

Số: 226 /NMĐTB2-KTATMT

Thái Bình, ngày 05 tháng 02 năm 2025

V/v cung cấp báo giá vật tư chất xúc tác cho hệ
thống SCR – NMNĐ Thái Bình 2.

Kính gửi: Các Nhà cung cấp

Chi nhánh Phát điện Dầu khí/Nhà máy Nhiệt điện Thái Bình 2 (NMNĐ Thái Bình 2) đang có nhu cầu triển khai mua sắm vật tư chất xúc tác (Catalyst) cho hệ thống khử NOx (SCR). Được biết Quý Công ty là đơn vị có năng lực, kinh nghiệm trong việc cung cấp vật tư/thiết bị cho các Nhà máy nhiệt điện. Do đó, đề nghị Quý Công ty quan tâm, xem xét và 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.
 - 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 14/02/2025.
 - 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@pvpgeb.vn; hungbb@pvpgeb.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);
- GD 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



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 các khối chất xúc tác và thay thế cho các vị trí bị hư hỏng tại Hệ thống SCR nhánh A Tổ máy S1 - NMNĐ Thái Bình 2"
(Đính kèm theo Công văn số 226 /NMĐTB2-KTATMT ngày 05 /02/2025)

Stt	Tên Vật tư	Yêu cầu kỹ thuật		Tài liệu tham chiếu	Đơn vị	Số lượng	Hãng sản xuất	Chủng loại	Ghi chú
		Kích thước bao (mWxmLxmH)	Yêu cầu/thành phần hóa học						
1	Khối xúc tác cho hệ thống SCR: VE532AH	2.346x1.410x1.356	+ Thành phần hóa: - Vanadium Pentoxide: 0,1~4% - Tungsten Trioxide: 1~7% - Silicon Dioxide: 15~25% - Kaolim: 13~23% - Titanium dioxide: 40~50% - Fibers: 8~12%	TB2-SDC.VP124-00100-M-M1A-DAS-0002 TB2-SDC.VP124-00100-M-M1A-DRD-0101	Module	3	Haldor Topsoe (Denmark)	Corrugated-Honeycomb	Mỗi Module bao gồm cả chân đỡ và lưới bảo vệ
2	Khối xúc tác cho hệ thống SCR: VF522AH	2.346 x 946 x 1.356	+ Nhiệt độ làm việc (Min/Max): 325°C/450°C + Nhiệt độ cho phép (Min/Max): 315°C/500°C; + Khoảng thời gian làm việc tại nhiệt độ cho phép (Min/Max): 8 giờ + Tỷ trọng Catalyst: 0.2g/cm2		Module	27	Haldor Topsoe (Denmark)	Corrugated-Honeycomb	Mỗi Module bao gồm cả chân đỡ và lưới bảo vệ
3	Khối xúc tác cho hệ thống SCR: VE432AH	1.880 x 1.410 x 1.356			Module	18	Haldor Topsoe (Denmark)	Corrugated-Honeycomb	Mỗi Module bao gồm cả chân đỡ và lưới bảo vệ
4	Khối xúc tác cho hệ thống SCR: VE422AH	1.880 x 946 x 1.356			Module	162	Haldor Topsoe (Denmark)	Corrugated-Honeycomb	Mỗi Module bao gồm cả chân đỡ và lưới bảo vệ
5	Dịch vụ thay thế các khối chất xúc tác bị hư hỏng.	- Chuẩn bị biện pháp thi công, công cụ dụng cụ cần thiết; - Tháo các khối chất xúc tác hư hỏng đưa về kho tại Nhà máy theo Chỉ định; - Thay thế/lắp đặt các khối chất xúc tác vào vị trí mới, hàn lại các tấm chèn; - Vệ sinh, nghiệm thu công việc		TB2-SDC.VP124-00100-M-M1A-SIN-0001	Module	210			Sử dụng tài nâng sẵn có tại Nhà máy

Ghi chú: Các tài liệu đính kèm phạm vi công việc: TB2-SDC.VP124-00100-M-M1A-DAS-0002; TB2-SDC.VP124-00100-M-M1A-DRD-0101





DOCUMENT SUBMISSION STATUS: FC

NOTE:

