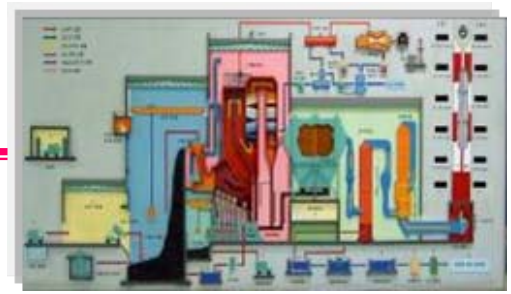
N5000 MV Inverter Case Studies



CONTENTS

N5000 Case 1

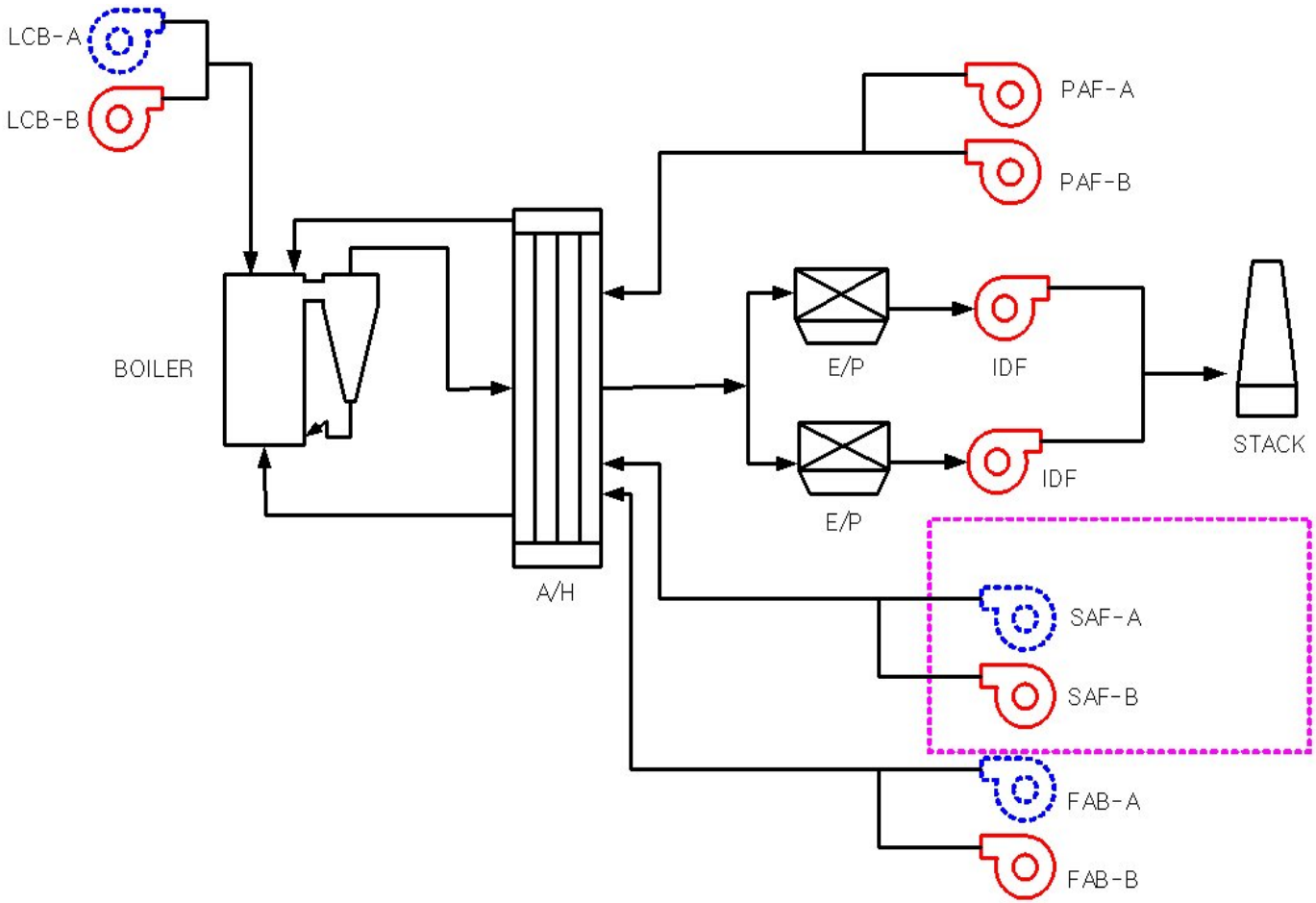
1. Inverter
   - Place : Korea East West Power Co., Ltd.
   - Voltage & Capacity : 6600V, 1000KVA
   - Q'ty : 2 sets
   - Date : 2006. 02(1set), 2006. 06(1set)
2. Motor
   - Voltage & Output : 6600V, 750KW
3. Application
   - SA Fan

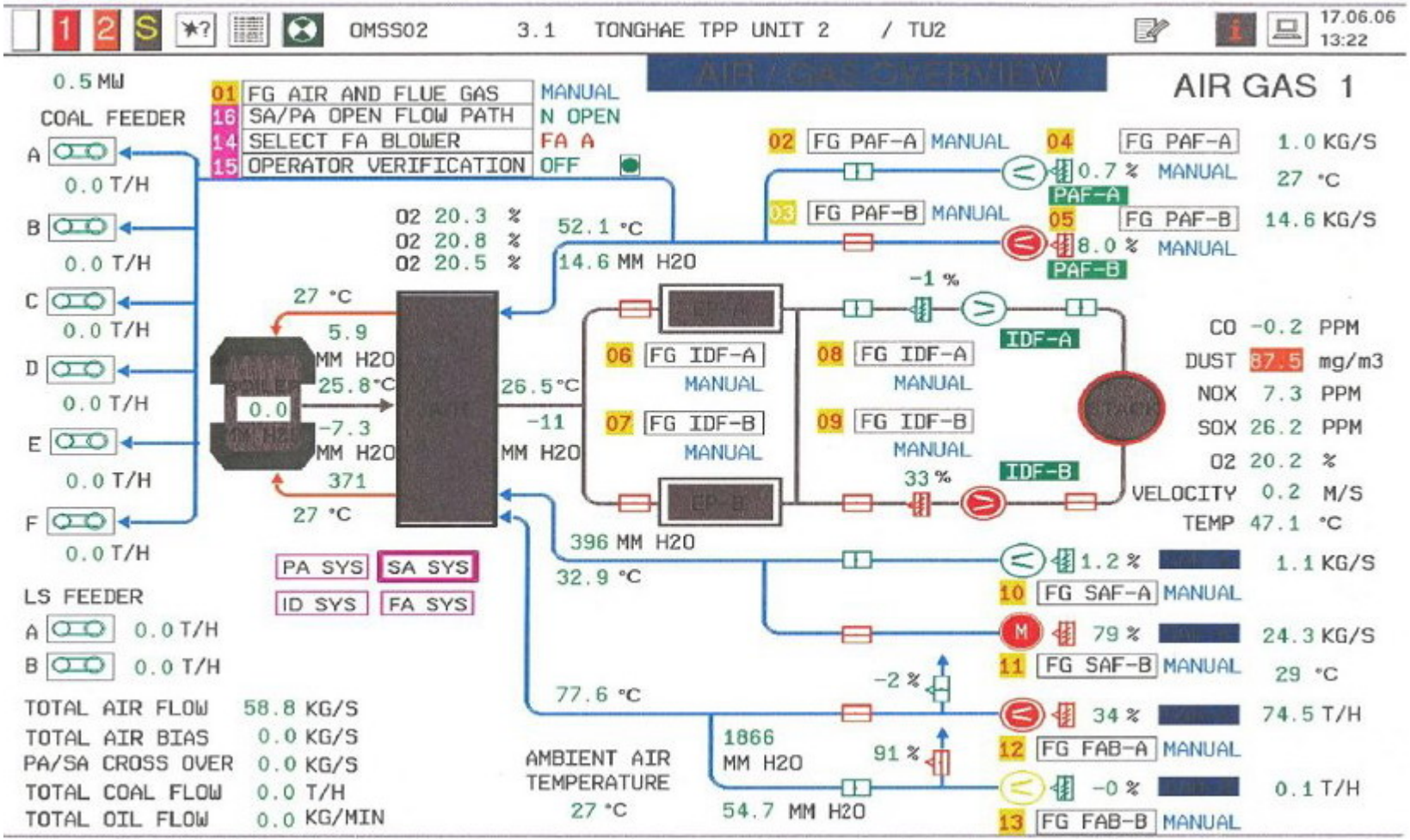
Korea East West Power Co., Ltd.

Application
1.SAF(SECONDARY AIR FAN)

2. Motor
- Voltage : 6600V
- Capacity : 750KW
- Current : 79.4A / 4pole

SAF(Secondary Air Fan)




OMSS02 3.1 TONGHAE TPP UNIT 2 / TU2
17.06.06
13:22
AIR GAS 1
0.5 MW
COAL FEEDER
A 0.0 T/H
B 0.0 T/H
C 0.0 T/H
D 0.0 T/H
E 0.0 T/H
F 0.0 T/H
01 FG AIR AND FLUE GAS MANUAL
16 SA/PA OPEN FLOW PATH N OPEN
14 SELECT FA BLOWER FA A
15 OPERATOR VERIFICATION OFF
O2 20.3 %
O2 20.8 %
O2 20.5 %
52.1 °C
14.6 MM H2O
27 °C
5.9 MM H2O
25.8°C
0.0
-7.3 MM H2O
371
27 °C
26.5°C
-11 MM H2O
02 FG PAF-A MANUAL
03 FG PAF-B MANUAL
04 FG PAF-A 0.7 % MANUAL
PAF-A
05 FG PAF-B 8.0 % MANUAL
PAF-B
1.0 KG/S
27 °C
14.6 KG/S
-1 %
IDF-A
06 FG IDF-A MANUAL
07 FG IDF-B MANUAL
08 FG IDF-A MANUAL
09 FG IDF-B MANUAL
33 %
IDF-B
CO -0.2 PPM
DUST 37.5 mg/m3
NOX 7.3 PPM
SOX 26.2 PPM
O2 20.2 %
VELOCITY 0.2 M/S
TEMP 47.1 °C
396 MM H2O
32.9 °C
1.2 %
10 FG SAF-A MANUAL
1.1 KG/S
79 %
11 FG SAF-B MANUAL
24.3 KG/S
29 °C
-2 %
77.6 °C
34 %
12 FG FAB-A MANUAL
74.5 T/H
1866 MM H2O
91 %
-0 %
13 FG FAB-B MANUAL
0.1 T/H
54.7 MM H2O
AMBIENT AIR TEMPERATURE
27 °C
PA SYS
SA SYS
ID SYS
FA SYS
LS FEEDER
A 0.0 T/H
B 0.0 T/H
TOTAL AIR FLOW 58.8 KG/S
TOTAL AIR BIAS 0.0 KG/S
PA/SA CROSS OVER 0.0 KG/S
TOTAL COAL FLOW 0.0 T/H
TOTAL OIL FLOW 0.0 KG/MIN

