickly developed and extensively applied in recent years, and is an applicable technology which can get outstanding performance and remarkable economic profit with small investment.



Sunrui has the largest anode production workshop

## Sacrificial Anode

## Aluminum alloy anodes

- General aluminum alloy anode
- High active aluminum alloy anode
- High performance aluminum alloy anode
- High temperature resistant aluminum alloy anode

## Magnesium alloy anodes

- General magnesium alloy anode
- Magnesium-manganese alloy anode
- High active magnesium alloy anode
- Ribbon magnesium alloy anode



Sacrificial anodes on ship hull



Long-strip sacrificial anodes



Buried magnesium alloy anodes



## Zinc alloy anodes

- General zinc alloy anode
- Ribbon zinc alloy anode
- Zinc grounding battery

## Iron alloy anodes

- Flange form iron alloy anode
- Pipe sections form iron alloy anode





Bracelet aluminum alloy anodes





Aluminum alloy anodes for platform jacket



## Sacrificial Anode

Table1 Sacrificial anode electrochemical performance parameters

Species	Open circuit potential -V, SCE	Work potential -V、SCE	Actual capacitance A•h/kg	Current efficiency %	Soluble
General aluminum alloy anodes	1.10~1.18	1.05~1.12	≥2400	≥85	
High active aluminum alloy anodes	1.10~1.18	1.05~1.12	≥2600	≥90	
High performance aluminum alloy anodes	1.45~1.50	1.40~1.45	≥2080	≥70	Corrosion products easy
Zinc alloy anodes	1.05~1.09	1.0 ~1.05	≥780	≥95	to fall off, the surface dissolve
General magnesium alloy anodes	≥1.50	≥1.45	≥1200	≥55	even.
Magnesium-manganese anodes	≥1.70	≥1.60	≥880	≥40	
High-active magnesium alloy anodes	≥1.85	≥1.75	≥1000	≥50	

### Table2 Sacrificial anodes used on ship hull

Model	Specification mm	Weight kg	Model	Specification mm	Weight kg
	L *W *H			L *W *H	
ZH-1	800*140*60	47.0	AH-1	800*140*60	16.0
ZH-3	800*140*40	31.0	AH-3	800*140*40	12.0
ZH-5	400*120*50	16.0	AH-5	400*120*50	6.5
ZH-7	400*100*40	11.0	AH-7	400*100*40	4.5
ZH-9	250*100*40	6.5	AH-9	250*100*40	2.5
ZH-11	300*150*50 Double iron feet	15.4	AH-11	300*150*50 Double iron feet	5.8
ZH-13	300*150*50 Screw type	12.0	AH-13	300*150*50 Screw type	5.8

P.S: Z means zinc alloy anodes, A means aluminum alloy anodes.

#### Table3 Bracelet aluminum sacrificial anodes

Model	Specification mm bore *length* thickness	Weight kg
AB-40	Φ1020*200*35	68
AB-32	Ф 819 <b>*</b> 60 <b>*</b> 30	13
AB-28	Φ731*250*40	64
AB-24	Ф 624 <b>*</b> 80 <b>*</b> 30	17
AB-20	Φ 515*460*60	130
AB-16	Φ425 <b>*</b> 510 <b>*</b> 40	72
AB-12	Ф 342*270*40	31
AB-8	$\Phi 234*410*40$	32

## Sacrificial Anode

#### Table4 Sacrificial anodes used for harbor installations and offshore structures

Model	Specification L*W*H mm	Weight kg
ZI-1	1000* (115+135) *130	115
ZI-2	750* (115+135) *130	85
ZI-3	500* (115+135) *130	56
ZI-4	500* (105+135) *100	40
AI-1	2300* (220+240) *230	310
AI-2	1600* (200+210) *220	190
AI-3	1500* (170+200) *180	130
AI-4	900* (150+170) *160	58
AI-5	1500* (148+178) *170	120
AI-6	850* (180+220) *180	85
AI-7	800* (200+280) *150	80
AI-8	700* (160+220) *180	72.5
AI-9	1250* (115+135) *130	56
AI-10	1000* (115+135) *130	46

