附件一

台鹽生技 TAIYEN 鹽實業股份有限公司

通霄精鹽廠
汽電共生設備汰換新建工程

Selective Catalytic Reduction System

SCR系統技術規範書

台灣汽電共生股份有限公司					
			陳宗佑	傅國富	2020-12-29
			陳宗佑	傅國富	2020-12-14
			驗證	審定	日期
0	2020-12-25	依109-0540號審查意見修正	郭佳峰	洪維良	Wolfgang Kurka
C	2020-12-11	進版無修正	郭佳峰	洪維良	Wolfgang Kurka
B	2020-06-02	依L-TCC-TEMES-20-049 審查意見修正	郭佳峰	洪維良	Wolfgang Kurka
A	2020-03-23	提送存查	郭佳峰	洪維良	Wolfgang Kurka
版次	日期	說明	設計	校對	審核
YARA		YARA Environmental Technologies GmbH Taiwan Branch No. 56, Lane 180, Sec.6, Min Chuan E. Rd. 11490 Taipei, Taiwan www.yara.com	專案編號	TYCN	
			文件編號	TESF-M-GL-905	
			總頁數	11 版次	B

TABLE OF CONTENTS

1. GENERAL INFORMATION

1.1. General Information about YARA

YARA Environmental Technologies is the center of competence for basic / detail engineering and turnkey solutions of SCR and SNCR DeNOx systems.

With over 500 systems installed globally our flue gas cleaning systems are used for the efficient removal of pollutants from flue gas using catalytic and non-catalytic denitrification processes, as well as SNOXTM system.

Our after sales service including catalyst rejuvenation assures optimum maintenance cost and catalyst lifetime of the DeNOx systems.

As part of YARA, the experts at YARA Environmental Technologies together with specialists within the group accompany you through all phases of the project – starting with the planning, continuing with the technical design and construction, right up to operation of the plant.

See also:

www.noxcare.com

www.yara.com

1.2. General Project Description

The proposal is based on the phone request and information received from Star Energy for one set DeNOx System for a new Gas Boiler TaiYen in Taiwan.

This proposal includes 1 set of SCR system, which will be installed on a new gas boiler plant. The reactor has 1 catalyst support structures for the initial catalyst (0.5 Layer) and 0.5 spare layer space for future catalyst. The reactor will be designed by YARA.

The DE-NOx is designed as compact Layout to minimize the space requirement and to optimize the performance. Similar design is used for many power plants, such as TYC (210 ton/hr), FPC - LP2 (200 ton/hr), LP1 (140 ton/hr), JP4&5 (2x350 ton/hr), NPC - KS1 (200 ton/hr), KS2 (200 ton/hr), KS3 (250 ton/hr) and JH1 (200 ton/hr) SCR retrofits projects implemented by YARA Environmental Technologies GmbH for similar projects.

The current Design is the most advanced technology for boilers. It ensures the best performance with the lowest investment and operation cost. Due to the special construction of the inlet duct and reactor the catalyst plugging can be minimized.

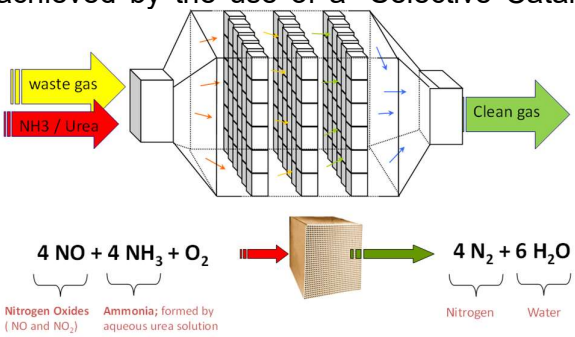
1.3. Confidentiality

Text The content of this offer is intellectual property of YARA Environmental Technologies. Thus copy and transmission in any form to anybody beside the original recipients of this offer is prohibited.

2. GENERAL PROCESS DESCRIPTION

2.1. Chemical Reactions

The abatement of NOx (NO and NO2) is achieved by the use of a "Selective Catalytic Reduction (SCR) system". This is a dry flue gas treatment process, which uses ammonia (NH3) as a reducing agent and a catalyst.



The selective catalytic reduction of NOX is performed on a catalyst (substrate material TiO2 as Anatase and transition metals such as V, W and/or Mo as active sites) with ammonia as a reducing agent forming harmless reaction products according to the following reaction mechanisms:

$$NO2 + NO + 2\ NH3 \leftrightarrow 2\ N2 + 3\ H2O$$

$$4\ NO + 4\ NH3 + O2 \leftrightarrow 4\ N2 + 6\ H2O$$

$$2\ NO2 + 4\ NH3 + O2 \leftrightarrow 3\ N2 + 6\ H2O$$

Ammonia (NH3) is injected into flue gas and reacts with NOx on the SCR catalyst resulting in nitrogen (N2) and water (H2O).

In this case aqueous ammonia (<25%) is used as reduction agent.