Case 1

3. Inverter
- Voltage： 6.6KV
- Capacity：1000KVA

Case 1

Case 1

Inverter Input VCB

Inverter / Bypass & Output VCS

Case 1


운전감시반
HiRUN-N5000
Ref 주파수
30.0 Hz
Out 주파수
30.0 Hz
운전상태
FWD
Out 전류
15 A
Out 전압
3299 V
전동기회전수
900 RPM
부스트주파수
1.8 Hz
부스트전압
66 V
MAS
PID피드백
0
조견누적시간
119시16분
투입누적시간
3997시56분
1 2 3 4 5 6 7 8
DI1
DI2
DO
UP
RUN
STP
Dn
운전감시반
HiRUN-N5000
37.7 Hz
37.7 Hz
FWD
15 A
4146 V
1130 RPM
1.8 Hz
66 V
MAS
0
119시28분
3998시6분
1 2 3 4 5 6 7 8
DI1
DI2
DO
RUN
STP
Dn

Case 1


CTPT감시반
HiRUN-N5000
3상 입력전압
3상 출력전압
3상 출력전류
V_R 6964 V
V_S 7093 V
V_T 7028 V
V_U 5169 V
V_V 5169 V
V_W 5169 V
I_U 31 A
I_V 31 A
I_W 30 A
CELL감시반
HiRUN-N5000
V_U1 826 V
V_U1 829 V
V_W1 829 V
V_U2 843 V
V_W2 851 V
V_U3 837 V
V_W3 844 V
V_U4 847 V
V_W4 849 V
V_U5 838 V
V_W5 824 V
V_U6 839 V
V_W6 838 V
운전조작반
HiRUN-N5000
MASTER
출력주파수 47.1 Hz
운전 상태 FWD
전동기속도 1412 RPM
경고 해제
고장 해제
지령주파수 F01 47.1 Hz
가속 시간 F02 00 Sec
방향 설정 F04 1 FWD
감속 시간 F03 00 Sec
Up
고장
RUN
STP
Dn