#### Table5 Sacrificial anodes used in ballast tanks

Model	Specification L*W*H mm	Weight kg
ZT-1	500* (115+135) *130	56
ZT-2	1500* (65+75) *70	50
ZT-3	500* (110+130) *120	50
ZT-4	1000* (58.5+78.5) *68	33
ZT-5	800* (56+74) *65	25
ZT-6	1150* (48+54) *51	20
AT-1	500* (115+135) *130	23
AT-2	1500* (65+75) *70	21.5
AT-3	500* (110+130) *120	20
AT-4	1000* (58.5+78.5) *68	13. 2
AT-5	800* (56+74) *65	10
AT-6	1150* (48+54) *51	9

P.S: The types of ZT-7, ZT-8, AT-7 and AT-8 are flat-anode. The iron feet material of ZT-2, ZT-4, ZT-5, ZT-6, AT-2, AT-4, AT-5 and AT-6 types are steel.



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## Sacrificial Anode

# Sacrificial Anode

#### Table6 Sacrificial anodes used for buried pipelines and storage tanks

Model	Specification L*W*H mm	Weight kg
ZP-1	1000* (78+88) *85	50
ZP-2	1000* (65+75) *65	33
ZP-3	800* (60+80) *65	25
ZP-4	800 * (55+64) *60	22
ZP-5	650* (58+64) *60	18
ZP-6	550* (58+64) *60	15
ZP-7	600* (52+56) *54	12.5
ZP-8	600* (40+48) *45	9
MG-22	700* (130+150) *125	22
MG-14	700* (100+110) *105	14
MG-11	700* (90+100) *90	11
MG-8	700* (75+85) *80	8
MG-4	700* (55+60) *55	4
MG-2	350* (55+60) *55	2

P.S: M means magnesium alloy anodes.

#### Table7 Round-disk sacrificial anodes used for seawater cooling system

Model	Specification mm L* (on bottom+ up bottom) *H	Weight kg
ZE-8	Ф300*60	30
ZE-9	Ф360*40	28.5
ZE-10	Ф300*40	20
ZE-11	Ф200*50	10.5
ZE-12	Φ180*50	8.5
ZE-13	Ф120*100	7.5
AE-11	Ф300*60	11.5
AE-12	Ф360*40	9
AE-13	Ф300*40	7.5
AE-14	Ф200*50	4
AE-15	Φ180*50	3.5
AE-16	Φ120*100	2.5

#### Table8 Long-strip sacrificial anodes used for seawater cooling system

Model	Specification L*W*H mm	Weight kg
ZE-1	500× (115+135) ×130	56
ZE-2	1000* (80+100) *80	50
ZE-3	500* (105+135) *100	40
ZE-4	500* (80+100) *80	25
ZE-5	400* (110+120) *50	16
ZE-6	300* (140+160) *40	12.5
ZE-7	200* (90+110) *40	5.5
AE-1	1200* (200+280) *150	120
AE-2	800* (200+280) *150	80
AE-3	1000* (115+135) *130	46
AE-4	500* (115+135) *130	23
AE-5	1000* (80+100) *80	20
AE-6	500* (105+135) *100	16
AE-7	500* (80+100) *80	10
AE-8	400* (110+120) *50	7
AE-9	300* (140+160) *40	5
AE-10	200* (90+110) *40	3

#### Table9 Sacrificial anodes used for the inside of storage tanks

Model	Specification L*W*H mm	Weight kg
ZC-1	750* (115+135) *130	85
ZC-2	550* (115+135) *130	56
ZC-3	500* (115+135) *100	40
ZC-4	300* (115+135) *100	25
AC-1	750* (115+135) *130	35
AC-2	500* (115+135) *130	23
AC-3	500* (115+135) *100	26
AC-4	300* (115+135) *100	10



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## Impressed Current System Power



Working interface of ocean monitoring system

#### Table10 Potentiated parameter of transform-rectifier

Model	Input volt	Output current/volt	Notes
KHL-1-10	220V (380V) /50Hz	0~150A/0~150V	Silicon-controlled
CBH-1-8	220V (380V) /50Hz	$1 \sim 100 \text{A} / 10 \sim 150 \text{V}$	Magnetic saturation
INA	220(380)V/50Hz	0~300A/0~24V	
DJH	380V/50Hz	0~300A/0~40V	High power transistor
GKH	220V (380V) /50Hz	0~100A/0~50V	High frequency switch.

