CHI NHÁNH PHÁT ĐIỆN DẦU KHÍ
NHÀ MÁY NHIỆT ĐIỆN THÁI BÌNH 2

CỘNG HÒA XÃ HỘI CHỦ NGHĨA VIỆT NAM
Độc lập - Tự do - Hạnh phúc

Số: 542 /NMĐTB2-KTATMT
V/v cung cấp báo giá vật tư chất xúc tác cho hệ thống SCR – NMNĐ Thái Bình 2.

Thái Bình, ngày 21 tháng 3 năm 2025

Kính gửi: Các Nhà cung cấp

Ngày 05/02/2025 Nhà máy Nhiệt điện Thái Bình 2 (Nhà máy) có Công văn số 226/NMĐTB2-KTATMT về việc "cung cấp báo giá vật tư chất xúc tác cho hệ thống SCR – NMNĐ Thái Bình 2". Tuy nhiên, do điều chỉnh phạm vi công việc, Nhà máy xin được gửi lại phạm vi công việc và đề nghị Quý Công ty quan tâm, xem xét, cung cấp báo giá với nội dung như sau:

- Phạm vi công việc:
  - ✓ Danh mục hàng hóa/dịch vụ như đính kèm;
  - ✓ Hàng hóa mới 100%, chưa qua sử dụng, bảo hành theo tiêu chuẩn của Nhà sản xuất và tối thiểu 12 tháng kể từ khi được bàn giao. Hàng hóa được sản xuất từ năm 2024 trở lại đây và đáp ứng yêu cầu kỹ thuật được đề cập trong phạm vi công việc.
- Tiến độ cung cấp: Do Nhà cung cấp đề xuất nhưng không muộn hơn 30/9/2025.
- Địa điểm giao hàng: NMNĐ Thái Bình 2, xã Mỹ Lộc, huyện Thái Thụy, tỉnh Thái Bình.
- Hiệu lực báo giá: 30 ngày kể từ ngày báo giá.
- Thời gian gửi báo giá: không muộn hơn 15h00 ngày 28/3/2025.
- Báo giá được ký tên, đóng dấu bởi Người đại diện đủ thẩm quyền của Quý Công ty.
- Phương thức gửi báo giá: Gửi trực tiếp qua bưu điện theo địa chỉ tiếp nhận báo giá hoặc qua Email, Fax.
- Thông tin liên hệ:
  - ✓ Người nhận: Trần Văn Yên, Phòng KTATMT, NMNĐ Thái Bình 2;
  - ✓ Địa chỉ: Xã Mỹ Lộc, huyện Thái Thụy, tỉnh Thái Bình;
  - ✓ Số điện thoại liên hệ: 0978807036; Email: yentv@pvpgb.vn; hungbb@pvpgb.vn

NMNĐ Thái Bình 2 cảm ơn sự hợp tác của Quý Công ty.

Trân trọng./.

Nơi nhận:
- Như trên;
- CNPĐ DK (để b/c);
- GĐ NM (để b/c);
- Phòng: TM (để p/h);
- Lưu: VT, KTATMT (TVY: 1 b).

Đính kèm:
- Phạm vi công việc mua sắm.

TL. GIÁM ĐỐC CHI NHÁNH PĐDK
KT. GIÁM ĐỐC NMNĐ THÁI BÌNH 2
PHÓ GIÁM ĐỐC

M.S.C.N: 0100681552-036 CHI NHÁNH PHÁT ĐIỆN DẦU KHÍ TẬP ĐOÀN DẦU KHÍ VIỆT NAM THÀNH PHỐ HÀ NỘI

Nguyễn Văn Chung

Xã Mỹ Lộc - huyện Thái Thụy - tỉnh Thái Bình
ĐT: 02273.721.515; Fax: 02273.721.678

PVCV đơn hàng "Mua sắm và lắp đặt các khối chất xúc tác tại nhánh A Hệ thống SCR Tổ máy S1 - NMNĐ Thái Bình 2"
Order "Procurement and installation of catalyst blocks at branch A of SCR system Unit S1 - Thai Binh 2 Thermal Power Plant"

Stt/No.	Tên Vật tư/ Goods Name	Yêu cầu kỹ thuật/Tech Specification		Tài liệu tham chiếu/Ref Document	Đơn vị/Unit	Số lượng/Quantity	Hãng sản xuất gốc/OEM	Ghi chú/Remark
		Kích thước bao/Dimension (LxW mm)	Thông số đảm bảo/*Guaranteed parameters*					
I	**Mua sắm vật tư Catalyst**							
1	Khối xúc tác cho hệ thống SCR/*Catalyst of SCR System:* **VE532AH**	2.346x1.410	- Catalyst mass per layer (70 modules): ≤65000kg; - NOx concentration at SCR system outlet at BMCR, RO with Performance/worst coal (ppm, O2 6% dry volume): ≤ 499.4 mg/Nm3; - Catalyst life to meet the NOx concentration at SCR system outlet and ammonia slip requirement 2 ppmd at 6% O2 (From the point of boiler flue gas passing through SCR De-Nox system initially): ≥16.000 hr; - Max Ammonia Consumption as 99.5% concentration (Based on 499.4mg/Nm 3 NOx emission at SCR system outlet) With 3 initial layers, RO with worst coal: ≤ 209.5 kg/hr/reactor - SCR De-NOx system gas side draft loss (From right after connecting point of economizer outlet duct and economizer bypass duct to air preheater expansion joint inlet) With 3 Initial layers: ≤79.35 mmH2O	TB2-SDC VP124-00100-M-M1A-DAS-0002 TB2-SDC.VP124-00100-M-M1A-DRD-0101 TB2-SDC.VP124-00HSJ-M-M1A-CAL-0001 TB2-SDC.VP124-00UVJ-M-M1A-DRD-0001 Rev1	Module	3	Haldor Topsoe (Denmark)	Mỗi Module bao gồm cả chân đỡ, lưới bảo vệ và các tấm chèn (giữa các khối catalyst, giữa catalyst và thành SCR) phù hợp với biên dạng catalyst/*Each Module including support feet, protective grids and Seal plate/Dust hoods (between catalyst blocks, between catalyst and SCR wall).*
2	Khối xúc tác cho hệ thống SCR/*Catalyst of SCR System* : **VF522AH**	2.346 x 946			Module	27	Haldor Topsoe (Denmark)	
3	Khối xúc tác cho hệ thống SCR/*Catalyst of SCR System:* **VE432AH**	1.880 x 1.410			Module	18	Haldor Topsoe (Denmark)	
4	Khối xúc tác cho hệ thống SCR/*Catalyst of SCR System* : **VE422AH**	1.880 x 946			Module	162	Haldor Topsoe (Denmark)	
5	Tấm chèn giữa các khối Catalyst và giữa khối Catalyst và vách SCR/Seal Plate (Dust hoods)		Thickness: 0.6mm Material: C.S. COLD ROLLED ASTM A1008, S235JRG2	TB2-SDC.VP124-00100-M-M1A-SIN-0001 (Page 70/71)	Lot	1	Haldor Topsoe (Denmark)	Các tấm chèn có chiều dày 0.6mm, vật liệu: C.S. COLD ROLLED ASTM A1008, S235JRG2 hoặc tương đương phù hợp với biên dạng các khối xúc tác/Seal Plate are 0.6mm thick, material: C.S. COLD ROLLED ASTM A1008, S235JRG2 or equivalent conform to the shape of the catalyst blocks.
II	**Thi công lắp đặt**							
1	Dịch vụ lắp đặt	- Chuẩn bị biện pháp thi công, công cụ dụng cụ cần thiết/*Prepare construction method, necessary tools and equipments;* - Tháo các khối chất xúc tác hư hỏng đưa về kho tại Nhà máy theo Chỉ định/*Remove damaged catalyst blocks and bring them to the Factory warehouse as specified;* - Thay thế/lắp đặt các khối chất xúc tác mới vào vị trí, lưới bảo vệ, lắp đặt các tấm chèn chắn tro giữa các khối xúc tác và giữa khối xúc tác với thành SCR/*Replace/install new catalyst blocks in place, protective grids, install ash shields/seal plate between catalyst blocks, between catalyst blocks and SCR reactor wall;* - Vệ sinh, nghiệm thu công việc/*Clean and accept the work.*		TB2-SDC.VP124-00100-M-M1A-SIN-0001	Gói	1		Sử dụng tời nâng sẵn có tại Nhà máy để lắp đặt/Contractor may use factory monorail to install

DOCUMENT SUBMISSION STATUS: FC

NOTE:

ISSUE TO PVC
FOR FINAL

REV.	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	APPROVED
2	26 Jun. 2017	For Construction	S.J.HEO	G.Y.OH	S.H.YANG	
1	20 Feb. 2017	For Construction	G.Y.OH	G.Y.OH	S.H.YANG	
0	2 Nov. 2016	For Construction	G.Y.OH	G.Y.OH	S.H.YANG	

OWNER

VIETNAM OIL AND GAS GROUP (PVN)

OWNER'S CONSULTANT

FICHTNER

PVPOWER PCC

EPC CONTRACTOR

PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PVC)

EPC CONSTRACTOR'S CONSULTANT

WORLEYPARSONS

POWER ISLAND PACKAGE SUPPLIER

SOJITZ CORPORATION

DAELIM INDUSTRIAL CO., LTD

PROJECT TITLE

THAI BINH 2 THERMAL POWER PLANT 2 x 600MW

DRAWING / DOCUMENT TITLE

Technical Data Sheet

Vendor's Logo:

FUNCTION	NAME	SIGN	DATE
DRWN	S.J.HEO		20 Feb. 2017
CHKD	G.Y.OH		20 Feb. 2017
APPD	S.H.YANG		20 Feb. 2017

DOCUMENT NO: TB2-SDC.VP124-00100-M-M1A-DAS-0002	No of page: 29	Scale	Rev.2

P.O NO.	110180-29-124-001-A01
ITEM NO.	124
ITEM DESCRIPTION	De-Nox System
DOCUMENT NO.	TB2-SDC.VP124-00100-M-M1A-DAS-0002
DOCUMENT TITLE	Technical Data Sheet
REV NO.	2

Daelim's Approval Status

Daelim Industrial Co., Ltd.	
Job No.	110180
	A - APPROVED
	B - APPROVED WITH COMMENTS
	C - RETURNED FOR CORRECTION
	D - REJECTED
	N - NOT APPLICABLE(REFERENCE ONLY)
SIGNED BY :	DATE :

DIC'S PERMISSION TO PROCEED OR REVIEW TAKEN ON VENDOR PRINTS SHALL NOT RELIEVE VENDOR FROM ITS RESPONSIBILITIES OR LIABILITIES UNDER THE PURCHASE ORDER.

VENDOR'S LOGO:

S&T Corporation

Document Review Comment Sheet

Daelim's Ref. No : TB2-DIC-VD-T-10089

No.	Document No.	Rev	Title	Purpose	Approval Status
1	TB2-SDC.VP124-00100-M-M1A-DAS-0002	1	Technical Data Sheet	FF	C

No.	Daelim's Comments	Vendor's Response
1	Please refer to comments on attached file.	Revised based on comments
2	PVC/PVN's comment will be forwarded separately if any, then vendor should submit revised VP reflecting their comments eeen though current final result is 'A'	Noted
3		
4		

*** Legend**

Purpose:
AP - For Approval
RE - For Reference
FF - For Final / FC - For Construction
F - Final / AB - As Built
INFO - For Information

Approval Status:
A - Approved
B - Approved with Comments
C - Returned for Correction
D - Rejected
N - Reference Only

No.	Document No.	Rev	Title	Purpose	Approval Status	
					In	Out
1	TB2-SDC.VP124-00100-M-M1A-DAS-0002	1	Technical Data Sheet	FC	-	A

	TB2PP/ **Owner/PMC's Comments**	**Contractor's Response**
	General comment	
1	No comment.	
2		
3		

Legend:

Document Purpose
AP = For Approval
RE = For Reference
FC = For Construction
AB = As Built
IN = For Information

AP Outgoing Status
A = Approved
B = Approved with Comments
C = Returned for Correction
D = Rejected

RE Outgoing Status
I = Accepted for Reference
R = Returned for Correction
IB = Accepted with comments.

1. Performance Guarantee

	Description	Guarantee Value
1.1.1	NOx concentration at SCR system outlet at BMCR, RO with Performance and worst coal (ppm, O_2 6% dry volume)	
	- After 16,000 hrs operating	≤ 499.4mg/Nm3
1.1.2	Catalyst life to meet the NOx concentration at SCR system outlet and ammonia slip requirement (From the point of boiler flue gas passing through SCR De-Nox system initially)	
	- with the initial charge of catalyst (hrs)	≥ 16,000 hrs operating hours
1.1.3	SCR De-NOx system gas side draft loss (From right after connecting point of economizer outlet duct and economizer bypass duct to air preheater expansion joint inlet)	
	- With all catalyst including all future layer at BMCR (Max. pressure drop)	≤ 105.8 mmH_2O
1.1.4	Ammonia Consumption (kg/hr.unit)	
	- BMCR with performance coal (3Initial Layers)	≤ 446
	- BMCR with worst coal (3Initial Layers)	≤ 442
	- RO with performance coal (3Initial Layers)	≤ 423
	- RO with worst coal (3Initial Layers)	≤ 419
1.1.5	System availability, %	≥ 98

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2. Predicted Performance

2.1 Performance Coal

Description	Performance coal									
	BMCR	TCC	RO	75%RO	60%RO	50%RO	45%RO	30%RO	TOP HEATER OFF	ALL HP HEATER OFF
A. Flue Gas Flow Rate, Wet/Dry (kg/hr/reactor)										
1) SCR inlet terminal point	1,247,967 /1,196,646	1,205,760 /1,156,175	1,183,782 /1,135,101	963,877 /900,647	841,700 /788,842	761,095 /714,973	708,931 /666,395	563,508 /531,444	1,210,863 /1,128,040	1,241,594 /1,156,669
2) Downstream of AIG	1,258,243 /1,206,921	1,216,028 /1,166,442	1,194,047 /1,145,365	974,092 /910,861	851,886 /799,026	771,261 /728,138	719,088 /676,551	573,636 /541,572	1,221,132 /1,138,308	1,251,869 /1,166,943
3) SCR outlet terminal point	1,258,243 /1,206,921	1,216,028 /1,166,442	1,194,047 /1,145,365	974,092 /910,861	851,886 /799,026	771,261 /725,138	719,088 /676,551	573,636 /541,572	1,221,132 /1,138,308	1,251,869 /1,166,943
B. Flue Gas Flow Rate, Wet/Dry (Nm^3/hr/reactor)										
1) SCR inlet terminal point	936,912 /872,827	905,225 /843,308	888,726 /827,937	725,811 /678,198	635,246 /595,352	575,715 /540,827	536,663 /504,463	427,548 /403,220	909,056 /846,877	932,128 /868,370
2) Downstream of AIG	945,399 /881,312	913,702 /851,783	897,197 /836,407	734,219 /686,604	643,615 /603,627	584,060 /548,982	544,995 /512,511	435,844 /411,137	917,534 /854,885	940,613 /876,292
3) SCR outlet terminal point	945,399 /881,312	913,702 /851,783	897,197 /836,407	734,219 /686,604	643,615 /603,627	584,060 /548,982	544,995 /512,511	435,844 /411,137	917,534 /854,885	940,613 /876,292
C. Flow Gas Flow Rate/Temperature (Am^3/hr/reactor)										
1) SCR inlet terminal point	2,315,138 /392	2,218,104 /387	2,173,394 /386	1,717,040 /367	1,474,240 /356	1,313,435 /346	1,207,435 /338	918,224 /311	2,214,208 /383	2,251,074 /377
2) Downstream of AIG	2,333,008 /390	2,232,407 /384	2,187,733 /383	1,734,352 /365	1,491,361 /354	1,330,348 /344	1,224,484 /336	934,364 /309	2,231,728 /381	2,268,322 /375
3) SCR reactor	2,333,157 /390	2,232,543 /384	2,187,864 /383	1,734,455 /365	1,491,450 /354	1,330,427 /344	1,224,557 /336	934,420 /309	2,231,862 /381	2,268,458 /375
4) SCR outlet terminal point	2,348,402 /390	2,246,452 /384	2,201,161 /383	1,742,897 /365	1,497,813 /354	1,335,508 /344	1,228,870 /336	937,019 /309	2,245,768 /381	2,282,939 /375
D. Flue Gas Pressure (mmH_2O)										
1) SCR inlet terminal point	-146.90	-138.10	-133.50	-93.30	-74.40	-63.40	-56.80	-40.70	-139.10	-145.60
2) AIG inlet point	-155.17	-144.14	-139.21	-98.02	-78.84	-67.70	-61.09	-44.95	-145.15	-152.16
3) AIG outlet point	-160.45	-149.39	-144.36	-102.40	-82.85	-71.47	-64.71	-48.13	-150.40	-157.43
4) Mixing devices outlet point	-161.72	-150.61	-145.56	-103.22	-83.50	-72.03	-65.21	-48.48	-151.62	-158.68
5) SCR reactor inlet point	-161.89	-150.78	-145.73	-103.35	-83.63	-72.15	-65.32	-48.59	-151.79	-158.85
6) SCR reactor outlet point										
– With initial catalyst charge	-227.90	-204.79	-198.24	-143.86	-118.13	-102.16	-108.72	-85.44	-216.74	-224.71
– With all catalyst including future layer	-237.90	-237.94	-217.24	-162.86	-137.13	-121.16	-130.72	-107.44	-238.74	-246.71
8) SCR outlet terminal point										
– With initial catalyst charge	-221.70	-207.55	-200.92	-146.23	-120.40	-103.76	-110.20	-86.60	-219.50	-227.50
– With all catalyst including future layer	-240.70	-226.55	-219.92	-165.23	-139.40	-122.76	-132.20	-108.60	-241.50	-249.50
E. Flue Gas Velocity (Theoretical, m/sec)										
1) SCR inlet duct	16.0	15.5	15.2	12.0	10.3	9.2	8.4	6.4	15.5	15.7
2) SCR reactor	4.7	4.5	4.4	3.5	3.0	2.7	2.4	1.9	4.5	4.6
3) In catalyst layer	5.8	5.5	5.4	4.3	3.7	3.3	3.0	2.3	5.5	5.6
4) SCR reactor outlet duct	11.6	11.1	10.9	8.6	7.4	6.6	6.1	4.6	11.1	11.3
F. Ammonia Consumption as 99.5% concentration (Based on 499.4mg/Nm^3 NOx emission at SCR system outlet),(kg/hr)										
1) per SCR reactor	223	216	212	162	132	113	103	75	216	222
2) per Unit	446	431	423	323	264	225	207	150	433	444

Description	Performance coal									
	BMCR	TCC	RO	75%RO	60%RO	50%RO	45%RO	30%RO	TOP HEATER OFF	ALL HP HEATER OFF
3) for Two(2) Units	892	862	846	646	528	451	413	301	865	887
G. Stoichiometric(NH_3/NOx) ratio (Based on 499.4mg/Nm^3 NOx emission at SCR system outlet),(kg/hr)										
1) Stoichiometric Ratio	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
H. Ammonia Concentration										
1) Accumulator outlet,(%)	99.5	99.5	99.5	99.5	99.5	99.5	99.5	99.5	99.5	99.5
2) Ammonia/Air Mixer outlet,(vol %)	3.37	3.26	3.20	2.46	2.02	1.73	1.59	1.16	3.27	3.35
3) SCR reactor outlet duct (ppm, 6% O2)	2	2	2	2	2	2	2	2	2	2
I. Diluted Ammonia at upstream of Ammonia Injection Grid per Reactor										
1) Flow rate(Am^3/min. / ℃)	145.6 / 15	145.5 / 15	145.4 / 15	144.3 / 15	143.7 / 15	143.2 / 15	143.0 / 15	142.4 / 15	145.5 / 15	145.6 / 15
2) Pressure,(mmH_2O·g)	250	250	250	250	250	250	250	250	250	250
3) NH_3 concentration(vol%)	3.37	3.26	3.20	2.46	2.02	1.73	1.59	1.16	3.27	3.35
4) NH_3 flowrate(kg/hr)	223.0	215.5	211.5	161.5	132.0	112.7	103.3	75.2	216.3	221.8
J. Wet Flue Gas Volumetric Composition(Based on 6% O2)										
1) SCR inlet duct										
a) N_2	74.69	74.69	74.69	74.84	75.01	75.13	75.16	75.33	74.69	74.69
b) O_2	3.95	3.95	3.95	5.02	6.04	6.88	7.10	8.27	3.95	3.95
c) H_2O	6.84	6.84	6.84	6.56	6.28	6.06	6.00	5.69	6.84	6.84
d) SO_2	0.049	0.049	0.049	0.049	0.039	0.039	0.039	0.039	0.049	0.049
e) SO_3	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
e) CO_2	14.47	14.47	14.47	13.53	12.63	11.89	11.70	10.67	14.47	14.47
f) Dust (mg/Nm^3)	33,437	33,437	33,437	33,417	33,435	33,416	33,408	33,424	33,437	33,437
2) SCR outlet duct										
a) N_2	74.7	74.71	74.71	74.87	75.03	75.14	75.16	75.31	74.67	74.66
b) O_2	4.10	4.10	4.10	5.20	6.23	7.07	7.30	8.50	4.10	4.09
c) H_2O	6.78	6.78	6.78	6.49	6.21	6.01	5.96	5.67	6.83	6.84
d) SO_2	0.049	0.049	0.049	0.049	0.039	0.039	0.039	0.039	0.049	0.049
e) SO_3	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
f) CO_2	14.34	14.34	14.33	13.38	12.46	11.72	11.51	10.46	14.33	14.33
g) NH_3	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.03	0.03
f) Dust (mg/Nm^3)	31,765	31,765	31,765	31,746	31,763	31,745	31,738	31,753	31,765	31,765
g) $(NH_4)_2SO_4$, (mg/Nm^3)	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
h) NH_4HSO_4, (mg/Nm^3)	8.76	8.76	8.76	8.74	8.73	8.72	8.71	8.7	8.76	8.76

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Description	Performance coal									
	BMCR	TCC	RO	75%RO	60%RO	50%RO	45%RO	30%RO	TOP HEATER OFF	ALL HP HEATER OFF
K. Moisture Contents, (% by wgt.)										
1) SCR reactor inlet	4.13	4.13	4.13	3.96	3.79	3.66	3.62	3.44	4.13	4.13
2) SCR reactor outlet	4.10	4.10	4.10	3.92	3.76	3.63	3.60	3.43	4.13	4.13
L. Auxiliary Steam Consumption										
1) Heating steam for ammonia vaporizer (kg/hr. 2units)	568.90	549.66	539.64	412.16	336.97	287.61	263.76	191.75	551.98	565.99

2.2 Worst Coal

Description	Worst Coal									
	BMCR	TCC	RO	75%RO	60%RO	50%RO	45%RO	30%RO	TOP HEATER OFF	ALL HP HEATER OFF
A. Flue Gas Flow Rate, Wet/Dry (kg/hr/reactor)										
1) SCR inlet terminal point	1,246,198 /1,183,588	1,203,718 /1,143,243	1,182,150 /1,122,758	961,813 /915,877	839,863 /801,754	759,190 /725,976	707,072 /676,235	562,124 /538,816	1,208,481 /1,147,767	1,238,759 /1,176,524
2) Downstream of AIG	1,256,472 /1,193,861	1,213,985 /1,153,509	1,192,412 /1,133,020	972,026 /926,089	850,047 /811,937	769,355 /736,140	717,227 /686,390	572,251 /548,943	1,218,749 /1,158,033	1,249,032 /1,186,795
3) SCR outlet terminal point	1,256,472 /1,193,861	1,213,985 /1,153,509	1,192,412 /1,133,020	972,026 /926,089	850,047 /811,937	769,355 /736,140	717,227 /686,390	572,251 /548,943	1,218,749 /1,158,033	1,249,032 /1,186,795
B. Flue Gas Flow Rate, Wet/Dry (Nm^3/hr/reactor)										
1) SCR inlet terminal point	943,375 /865,829	911,218 /836,315	894,890 /821,330	729,199 /671,957	638,194 /590,393	577,771 /536,171	538,516 /500,174	429,102 /400,309	914,823 /839,625	937,744 /860,661
2) Downstream of AIG	951,859 /874,312	919,692 /844,788	903,359 /829,798	737,604 /680,361	646,562 /598,667	586,114 /544,327	546,847 /508,224	437,398 /408,229	923,298 /847,637	946,226 /868,588
3) SCR outlet terminal point	951,859 /874,312	919,692 /844,788	903,359 /829,798	737,604 /680,361	646,562 /598,667	586,114 /544,327	546,847 /508,224	437,398 /408,229	923,298 /847,637	946,226 /868,588
C. Flow Gas Flow Rate/Temperature (Am^3/hr/reactor)										
1) SCR inlet terminal point	2,331,542 / 392	2,331,138 / 387	2,188,834 / 386	1,725,190 / 367	1,481,169 / 356	1,318,176 / 346	1,211,948 / 338	921,581 / 311	2,225,208 / 382	2,264,992 / 377
2) Downstream of AIG	2,349,389 / 390	2,247,395 / 384	2,203,126 / 383	1,742,486 / 365	1,498,276 / 354	1,335,078 / 344	1,228,681 / 336	937,713 / 309	2,242,668 / 380	2,282,217 / 375
3) SCR reactor	2,349,538 / 390	2,247,532 / 384	2,203,258 / 383	1,742,590 / 365	1,498,366 / 354	1,335,157 / 344	1,228,754 / 336	937,768 / 309	2,242,802 / 380	2,282,354 / 375
4) SCR outlet terminal point	2,364,894 / 390	2,261,872 / 384	2,216,980 / 383	1,751,071 / 365	1,504,759 / 354	1,340,257 / 344	1,233,083 / 336	940,378 / 309	2,256,778 / 380	2,296,927 / 375
D. Flue Gas Pressure (mmH_2O)										
1) SCR inlet terminal point	-148.8	-139.7	-135.2	-94.1	-75	-63.8	-57.1	-40.9	-140.7	-147.2
2) AIG inlet point	-157.28	-145.74	-141.16	-99.06	-79.68	-68.37	-61.64	-45.43	-146.75	-155.47
3) AIG outlet point	-162.56	-150.99	-146.31	-103.44	-83.69	-72.14	-65.26	-48.61	-152	-160.75
4) Mixing devices outlet point	-163.83	-152.21	-147.51	-104.26	-84.34	-72.7	-65.76	-48.96	-153.22	-162.02
5) SCR reactor inlet point	-164.0	-152.4	-147.7	-104.4	-84.5	-72.8	-65.9	-49.1	-153.4	-162.2
6) SCR reactor outlet point										
– With initial catalyst charge	-230.0	-217.7	-211.7	-158.9	-133.9	-118.9	-109.3	-85.9	-218.7	-228.8
– With all catalyst including future layer	-252.0	-239.7	-233.7	-180.9	-155.9	-140.9	-131.3	-107.9	-240.7	-250.8
8) SCR outlet terminal point										
– With initial catalyst charge	-232.8	-220.5	-214.4	-160.9	-136.1	-120.5	-110.8	-87.0	-221.5	-231.6
– With all catalyst including future layer	-254.8	-242.5	-236.4	-182.9	-158.1	-142.5	-132.8	-109.0	-243.5	-253.6
E. Flue Gas Velocity (Theoretical, m/sec)										
1) SCR inlet duct	16.0	15.5	15.2	12.0	10.3	9.2	8.4	6.4	15.5	15.7
2) SCR reactor	4.7	4.5	4.4	3.5	3.0	2.7	2.4	1.9	4.5	4.6
3) In catalyst layer	5.8	5.5	5.4	4.3	3.7	3.3	3.0	2.3	5.5	5.6
4) SCR reactor outlet duct	11.6	11.1	10.9	8.6	7.4	6.6	6.1	4.6	11.1	11.3
F. Ammonia Consumption as 99.5% concentration (Based on 499.4mg/Nm^3 NOx emission at SCR system outlet),(kg/hr)										
1) per SCR reactor	221	213	210	160	131	112	102	74	214	220
2) per Unit	442	427	419	319	261	223	204	149	429	439

2

Description	Worst Coal									
	BMCR	TCC	RO	75%RO	60%RO	50%RO	45%RO	30%RO	TOP HEATER OFF	ALL HP HEATER OFF
3) for Two(2) Units	883	853	838	639	522	446	409	297	857	878
G. Stoichiometric(NH_3/NOx) ratio (Based on 499.4mg/Nm^3 NOx emission at SCR system outlet),(kg/hr)										
1) Stoichiometric Ratio	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
H. Ammonia Concentration										
1) Accumulator outlet,(%)	99.5	99.5	99.5	99.5	99.5	99.5	99.5	99.5	99.5	99.5
2) Ammonia/Air Mixer outlet,(vol %)	3.34	3.23	3.17	2.43	2.00	1.71	1.57	1.16	3.24	3.32
3) SCR reactor outlet duct (ppm, 6% O2)	300	300	300	300	300	300	300	300	300	300
I. Diluted Ammonia at upstream of Ammonia Injection Grid per Reactor										
1) Flow rate(Am^3/min. / ℃)	145.6 / 15	145.5 / 15	145.4 / 15	144.3 / 15	143.7 / 15	143.2 / 15	143.0 / 15	142.4 / 15	145.5 / 15	145.6 / 15
2) Pressure,(mmH_2O·g)	250	250	250	250	250	250	250	250	250	250
3) NH_3 concentration(vol%)	3.34	3.23	3.17	2.43	2.00	1.71	1.57	1.16	3.24	3.32
4) NH_3 flowrate(kg/hr)	220.75	213.25	209.50	159.65	130.50	111.50	102.15	74.25	214.25	219.50
J. Wet Flue Gas Volumetric Composition(Based on 6% O2)										
1) SCR inlet duct										
a) N_2	74.00	74.00	74.00	74.20	74.40	74.56	74.60	74.82	74.00	74.00
b) O_2	3.91	3.91	3.91	4.98	6.00	6.83	7.05	8.22	3.91	3.91
c) H_2O	8.22	8.22	8.22	7.85	7.49	7.20	7.12	6.71	8.22	8.22
d) SO_2	0.099	0.099	0.099	0.089	0.079	0.079	0.079	0.069	0.099	0.099
e) SO_3	0.0015	0.0015	0.0015	0.0014	0.0012	0.0012	0.0012	0.0011	0.0015	0.0015
e) CO_2	13.77	13.77	13.77	12.88	12.03	11.33	11.15	10.18	13.77	13.77
f) Dust (mg/Nm^3)	36,275	36,275	36,275	36,289	36,254	36,277	36,254	36,234	36,275	36,275
2) SCR outlet duct										
a) N_2	74.02	74.02	74.02	74.23	74.43	74.58	74.61	74.81	73.98	73.97
b) O_2	4.06	4.06	4.06	5.16	6.19	7.02	7.25	8.45	4.06	4.05
c) H_2O	8.15	8.14	8.14	7.76	7.41	7.13	7.06	6.67	8.19	8.2
d) SO_2	0.099	0.099	0.099	0.089	0.079	0.079	0.079	0.069	0.099	0.099
e) SO_3	0.0015	0.0015	0.0015	0.0014	0.0012	0.0012	0.0012	0.0011	0.0015	0.0015
f) CO_2	13.65	13.64	13.64	12.73	11.87	11.16	10.97	9.98	13.64	13.64
g) NH_3	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.03	0.03
f) Dust (mg/Nm^3)	34,461	34,461	34,461	34,475	34,441	34,463	34,441	34,422	34,461	34,461
g) $(NH_4)_2SO_4$, (mg/Nm^3)	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
h) NH_4HSO_4, (mg/Nm^3)	8.84	8.84	8.84	8.82	8.80	8.78	8.78	8.76	8.84	8.84

2

Description	Worst Coal									
	BMCR	TCC	RO	75%RO	60%RO	50%RO	45%RO	30%RO	TOP HEATER OFF	ALL HP HEATER OFF
K. Moisture Contents, (% by wgt.)										
1) SCR reactor inlet	5.01	5.01	5.01	4.78	4.56	4.38	4.34	4.09	5.01	5.1
2) SCR reactor outlet	4.96	4.96	4.96	4.73	4.51	4.34	4.30	4.06	4.99	5.00
L. Auxiliary Steam Consumption										
1) Heating steam for ammonia vaporizer (kg/hr. unit)	563.62	544.40	534.65	407.50	333.19	284.36	260.78	189.70	546.56	560.25

3. SCR Reactor & Auxiliary System

Description	Design Data
A. SCR reactor (KKS Number : 15HSD10BR011 / 012, 25HSD10BR011 / 012)	
1) Number per unit	Two (2)
2) Dimension, (mW x mL x mH)	14.0 x 10.0 x 22.8
3) Design Temperature (℃)	400
4) Design Pressure, Positive/Negative (barg)	±0.087 (at Transient)
5) Design Velocity, Reactor/Catalyst (m/sec)	4.89 / 6.65
6) Materials(ASTM)/thickness (mm)	
– Shell	A36 / 6
– Stiffeners	A36 / Angle or Channel
– Internal structures	A36 / H-Beam
7) Distance between catalyst layers (m)	3.0
8) Total weight of SCR reactor including initial catalyst charge Soot blower, duct, support, reactor housing, and relative accessories (ton/reactor)	1,041
9) Additional weight of spare catalyst layers & Soot blower (ton/reactor)	129
10) Total weight of SCR reactor with all catalyst charge including future catalyst, sootblower, duct, support, reactor housing and relative accessories, (ton/reactor)	1,170
11) Access door number per reactor and size, length & width (mm)	4 ea / 800 x 800
12) Sealing type of access door	Bolting & Gasket
13) Distance from AIG to surface of first catalyst layer (mm)	Approx. 22,500
14) Test nozzles	
– Location	Between Catalyst
– Number	Eight (8)
– Size	150A
B. Catalyst	
1) Manufacturer	Haldor Topsoe
2) Type / Model No.	Corrugated-Honeycomb
3) Chemical composition	Vanadium pentoxide, 0.1~4% Tungsten trioxide, 1~7% Silicon Dioxide, 15~25% Kaolim, 13~23% Titanium dioxide, 40~50% Fibers, 8~12%
4) Number of catalyst layer per reactor	3 Initial + 1 Future
5) Number of catalyst modules installed per layer	14 x 5
6) Dimension of each catalyst module (mW x mL x mH)	VE422AH : 1,880 x 946 x 1,356 VE522AH : 2,346 x 946 x 1,356 VE432AH : 1,880 x 1,410 x 1,356 VR532AH : 2,346 x 1,410 x 1,356
7) Weight of each catalyst module, (kg/module)	VE422AH : 566 VE522AH : 703 VE432AH : 850 VR532AH : 1,065
8) Surface area of each catalyst module (m^2/module)	VE422AH : 528.1 VE522AH : 660.1 VE432AH : 792.2 VR532AH : 990.2
9) Catalyst pitch (Cell / Plate, mm)	10 / 9.1
10) Catalyst void fraction (%)	80.0

11) Number of catalyst block (EA/Module)	82
12) Catalyst block size(mmW x mmL x mmH)	A : 466 x 466 x572 H : 466 x 466 x322
13) Operating temperature, min./max.(℃)	325°C / 450°C
14) Allowable temperature, min./max.(℃)	315°C / 500°C
15) Duration of operating time at min./max. allowable temperature(hr)	8hr
16) Initial catalyst volume, reactor/unit(m^3)	297.56 / 595.12
17) Future catalyst volume, reactor/unit	99.18 / 198.4
18) Catalyst specific surface area (m^2/m^3)	405
19) Catalyst density (g/cm^2)	0.2
20) Pressure drop per catalyst layer (mmH_2O)	12.06
21) Gas hourly space velocity (hr^{-1})	3,178
22) Gas linear velocity(m/s) at the reactor / in catalyst	4.89 / 6.65
23) Allowable catalyst temperature rising rate (℃/min)	150
24) Sampling catalyst	
– Type	Coupons
– Number per layer / reactor / unit	24 / 72 / 144
C. SCR Ash Blower (Sonic Horn Type) (KKS Number : 15HST10AN011~022, 15HST20AN011~022, 25HST10AN011~022, 25HST20AN011~022)	
1) Manufacturer	GE Energy
2) Type / Model No.	Sonic Horn
3) Number, layer/reactor (excluding future layer)	Four (4) / Twelve (12)
4) Acoustic Frequency (Hz)	75
5) Output Level (dB)	147
6) Weight (kg)	60kg (Only Horn)
7) Dimension(mmW x mmH)	1,493 x 1,338
8) Material	
- Body	304SS
- Horn	Cast Iron
9) Air Pressure (kg/cm^2g)	5 ~ 6
10) Operating Cycle	Every 10 min.
11) Operating time / Sonic Horn (sec)	10
D. Ammonia Injection Grid (KKS Number : 15HSJ10BN011 / 012)	
1) Number, reactor/unit	One (1) / Two (2)
2) Number of injection branches per grid	8
3) Material of injection branch (ASTM)	
- Contact with flue gas	A312-TP316
- Contact with ammonia	A312-TP316
4) Nozzle	
a) Manufacturer	S&TC
b) Type	Pipe & Nozzle

c) Material(ASTM)	A312-TP316
d) Number of nozzles, branch/reactor	112 / 896
e) Diluted NH_3 flow rate, nozzle/branch/reactor (Am^3/min)	0.163 / 18.2 / 145.6
f) NH_3 consumption rate, nozzle/branch/reactor (kg/hr, as anhydrous NH_3)	0.25 / 27.9 / 222.9
g) Max. design flow rate per nozzle,(m^3/min)	0.36
h) Required injection Pressure,($mmH_2O.g$)	Approx. 250
5) Pressure drop through AIG, ($mmH_2O.g$)	Max 400
6) Injection grid branch flow control valve	
a) Type	Butterfly Valve
b) Number per reactor	16
c) Size	100A
E. Inlet Duct (KKS Number : 15HTA10BR001, 15HTA20BR001, 25HTA10BR001, 25HTA20BR001)	
1) Location (from/to)	Eco. Out / SCR inlet
2) Length (mm)	35,000
3) Max. flow rate, (Am^3/hr)	2,331,526
4) Gas temp, max/min, (℃)	392 / 311
5) Maximum velocity, (m/s)	16
6) Design pressure, operating/transient (barg)	±0.087 (at Transient)
7) Duct size, W x H x L (mm)	11,000 x 3,600 x 35,000
8) Material(ASTM)	
a) Plate/thickness, (mm)	A36 / 6
b) Guide vane	A36
c) Stiffener	A36
9) Duct support	
a) Type	Structure Support
b) Material(ASTM)	A36
10) Test nozzle	
a) Number	8
b) Location	Inlet Duct
c) Type	Pipe & Flange
d) Size (mm)	150A
11) Ash removal hopper (if required)	
a) Number per reactor	4
b) Location	Bottom of inlet duct
c) Material(ASTM)	A36
F. Outlet duct (KKS Number : 15HTA10BR002, 15HTA20BR002, 25HTA10BR002, 25HTA20BR002)	
1) Location (from/to)	SCR reactor hopper / APH inlet EXJ
2) Length (mm)	19,900
3) Max. flow rate, (Am^3/hr)	2,364,894
4) Gas temp, max/min, (℃)	390 / 309
5) Maximum velocity, (m/s)	16

6) Design pressure, operating/transient (barg)	±0.087 (at Transient)
7) Duct size, W x H x L (mm)	11,000 x 5,100 x 19,900
8) Material(ASTM)	
a) Plate/thickness, (mm)	A36 / 6
b) Guide vane	N/A
c) Stiffener	A36
9) Duct support	
a) Type	Structure Support
b) Material(ASTM)	A36
10) Test nozzle	
a) Number	8
b) Location	Outlet Duct
c) Type	Pipe & Flange
d) Size (mm)	150A
11) Ash removal hopper (if required)	
a) Number per reactor	N/A
b) Location	N/A
c) Material(ASTM)	N/A
d) Outlet nozzle size (mm)	N/A
e) Ash removal quantity (kg/h)	N/A
G. By-pass duct (KKS Number : 15HTA10BR003, 15HTA20BR003, 25HTA10BR003, 25HTA20BR003)	
1) Location (from/to)	
2) Length (mm)	8,100
3) Max. flow rate, (Am^3/hr)	1,481,167
4) Gas temp, max/min, (℃)	356 / 311
5) Maximum velocity, (m/s)	16
6) Design pressure, operating/transient (barg)	±0.087 (at Transient)
7) Duct size, W x H x L (mm)	11,100 x 2,300 x 8,100
8) Material(ASTM)	
a) Plate/thickness, (mm)	A36 / 6
b) Guide vane	N/A
c) Stiffener	A36
9) Duct support	
a) Type	Structure Support
b) Material(ASTM)	A36
10) Test nozzle	
a) Number	N/A
b) Location	N/A
c) Type	N/A
d) Size (mm)	N/A
11) Ash removal hopper (if required)	
a) Number per reactor	N/A

b) Location	N/A
c) Material(ASTM)	N/A
d) Outlet nozzle size (mm)	N/A
e) Ash removal quantity (kg/h)	N/A
H. Inlet Damper (KKS Number : 15HSD10AA4001, 15HSD20AA401, 25HSD10AA4001, 25HSD20AA401)	
1) Name of Damper	SCR inlet damper
2) Location	SCR inlet duct
3) Type	Control Louver / Multi Louver
4) Manufacturer	Samkwang PS
5) Max. flow rate, (Am^3/hr)	2,331,526
6) Damper driver type	Electric
7) Operating gas temperature, max/min, (℃)	392 / 311
8) Design temperature, (℃)	420
9) Leakage at full close, (%)	1 ≤
10) Damper frame inside dimension (mm)	
a) Parallel to blade axis	11,100
b) Perpendicular to blade axis	3,600
11) Material(ASTM)	
a) Frame/thickness, (mm)	A36 / 6
b) Blade/thickness, (mm)	A36 / 6
c) Shaft/Diameter, (mm/ø)	S45C / ø80
d) Seals/thickness, (mm)	ASTM B575 / 0.25
12) Weight of assembled damper, (kg)	8,133
13) Max. operating time, Opening/Closing, (sec)	Approx 30 / 30
14) Operating torque requirement, Opening/Closing, (Nm)	3,516 / 3,516
I. Outlet Damper (KKS Number : 15HSD10AA402, 15HSD20AA402, 25HSD10AA402, 25HSD20AA402)	
1) Name of Damper	SCR outlet damper
2) Location	SCR Outlet Duct
3) Type	Control Louver / Multi Louver
4) Manufacturer	Samkwang PS
5) Max. flow rate, (m^3/hr)	2,364,894
6) Damper driver type	Electric
7) Operating gas temperature, max/min, (℃)	390 / 308
8) Design temperature, (℃)	420
9) Leakage at full close, (%)	1 ≥
10) Damper frame inside dimension (mm)	
a) Parallel to blade axis	11,100
b) Perpendicular to blade axis	5,100
11) Material(ASTM)	
a) Frame/thickness, (mm)	A36 / 6
b) Blade/thickness, (mm)	A36 / 6

c) Shaft/Diameter, (mm/ø)	S45C / ø80
d) Seals/thickness, (mm)	ASTM B575 / 0.25
12) Weight of assembled damper, (kg)	9,560
13) Max. operating time, Opening/Closing, (sec)	Approx 30 / 30
14) Operating torque requirement, Opening/Closing, (Nm)	4,982 / 4,982
J. Bypass Damper (KKS Number : 15HSD10AA403, 15HSD20AA403, 25HSD10AA403, 25HSD20AA403)	
1) Name of Damper	SCR By-pass Damper
2) Location	SCR By-pass Duct
3) Type	Tandem shut-off Louver / Multi Louver
4) Manufacturer	Samkwang PS
5) Max. flow rate, (m^3/hr)	1,481,167
6) Damper driver type	Electric
7) Operating gas temperature, max/min, (℃)	356 / Boiler Start-up
8) Design temperature, (℃)	420
9) Maximum pressure drop at full open, ($mmH_2O.g$)	1.96
10) Leakage at full close, (%)	0
11) Damper frame inside dimension (mm)	
a) Parallel to blade axis	11,100
b) Perpendicular to blade axis	2,300
12) Material(ASTM)	
a) Frame/thickness, (mm)	A36 / 6
b) Blade/thickness, (mm)	A36 / 6
c) Shaft/thickness, (mm/ø)	S45C / ø80
d) Seals/thickness, (mm)	ASTM B575 / 0.25
13) Weight of assembled damper, (kg)	8,019
14) Max. operating time, Opening/Closing, (sec)	Approx 30 / 30
15) Operating torque requirement, Opening/Closing, (Nm)	4,289 / 4,289
16) Seal air fan (If required)	
a) Number per unit	2
b) Motor rating (kW/V/Phase)	7.5 / 400 / 3
c) Heater (kW)	N/A
d) Flowrate (m^3/min)	122.9
e) Pressure (mmH_2O)	122.4
J. SCR In. Expansion Joint (EJ-02A/B) (KKS Number : 15HTA10BR004, 15HTA20BR004, 25HTA10BR004, 25HTA20BR004)	
1) Location	SCR inlet duct
2) Manufacturer	Forwis Co., Ltd
3) Type	Non metallic, Belt(U-type)
4) Number per unit	Two(2)
5) Materials	
	Heat Treated Glass Fabric / 1.6
	PTFE Coated & Laminated Glass Fiber Fabric / 1.12

a) Bellows / thickness (mm)	Glass Fiber Fabric / 1.5
	Tefron Coated Glass Fiber Fabric / 0.25
	E-Glass Fiber / 12
	Wire Insert Glass Fiber Fabric / 2.4
b) Frame / thickness (mm)	A36 / 9
c) Backup Bar / thickness (mm)	A36 / 9
6) Size (mmW x mmL x mmH)	11,100 x 3,600 x 500
7) Weight(kg)	Approx. 3,045
8) Maximum movement, Axial(mm)/Lateral Y,Z(mm)/Angle(degree)	-95.99 / 0, 0.03 / 0
9) Design temperature (℃)	420
10) Design pressure (barg)	±0.087 (at Transient)
11) Drain hole	
a) Drain hole required (Yes or No)	N/A
b) Drain hole size (mm)	N/A
c) Material/thickness (mm)	N/A
K. SCR In. Expansion Joint (EJ-03A/B) (KKS Number : 15HTA10BR005, 15HTA20BR005, 25HTA10BR005, 25HTA20BR005)	
1) Location	SCR inlet duct
2) Manufacturer	Forwis Co., Ltd
3) Type / Model No.	Non metallic, Belt(U-type)
4) Number per unit	Two(2)
5) Material	
a) Bellows / thickness (mm)	Heat Treated Glass Fabric / 1.6
	PTFE Coated & Laminated Glass Fiber Fabric / 1.12
	Glass Fiber Fabric / 1.5
	Tefron Coated Glass Fiber Fabric / 0.25
	E-Glass Fiber / 12
	Wire Insert Glass Fiber Fabric / 2.4
b) Frame / thickness (mm)	A36 / 9
c) Backup Bar / thickness (mm)	A36 / 9
6) Size (mmW x mmL x mmH)	14,000 x 3,000 x 500
7) Weight(kg)	Approx. 3,582
8) Maximum movement, Axial(mm)/Lateral Y,Z(mm)/Angle(degree)	-24.27 / 21.82, 72.54 / 8.67
9) Design temperature (℃)	420
10) Design pressure (barg)	±0.087 (at Transient)
11) Drain hole	
a) Drain hole required (Yes or No)	N/A
b) Drain hole size (mm)	N/A
c) Material/thickness (mm)	N/A
L. SCR Out. Expansion Joint (EJ-04A/B) (KKS Number : 15HTA10BR006, 15HTA20BR006, 25HTA10BR006, 25HTA20BR006)	
1) Location	SCR Out
2) Manufacturer	Forwis Co., Ltd