1) Output coupling test in DCS

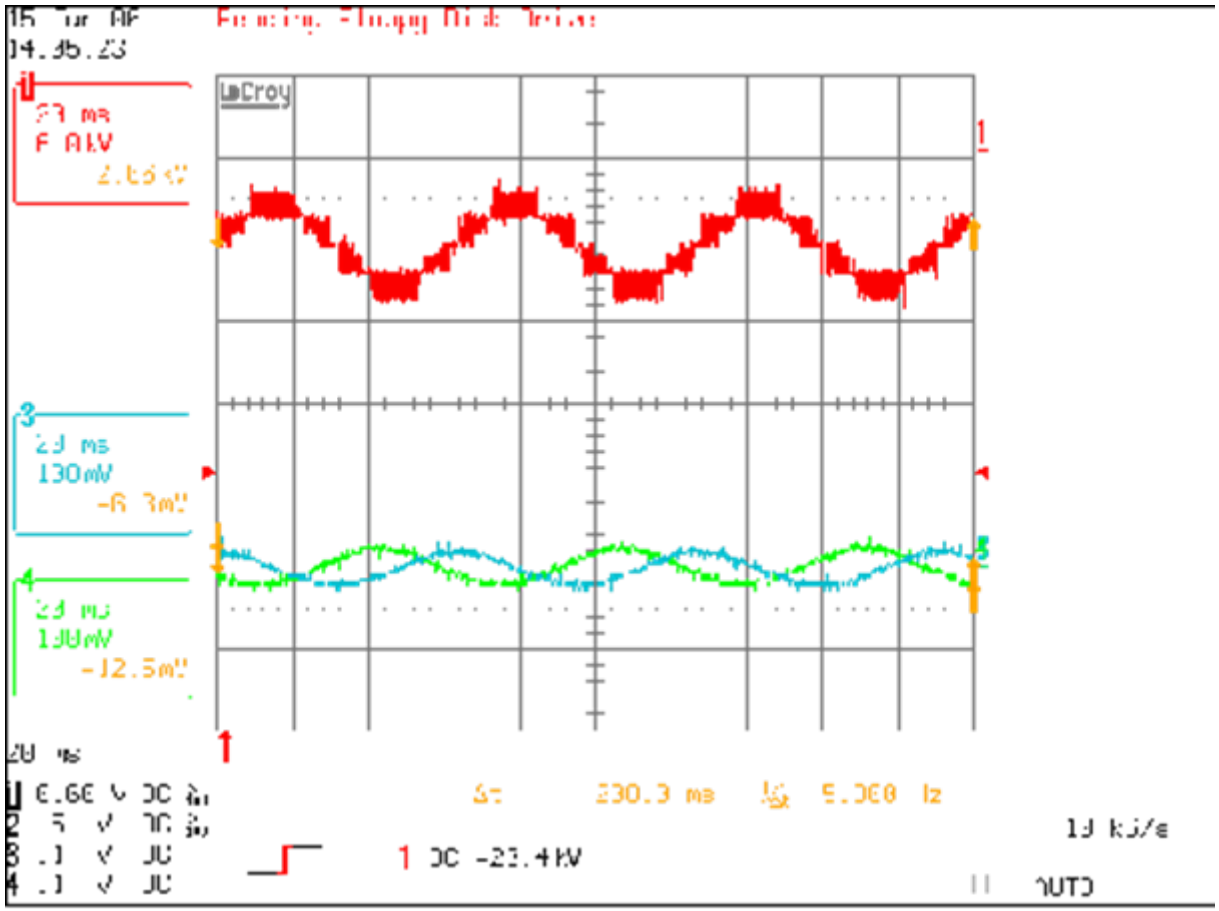


Fig 1. Vane 80% open, 10% setting

2) Output coupling test in DCS

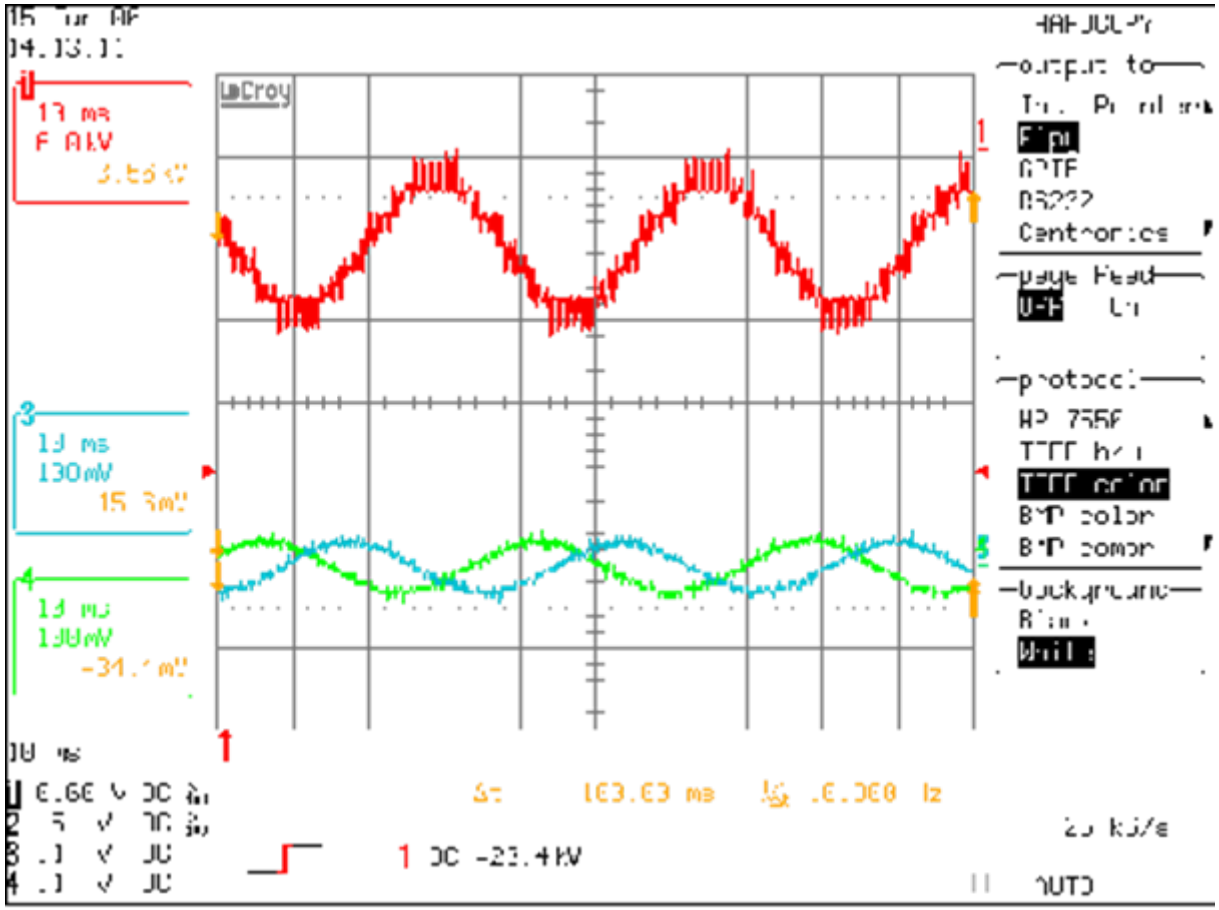


Fig 2. Vane 80% open, 20% setting

3) Output coupling test in DCS

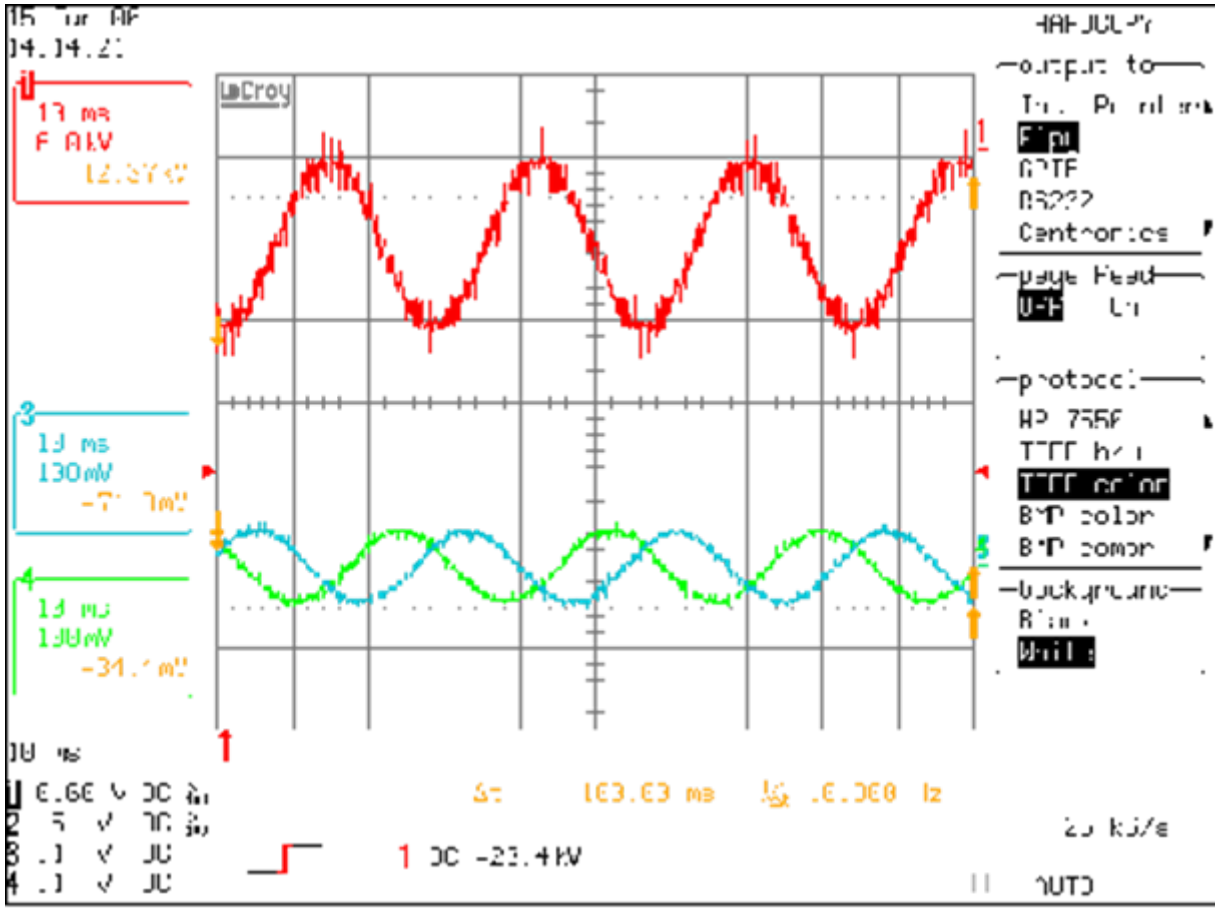


Fig 3. Vane 80% open, 30% setting

4) Output coupling test in DCS

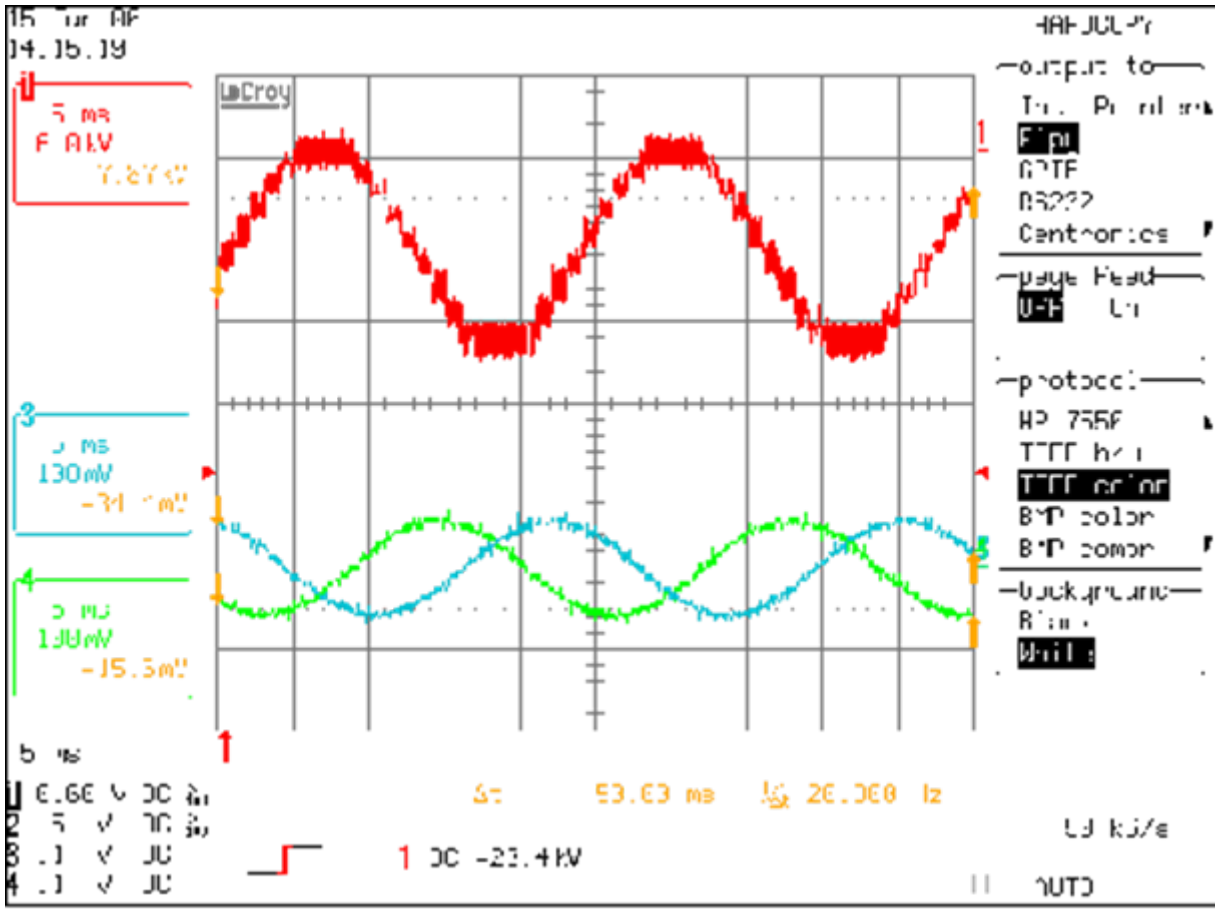