ISSUE TO PVC
FOR FINAL

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				
REV.	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	APPROVED			
OWNER			OWNER'S CONSULTANT						
 VIETNAM OIL AND GAS GROUP (PVN)			 FICHTNER GmbH & Co. KG				 PV POWER PCC		
EPC CONTRACTOR			EPC CONSTRUCTOR'S CONSULTANT						
 PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PVC)			 WORLEYPARSONS						
POWER ISLAND PACKAGE SUPPLIER									
									
PROJECT TITLE			DAELIM INDUSTRIAL CO., LTD						
DRAWING / DOCUMENT TITLE			THAI BINH 2 THERMAL POWER PLANT 2 x 600MW						
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:



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,		Noted		
3	then vendor should submit revised VP reflecting their comments een though current final result is 'A'				
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/Nm ³
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 ₂ O
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





2. Predicted Performance
2.1 Performance Coal

Description	Performance coal										TOP HEATER OFF	ALL HP HEATER OFF
	BMCR	TCC	RO	75%RO	60%RO	50%RO	45%RO	30%RO				
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	1,210,863 /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	1,221,132 /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	1,221,132 /1,138,308	1,251,869 /1,166,943	
B. Flue Gas Flow Rate, Wet/Dry (Nm³/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	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	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	917,534 /854,885	940,613 /876,292	
C. Flow Gas Flow Rate/Temperature (Am³/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	2,214,208 /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	2,231,728 /381	2,268,322 /375	
3) SCR reactor	2,333,157 /390	2,232,543 /384	2,187,884 /383	1,734,455 /365	1,491,450 /354	1,330,427 /344	1,224,557 /336	934,420 /309	2,231,862 /381	2,231,862 /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	2,245,768 /381	2,282,939 /375	
D. Flue Gas Pressure (mmH₂O)												
1) SCR inlet terminal point	-146.90	-138.10	-133.50	-93.30	-74.40	-63.40	-56.80	-40.70	-139.10	-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	-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	-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	-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	-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	-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	-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	-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	-241.50	-249.50	
E. Flue Gas Velocity (Theoretical, msec)												
1) SCR inlet duct	16.0	15.5	15.2	12.0	10.3	9.2	8.4	6.4	15.5	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	4.5	4.6	
3) In catalyst layer	5.8	5.5	5.4	4.3	3.7	3.3	3.0	2.3	5.5	5.5	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	11.1	11.3	
F. Ammonia Consumption as 99.5% concentration (Based on 499.4mg/Nm³ NOx emission at SCR system outlet),(kg/hr)												
1) per SCR reactor	223	216	212	162	132	113	103	75	216	216	222	
2) per Unit	446	431	423	323	264	225	207	150	433	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 /NO _x) ratio (Based on 499.4mg/Nm ³ NO _x 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. / °C)		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 ₂ O g)		250	250	250	250	250	250	250	250	250	250
3) NH ₃ concentration(vd%)		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 ₂ O	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 ₂ O	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) ₂ SO 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 ₄ HSO ₄ (mg/Nm ³)	8.76	8.76	8.76	8.74	8.73	8.72	8.71	8.7	8.76	8.76	



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. Zunits)	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										TOP HEATER OFF	ALL HP HEATER OFF
	BMCR	TCC	RO	75%RO	60%RO	50%RO	45%RO	30%RO				
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 /546,943	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 /546,943	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 /838,315	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 /362	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	2,242,688 /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 ₂ O)												
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		



Description	Worst Coal											ALL HP HEATER OFF
	BMCR	TCC	RO	75%RO	60%RO	50%RO	45%RO	30%RO	TOP 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 NO _x 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. / °C)	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 ₂ O.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 ₂ O	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 ₂ O	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) ₂ SO 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 ₄ HSO ₄ . (mg/Nm ³)	8.84	8.84	8.84	8.82	8.80	8.78	8.78	8.76	8.84	8.84		