3) Type / Model No.	Non metallic, Belt(U-type)
4) Number per unit	Two(2)
5) Material	
a) Bellows / thickness (mm)	Heat Treated Glass Fabric / 1.6
	PTFE Coated & Laminated Glass Fiber Fabric / 1.12
	Glass Fiber Fabric / 1.5
	Tefron Coated Glass Fiber Fabric / 0.25
	E-Glass Fiber / 12
	Wire Insert Glass Fiber Fabric / 2.4
b) Frame / thickness (mm)	A36 / 9
c) Backup Bar / thickness (mm)	A36 / 9
6) Size (mmW x mmL x mmH)	11,100 x 5,100 x 500
7) Weight(kg)	Approx. 3,434
8) Maximum movement, Axial(mm)/Lateral Y,Z(mm)/Angle(degree)	-2.73 / 0, 2.45 / 0.28
9) Design temperature (℃)	420
10) Design pressure (barg)	±0.087 (at Transient)
11) Drain hole	
a) Drain hole required (Yes or No)	N/A
b) Drain hole size (mm)	N/A
c) Material/thickness (mm)	N/A
M. SCR By-Pass Expansion Joint (EJ-05A/B) (KKS Number : 15HTA10BR007, 15HTA20BR007, 25HTA10BR007, 25HTA20BR007)	
1) Location	By-pass Duct
2) Manufacturer	Forwis Co., Ltd
3) Type / Model No.	Non metallic, Belt(U-type)
4) Number per unit	Two(2)
5) Material	
a) Bellows / thickness (mm)	Heat Treated Glass Fabric / 1.6
	PTFE Coated & Laminated Glass Fiber Fabric / 1.12
	Glass Fiber Fabric / 1.5
	Tefron Coated Glass Fiber Fabric / 0.25
	E-Glass Fiber / 12
	Wire Insert Glass Fiber Fabric / 2.4
b) Frame / thickness (mm)	A36 / 9
c) Backup Bar / thickness (mm)	A36 / 9
6) Size (mmW x mmL x mmH)	11,100 x 2,300 x 500
7) Weight(kg)	Approx. 2,996
8) Maximum movement, Axial(mm)/Lateral Y,Z(mm)/Angle(degree)	-74.72 / 9.51, 21.82 / 2.94
9) Design temperature (℃)	420
10) Design pressure (barg)	±0.087 (at Transient)
11) Drain hole	
a) Drain hole required (Yes or No)	N/A

b) Drain hole size (mm)	N/A
c) Material/thickness (mm)	N/A

4. Ammonia Storage and Handling System

Description	Design Data
A. Ammonia Storage Tank (KKS Number : 05HSS10BB011 / 012)	
1) Number per two(2) unit	Two (2)
2) Manufacturer	S&TC
3) Type	Horizontal, Cylindrical
4) Applicable code	ASME Sec. VIII
5) Capacity, Liquid / Vapor, (m^3)	180.2 / 31.8
6) Available capacity, (kg/m^3), at 38℃	105,057 / 180.2
7) Design temperature(℃) / pressure (bar.g)	55 / 22
8) Max. operating temp. (℃) / pressure (bar.g)	38 / 13.8
9) Tank dimension, dia. / length, (mm)	4,100 ID / 14,690 TL
10) Weight, empty / full, (ton)	72.1 / 186
11) Material(ASTM) / thickness, (mm)	
a) Shell	A516-70N / 37
b) Head	A516-70N / 43
c) Nozzle	Over 50A : A106B / Sch. 160 Below 40A : A105 / Sch.XXS
d) Other	A283-C or Equival.
12) Corrosion allowance, (mm)	3
13) Access door for inspection, number / size, (mm)	1ea / Φ 600

B. Ammonia Unloading Compressor (KKS Number : 05HSS10AN111 / 112)

1) Number per two(2) units	Two (2)
2) Manufacturer	Croken
3) Type / Model No.	Reciprocating / C-691
4) Number of stage	Single
5) Rated capacity(l/min) / pressure (bar.g)	1,100 / 7
6) Design temp.(℃) / pressure (bar.g)	55 / 22
7) Power consumption (kW)	16.5
8) Motor (kW / V / phase)	22 / 400 / 3
9) Material(ASTM) / thickness(mm)	
a) Casing / Cylinder / Head	A536
b) Impeller / Blade / Piston	A48
c) Shaft	A536
d) Seals	PTFE-glass
10) Sound levels (dB(A))	≤85

C. Waste Ammonia Dilution Tank (KKS Number : 05HSG10BB010)

1) Number per two(2) units	One (1)
2) Manufacture	S&TC
3) Type	Vertical, Coneroof
4) Applicable code	API 650
5) Capacity (m^3)	11.4
6) Effective capacity, (m^3)	10
7) Tank size, dia. / height, (mm)	2,200 / 3,000
8) Weight, empty / operating / full, (ton)	2,543 / 12,544 / 13,947

9) Material(ASTM) / thickness(mm)	
a) Shell	A240-TP304 / 6
b) Head	A240-TP304 / 6
c) Bottom	A240-TP304 / 6
d) Nozzle	A312-TP304 / Sch 40
10) Heater	
a) Type	N/A
b) Power(kW / V / Phase)	N/A
c) Capacity(kW)	N/A

D. Water Spray System (1)

1) Location	Ammonia Storage Tank Area
2) Type	Full Cone Spray
3) Applicable code	NFPA 13
4) Capacity, (m^3 / min)	1.91
5) Required Water Pressure, (kg/cm^2 . g)	2.1
6) Material(ASTM) / thickness, (mm)	
a) Header	ASTM A53 Gr.B Galva / Sch. 40
b) Nozzle	Bronze
8) Nozzle	
a) Number of header	6
b) Number of nozzle per header	7
c) Flowrate per nozzle (kg/min)	45

E. Water Spray System (2)

1) Location	Unloading Compressor Area
2) Type	Full Cone Spray
3) Applicable code	NFPA 13
4) Capacity, (m^3 / min)	0.27
5) Required Water Pressure, (kg/cm^2 . g)	2.1
6) Material(ASTM) / thickness, (mm)	
a) Header	ASTM A53 Gr.B Galva / Sch. 40
b) Nozzle	Bronze
7) Nozzle	
a) Number of header	1
b) Number of nozzle per header	6
c) Flowrate per nozzle (kg/min)	45

F. Water Spray System (3)

1) Location	Ammonia Tank Lorry Area
2) Type	Full Cone Spray
3) Applicable code	NFPA 13
4) Capacity, (m^3 / min)	0.27
5) Required Water Pressure, (kg/cm^2 . g)	2.1
6) Material(ASTM) / thickness, (mm)	
a) Header	ASTM A53 Gr.B Galva / Sch. 40
b) Nozzle	Bronze
7) Nozzle	
a) Number of header	1

b) Number of nozzle per header	6
c) Flowrate per nozzle (kg/min)	45

G. Water Spray System (4)

1) Location	Vaporizer Area
2) Type	Full Cone Spray
3) Applicable code	NFPA 13
4) Capacity, (m^3 / min)	0.27
5) Required Water Pressure, (kg/cm^2 . g)	2.1
6) Material(ASTM) / thickness, (mm)	
a) Header	ASTM A53 Gr.B Galva / Sch. 40
b) Nozzle	Bronze
7) Nozzle	
a) Number of header	1
b) Number of nozzle per header	6
c) Flowrate per nozzle (kg/min)	45

H. Water Spray System (5)

1) Location	Accumulator
2) Type	Full Cone Spray
3) Applicable code	NFPA 13
4) Capacity, (m^3 / min)	0.27
5) Required Water Pressure, (kg/cm^2 . g)	2.1
6) Material(ASTM) / thickness, (mm)	
a) Header	ASTM A53 Gr.B Galva / Sch. 40
b) Nozzle	Bronze
7) Nozzle	
a) Number of header	1
b) Number of nozzle per header	6
c) Flowrate per nozzle (kg/min)	45

5. Ammonia Injection System

Description	Design Data
A. Vaporizer (KKS Number : 05HSJ20BB011 / 012)	
1) Number for two(2) units	Two(2)
2) Manufacturer	JINU DEV
3) Type	Indirect Water Bath
4) Design Code	ASME Sec. VIII
5) NH_3 Vapor Capacity, normal / max (kg/hr)	891.77 / 1200
6) Design pressure inside shell / outside shell, (bar . g)	22 / ATM
7) Design temp. inside shell / outside shell (℃)	55 / 80
8) Inflow ammonia pressure, min / max (bar.g)	4.2 / 13.8
9) Inflow ammonia temp. min / max (℃)	4.8 / 38
10) Outflow ammonia pressure, min / typical / max (bar.g)	4.2 / 8.75 / 13.8
11) Outflow ammonia temp. min / nor / max (℃)	35 / 40 / 45
12) Material (ASTM) / Thickness (mm)	
a) Outside shell	A240-TP304 / 5
b) Inside shell	A312-TP304 / SCH40
c) Ammonia coil	A312-TP304 / SCH40
d) Steam coil	A312-TP304 / SCH40
13) Dimension, dia. / height (mm)	1,550 / 2,540
14) Weight, Empty / Operation / full, (kg)	1920 / 5340 / 6090
15) Steam consumption, min / nor / max, (kg/h) at BMCR(Perfromance coal)	638 / 687 / 758
16) Water consumption, min / nor / max, (kg/h)	2,000 / 2,000 / 2,000
B. Accumulator (KKS Number : 05HSJ20BB021 / 022)	
1) Number for two(2) units	Two(2)
2) Manufacturer	S&TC
3) Type	Vertical, Cylindrical
4) Design Code	ASME Sec. VIII
5) Capacity(m^3)	2.5
6) Design temp. (℃) / pressure(bar.g)	55 / 22
7) Operating temp. (℃) / pressure(bar.g)	40 / 13.8
8) Inlet ammonia temp. (℃) / pressure(bar.g)	40 / 13.8
9) Material (ASTM) / Thickness(mm)	
a) Shell	A516-70N / 13
b) Head	A516-70N / 15
c) Nozzle	Over 65A : A106-B / Sch 160 Below 50A : A105 / Sch XXS
10) Dimension, dia. / height, (mm)	1,200 / 1,800
11) Weight, Empty / Operation / Full, (kg)	1,900 / 1,950 / 4,400
12) Corrosion Allowance, (mm)	3
C. Dilution Air Blower (KKS Number : 15HSG10AN011 / 012, 25HSG10AN011 / 012)	
1) Number per unit	Two (2)

2) Manufacturer	Taeil Blower
3) Type	Centrifugal, Turbo Blower
4) Rated capacity (m^3 / min) / pressure($mmH_2O.g$)	273 / 650
5) Design pressure ($mmH_2O.g$) / temperature, (℃)	748 / 20
6) Power consumption, (kW)	47.3
7) Motor (kW / V / phase)	55 / 400 / 3
8) Material (ASTM) / thickness(mm)	
a) Casing	SS400
b) Impeller	SS400
c) Shaft	SM45C
9) Sound level dB (A)	85 ≥

6. Other Equipment

Description	Design Data
A. Pumps (KKS Number : 05HSN10AP111 / 112)	
1) Name of Pumps	Sump pump
2) Locations / Service	Ammonia Storage Shelter Sump / Ammonia Dilution Water
3) Number of pumps, oper. / spare	One (1) / One (1)
4) Manufacturer / Model No.	Duk-ji
5) Fluid pumped	Dilution Ammonia
6) Capacity (m^3/ hr)	18
7) Head (mH_2O)	15
8) Shut – off head (mH_2O)	17
9) Speed (rpm)	1460
10) Efficiency at design point (%)	24
11) Power consumption, design / max. (kW)	3.1 / 3.7
12) Motor rating (kW / V / Phase)	5.5 / 400 / 3
13) Materials (ASTM)	
a) Casing	A743-CF8
b) Shaft / Shaft sleeve	A276-410 / A276-304
c) Impeller	A743-CF8
d) Seals	N/A
14) Weight including motor, empty / operating (kg)	345 / 449
15) Sound level (dB(A))	85 ≥
B. Test Ports	
1) Number of each location	
a) Upstream ammonia injection grid	Eight (8)
b) Future Layer	Eight (8)
c) 3rd Layer	Eight (8)
d) 2nd Layer	Eight (8)
e) 1st Layer	Eight (8)
f) Outlet duct	Eight (8)
2) Size(mm)	150A

C. Thermal Insulation & Lagging

Location	Insulation			Lagging		
	Material	Density(kg/m^3)	Thickmess(mm)	Material	Type (Ribbed or Flat)	Minimum Thickness (mm)
Inlet Duct	Calcium Silicate / Mineral Wool	80	150	Aluminum	Ribbed	1.2 / 0.6
SCR Reactor	Calcium Silicate / Mineral Wool	80	150	Aluminum	Ribbed	1.2 / 0.6
Outlet Duct	Calcium Silicate / Mineral Wool	80	150	Aluminum	Ribbed	1.2 / 0.6
By-pass Duct	Calcium Silicate / Mineral Wool	80	150	Aluminum	Ribbed	1.2 / 0.6
Vaporizer	Mineral Wool	80	50	A240 TP304	Flat	0.8
Accumulator	Mineral Wool	80	50	Aluminum	Flat	0.6

D. Motor List (List all electric motors.)

Description	Design Data						
	Rating (kW)	Volt (V)	P.F (%)	Eff. (%)	Speed (rpm)	Enclosure Type	Remarks
Amm. Unloading Compressor	22	400	83	91.6	1470	TEFC, IP55	COMMON
Amm. Unloading Compressor	22	400	83	91.6	1470	TEFC, IP55	COMMON
Sump Pump	5.5	400	80.5	87.7	1460	TEFC, IP55	COMMON
Sump Pump	5.5	400	80.5	87.7	1460	TEFC, IP55	COMMON
Dilution Air Blower	55	400	85	93.5	1480	TEFC, IP55	Unit 1A
Dilution Air Blower	55	400	85	93.5	1480	TEFC, IP55	Unit 1B
Dilution Air Blower	55	400	85	93.5	1480	TEFC, IP55	Unit 2A
Dilution Air Blower	55	400	85	93.5	1480	TEFC, IP55	Unit 2B
Seal Air Blower	7.5	400	82	88.7	1440	TEFC, IP55	Unit 1A
Seal Air Blower	7.5	400	82	88.7	1440	TEFC, IP55	Unit 1B
Seal Air Blower	7.5	400	82	88.7	1440	TEFC, IP55	Unit 2A
Seal Air Blower	7.5	400	82	88.7	1440	TEFC, IP55	Unit 2B

7. Instrumentation

Description	Design Data
A. Instruments	
1) NOx analyzer	
a) Manufacturer	SICK Maihak
b) Model No.	GM32-7
c) Application	SCR Inlet 4sets/SCR outlet 4sets
d) Quantity	8sets
e) Repeatability	<2%
f) Measuring method	UV
g) Extractive or in-situ type	In-situ Type
h) Auto-range change function	2range available
i) Measuring range	Inlet: 0~600ppm/ Outlet:0~300ppm
j) Response time	<10sec
k) Sample Temperature / Pressure requirement	<500℃/ +-60hPa
l) Sample moisture / dust requirement	max.96%rF/>30g/m3
m) Number of cabinets	8sets/only connection unit
n) Dimension of cabinets / Shelter	450(W)x400(H)x158(D)/N.A
o) Signal output	4~20mADC
p) Power supply (V/capacity(VA)/phase)	
- Analyzer	220V/260VA(Max)/ 50Hz
- Air blower	220VAC/260VA(max) 50Hz
2) NOx analyzer	
a) Manufacturer	SICK Maihak
b) Model No.	GM32-7
c) Application	SCR Inlet 4sets/SCR outlet 4sets
d) Quantity	8sets
e) Repeatability	<2%
f) Measuring method	UV
g) Extractive or in-situ type	In-situ Type
h) Auto-range change function	2range available
i) Measuring range	Inlet: 0~600ppm/ Outlet:0~300ppm
j) Response time	<10sec
k) Sample Temperature / Pressure requirement	<500℃/ +-60hPa
l) Sample moisture / dust requirement	max.96%rF/>30g/m3
m) Number of cabinets	8sets/only connection unit
n) Dimension of cabinets / Shelter	450(W)x400(H)x158(D)/N.A
o) Signal output	4~20mADC
p) Power supply (V/capacity(VA)/phase)	
- Analyzer	220V/260VA(Max)/ 50Hz
- Air blower	N/A
3) O_2 analyzer	
a) Manufacturer	SICK-Maihak
b) Model No.	Zirkor5000
c) Application	SCR Inlet 4sets/Outlet 4sets
d) Quantity	8sets

e) Repeatability	<2%
f) Measuring method	Zirconia
g) Extractive or in-situ type	In-situ
h) Auto-range change function	2range available(Key selectable)
i) Measuring range	0~25Vol%
j) Response time	<10sec
k) Sample Temperature / Pressure requirement	up to 600℃/-50~50mbar
l) Sample moisture / dust requirement	max.96%rF/>30g/m3
m) Number of cabinets	8set(Only Control unit)
n) Dimension of cabinets / Shelter	300(H)x400(W)x225(D)/N.A
o) Signal output	4~20mA
p) Power supply (V/capacity(VA)/phase)	
- Analyzer	115~230V/400VA/1ph
- Air blower	Blower N/A
4) NH_3 analyzer	
a) Manufacturer	SICK Maihak
b) Model No.	GM700
c) Application	SCR Oultet
d) Quantity	4sets
e) Repeatability	<2%
f) Measuring method	TDLS(Tuneable Diode Laser Spectroscopy)
g) Extractive or in-situ type	In-situ
h) Auto-range change function (Yes/No)	NO
i) Measuring range	0~10ppm
j) Response time	<10sec
k) Sample Temperature / Pressure requirement	<430℃/ +-120hPa
l) Sample moisture / dust requirement	max.96%rF/>30g/m3
m) Number of cabinets	4sets
n) Dimension of cabinets / Shelter	289(W)x330(H)x140(D)
o) Signal output	4~20mADC
p) Power supply (V/capacity(VA)/phase)	
- Analyzer	220V/50VA(Max)/ 50Hz
- Air blower	N/A
4) NH_3 Leak Detector	
a) Manufacturer	Gastron
b) Model No.	GTD-2000TX
c) Application	Gas Detector
d) Quantity	17sets
e) Signal output	4~20mADC
f) Power supply (V/capacity(VA)/phase)	230V, 1phase

B. List of all control valves

Application	Number	Type	Trim mat'l	Manufacturer
Temp. Control Valve	05HSU10AA001	Globe	410SS	Curties Wright
Temp. Control Valve	05HSU20AA001	Globe	410SS	Curties Wright
Press. Control Valve	05HSJ10AA002	Globe	316SS + STF	Curties Wright
Press. Control Valve	05HSJ20AA002	Globe	316SS + STF	Curties Wright
Flow. Control Valve	15HSJ10AA001	Globe	316SS	Curties Wright
Flow. Control Valve	15HSJ10AA002	Globe	316SS	Curties Wright
Flow. Control Valve	15HSJ10AA003	Globe	316SS	Curties Wright
Flow. Control Valve	15HSJ10AA004	Globe	316SS	Curties Wright
Flow. Control Valve	25HSJ10AA001	Globe	316SS	Curties Wright
Flow. Control Valve	25HSJ10AA002	Globe	316SS	Curties Wright
Flow. Control Valve	25HSJ10AA003	Globe	316SS	Curties Wright
Flow. Control Valve	25HSJ10AA004	Globe	316SS	Curties Wright

C. Others Instruments

Description	Design data		
Instruments	Nember	Type	MFR/Model No
1) Electronic (press/temp/level/flow/etc.) transmitters			
- LEVEL	2 SETS	ELECTRONIC (SMART)	SIEMENS/ 7MF4433-1EA02-1DC6-ZA02+B11
- FLOW	8 SETS	ELECTRONIC (SMART)	SIEMENS/ 7MF4433-1HA02-1DC6-ZA02+B11
- PRESS.	22 SETS	ELECTRONIC (SMART)	SIEMENS/ 7MF4033-1CA10-1DC6-ZA02+B11
- DIFF. PRESS.	25 SETS	ELECTRONIC (SMART)	SIEMENS/ 7MF4433-1BA02-1DC6-ZA02+B11
- LEVEL SWITCH	6 SETS	FLOAT TYPE	HITROL / HM-90-2F-Ex
- PRESS. SWITCH	2 SETS	BOURDON	WISE / P941
2) Solenoid valves			
- Ball Valve	7 SETS	BALL	YOUNG POONG / B10
- Butterfly Valve	6 SETS	BUTTERFLY	ACE / AV-CLR
- Globe Valve	15 SETS	Globe	Curties Wright
3) Field gauges			
- Pressure Measurement			
Presssure Gauge	4 SETS	Bourdon	WISE / P2586A3EDH05030
Low Pressure Guage	10 SETS	CHAMBER	WISE / P4214A4EDJZZZ30
Pressure Guage	14 SETS	Diaphragm	WISE / P252 + P711XAJEDHZZZD
Pressure Switch	2 SETS	Bourdon	WISE / P941
- Temp.	13 SETS	BI-METAL	WISE / T1906Y1ED1ZZZZ0 + A6110CC0A0ZZZ00
- Level			
Reflex	2 SETS	REFLEX	WISE / L100
Tubular	1 SETS	TUBULAR	WISE / L400
4) Flow measurement			
Orifice	4 SETS	CONCENTRIC	WISE / F500
Oriflow	32 SETS	ORIFICE Type	AUTOFLOW / ALG
5) Thermocouples & RTD	36 SETS	K TYPE	WISE/ R312PK1F99RECZ0 + A6110CC0A0ZZZ00
6) Load Cell	8EA	Truck & Tank weighing	LAUMAS / CBL-100000

Description	Design Data
D. Local Control Pannel	
a) Manufacturer / Model No.	ILIE
b) Dimension (H x W x D, mm)	800 x 1000 x 370
c) No. Of Cabinet	1
d) Enclosure Type	Exd ⅡC T6
e) Material and Thickness	Cast Aluminium Alloy/50mm
f) Power consumption, watt	1,000
g) Heat Disspation, cal/h	N/A

DOCUMENT SUBMISSION STATUS: FF

NOTE:

0	20 June. 2016	For Construction	S.J.HEO	G.Y.OH	S.H.YANG	
REV.	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	APPROVED

OWNER

VIETNAM OIL AND GAS GROUP (PVN)

OWNER'S CONSULTANT

FICHTNER

PVPOWER PCC

EPC CONTRACTOR

PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PVC)

EPC CONSTRACTOR'S CONSULTANT

WORLEYPARSONS

POWER ISLAND PACKAGE SUPPLIER

SOJITZ CORPORATION

DAELIM INDUSTRIAL CO., LTD.

PROJECT TITLE

THAI BINH 2 THERMAL POWER PLANT 2 x 600MW

DRAWING / DOCUMENT TITLE

SCR OF CATALYST VOLUME CALCULATION SHEET

Vendor's Logo:

S&T Corporation

FUNCTION	NAME	SIGN	DATE
DRWN	S.J.HEO		20 Jun. 2016
CHKD	G.Y.OH		20 Jun. 2016
APPD	S.H.YANG		20 Jun. 2016

DOCUMENT NO: TB2-SDC.VP124-00HTA-M-M1A-CAL-0002	No of page: 7	Scale	Rev.0

P.O NO.	110180-29-124-001-A01
ITEM NO.	124
ITEM DESCRIPTION	De-Nox System
DOCUMENT NO.	TB2-SDC.VP124-00HTA-M-M1A-CAL-0002
DOCUMENT TITLE	SCR OF CATALYST VOLUME CALCULATION SHEET
REV NO.	0

Daelim's Approval Status

Daelim Industrial Co., Ltd.	
Job No.	110180
	A - APPROVED
	B - APPROVED WITH COMMENTS
	C - RETURNED FOR CORRECTION
	D - REJECTED
	N - NOT APPLICABLE(REFERENCE ONLY)
SIGNED BY :	DATE :

DIC'S PERMISSION TO PROCEED OR REVIEW TAKEN ON VENDOR PRINTS SHALL NOT RELIEVE VENDOR FROM ITS RESPONSIBILITIES OR LIABILITIES UNDER THE PURCHASE ORDER.

VENDOR'S LOGO:

S&T Corporation

Document Review Comment Sheet

Daelim's Ref. No :

No.	Document No.	Rev	Title	Purpose	Approval Status
1	TB2-SDC.CP124-00HTA-M-M1A-CAL-0002	A	Catalyst Volume Calculation	AP	A

No.	Daelim's Comments	Vendor's Response
1	Vendor Shall start the manufacturing but vendor shall deduct the cost for the reduced volume of catalyst.	1. S&TC start the manufacturing of catalyst as per meeting with DIC on 2016.06.03. 2. S&TC can't aceept the deduction of catalyst price. S&TC already explained the reason why can't deduction of catalyst price through official letter and meeting with DIC. Also S&TC clarify opininon for deduction of catalyst price through the MOM 2016.06.03 which is prepared on the meeting with DIC.

*** Legend**

Purpose:
AP - For Approval
RE - For Reference
FF - For Final / FC - For Construction
F - Final / AB - As Built
INFO - For Information

Approval Status:
A - Approved
B - Approved with Comments
C - Returned for Correction
D - Rejected
N - Reference Only

No.	Document No.	Rev	Title	Purpose	Approval Status	
					In	Out
1	TB2-SDC.VP124-00HTA-M-M1A-CAL-0002	A	SCR OF CATALYST VOLUME CALCULATION SHEET	RE	-	I

	Owner/PMC's Comments	Contractor's Response
	General comment	
1	No comment.	

Legend:

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RE Outgoing Status
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1. Calculation Basis

The catalyst volume is calculated based on the BMCR worst coal Load conditions. DeNOx efficiency is 54.6% and ammonia slip is 2 ppmd @ 6% O_2.

2. Calculation model

The model for calculating the necessary catalyst volume is based on a 1st-order rate constant, K_{NH3}, in the conversion of NH_3. The reason for considering NH_3 in the DeNOx reaction is that this is the limiting component, i.e. is rate determining, since the NH_3/NOx ratio is less than 1. A 1st-order reaction means that the reaction rate is directly proportional to the concentration of ammonia in the flue gas.

The DeNOx reactions occur on the outer surface of the catalyst. This means that the rate of reaction is proportional to the total catalyst surface area, A, and reverse proportional the flue gas flow rate, F:

$$-r_{NH3} = K_{NH3} \times A/F \times c_{NH3}$$

The rate constant K_{NH3} depends primarily on the temperature and the catalyst type and age but the flow conditions in the catalyst (linear velocity) also have some influence.

The rate equation can be integrated over the entire catalyst volume[1] to:

$$\ln(1 - X_{NH3}) = -K_{NH3}\frac{A}{F}$$

in which X is the fractional conversion of NH_3:

$$X_{NH3} = \frac{c^{in} - c^{out}}{c^{in}}$$

Rearranging yields:

$$\frac{F}{A} = NHAV = \frac{-K_{NH3}}{Ln(1 - X_{NH3})}$$

in which NHAV is the so-called Normal Hourly Area Velocity ($Nm^3/m^2/hr$) defined as F/A. A is total catalyst surface area, i.e. catalyst volume multiplied by A_{cat} where A_{cat} is the specific surface area of the catalyst.

[1] For details please refer to text books on chemical reaction kinetics

It should be noted that for SCR DeNOx, area velocity, NHAV, is used rather than space velocity. This is because, as mentioned above, the NOx conversion occurs on the catalyst surface.

The rate constant K_{NH3} has to be corrected for the diffusion resistance from the bulk gas phase to the catalyst surface. This is done by considering it composed of two parts: the diffusion rate expressed by k_g and the surface reaction rate k_s. Furthermore it has to be corrected for deactivation over the life of the catalyst by the correction factor $f_{EOR\ activity}$:

$$K_{NH3} = \frac{1}{\left(\frac{1}{k_{surface}} + \frac{1}{k_g}\right)} * f_{EOR\ activty}$$

It is unavoidable that the mixing of ammonia into the flue gas has some inhomogeneity and that the flue gas flow rate is not entirely uniform in the reactor cross section. This means that the necessary catalyst volume becomes somewhat larger than the 'ideal' volume, i.e. the volume for perfect mixing and ideal flow conditions. These deviations are expressed by the correction factors $f_{NH3,mal}$ and $f_{gas,\ mal}$.

Thus, in overall:

$$Catalyst\ Volume = \frac{F}{NHAV * A_{cat} * f_{NH3,mal} * f_{gas,mal}}$$

- $f_{NH3,mal}$ is the calculated ammonia maldistribution factor, which corrects for a non-ideal distribution of NH_3 and NO_x in the flue gas. It depends mainly on the type of ammonia injection system (grid or mixer) and the NO_x distribution from the boiler

- $f_{gas,mal}$ is the calculated gas maldistribution factor, which corrects for a none-ideal distribution of the flue gas at the inlet to the first catalyst layer.

- $f_{EOR\ activity}$ is the relative activity at the end of the guarantee period. It is calculated based on the type of fuel used in the boiler.

- $k_{surface}$ is the surface activity of the catalyst. It depends on
  - NO_x content
  - NH_3/NO_x-ratio
  - Gas composition (O_2, H_2O, etc)
  - Temperature

- Pressure
- Catalyst type (chemical composition, porosity, wall thickness)

- k_g is the mass transfer coefficient. It is calculated in Topsøe's computer program using fluid dynamic models. It depends on:
  - The linear velocity of the gas in catalyst channels, hydraulic diameter[2] (catalyst channel size) and length of catalyst element
  - Flow pattern in the catalyst channel (turbulent, laminar, mixed)
  - Temperature and gas composition

The calculation of the correction factors $f_{NH3,mal}$ and $f_{gas,\ mal}$ is done using Topsøe's proprietary computer programs. Described very simplified, a large number of simulations are run with ammonia-to-NOx ratios varying around the average. The average performance of these simulations is compared to performance with no variation and the deviation is expressed as a correction factor, $f_{NH3,mal}$. The same is done with the flue gas flow rate varying around the average to obtain $f_{gas,mal}$.
It is not possible to perform these calculations manually.

In case the ammonia to NOx ratio is much less than 1, a ±10% variation has very little impact on performance and in such case $f_{NH3,mal} \approx 1$.

[2] The size of the channel openings of the special wave shaped structure of DNX® catalysts is described by use of a term from fluid dynamics: hydraulic diameter. The hydraulic diameter, D_h, is defined as:

$$D_h = 4 \times \frac{Channel\ cross\ sec\ tion\ area}{Channel\ perimeter\ lenght}$$

3. Catalyst volume calculation

3.1 Design parameters

Parameter	BMCR Worst coal
Gas flow rate, F, Nm^3/hr	939,655
Temp., °C	392
NO_x^{in}, ppm dry / dry @6% O_2	598 / 536
NO_x^{out}, ppm dry @6% O_2	243
A_{cat}, m^2/m^3	405
$k_{surface}$	175.47
k_g	80.13
$f_{NH3, mal}$	1.0
$f_{gas, mal}$	0.9691
f_{EOR}	0.7395
X_{NH3}	0.9932
K_{NH3}	40.68
NHAV, $Nm^3/m^2/h$	8.15
Catalyst volume, m^3	293.8
Offered volume, m^3	297.56

Calc. no 1557425

The values of $k_{surface}$, k_g, $f_{NH3,mal}$ and $f_{gas,mal}$ are calculated on Topsøe's advanced in-house computer program.

The NH_3/NOx ratio is 0.5497 « 1.0 and therefore $f_{NH3,mal}$ = 1

The values of X_{NH3}, K_{NH3}, NHAV and catalyst volume are calculated according to the formulas above.

With NH_3/NOx ratio = 0.5497 the inlet ammonia concentration is 536×0.5497 = 294.6 ppm dry @6% O_2. The outlet concentration of NH_3 (the ammonia slip) is 2 ppm dry @6% O_2. The ammonia conversion thus is:

$$X_{NH3} = \frac{294.6 - 2.0}{294.6} = 0.9932$$

The rate constant:

$$K_{NH3} = \frac{1}{\left(\frac{1}{175.47} + \frac{1}{80.13}\right)} * 0.7395 = 40.68$$

and then

$$NHAV = \frac{-40.68}{Ln(1-0.9932)} = 8.15$$

And finally

$$Catalyst\ Volume = \frac{939{,}655}{8.15 * 405 * 1.0 * 0.9691} = 293.8$$

3.2 Conclusion

The calculated volume is less than 297 m^3. Thus the offered volume of 297.56 m^3 is suitable.

4. Reaction stoichiometry and ammonia consumption

The catalyst volume and the NH_3 consumption are based on the following reactions:

$$NO + NH_3 + ¼\ O_2 \rightarrow N_2 + 1½\ H_2O$$
$$NO + NO_2 + 2\ NH_3 \rightarrow 2\ N_2 + 3\ H_2O$$

i.e. a 1:1 stoichiometric reaction ratio between NH_3 and NOx.

The ammonia consumption (100 % NH_3) is calculated from:

$$NH_3 \text{ consumption (kg/hr)} = \text{Flow} \times (NOx^{in} \times \%DeNOx/100 + NH_3 \text{ slip}) / 22.414/10^6 \times 17.0$$

Flow is Nm^3/hr on wet basis. NOx^{in} and NH_3 slip are ppm on wet, actual O_2 basis.

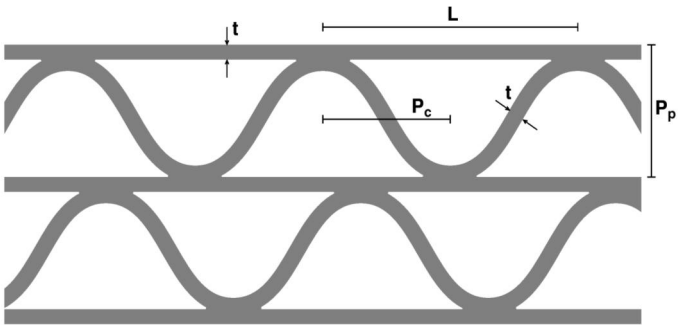
5. Catalyst Data

Physical properties	
Wall thickness, mm	0.8
Channel hydraulic diameter, mm	7.9
Cell pitch, mm	10.0
Plate pitch, mm	9.1
Cell density, CPSI	7.1
Specific area m^2/m^3	405
Open area (void), %	80
Leading edge reinforcement	Yes
Chemical composition	
Vanadium pentoxide, %	0.1 - 4
Tungsten trioxide, %	1 - 7
Silicon dioxide, %	15 - 25
Kaolin, %	13 - 23
Titanium dioxide, %	40 - 50
Fibres	8 - 12
Element sizes	
Element cross section including metal frame, mm x mm	466 x 466
Element height, mm	322 / 342 / 572 / 612
Net catalyst depth, mm	250 / 270 / 500 / 540

5.1 Reactor data

Parameter	**Design**
Catalyst type	DNX-XD
Total catalyst volume 2 units, m^3	1,190.24
Catalyst volume per unit, m^3	595.12
Number of reactors per unit	2
Catalyst volume per reactor, m^3	297.56
Net catalyst depth, total, mm	2,250
Number of layers	3+1
Reactor dimensions (L × W), m	14 × 10
Module size (L × W × H), mm (drawing number)	VE422AH: 1,880 × 946 × 1,356 VE522AH: 2,346 × 946 × 1,356 VE432AH: 1,880 × 1,410 × 1,356 VE532AH: 2,346 × 1,410 × 1,356
Module weight, kg	VE422AH: 566 VE522AH: 703 VE432AH: 850 VE532AH: 1065
Approx. total weight of all modules per reactor (3 layers), tonnes	129.1

Note: Catalyst geometry



Document Review Comment Sheet

Daelim's Ref. No :

No.	Document No.	Rev	Title	Purpose	Approval Status
1	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0001	0	FRAMING PLAN AT T.O.S EL+25,375(PLATFORM)	AP	C
	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0001-02	0	FRAMING PLAN AT T.O.S EL+32,375(PLATFORM)	AP	C
2	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0002	0	FRAMING PLAN AT T.O.S EL+35,175(PLATFORM)	AP	C
3	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0003	0	FRAMING PLAN AT T.O.S EL+37,975(PLATFORM)	AP	C
3	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0003-02	0	FRAMING PLAN AT T.O.S EL+41,775(PLATFORM)	AP	C
4	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0004	0	FRAMING PLAN AT T.O.S EL+46,575(PLATFORM)	AP	C
4	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0004-02	0	FRAMING PLAN AT T.O.S EL+49,975(PLATFORM)	AP	C
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7	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0007	0	FRAMING PLAN AT T.O.S EL+64,075(PLATFORM)	AP	C
8	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0008	0	FRAMING ELEVATION & SECTION - 1(PLATFROM)	AP	C
9	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0009	0	STAIR ENLARGED FRAMING PLAN - 1	AP	C
10	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0010	0	STAIR ENLARGED FRAMING PLAN - 2	AP	C
11	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0011	0	STAIR SECTIONS	AP	C
12	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0012	0	STAIR & HANDRAIL DETAILS	AP	C
13	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0013	0	TYPICAL CONNECTION DETAILS	AP	C
14	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0014	0	STEEL CONNECTION DETAILS-1	AP	C
15	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0015	0	STEEL CONNECTION DETAILS-2	AP	C
16	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0016	0	STEEL CONNECTION DETAILS-3	AP	C
17	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0017	0	STEEL CONNECTION DETAILS-4	AP	C
18	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0018	0	STEEL CONNECTION DETAILS-5	AP	C
19	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0019	0	STEEL CONNECTION DETAILS-6	AP	C
20	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0020	0	STEEL CONNECTION DETAILS-7	AP	C
21	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0021	0	GENERAL NOTES	AP	C
22	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0022	0	WELDING GENERAL DETAILS	AP	C

No.	Daelim's Comments	Vendor's Response
1	This document should be revised as per the owner's comment will be provided later.	Confirm.
2	General Comment Vendor should submit reply sheet from daelim's commnet as follwing	Confirm.
3	Vendor has responsibility to obtain approval from DIC; Manufacturer and design of catalyst must be approved by DIC but not approved yet. Therefore,	This drawing is not related with catalyst. Please approval this drawing.
4	Please confirm that this document fully comply with project requirement and comment. If not, DIC cannot approve this document without owner's approval.	This document comply with project reqruiement. Please approval this drawing.
5	SDC will not review this document until this document is fully complied with DIC's comment. Furthermore, we will not review any of the vendor's document which is related with the catalyst at the moment because the catalyst supplier have not approved by DIC, yet. Therefore vendor to submit officially the required technical documents for our review and approval. It will be borne by vendor for all the defects which are caused by your late submitssion.	This drawing is not related with catalyst. Please approval this drawing.

Document Review Comment Sheet

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1	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0001	0	FRAMING PLAN AT T.O.S EL+25,375(PLATFORM)	AP	C
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3	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0003	0	FRAMING PLAN AT T.O.S EL+37,975(PLATFORM)	AP	C
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9	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0009	0	STAIR ENLARGED FRAMING PLAN - 1	AP	C
10	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0010	0	STAIR ENLARGED FRAMING PLAN - 2	AP	C
11	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0011	0	STAIR SECTIONS	AP	C
12	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0012	0	STAIR & HANDRAIL DETAILS	AP	C
13	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0013	0	TYPICAL CONNECTION DETAILS	AP	C
14	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0014	0	STEEL CONNECTION DETAILS-1	AP	C
15	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0015	0	STEEL CONNECTION DETAILS-2	AP	C
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19	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0019	0	STEEL CONNECTION DETAILS-6	AP	C
20	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0020	0	STEEL CONNECTION DETAILS-7	AP	C
21	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0021	0	GENERAL NOTES	AP	C
22	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0022	0	WELDING GENERAL DETAILS	AP	C

No.	Daelim's Comments	Vendor's Response
6	The reply sheet of owner had been left off this document. Please insert reply sheet according to owner;s comment regarding this drawing rev.B(TB2-PEB-SDC-M1A-TVI-04040)	Confirm.

*** Legend**

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Document Review Comment Sheet			Ref. No TB2-PEB-SDC-M1A-TVI-04040			
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2	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0001-02	A	FRAMING PLAN AT T.O.S EL+32,375(PLATFORM)	RE	-	R
3	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0002	B	FRAMING PLAN AT T.O.S EL+35,175(PLATFORM)	RE	-	R
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8	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0004-03	A	FRAMING PLAN AT T.O.S EL+53,375(PLATFORM)	RE	-	R
9	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0005	B	FRAMING PLAN AT T.O.S EL+56,775(PLATFORM)	RE	-	R
10	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0006	B	FRAMING PLAN AT T.O.S EL+59,875(PLATFORM)	RE	-	R
11	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0007	B	FRAMING PLAN AT T.O.S EL+64,075(PLATFORM)	RE	-	R
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15	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0011	B	STAIR SECTIONS	RE	-	R
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19	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0015	A	STEEL CONNECTION DETAILS-2	RE	-	R
20	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0016	A	STEEL CONNECTION DETAILS-3	RE	-	R
21	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0017	A	STEEL CONNECTION DETAILS-4	RE	-	R
22	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0018	A	STEEL CONNECTION DETAILS-5	RE	-	R
23	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0019	A	STEEL CONNECTION DETAILS-6	RE	-	R
24	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0020	A	STEEL CONNECTION DETAILS-7	RE	-	R
25	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0021	A	GENERAL NOTES	RE	-	R
26	TB2-SDC.VP124-00UVJ-M-M1A-DRD-0022	A	WELDING GENERAL DETAILS	RE	-	R

No	PEB's Comments	Item status	해 석
1	Suggest adding SCR Structural Steel to all drawing titles to relate these drawings to the SCR support steel.		Add "SCR suppor steel sturucture" on title
2	**TB2-SDC.VP124-00UVJ-M-M1A-DRD-0001 Rev B:** This drawing indicates all steel is ASTM A36 or ASTM A572. General notes indicate a Korean Standard. The structural steel material approve by the Owner for the boiler structure is GBS material found on the boiler steel general notes. SDC needs to review the materials and present a unified material type for the boiler structure.		Delet the KS code from general note.
3	**TB2-SDC.VP124-00UVJ-M-M1A-DRD-0001 Rev B:** If this drawing shows a platform why is there no grating or walking surfaces indicated on the drawing?		There is no platform on this elevation.
4	**TB2-SDC.VP124-00UVJ-M-M1A-DRD-0001 Rev B:** The drawing nomenclature and symbols are not typical and are difficult to follow. A structurctural arrangement drawing uses a single line for a member with only Moment connections identified. All other connections are shear connections or shear plus axial. The reactions are indicated for connection design. Request to follow standard practice.		SG meaning is moment connection and SB is shear connection on the member list.
5	**TB2-SDC.VP124-00UVJ-M-M1A-DRD-0001 Rev B:** There are items shown that look like duct supports. What are these items, the locations of the items, and the details of the attachment to the steel for the items?		Please refer to "SCR of support detail drawing TB2-SDC.VP124-00100-M-M1A-DPS-001~0024".
6	**TB2-SDC.VP124-00UVJ-M-M1A-DRD-0001 Rev B:** Why is horizontal bracing indicated with dotted lines which are hidden lines in typical drafting practice? Are these braces located at the same elevation as the framing plan members? This information needs to be on the plan drawings.		At this elevation all members supplied by BWBC. This drawing just included to show the duct arrange at this elevation.
7	**TB2-SDC.VP124-00UVJ-M-M1A-DRD-0001 Rev B:** There are rectangular objects which are located in plan in both axes in one location and only located in the east west direction in the other location. What are these object and are there reference drawings that need to be indicated on this drawing for the object design drawings?		Please refer to above reply of No.6.
8	**TB2-SDC.VP124-00UVJ-M-M1A-DRD-0001 Rev B:** This is no reference to the General Note or Standard Connection drawings on this drawing. How does one know which drawings work with this drawing?		Please refer to above reply of No.4.
9	**TB2-SDC.VP124-00UVJ-M-M1A-DRD-0001 Rev B:** There appears to be revised dimensions on the drawing but there is no description in the revision block or revision indicated next to the "clouded" revisions.		Add the cloud mark on rivised.
10	**TB2-SDC.VP124-00UVJ-M-M1A-DRD-0002 REV B:** Usually platform arrangement elevation is the top of the walking surface and the top of steel is indicated based on the floor plan elevation. Use standard practice.		The elevation is top of steel structure at each elevation.

No	PEB's Comments	Item status	해 석
11	**TB2-SDC.VP124-00UVJ-M-M1A-DRD-0002 REV B:** Most comments for 0001 REV B apply to this drawing also.		Confirmed.
12	**TB2-SDC.VP124-00UVJ-M-M1A-DRD-0002 REV B:** The grating is shown to be spanning the longest spans of more than 3 meters which will not support the typical floor loads required for the boiler area platforms. Is the grating drawn in the incorrect direction? Please revie and correct. Usually the handrail locations are indicated on the arrangements with a line type that is identified on the General notes. The drawing needs to shown where there is toeplate only, or handrail with toeplate. this comment applies to all the drawings in this set.		The hatch mark is just showing the grating not the direction of grating. But we revised the direction of grating to avid confusion.
13	general comment. Coordinate with BWBC to provide access from boiler portion of structure to SCR portion of structure at more elevations.		All elevation setted after discussed with BWBC and the elevation is confirmed by BWBC.
14	An analysis of access and egress is needed with respect to the IBC 2006 and applicable NFPA standards to assure that exits are provide per fire and safety code requirements.		Confirmed.
15	**TB2-SDC.VP124-00UVJ-M-M1A-DRD-0001-02/0003-02/0004-02/ 0004-03 :** The use of 0001-02/0003-02/0004-02/0004-03 does not conform to the document numbering system for the Project. Change the drawing number to conform to the procedure. No suffixes allowed.		Revised the drawing number as per comment.
16	**TB2-SDC.VP124-00UVJ-M-M1A-DRD-0002 Rev B:** Indicate the details needed for attachment of equipment to the structure. Provide reference drawings for equipment. Identify equipment centerlines on the drawing.		The hole location stated on the drawing for equipment installation.
17	**TB2-SDC.VP124-00UVJ-M-M1A-DRD-0003 Rev B:** When there are multiple plan elevations on a drawing, indicate in drawing title.		Please refer to "TB2-SDC.VP124-00UVJ-M-M1A-DRD-0008".