Fig 4. Vane 80% open, 40% setting

5) Output coupling test in DCS

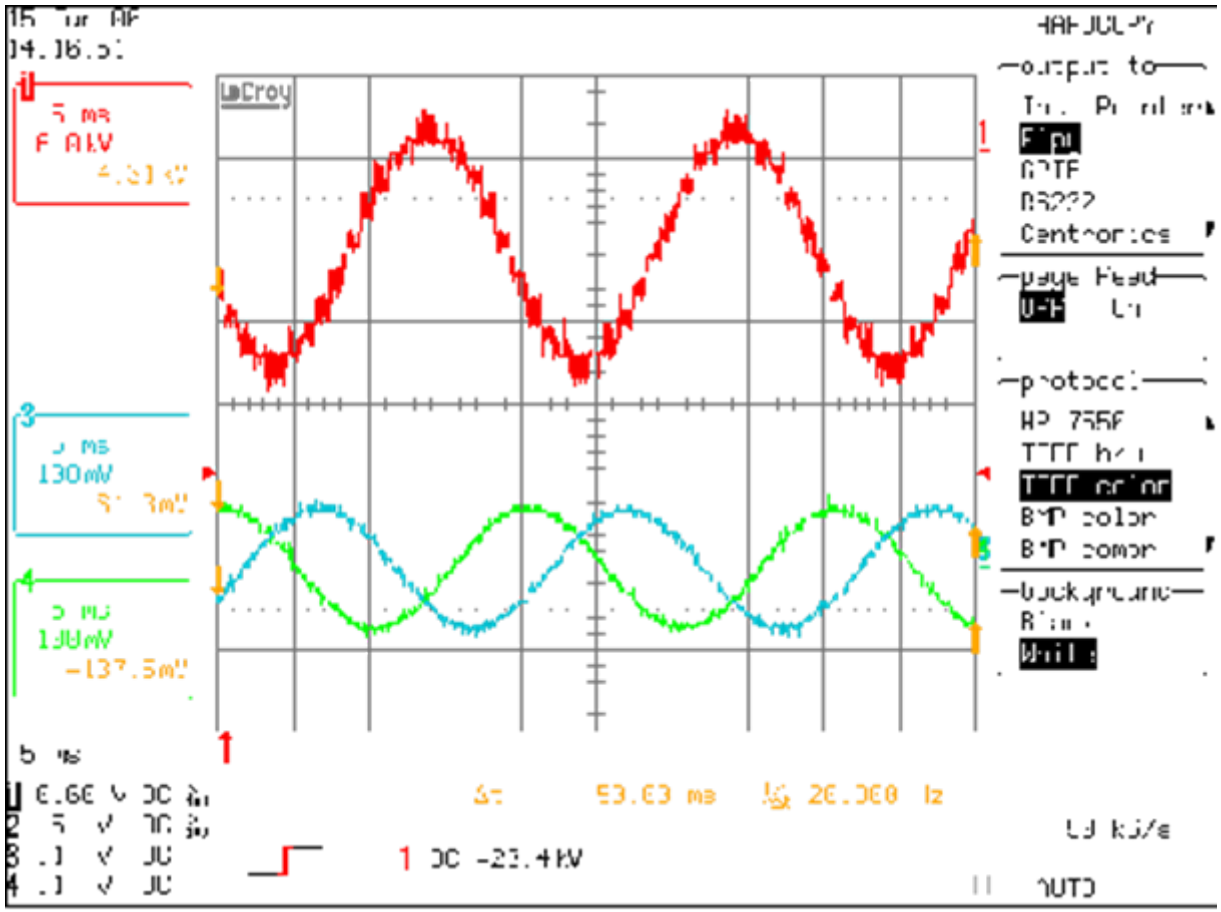


Fig 5. Vane 80% open, 50% setting

6) Output coupling test in DCS

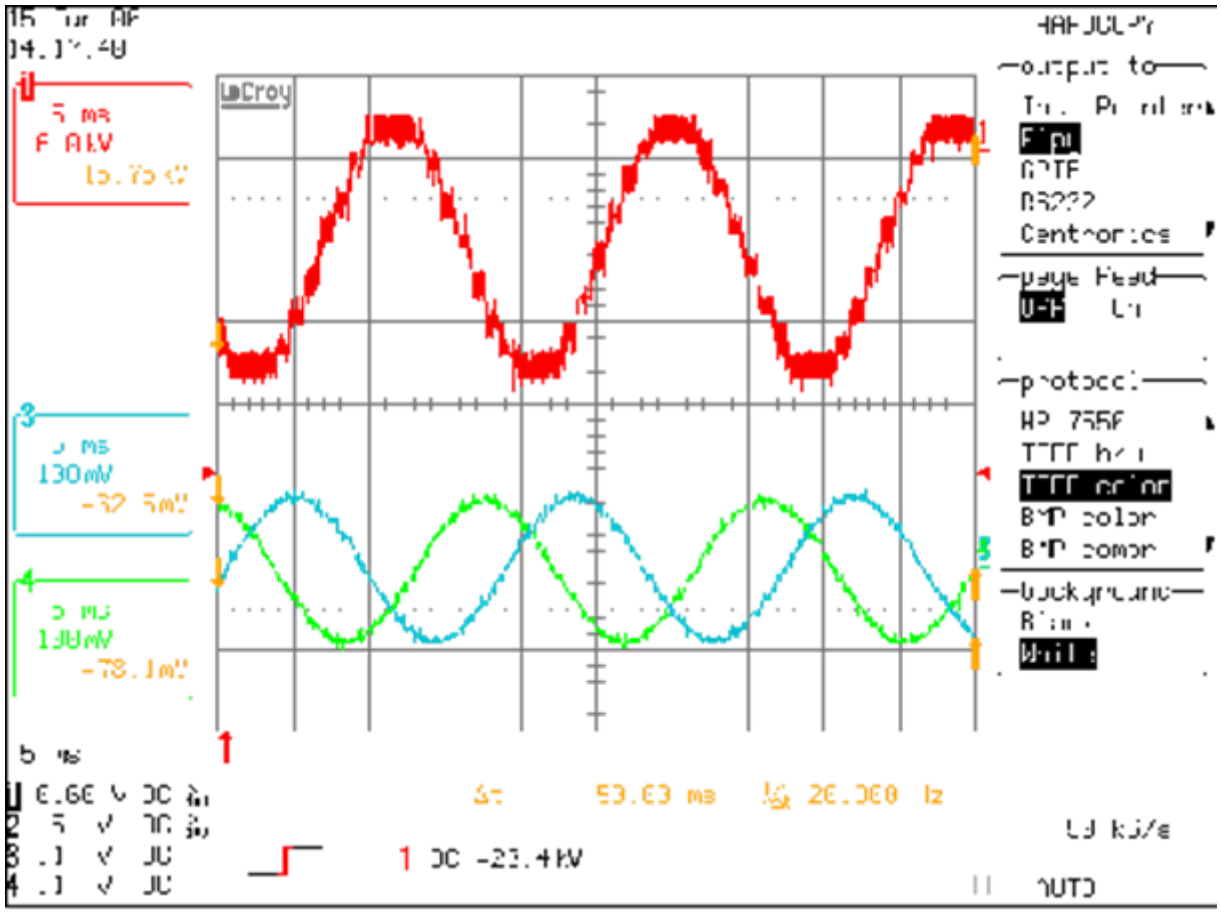


Fig 6. Vane 80% open, 60% setting

7) Output coupling test in DCS

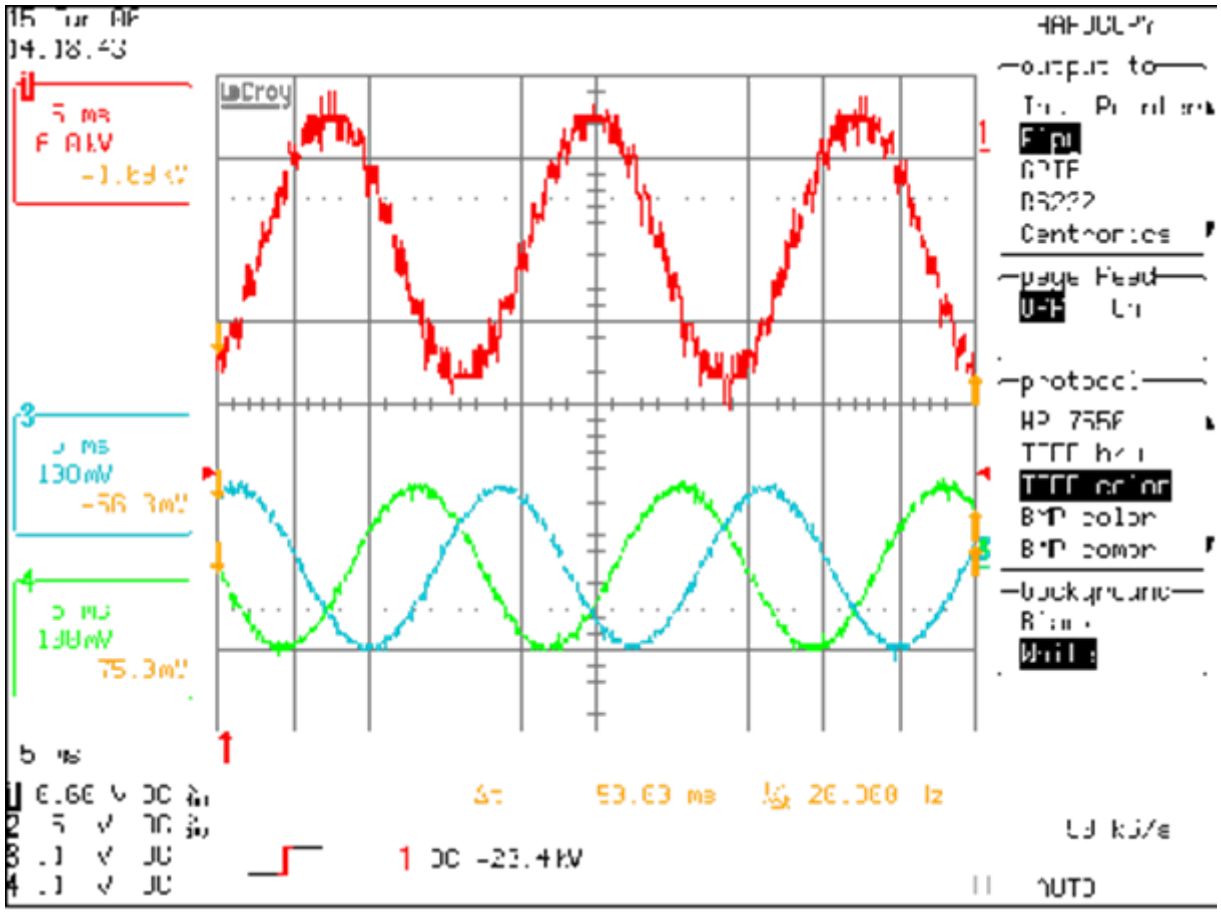


Fig 7. Vane 80% open, 70% setting

8) Output coupling test in DCS