Description		Worst Coal								TOP HEATER OFF	ALL HP HEATER OFF
		BMCR	TCC	RO	75%RO	60%RO	50%RO	45%RO	30%RO		
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 (°C)	400
4) Design Pressure, Positive/Negative (barg)	±0.087 (at Transient)
5) Design Velocity, Reactor/Catalyst (m/sec)	4.89 / 6.65
6) Materials(AS TM)/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% Kaolin, 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.(°C)	325°C / 450°C
14) Allowable temperature, min./max.(°C)	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 ₂ O)	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 (°C/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 ² g)	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 ₂ O.g)	Approx. 250
5) Pressure drop through AIG, (mmH ₂ O.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, (°C)	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, (°C)	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, (°C)	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	Sankwang PS
5) Max. flow rate, (Am ³ /hr)	2,331,526
6) Damper driver type	Electric
7) Operating gas temperature, max/min, (°C)	392 / 311
8) Design temperature, (°C)	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	Sankwang PS
5) Max. flow rate, (m ³ /hr)	2,364,894
6) Damper driver type	Electric
7) Operating gas temperature, max/min, (°C)	390 / 308
8) Design temperature, (°C)	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, (°C)	356 / Boiler Start-up
8) Design temperature, (°C)	420
9) Maximum pressure drop at full open, (mmH ₂ O.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 ₂ O)	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 (°C)	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	
b) Frame / thickness (mm)	E-Glass Fiber / 12	
	Wire Insert Glass Fiber Fabric / 2.4	
	A36 / 9	
	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 (°C)	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
	Teflon 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 (°C)	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 (E-J-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
	Teflon 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 (°C)	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 °C	105.057 / 180.2
7) Design temperature(°C) / pressure (bar.g)	55 / 22
8) Max. operating temp. (°C) / 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	Croten
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.(°C) / 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 (°C)	55 / 80
8) Inflow ammonia pressure, min / max (bar.g)	4.2 / 13.8
9) Inflow ammonia temp. min / max (°C)	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 (°C)	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(Performance 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. (°C) / pressure(bar.g)	55 / 22
7) Operating temp. (°C) / pressure(bar.g)	40 / 13.8
8) Inlet ammonia temp. (°C) / 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 ₂ O.g)	273 / 650
5) Design pressure (mmH ₂ O.g) / temperature, (°C)	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 ₂ O)	15
8) Shut – off head (mH ₂ O)	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)	Thickness(mm)	Material	Type (Ribbed or Flat)	Minimum Thickness (mm)
Inlet Duct	Calcium Silicate / Mineral Wool	80	150	Aluminum	Ribbed	1.2 / 0.6
	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
	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
	Mineral Wool	80	50	A240 TP304	Flat	0.8
Vaporizer	Mineral Wool	80	50	Aluminum	Flat	0.6
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°C/ +60hPa
l) Sample moisture / dust requirement	max.96%F/>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°C/ +60hPa
l) Sample moisture / dust requirement	max.96%F/>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°C/ 50~50mbar
l) Sample moisture / dust requirement		max.96%F/>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 Outlet
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°C/ +120hPa
l) Sample moisture / dust requirement		max.96%F/>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
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			
Pressure Gauge	4 SETS	Bourdon	WISE / P2586A3EDH05030
Low Pressure Gauge	10 SETS	CHAMBER	WISE / P4214A4EDJZZ30
Pressure Gauge	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 II C T6
e) Material and Thickness	Cast Aluminium Alloy/50mm
f) Power consumption, watt	1,000
g) Heat Disspation, cal/h	N/A