No	PEB's Comments	Item status	해 석
18	**TB2-SDC.VP124-00UVJ-M-M1A-DRD-0003 Rev B:** Steel is going off the drawing to the east. Not acceptable.		We don't undersatand for this comment. The steel strucuture design is comply with column plan. There is not exceed any members from column plan.
19	How are personnel going to access the instrumentation and doorways when the distance between the SCR and platforms is 600 mm? Usually the gap between the two is much smaller, less than 150 mm so that handrail is not required.		The catalyst loading door installed at loading door flange. The lodaing door flange extruded 200mm from reactor wall. And the distance between loading door flange and flatform is 294mm. This this distance enough to catalyst loading work and general distance. And in any case for safety the handrail is needed.
20	Indicate the design floor live loads on each drawing. The live loads in the areas of catalyst module transfer will be much higher than those where only personnel access is required.		The live load is applied as 565kg/m^2.
21	Usually there are quite a few instruments in the SCR walls and there is a platform access between the boxes and all aound the boxes? In the current arrangement the modules have to be transported a longer distance than if the access doors were on the south side of the SCR boxes. Why was the current arrangement chosen?		The short side is more compatable to install and uninstall of catalyst. The fornt side of SCR reactor installaed soot blower. Hence there is not proper to install and uninsatll of catalyst. The back side of reactor there is not platforms. In addition the catalyst landing area is just beside of short length side of reactor. It is most good way to catalyst loading and unloading.
22	The hoist beam needs to be shown in more detail and the aloowable maximum lift capacity needs to be indicated.		The hoist beam designed base on the hoist capacity.
23	Is there going to be removable handrail required at the elevations where the catalyst is lifted for installation in the SCR and for removal from the SCR? Needs to be shown.		The removable platfrom stated on the platform drawing.
24	The enlarged plans and elevations for the stairs need to be referenced on the appropriate drawings.		All of related drawing number stated on platform drawings.
25	Welds need to be prequalified welds as shown in AiSC and AWS.		All welding is comply with AISC and AWS.
26	Handrail posts need to be schedule 80 to conform to Technical requirements.		The handrail manufactured sch 40.
27	Is a scallop a cope? All copes need to be according to AISC code.		All scallopes comply with AISC.

Legend

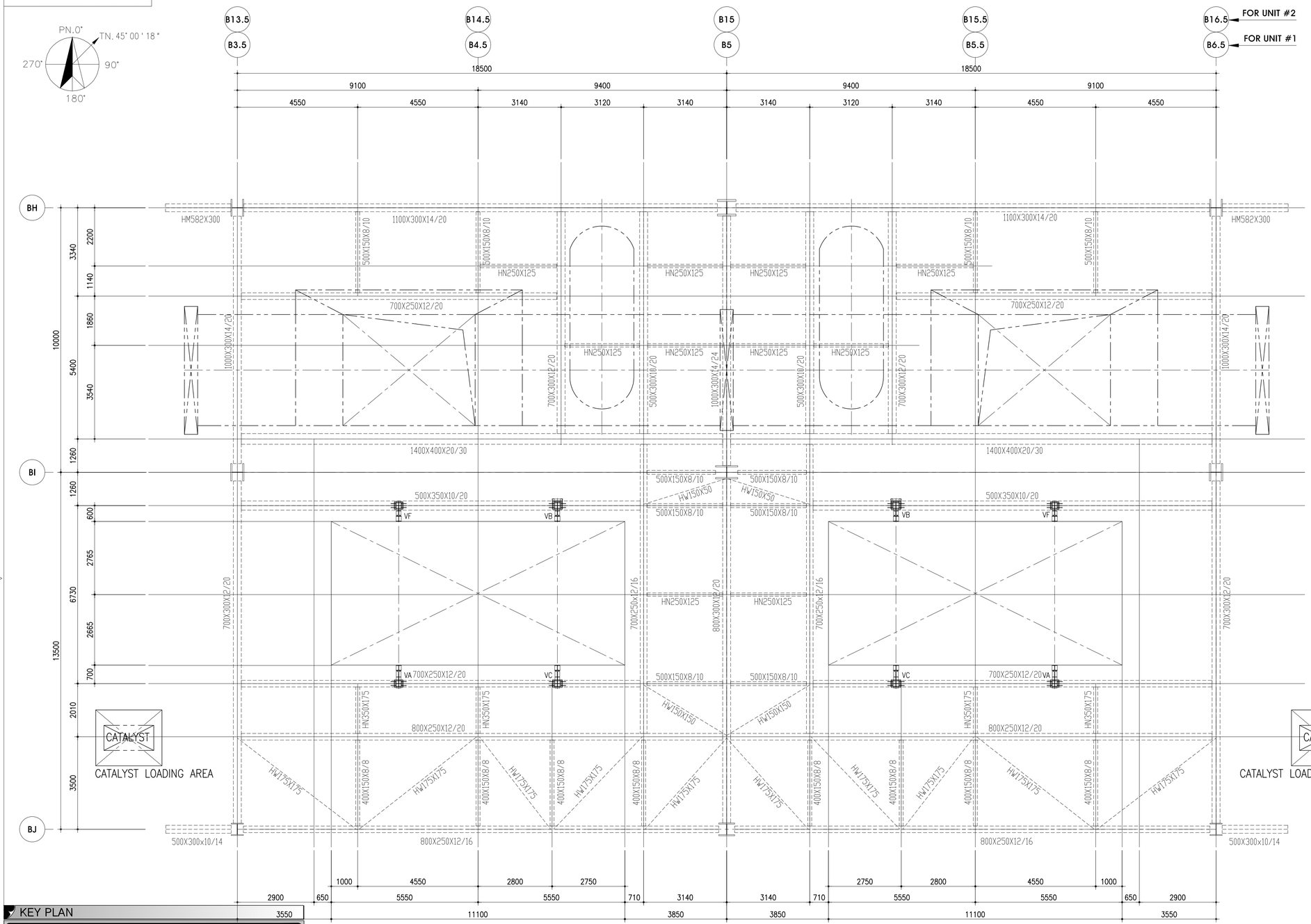
Contractor Purpose:
AP = For Approval
RE = For Reference
FC = For Construction
AB = As Built
INFO = For Information

TB2PEB Approval Status:

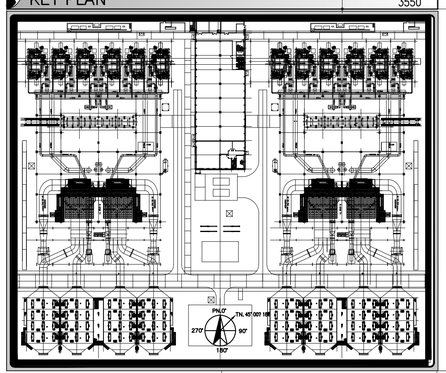
For AP:
A = Approved
B = Approved with Comments
C = Returned for Correction
D = Rejected

For RE:
I=Accepted for Reference
R= Returned for Correction
IB = Approved with Comments

TB2-SDC.VP124-00UVJ-M-M1A-DRD-0001



KEY PLAN



1 FRAMING PLAN AT T.O.S EL+25,375
PLATFORM

SCALE : 1/80

MEMBER LIST

MARK	MEMBER SIZE	MATERIAL	REMARK
COLUMN			
SC1, SC2	H-200 X 200 X 8 X 12	ASTM A36	
SC3	H-300 X 300 X 10 X 15	ASTM A572	
SC4	H-350 X 350 X 12 X 19	ASTM A572	
GIRDER & BEAM			
SG1	H-500 X 200 X 10 X 16	ASTM A36	
SG2	H-400 X 200 X 8 X 13	ASTM A36	
SCG1	H-400 X 200 X 8 X 13	ASTM A36	
SCG2	H-600 X 200 X 11 X 17	ASTM A36	
SB1	BH-1100 X 300 X 20 X 30	ASTM A572	
SB1A	BH-1200 X 350 X 20 X 35	ASTM A572	
SB2	H-900 X 300 X 16 X 28	ASTM A572	
SB2A	H-700 X 300 X 13 X 24	ASTM A572	
SB3	H-582 X 300 X 12 X 17	ASTM A572	
SB4	H-600 X 200 X 11 X 17	ASTM A36	
SB5	H-500 X 200 X 10 X 16	ASTM A36	
SB6	H-400 X 200 X 8 X 13	ASTM A36	
SB7	H-350 X 175 X 7 X 11	ASTM A36	
SB7A	H-340 X 250 X 9 X 14	ASTM A36	
SB8	H-300 X 150 X 6.5 X 9	ASTM A36	
SB9	H-200 X 100 X 5.5 X 8	ASTM A36	
SB10	H-200 X 200 X 8 X 12	ASTM A36	
SCB1	H-400 X 200 X 8 X 13	ASTM A36	
SCB2	H-500 X 200 X 10 X 16	ASTM A36	
SCB3	H-600 X 200 X 11 X 17	ASTM A36	
HBR1	2C-200 X 80 X 7.5 X 11	ASTM A36	
HBR2	2C-125 X 65 X 6 X 8	ASTM A36	
HBR3	L-100 X 100 X 8	ASTM A36	
ST1	C-250 X 90 X 9 X 13	ASTM A36	
JT1	C-200 X 90 X 8 X 13.5	ASTM A36	

NOTES

1. ALL DIMENSIONS ARE MILLIMETERS, UNLESS OTHERWISE NOTED.
2. GL ±0 = EL +0,000 = M.S.L EL +4.5m
3. STAIR DETAILS IS SEE DWG NO. M-M1A-DRD-0013~0016. (1)

LEGEND

1. B.O.BASE PL. : BOTTOM OF BASE PLATE
2. U.O.N : UNLESS OTHERWISE NOTED
3. T.O.S : TOP OF STEEL(T.O.B = TOP OF BEAM)
4. T.O.P : TOP OF PLATFORM
5. : GIRDER MOMENT CONNECTION
   900 GIRDER SPLICE(TYP.)
   : GIRDER SHEAR CONNECTION
   : BEAM MOMENT CONNECTION
   : BEAM SHEAR CONNECTION

DOCUMENT SUBMISSION STATUS : FOR FINAL

NOTE:

REV	DATE	DESCRIPTION	PREP	CHKD	APRD	APRD
1	03 Nov.2014	FOR FINAL	S.R.CHOI	S.C.JANG	C.Y.YANG	H.S.LEE
0	7 May.2014	FOR FINAL	S.R.CHOI	S.C.JANG	C.Y.YANG	H.S.LEE

OWNER	VIETNAM OIL AND GAS GROUP (PVN)
OWNER'S CONSULTANT	FICHTNER GmbH & Co. KG / FICHTNER / PV POWER PCC
EPC CONTRACTOR	PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PVC)
EPC CONTRACTOR'S CONSULTANT	WORLEYPARSONS
POWER ISLAND PACKAGE SUPPLIER	SOJITZ CORPORATION
	DAELIM INDUSTRIAL CO., LTD.

Daelim Industrial Co., Ltd.	
job No.	110180
	A – APPROVED
	B – APPROVED WITH COMMENTS
	C – RETURNED FOR CORRECTION
	D – REJECTED
	N – NOT APPLICABLE (REFERENCE ONLY)
SIGNED BY :	DATE :

DIC'S PERMISSION TO PROCEED OR REVIEW TAKEN ON VENDOR PRINTS SHALL NOT RELIEVE VENDOR FROM ITS RESPONSIBILITIES OR LIABILITIES UNDER THE PURCHASE ORDER.

PROJECT TITLE: THAI BINH2 THERMAL POWER PLANT 2 x 600MW

DRAWING TITLE: (1) SCR SUPPORT STEEL STRUCTURE DRAWING
SCR OF FRAMING PLAN AT T.O.S EL+25,375(PLATFORM)

VENDOR NAME: S&T CORPORATION

FUNCTION	NAME	SIGN	DATE
DRWN	S.C.JANG		03 Nov.2014
CHKD	S.H.PARK		03 Nov.2014
APPD	C.Y.YANG		03 Nov.2014
APPD	H.S.LEE		03 Nov.2014

DRAWING NO. TB2-SDC.VP124-00UVJ-M-M1A-DRD-0001 | JOB NO. 110180 | SCALE 1/80 | REV.NO. 1

FILE NAME: TB2-SDC.VP124-00UVJ-M-M1A-DRD-0001

A1 (594mm x 841mm)

DOCUMENT SUBMISSION STATUS: FF

NOTE:

0	4. Jun. 2018	For Approval	G.Y.OH	G.Y.OH	S.H.YANG	
REV.	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	APPROVED

OWNER

VIETNAM OIL AND GAS GROUP (PVN)

OWNER'S CONSULTANT

FICHTNER

PVPOWER PCC

EPC CONTRACTOR

PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PVC)

EPC CONSTRACTOR'S CONSULTANT

WORLEYPARSONS

POWER ISLAND PACKAGE SUPPLIER

SOJITZ CORPORATION

DAELIM INDUSTRIAL CO., LTD.

PROJECT TITLE

THAI BINH 2 THERMAL POWER PLANT 2 x 600MW

DRAWING / DOCUMENT TITLE

Catalyst Outline Drawing for De-NOx System

Vendor's Logo:

S&T Corporation

FUNCTION	NAME	SIGN	DATE
DRWN	G.Y.OH		4. Jun. 2018
CHKD	G.Y.OH		4. Jun. 2018
APPD	S.H.YANG		4. Jun. 2018

DOCUMENT NO: TB2-SDC.VP124-00100-M-M1A-DRD-0101	**No of page:** 6	**Scale**	**Rev.0**

P.O NO.	110180-29-124-001-A01
ITEM NO.	124
ITEM DESCRIPTION	De-Nox System
DOCUMENT NO.	TB2-SDC.VP124-00100-M-M1A-DRD-0101
DOCUMENT TITLE	Catalyst Outline Drawing for De-NOx Sysem
REV NO.	0

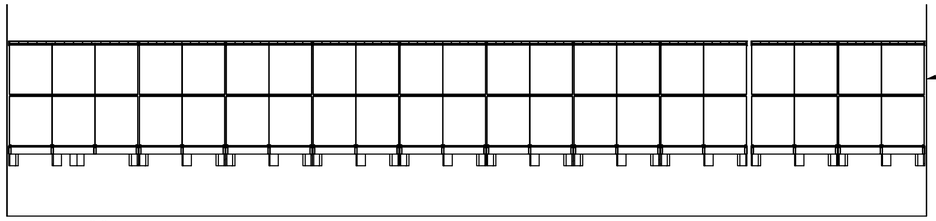
Daelim's Approval Status

Daelim Industrial Co., Ltd.	
Job No.	110180
	A - APPROVED
	B - APPROVED WITH COMMENTS
	C - RETURNED FOR CORRECTION
	D - REJECTED
	N - NOT APPLICABLE(REFERENCE ONLY)
SIGNED BY :	DATE :

DIC'S PERMISSION TO PROCEED OR REVIEW TAKEN ON VENDOR PRINTS SHALL NOT RELIEVE VENDOR FROM ITS RESPONSIBILITIES OR LIABILITIES UNDER THE PURCHASE ORDER.

VENDOR'S LOGO:

S&T Corporation



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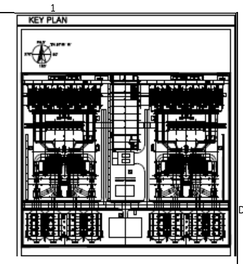
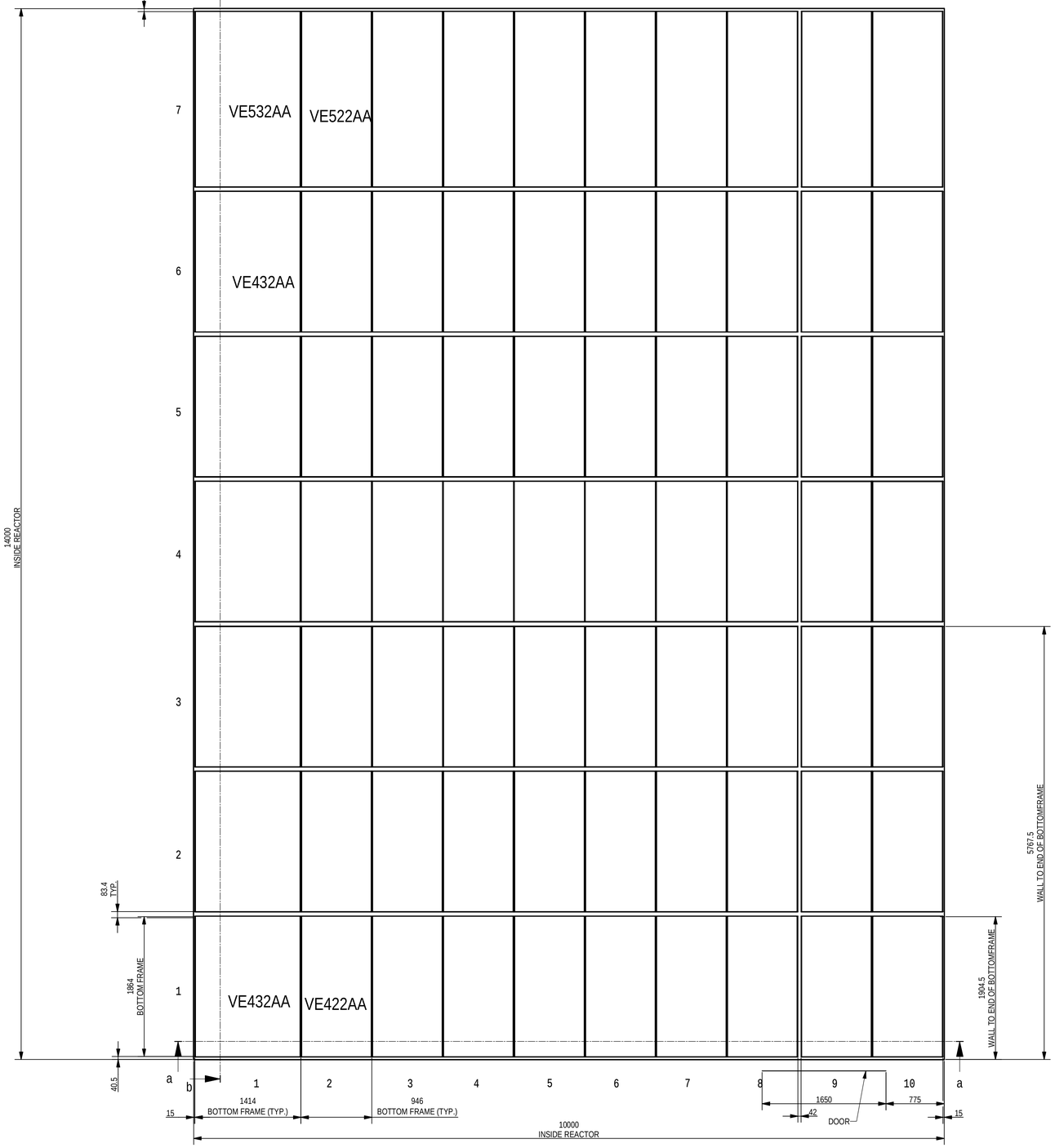
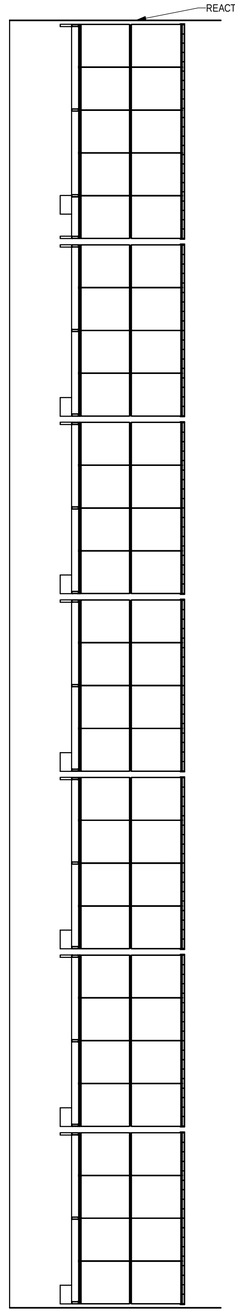






b-b

CUSTOMER APPROVAL	Mark One: ☐A ☐B ☐C
Signature and Date Required. Indicate as Follows Below: Name: Date:	A: No Comment. Drawing APPROVED for fabrication B: Comments Noted - Revise & Resubmit, Proceed with Fabrication C: Unacceptable. Revise Drawing & Resubmit for Reiew or Approval

GENERAL NOTES

1) ARRANGEMENT FOR GRATING FLOOR
BEAM AND MODULE ARRANGEMENTS SHOULD BE MADE IN A WAY THAT ENSURES AS FEW BEAMS AS POSSIBLE IN THE FLOW PATH UNDER THE CATALYST.
2) TO AVOID DUST BUILD-UPS, BOX BEAMS ARE RECOMMENTED INSIDE REACTOR

HALDOR TOPSOE

REV.	DESCRIPTION	DATE	DRAWN	CHECK	APPD.
0	Replacing drawing 1423230	Jun 21, 2016	JTM	CHSM	CHSM

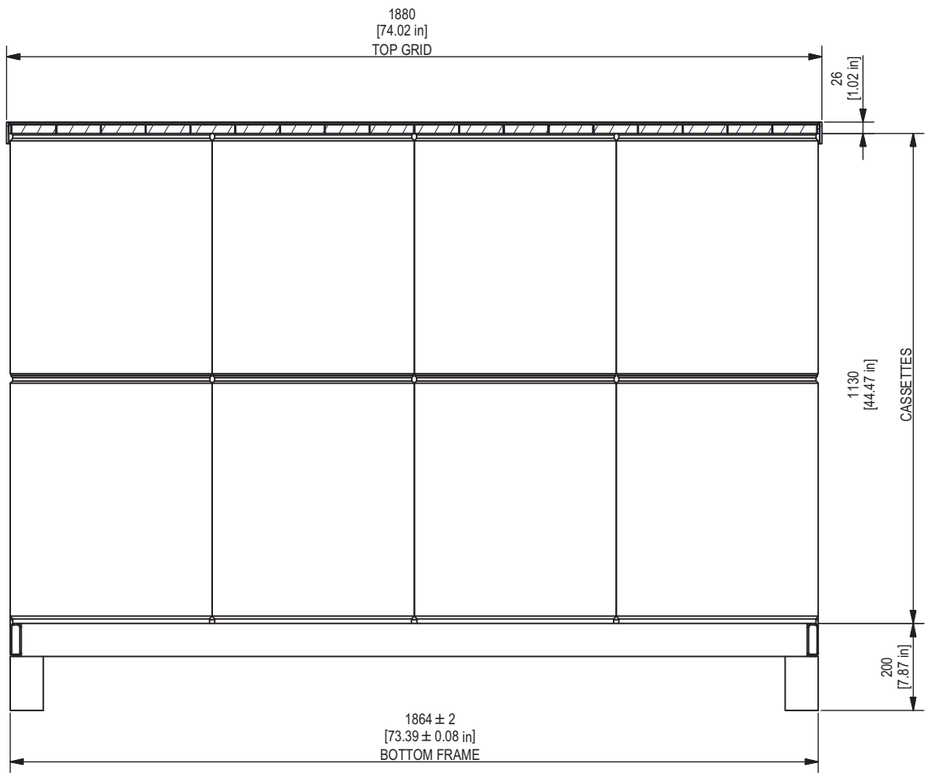
Thai Binh Power Plant
S&T Corporation
Republic of Korea

10 x 7 MODULE ARRANGEMENT
VERTICAL FLOW

CLIENT DOC. | CLIENT REV.

DWG SIZE: A1
SCALE: 1:33,33
ITEM: ARRANGEMENT

DOCUMENT ID
JOB NO. 72130-13-3143
DOCUMENT NUMBER M52007-001
REV. 0



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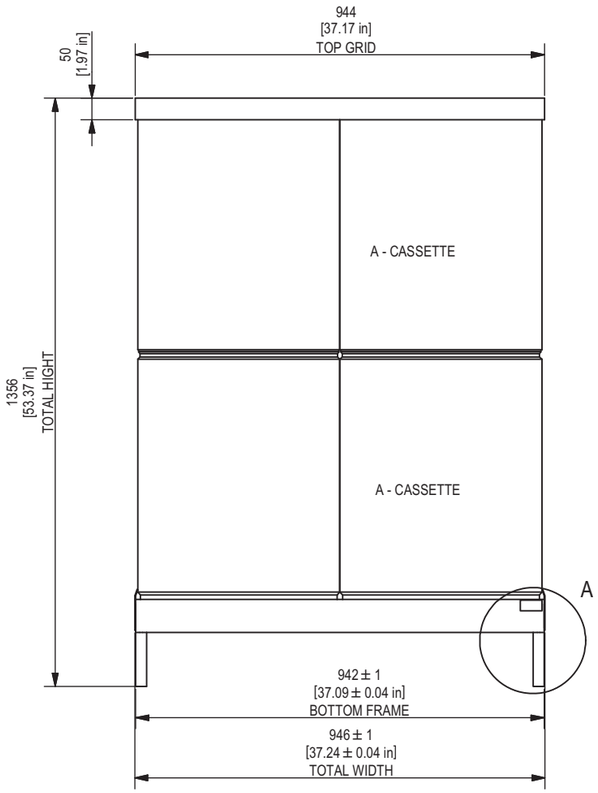
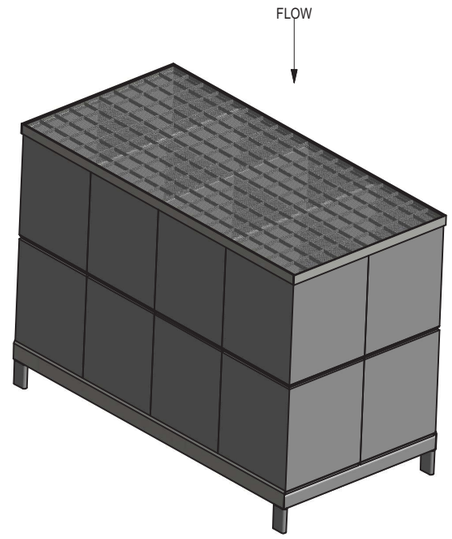
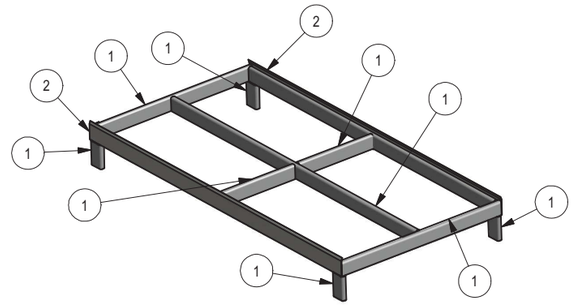
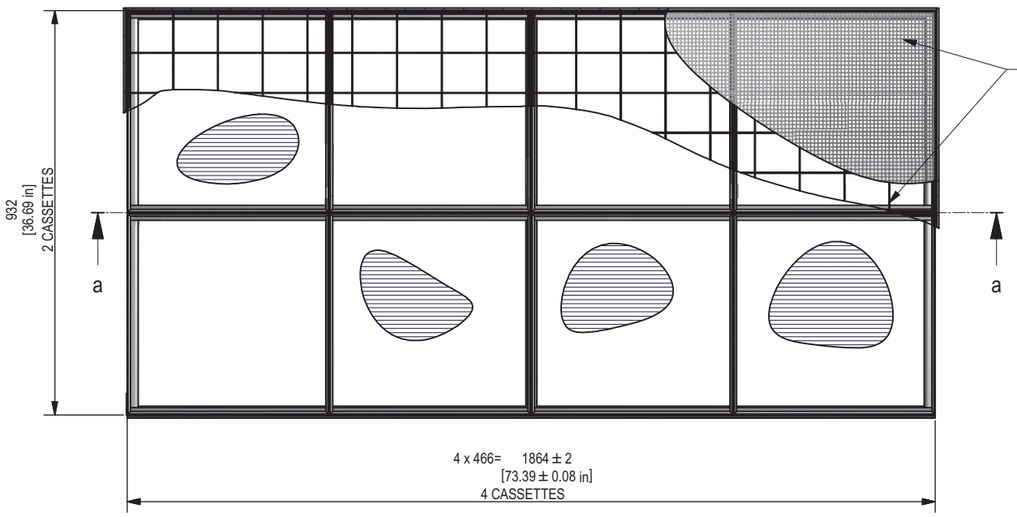


SIDE VIEW







TOP VIEW

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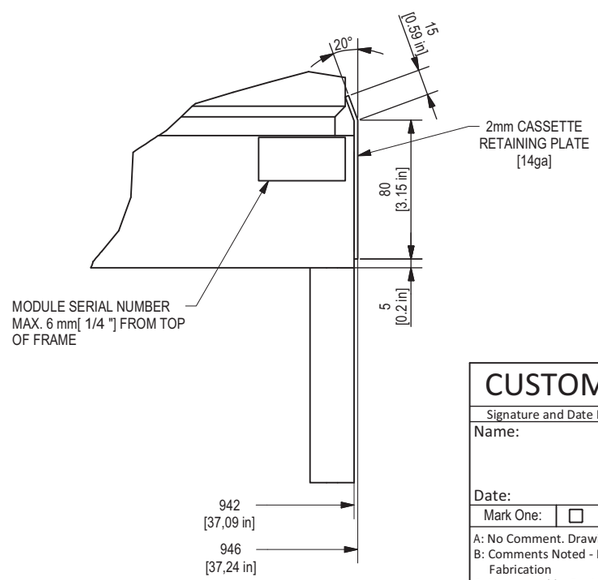


PARTS LIST			
ITEM	QTY	DESCRIPTION	MATERIAL
1	-	80 x 25 x 3, 3" x 1" x 11ga (0.12")	CS ASTM A36, S235G3
2	-	RETAINING PLATE [14 ga]	CS ASTM A36, S235G3

GENERAL NOTES

1) TOTAL WEIGHT OF A MODULE WITH TOP GRID: 514- 566 kg (1133 - 1248 lb)

2) ALL OUTSIDE WELDINGS ON THE BOTTOM FRAME MUST BE GROUND FLUSH WITH SURFACE

3) THE TOP LAYER CASSETTES MUST BE TURNED 90° COMPARED TO THE BOTTOM LAYER.

4) CASSETTES ARE TACKWELDED TO THE BOTTOMFRAME AND TO EACH OTHER IN THE TOP.

5) THE TOP GRID IS DESIGNED TO BE WALKED ON DURING MAINTENANCE IN THE REACTOR - POINT LOAD 120 kg (265 lbs)

6) THE CATALYST MODULE IS LIFTED, MOVED AND INSTALLED BY FORK LIFT/ PALLET CART AT BOTTOM OF MODULE

7) DIMENSIONS GIVEN IN mm AND US UNITS. DRAWN DIMENSIONS IN mm.

REV	DESCRIPTION	DATE	DRAWN	CHECK	APPD.
4					
3					
2					
1					
0	FIRST ISSUE	19-MAR-2013	CHSM/JTM		

CUSTOMER APPROVAL

Signature and Date Required. Indicate as Follows Below:

Name:

Date:

Mark One: ☐ A ☐ B ☐ C

A: No Comment. Drawing APPROVED
B: Comments Noted - Revise & Resubmit, Proceed with Fabrication
C: Unacceptable. Revise Drawing & Resubmit for Reiew or Approval

HALDOR TOPSØE A/S
COPENHAGEN
DENMARK

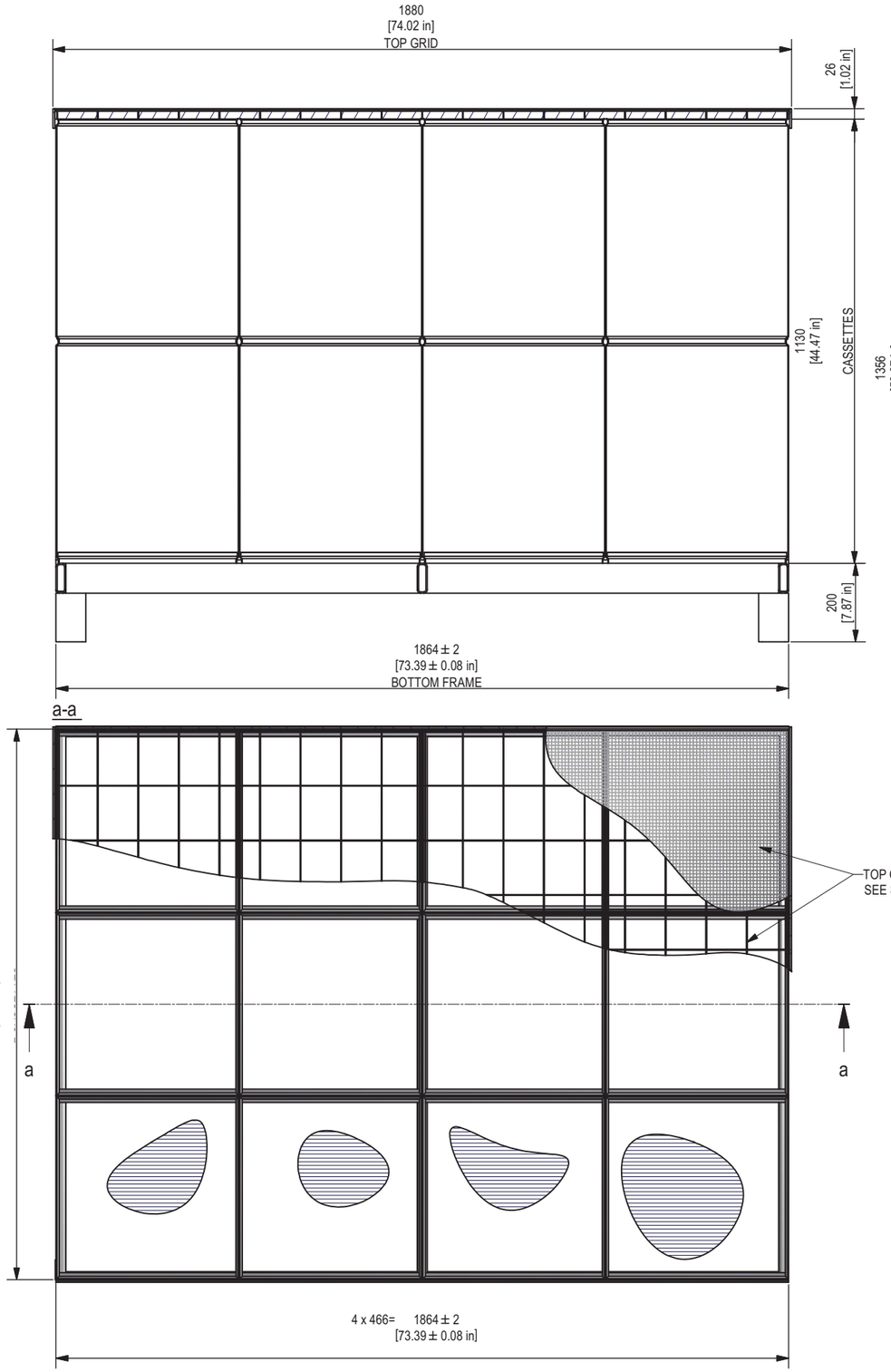
SCALE 1:10 | DOC. GRP. 52
DWG SIZE A2

THAI BINH POWER PLANT
VIETNAM

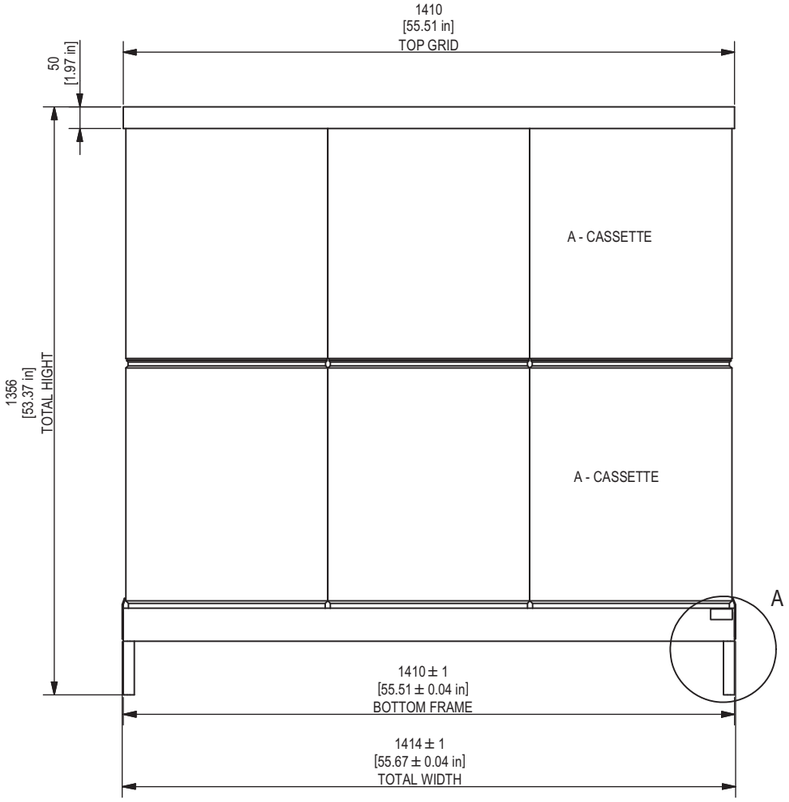
JOB NO. 13-3143 | ITEM VE422AH

CATALYST MODULE ON BOTTOM FRAME
WITH TOP GRID
VERTICAL FLOW

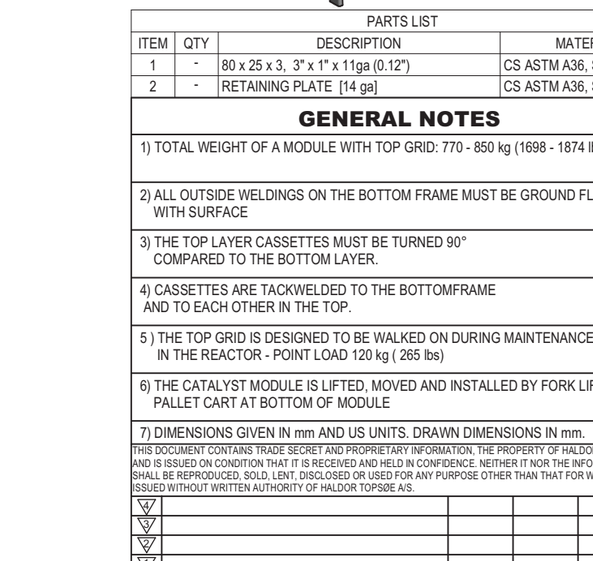
DWG. NO. 2343227 | REV. 0
SHEET 1 OF 1



TOP VIEW



SIDE VIEW



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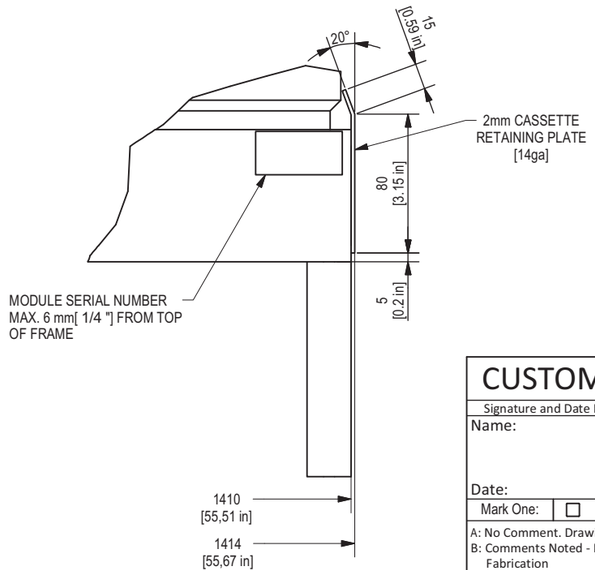


PARTS LIST			
ITEM	QTY	DESCRIPTION	MATERIAL
1	-	80 x 25 x 3, 3" x 1" x 11ga (0.12")	CS ASTM A36, S235G3
2	-	RETAINING PLATE [14 ga]	CS ASTM A36, S235G3

GENERAL NOTES

1) TOTAL WEIGHT OF A MODULE WITH TOP GRID: 770 - 850 kg (1698 - 1874 lb)

2) ALL OUTSIDE WELDINGS ON THE BOTTOM FRAME MUST BE GROUND FLUSH WITH SURFACE

3) THE TOP LAYER CASSETTES MUST BE TURNED 90° COMPARED TO THE BOTTOM LAYER.

4) CASSETTES ARE TACKWELDED TO THE BOTTOMFRAME AND TO EACH OTHER IN THE TOP.

5) THE TOP GRID IS DESIGNED TO BE WALKED ON DURING MAINTENANCE IN THE REACTOR - POINT LOAD 120 kg (265 lbs)

6) THE CATALYST MODULE IS LIFTED, MOVED AND INSTALLED BY FORK LIFT/ PALLET CART AT BOTTOM OF MODULE

7) DIMENSIONS GIVEN IN mm AND US UNITS. DRAWN DIMENSIONS IN mm.

REV	DESCRIPTION	DATE	DRAWN	CHECK	APPD.
V4					
V3					
V2					
V1					
V0	FIRST ISSUE	19-MAR-2013	CHSM/JTM		

CUSTOMER APPROVAL

Signature and Date Required. Indicate as Follows Below:

Name:

Date:

Mark One: ☐ A ☐ B ☐ C

A: No Comment. Drawing APPROVED
B: Comments Noted - Revise & Resubmit, Proceed with Fabrication
C: Unacceptable. Revise Drawing & Resubmit for Reiew or Approval

HALDOR TOPSØE A/S
COPENHAGEN
DENMARK

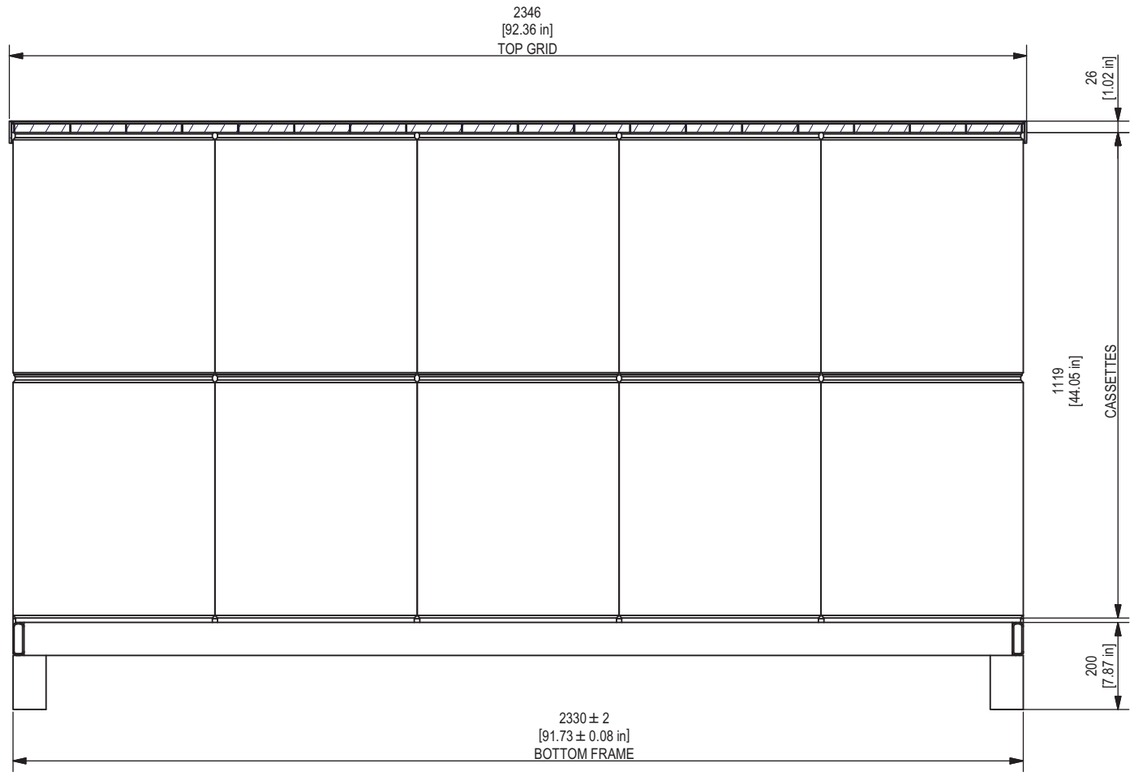
SCALE 1:10 | DOC. GRP. 52
DWG SIZE A2

THAI BINH POWER PLANT
VIETNAM

CATALYST MODULE ON BOTTOM FRAME
WITH TOP GRID
VERTICAL FLOW

JOB NO. 13-3143 | ITEM VE432AH

DWG. NO. 2343231 SHEET 1 OF 1 | REV. V0



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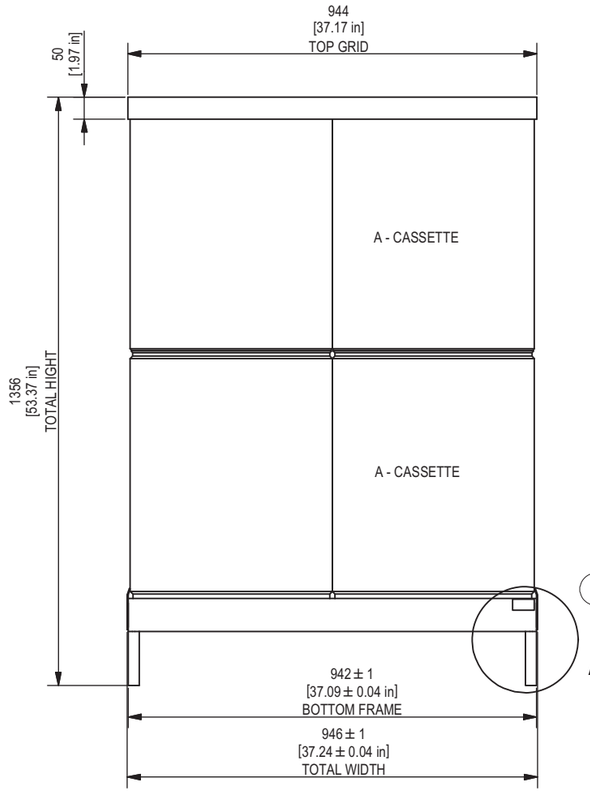
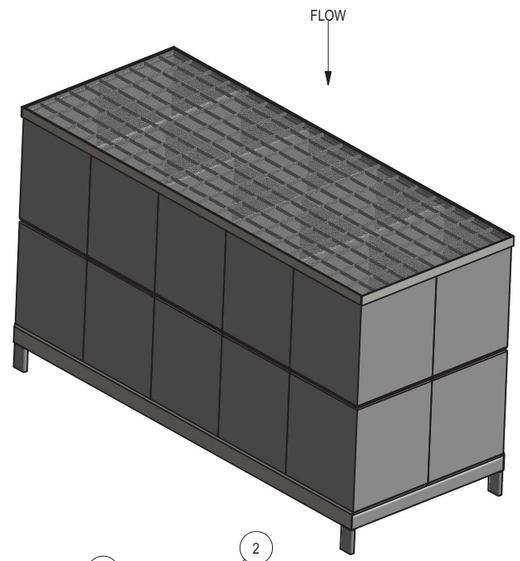
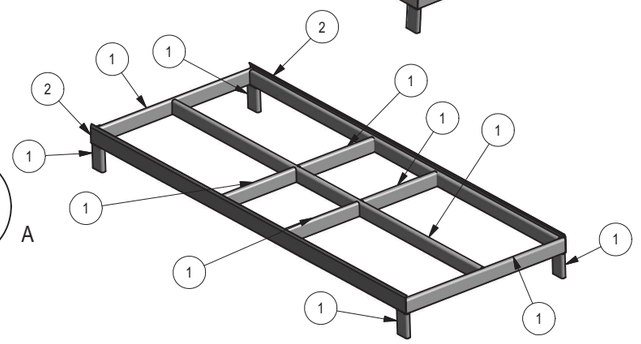
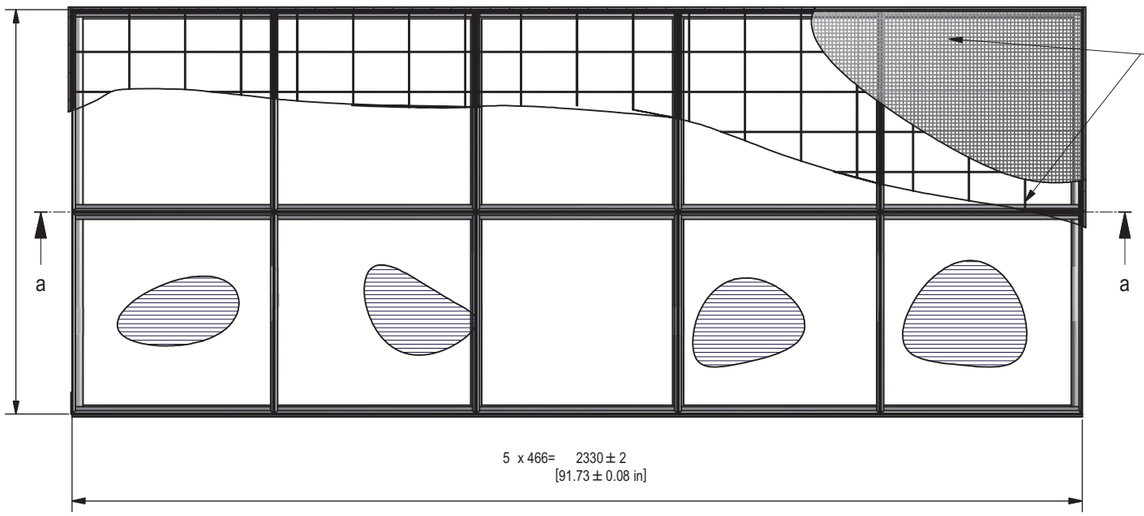


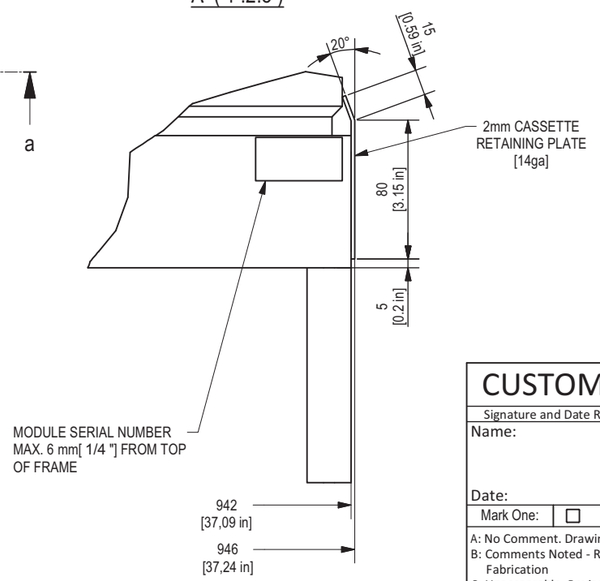
SIDE VIEW







TOP VIEW



PARTS LIST			
ITEM	QTY	DESCRIPTION	MATERIAL
1	-	80 x 25 x 3, 3" x 1" x 11ga (0.12")	CS ASTM A36, S235G3
2	-	RETAINING PLATE [14 ga]	CS ASTM A36, S235G3

GENERAL NOTES

1) TOTAL WEIGHT OF A MODULE WITH TOP GRID: 637 - 703 kg (1404 - 1550 lb)

2) ALL OUTSIDE WELDINGS ON THE BOTTOM FRAME MUST BE GROUND FLUSH WITH SURFACE

3) THE TOP LAYER CASSETTES MUST BE TURNED 90° COMPARED TO THE BOTTOM LAYER.