Several side reactions occur under certain conditions. One of these is oxidation of SO2 into SO3, the so-called SO2 conversion.

$$2\ SO2 + O2 \leftrightarrow 2\ SO3$$

This reaction has to be minimized by optimal catalyst design to avoid the formation of ammonia - sulfate compounds in the catalyst and downstream of the SCR system.

3. TECHNICAL DESIGN DATA

3.1. Flue Gas

Parameter	Unit	Design	Remark
Flue gas flow rate	Nm³/h wet @ act. O2	50845	-
Temperature	°C	350	-
Flue gas composition			
act. O_2	vol % wet	2.4524	-
CO_2	vol % wet	8.3738	-
H_2O	vol % wet	18.4319	-
NO_x inlet (< 50% NO_2)	ppmv, dry @ ref. O2	70	-
NO_x outlet	ppmv, dry @ ref. O2	30	
SO_2	vol % wet	0.00	-
N_2	vol % wet	70.7419	-
Dust	mg/Nm³	1.0	-

4. SCOPE OF SUPPLY

4.1. Description of Main Components

4.1.1. (P-6301)Storage tank for aqueous ammonia (25%)

Basic Data

Number of units	**1**
Net volume	~5.5 m³
Diameter(ID)	~1650 mm
Height	~3000 mm
Storage Capacity	20 days
Tank design temperature	MAX50°C ; MIN10 °C
Material	SS304

Technical Description

The tank is a single wall vertical type manufactured in stainless steel. From design point of view the tank is an open vessel (no pressure or vacuum built up) and when filling no ammonia gas will be released to the environment. The outlet of the tank is equipped with a manual shut off valve.

The tank is equipped with ladders, railing and an access cover on the roof for service reasons.

The tank is equipped with a level transmitter for both local and remote indication of the tank volume, and a tank pressure transmitter.

4.1.2. Reagent supply pump skid

Basic Data

Number of units	**1**
Dimension (L x W x H)	~3000 x ~700 x ~1050 mm
Weight	~550 kg
Operating temperature	Ambient °C
Material	A36 (weted pard SS316)

The supply pump skid is equipped with two pumps for supplying ammonia water from storage tank to AFCU system. The supply pump skid is a modularization and standard design by YARA. The supply pump skid will be supplied by YARA. The pump module communicates with the DCS.

4.1.3. Supply of Utility Services(FOR ONE PUMP)

Process Media	Consumption	
	Unit	Value
F - Compressed air (instrument)	Nm^3 / h	<1
I - Electricity low	KW	0.75

4.2. Reagent preparation and supply

4.2.1. Ammonia flow control unit (AFCU)

Basic Data

Number of units	**1**
Dimensions (L x W x H)	~350 x ~1900 x ~2000 Mm
Weight	~350 kg
Operating temperature	Ambient °C
Piping Material	SS304

From the storage area the aqueous ammonia is fed to the Ammonia supply system and the ammonia flow control unit (AFCU) and to the flue gas system. The AFCU is controlled according to the flue gas data and adjusts the ammonia flow which is fed to the nozzles, which are directly injecting into the flue gas duct.
The nozzles used are dual fluid atomizing nozzle. The aqueous ammonia is atomized with this nozzle and injected into the flue gas stream. Compressed or plant air is used as atomizing medium and is atomizing the aqueous ammonia into micro droplets to ensure a short evaporation time.

Supply of Utility Services

Process Media	Consumption	
	Unit	Value
F - Compressed air (instrument)	Nm^3 / h	35
I - Electricity low	KW	<0.05

4.2.2. (J-6301)INJECTORS

Basic Data

Number of injectors	**1**
Dimensions	~1450mm / 2”
Design inlet temperature	350 °C
Material	ASTM A240

Supply of services

The special injectors are manufactured in stainless steel. It has a spraying hole at the tip in an angle of 30º-35º. This means that the injection can be directed and adjusted. The spraying length and width as well as the size of the droplets are adjustable. Compressed air is used to atomize the droplets of reduction agent. For injectors in stand-by the compressed air is used for cooling of the injector.

4.3. Flue gas system

4.3.1. (L-6301)SCR reactor (boiler casing)

Basic Data

Number of units	**1**
Dimensions (D x W x H)	(L)~4256 x (W)~4122 x (H)~5905 mm
Operating temperature	~350 °C
Material	A36

Technical Description

The SCR reactor is integrated in the boiler casing and built as self-supporting structure. It is equipped with two manhole, the necessary connection points for instrumentation and catalyst access door from the side.

The flow direction in the SCR reactor is vertical.

The SCR reactor including the catalyst support structure will be designed for 1 catalyst layer (0.5+0.5) with spare high for future catalyst upgrade.

4.3.2. Catalyst

SCR Catalyst

Parameter	Unit	Value
Catalyst type	-	Honeycomb
Number of layers (initial + spare)	-	(0.5+0.5)
Working temperature	°C	~ 350
Catalyst volume	M^3	~2.6
Module height	mm/foot/inches (Kati)	~390 mm
Pitch	mm	~3 mm
Catalyst pressure drop, clean (0.5+0.5 layer)	mm WC	30

4.3.3. Analysers

Basic Data

Number of units	**1**
Parameter	NOx
Measurement range	0-100 ppm