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NOTE:									
0	4. Jun. 2018	For Approval		G.Y.OH	G.Y.OH		S.H.YANG		
REV.	DATE	DESCRIPTION		DRAWN	CHECKED	APPROVED	APPROVED		
OWNER			OWNER'S CONSULTANT						
			 FICHTNER GmbH & Co. KG						
VIETNAM OIL AND GAS GROUP (PVN)			PVPOWER PCC						
EPC CONTRACTOR			EPC CONTRACTOR'S CONSULTANT						
			 WORLEYPARSONS						
PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PVC)									
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:									
				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			
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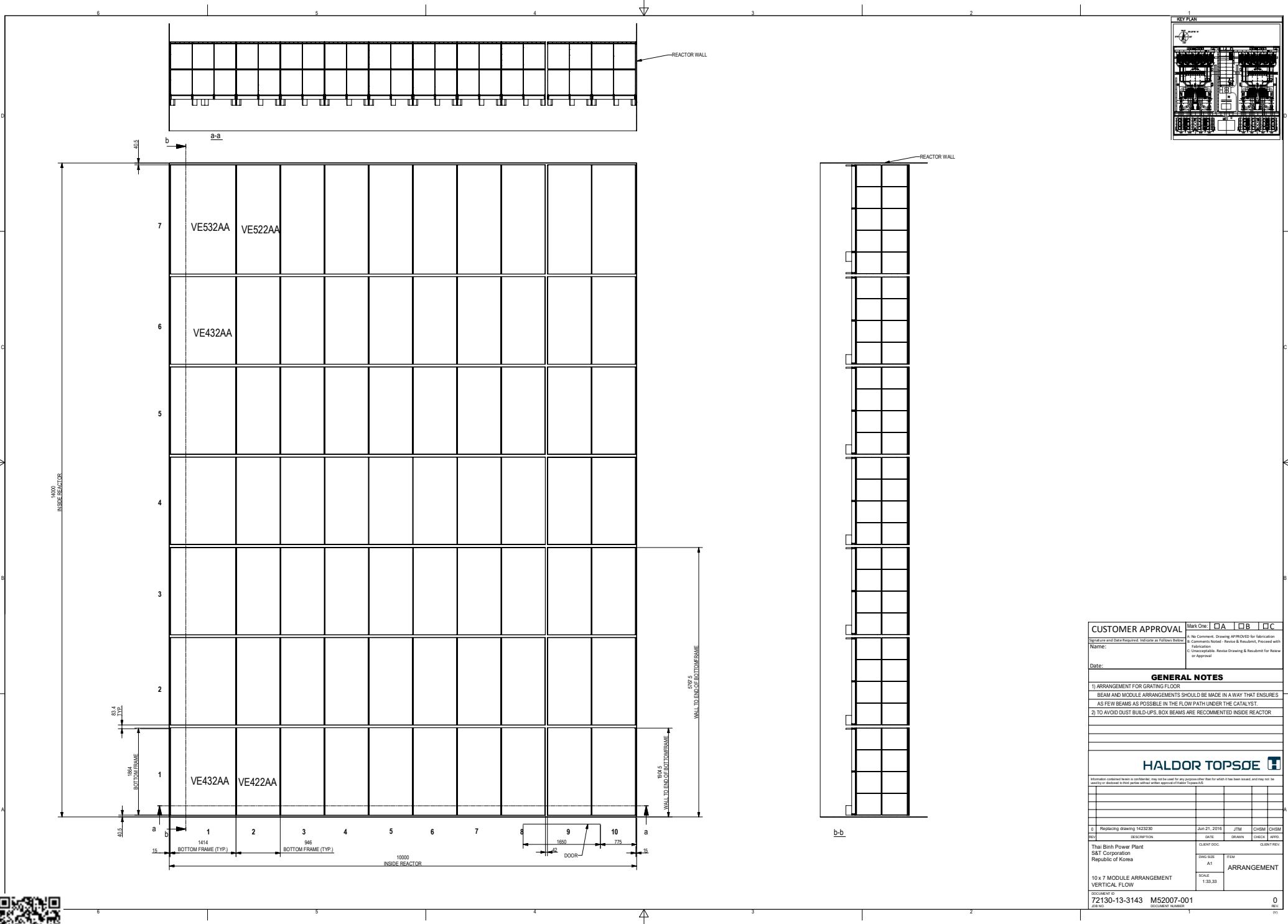
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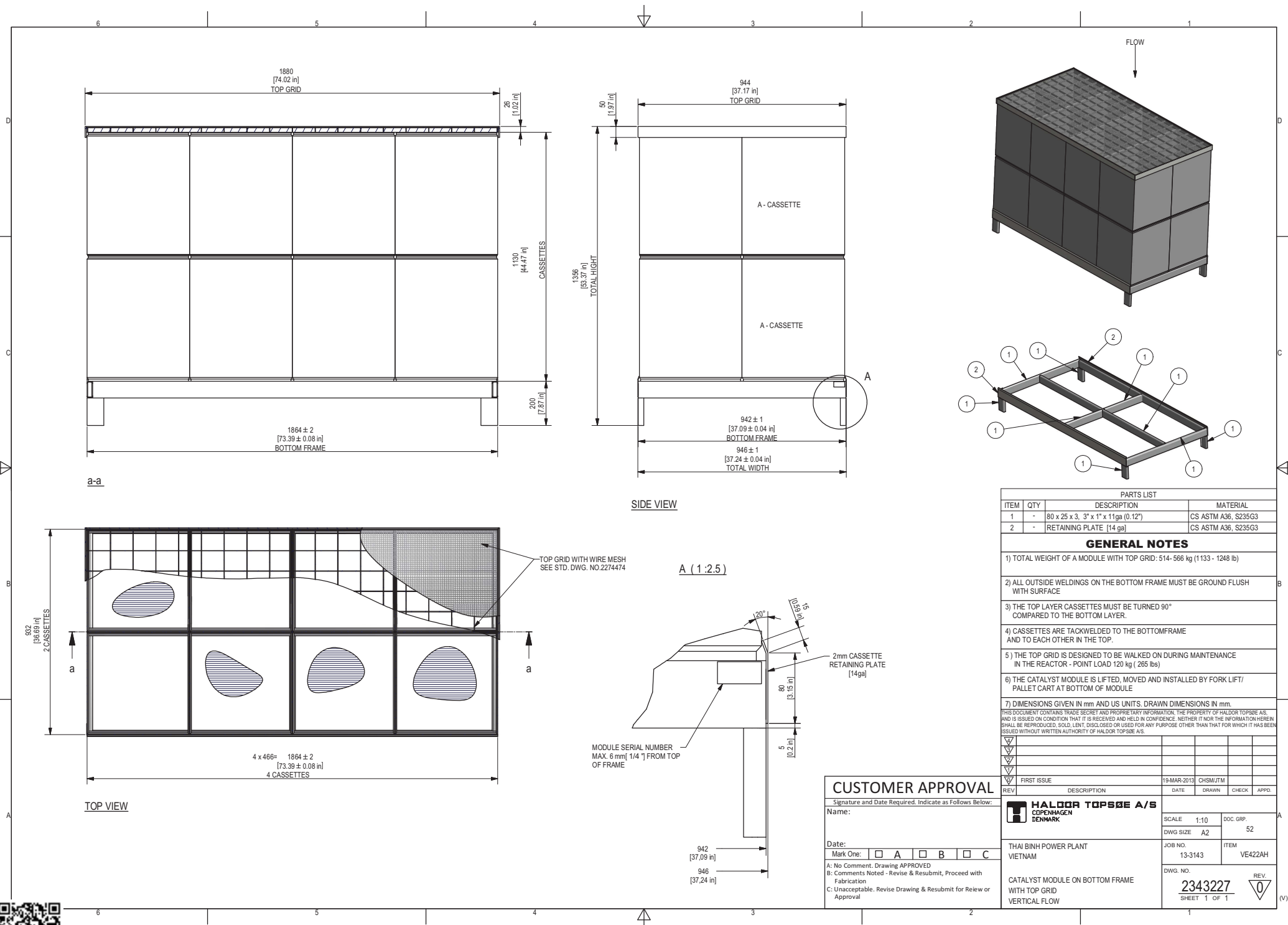
Daelim Industrial Co., Ltd.	
Job No.	110180
	A - APPROVED
	B - APPROVED WITH COMMENTS
	C - RETURNED FOR CORRECTION
	D - REJECTED
	N - NOT APPLICABLE(REFERENCE ONLY)
SIGNED BY :	DATE :
DIC'S PERMISSION TO PROCEED OR REVIEW TAKEN ON VENDOR PRINTS SHALL NOT RELIEVE VENDOR FROM ITS RESPONSIBILITIES OR LIABILITIES UNDER THE PURCHASE ORDER.	