4) CASSETTES ARE TACKWELDED TO THE BOTTOMFRAME AND TO EACH OTHER IN THE TOP.

5) THE TOP GRID IS DESIGNED TO BE WALKED ON DURING MAINTENANCE IN THE REACTOR - POINT LOAD 120 kg (265 lbs)

6) THE CATALYST MODULE IS LIFTED, MOVED AND INSTALLED BY FORK LIFT/ PALLET CART AT BOTTOM OF MODULE

7) DIMENSIONS GIVEN IN mm AND US UNITS. DRAWN DIMENSIONS IN mm.

REV	DESCRIPTION	DATE	DRAWN	CHECK	APPD.
4					
3					
2					
1					
0	FIRST ISSUE	19-MAR-2013	CHSM/JTM		

CUSTOMER APPROVAL

Signature and Date Required. Indicate as Follows Below:

Name:

Date:

Mark One: ☐ A ☐ B ☐ C

A: No Comment. Drawing APPROVED
B: Comments Noted - Revise & Resubmit, Proceed with Fabrication
C: Unacceptable. Revise Drawing & Resubmit for Reiew or Approval

HALDOR TOPSØE A/S
COPENHAGEN
DENMARK

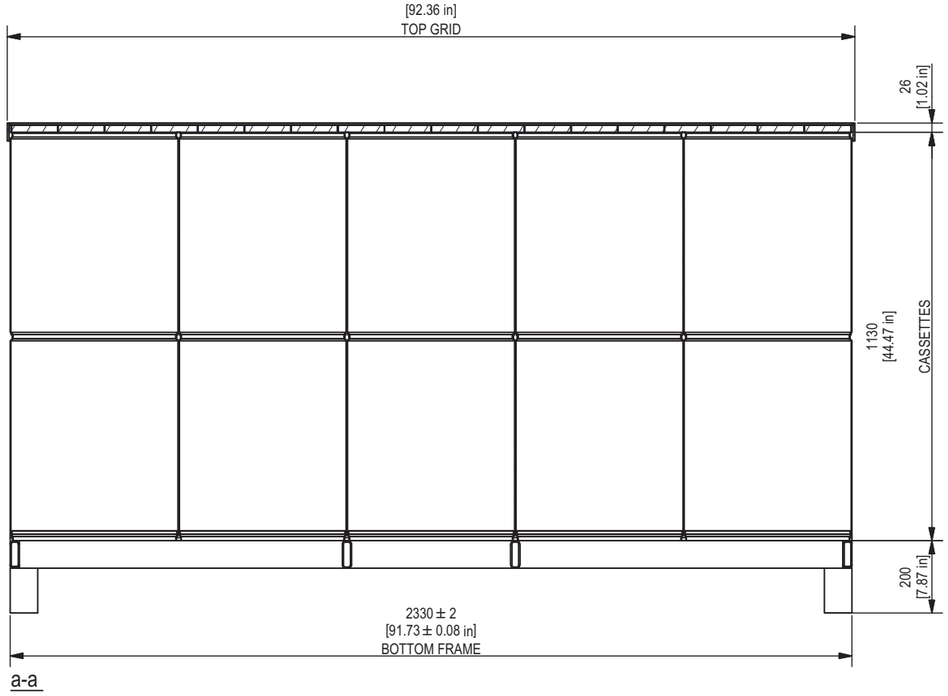
SCALE 1:10 | DOC. GRP. 52
DWG SIZE A2

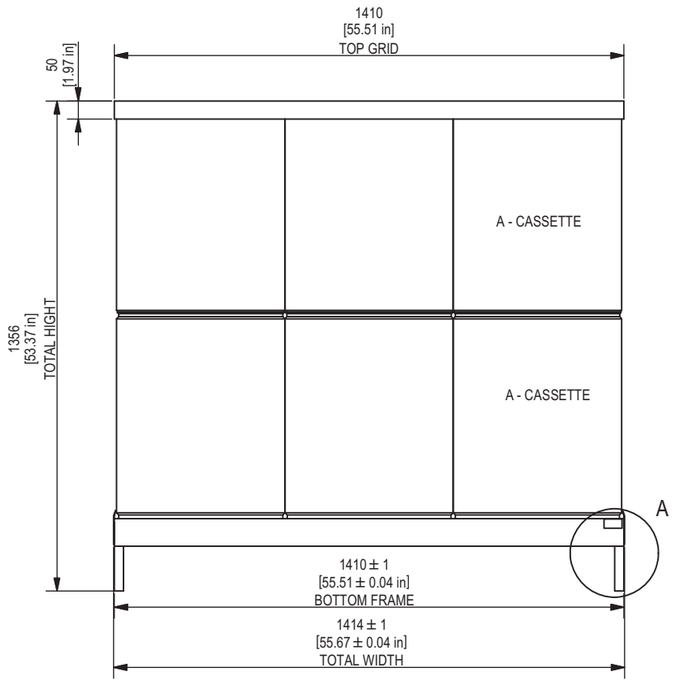
THAI BINH POWER PLANT
VIETNAM

JOB NO. 13-3143 | ITEM VE522AH

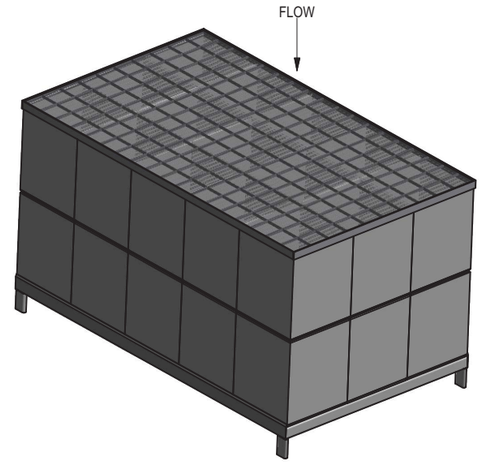
CATALYST MODULE ON BOTTOM FRAME
WITH TOP GRID
VERTICAL FLOW

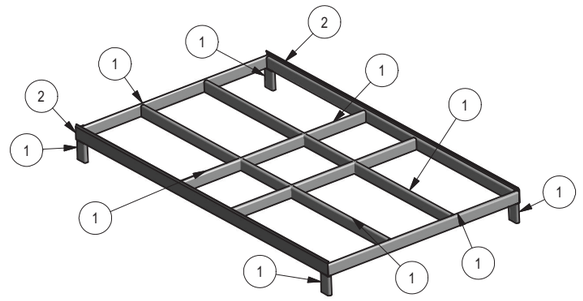
DWG. NO. 2343228 | REV. 0
SHEET 1 OF 1

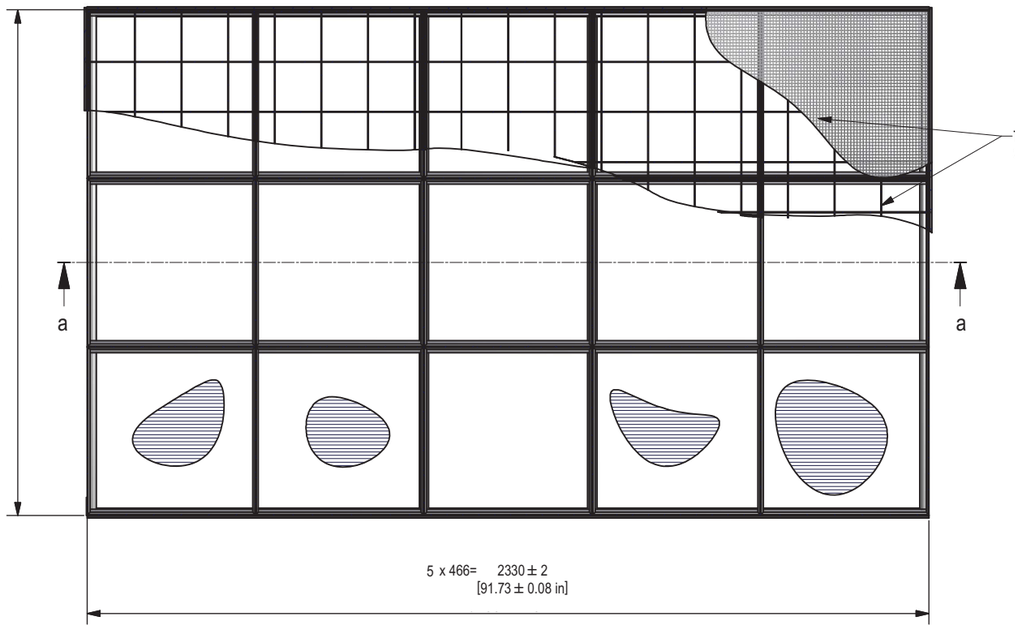




SIDE VIEW

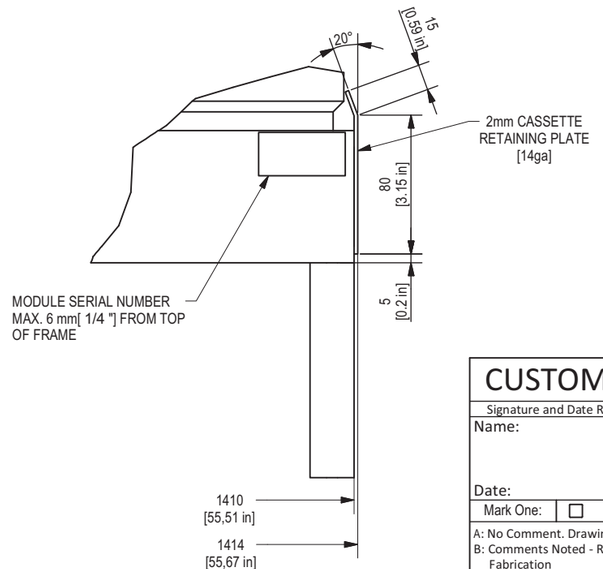






TOP VIEW

A (1 :2.5)



PARTS LIST			
ITEM	QTY	DESCRIPTION	MATERIAL
1	-	80 x 25 x 3, 3" x 1" x 11ga (0.12")	CS ASTM A36, S235G3
2	-	RETAINING PLATE [14 ga]	CS ASTM A36, S235G3

GENERAL NOTES

1) TOTAL WEIGHT OF A MODULE WITH TOP GRID: 965 - 1065 kg (2127 - 2348 lb)

2) ALL OUTSIDE WELDINGS ON THE BOTTOM FRAME MUST BE GROUND FLUSH WITH SURFACE

3) THE TOP LAYER CASSETTES MUST BE TURNED 90° COMPARED TO THE BOTTOM LAYER.

4) CASSETTES ARE TACKWELDED TO THE BOTTOMFRAME AND TO EACH OTHER IN THE TOP.

5) THE TOP GRID IS DESIGNED TO BE WALKED ON DURING MAINTENANCE IN THE REACTOR - POINT LOAD 120 kg (265 lbs)

6) THE CATALYST MODULE IS LIFTED, MOVED AND INSTALLED BY FORK LIFT/ PALLET CART AT BOTTOM OF MODULE

7) DIMENSIONS GIVEN IN mm AND US UNITS. DRAWN DIMENSIONS IN mm.

REV	DESCRIPTION	DATE	DRAWN	CHECK	APPD.
4					
3					
2					
1					
0	FIRST ISSUE	19-MAR-2013	CHSM/JTM		

CUSTOMER APPROVAL

Signature and Date Required. Indicate as Follows Below:

Name:

Date:

Mark One: ☐ A ☐ B ☐ C

A: No Comment. Drawing APPROVED
B: Comments Noted - Revise & Resubmit, Proceed with Fabrication
C: Unacceptable. Revise Drawing & Resubmit for Reiew or Approval

HALDOR TOPSØE A/S
COPENHAGEN
DENMARK

THAI BINH POWER PLANT
VIETNAM

CATALYST MODULE ON BOTTOM FRAME
WITH TOP GRID
VERTICAL FLOW

SCALE 1:10 | DOC. GRP. 52
DWG SIZE A2
JOB NO. 13-3143 | ITEM VE532AH
DWG. NO. 2343229 | REV. 0
SHEET 1 OF 1

Catalyst Module Weight

Catalyst Module Type	Q'ty per layer	Q'ty per reactor	Weigh per module (kg)	Weigh per Layer (kg)	Total Weight per Reactor (kg)
VE532	1	3	1,065	1,065	3,195
VF522	9	27	703	6,327	18,981
VE432	6	18	850	5,100	15,300
VE422	54	162	566	30,564	91,692
	70	210		43,056	129,168

DOCUMENT SUBMISSION STATUS: FA

NOTE: ISSUE TO PVC
FOR FINAL

REV.	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	APPROVED
2	10. Mar. 2017	For Construction	J.H.PARK	G.Y.OH	S.H.YANG	
1	7. Nov. 2016	For Construction	J.H.PARK	G.Y.OH	S.H.YANG	
0	10. Mar. 2016	For Construction	J.H.PARK	G.Y.OH	S.H.YANG	

OWNER

VIETNAM OIL AND GAS GROUP (PVN)

OWNER'S CONSULTANT

FICHTNER

PVPOWER PCC

EPC CONTRACTOR

PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PVC)

EPC CONSTRACTOR'S CONSULTANT

WORLEYPARSONS

POWER ISLAND PACKAGE SUPPLIER

SOJITZ CORPORATION

DAELIM INDUSTRIAL CO., LTD.

PROJECT TITLE

THAI BINH 2 THERMAL POWER PLANT 2 x 600MW

DRAWING / DOCUMENT TITLE

SCR SYSTEM INSTALLATION MANUAL INSTRUCTION

Vendor's Logo:

S&T Corporation

FUNCTION	NAME	SIGN	DATE
DRWN	J.H.PAR		10. Mar. 2017
CHKD	G.Y.OH		10. Mar. 2017
APPD	S.H.YANG		10. Mar. 2017

DOCUMENT NO: TB2-SDC.VP124-00100-M-M1A-SIN-0001	No of page: 65	Scale	Rev.2

P.O NO.	**110180-29-124-001-A01**
ITEM NO.	**124**
ITEM DESCRIPTION	**De-Nox System**
DOCUMENT NO.	**TB2-SDC.VP124-00100-M-M1A-SIN-0001**
DOCUMENT TITLE	**SCR SYSTEM INSTALLATION NAMUAL INSTRUCTION**
REV NO.	**2**

Daelim's Approval Status

Daelim Industrial Co., Ltd.	
Job No.	**110180**
	A - APPROVED
	B - APPROVED WITH COMMENTS
	C - RETURNED FOR CORRECTION
	D - REJECTED
	N - NOT APPLICABLE(REFERENCE ONLY)
SIGNED BY :	**DATE :**

DIC'S PERMISSION TO PROCEED OR REVIEW TAKEN ON VENDOR PRINTS SHALL NOT RELIEVE VENDOR FROM ITS RESPONSIBILITIES OR LIABILITIES UNDER THE PURCHASE ORDER.

VENDOR'S LOGO:

S&T Corporation

Document Review Comment Sheet

Daelim's Ref. No :

No.	Document No.	Rev	Title	Purpose	Approval Status
1	TB2-SDC.VP124-00100-M-M1A-SIN-0001	**1**	SCR SYSTEM INSTALLATION MANUAL INSTRUCTION	**FC**	**N**

No.	Daelim's Comments	Vendor's Response
1		As per monthly progress meeting comment between SDC and End user, we submit rev.2 SCR system installation manual instruction include catalyst installation drawing.
2		
3		

*** Legend**

Purpose:
AP - For Approval
RE - For Reference
FF - For Final / FC - For Construction
F - Final / AB - As Built
INFO - For Information

Approval Status:
A - Approved
B - Approved with Comments
C - Returned for Correction
D - Rejected
N - Reference Only

No.	Document No.	Rev	Title	Purpose	Approval Status	
					In	Out
1	TB2-SDC.VP124-00100-M-M1A-SIN-0001	1	SCR SYSTEM INSTALLATION MANUAL INSTRUCTION	FC	-	A

	Owner/PMC's Comments	Contractor's Response
	General comment	
1	No comment.	
2		
3		

Legend:

Document Purpose
AP = For Approval
RE = For Reference
FC = For Construction
AB = As Built
IN = For Information

AP Outgoing Status
A = Approved
B = Approved with Comments
C = Returned for Correction
D = Rejected

RE Outgoing Status
I = Accepted for Reference
R = Returned for Correction
IB = Accepted with comments.

1. Introduction

1.1 Objective

This document is to provide the erection guideline of SCR (Selective Catalystic Reduction of NO_x) inlet & outlet duct, reactor, equipment, valves, piping and platform to erector.

1.2 Definitions

Erector : Any erection company employed by customer

SCR manufacturer or supplier : S&TC

Boiler (BLR) manufacturer or supplier : Any boiler supplier awarded a contract by customer

Customer / Power island package supplier : Dalim Industrial Co. Ltd., / Solitz Corporation

EPC contractor : Petrovietnam Construction Joint Stock Corporation / Worleyparsons

Owner : Vietnam Oil and Gas Group (PVN) / Fichtner

2. General Background Specification of SCR Duct, Reactor, and Platform

Erector is recommended to know about the general background knowledge including overall shape, material of construction, installation position of SCR inlet & outlet duct and reactor, equipment, valves, piping with platform in order for they to understand this system generally before see installation method. Refer to the following general background knowledge of SCR.

2.1 Overall Shape after Erection

3-D modeling showing overall shape of SCR inlet & outlet duct, reactor, equipment, valves, piping and platform structure are shown below. Please refer to the followings.

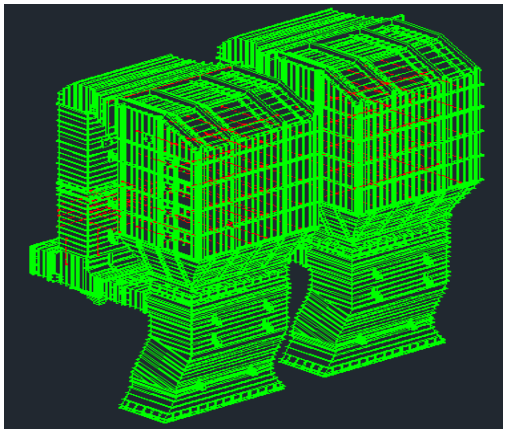


Figure 1. Two(2) Chambers of SCR Inlet Duct & Reactor (For BLR 1unit)

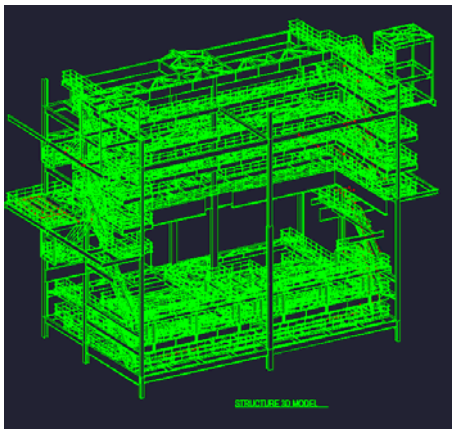


Figure 2. 3D Model of Platform Structure for SCR Duct & Reactor

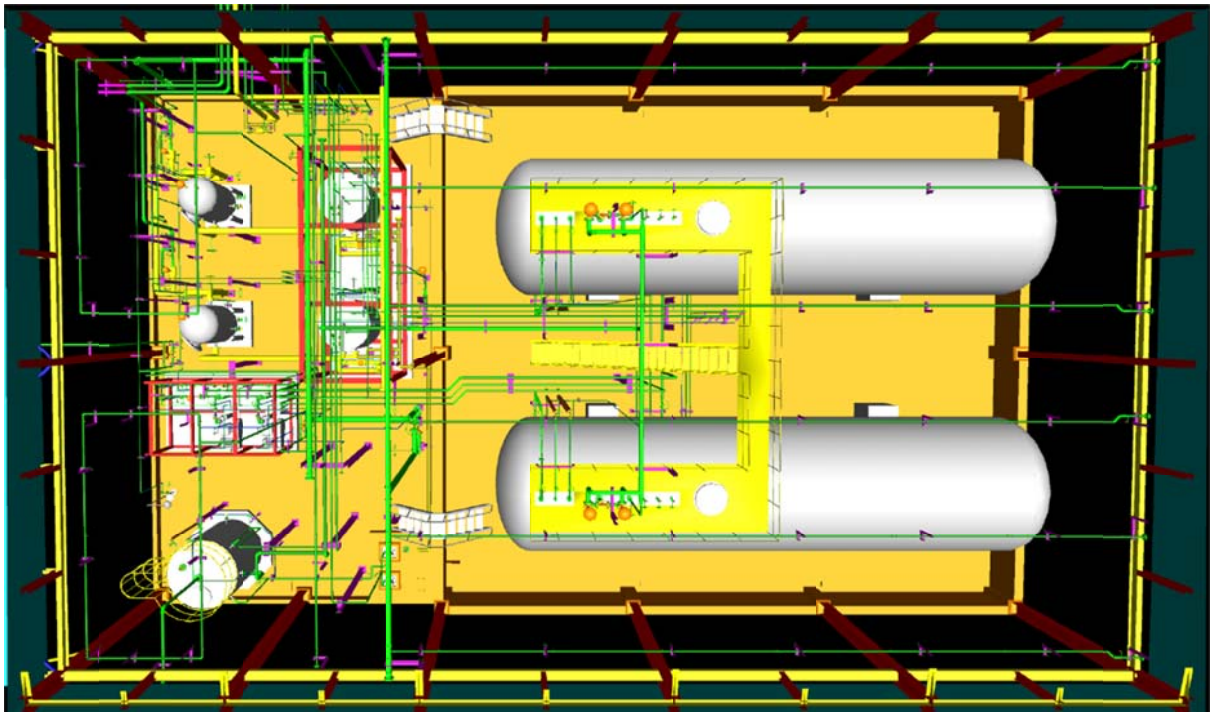


Figure 3. Model of Equipment , Piping & Valve arrangement for SCR System.

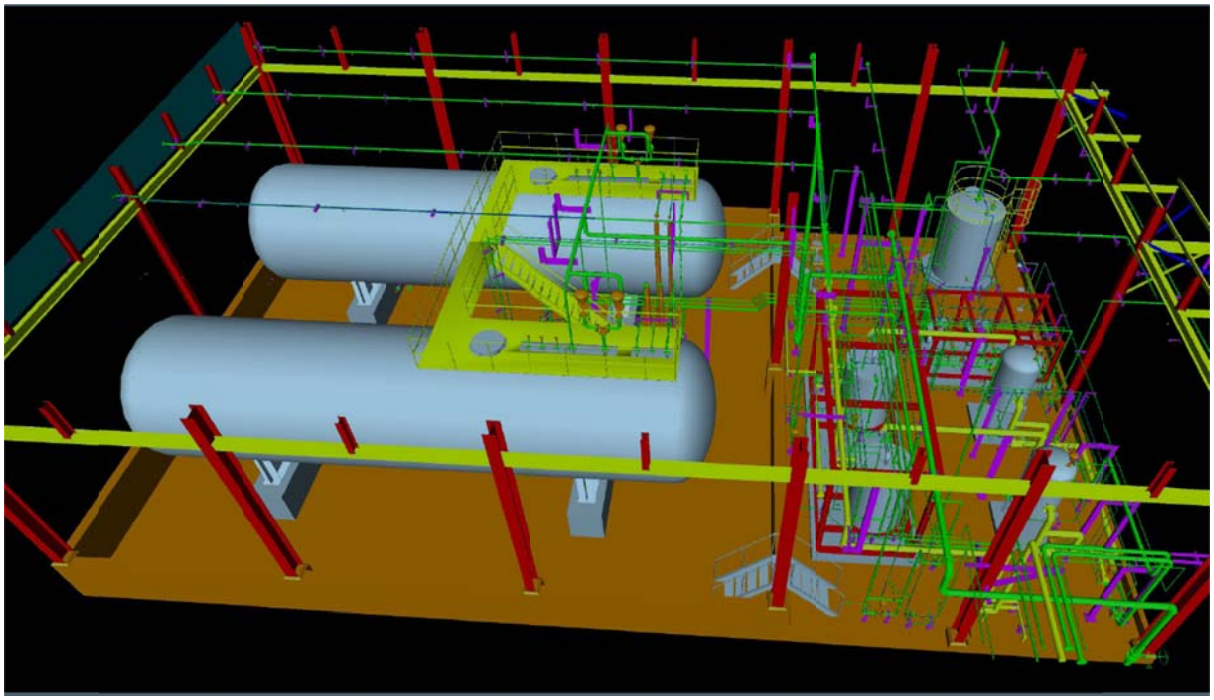


Figure 4. 3D Model of Equipment , Piping & Valve arrangement for SCR System.

2.2 Installation Position

SCR inlet duct is installed from outlet of duct flowing flue gas generated from boiler furnace during coal combustion. Other side of SCR inlet duct is connected to reactor. In addition, SCR reactor is located on between SCR inlet duct and outlet duct which is located on expansion joint above APH (Air

Pre-heater) system. Those items such as equipment, piping & valve are installed based on attached above 3D modeling and P&ID.

3. Erection

3.1 Preparation Activities for Erection

Erector must do some preparation activities before beginning the site construction work to prevent defaulting installation. In this section, guideline complied by erector necessarily before erection is introduced.

Si. No.	Description on Preparation Activities before erection
1.	Inspecting and checking technical specification, quantity, and damage status such as corrosion, erosion, etc. of material delivered from shop by comparing with related document and drawing.
2.	Investigating the work space for site pre-assembly and temporary holding space near to erection spot.
3.	Checking whether scaffold is needed or not by considering around existing structure. Erector shall prepare the scaffold, if required.
4.	After finishing site pre-assembly and final erection, Erector shall inspect the spot needed touch-up painting and apply it in accordance with painting procedure. So, prepare the proper touch-up paint.

3.2 Erection General Sequence

Erection work of SCR inlet & outlet duct, reactor is processed by connecting or combining between the pre-shop assemblies as like frame, beams, brackets, plates, and girders at construction site in order to form the site assembly at first as like Figure 3 showing some SCR reactor parts. The others including SCR inlet/outlet ducts also should be made as site assembly part unit and then installed step by step.

Figure 3 Site Assembly of SCR duct and reactor

The pictures shown on Figure 3 to 5 were taken during experience projects executed by S&TC. It could be helpful for erector to understand general erection concept and process.

After finishing site pre-assembly work, erector to arrange the site pre assemblies. At first, duct to be installed and then reactor parts to be connected step by step. Furthermore, erector to determine the order what should they do at first between inlet and outlet ducts by considering site condition. If boiler duct connected with SCR inlet duct was installed erector can install the SCR inlet duct at first. Refer to the following description on installation method of SCR reactor.

The first site assembly part of SCR reactor should be laid down on outlet duct at above of APH is lifted and putted down on proper erection location in compliance with erection drawing and then second site assembly part is lifted and putted down on first site assembly part as like Figure 4.

Figure 4.1 Lifting First Site Ass'y

Figure 4.2 Dropping First Site Ass'y

4.3 Lifting Second Site Ass'y

Figure 4.4 Dropping Second on First Site Ass'y.

Finally, the connection work between site assembly parts is fulfilled by bolting and welding as like Figure 5. The other site assembly parts are also putted and combined accordingly.

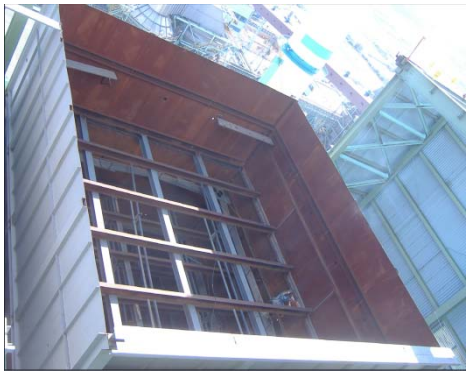


Figure 5.1 Internal Connecting between two site ass'y parts

Figure 5.2 Enlargement of 'Figure 5.1'

Figure 5.3 External Connecting between site ass'y parts

In case of platform, shop assembly beams are connected at existing boiler structure directly without site pre-fabricated work stage as like making site assembly parts. Erector can install the platform structure by connecting between beams and existing by referring to E-drawing in Attachment #1.

3.3 Erection Method

As stated Section 3.2 above, SCR duct, reactor and platform are erected by making pre site assemblies or connecting at existing boiler structure supplied by others. In this document, detail erection method is not described as its construction work can be conducted through erection reference drawings shown in the '3.4 Guideline Drawing for Erection', '3.5 Reference Erection Drawings' and typical method such as bolting, welding, etc.

3.4 Guideline Drawing for Erection

There are captured drawings showing the erection position of site assembly parts for SCR duct, reactor. Please refer to the followings.

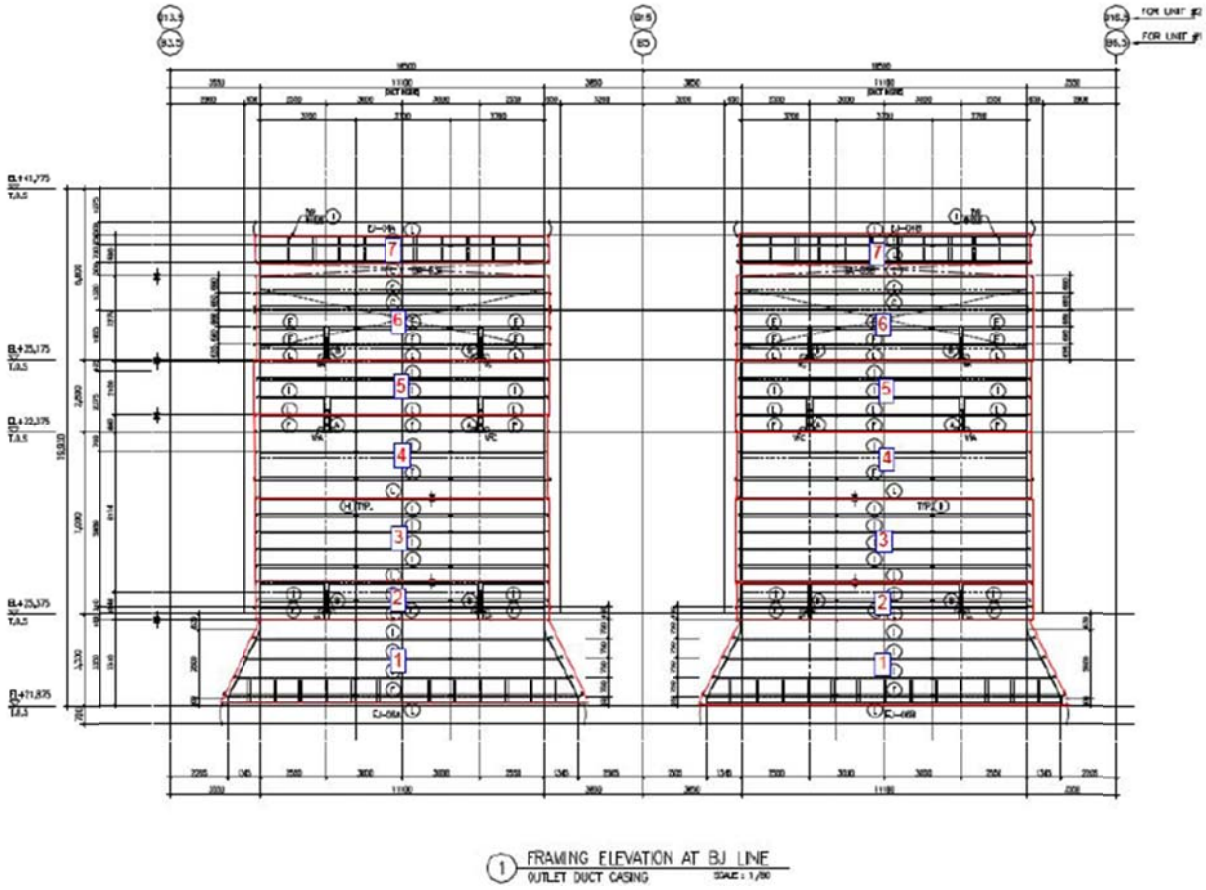


Figure 6.1 Site Assembly Parts of Outlet Duct

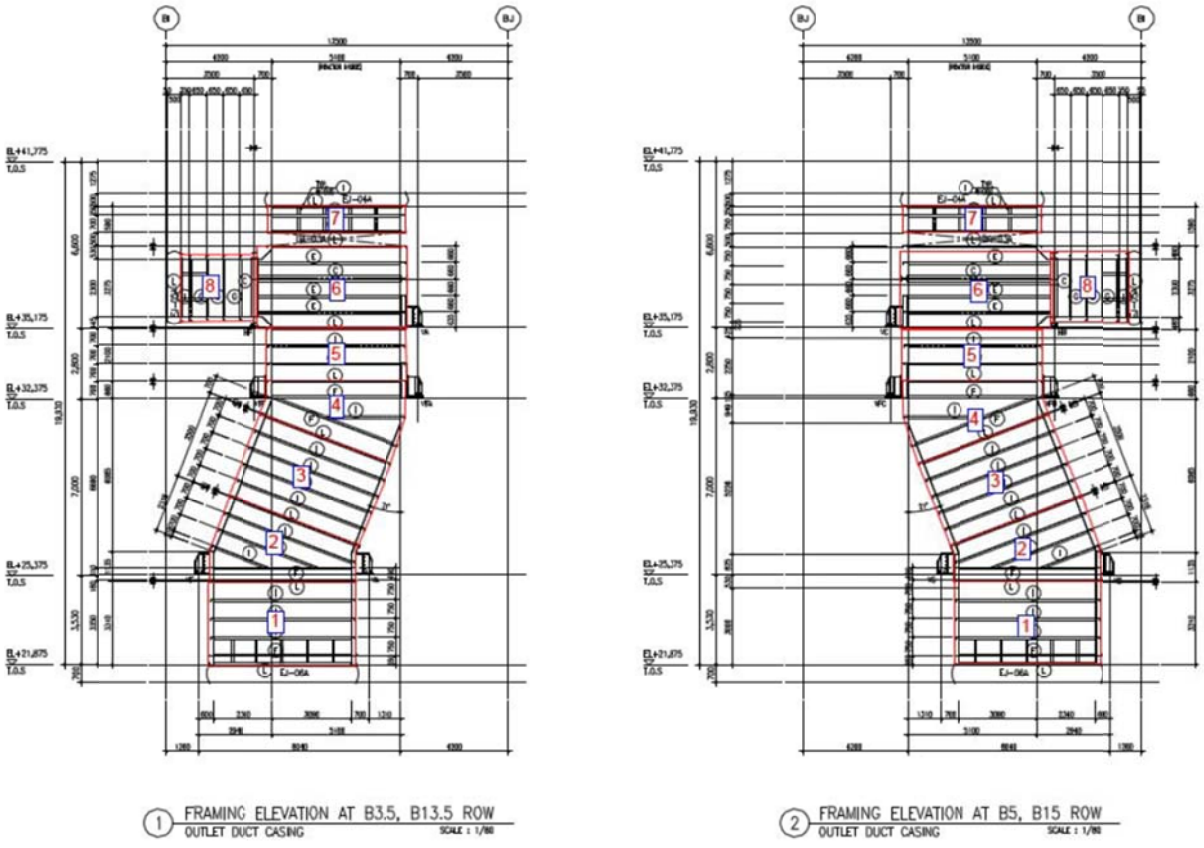


Figure 6.2 Site Assembly Parts of Outlet Duct

The above drawings are shown the number of site assembly parts for SCR outlet duct. Erector should put down site assembly parts from No.1 step by step after finishing the fabrication of site assembly part. Expansion joints shall be located between No.6 and No.7. So, don't put No.7 down on No. 6 directly. The relating drawing No. is TB2-SDC.VP124-00HTA-M-M1A-DGA-0001 ~ 0010 and TB2-SDC.VP124-00HTA-M-M1A-DID-0001 ~ 0048 for shown part no above Figure 6.2.

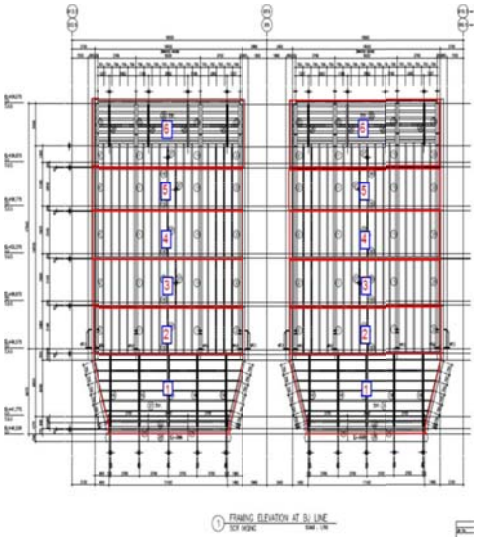
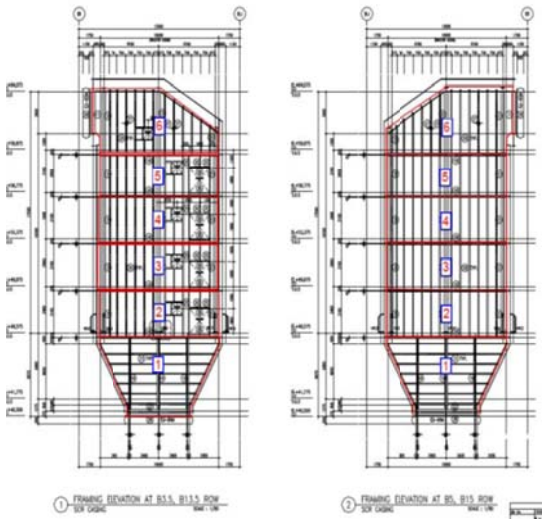


Figure 6.3 Site Assembly Parts of Reactor



6.4 Site Assembly Parts of Outlet Duct

The above drawings are shown the number of site assembly parts for SCR reactor. Erector should put down site assembly parts from No.1 step by step after finishing the fabrication of site assembly part. The site assembly part for SCR reactor should be putted down on expansion joint at over part no.7 of site assembly for SCR outlet duct. The relating drawing No. is TB2-SDC.VP124-00HSD-M-M1A-DGA-0001 ~ 0043 and TB2-SDC.VP124-00HTA-M-M1A-DID-0001 ~ 0048 for shown part no above Figure 6.3 and 6.4.

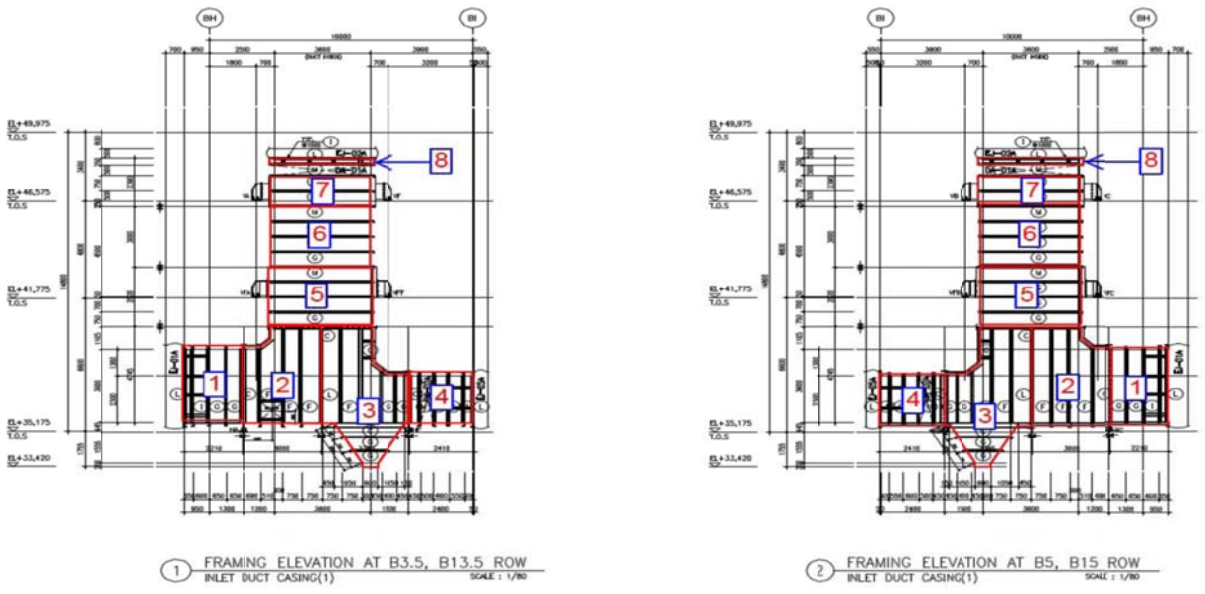


Figure 6.5 Site Assembly Parts of Inlet Duct (No.1 ~ 8)

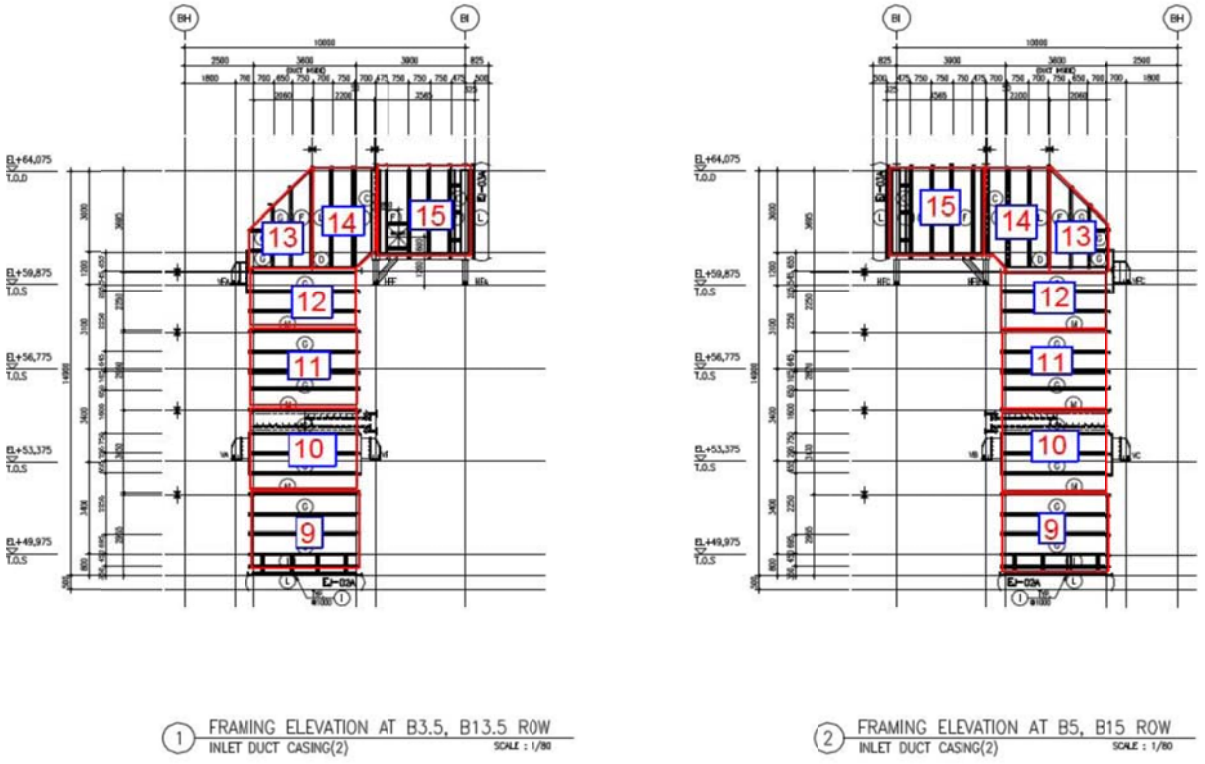


Figure 6.6 Site Assembly Parts of Inlet Duct (No.9 ~ 15)

The above drawings are shown the number of site assembly parts for SCR inlet duct. Erector should install assembly parts from No.1 up to No.15 step by step after finishing the fabrication of site assembly part. Expansion joints shall be located between No.7 and No.8 of assembly parts for SCR inlet duct, No.8 and No.9 of assembly parts for SCR inlet duct. In addition, there are expansion joints between inlet duct and others like outlet duct, reactor either as like the followings.
Between No.4 of assembly parts for SCR inlet duct and No.8 of assembly parts for SCR outlet duct, No.15 of assembly parts for SCR inlet duct and No.6 of assembly parts for SCR reactor. The relating drawing No. is TB2-SDC.VP124-00HTA-M-M1A-DGA-0001 ~ 0010 and TB2-SDC.VP124-00HTA-M-M1A-DID-0001 ~ 0048 for shown part no above Figure 6.4 and 6.5.