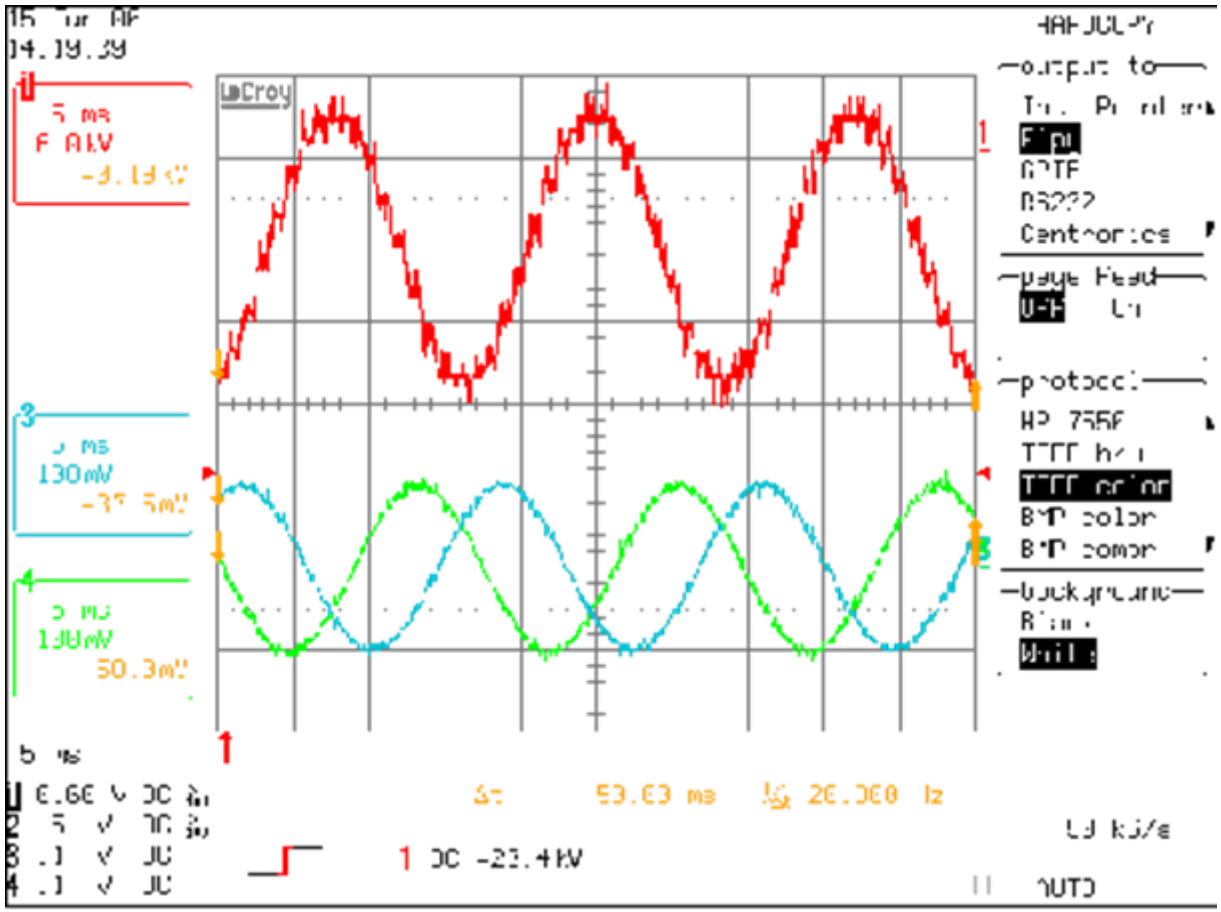


Fig 8. Vane 80% open, 80% setting

9) Output coupling test in DCS

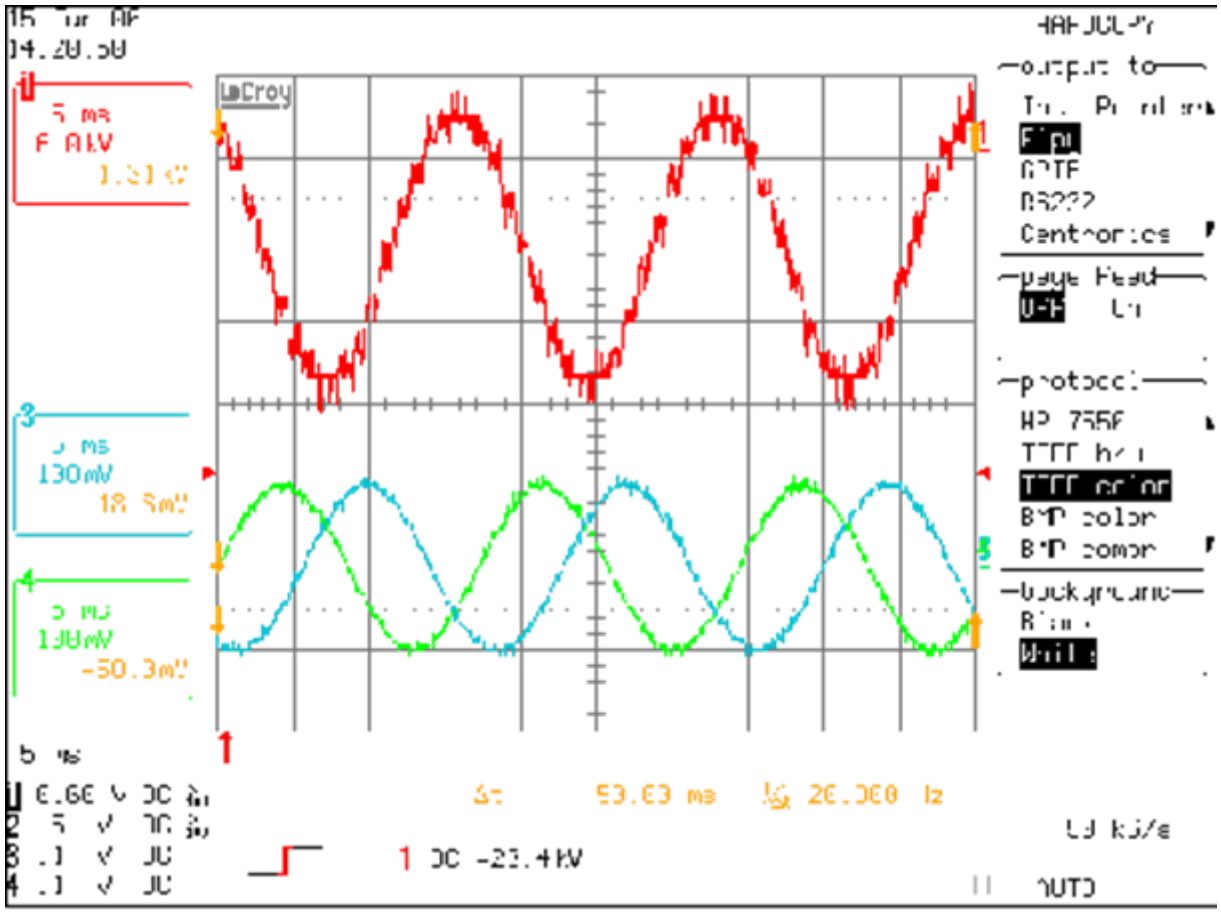


Fig 9. Vane 80% open, 90% setting

10) Output coupling test in DCS

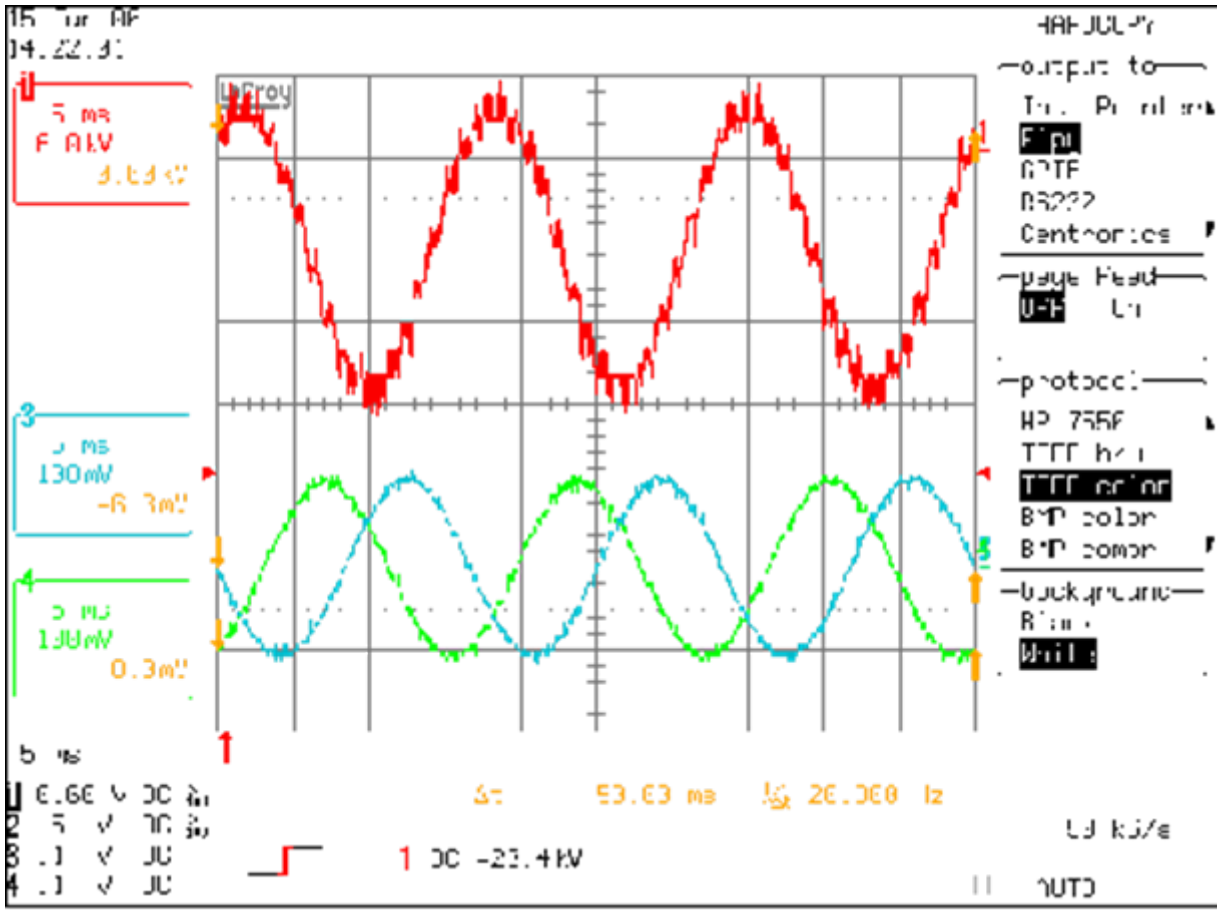


Fig 10. Vane 80% open, 100% setting

11) Acc/Dec Time Test

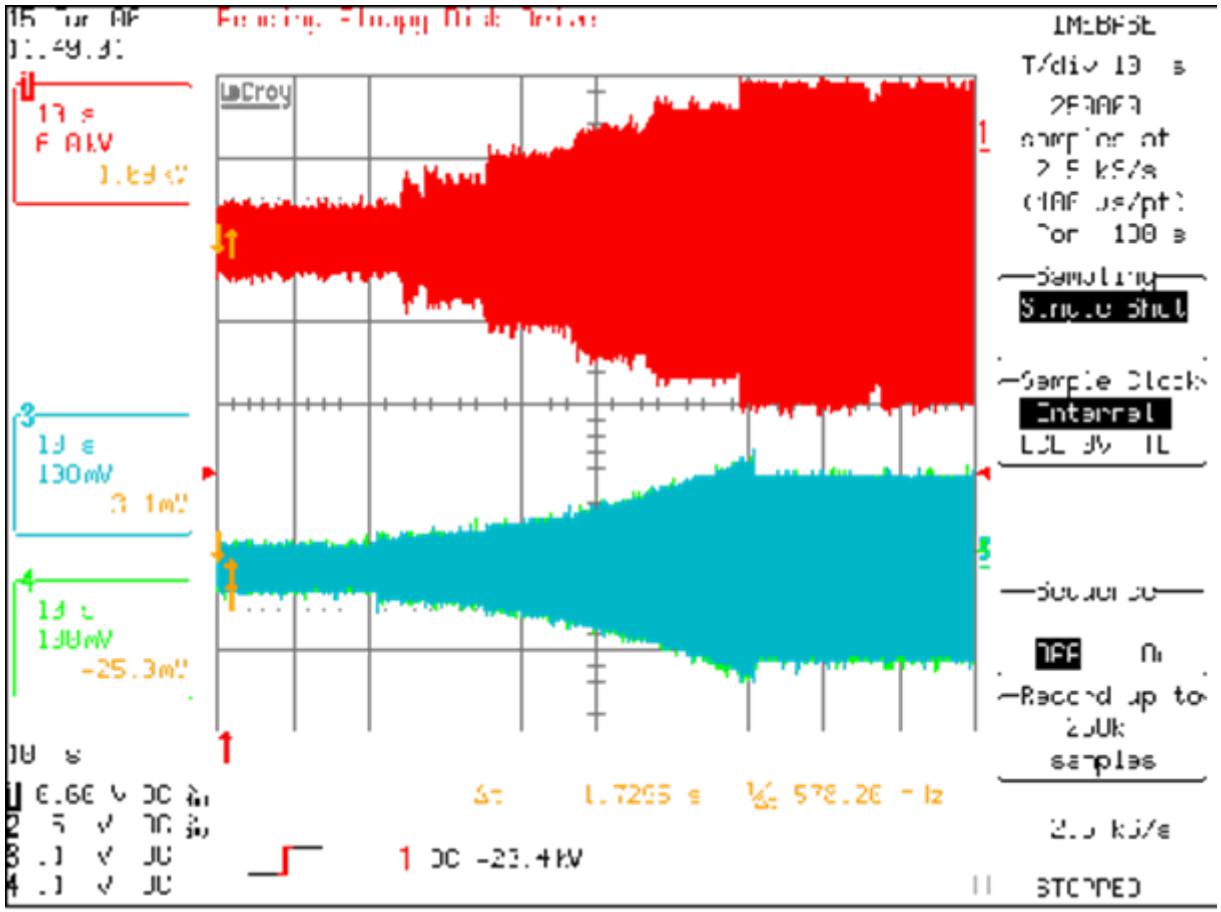


Fig 11. 60[sec] Acc.(from 20[Hz] to 60[Hz], Fan is connecting)