P.S: All voltage of product in table can be made by requirement

#### Table11 Remote monitors power supply specification

No	Name	Technical parameters
1	Input power	Three phase, 380V/50Hz
2	Fixed output volt	50V
3	Fixed output current	300A
4	Unit control range	-2.0~+1.0V
5	Unit control deviation	$\pm 10 \text{mV}$
6	Protection requirements	Meet three anti on sea
7	Working temperature	$-10$ C $\sim$ 50 C

## Auxiliary Anode

Auxiliary anode is an important part of impressed current cathodic protection system. Different kinds of auxiliary anodes are applied to different environments. For example, high silicon cast iron anode is usually used in soil, though auxiliary anodes such as titanium with platinum plating, tantalum-niobium and lead-silver are used in seawater.

#### Table12 Common specifications of auxiliary anodes

Model	Name	Shape	Specification mm L*W*H	Operating current A	Life year
CYB-3	Platinum niobium	rectangular	800*180*25	≤70	
CYB-4	composite anode	rectangular	600*180*25	≤50	20
CYB-2	Platinum titanium anode	rectangular	920*180*25	≤50	
CYY-1	Ti based metal	roundel	Ф340*33	≤50	15
CYY-2	oxide anodes	rectangular	1200*253*33	≤100	15
CYQ-5	T and allower miner	rectangular	920*180*40	1.5~30	
CYQ-6	platinum anode	rectangular	1340*180*40	2.5~50	>10
CYQ-7	r	rectangular	540*180*40	1.0~2.0	
DYY-1		tubular	Ф25*1000	8~12	
DYY-2		tubular	Φ25*500	5~8	
DYY-3		tubular	Φ50*500	10	20
DYY-4	Buried metal	tubular	Φ50*800	12.5	
DYY-5	Oxfue alloue	tubular	Φ50*1000	15	
DYY-6		ribbon	6.35*0.635	2.3	50
DYY-7		ribbon	12.7*0.9	4.6	50
DYY-1/n		cluster	Ф25*1000*n	$(8 \sim 12) \times n$	
DYY-2/n		cluster	Ф25*700*n	$(5 \sim 8) \times n$	
DYY-6			Φ50*1500	1.2~18.8	20
DYY-7	high silicon	~	Φ75*1200	1.5~22.6	20
DYY-1/n	cast-iron anode	Cylindrical	Φ75*1500	1.8~28.3	
DYY-2/n			Φ100*1500	2.4~37.7	
PRX-1	Conducting polymer flexible anode	Filamentous	Ф13.2	52mA/m	40
TRX-1	MMO/Ti Flexible	Filamentous	Φ0.8	52.5 mA/m	40
TRX-2	anode	i namentous	Φ1.6	160 mA/m	40

P.S: Product life may change under the impact of working medium and current density.



#### Titanium and titanium joints and conduction



Platinum-niobium auxiliary anode





Mosaic composite anode





**Deep-well anode** 



MMO (mixed metal oxide) meshed High silicon cast iron anode



## Flexible Anode

Superiority

and flexible use

• Even distribution of protection current

Flex anode is an auxiliary long-line continuous anode. As a new anode product in the field of anode protection, it not only successfully solves the problem of anode protection' for old pipes, but also solves some traditional technical problems of anode protection. It is mainly applied to anode protection for buried steel pipes and storage tanks, with convenient construction and remarkable anti-corrosive effect. Sunrui is exclusive agent of Telpro Flex-Anode in China. Sunrui can supply MMO/Ti flexible anode, conductive flexible anode etc.

• Arbitrary clipping in accordance with protection object, convenient

• Minimum disturbing influence on surrounding metal structures, No

shield or interference in complex pipe network area



# MMO/Ti wire

Telpro-MMO/Ti flexible anode

• No pollution on environment, good sealing performance, low grounding resistance, ensure the service life of the anodes and improving economy of cathodic protection



Conducting polymers MMO/Ti flexible anode

## Application

- Cathodic protection of aging and damaged pipes
- Cathodic protection of pipes in high soil resistivity region
- Cathodic protection of power and municipal utilities, pipe network, oil tank etc.