3.5 Reference Erection Drawing

There are reference drawings for erection for SCR duct, reactor, equipment, valves, piping and platform formally issued by S&TC for Thai Binh 2 PJT. Erector must necessarily check and take into account them during site construction work for SCR duct, reactor, equipment, valves, piping and platform. The drawing number and description of them are like followings.

Drawing Number	Drawing Title	Description
TB2-SDC.VP124-00HSD-M-M1A-DGA-0001 ~ 0010	General arrangement drawing	These drawings shown on general arrangement of inlet/outlet duct, reactor, and platform for SCR.
TB2-SDC.VP124-00HTA-M-M1A-DRD-0001 ~ 0061	SCR of flue gas duct detail drawing	These drawings shown general arrangement of SCR inlet/outlet duct and field welding points between site assembly parts of SCR inlet/outlet duct.
TB2-SDC.VP124-00HSD-M-M1A-DRD-0001 ~ 0043	SCR of SCR reactor assembly & Detail drawing	These drawings shown on general arrangement of SCR reactor and field welding points between site assembly parts of SCR reactor.
TB2-SDC.VP124-00HTA-M-M1A-DID-0001 ~ 0017	E-drawing for SCR shop drawing of inlet/outlet duct and reactor	These drawings shown on site combination of SCR inlet/outlet duct and reactor by indicating the part number of shop assembly.

TB2-SDC.VP124-00HTA-M-M1A-DID-0018 ~ 0048	E-drawing for SCR shop drawing for structure	These drawings shown on combination of shop assemblies for SCR structure by indicating the part number of shop assembly on finished erection status.
TB2-SDC.VP124-00100-M-M1A-DPS-0001 ~ 0024	Reactor and Duct Support Detail.	These drawings are shown the reactor and duct support detail.
TB2-SDC.VP124-01HSD-M-M1A-DRD-0001	Interfacing and Terminal Point Details for Unit 1	Detail dimension is shown on this drawing between boiler economizer flange and SCR inlet duct ion flange.
TB2-SDC.VP124-01HSD-M-M1A-DRD-0002	Interfacing and Terminal Point Details for Unit 2	Detail dimension is shown on this drawing between boiler economizer flange and SCR inlet duct ion flange.
TB2-SDC.VP124-00100-M-M1A-PID-0000~0014	Valves and instrument for P&ID	These drawings are shown the valves and instrument.
TB2-SDC.VP124-00100-M-M1A-DGA-0001&ISO-0001	Piping Arrangement & Isometric Drawings	This list is shown the piping specification connected to each equipment for SCR system and is specified in P&ID in detail.
TB2-SDC.VP124-00HTA-M-M1A-SPC-0006-01~011	Ammonia storage tank detail.	These drawings are shown the ammonia storage tank detail.
TB2-SDC.VP124-00HTA-M-M1A-DRD-0201	Ammonia Unloading Compressor detail.	These drawings are shown the ammonia unloading compressor detail.

TB2-SDC.VP124-00HTA-M-M1A-SPC-01~09	Ammonia Dilution Tank detail.	These drawings are shown the ammonia dilution tank detail
TB2-SDC.VP124-00HTA-M-M1A-SPC-01~09	Sump pump detail.	These drawings are shown the sump pump detail.
TB2-SDC.VP124-00HTA-M-M1A-DRD-0501~0507	Vaporizer Detail	These drawings are shown the vaporizer detail.
TB2-SDC.VP124-00HTA-M-M1A-SPC-0007-01~07	Accumulator Detail.	These drawings are shown the accumulator detail.
TB2-SDC.VP124-00HTA-M-M1A-DRD-0001~0002	Ammonia Injection Grid Detail.	These drawings are shown the ammonia injection grid detail.
TB2-SDC.VP124-00HTA-M-M1A-DRD-0101~0103	Damper Detail.	These drawings are shown the SCR inlet, outlet, bypass damper detail.
TB2-SDC.VP124-00HTA-M-M1A-DGA-0001~0004	Expansion Joint Detail.	These drawings are shown the SCR inlet, outlet, bypass expansion joint detail.
TB2-SDC.VP124-00HTA-M-M1A-SPC-003-1~5	SCR Ash Blowers Detail.	These drawings are shown the SCR ash blowers detail.
TB2-SDC.VP124-00HTA-M-M1A-SPC-0006-01	Air Receiver Tank Detail.	This drawing is shown the air receiver tank detail.

TB2-SDC.VP124-00HTA-M-M1A-SPC-0003	Air Dryer Detail.	This drawing is shown the air dryer detail.
TB2-SDC.VP124-00100-M-M1A-DRD-0002	Seal air Blower Detail.	This drawing is shown the seal air blower detail.
TB2-SDC.VP124-00HTA-M-M1A-SPC-0004	Dilution Air Blower Detail.	This drawing is shown the dilution air blower detail.
TB2-SDC.VP124-00THS-M-M1A-DRD-0101	Ammonia Air Mixer Detail.	This drawing is shown the ammonia air mixer detail.

Erector can see these drawings by requesting their owner or through the 'Attachment #1' in this document. In addition, they can also get the information on material specification of components of shop assembly product via bill material list shown on these drawings as well as erection method. Erector must consider the material specification for their erection work either.

3.6 Caution

1) Don't try to do construction work during not only wild weather such as heavy rain, snow, and wind but also, natural disaster including earthquake, flood, typhoon, and lighting strike.
2) Prepare the necessary transportation equipment including crane for construction work.
3) Choose firmed and dry area for temporary storage in order to prevent and protect material damages during storage out of environment factors such as storm water, dust, etc. which cause rusty, stain, etc. during construction work.
4) The workers working on construction site must be equipped with minimum personal protective equipment as below:

- Safety Helmet.
- Safety shoes.
- Full body hardness.
- High visibility vest.
- Safety gloves.

3.7 Erection Tolerance

The erection tolerances are shown as following table per kinds of supplied material type.

No.	Type of supplied material	Allowable erection tolerance (mm)
1	Reactor and duct Frame	-5 ~ +5
2	Equipment and Skids.	-2 ~ +2 (Anchoring point)
3	Steel structure	-5 ~ +5
4	Expansion joint	-6.35 ~ +6.35
5	Piping	-3 ~ +3
6	Ammonia dilution Tank	-2 ~ +2
7	Ammonia Injection Grid	-2 ~ +2
8	Air Receiver Tank	-2 ~ +2
9	Air Dryer	-2 ~ +2
10	Seal Air Blower	-2 ~ +2
11	Ammonia Air Mixer	-2 ~ +2

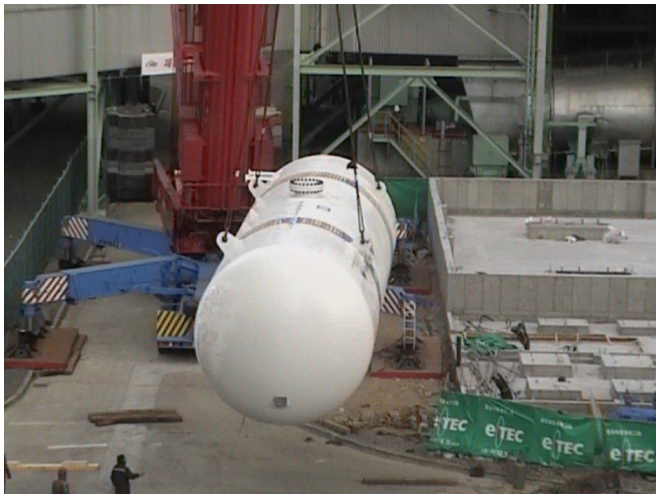
During installation the erection tolerance exceed above allowable erection tolerance, immediately notify to the supplied before erection work. The allowable erection tolerance is based on S&TC experience.

3.8 Ammonia Storage Tank

Ammonia storage tank is very large and heavy. Therefor very careful to handling of ammonia storage tanks when installation. Before installation of ammonia storage tank take care of selection the crane capacity. If possible the crane locates as possible as close to installation position of ammonia storage tank for safe installation. During lifting of ammonia storage tank at least two (2) workers hold the rope that is tied on the ammonia storage tank to prevent un expected large movement caused by wind or inertia.

1) Tie the wire lope with lifting lugs on the ammonia storage tanks. During tie the wire rope on the lifting lugs, take caution because the wiring work perform at high elevation.

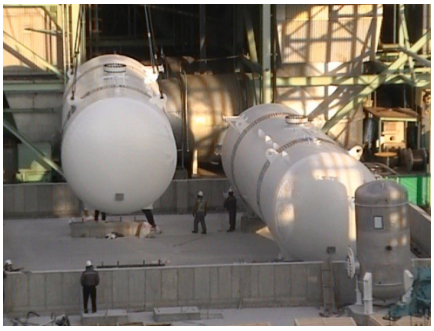
2) After than lift the ammonia storage tank by crane. The sequence of lifting from far side of ammonia storage tank from crane.



3) Stop the moving at the above of ammonia storage pedestals.

4) At the each side of anchor point the installation worker shall be locate to proper installation of ammonia storage tank without any damage or accident caused by miss landing on the pedestals.


5) After located worker at each point the crane goes down the ammonia storage tank as per worker signal to exact landing of ammonia storage tank on the pedestal.

6) Before set the position of ammonia storage tank use a shim plate to keep the horizontality of ammonia storage tank if needed. Important thing is keep the design elevation of ammonia storage tank to avoid miss matching of nozzles.
7) After confirm of ammonia storage tank horizontality separate wire rope from ammonia storage tank.
8) Finally tighten the nuts to finalize installation of ammonia storage tank.
9) After finish of ammonia storage tank settling install the platforms for ammonia storage tanks.

3.9 Ammonia Dilution Tank

Before installation of ammonia dilution tank take care of selection the crane capacity. If possible the crane locates as possible as close to installation position of ammonia dilution tank for safe installation. During lifting of ammonia dilution tank at least two (2) workers hold the rope that is tied on the ammonia dilution tank to prevent unexpected large movement caused by wind or inertia.

1) Tie the wire lope with lifting lugs on the ammonia dilution tank. During tie the wire rope on the lifting lugs, take caution because the wiring work perform at high elevation.

2) After than lift the ammonia dilution tank by crane. The sequence of lifting from far side of ammonia dilution tank from crane.
3) Stop the moving at the above of ammonia dilution pedestals.
4) Installation worker shall locate ammonia dilution tank at the proper location without any damage or accident caused by miss landing on the pedestals.
5) After confirm of ammonia dilution tank verticality, separate wire rope from ammonia dilution tank.
6) Finally tighten the nuts to finalize installation of ammonia dilution tank.

3.10 Ammonia Injection Grid (AIG)

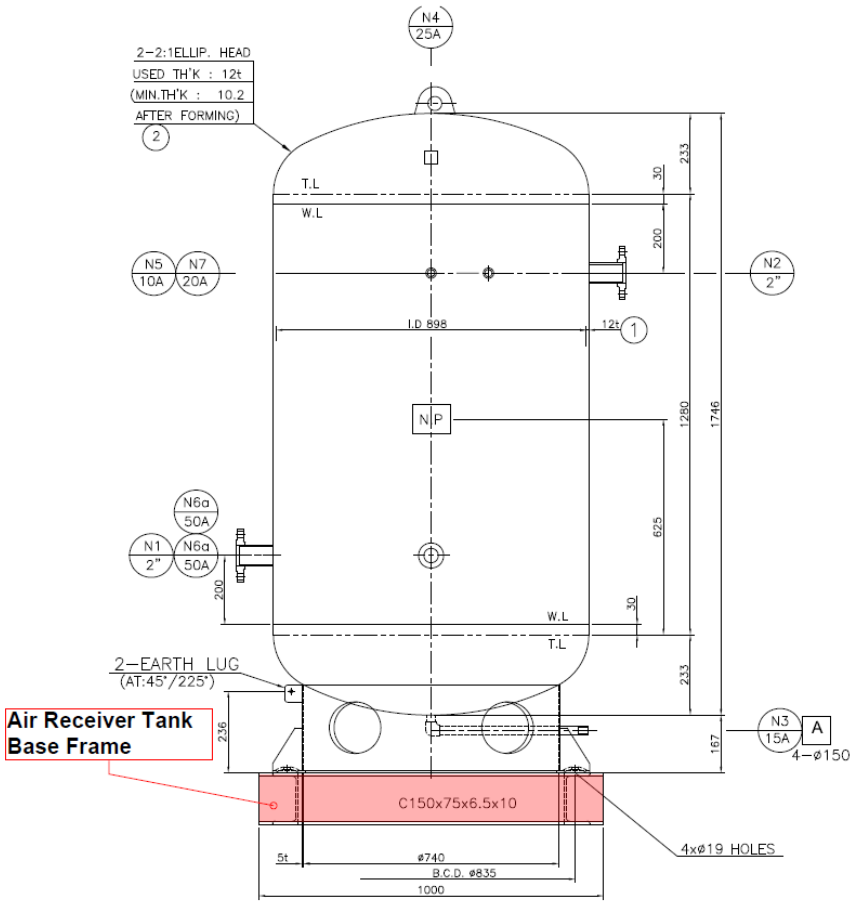
1) Check the installation location is match with drawing and the tag number also.
2) Set the position of AIG as fully close and fix the linkage.
3) Before installation of AIG, check the tolerance between duct and AIG flange for diagonal and angle.
4) There is no problem of diagonal and angle difference between duct and AIG flange start installation.
5) Lift AIG by crane and set the position of AIG.
6) Check the coincidence between AIG and duct lines. If the AIG and duct lines well fit, the bolt and nut fasten tightly.
7) Checks the installation status by visual after finalizes of fasten.

3.11 Ammonia Receiver Tank

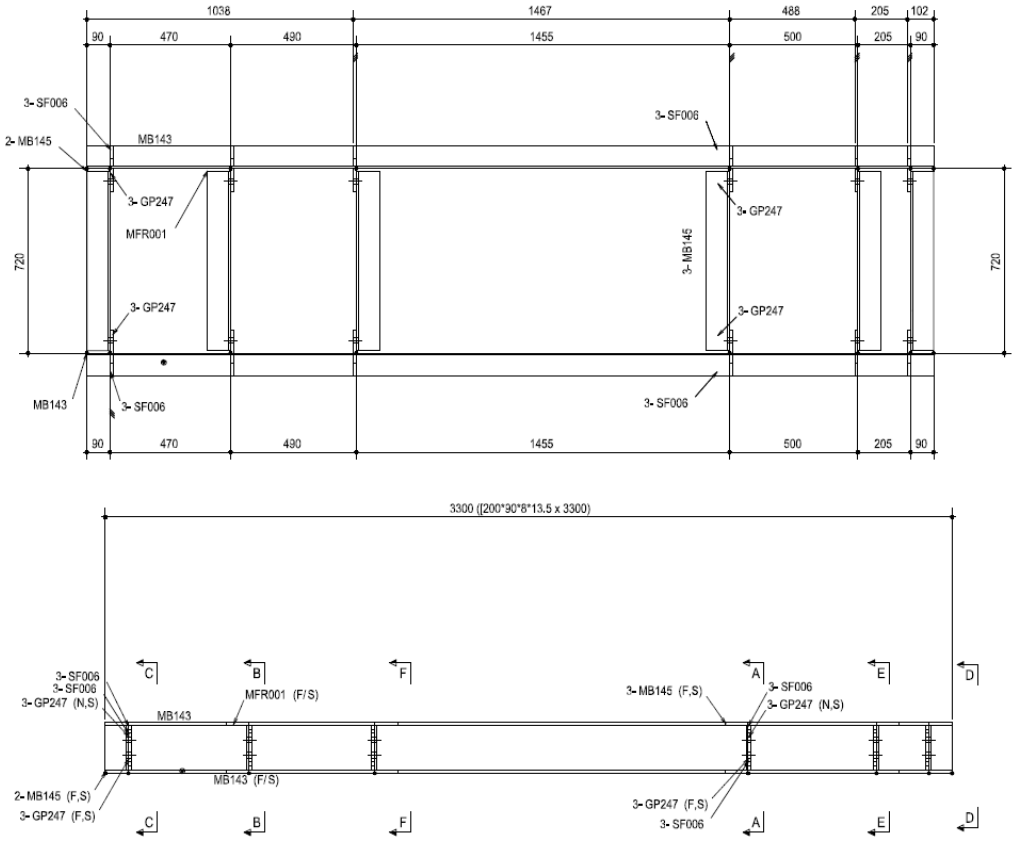
Before installation of air receiver tank take care of selection the crane capacity. If possible the crane locates as possible as close to installation position of air receiver tank for safe installation. During lifting of ammonia dilution tank at least two (2) workers hold the rope that is tied on the air receiver tank to prevent unexpected large movement caused by wind or inertia. Please refer to attached “Attachment 1. Ammonia receiver tank and Air Dryer installation drawing”.

1) Tie the wire lope with lifting lugs on the air receiver tank. During tie the wire rope on the lifting lugs, take caution because the wiring work perform at high elevation.

2) After than lift the air receiver tank by crane. The sequence of lifting from far side of air receiver tank from crane.
3) Stop the moving at the above of air receiver installation position.
4) The air receiver tank installed on the B017 which is a steel structure member supplied by S&TC at EL+46575 of SCR area.
5) When lay down and installation of air receiver tank shall check the nozzle location is correct or not.
6) If occur any discrepancy of dimensions when installation the nozzle location shall be most priority order.
7) After confirm of air receiver tank verticality, separate wire rope from ammonia dilution tank.
8) At the bottom of air receiver tank supplied additional base frame for air receiver tank. This base frame welding on the B017 at site. Refer to the detail drawing attached “Attachment 1. Air Receiver Tank and Air Dryer Installation Drawing”.
9) After than tighten bolt and nuts for air receiver tank and base frame.
10) Finally grounding the air receiver tank. The air receive thank installed two earth lug for grounding.



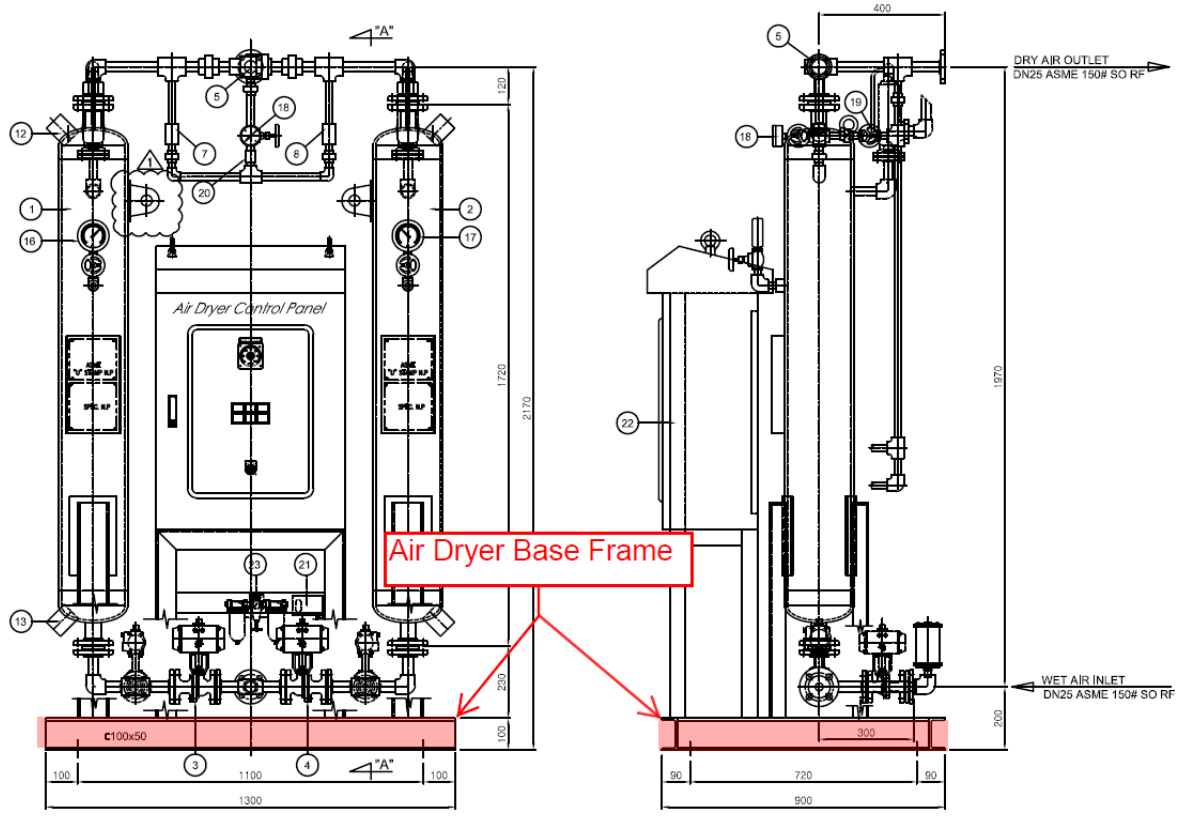
Air Receiver Tank



B017 (Steel Structural Member at EL+46,575)

3.12 Air Dryer

1) The air dryer installed at EL+46,575.
2) To installation of air dryer, lifting by crane. When lifting the air dryer shall keep the safety.
3) The air dryer will be located on the B017 which is a steel structural member supplied by S&TC located at EL+46,575 SCR area.
4) When lay down and installation of air dryer shall check the nozzle location is correct or not.
5) After confirm of air dryer verticality, separate wire rope from air dryer.
6) Air dryer installed on the air dryer base frame. The base frame welding on the B017 at site. Detail installation drawing shall refer to attached “Attachment 1. Air Receiver Tank and Air Dryer installation drawing”.
7) Installed where it is possible to be ventilated in order to keep the temperature and It should be installed where the circulation of cooled air flowed to condenser.
8) Before connection the electric power, it shall be grounding work.
9) The air dryer base frame have earth lug for grounding.
10) Connect the power with power male in accordance with the required power sign.



Air Dryer

3.13 Seal Air Blower

1) Install airflow switch in blower with airflow hole facing in direction of air from fan so that air from fan will pass through hole on switch. Secure with screw, lock washer, and flat washer
2) Connect tagged wire to airflow switch.
3) Install seal air blower between flange of blower and flange.
4) Install blower and secure with cap screws and flat washers.
5) Install wires and secure with nuts, flat washers, and lock washers.
6) Install drive control assembly and secure with cap screws and flat washers.
7) Please refer to attached “Attachment 2. Seal air blower installation drawing”.

3.14 Ammonia Air Mixer

1) Check the position of ammonia/air mixer based on P&ID before installation.
2) Ammonia air mixer is already installed in AFCU skid. There is no need additional installation work at site.

3) Please refer to attached “Attachment 3. Ammonia Flow Control Unit Skid”.

3.15 Skid Equipment

Skid equipment is same as below table. All skid equipment installed as same method described

in this manual.

No.	Equipment Name	Skid No.
1	Unloading Compressor	SK-001
2	Vaporizer	SK-002
3	AFCU	SK-003
4	Dilution Air Blower	SK-004

1) Before installation of skid check the exact position put the skid. After than start the work of installation.
2) Select proper crane capacity take in to consideration of skid weight and distance from foundation to crane.
3) Take care to prevent damage of instrument which is installed at the skids.
4) Keep in horizontality between pedestal/steel structure and skid. Take care of nozzle elevation.
5) After than tighten the nuts to fix skid on the pedestal/steel structure.
6) After finished tighten the nuts connection each pipe lines.

3.16 Accumulator

Accumulator install on the pedestal. Basically the installation procedure same as ammonia storage tanks installation procedure.

1) Before installation if skid check the exact position. After than start the work of installation.

2) After check of installation position, lift the accumulator carefully. The accumulator center of gravity is high.
3) Tie the wire rope with lifting lugs top of the accumulator. After tie check again the condition of tie.
4) After than lift slowly and move to the above accumulator pedestal.
5) Carefully going down near elevation where to locate.

6) Installation worker on the ground check the location of hole on the accumulator legs matching or not with anchor bolt. If not the ground worker shall give the sign to the crane operator where to move the accumulator.
7) If the holes of accumulator legs with anchor bolt, put on the pedestal with leveling.
8) After leveling tighten the nuts to fix accumulator on the pedestal.
9) After finish of tightening of nuts attach the insulation on the accumulator wall.


10) After finish insulation attach finish with lagging sheet.

3.17 Piping

Piping installation perform in accordance with ISO drawing and piping arrangement drawing. Small size piping (Below DN50) installed at the site. The materials will be delivered as law materials. Large bore piping (Over DN65) will be delivered as spool.

For small bore piping will be installed at the site in accordance with ISO drawing and piping arrangement drawing. The piping work shall be done after installation of all equipment positioned. The type of connection between pipe and equipment, piping and piping shall be checked before installation work. The welding method for DN50 or smaller, in stainless steels GTAW shall be used for the root of all butt welds.

For large bore piping (Over DN 65) is quite heavy compare than small bore piping. Therefore ensure the safety for installation work and handling. In generally, installed the pipe support in advance after than put on the piping spool on the pipe support. And connection or welding with another piping spools.

In case of flange connection piping, secure the tightness of connection bolts and check the gaskets.

3.18 Expansion Joint

The following preassembly steps should be taken prior to installation of nonmetallic expansion joints.

1) Duct inspection

a. Confirm that the expansion joint assembly size and tag number is correct for the proposed location.
b. Confirm that the ducting on each side of the opening is aligned within -6.35 ~ +6.35mm. Although fabric expansion joints are quite flexible, there are definite movement limitations.
c. Expansion joints should not be used to adjust for duct misalignment unless specified by the design conditions.
d. Confirm that the opening (face to face dimension) for which the joint was designed does not exceeds -6.35 ~ +6.35mm of nominal. If the duct opening exceeds this tolerance, notify manufacturer at once for disposition.
e. The attachment edges or flanges of the ductwork should be smooth, clean and parallel to each other.
f. Clear the area around the ductwork of all sharp objects, protrusions and debris. Any which are not removable should be tagged or roped off so they can be avoided.

2) Expansion Joint Inspection.
a. Expansion joints and components should remain packaged until just prior to installation, particularly if the expansion joint must be moved.
b. Once the shipping container or packaging materials are removed, the expansion joint should not be moved, except during actual installation.
c. Using manufacturer's manufacturing drawings and/or shipping documents, confirm that all components are present and in good condition.
d. The expansion joint shall be marked "Out side" at outer surface and "In side" at inner surface of the bellows. And then site inspector shall be check these mark.
e. The expansion joint shall be marked "OUT SIDE" at outer surface and "IN SIDE" at inner surface of the bellows, and then site inspector shall be check these mark.

3) Field Assembled Frame on the Ground.
Prepare an assembly area for the expansion joint adjacent to the duct opening or on the ground at the site. If possible, transportation joint components in the original shipping containers to assembly location. If not, use nylon straps, rope or other rigging to transportation joints.
a. Identify and separate upstream and downstream duct frame. Arrange each of duct frame on the ground so they are level and plane.
b. Verify match markings at all weld points. And then full welding the frame.
c. Back-up bras are factory drilled and normally required no modification to match the attachment flanges. Each expansion joint assembly required two sets of back-up bars.

d. Clean up surrounding area and remove any debris which may damage the expansion joint.
e. The expansion joint now assembled and ready for installation. Product bellows from damage during remaining erection process, taking care to remove any temporary covers and/or construction dust prior to start up.

4) Installation
a. The belt is normally spliced at the mid-point of the long side or short side. Find the mid-point of the duct flange on the long side. Start at this point and unfold the belt around the duct, kepping the side marked “Outside”, to the outside.
b. On horizontal ducts always splice on top or side, never on the bottom.
c. Keep belt supported on a platform while unfolding and positioning. Do not hang belt hokes, as its weight could tear the holes.
d. When in place and lined up correctly, the belt can held in place using screw clamps, strong pinching tongs etc.
e. Position back-up bar correctly on the expansion joint flange and secure it with screw clamps.
f. Drill through the belt using back-up bar and duct flange as drill guide. It is very important that the screw clamps (on both sides of the hole) hold the materials tight and keep them fastened in place.
g. Locate the attachment in the bellows using a drill bit or punch equal to or slightly larger than the belt diameter.
h. Attach belt to flanges with back-up bars and bolts, tightening by hand or impact wrench. The installer must ensure that bolts are installed with the nut positioned on the back-up bar side. Confirm from the corner along the side and install the back-up bars. Remove all peripheral slack as the belt is bolted around the frame. Do not install the back-up bars 1829 to 2438 mm. either side of the splice.
i. Beginning at a corner nearest where the splice will occur, bolt the fabric belt and back-up bars in place around the frame. Always position the beginning of the belt of the mid-point of a back-up bar section.
j. Splicing the belt by erector with splicing procedure as attached.
k. Bolt the final section of back-up bar in place after completion of the splice.
l. Final-tighten all bolts to 47 to 61N-m using torque wrench.

3.19 Ash Soot Blower

The ash soot blower cleaning system that has been supplied for SCR reactor has been specifically designed and engineered to meet the unique demands of SCR application. It is imperative that it be installed. Operated and maintained properly to assure trouble-free operation and adequate cleaning of the SCR catalyst. Refer to the installation drawings for specific

installation and operational instructions. If it becomes necessary to make any modification to the location of the acoustic cleaners, please contact supplier for recommendations. Horn placement is cortical to the effective operation of the cleaning system. Any deviation from the installation drawing provided for ash soot blower system should be reviewed / approved by supplier. 1

The installation drawing shall be refer to " TB2-SDC.VP124-00HTA-SPC-0003".
Refer to attached "Attachment 4. Soot blower installation drawing".

The following items should be reviewed prior to start-up of a system.

a. Air piping

   Proper airflow to the acoustic cleaner is critical to sounding verify that existing or piping design is sized per the installation drawing provided for this system.

b. Air pressure

   70 to 90 psi is the recommended pressure to sound the horns. Check the air pressure before and during sounding of the acoustic cleaners. Ideally the air pressure will be about 80psi which is the middle of stated pressure requirements.

c. Verify operation

   Prior to make sure that the acoustic cleaners are sounding properly, User should hear a definite "foghorn" tone and may even feel some resonation in user feet or body when the acoustic cleaner sounds. If the horn makes a very high pitched squeal or doesn't sound at all, refer to the trouble/shooting section of this manual or contact GE for assistance.

d. Verify sounding sequence

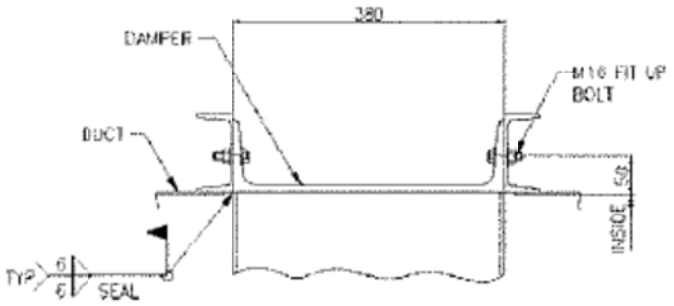
   The actual sounding sequence of the acoustic cleaners should be checked to make sure that the proper operating sequence is being employed.

Once installed, the horn should be placed into operation as soon as possible. An unused horn is subject to build up problems that may obstruct the bell and prevent the horn from sounding. Each sounding of the horn will purge any material that might migrate in to the bell.

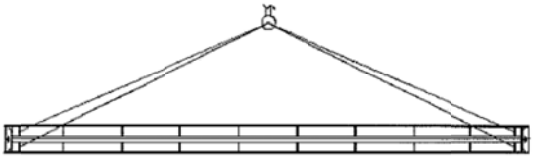
3.20 Damper

1. Check the installation location is match with drawing and the tag number also.
2. Set the position of damper blade as full close and fix the linkage.
3. Before installation of damper, check the tolerance between duct and damper flange for diagonal and angle.
4. There is no problem of diagonal and angle difference between duct and damper flange start installation.
5. Clean up the flange face of damper and duct.
6. Lift damper by crane and set the position of damper in accordance with flow direction of the duct.

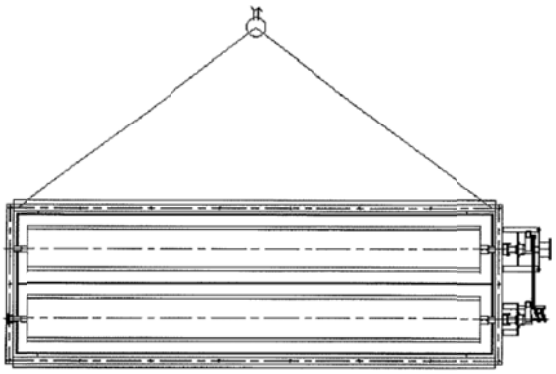
7. Joint for four(4) corner of damper and duct, ever 1000mm distance. But not tighten of all bolt and nuts.
8. Check the coincidence between damper and duct lines. If the damper and duct lines well fit, the bolt and nut fasten tightly.
9. When fasten the bolt and nuts in sequence of opposite angle and symmetry to prevent joint force equalization.
10. Checks the installation status by visual after finalizes of fasten.
11. Is there no problem of installation, start the damper to check operation status.
12. If find any problems of installation, un fasten the bolt and nuts again from a~j.
13. Fasten all of damper connection bolt and nut after operation status check if there are no problems.
14. All of damper connection bolts fasten as sequence of above i.
15. After fasten all of connection bolts, seal welding of all gaps between damper and duct flange.
16. After welding, finalize installation.
17. After finish installation, check again the operating status of damper.



For proper operation and absorption of thermal expansion the idle side assembled as cover bearing. Therefore, necessary pay close attention for transportation and handling. The drive side and idle side always keep same elevation. Please refer to following handling drawing of damper. As shown at below drawing, the bearing side always keeps the horizontality during handling. If not keeping the horizontality during handling and transportation cause blade can be one side weighted. It makes interference between blade and damper frame that is high possibility of malefaction at high temperature operation circumstance.



In case of installed on vertical duct.



In case of installed on horizontal duct

3.21 Dilution Air Blower

1. Casing, Motor bed and Bearing bed are usually mounted permanently at the same time.
2. Shaft and impeller

   - Carefully clean inside of impeller hub with solvent and lubricate bore with white lead oil for ease of shaft entrance.

   - Slide the shaft into the impeller_ Make sure rotation arrow fastened on the fan casing. Corresponds to arrow on impeller.

   - Caution : Before mounting impeller on shaft, the drive side inlet bell must be slipped over shaft into place.

   - Slip remaining inlet bell into place on the shaft. Vane must rotate air in direction of impeller rotation.
3. Impeller and shaft into Fan casing.

   - Mount shaft through the fan inlet on the bearing stand.

   - Place shaft into fan casing through the fan inlet and bolt suction flange on the casing.

   - Mount bearings on their supports, align inlet bell with impeller, align bearings, shim bearing housings where necessary and tighten nuts on all bolts.
4. If a shaft seal is required, bolt assembly to fan casing. Make sure felt seal seats itself around the shaft to prevent air leakage.
5. Mount motor on its bed and connect to V-belt drive or couple to fan shaft.
6. The fan is now ready to be connected into the system If a belt cover is required, this can be fastened to fan after system has been balanced.
7. Please refer to attached “Attachment 5. Dilution Air Blower Installation Drawing”.

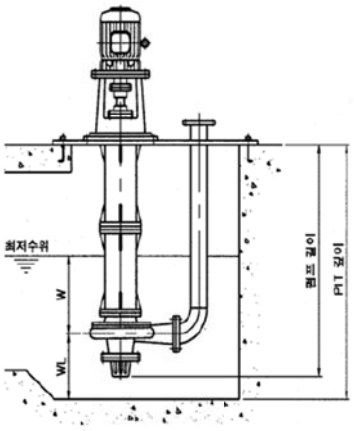
3.22 Ammonia Sump Pump

1. Sold concrete base which can withstand pump weight and absorb vibration
2. support the front side of the bed
3. The base bolts should be installed correctly by referring to its dimensions. Install the based bolts which are suitable to the pump bed. If not, draw the bed dimensions onto a wooden

board to install the base bolts.

4. The base bed should be leveled.
5. If bolts installation is tricky because building floor concrete is thin, raise the base before bolts installation
6. To help smooth intake of the pump, make sure the distance between pit floor and pump inlet (ML1) and the distance between pump inlet and min. submersion level (ML2) are bigger than the values in the table 1 (In case of Thai Binh2 project, the Ø 50 is used)

= Table 1 =



Diameter (mm)	W	WL
ø 40	200	350
ø 50		
ø 65	250	400
ø 80		
ø 100	300	450
ø 125		
ø 150	350	500

Fig. 3

7. Place Sump Cover Plate on the base bed surface and loosely tighten the base bolts.
8. After Cover Plate is appropriately leveled and grout is completely dry, tighten the base bolts tightly. (after 2-3 days)
9. If the pump cannot be installed in an assembled status due to its long length, separate its motor.
10. When the pump is completely installed, assemble adjusting nuts to adjust impeller gaps
11. Put the motor on a motor table and check the voltage and frequency on its nameplate while not fixing coupling bolts before connecting power cord.
12. Apply power temporarily and check motor rotation direction. If the rotation direction is right, connect power completely and tighten coupling bolts.
13. Check other pipes.

3.23 Catalyst

1. Preparation for installation

Safety precautions
During handling of the catalyst, gloves, glasses and air masks should be worn as dust may irritate eyes and skin. Furthermore, exposure to excessive amounts of dust may cause irritation of the respiratory system. Please see Material safety data sheet (MSDS)

This manual must be read and understood before starting installation.

The installation crew should not initiate the work within the reactor until adequate venting and cooling have occurred after shutdown.

The catalyst modules are moved to the ground below the reactor.

Only just before installation of the catalyst and in the immediate vicinity of the reactor, the modules are unpacked. In case of rain the modules should be covered by the plywood plate or plastic to protect the catalyst against the rain.

Special care must be taken when handling the catalyst modules. Shocks from hitting the ground, reactor members or another catalyst module could cause damages to catalyst.

Precautions should be made to avoid damage by tools; pieces of metal, welding sparks, etc. falling onto the catalyst during other work in or outside the reactor.

If the catalyst has been mechanically damaged, Haldor Topsøe A/S should be consulted before it is loaded into the reactor. Any damaged catalyst should not be put into operation as this could affect the overall plant performance.

2. Installation procedure

The installation is uncomplicated and if it is well prepared a complete installation of one layer can typically be completed in one day. The limiting factor is usually the cranes ability to hoist the modules to the platform.

The total reactor dimensions should be measured and check with the drawings. The dust deflectors are flexible and some sealing gutters can be adjusted to fit small deviations.

The installation of a layer is started with the positioning of the module row at the back wall (opposite than the loading entrance door) of the reactor.

Each module has an individual number. These numbers must be recorded with the module positioning in the reactor during the installation. This information should be mailed or handed over to the contact person from Haldor Topsøe.

The installation is described in detailed steps in section 2.5.

This manual and copies of the drawings for the Modules, Sealing system, Dust deflectors and Arrangement should as minimum, be available for loading team.

3. Typical necessary tools for the installation of a catalyst layer

- Crowbars (1.-1.5 meters).
- 1 sledgehammer.
- 1 grinder with SS steel cutting discs.
- 1 normal toolbox with pliers and electrical screwdrivers etc.
- M10 (US 3/8'') wrench keys (spanners).
- 2 M10 (US 3/8'') socket wrench.
- Roll of duct tape.
- Pallet carts. Manual or electric. One of them with forks equal to or longer than 1870 mm.
- Lamps for reactor and torch lights.
- Measure tape suitable for the reactor dimensions or a Laser distance measurer (LDM).
- Knife or scissors for cutting ceramic sealing cord.

Please Note that Dust Mask are recommended for DNX installation according to the MSDS.

4. Preparations

- The floors must be vacuum cleaned to remove scales etc. before initiating the installation of the catalyst modules.
- Holes that can cause a bypass must be closed.
- The drawings of gutters and dust deflectors should be available in a large print at the platform to help the crew find the right position for each part.
- Big edges, weld seems etc. in the floor and corners as shown in Picture 4, may cause problems and should be grinded down if the position interferes with the position of the sealing gutters or dust deflectors.
- Cut the ø12 / ½'' sealing cord in pieces which can reach from wall to wall + 1 meter, where it is to be installed (between the modules long side). Make a big nut in each end.
- The forks on the pallet cart will normally stick out on the back side of the module when the module is lifted. This creates a risk of bending and damaging the sealing gutters when the module is positioned. If the sealing gutters are damaged they can cause a bypass and should be replaced or repaired. To avoid this, please take care that the pallet cars forks do not damage the sealing gutters. To help with this, pieces of wood can be cut to act as spacers on the pallet forks, preventing the tip of the fork to stick out.
- Before the lifting yoke is used it must be checked that all bolts and nuts are tightened, and that the chains are adjusted to fit the module.

Fig.4 Problematic floor/wall junction an welding on wall

5. Installation in steps.

5.1 Check the lifting yoke before use

The modules are lifted to the platform using a lifting yoke. Before the lifting yoke is used it must be checked that all bolts and nuts are tightened, that the chains are adjusted to the same length and that they fit the module height.

5.2 Installation of grating for catalyst loading

The gratings are installation inside of SCR reactor for catalyst installation. The gratings are tag welded on the catalyst support. When tag welding the grating shall be consider thermal expansion of grating during operation. Therefore one side supported on catalyst support tagging and another side not welding for thermal expansion.

5.3 Installation of sealing gutters at the walls

Sealing gutters are placed at the wall opposite the door, and along the left and right side walls according to the drawing of the sealing. Please make sure that the sealing gutters overlap each other where they meet, typically 20-100 mm. please see sealing drawing. Ensure that they cover the whole length of the wall and prevent bypass. Pay attention to the junctions in corners and the bullet points described in preparations.

5.4 Installation of modules and sealing gutters between the modules

The loading starts in the opposite corner than the door . The module is driven into the reactor by a pallet cart. The last adjustments of the module positioning can be made using a long crowbar.

The module must be pushed tight up to the sealing gutters. The gutters have a distortion that ensures the sealing function. Precautions should be taken to ensure that the correct distance between the module and wall is obtained when the module is placed. It might be necessary to field fit the gutter and/or placing it in a slightly higher position, interference between gutter and module number plate must be avoided.

Take care that the pallet cart does not bend the sealing gutters. If the gutter is damaged it must be repaired or replaced.

After placing the sealing gutters and module it must be ensured that there is no bypass around the module bottom frame or connections between sealing gutters. Possible bypasses should be eliminated or minimized.

5.5 Module map

When placing a module the module number (metal plate with number) and position should be recorded on a module map (Copy of the arrangement drawing could be used as map). The module map should show the position of each module in the reactor. The module map should be sent to Haldor Topsøe. Refer to attached “Attachment 6. Catalyst arrangement Drawing”.

5.6 Installation of sealing cord

Sealing cord must be mounted between the modules where the long sides are pushed close to each other, as shown in Fig 5. The sealing cord is held in position with duct tape while the second module is placed. Make sure that the module bottom frames are pushed tight together. The sealing cord should be positioned just above the bottom frames. The two bottom frames retaining plates will for a V for the sealing cord when they are pushed together. The sealing cord extends from wall to wall and is secured with a big knot in both ends. The knot should be larger than the gap between the modules cassettes. Do not stretch the sealing cord when placing it.

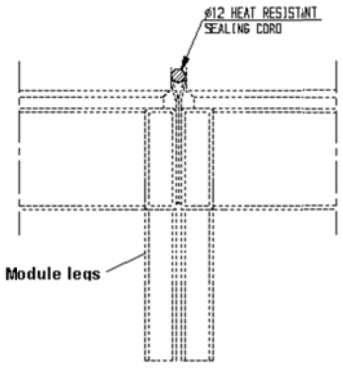


Fig.5 Sealing cord between modules

5.7 Continue according to Fig.5

The installation continues according to Fig. 5. Modules, sealing gutters and sealing cord are placed according to the drawings.

5.8 Installation of adjustable sealing gutters

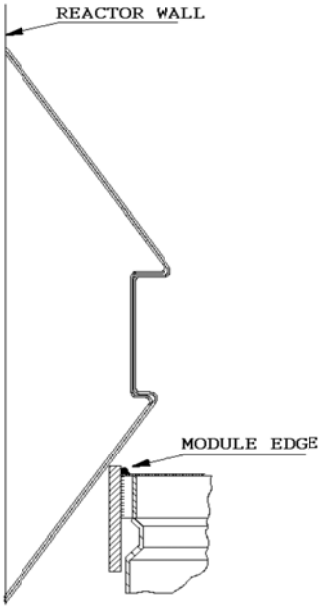
Some of the gutters are adjustable to compensate for installation tolerances. It is recommended to frequently measure the empty space in the reactor to make sure that there is space enough for the modules and sealing gutters. The needed distances can be calculated from the drawings. Long tape measure or LDM is required for this task.

The adjustable sealing gutters have nuts which must be tightened when the width of the sealing gutter has been determined. The chosen width should be as close the distance on the drawings but make sure, that all the rest of the modules and sealing gutters can be installed and that there will be no bypasses.

The last modules in each row should be installed next to an adjustable gutter so the sealing gutter can be fitted for the gap.

5.9 Placement of Dust Deflector at the walls

While the module installation continues, the installation of the dust deflectors may begin. The position of each dust deflector type is shown on the Dust Deflector drawing. The deflectors are placed along the wall as shown in Fig. 6 and adjusted to cover the whole length of the wall. The deflectors overlap each other where they meet, typically 20-100 mm. See drawing for details.



Please note:

The deflector is not symmetric.

The deflector has to be positioned as shown in Fig. 6

Fig.6 Deflector at wall. Positioned. Not installed

5.10 Installation of Dust Deflectors at the walls

When a wall side is completed the deflectors are pushed down into final position as shown on Fig. 7.