12) Acc/Dec Time Test

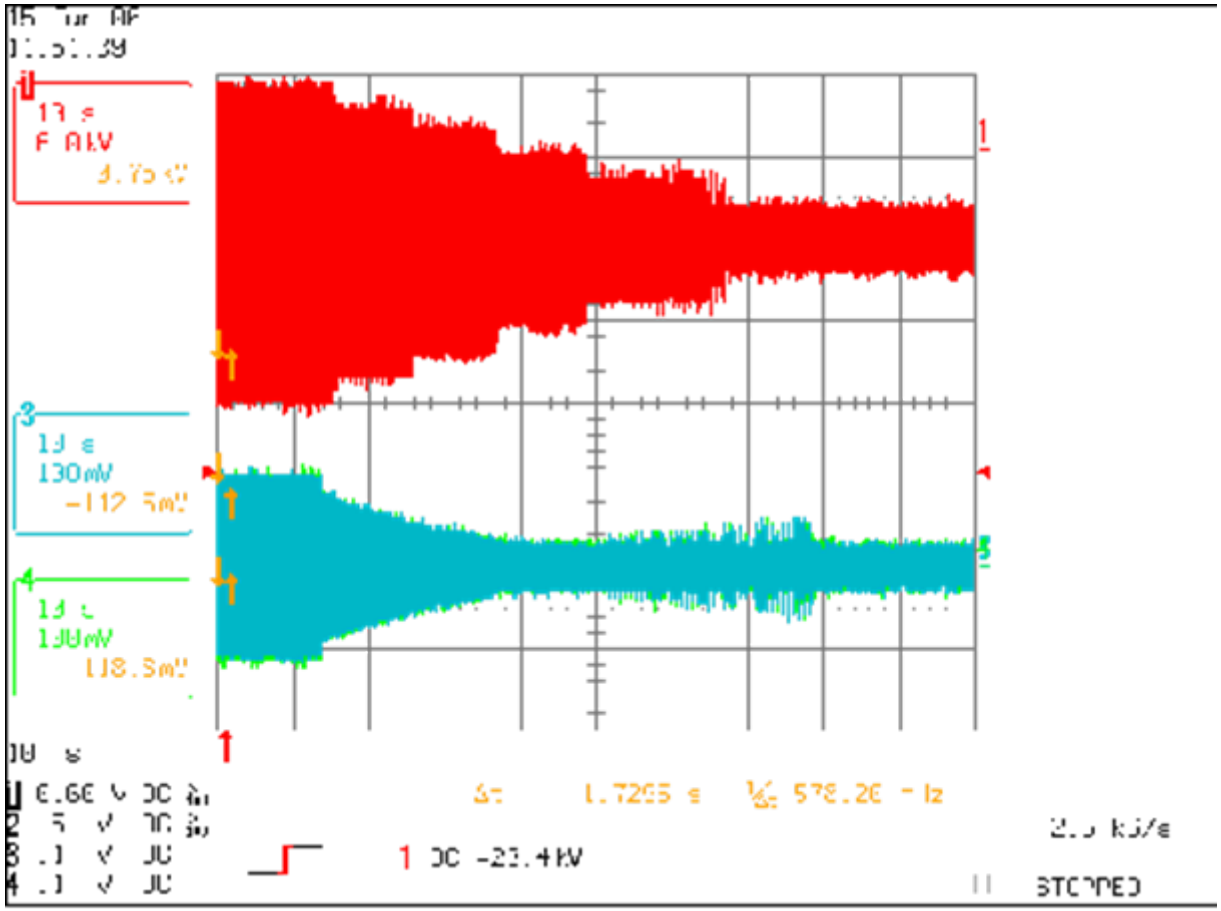
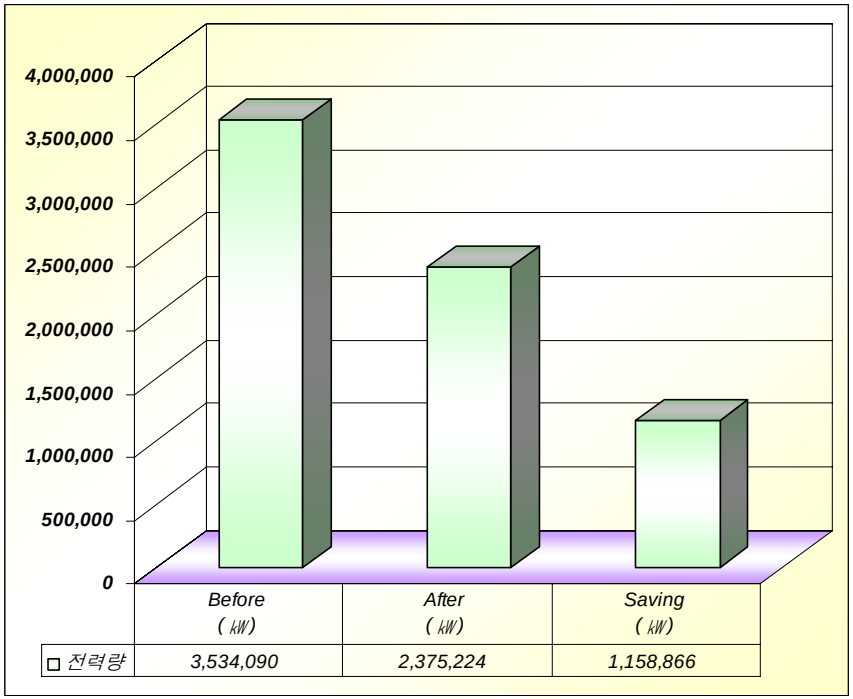
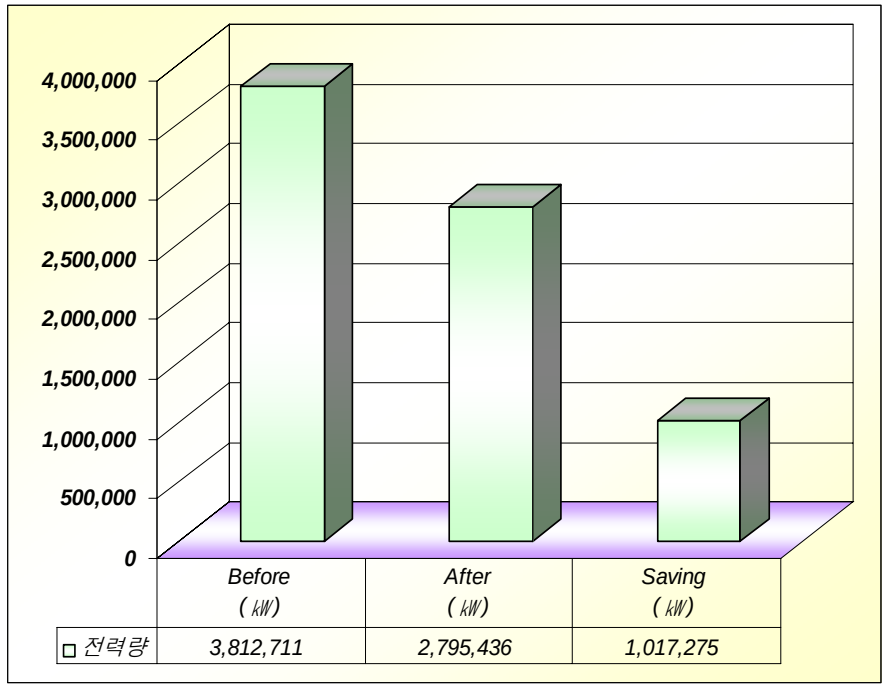


Fig 12. 60[sec] Dec.(from 60[Hz] to 20[Hz], Fan is connecting)

Case 1





1st SAF Saving Money / year :

54,652,000 KRW

2nd SAF Saving Money / year :

47,975,000 KRW

N5000 Case 2

1. Inverter
   - Place : HHI Transformer Factory
   - Voltage & Capacity : 6600V, 4500KVA
   - 부하 : M-G SET
   - Q'ty : 3 sets
   - Date : 2006. 09(1set), 2007. 03(2sets)
2. Motor
   - Voltage & Output : 6600V, 60HZ, 3000KW, 6P
3. Application
   - M-G set for Transformer Test