**MMO/Tinet** 



MMO/Ti flexible anode

## Reference Electrode

Reference electrode is used to measure the potential of the protected base. So, the electrode reaction on the reference electrode must be single reversible reaction, and the stability and reproducibility of reference electrode potential is good.

#### Table13 Reference electrode specifications

Model	Name	Life year	Environment	
CCY	Ag / AgCl reference electrode	10	Seawater	
CYL	Silver / silver halide reference electrode	10	Seawater	
CCX-1	High-purity zinc reference electrode	10	Security Drashish water	
CCX-2	Zinc- aluminum-silicon reference electrode	10	Seawater, Brackish water	
MMO-1	Molybdenum / molybdenum oxide reference electrode	10	Concrete soil	
MCT-1		5	soil	
MCT-2	Copper / saturated copper	10	Buried with a long electrode life	
TCCT	sulfate reference electrode	Continue to use after	Tank ( portable )	
CCT	-	adding copper sulfate	Water, soil (Portable)	



#### Ag-AgCl or Ag-AgX reference electrode



Several types of reference electrodes and auxiliary anodes

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Long-term Cu-CuSO<sub>4</sub> reference electrode

## Cathodic Protection Accessories

#### Table14 Common test station type and specification

•	lest station
•	Grounding cells

- Insulating flanges, Insulating couplings
- Anode backfills of various
- Compositions
- Shaft grounding system •
- Monitoring unites of stray current in metro system
- Al welding agent and Welding mold
- Copper lead welding
- Lightning protection equipment
- Reinforced concrete corrosion sensor
- Remote control system

Model	Specification L*W*H mm	Material
CS-1	2000*Ф108*4	Carbon Steel
CS-2	1800*Ф89*3	Carbon Steel
CS-3	1200*120*120	Stainless steel
CS-4	1600*120*120	Cement
CS-5	1800* <del>0</del> 89*4	FRP

#### Table15 Common zinc grounding cell specification

Model	Specification L*W*H mm
ZJD-1	1000*40*40
ZJD-2	1500*40*40
ZJD-3	Φ40*1000
ZJD-4	Φ40*1500
ZJD-5	Φ60*2000



Test station



**Potential transmitter** 

Solid state to coupler



Double zinc grounding





Spark gap type equipotential connector



## **ECI Characteristics**

- NDT (nondestructive testing) technology
- Measure several important corrosion parameters simultaneously: the linear polarization, resistivity, open circuit potential, temperature, chlorine content
- Contain all the necessary electrodes and circuit components
- As a terminal device of digital network
- Digital signal has anti-jamming ability of EMI source nearby
- Use the SDI 12 industry standard protocols
- The longest measurement network of each terminal connection is up to 200 feet
- Use solar cell and power supply, and can make wireless telecommunication through concrete external cellular transceiver



Matro stray current monitoring system

#### Table17 Stray current monitoring system for subway

Products	Cu/SO 4 Reference Electrode	MoO3 Reference Electrode	Drainage tank	Unilateral connecting device	Intelligent monitor	Intelligent sensor	Intelligent adapter
Annual capacity	4000pcs	2000pcs	100sets	100sets	100sets	1000sets	500sets





#### Table16 Parameters of ECI corrosion monitoring probe technology

Appearance size	L (83 mm) $\times$ W (94 mm) $\times$ H (122 mm)
Shell material	VALOXTM Plastic,, Epoxy filler, Waterproof sealing
The concentration of chloride ion indicator	range: ±1.3V
Resistivity measurement	range: 1,000 $\sim$ 19,000 $\Omega \cdot \text{cm}$
The polarization resistance measurements	1 M $\Omega \cdot cm \sim 1$ K $\Omega \cdot cm$
The open circuit potential	±1.3V <sup>2</sup>
Temperature sensor	$-40^{\circ}$ C $\sim$ $+70^{\circ}$ C
Power consumption	non activated state: 1.5 mA /12 V; activated state: 4.5 mA /12 V
Communication protocol	Compatible with SDI-12 1.2 version

## **Coating Protection**

Coating protection technology is one of the most common and effective methods to protect metal structures. The coatings are composed of anticorrosion coating and antifouling coating etc. Anticorrosion coating utilizes physical barrier of corrosive medium and slow-release function of anticorrosion additives to protect metals substrate. Antifouling coating utilizes the effects of biological inhibition components gradually exuding, coating's peeling off, coating's low surface tension, coating's surface electrostatic and electrolytic products and so on to prevent the marine fouling life from adhering the water-merged parts of the structures.