5.11 Installation of Dust Deflectors between modules.

The triangular deflectors are placed between the modules according to Fig.7 and Dust deflector drawing. The triangular deflectors are placed with gaps between each other. The short top pieces/connecters are clicked onto the deflectors so the overlap two deflectors and closes the gap. The top pieces can be squashed a bit prior to installing them. This will typical make them easier to click onto the deflectors.

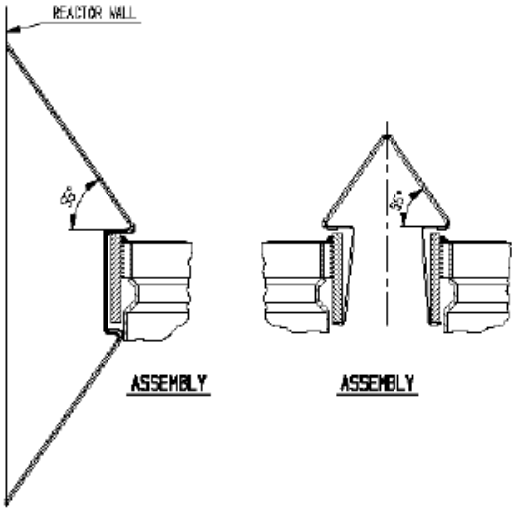


Fig. 7 Correct insatllation of the dust hoods.

5.12 Site fitting of Dust Deflectors

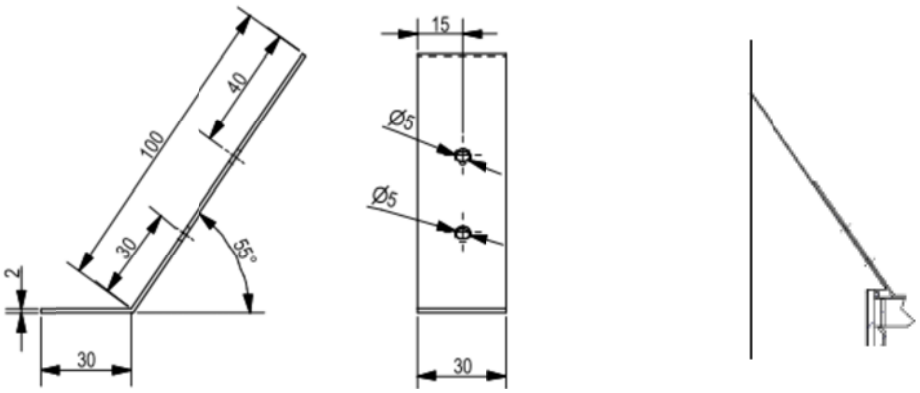
Due to tolerances a perfect match can not be expected at the meeting points of the deflectors. Therefore some field fitting must be expected. By the use of a pen the measure is transferred from one part to another where after the deflector is cut to fit by an angle grinder. Typically 2-3 man-hours will be required per catalyst layer for this task.

Fig. 8 Dust deflector. Cut to fit.

Fig. 9 Dust deflector in corner, cut to fit.

5.13 Installation of support legs for dust deflectors.

Support legs (if part of the dust deflector supply) are distributed evenly to the deflectors at the walls. The support legs are installed on the deflectors with self tapping screws (please see Fig 10). The foot should be placed on top of the module top grid. It is preferred to positioning the support legs where 2 deflectors meet so the screw penetrates both deflectors. The support legs can also be used on the deflector types between the modules if some of these are loose, due to a larger installation distance between the modules than on the drawing.



Typical support leg.

Support legs installed on deflector next to wall

Fig. 10 Support legs

5.14 Final check of installation

Before the man holes are closed it must be checked that the dust hoods are pushed close to each other and that gaps are closed. Foreign objects like tools and equipment must be removed from the top grids. If needed the top grids should be vacuum cleaned.

5.15 Example of a catalyst installation

Fig. 11 to Fig. 14 shows a typical DNX installation for reference and illustration:

Fig. 11 Use of the lifting yoke.

Fig. 12 Transport of modules into the reactor using a pallet car.

Fig. 13 Sealing gutters between modules

Fig. 14 Dust hoods on top of the modules

3.24 Analyzer

GM32
Measuring Probe Version

Simultaneous or individual measurement of
SO_2, NO, NO_2 and NH_3 as well as temperature and pressure

Intended purpose

The GM32 gas analyzer serves for continuous measurement of gas concentrations of SO_2, NO, NO_2 and NH_3 as well as the reference values of temperature and pressure in industrial plants.

As in-situ measuring device, the GM32 determines the measured values directly in the gas carrying duct from the measuring gas spectrum.

Versions

The GM32 provides simultaneous multi-component measurement (combinations of measuring components) as well as single-component measurement. The following measuring probes are available for optimized adaptation of the measuring device to the measuring point:

- GMP measuring probe with open measuring aperture for use with high dust loads in the measuring gas
- GPP measuring probe with gas-permeable ceramic filter in the measuring gap.

The GM32 gas analyzer comprises the following components:

- Sender/receiver unit
- Measuring probe, GMP or GPP
- Connection unit
- Purge air unit (for GMP probe)
- Mounting flange
- SCU operating unit (option)

SICK
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Project planning and preparation

Project planning of the measuring device is very important to ensure unrestricted function and efficient start-up. The main requirements and preparations at the installation site as well as a wiring example with connection options are described in the following.

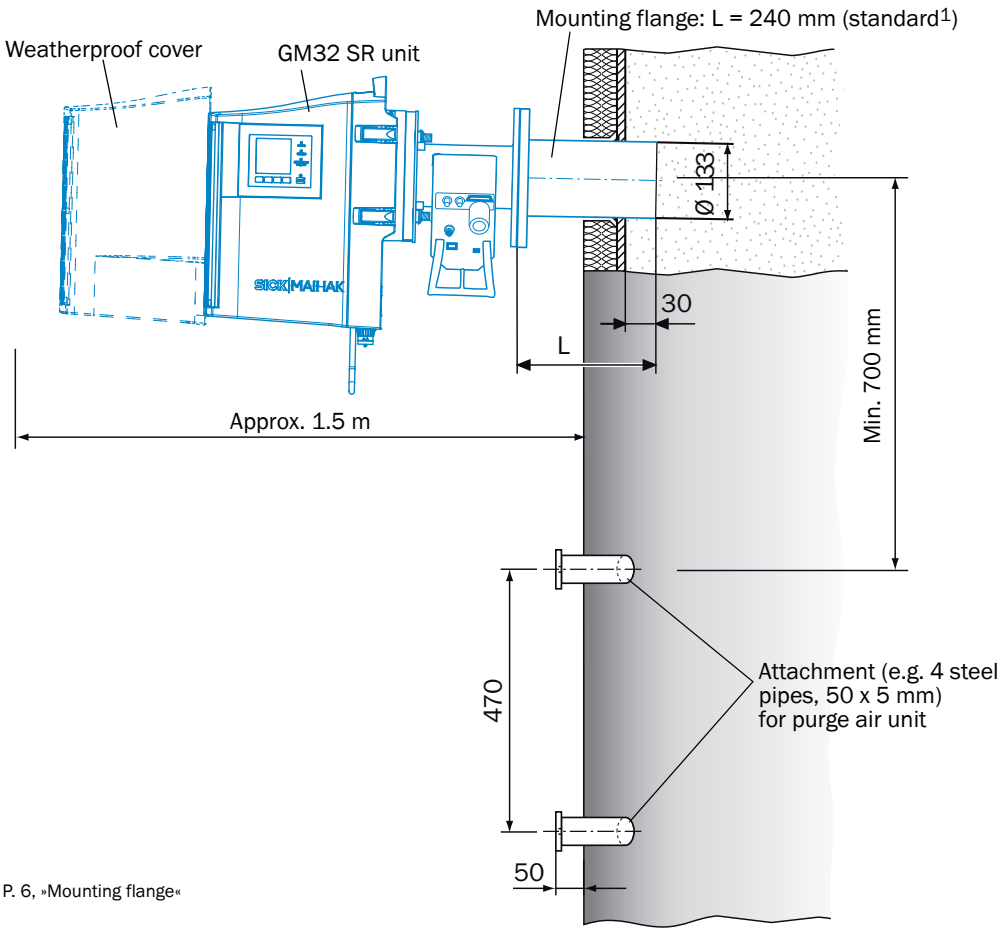
Requirements at the installation site

- Determination of measuring point
  - Provide for an unhindered inlet and outlet paths.
  - Provide for calibration openings at easily accessible places. Ensure that the measuring device and the calibration probe do not influence each other; provide for a calibration socket of min. 0.5 m in flow direction before the measuring device.
  - Provide for an opening with suitable size for the tube of the mounting flange.
  - Provide for adequate clearance for installation and maintenance activities for the duct insulation cut-out.
  - Provide for adequate clearance, e.g. for swiveling out the sender/receiver unit and pulling out the probe.
  - Ensure that the ambient temperature is in the specified temperature range; → P. 4
  - For outdoor installation, provide for adequate weather protection for the device components.
  - Check whether the required power supply (connection unit, purge air unit, etc.) is available → P. 4
  - Provide for sufficiently long signal cables to the measuring device connection unit.
  - The fitting location on the duct/stack must be capable of holding approx. 40 kg on each side.

Preparations for installation

Mounting suggestion for the GM32 device components on a vertical duct/stack.

Fig. 1 Example: Mounting options for the measuring probe, mounting flange and purge air unit version

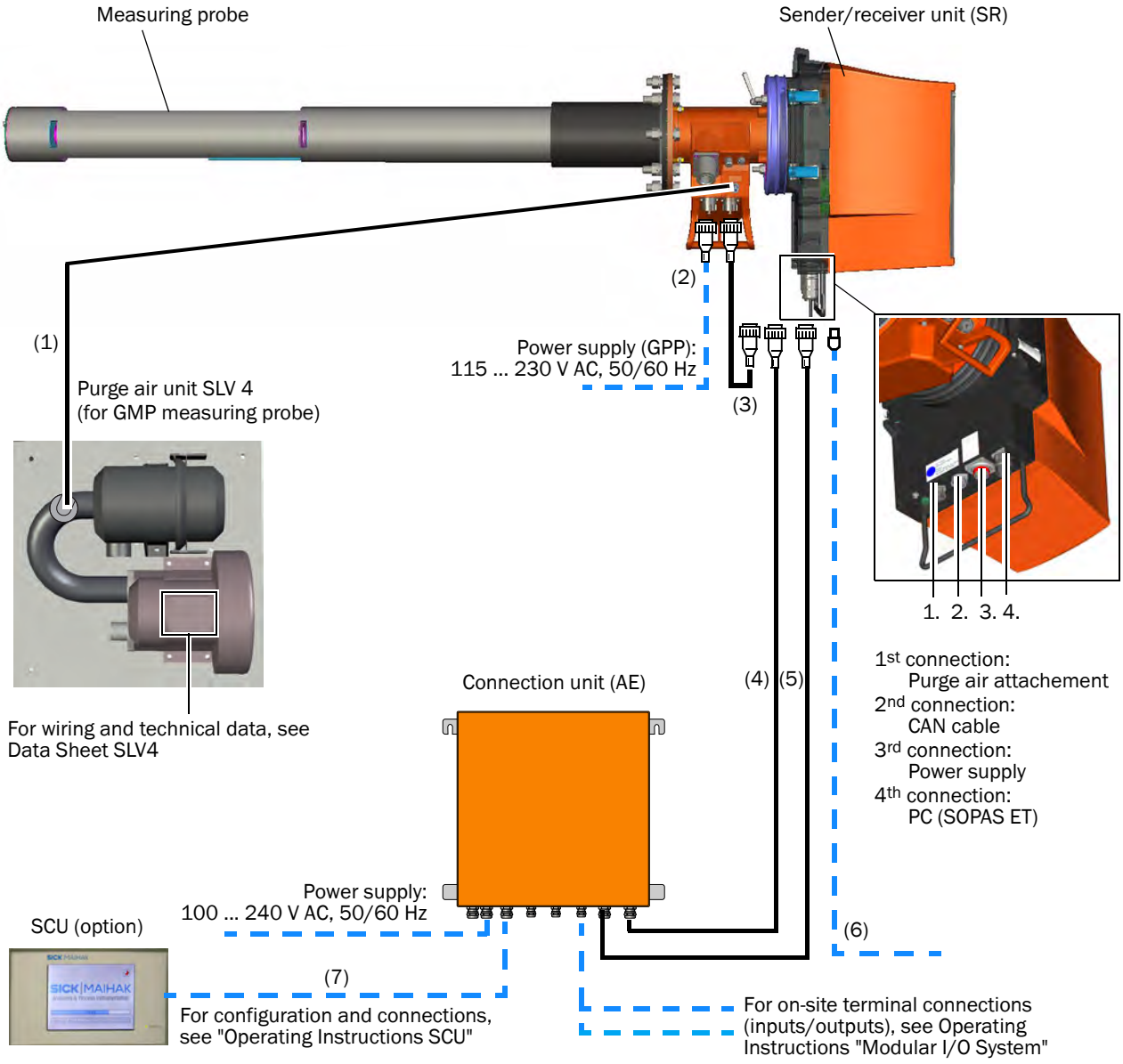


1) → P. 6, »Mounting flange«

Wiring and connections

The Figure below shows a wiring example with the connections of the GM32 components. See the Operating Instructions for details for the concrete connection assignments, e.g. from the connection unit.

Fig. 2 Wiring example: Measuring probe version



No.	Signal cable for connection	Length	Order no.	Remark
(1)	Filter monitoring	5 m	2032143	Included in the purge air attach. (probe)
(2)	GPP probe power supply	10 m	2017519	Included in the GPP probe
(3)	SE – purge air attachement (CAN cable)	0.8 m	2023704	Included in the Purge air attachement (probe)
(4)	AE – SR (CAN cable)	10 m 20 m	2028786 2045422	Order separately
(5)	Power supply SR (Standard)	10 m 20 m	2046548 2046549	Order separately
(6)	Ethernet cable – PC/network		–	No, on-site
(7)	CAN cable – SCU		–	No, on-site

Technical Data

Technical Data	GM32		
Measuring Parameters			
Measuring principle	Differential Optical Absorption Spectroscopy (DOAS)		
Measured components	SO_2, NO, NO_2, NH_3 thereof TÜV-tested for suitability: SO_2, NO		
Available measuring ranges (calibration ranges)	Min.	Max.	TÜV tested for suitability at T = 140 °C and active measuring path = 1.86 m
SO_2:	0 ... 40 $mg/m^3_{Operation} \cdot m$	0 ... 20,000 $mg/m^3 \cdot m$	0 ... 75 $mg/m^3_{Standard}$
NO:	0 ... 50 $mg/m^3_{Operation} \cdot m$	0 ... 2,500 $mg/m^3 \cdot m$	0 ... 70 $mg/m^3_{Standard}$
NO_2:	0 ... 100 $mg/m^3_{Operation} \cdot m$	0 ... 2,000 $mg/m^3 \cdot m$	–
NH_3:	0 ... 25 $mg/m^3_{Operation} \cdot m$	0 ... 50 $mg/m^3 \cdot m$	–
Measuring distance	Active measuring path → P. 7, Fig. 4 and → P. 7, Fig. 5		
Measurement uncertainty	• ±2 % with SO_2, NO, NH_3 • ±5 % with NO_2		
System response time t_{90}	• GMP measuring probe: ≥5 s, adjustable; > 30 s (TÜV tested for suitability) • GPP measuring probe: ≥120 s s (TÜV tested for suitability)		
Measuring Conditions			
Measuring temperature	≤ 500 °C; higher temperatures on request		
Process pressure	±60 hPa (relative)		
Ambient Conditions			
Ambient temperature	–20 ... +55 °C; temperature change max. 10 K/h		
Storage temperature	–20 ... +55 °C		
Rel. humidity	max. 96 % rF		
Moisture condensation	Moisture condensation on optical interfaces not allowed		
Shock & vibration	According to EN 61010-1		
Approvals			
Compliances for SO_2 and NO components	• TÜV-tested for continuous emission control according EC regulations (2001/80/EC, 2000/76/EC) • EN 15267-3, EN 14181 and DIN ISO 14956		
Electrical safety	CE		
Protection class	IP 65, IP 69K		
Input/Output Signals, Interface	**Modules can be selected and extended as required**		
Analog outputs (option)	2 outputs[1]: 0/4 ... 22 mA, load max. 500 Ω; electrically isolated; max. power dissipation (for 24 V): 1.10 W; max. 16 outputs		
Analog inputs (option)	2 inputs[1]: 0/4 ... 22 mA, input resistance max. 100 Ω; max. power dissipation (for 24 V): 0.25 W		
Digital outputs (option)	4 outputs[1] (max. 8): 48 V AC/DC, make-contact, 1.0 W (for 24 V); 0.5 A max. switching current, max. switching capacity (for 24 W): 25 VA; max. 8 outputs		
Digital inputs (option)	4 inputs[1]: approx. 3.9 V at open contact, <4.5 mA with closed contact, 0.55 W		
Interfaces	• Serial: RS232 (internal) • Ethernet • Extendable via optional SCU operating unit		
Bus protocol	• OPC • TCP/IP via Ethernet (optional interface module)		
Power supply	• 100 ... 250 V AC, 50/60 Hz; 260 VA max. power input • Purge air unit SLV4, see Operating Instructions Separate power supply of GPP probe: 115/230 V AC; 50/60 Hz, max. 150 VA power input		

Technical Data	GM32
General information	
System components	• Sender/receiver unit • Measuring probe with purge air fixture – Type GMP with open measuring aperture or – Type GPP, gas diffusion probe • Flange (option) • Purge air unit with GMP probe: See Operating Instructions SLV4 • SCU operating unit: See Operating Instructions SCU
Dimensions (L x W x H) (see Dimensions)	• Sender/receiver unit (including purge air fixture): 586 x 315 x 580 mm • Measuring probes: See → P. 7, Fig. 4 • Connection unit: 450 x 400 mm, → P. 8, Fig. 7 • Purge air unit SLV4: 550 x 550 x 270 mm; see Operating Instructions SLV4
Weight	• Sender/receiver unit: approx. 20 kg • Purge air attachment: 7 kg • Connection unit: 16 kg • Measuring probes – GMP: 25 kg max. – GPP: 45 kg max. • Purge air unit: 14 kg; see Operating Instructions SLV4
Control function	• Internal zero point control, contamination correction • Check cycle for zero and reference point, equivalent to QAL3 (option)

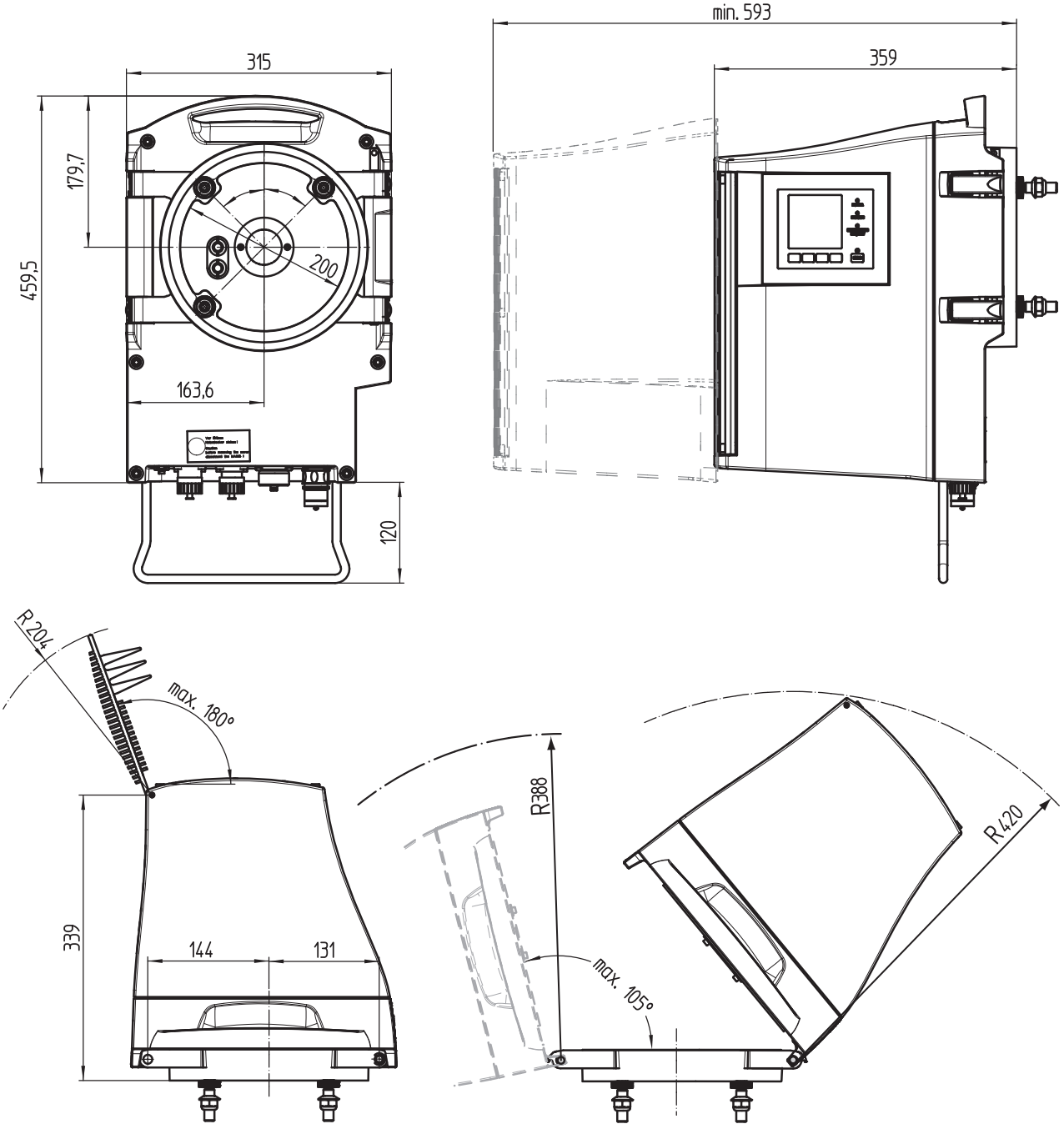
[1] per module

For more information and technical information on the GM32 system and its components, see the following documents:

- Data Sheet GM32, Cross-Duct Version, Part No. 8012710
- Operating Instructions GM32, Cross-Duct Version, Part No. 8012704
- Operating Instructions GM32, Measuring Probe Version, Part No. 8012707
- Technical Information GM32, Cross-Duct Version, Part No. 8011085
- Technical Information GM32, Measuring Probe Version, Part No. 8011513
- Operating Instructions Purge Air Unit SLV4, Part No. 8008088
- Operating Unit SCU: See Operating Instructions SCU, Part No. 8011910
- Technical Information Modular I/O System, Part No. 8011913

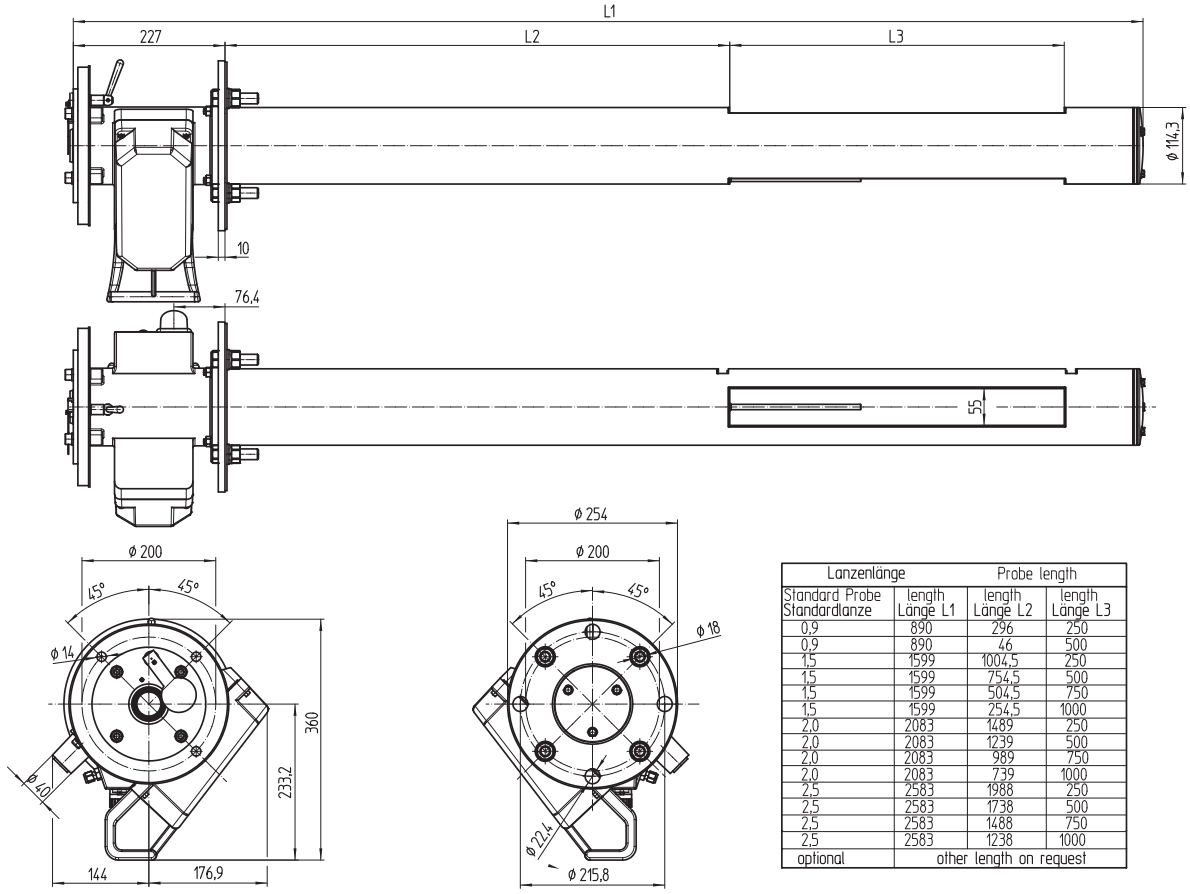
Dimensions

Fig. 3 GM32 sender/receiver unit



The housing of the sender/receiver unit can be swiveled open to the left or right of the device flange (max. 120°).

Fig. 4 GM32 measuring probe, type GMP – open measuring probe



Lanzenlänge	Probe length		
Standard Probe Standardlanze	length Länge L1	length Länge L2	length Länge L3
0,9	890	296	250
0,9	890	46	500
1,5	1599	1004,5	250
1,5	1599	754,5	500
1,5	1599	504,5	750
1,5	1599	254,5	1000
2,0	2083	1489	250
2,0	2083	1239	500
2,0	2083	989	750
2,0	2083	739	1000
2,5	2583	1988	250
2,5	2583	1738	500
2,5	2583	1488	750
2,5	2583	1238	1000
optional	other length on request		

Fig. 5 GM32 measuring probe, type GPP – gas diffusion probe

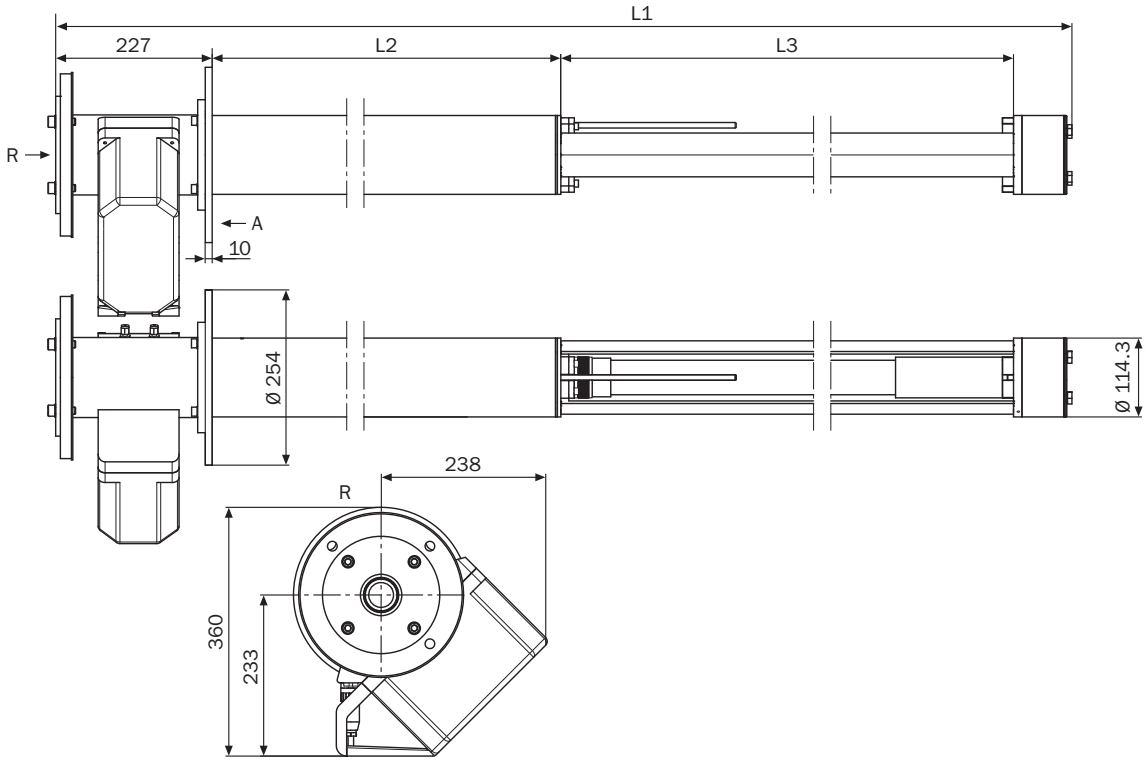


Fig. 6 Mounting flange

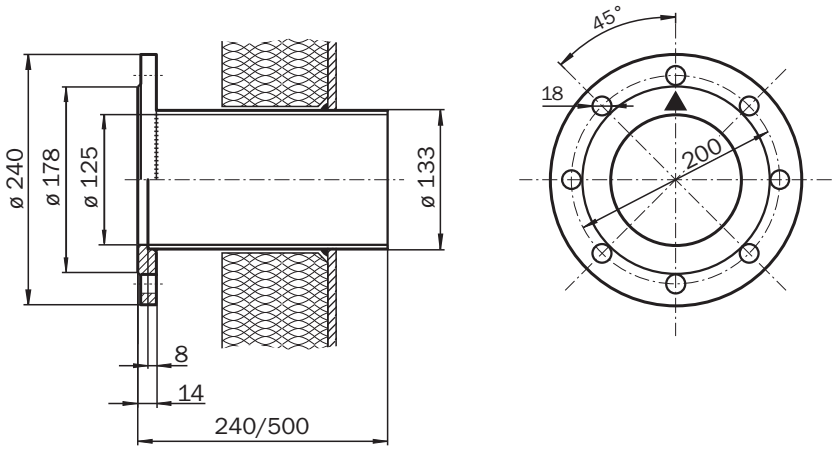
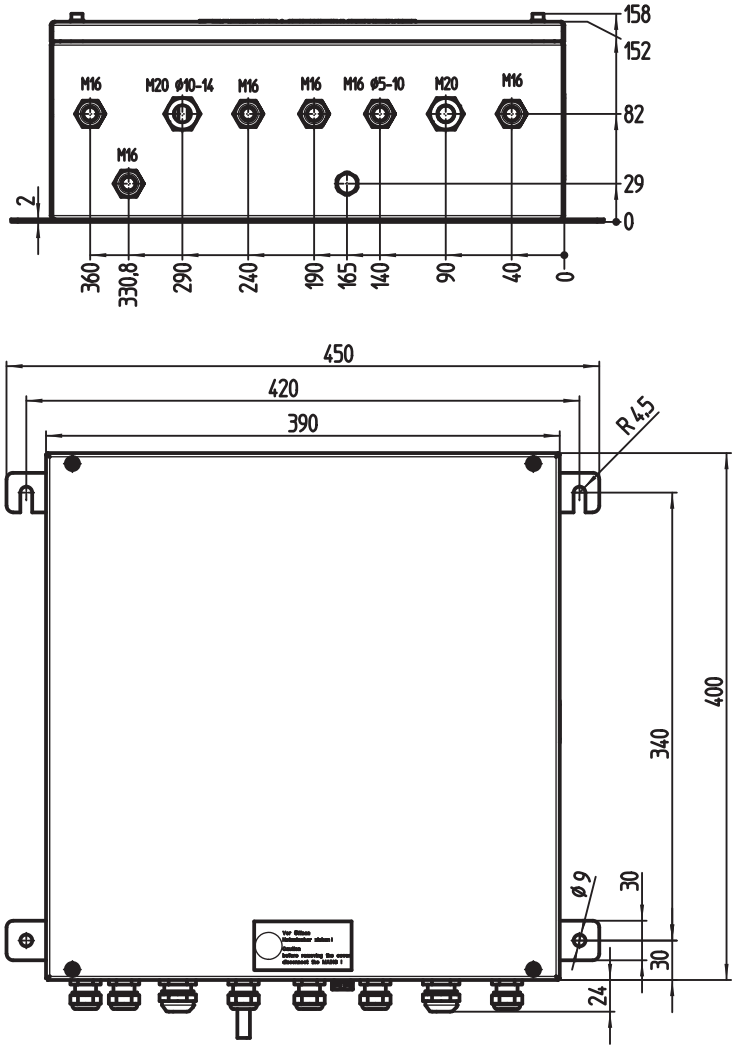


Fig. 7 Connection unit



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Data sheet

GAS ANALYSIS

SOLUTION

BEST

ZIRKOR 5200 –

Oxygen Analyzer System for power plants

The power plant system ZIRKOR 5200 is designed for the measurement of O_2 in exhaust gases from power plants, waste incinerators and cement plants even in high dust applications and depending on the probe type, up to 600° C (with cooling tube temperatures up to 1400 °C are admissible).

The rugged ZIRKOR 5200 probe is fitted with a protective tube and filter head so that it can even be mounted horizontally. Various different probe lengths from 520 mm, 950 mm and 1865 mm are available to exactly match the installation conditions (other lengths are also available).

The associated microprocessor-based electronics unit is mounted in a rugged industrial sheet steel enclosure, with a viewing window. It includes the reference air supply with reference air pump and a flow meter. Customer supplied instrument air can be connected as an alternative when ordered with the corresponding pneumatic unit.

This system is self-starting. A large digital display with self-explanatory menu texts, easy operation with the use of softkeys, full automatic calibration with solenoid valves and two freely-programmable O_2 measuring ranges are just some of the features of this system.

The ZIRKOR 5200 System consists of the following components:

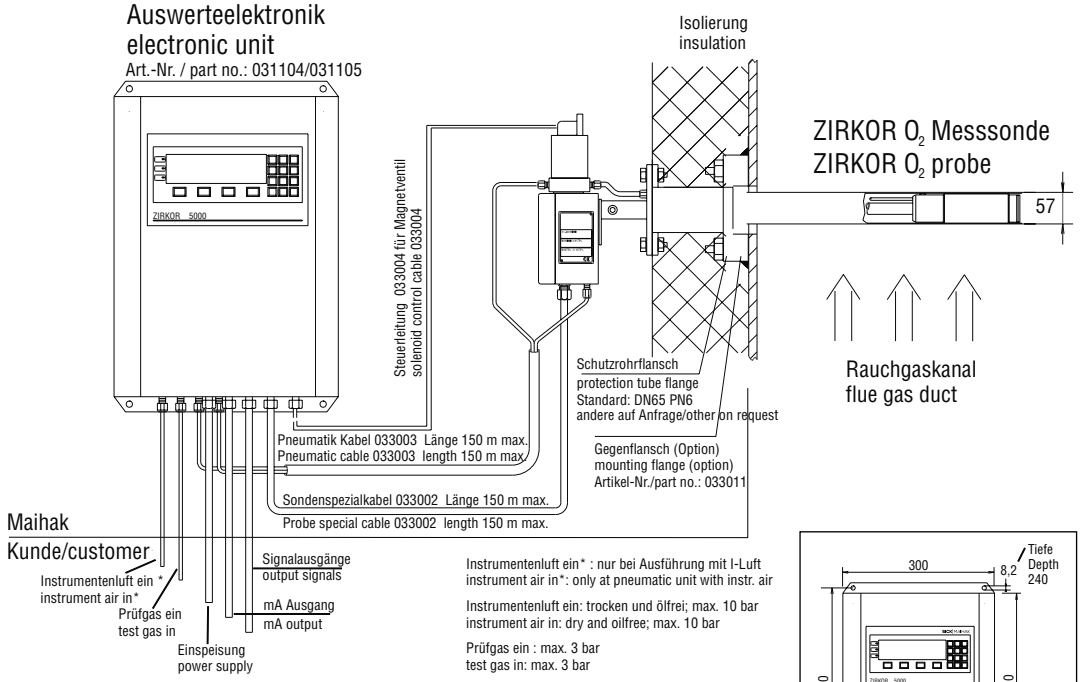
1. **Probe** with protective tube, filter head and solenoid valve and the probe flange
2. **Microprocessor electronics** with integrated pneumatics for test gas and reference air
3. **Interconnecting cable** between probe and electronics (maximum length 150 m)

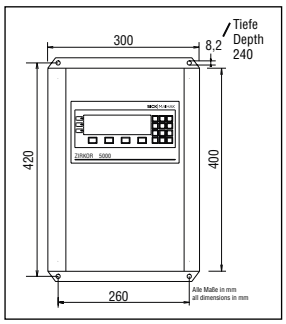
Technical Data

Zirkonoxide Oxygen measuring probe	
Length:	520 to 1865 mm
Flue gas temp.:	600 °C - 1400 °C
Meas. principle:	Zirkonoxide
Material:	1.4571/1.4301stst
Flange:	similar to DN65 PN6
Filter element:	sintered metal 20 µm
Protection plug:	IP 65

Electronics unit in sheet steel enclosure with window	
Protection:	IP 65
Dimensions:	HxWxD 300x400x225 mm
Weight:	approx. 14 kg
Line voltage:	115/230 V / 50 - 60 Hz +/-10 %
Power cons.:	400 VA during warm-up, < 200 VA continuous operation
Ambient temp.:	-20 °C up to +55 °C (instrument air) -20 °C up to +40 °C (pump version)
EMI tested:	acc. EN 50081-2 and EN 50082-2
Meas. ranges:	2, key selectable, each programmable from 0 - 2 % O_2 to 0 - 25 % O_2
Output:	0/4 - 20 mA programmable potential-free, load 500 Ohm max.
Interface:	RS232, RS485, bus-interface on request
Accuracy:	± 0.2 % of reading (± 0.01 % O_2), with monthly calibration
Operation:	with soft keys, menu control, self-explanatory
Displays:	LCD-display LED-illuminated 240 x 64 dots
Spectrum:	actual values, parameters, system functions, system status
Language:	display texts in German and English
Alarm display:	LED status for alarm, service, fault
Relay outputs:	system fault, service, O_2 range, solenoid valve probe, 2 O_2 limits min/max
Digital inputs:	release auto. cal., test gas status, O_2 range select
Value memory:	on/off during calibration
System test:	with air and/or test gas
Calibration:	single point or two point with air and/or with test gas bottle
Auto. cal.:	active by time selection
Auto. start-up:	with auto calibration and air
Pneumatics:	integrated for instrument air or with pump and flow control

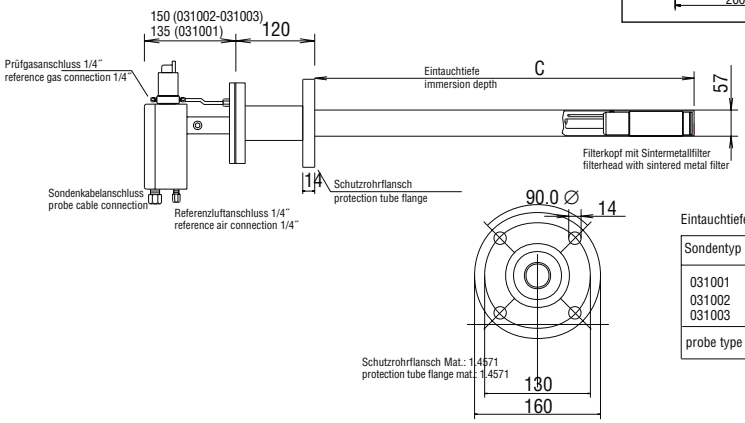
ZIRKOR 5200 O_2-Analysing System





Electronic Unit

Probe 600 °C

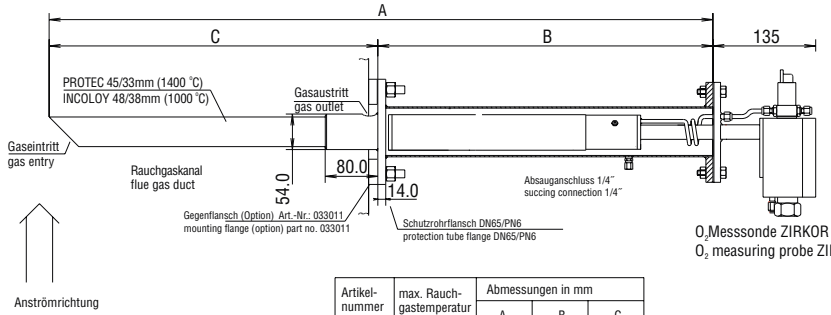


Eintauchtiefe / immersion depth:

Sondentyp	max. Rauchgas-temperatur	C (mm)
031001	600 °C	520
031002	600 °C	350
031003	600 °C	1865
probe type	max. flue gas temperatur	C (mm)

alle Maße in mm
all dimensions in mm

Probe 1000 °C
Probe 1400 °C



O_2Messsonde ZIRKOR 5201
O_2 measuring probe ZIRKOR 5201

Artikel-nummer	max. Rauch-gastemperatur	Abmessungen in mm		
		A	B	C
031006	1400°C	1150	650	500
031007	1400°C	1650	650	1000
031008	1000°C	1150	650	500
031009	1000°C	1650	650	1000
part no.	max. flue gas temperature	dimensions in mm		

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PRODUCT INFORMATION

GM700
Laser Gas Analyzer

Measurement of gaseous components
under difficult conditions
In-situ and extractive technology

SICK | MAIHAK
Analyzers and Process Instrumentation

GM700
Sophisticated Gas Analysis "brought into Line"

The GM700 series offers new possibilities to measure difficult and selective gas components such as HF, HCL or NH_3 with all-time flexibility – without the need of test gases. Using direct laser spectroscopy with a precisely adjusted spectral line the GM700 allows high-resolution measurements, free of cross-interference, drift and the necessity for any calibration.

AREAS OF APPLICATIONS

- Emission monitoring in the fertilizer production, waste incineration, aluminium and ceramics industry
- NH_3 slip monitoring in DeNOx plants
- Glass industry
- Scrubber monitoring in the iron and steel industry
- Plastics processing
- Chemical and petrochemical industry
- Automotive applications

GM700 CROSS DUCT

- Representative results due to the measurement across the entire duct cross-section
- Main application for measurement of HF
- Drift- and calibration-free
- Particularly low maintenance

GM700 MEASURING PROBE

- Drift- and calibration-free
- One side duct access
- Easy installation
- Integrated zero point path
- Measurement performance independent from the channel dimensions

GME700 EXTRACTIVE

- Hot-wet analyzer
- Drift- and calibration-free
- Easy integration into existing extractive systems
- Applicable without limits using the appropriate gas conditioning (e. g. high pressures and temperatures)

KEY FEATURES

- Broad field of applications due to the choice of extractive or in-situ analyzer design
- Precise and drift-free by the direct spectroscopy – no calibration with problematic test gases necessary, means high cost saving
- High selectivity due to very high spectral resolution – no cross-interference from other gases
- Fast response
- Applicable in harsh conditions
- Very low maintenance requirements and long servicing intervals

GM700
Cross Duct

GM700
Measuring
Probe

GME700
Extractive (19", 4 HU)

SYSTEM COMPONENTS

The GM700 system offers the following models for best adaption to the measurement task:

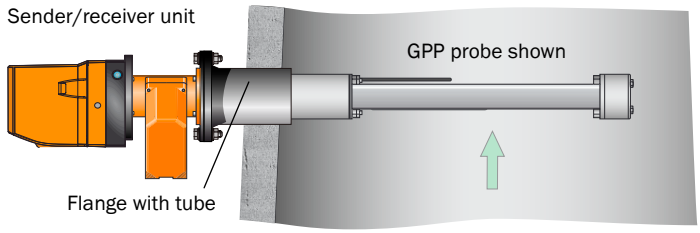
- **GM700 model with measuring probe**
  - Sender/receiver unit with the optical and electronical modules
  - Probe as a version with an aperture (GMP) or as a gas diffusion probe (GPP)
  - AWE unit for processing, control and output of measuring data

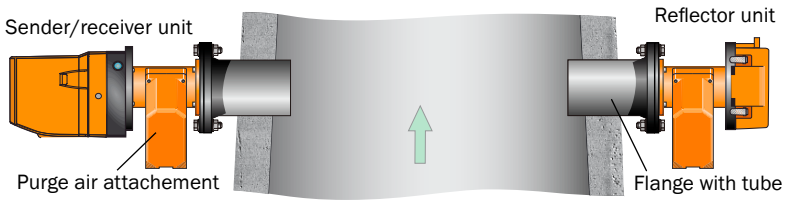
- **GM700 cross duct model**
  - Sender/receiver unit with the optical and electronical modules
  - Reflector unit with triple reflector and a purge air attachment
  - AWE unit (see above)

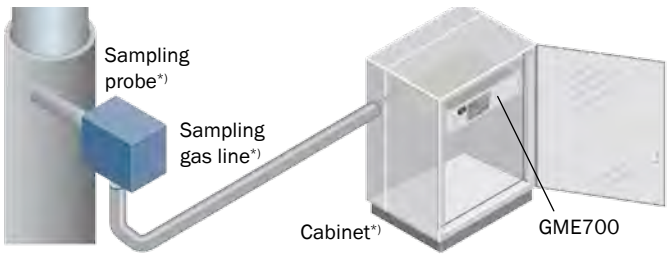
- **GME700 extractive analyzer**
  - Compact 19" unit (4 HU) with integrated analyzer and evaluation unit as well as a heated cell

Optional components

- Purge air unit (for GMP probe and cross duct) for protection against contamination
- Weather proof covers
- Flanges with tube for mounting





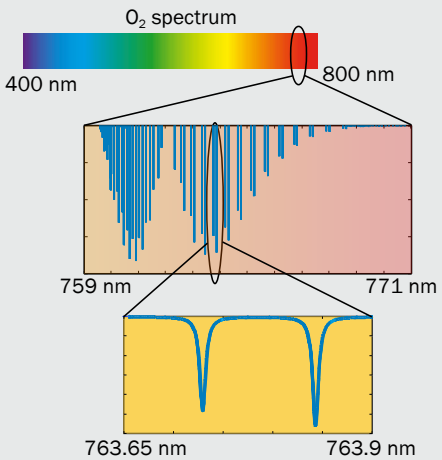


*) Not covered by the standard scope of delivery

TUNABLE LASER DIODE SPECTROSCOPY (TDLS)

A laser beam is sent from the sender through the measuring gas onto the reflector, that aims the beam back to a highly sensitive photo diode in the sender/receiver unit. The laser diode wavelength is tuned to one absorption line of the measuring gas component. This line is scanned by modulating the wavelength, and then the transmission signal is recorded by the photo diode.