1.Syncronous Generator
1) 6600V , 23 MVA

1. Syncronous Generator
2) 6600V , 23 MVA

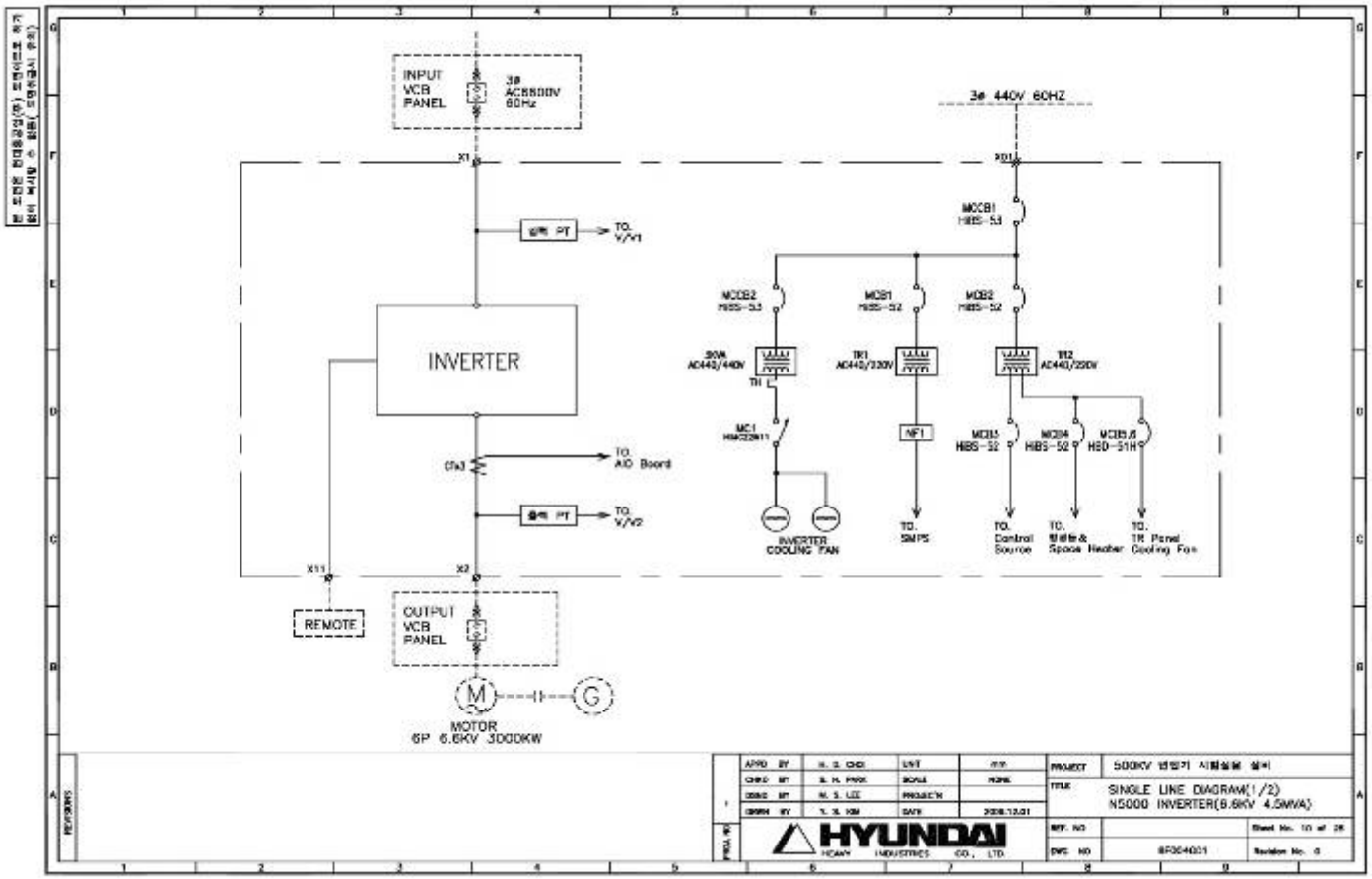
Case 2

2. Motor
1)6600V, 60HZ , 6P, 3000KW

Case 2

2. Motor
2) 6600V, 60HZ , 6P, 3000KW

Single Line Diagram

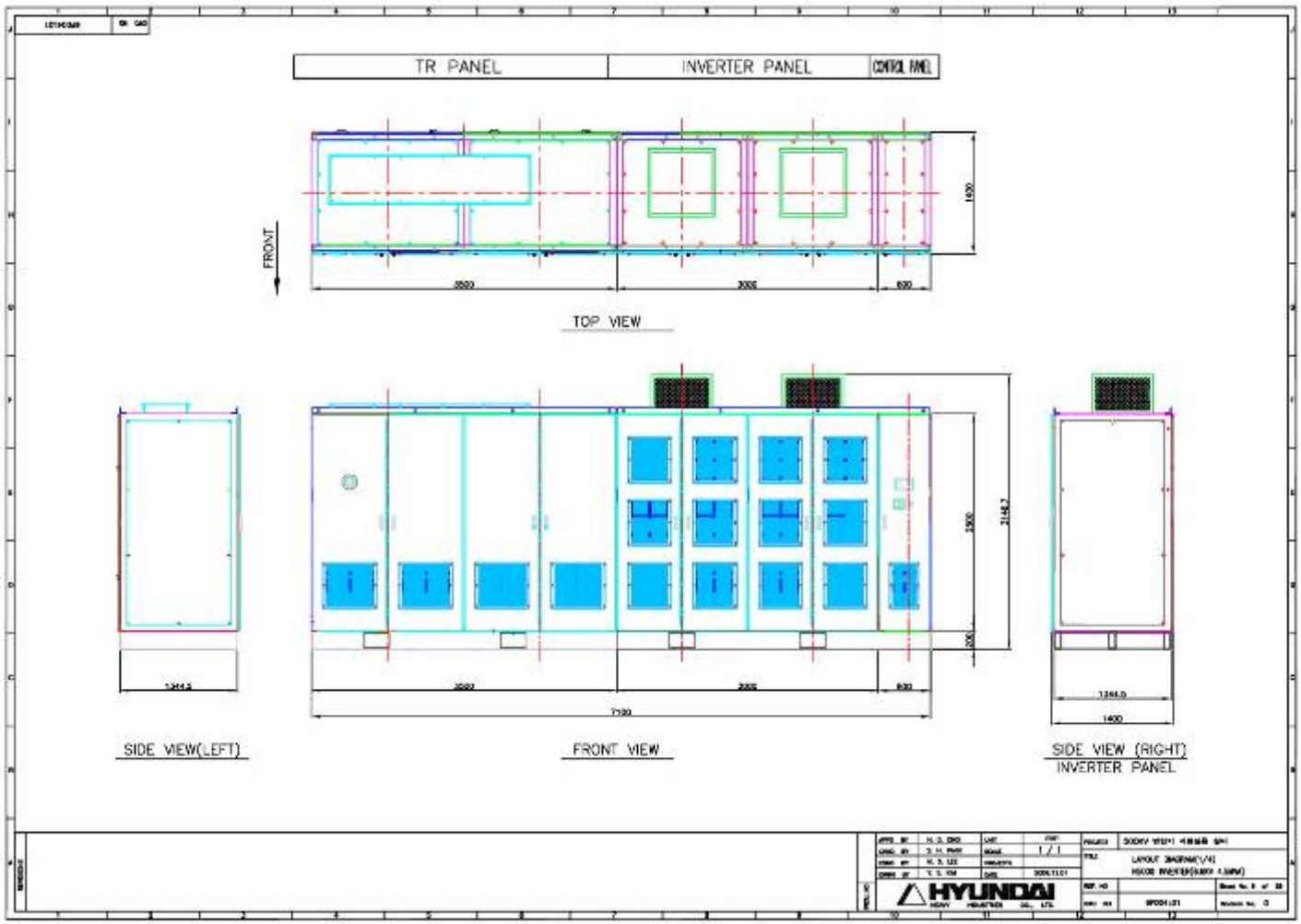


3. Inverter
 – 6.6KV,4500KVA
 – Multi Level Inverter, 36 pulse input

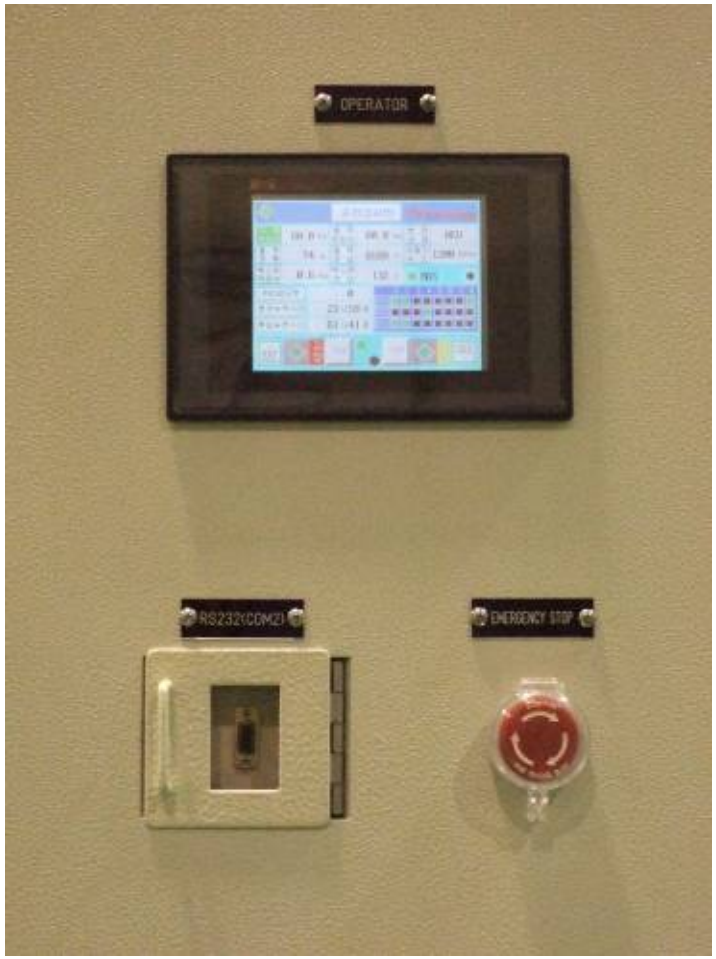
Case 2

Case 2

Outline Dimension



Case 2


OPERATOR
RS232(COM2)
EMERGENCY STOP


운전감시반
68.8 Hz
56.8 Hz
FWD
19 A
3882 V
1128 RPM
8.8 Hz
8 V
MAS
PID피드백
8
8시24분
2시 2분
RUN
STP


운전감시반
68.8 Hz
68.8 Hz
REV
74 A
6599 V
1200 RPM
8.6 Hz
132 V
MAS
PID피드백
8
23시54분
61시36분
RUN
STP

Inverter Operating Curve

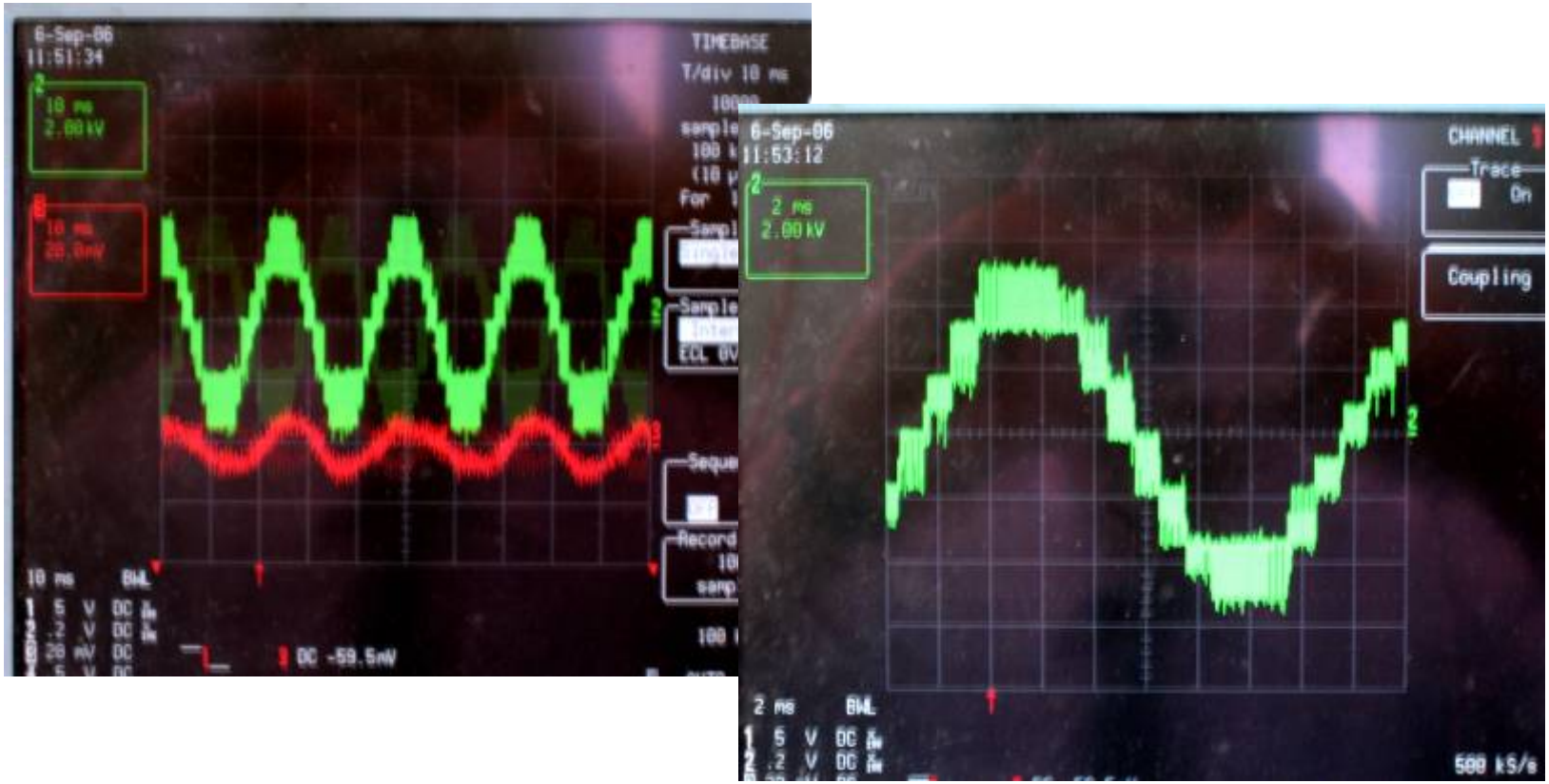
Output Frequency (Blue)
Output Voltage (Red)

Output Current
50A/div.