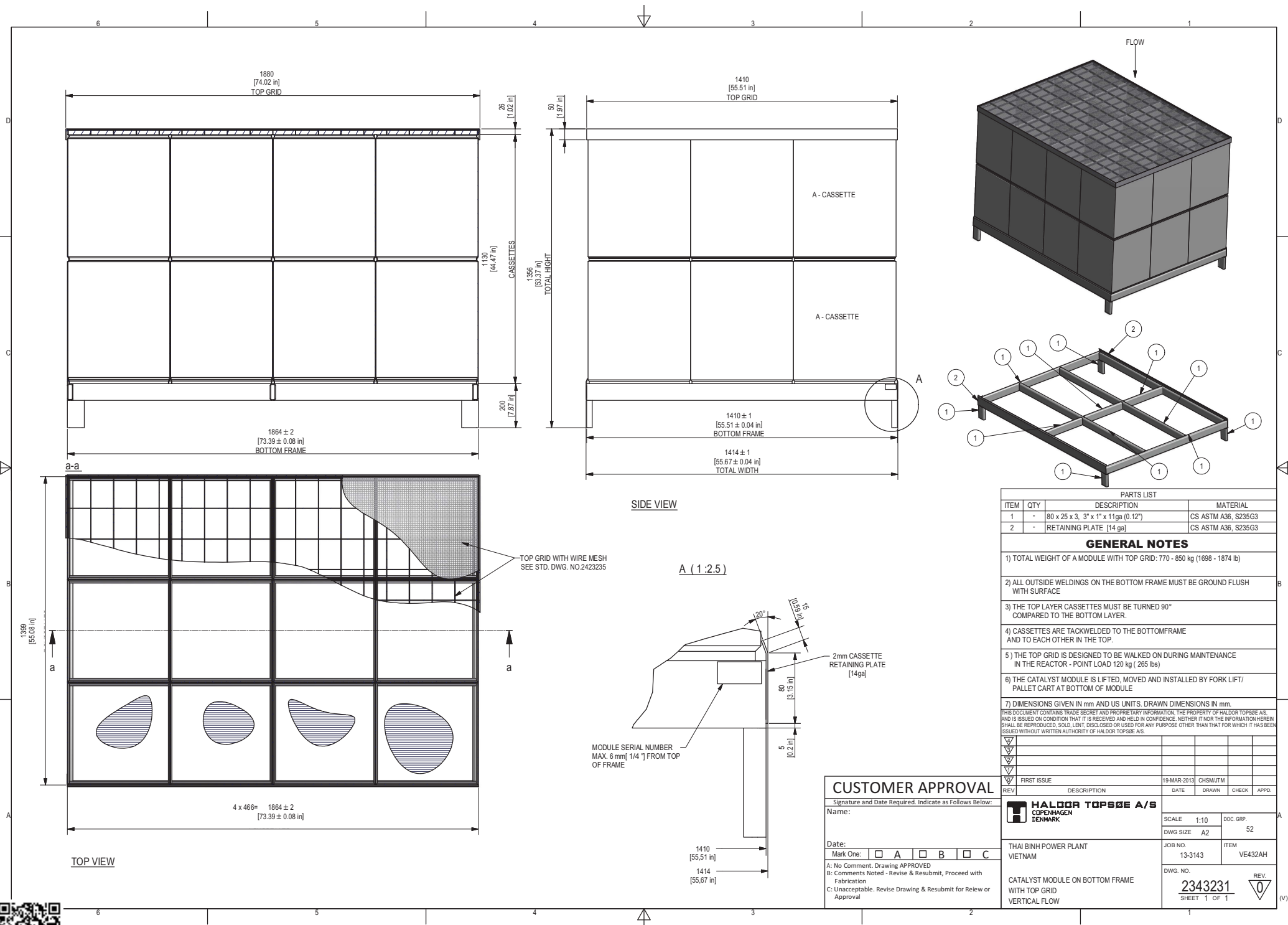
VENDOR'S LOGO:

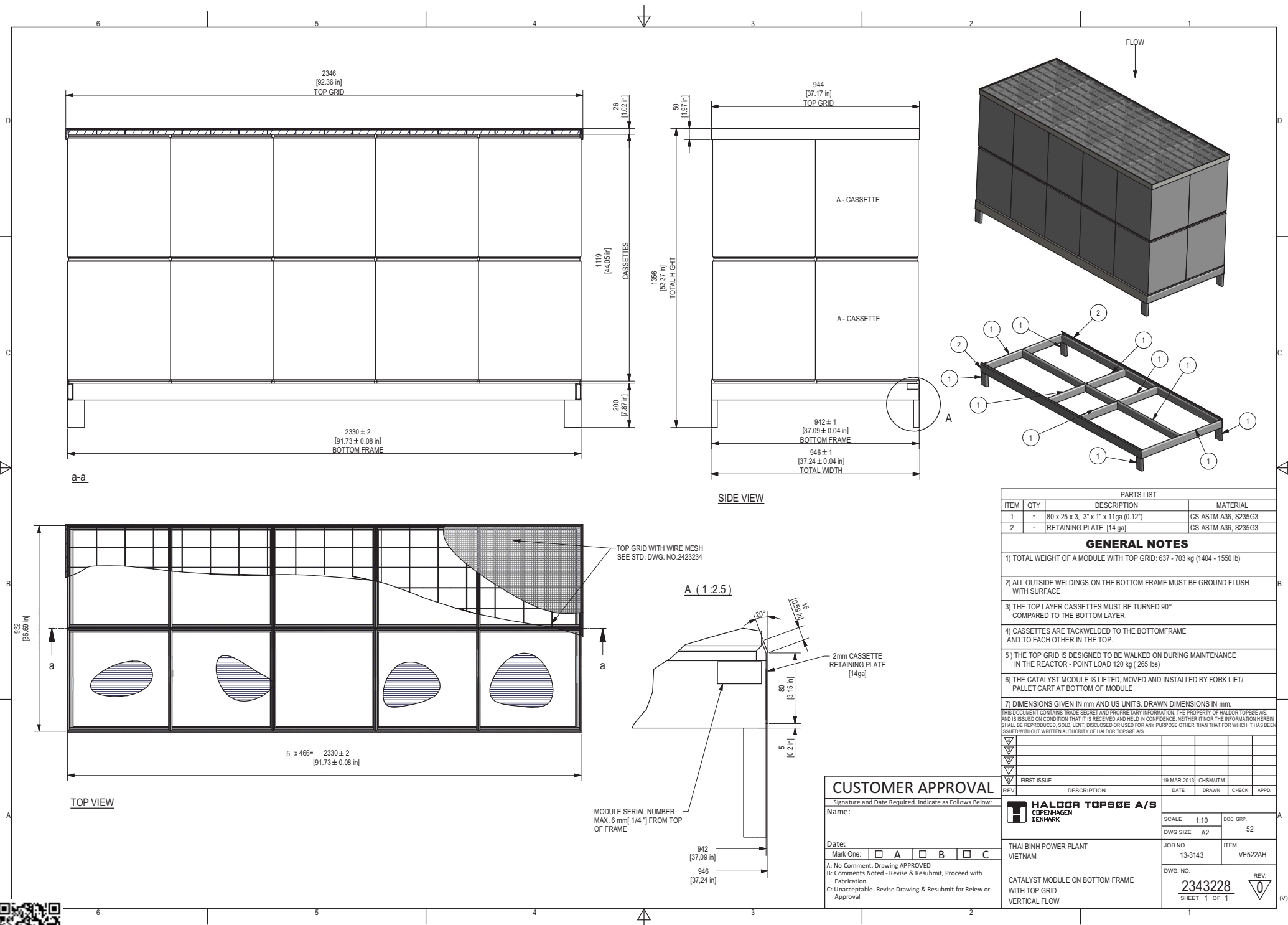


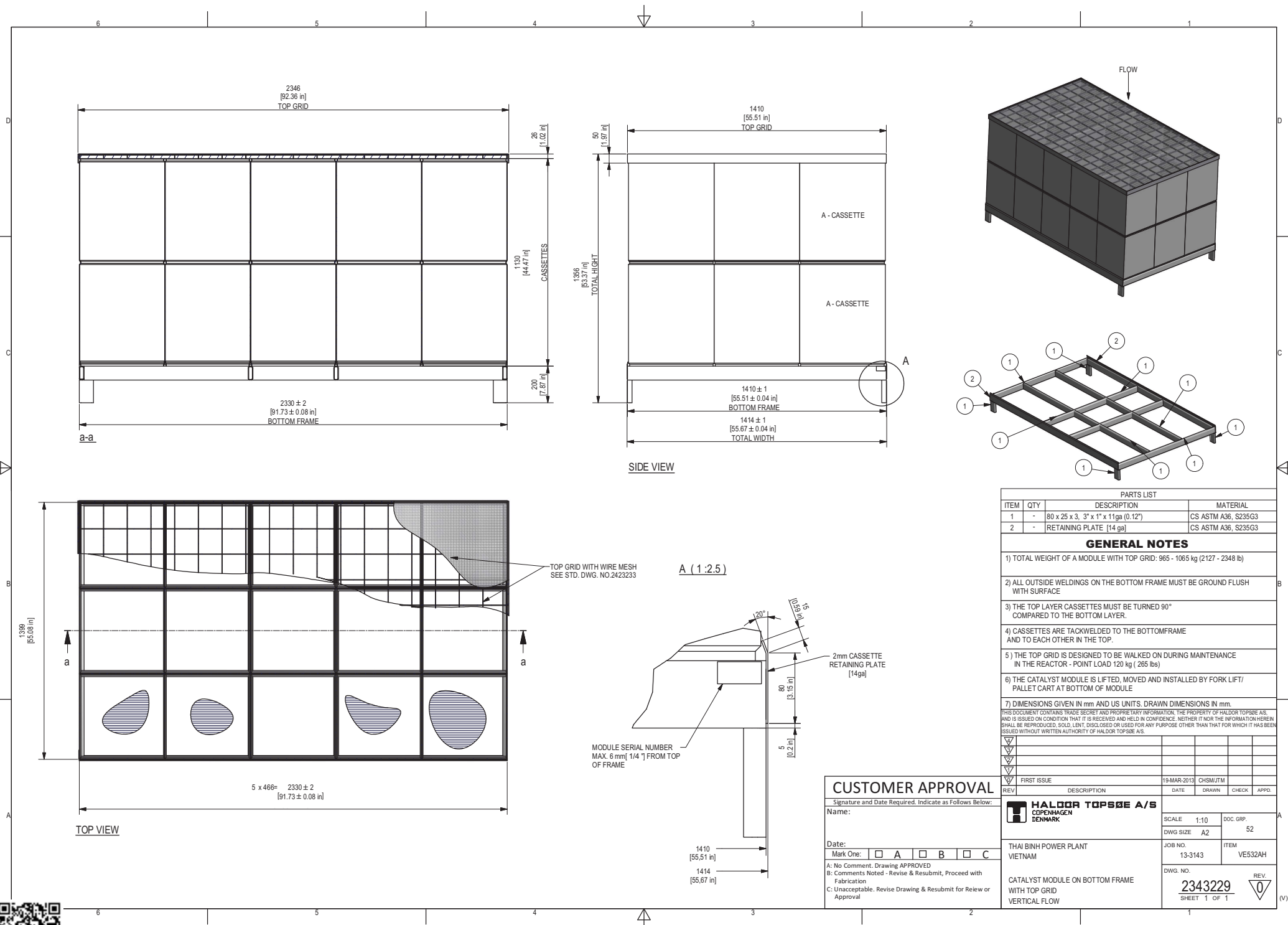


CUSTOMER APPROVAL		Mark One: ☐ A ☐ B ☐ C															
Signature and Date Required: Indicate as Follows Below: Name: _____ Date: _____		A: No Comment. Drawing APPROVED for fabrication B: Comments Noted. Review & Resubmit. Proceed with fabrication C: Unacceptable. Revise Drawing & Resubmit for Review 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 RECOMMENDED INSIDE REACTOR																	
HALDOR TOPSOE																	
Information contained herein is confidential, may not be used for any purpose other than for which it has been issued, and may not be copied or disclosed in third parties without written approval of Haldor Topsoe AS																	
<table border="1"><thead><tr><th>REV</th><th>DESCRIPTION</th><th>DATE</th><th>DRAWN</th><th>CHECK</th><th>APPRO</th></tr></thead><tbody><tr><td>1</td><td>Replacing drawing 1423230</td><td>Jun 21, 2016</td><td>JTM</td><td>CHSM</td><td>CHSM</td></tr></tbody></table>						REV	DESCRIPTION	DATE	DRAWN	CHECK	APPRO	1	Replacing drawing 1423230	Jun 21, 2016	JTM	CHSM	CHSM
REV	DESCRIPTION	DATE	DRAWN	CHECK	APPRO												
1	Replacing drawing 1423230	Jun 21, 2016	JTM	CHSM	CHSM												
Thai Binh Power Plant S&T Corporation Republic of Korea		CLIENT DOC		CLIENT REV													
10 x 7 MODULE ARRANGEMENT VERTICAL FLOW		DWG SIZE: A1 SCALE: 1:33.33		ITEM: ARRANGEMENT													
DOCUMENT ID: 72130-13-3143		M52007-001		0													
JOB NO.		DOCUMENT NUMBER		REV													











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