An appropiate signal evaluation delivers the size of the absorption line from which the gas concentration is calculated. The TDLS method allows therefore the selective measurement in a gas mixture. Measuring gas components of the GM700 are NH_3, HF, HCl and O_2 for example.



Technical Data	GM700 series		
Model	**GM700** **Probe model**	**GM700** **Cross duct model**	**GME700** **Extractive analyzer (19")**
Measuring parameters			
Measuring principle	TDLS (Tunable Diode Laser Spectroscopy)		
Measuring component	NH_3, HF, HCl, O_2		
Available measuring range	Minimum measuring range[1)]	Maximum measuring range[1)]	Minimum measuring range[2)]
NH_3	0 ... 10 ppm	0 ... 5000 ppm	0 ... 5 ppm
NH_3/H_2O	0 ... 5 vol%	0 ... 100 vol%	0 ... 2.5 vol%
HF	0 ... 2 ppm	0 ... 2000 ppm	0 ... 1 ppm
HCl	0 ... 10 ppm	0 ... 3000 ppm	0 ... 5 ppm
HCl/H_2O	0 ... 10 ppm/0 ... 50 vol%	0 ... 3000 ppm/0 ... 100 vol%	0 ... 5 ppm/0 ... 25 vol%
O_2	0 ... 3 vol%	0 ... 100 vol%	0 ...1.5 vol%
Accuracy	< 2 ...< 5 % of measuring value, dependent on the relevant application		
Measurement conditions	**Probe model**	**Cross duct model**	**Extractive analyzer**
Meas. gas temperature	–40 ... +430 °C	–40 ... +430 °C; higher on request	Heated cell up to 200 °C
Meas. gas pressure	• GMP probe: depend. on purge air • GPP probe: < ±120 hPa	Dependent on purge air	Dependent on gas conditioning
Ambient conditions			
Ambient temperature	–40 ... +50 °C; in 4 ranges adjustable		0 ... +50 °C
Approval			
Conformities	EMV according to EN 61326		
Protection class	IP65		IP20
Electrical safety	CE		
Inputs, outputs, controls via AWE evaluation unit			
Analog outputs	3 outputs: 0/4 ... 20 mA, max. load 500 Ω; electrically isolated		
Analog inputs	1 input: 0 ... 20 mA; optional for gas temperature and pressure		
Digital outputs	3 outputs: potential-free; 48 V AC/DC Status signal: malfunction (normally closed contact), maintenance request (normally open contact), Function control (normally open contact)		
Digital inputs	3 inputs for the connection of floating contacts; for 24 V		
Interfaces	RS232 (service)		
Bus protocoll	PROFIBUS (optional)		
General	**Probe model**	**Cross duct model**	**Extractive analyzer**
System components	• Sender/receiver unit • Measuring probe • AWE evaluation unit • Purge air for GMP probe • Flange with tube	• Sender/receiver unit • Reflector unit • AWE evaluation unit • Purge air unit(s) • Flange with tube	• 19" unit
Check function	Integrated check cycle for zero and span check		
Mounting	1 installation location on the duct	2 installation locations opposite on the duct	19" installation

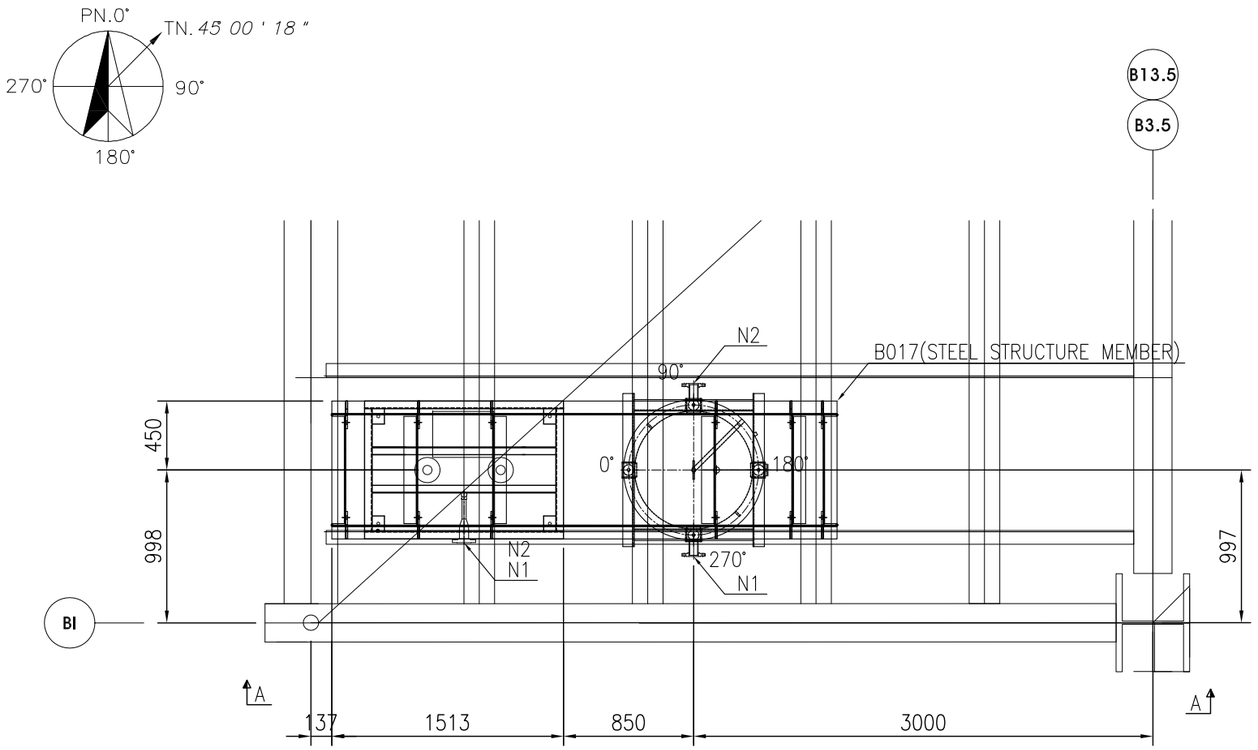
[1)] At 20 °C, 1000 hPa, 1 m measuring path. The maximum measuring ranges are subject to conditions on-site and on the individual configuration.

[2)] Maximum measuring range of the GME700 refer to GM700

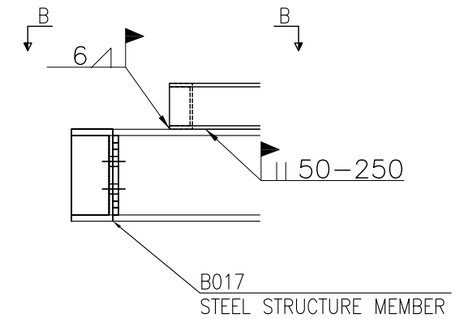
SICK MAIHAK | Analyse Industrielle
17, rue de Campanules | 77185 Lognes | France | www.sick-maihak.fr
Tel : + 33 1 - 64 62 78 00 | Fax : + 33 1 64 62 78 01 | info@sick-maihak.fr

SICK | MAIHAK
Analyzers and Process Instrumentation

Attachment 1.
Air Receiver Tank and Air Dryer
Installation Drawing



EL +46575(T.O.S)



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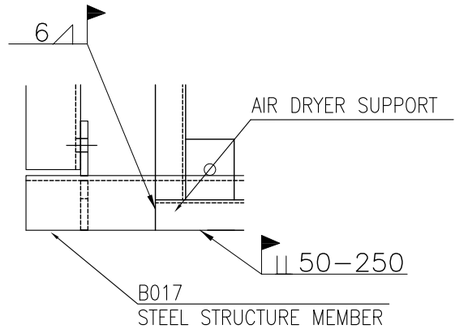

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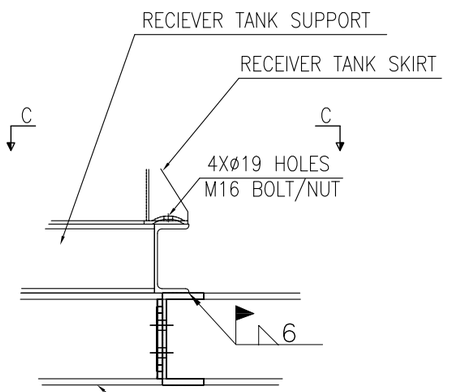

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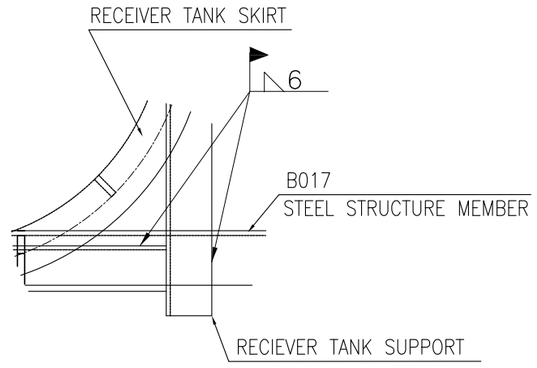

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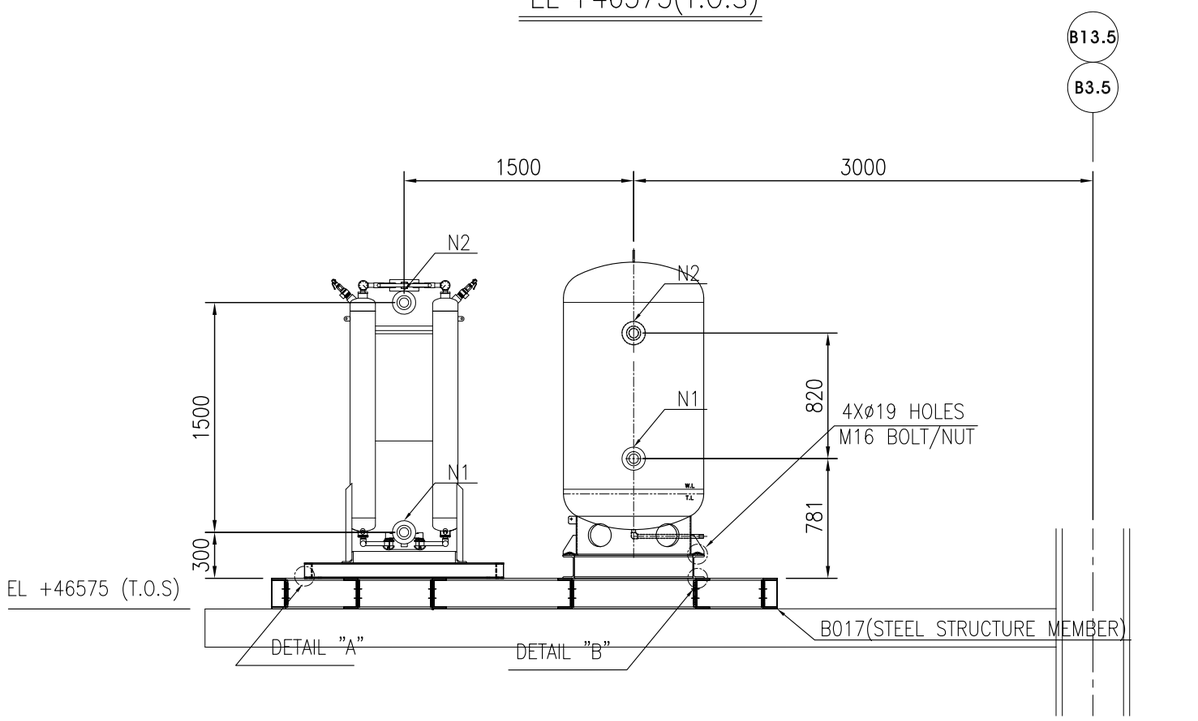

SEC "A–A"

N – NOT APPLICABLE (REFERENCE ONLY)

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DOCUMENT SUBMISSION STATUS : FOR APPROVAL

NOTE:

REV	DATE	DESCRIPTION	PREP	CHKD	APRD	APRD
1	23 Dec. 2015	FOR CONSTRUCTION	S.J.HEO	S.J.KANG	G.Y.OH	S.H.YANG

OWNER: VIETNAM OIL AND GAS GROUP (PVN)

OWNER'S CONSULTANT: FICHTNER GmbH & Co. KG — FICHTNER / PV POWER PCC

EPC CONTRACTOR: PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PVC)

EPC CONSTRACTOR'S CONSULTANT: WorleyParsons — WORLEYPARSONS

POWER ISLAND PACKAGE SUPPLIER: SOJITZ CORPORATION / DAELIM INDUSTRIAL CO., LTD.

PROJECT TITLE: THAI BINH2 THERMAL POWER PLANT 2 x 600MW

DRAWING TITLE: INSTALLATION DRAWING FOR DILUATION AIR BLOWER SKID

VENDOR NAME: S&T CORPORATION

FUNCTION	NAME	SIGN	DATE
DRWN	J.LEE		2013.04.19
CHKD	G.Y.OH		2013.04.19
APPD	C.Y.YANG		2013.04.19
APPD	H.S.LEE		2013.04.19

DRAWING NO.

JOB NO. 110180

SCALE NONE

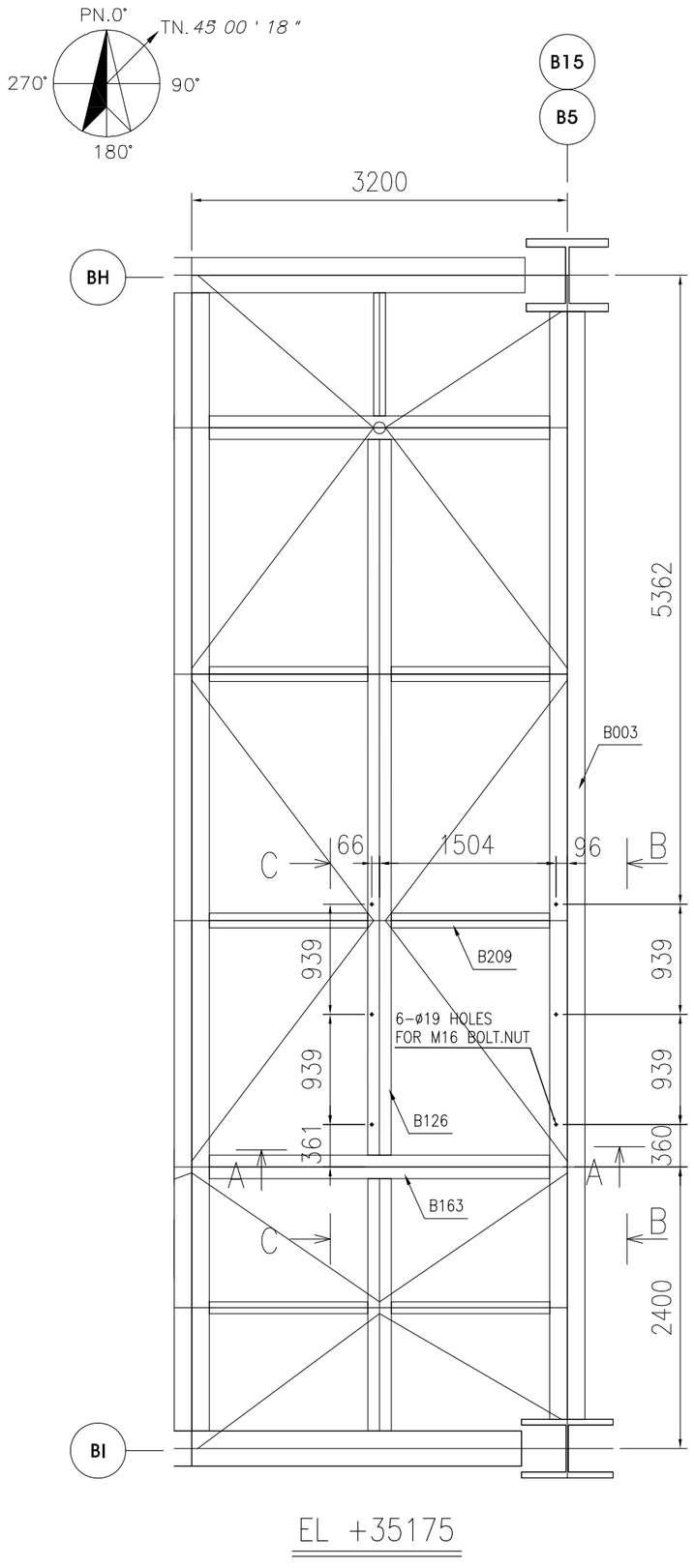
REV.NO. 1

FILE NAME:

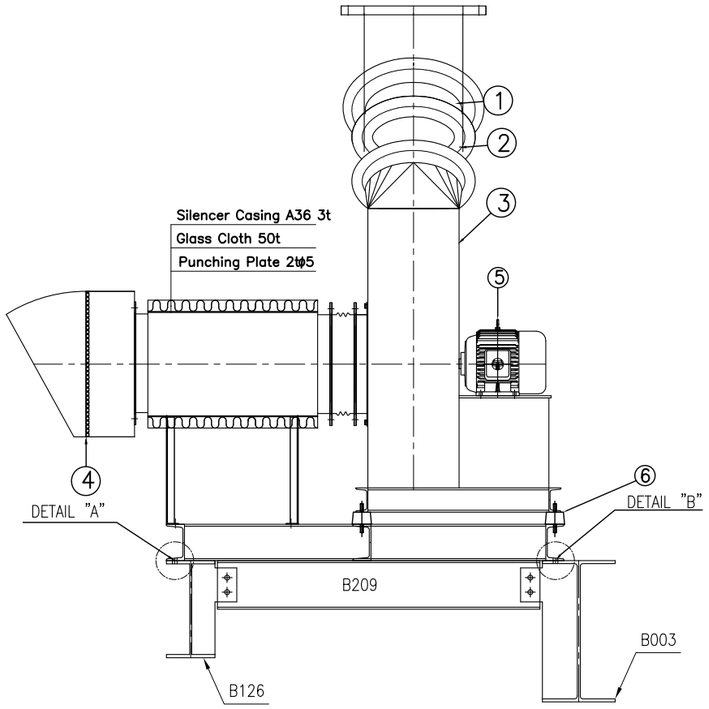
A1 (594mm x 841mm)

Attachment 2.

Seal Air Blower Installation Drawing



EL +35175



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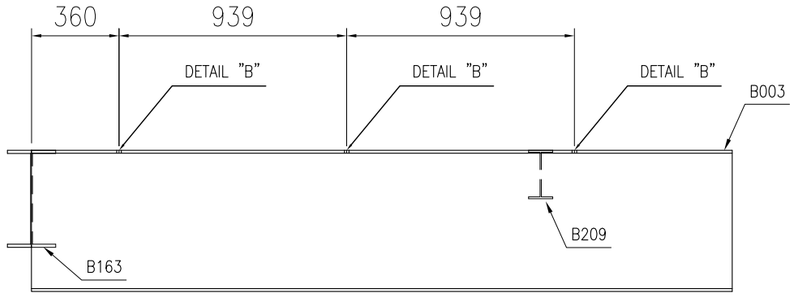

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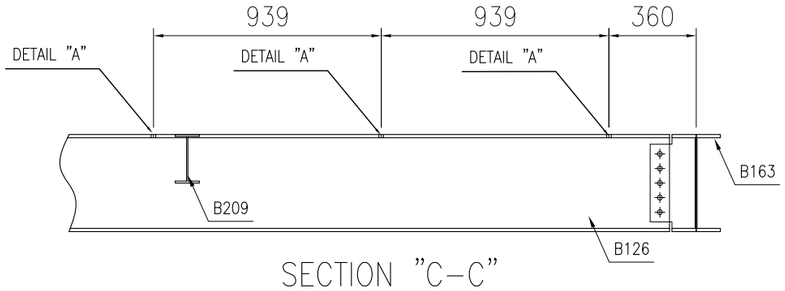

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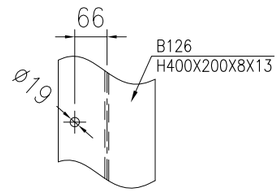

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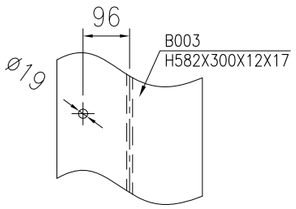

DETAIL "B"

NO.	DESCRIPTION	MATERIAL	Q'TY	SIZE	REMARK
1	CHEKE DAMPER	A 36	2	D 400	
2	OUTLET CANVAS	Polyester	2	0.45mm	
3	CASING	A 36	2	3.0t	
4	FILTER (Demister)	SUS 304	2	12t (0.25mm)	
5	MOTOR	–	2	7.5 kw	
6	RUBBER MOUNT	RUBBER	8	ø 80	
7					

SPECIFICATIONS

Damper KKS NO.	FV-15HSD10AA403 FV-15HSD20AA403	MODEL	TF # 4
		GAS TEMP.(max/min)	20
		GAS HANDLED	AIR
		BEARING	N/A
CAPACITY	122.9 m³/min	WEIGHT	kg
STATIC PRESS.	1200.3 Pa	HORSE POWER	10 HP
SPEED	1440 rpm		

MOTOR: TYPE, TEFC 7.5 KW 4 Pole 3 ø 50 Hz 400 V

Daelim Industrial Co., Ltd.						
job No.	110180					
	A – APPROVED					
	B – APPROVED WITH COMMENTS					
	C – RETURNED FOR CORRECTION					
	D – REJECTED					
	N – NOT APPLICABLE (REFERENCE ONLY)					
SIGNED BY :	DATE :					

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EPC CONTRACTOR'S CONSULTANT: WorleyParsons — WORLEYPARSONS

POWER ISLAND PACKAGE SUPPLIER: sojitz — SOJITZ CORPORATION; DAELIM — DAELIM INDUSTRIAL CO., LTD.

PROJECT TITLE: THAI BINH2 THERMAL POWER PLANT 2 x 600MW

DRAWING TITLE: INSTALLATION DRAWING FOR SEAL AIR BLOWER

VENDOR NAME: S&T CORPORATION

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DRWN	J.LEE		2013.04.19
CHKD	G.Y.OH		2013.04.19
APPD	C.Y.YANG		2013.04.19
APPD	H.S.LEE		2013.04.19

DRAWING NO.

JOB NO. 110180

SCALE NONE

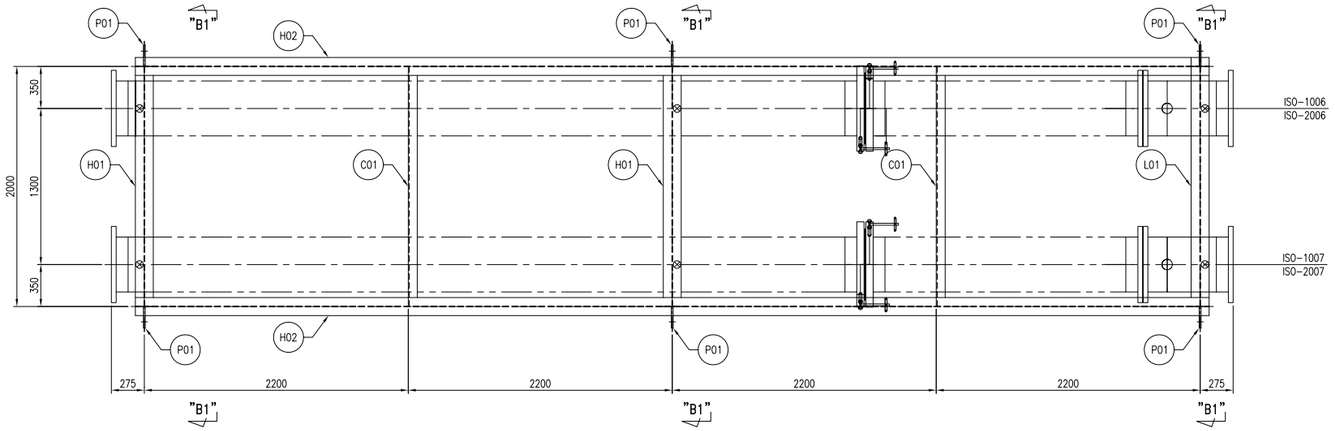
REV.NO. A

FILE NAME:

A1 (594mm x 841mm)

Attachment 3.

Ammonia Flow Control Unit Skid



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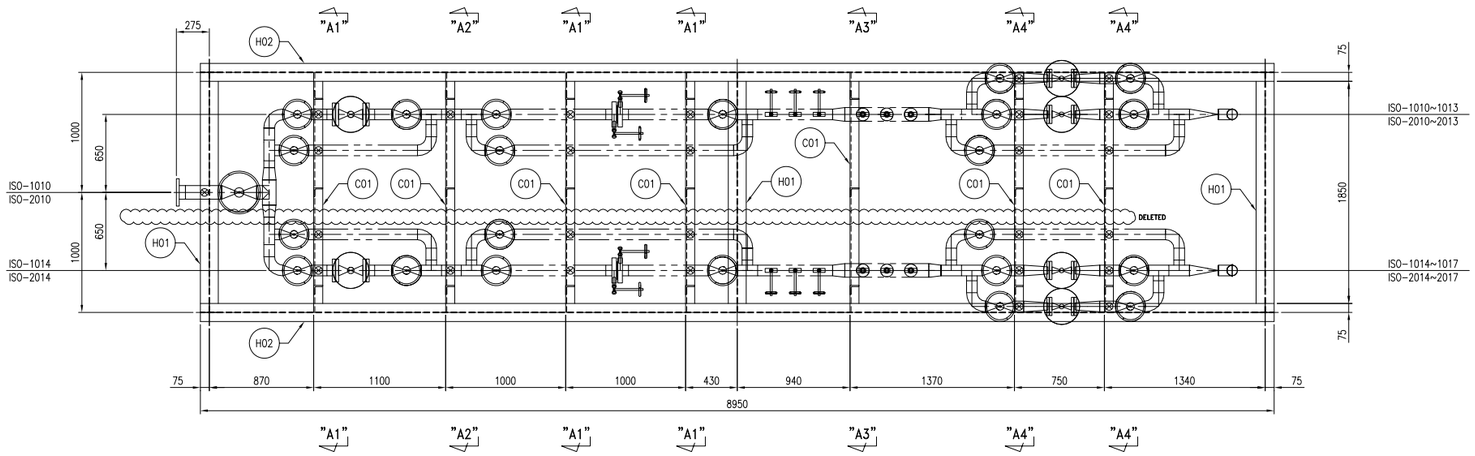

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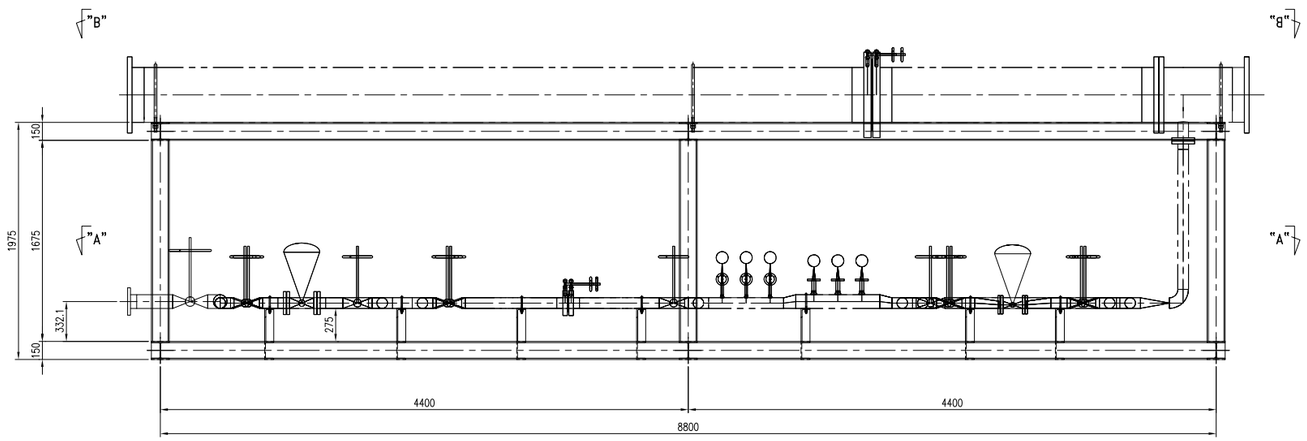
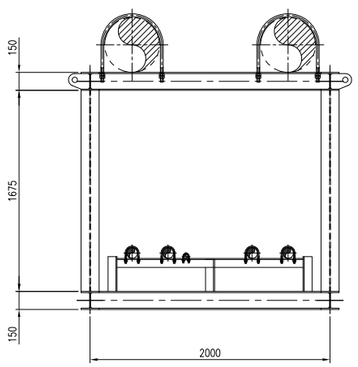




SIDE ELEVATION VIEW

NO	DESCRIPTION	MATERIAL	Q'TY	SIZE	WT (KG) UNIT	WT (KG) TOTAL	REMARK
	–						
H01	H-BEAM	A36	6	H150X150x7x10-1993	62.0	372.0	
H02	H-BEAM	A36	4	H150X150x7x10-8950	278.3	1113.2	
H03	H-BEAM	A36	6	H150X150x7x10-1675	52.1	312.6	
L01	ANGLE	A36	5		15.4	77.0	
L02	ANGLE	A36	10	L75x75x9-290	2.9	29.0	
L03	ANGLE	A36	11	L75x75x9-266	2.6	28.6	
L04	ANGLE	A36	2	L75x75x9-2100	20.9	41.8	
C01	CHANNEL	A36	9	C150x75x6.5x10-1993	11.8	106.2	
P01	LUG PLATE	SS400	6	PL16x260x353	–	11.5	
	U-BOLT	A36(GALV.)	26	80A	–	–	
	U-BOLT	A36(GALV.)	2	100A	–	–	
	U-BOLT	A36(GALV.)	6	450A	–	–	

TOTAL W.T = 2091.9 Kg

* 상기 수량은 **1UNIT**에 대한 물량이며 총 제작 수량은 **2 UNIT** 입니다.

* REFERENCE DRAWING

1.TB2-SDC.VP124-00100-P-MIA-ISO-1006
2.TB2-SDC.VP124-00100-P-MIA-ISO-1010~1017
3.TB2-SDC.VP124-00100-P-MIA-ISO-2006
4.TB2-SDC.VP124-00100-P-MIA-ISO-2010~2017

DOCUMENT SUBMISSION STATUS : FOR APPROVAL

NOTE:

REV	DATE	DESCRIPTION	PREP	CHKD	APRD	APRD
1	2015.02.11	FOR REFERENCE	H.C.JUNG	S.D.SONG	S.P.CHOI	Y.Y.SUNG

OWNER: VIETNAM OIL AND GAS GROUP (PVN)

OWNER'S CONSULTANT: FICHTNER GmbH & Co. KG / FICHTNER / PV POWER PCC

EPC CONTRACTOR: PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PVC)

EPC CONSTRACTOR'S CONSULTANT: WORLEYPARSONS

POWER ISLAND PACKAGE SUPPLIER: SOJITZ CORPORATION / DAELIM INDUSTRIAL CO., LTD.

PROJECT TITLE: THAI BINH2 THERMAL POWER PLANT 2 x 600MW

DRAWING TITLE: AMMONIA FLOW CONTROL UNIT SKID

VENDOR NAME: S&T CORPORATION

FUNCTION	NAME	SIGN	DATE
DRWN			
CHKD			
APPD			
APPD			

DRAWING NO.

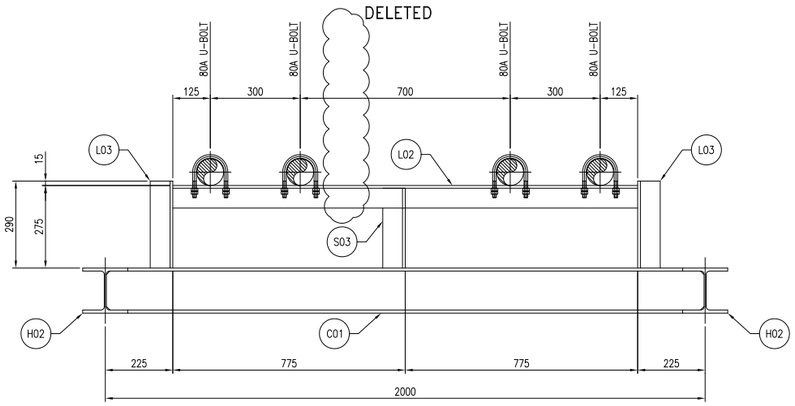
JOB NO. 110180

SCALE 1/30

REV.NO. 1

FILE NAME:TB2-SDC.VP124-03100-P-MIA-DGA-0003

A1 (594mm x 841mm)



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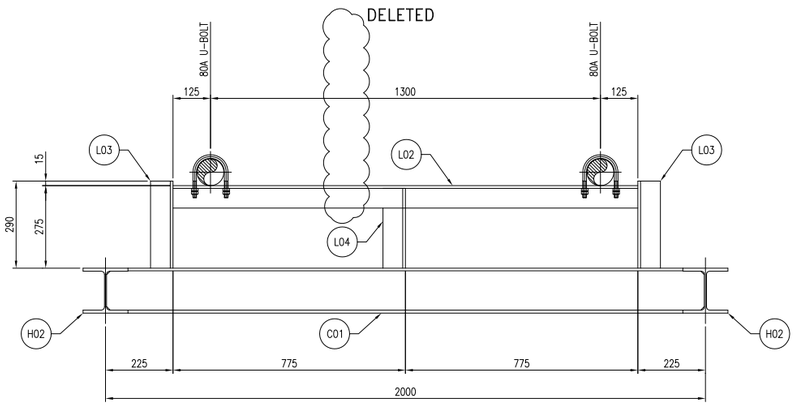

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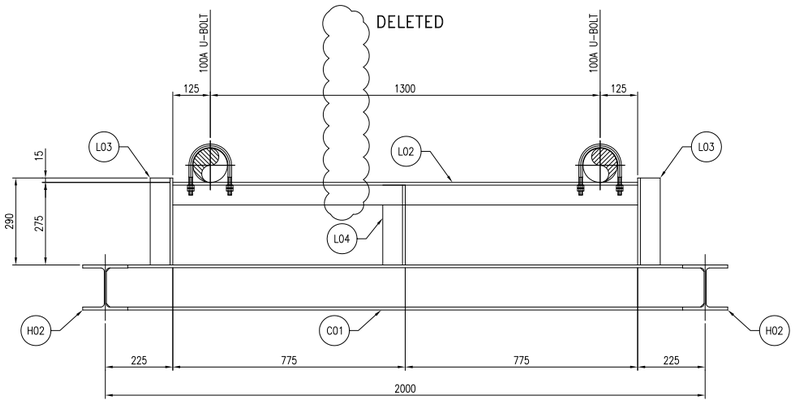

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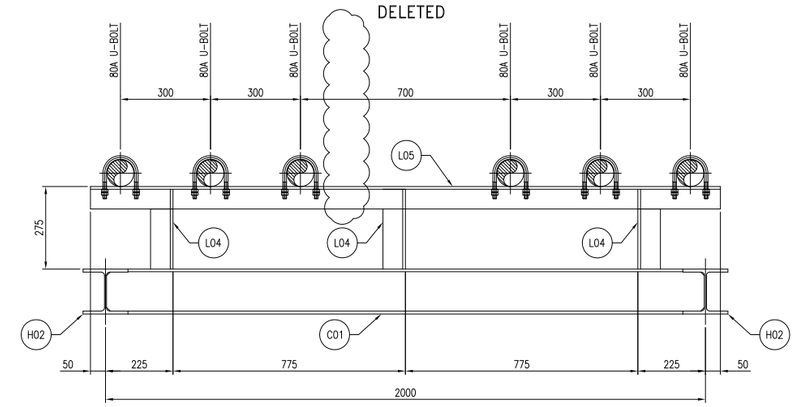

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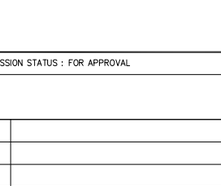
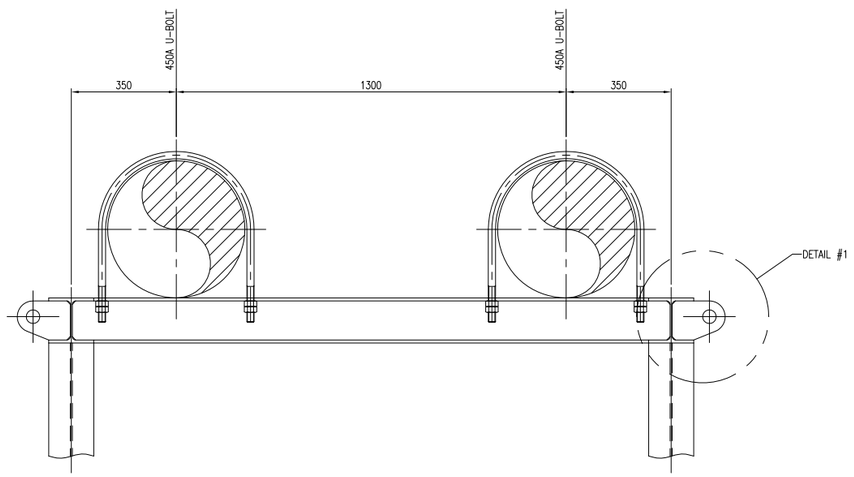


PIPE SIZE	PIPE OD	M	C
15A	21.4	M10	35
20A	26.7	M10	40
25A	33.4	M10	60
40A	48.3	M10	75
50A	60.4	M10	90
80A	88.9	M12	105
100A	114.3	M12	130
450A	457.2	M24	490

DIMENSION OF U-BOLT



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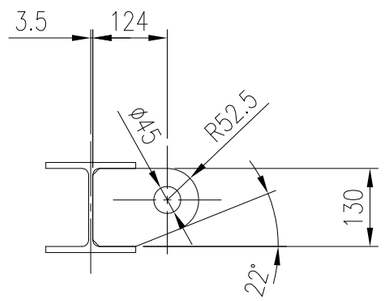

DETAIL #1
(LUG DETAIL)

DOCUMENT SUBMISSION STATUS : FOR APPROVAL

NOTE:

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1	2015.02.11	FOR REFERENCE	H.C.JUNG	S.D.SONG	S.P.CHOI	Y.Y.SUNG

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DRAWING TITLE: AMMONIA FLOW CONTROL UNIT SKID

VENDOR NAME: S&T CORPORATION

FUNCTION	NAME	SIGN	DATE
DRWN			
CHKD			
APPD			
APPD			

DRAWING NO.

JOB NO. 110180 | SCALE 1/30 | REV.NO. 1

FILE NAME:TB2-SDCVP124-03100-P-MIA-DGA-0003

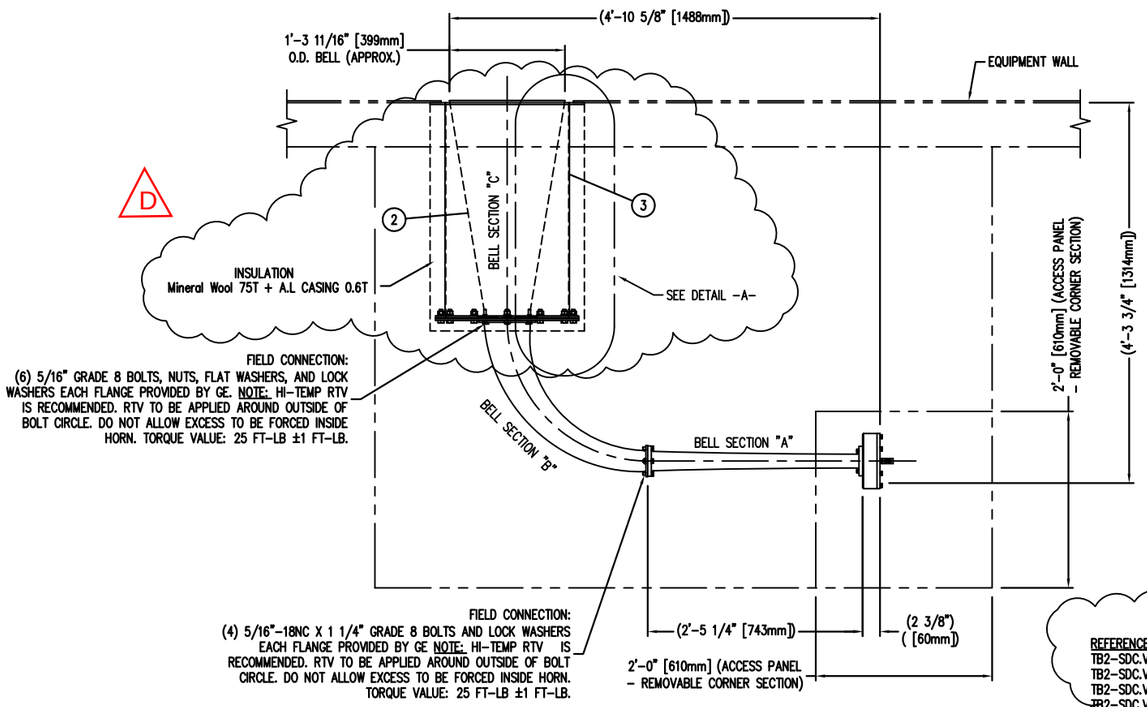
A1 (594mm x 841mm)

Attachment 4.

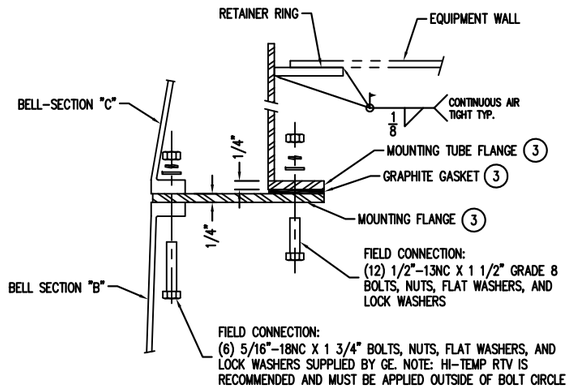
Soot Blower Installation Drawing

TB2-B-CC-DDD-MMM-FXXX

SYSTEM SPECIFICATIONS			
COMPR. AIR REQUIREMENTS	28~38 L/S @ 5~6barg	GAS TEMPERATURE	N/A
APPLICATION	SCR	OEM	N/A



PLAN VIEW



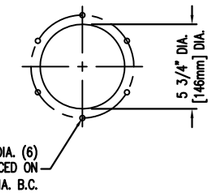
DETAIL -A-

D

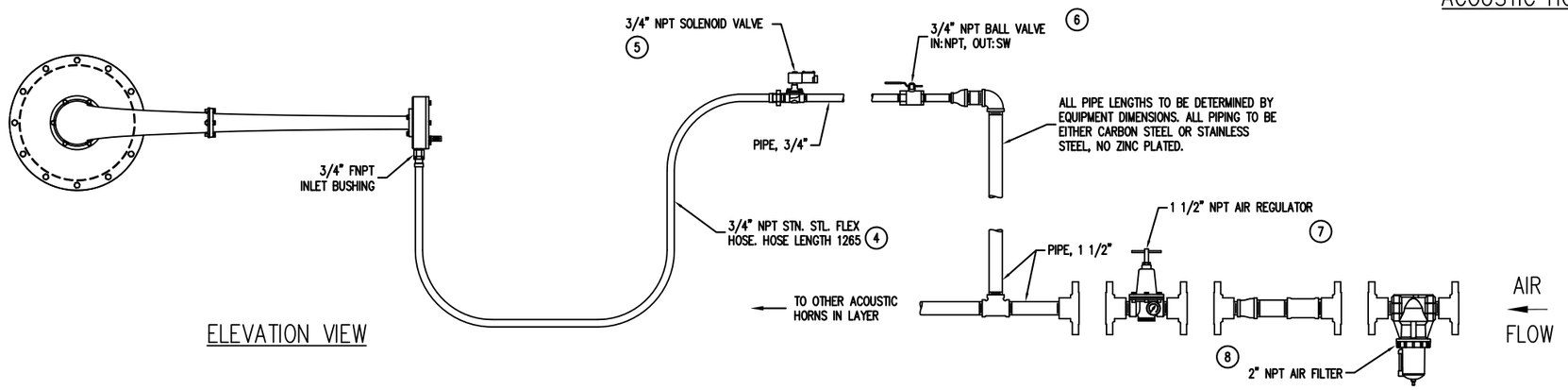
REFERENCE DRAWINGS:
TB2-SDC.VP124-00HTA-M-M1A-SPC-003-1: GENERAL ARRANGEMENT
TB2-SDC.VP124-00HTA-M-M1A-SPC-003-2: GENERAL ARRANGEMENT
TB2-SDC.VP124-00HTA-M-M1A-SPC-003-3: GENERAL ARRANGEMENT
TB2-SDC.VP124-00HTA-M-M1A-SPC-003-5: PIPING AND INSTRUMENTATION DIAGRAM - UNIT 1
TB2-SDC.VP124-00HTA-M-M1A-SPC-003-7: PIPING AND INSTRUMENTATION DIAGRAM - TAG NUMBER CHART

PLUMBING GENERAL ARRANGEMENT

NOTE: THIS IS A PICTORIAL VIEW OF SINGLE HORN PIPING, USE FOR REFERENCE ONLY. REFER TO SCHEMATIC DETAIL FOR MORE SPECIFIC INFORMATION.



BOLT HOLE PATTERN BETWEEN ACOUSTIC HORN SECTIONS B AND C



ELEVATION VIEW

REV	DATE	DESCRIPTION	PREP	CHKD	APRD	APRD
0	14 Jan.2015	FOR CONSTRUCTION	J.LEE	G.Y.OH	C.Y.YANG	H.S.LEE

DOCUMENT SUBMISSION STATUS:

NOTE:

OWNER	VIETNAM OIL AND GAS GROUP (PVN)
OWNER'S CONSULTANT	FICHTNER GmbH & Co. KG / FICHTNER / PV POWER PCC
EPC CONTRACTOR	PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PVC)
EPC CONTRACTOR'S CONSULTANT	WORLEYPARSONS
POWER ISLAND PACKAGE SUPPLIER	SOJITZ CORPORATION / DAELIM INDUSTRIAL CO., LTD.

PROJECT TITLE: THAI BINH2 THERMAL POWER PLANT 2 x 600MW

DRAWING TITLE: ACOUSTIC INSTALLTION DC-75 DETAILS

Daelim Industrial Co., Ltd.	
Job No.	110180
	A – APPROVED
	B – APPROVED WITH COMMENTS
	C – RETURNED FOR CORRECTION
	D – REJECTED
	N – NOT APPLICABLE (REFERENCE ONLY)
SIGNED BY :	DATE :

DIC'S PERMISSION TO PROCEED OR REVIEW TAKEN ON VENDOR PRINTS SHALL NOT RELIEVE VENDOR FROM ITS RESPONSIBILITIES OR LIABILITIES UNDER THE PURCHASE ORDER.