Sunrui has been engaged in research, development and application of anticorrosion and antifouling coatings technology for about 40 years. It successively created more than dozens of national standards, military standards and industry standards about anticorrosion or antifouling coatings technology. Sunrui is in the domestic leading position of marine environment anticorrosion and antifouling coatings field. The series products of anticorrosion and antifouling coatings that Sunrui produced have been extensively applied in many areas such as ships, harbor installations, submerged pipelines, underground pipelines and pipe network, offshore platforms, petrochemical plants and power plants to create significant economic profits as well as social benefits.



Cold spray anticorrosion coating



Cold spray repair coating



Metal ceramic antifouling coating



Composite coating for fasteners

## Application and Service

#### • Ship

- Harbor installation
- Marine engineering
- Underground pipeline
- Oil storage tank
- Power plant

Service

- Petrochemical enterprise
- Reinforced concrete structure and pile Foundation of building
  - of metallic structures
  - - protection scheme





# Application

• Studies and technology counseling of anti-corrosion program as well as the engineering, surveillance, and inspection of anti-corrosion projects of all kinds

• Design, engineering, debugging, quality surveillance, survey of protection performance and personnel training of various cathodic protection projects • Investigation, inspection, life estimation, failure analysis and anti-corrosion

design of metallic structure, and the supply of supplemental optimum cathodic

• Various series of cathodic protection products and coating products

• Design, engineering, surveillance, and inspection of protection performance of coating and combining coating with cathodic protection

• Technical training, guidance and service

Cathodic protection for Donghai Bridge Won the highest prize of national technology progress



## Ship & bridge field

Sunrui has completed many cathodic protection projects and coating protection engineering for Shanghai Yangtze River Bridge, Donghai Bridge, Qingdao Bay Bridge, and Hong Kong-Zhuhai-Macao Bridge with supplying corrosion control products and engineering service. Sunrui has rich engineering performance and experience in cathodic protection technology of military ship, container ship, bulk carrier ships and coastal facilities.

#### Table18 Cathodic protection projects for bridge

Customer	Cathodic protection project	Finish date
The Hong kong-Zhuhai-Macao Bridge Construction Headquarters	Project for steel pilings of Hang Kong-Zhuhai-Macao bridge	under construction
Traffic Engineering Construction Bureau of Jiangsu Province	Project for CQ-A6 of Chongqi bridge	2012
Shandong Hi-speed Group Co., Ltd.	Project for 2, 6, 7 sections steel cover boxes of Qingdao Bay Bridge	2010
Nan'ao Bridge Construction Corporation	Project for steel pilings docks of Nan'ao Bridge	2010
Shanghai Yangtze River Tunnel Bridge Construction Development Co.,Ltd.	Project for steel pilings docks of Yangtze River Bridge in Shanghai Chongming more	2009
Shanghai Tongsheng Bridge Construction Co.,Ltd.	Project for steel pilings docks of Donghai Bridge	2008



Cathodic protection project for Liaoning ship



Cathodic protection for Donghai Bridge



Cathodic protection project for container ship



United protection project for Jiaozhou Bay Cross-sea Bridge

## Harbor & port field

Sunrui has quickly developed in the corrosion control field of harbor. It has undertaken and completed the Tianjin port, Qingdao port, Zhuhai Gaolan Port, Yangshan port, Caofeidian port and other large coating and cathodic protection projects. Because of the first-class technical level and nice engineering quality of these constructions, Sunrui has good reputation in anticorrosion industry.