VENDOR NAME: S&T CORPORATION

FUNCTION	NAME	SIGN	DATE
DRWN	J.LEE		
CHKD	G.Y.OH		
APPD	C.Y.YANG		
APPD	H.S.LEE		

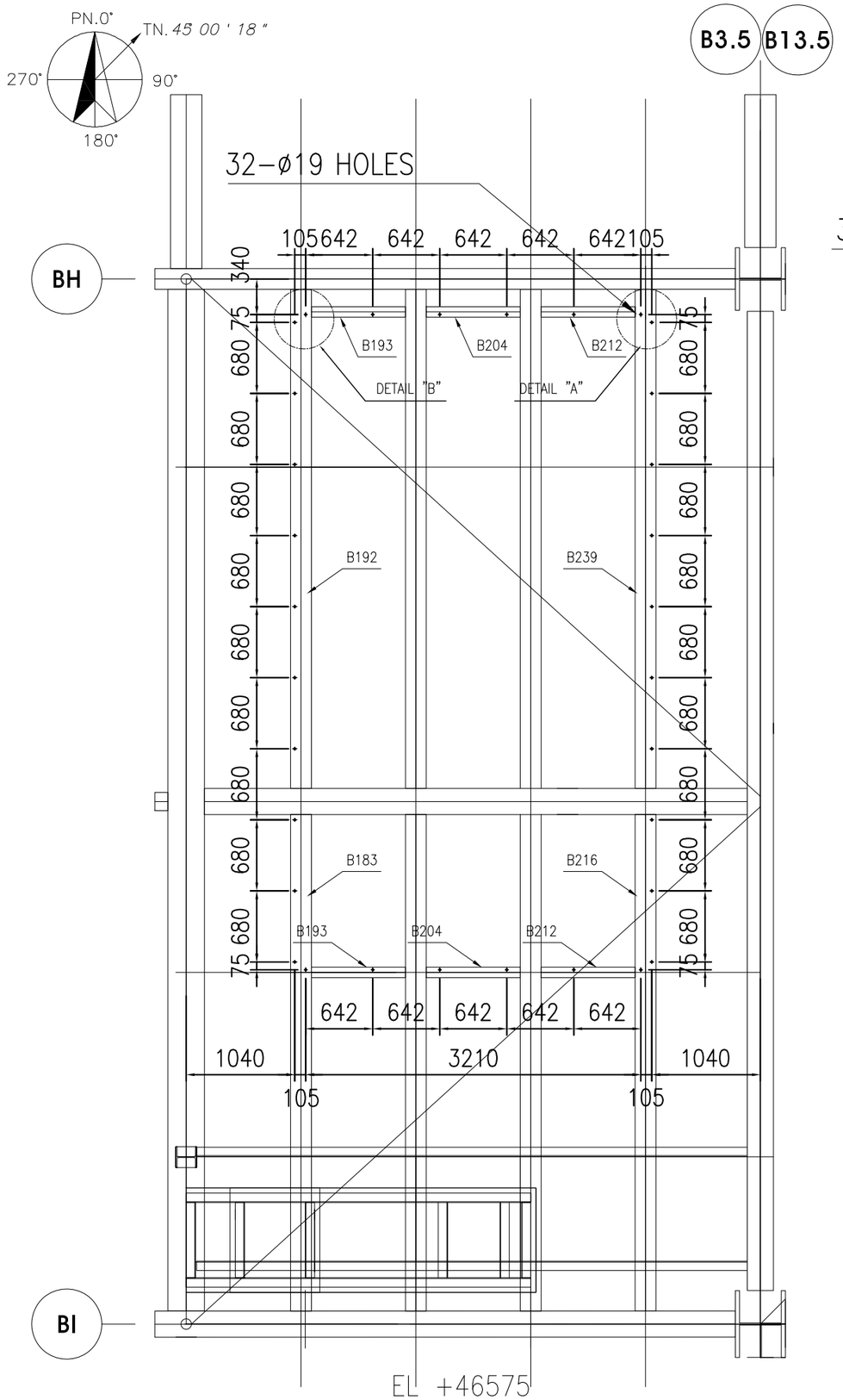
DRAWING NO. TB2-SDC.VP124-00HTA-M-M1A-SPC-003-4 | JOB NO. 110180 | SCALE 1/1 | REV.NO. 0

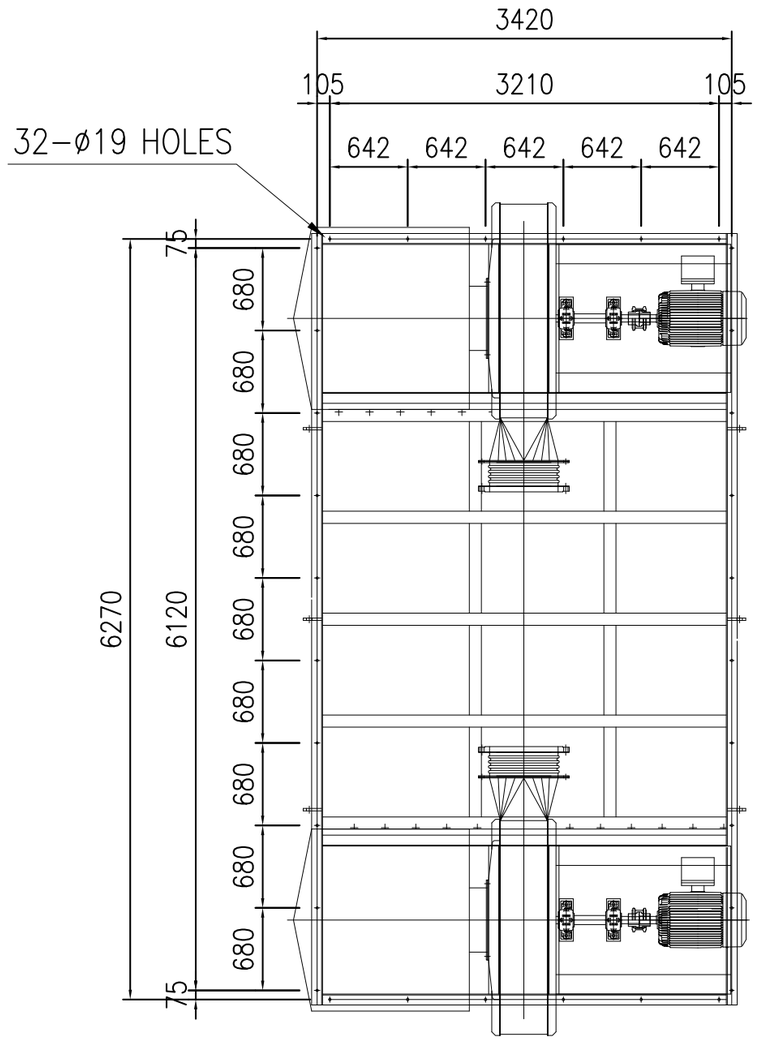
FILE NAME : TB2-B-CC-DDD-MMM-FXXX

A3 (297mm x 420mm)

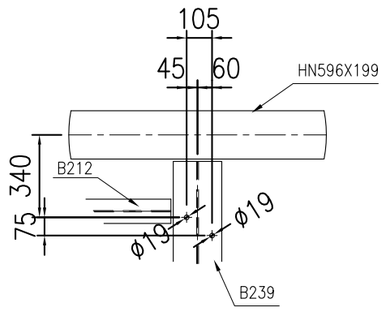
Attachment 5.

Dilution Air Blower Installation Drawing

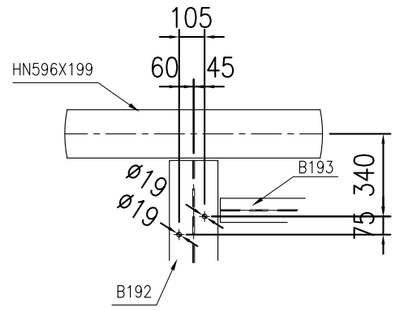




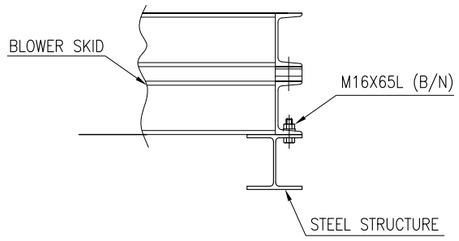
DILUTION AIR BLOWER SKID



DETAIL "A"



DETAIL "B"



CONNECTION DETAIL

Daelim Industrial Co., Ltd.	
job No.	110180
	A – APPROVED
	B – APPROVED WITH COMMENTS
	C – RETURNED FOR CORRECTION
	D – REJECTED
	N – NOT APPLICABLE (REFERENCE ONLY)
SIGNED BY :	DATE :

DIC'S PERMISSION TO PROCEED OR REVIEW TAKEN ON VENDOR PRINTS SHALL NOT RELIEVE VENDOR FROM ITS RESPONSIBILITIES OR LIABILITIES UNDER THE PURCHASE ORDER.

DOCUMENT SUBMISSION STATUS : FOR APPROVAL

NOTE:

REV	DATE	DESCRIPTION	PREP	CHKD	APRD	APRD
A	23 Dec. 2015	FOR CONSTRUCTION	S.J.HEO	S.J.KANG	G.Y.OH	S.H.YANG

OWNER: VIETNAM OIL AND GAS GROUP (PVN)

OWNER'S CONSULTANT: FICHTNER GmbH & Co. KG (FICHTNER) / PV POWER PCC

EPC CONTRACTOR: PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PVC)

EPC CONSTRACTOR'S CONSULTANT: WORLEYPARSONS

POWER ISLAND PACKAGE SUPPLIER: SOJITZ CORPORATION / DAELIM INDUSTRIAL CO., LTD.

PROJECT TITLE: THAI BINH2 THERMAL POWER PLANT 2 x 600MW

DRAWING TITLE: INSTALLATION DRAWING FOR DILUATION AIR BLOWER SKID

VENDOR NAME: S&T CORPORATION

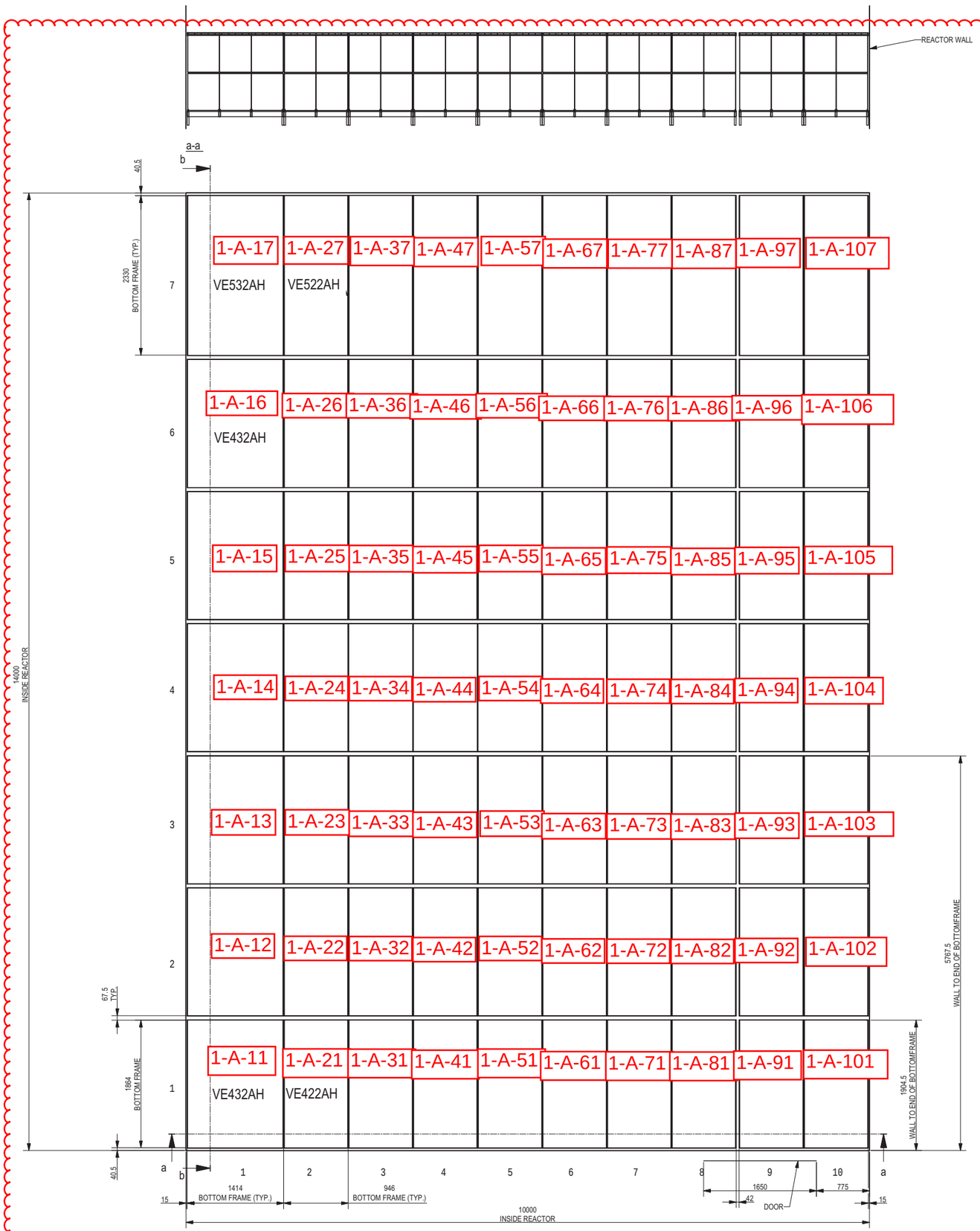
FUNCTION	NAME	SIGN	DATE
DRWN	J.LEE		2013.04.19
CHKD	G.Y.OH		2013.04.19
APPD	C.Y.YANG		2013.04.19
APPD	H.S.LEE		2013.04.19

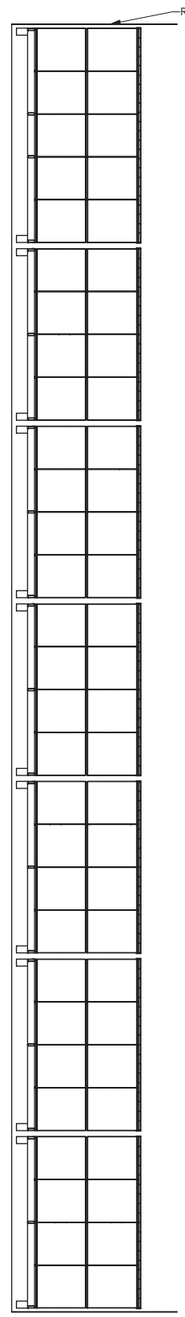
DRAWING NO. | JOB NO. 110180 | SCALE NONE | REV.NO. A | FILE NAME:

A1 (594mm x 841mm)

Attachment 6.

Catalyst Arrangement Drawing





b-b

CUSTOMER APPROVAL

Signature and Date Required. Indicate as Follows Below:

Name:

Date:

Mark One: ☐A ☐B ☐C

A: No Comment. Drawing APPROVED for fabrication
B: Comments Noted - Revise & Resubmit, Proceed with Fabrication
C: Unacceptable. Revise Drawing & Resubmit for Review or Approval

GENERAL NOTES

1) ARRANGEMENT FOR GRATING FLOOR
BEAM AND MODULE ARRANGEMENTS SHOULD BE MADE IN A WAY THAT ENSURES AS FEW BEAMS AS POSSIBLE IN THE FLOW PATH UNDER THE CATALYST.
2) TO AVOID DUST BUILD-UPS, BOX BEAMS ARE RECOMMENTED INSIDE REACTOR

REV	DESCRIPTION	DATE	DRAWN	CHECK	APP'D
1	ARRANGEMENT CHANGED	19-NOV-2013	CHSM/JTM		
A	FIRST ISSUE	19-MAR-2013	CHSM/JTM	CHSM	CHSM

HALDOR TOPSØE A/S
COPENHAGEN
DENMARK

SCALE 1:33,33 | DOC. GRP. 52
DWG SIZE A1

THAI BINH POWER PLANT
VIETNAM

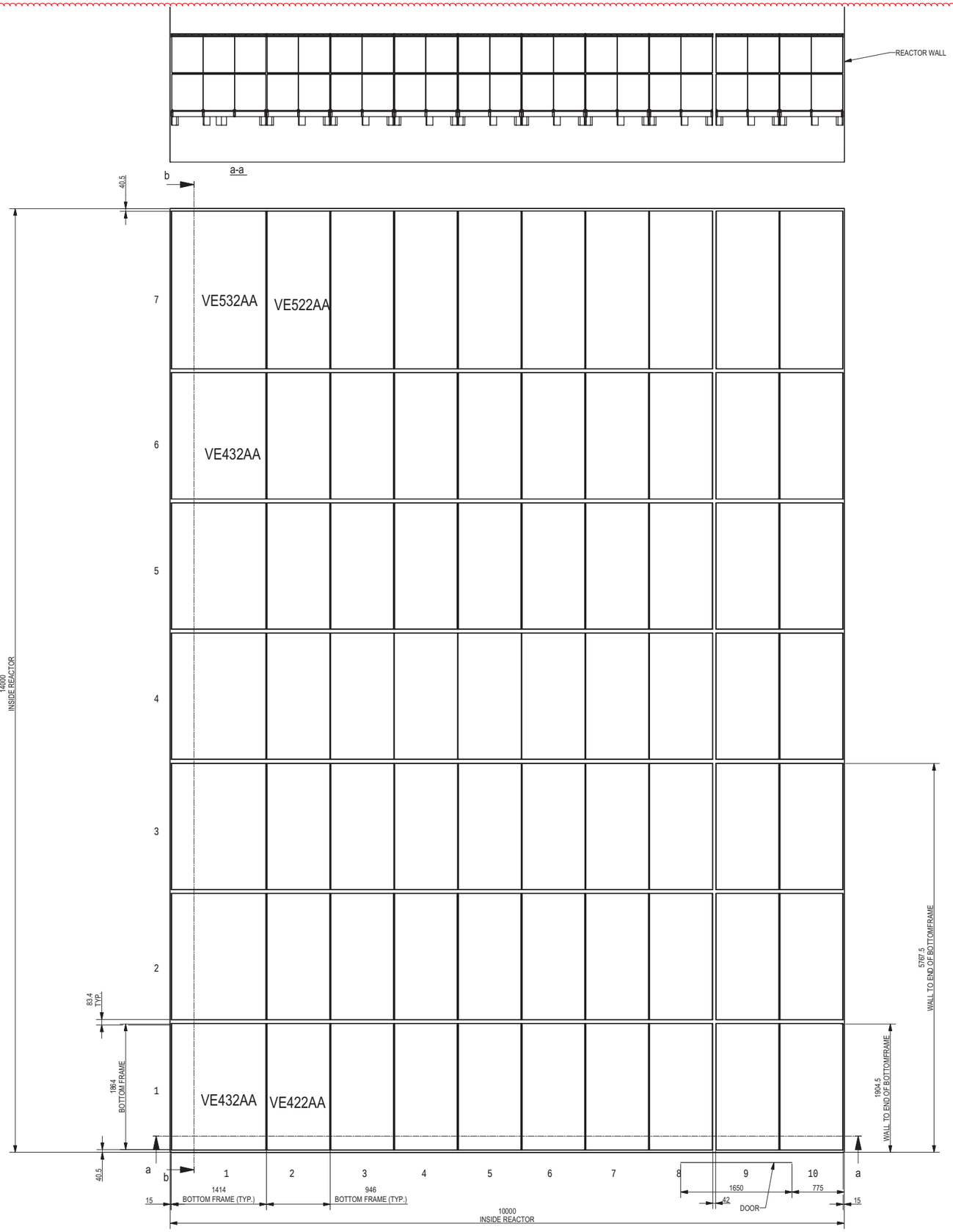
JOB NO. 13-3143 | ITEM ARRANGEMENT

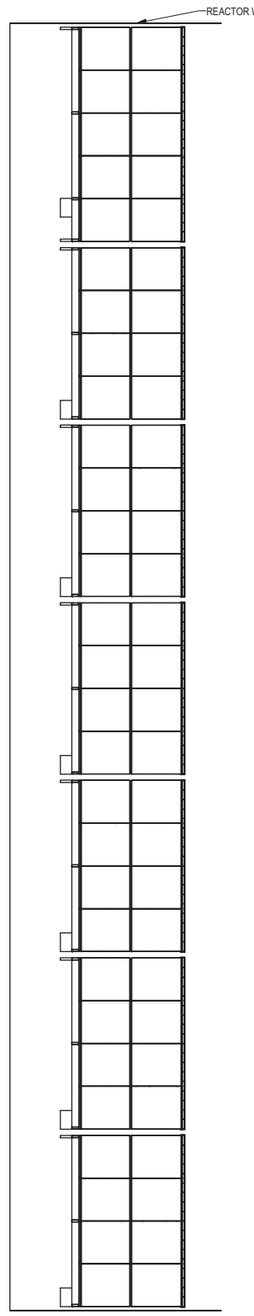
10 x 7 MODULE ARRANGEMENT
VERTICAL FLOW

DWG. NO. 1423230 | REV. 1 (V)
SHEET 1 OF 1

Attachment 7.

Catalyst Installation Drawing





CUSTOMER APPROVAL	Mark One: ☐A ☐B ☐C
Signature and Date Required. Indicate as Follows Below: Name: Date:	A: No Comment. Drawing APPROVED for fabrication B: Comments Noted - Revise & Resubmit, Proceed with Fabrication C: Unacceptable. Revise Drawing & Resubmit for Review or Approval

GENERAL NOTES

1) ARRANGEMENT FOR GRATING FLOOR
BEAM AND MODULE ARRANGEMENTS SHOULD BE MADE IN A WAY THAT ENSURES AS FEW BEAMS AS POSSIBLE IN THE FLOW PATH UNDER THE CATALYST.
2) TO AVOID DUST BUILD-UPS, BOX BEAMS ARE RECOMMENTED INSIDE REACTOR

HALDOR TOPSOE

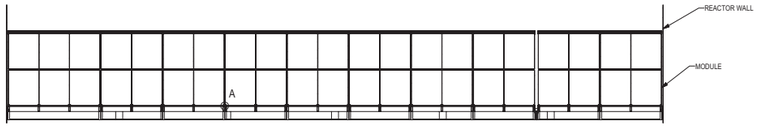
REV.	DESCRIPTION	DATE	DRAWN	CHECK	APPR.
0	Replacing drawing 1423230	Jun 21, 2016	JTM	CHSM	CHSM

Thai Binh Power Plant
S&T Corporation
Republic of Korea

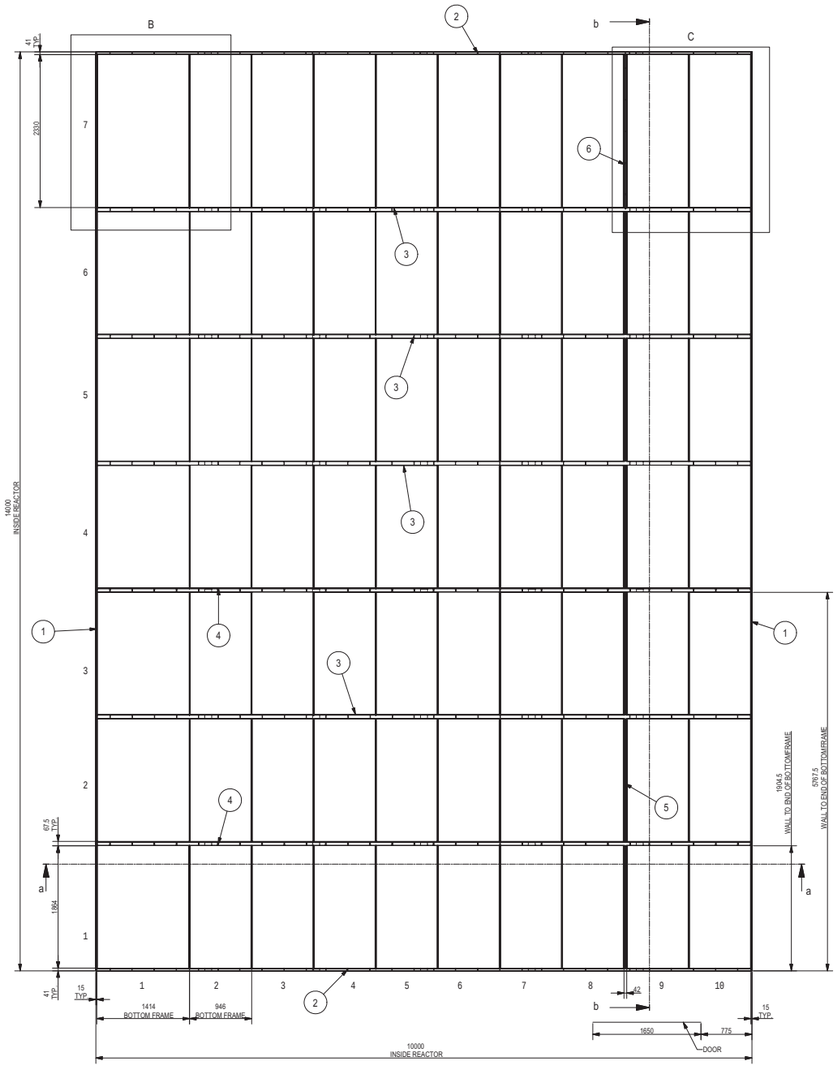
10 x 7 MODULE ARRANGEMENT
VERTICAL FLOW

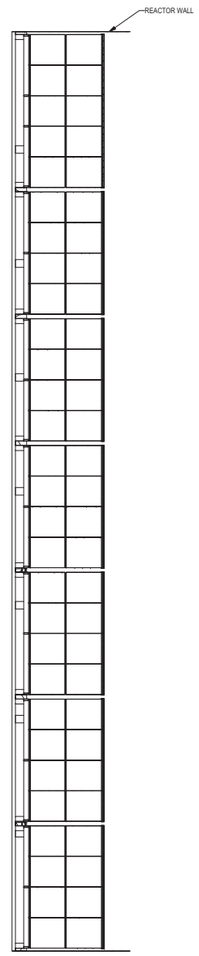
CLIENT DOC. | CLIENT REV.
DWG SIZE: A1
ITEM: ARRANGEMENT
SCALE: 1:33,33

DOCUMENT ID: 72130-13-3143 M52007-001 0
(VENDOR) (DOCUMENT NUMBER) (REV.)

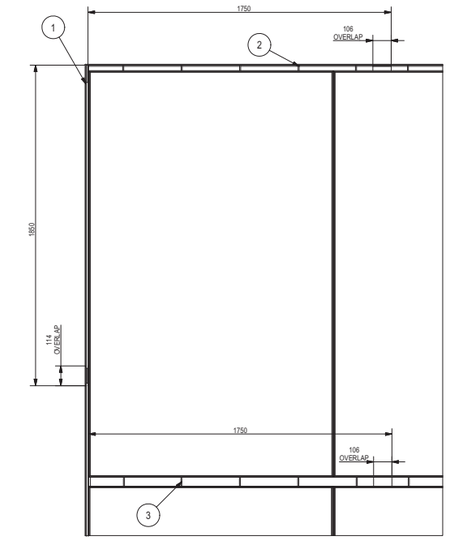


a-a

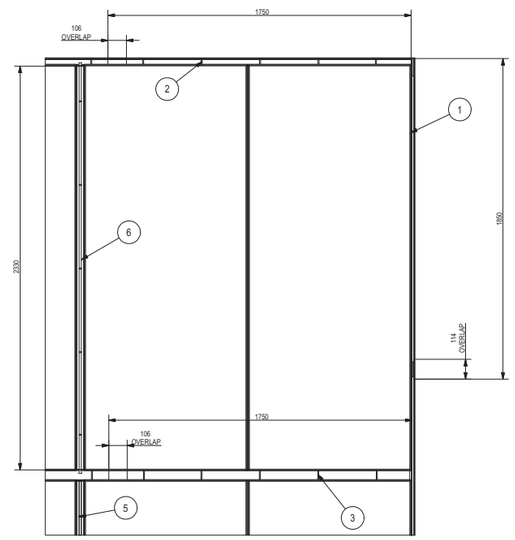




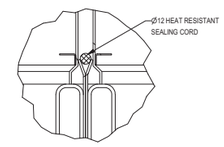
b-b (1 : 33)



B (1 : 12.5)

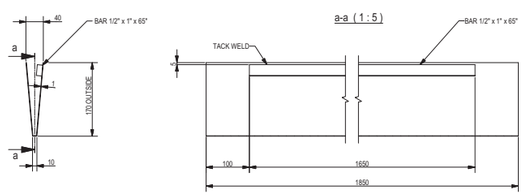


C (1 : 12.5)

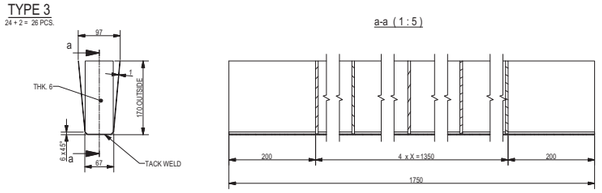


A (1 : 2)

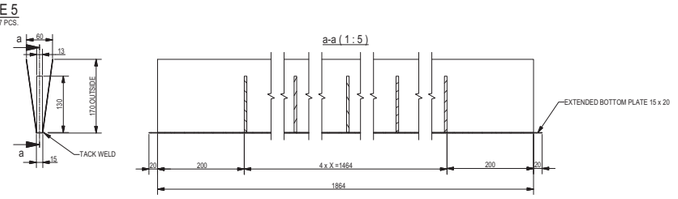
TYPE 1
16 + 2 = 18 PCS.



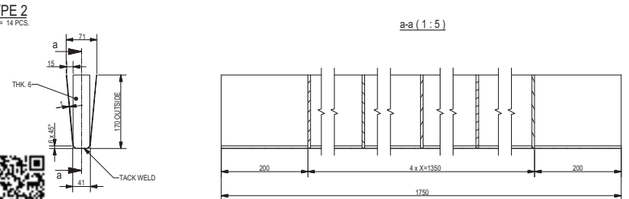
TYPE 3
24 + 2 = 26 PCS.



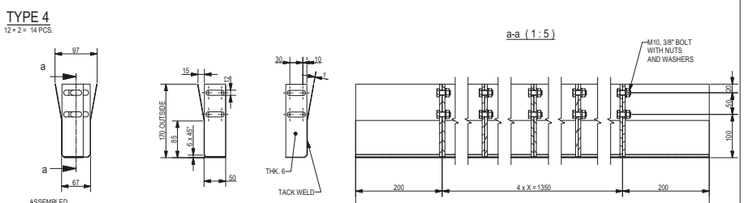
TYPE 5
6 + 1 = 7 PCS.



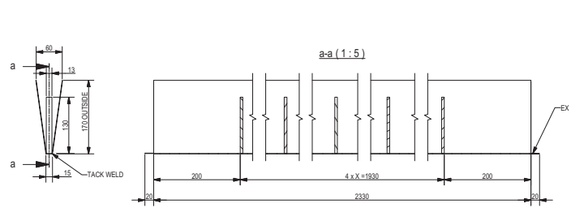
TYPE 2
12 + 2 = 14 PCS.



TYPE 4
12 + 2 = 14 PCS.



TYPE 6
1 + 1 = 2 PCS.



GENERAL NOTES

1) MATERIAL: CS COLD ROLLED ASTM A1008, S235 JRG2
2) ALL ITEMS TO BE MARKED CLEARLY WITH TYPE NO. IN WATERPROOF INK
3) A TEST OF EACH TYPE TO BE PRODUCED AND CHECKED FOR FIT BEFORE PRODUCTION OF THE LOT
4) BOLTS TO BE DELIVERED HAND TIGHTENED IN SHOWN POSITIONS (SEE ITEM DRAWING) BY SUPPLIER OF SEALING GUTTERS
5) THE BOLTS MUST BE FIRMLY TIGHTENED AFTER ADJUSTMENT ON SITE

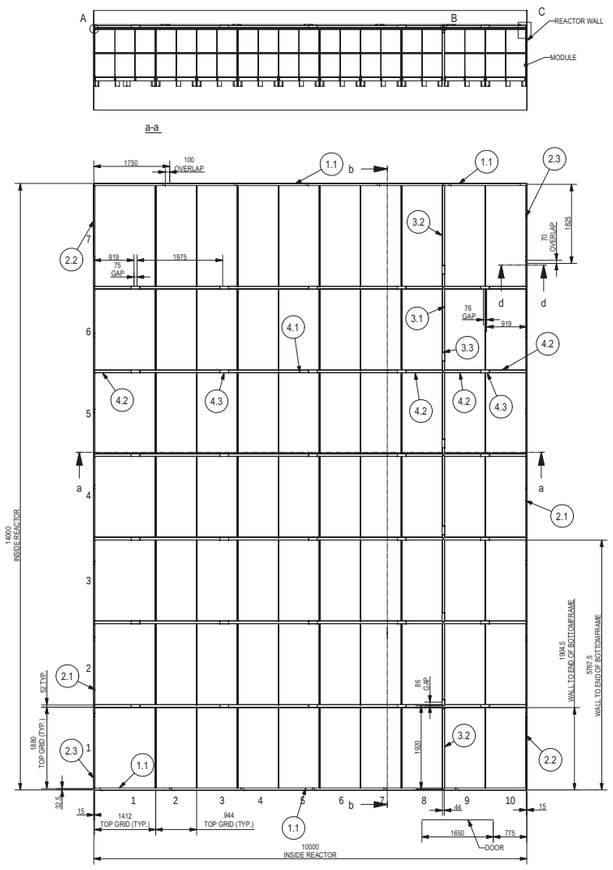
HALDOR TOPSOE

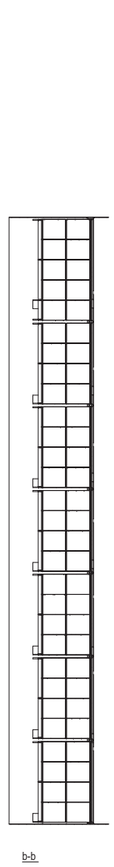
REV	DESCRIPTION	DATE	DRAWN	CHECK	APPD
0	Replacing drawing 0423427	Sep 02, 2016	JTM	-	-

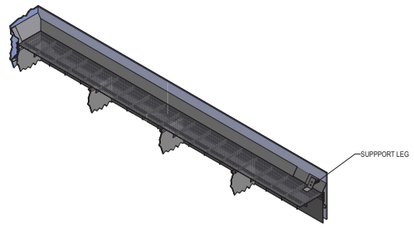
Thai Binh Power Plant
S&T Corporation
Republic of Korea
SEALING GUTTERS FOR ONE LAYER
10 x 7 CATALYST
MODULE ARRANGEMENT
AND DETAILS, VERTICAL FLOW

CLIENT DOC. | CLIENT REV.
DWG SIZE: A0 | SCALE: 1:33 | ITEM: SEALING

DOCUMENT ID: 72130-13-3143 M52010-001 0
JOB NO. | DOCUMENT NUMBER | REV.

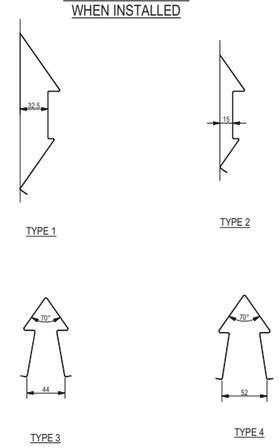






C

DETAIL DIMENSIONS WHEN INSTALLED



TYPE 1

TYPE 2

TYPE 3

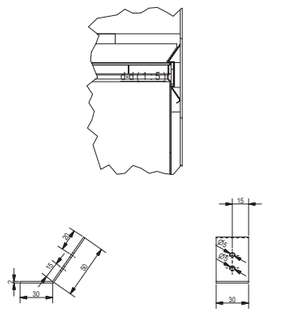
TYPE 4

SUPPORT LEG

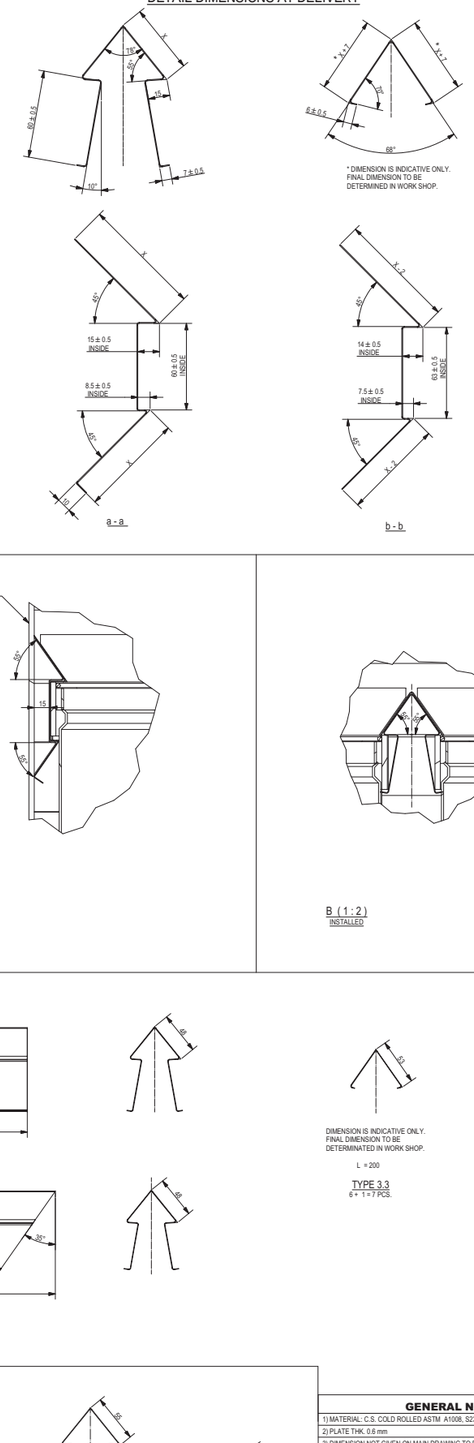
26 + 3 = 29 PCS

70 PCS SELF TAPPING METAL PLATE SCREWS FOR SUPPORT LEGS.

(-THREAD DIAMETER LESS THAN 5mm,
- HEAD DIAMETER MORE THAN 6mm
- LENGTH BETWEEN: 15-30mm)



DETAIL DIMENSIONS AT DELIVERY



* DIMENSION IS INDICATIVE ONLY. FINAL DIMENSION TO BE DETERMINED IN WORK SHOP.

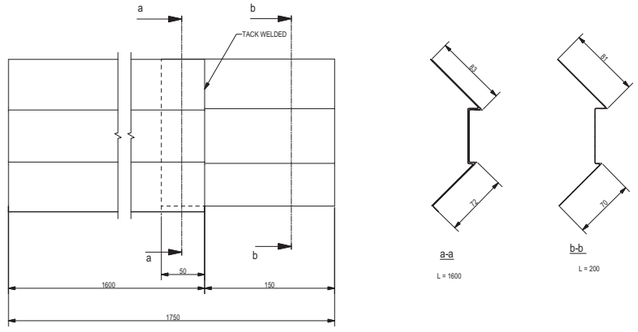
a - a

b - b

A (1 : 2)
INSTALLED

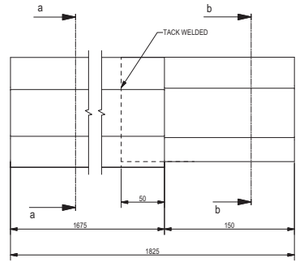
B (1 : 2)
INSTALLED

TYPE 1
1 : 2.5
PLATE THK.= 0.6mm

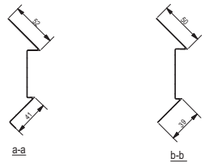


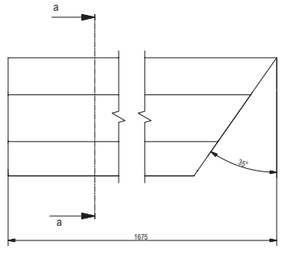
TYPE 1.1
12 + 2 = 14 PCS.

TYPE 2
1 : 2.5
PLATE THK.= 0.6mm

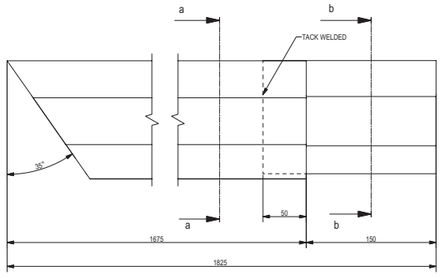


TYPE 2.1
12 + 2 = 14 PCS.





TYPE 2.2
2 + 1 = 3 PCS.



TYPE 2.3
2 + 1 = 3 PCS.

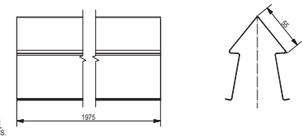
TYPE 3
1 : 2.5
PLATE THK.= 0.6mm

TYPE 3.1
5 + 1 = 6 PCS.

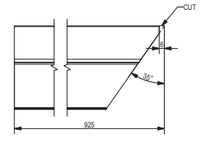
TYPE 3.2
2 + 1 = 3 PCS.

TYPE 3.3
6 + 1 = 7 PCS.

TYPE 4
1 : 2.5
PLATE THK.= 0.6mm



TYPE 4.1
18 + 2 = 20 PCS.



TYPE 4.2
24 + 2 = 26 PCS.

TYPE 4.3
30 + 2 = 32 PCS.

DIMENSION IS INDICATIVE ONLY. FINAL DIMENSION TO BE DETERMINATED IN WORK SHOP.

L = 200

GENERAL NOTES

1) MATERIAL: C.S. COLD ROLLED ASTM A1008, S235JRG2
2) PLATE THK. 0.6 mm
3) DIMENSION NOT GIVEN ON MAIN DRAWING TO BE FOUND IN DETAIL DIMENSIONS
4) A TEST OF EACH TYPE TO BE PRODUCED AND CHECKED FOR FIT/ ASSEMBLING BEFORE PRODUCTION OF THE LOT
5) ALL ITEM TO BE CLEARLY MARKED WITH TYPE NO. IN WATERPROOF INK.
6) BENDING TOOL SIZE 5 (R=~1.5mm)

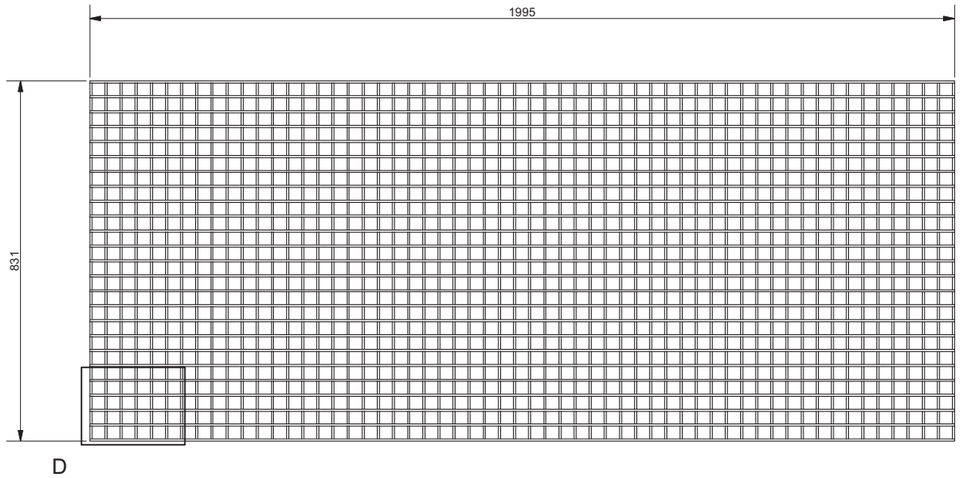
HALDOR TOPSOE

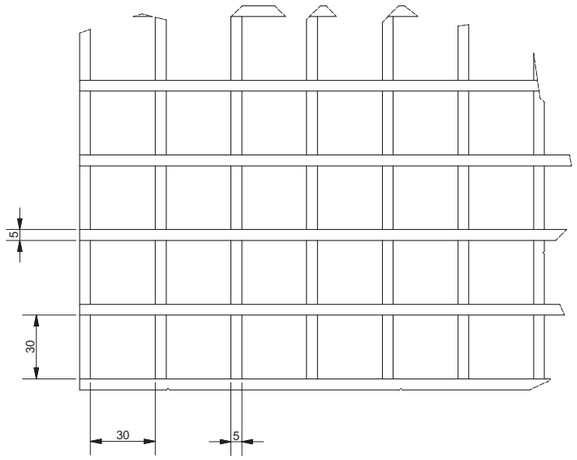
REV	DESCRIPTION	DATE	DRAWN	CHECK	APPD
0	Replacing drawing 0423426	Sep 02, 2016	JTM	CHSM	CHSM

Thai Binh Power Plant
S&T Corporation
Republic of Korea
DUST DEFLECTION SYSTEM FOR ONE LAYER 10 X 7 MODULE ARRANGEMENT AND DETAILS VERTICAL FLOW

CLIENT DOC.
CLIENT REF.
DWG SIZE: A0
SCALE
ITEM: DUST HOODS

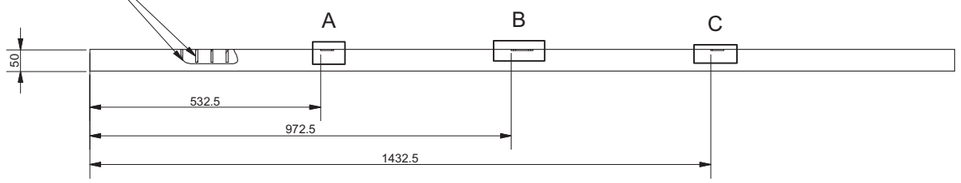
DOCUMENT ID
72130-13-3143 M52009-001 0



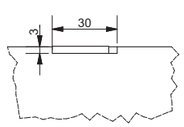


D (1 : 2)

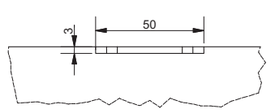
GRATING TYPE
BEARING BARS 50X3mm.
CROSS BARS. 14pc 30X3mm and 45pc 15X3mm



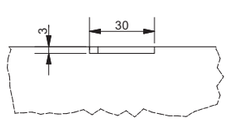
WELD SLOT FOR FIXING GRATINGS TOGHETHER WHEN INSTALLED.
ONLY AT THE LONG SIDES OUTHER BARS (2 BARS IN TOTAL)



A (1 : 2)



B (1 : 2)



C (1 : 2)

HALDOR TOPSØE

REV	DESCRIPTION	DATE	DRAWN	CHECK	APPD.
0	First issue	Aug 26, 2016	JTM	CHSM	CHSM

Thai Binh Power Plant
S&T Corporation
Republic of Korea
Grating

CLIENT DOC. | CLIENT REV.

DWG SIZE: A2
SCALE: 1 : 10
ITEM: Grating

DOCUMENT ID
72130-13-3143 JOB NO.
M52011-002 DOCUMENT NUMBER
0 REV.
(V)