#### Table19 Cathodic protection projects for harbor and port

Customer	Cathodic protection project	Finish date
Qingdao Shihua Crude Oil Dock Co., Ltd	Project for steel pilings docks of Shihua liquid chemical wharf	2013
Yuanhang Ore Terminal Company of Tianjin Port	Project for steel pilings docks of Yuanhang Ore Terminal	2012
Qingdao Hongxing Logistics Industrial Co., Ltd	Project for Hongxing Liquid chemical wharf	2011
Fujian Kemen Port Logistics Co., Ltd	Project for Fujian Kemen Port 4# and 5# berths	2011
Dandong Port Group Company	Project for steel pilings docks of Dandong port 1#, 2#, 3#, 12# and 13# berths	2010
Zhuhai international container Terminals Limited	Project for Gaolan Harbor of Zhuhai	2010
China Hudian Corporation Fujian Power Company	Project for steel pilings docks of Luoyuan bay Kemen operation area 10# and 11# berths in Fuzhou	2008
Dalian Changxing Island Port Co., Ltd	Project for steel pilings docks of public port district 1#, 2# and 3# berths in Dalian Changxing Island	2007



Cathodic protection project for **Gaolan Harbor of Zhuhai** 



Cathodic protection for steel pilings docks of Fulian Harbor





Cathodic protection for 300,000 tons crude oil harbor in Caofeidian



Coating and sacrificial anode cathodic protection for steel pilings docks of Tianjin Harbor



## Pipe network & oil tank field

Sunrui has completed many cathodic protection projects of underground pipe network, gas pipeline, water pipeline for Guangxi petrochemical, Lanzhou petrochemical, Yunnan petrochemical, West-East gas pipeline, South-to-North water diversion, Northwest of Liaoning Province Water Transfer and so on. Many of the projects are national or provincial key projects. Sunrui also undertook a number of cathodic protection projects for oil tanks area in Huangdao national reserve depot, Zhoushan national strategic reserve depot, and Guangxi commercial oil reserves and so on.

#### Table20 Cathodic Protection Projects for Petrochemical

Customer	Cathodic protection project	Finish date
CNPC Guangdong Petrochemical Industries Company	Project for the factory of Guangdong petrochemical	under construction
Qingdao HaiYe Mercuria Company	Project for storage tanks of HaiYe Mercuria Company	under construction
CNPC Yunnan Petrochemical Industries Company	Project for storage tanks area of Yunnan Petrochemical	2013
CNOOC Yantai Petrochemical Industries Company	Project for storage tanks area for Yantai Petrochemical	2013
CNPC Engineering Design Co., Ltd Southwest Branch	project for nation base oil storage tanks area in Lanzhou	2011
Xinjiang Petrochemical Construction Group Co., Ltd	Project for nation base oil storage tanks area in Dushanzi	2010
CNPC Guangxi Petrochemical Industries Company	Project for $100 \times 10^4 \text{m}^3$ crude oil commercial reserves in Qinzhou	2010
Chinese HQCEC	Project for No.1227 crude oil reserves in Qingzhou	2009
PetroChina Co., Ltd Pipeline Company	Project for crude oil commercial reserves in Daqing Linyuan	2008
CNPC Guangxi Petrochemical Industries Company	Project for the factory and oil storage tanks of Guangxi petrochemical	2007



Cathodic protection project for **Guangxi Petrochemical** 



Cathodic protection project for grounding network of Lanzhou Petrochemical



Cathodic protection project for nation oil storage tanks of Zhoushan



Cathodic protection project for PCCP of South-to-North water diversion

# Power and municipal facilities field

The cathodic protection project for grounding network and circulating water pipeline of Huaneng Yuhuan power plant has been completed by Sunrui. The power plant is the first 4\*1000MW supercritical coal-fired power plant unit in the country. The cathodic protection project for grounding network and circulating water pipeline of Taishan power plant is one of national key projects and a key project of Guangdong province during the eleventh five-year plan.

#### Table21 Cathodic Protection Projects of Power Station

Customer	Cathodic protection project	Finish date
Zhejiang Zhenhai Power Plant	Project for pipeline of the power plant	2013
Zhejiang Liuheng Power Plant	Project for pipeline and grounding network of the power plant	2012
Shanghai Foundation Engineering Group Co., Ltd	Project for water channel of Sanmen nuclear power	2011
The First Phase of Fujian Shishi Hong Shan Thermoelectric	Project for grounding network and circulating water pipeline	2010
Aceh Plant in Indonesia	Project for circulating water pump of the power plant	2010
Shenyang Power Machinery General Factory	Project for Haiyang nuclear power network	2010
Shenyang Power Machinery General Factory	Project for the 1th phase of Yangjiang nuclear power	2009



network and circulating water pipeline of Huaneng Yuhuan power plant



Cathodic protection projects for grounding network and circulating water pipeline of Taishan power plant









Cathodic protection projects for circulating water pipeline and condenser of Jiangsu **Nuclear Power Corporation** 



Cathodic protection project for UCH power plant in Pakistan



## Marine engineering field

Sunrui has undertaken a lot of sacrificial anodes delivery projects of marine engineering to show strong technical strength and market competitiveness. A single one of the sacrificial aluminum anodes made by Sunrui and supplied for Liwan 3-1 offshore platform project is more than 620 kg. It is currently the largest single anode in the world at present. Sunrui owns more than 70% domestic market share and represents the world's most advanced level in marine engineering field.

#### Table22 Typical Projects in Marine Engineering

Customer	Cathodic protection project	Product	Total weight	Project location	Finish date
Offshore Oil (Qingdao) Co., Ltd	Liwan 3-1 project LF7-2 Enping oilfield group project	Aluminum alloy sacrificial anode for platform jacket	1610T 426T 660T	Panyu Lufeng Enping	2011.6 2012.6 2013.6
Shenzhen Chiwan Sembawang Engineering Co., Ltd	PY4-2&PY5-1 project HY7-1 & HY7-1N project	Aluminum alloy sacrificial anode for platform jacket	1000T 500T	Panyu Huangyan	2011.5 2013.4
Offshore Oil Engineering Corp	Liwan 3-1 project	Aluminum alloy sacrificial anode for platform jacket	1200T	Panyu	2011.5
Penglai Jutal Offshore Engineering Co., Ltd	PY34-1 project Enping oilfield group HZ24-2 project	Aluminum alloy sacrificial anode for platform jacket	1170T 500T	Panyu Huizhou	2012.3 2013.6
CNOOC Panyu to Huizhou Project Department	CNOOC Panyu to Huizhou project	Aluminum alloy sacrificial anode submarinepipeline	480T	Panyu	2005.8
CNOOC Energy Technology Company Pipeline Engineering Company	Liwan 3-1project	Aluminum alloy sacrificial lanode submarinepipeline	120T	Panyu	2011.5



Cathodic protection project for Liwan 3-1 offshore platform



Cathodic protection project for Penglai 19-3 offshore platform





Cathodic protection project for Huangyan 7-1 offshore platform

Cathodic protection project for Bohai Suizhong 36-1 oilfield center platform

## Subway field

The metro stray current will greatly increase the risk of subway corrosion. So, the state formulates the "metro stray current corrosion protection technology procedures" to ensure that the subway has been effectively protected through limiting the subway stray current. Sunrui is committed to research and spread subway stray current protection technology for more than 10 years. With high-speed development of subway and rapid rail in domestic, Sunrui will work much better in this field.

#### Table23 Delivery Performance of Metro Stray Current Protection Projects

Cathodic protection project
Pearl Line of City Rail Transit of Shanghai
Guangzhou Subway
City Rail Transit of Beijing
Fast Track Rail Transit from Tianjin City to th
Binhai New Area
Shenzhen Subway
Wuhan Subway
Nanjing Subway
Shanghai Subway
Tianjin Subway



Metro stray current protection project for Chengdu Subway



Metro stray current protection project for Guangzhou Subway



#### **Delivery products**

Integrated monitoring system of stray current protection system Reference electrode of stray current protection system Drainage tank of stray current protection system

Integrated test system of stray current

Reference electrode of stray current protection system Reference electrode of stray current protection system Reference electrode of stray current protection system Reference electrode of stray current protection system









Metro stray current protection project for Shanghai City Rail