Motor rpm

Case 2

Output Voltage & Current



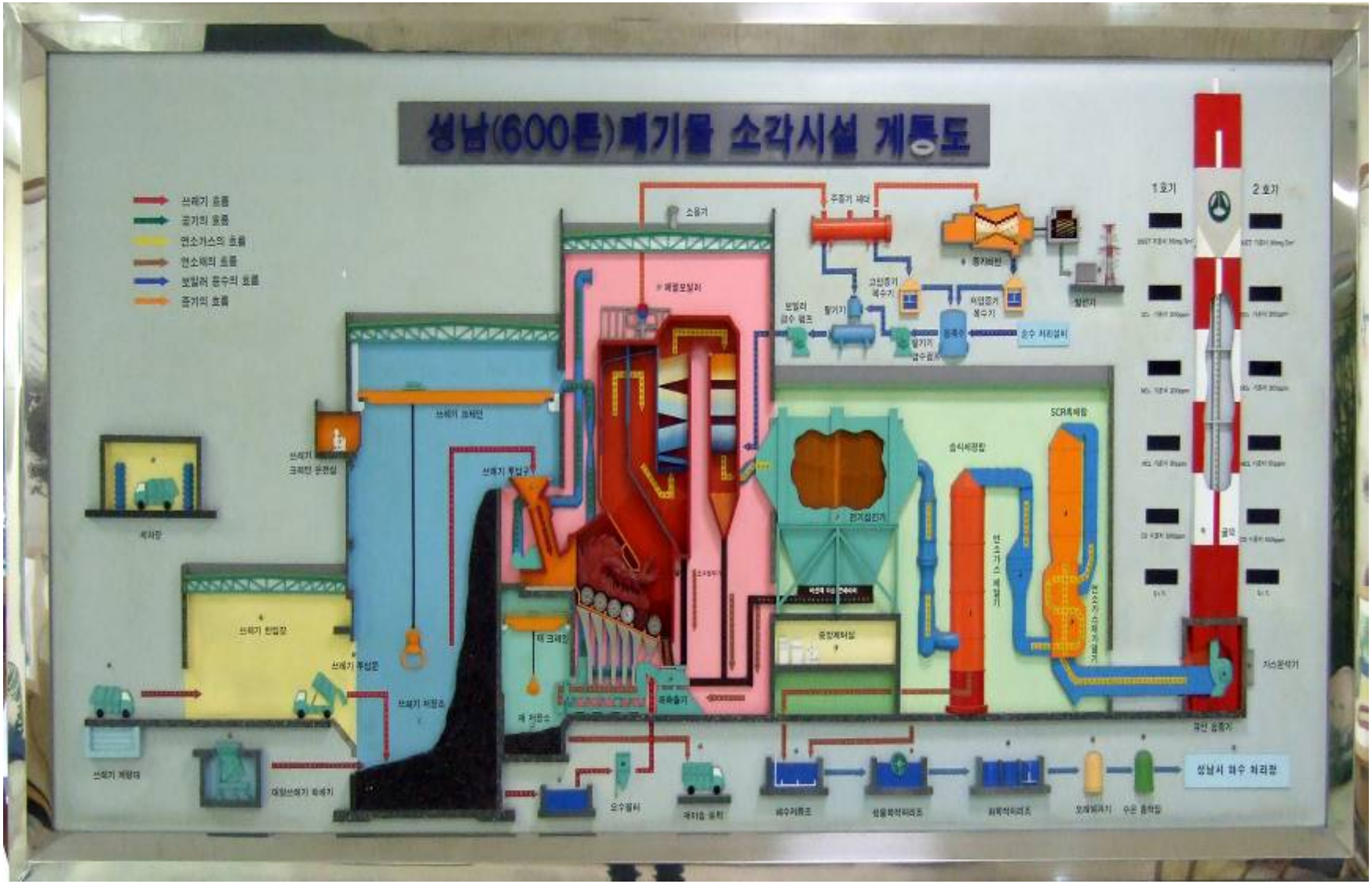
N5000 Case 3

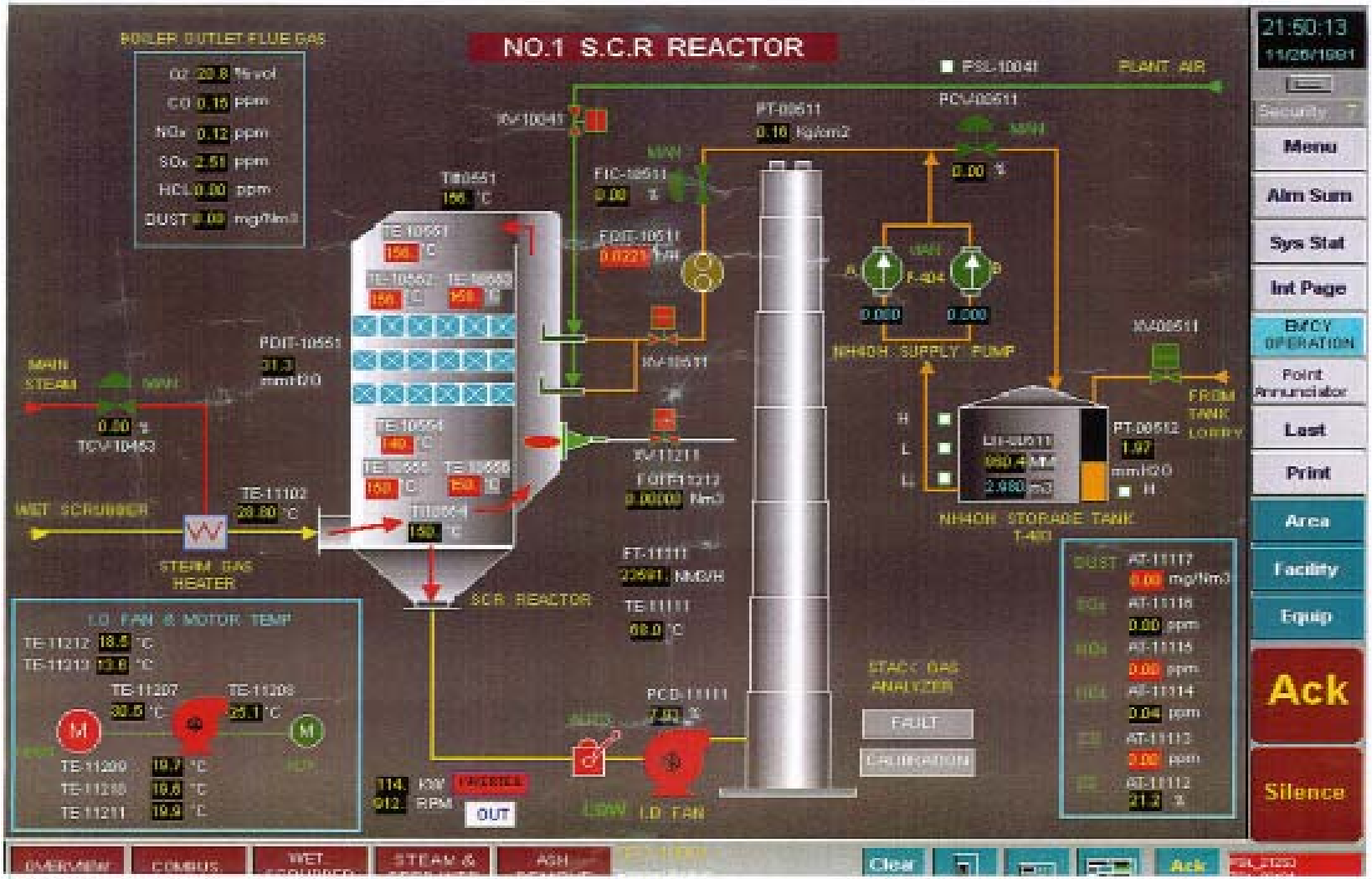
1. Inverter
   - Place : Sung-Nam Refuse Incineration Plant
   - Voltage & Capacity : 6600V, 800KVA
   - Q'ty : 2 sets
   - Date : 2006. 12 (2sets)
2. Motor
   - Voltage & Output : 6600V, 1000KW ,4/8P
3. Application
   - ID FAN

Case 3

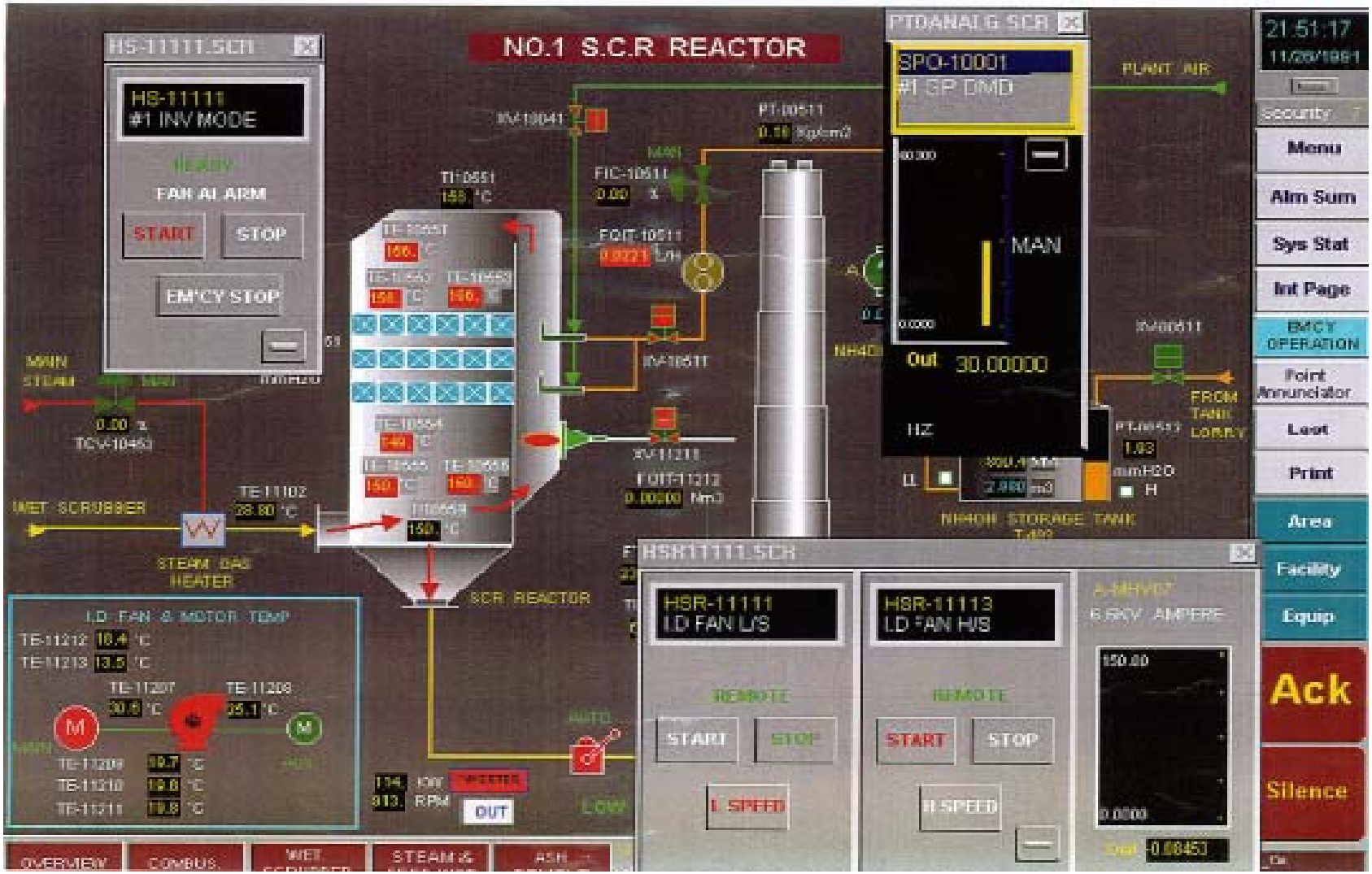
Case 3

Case 3

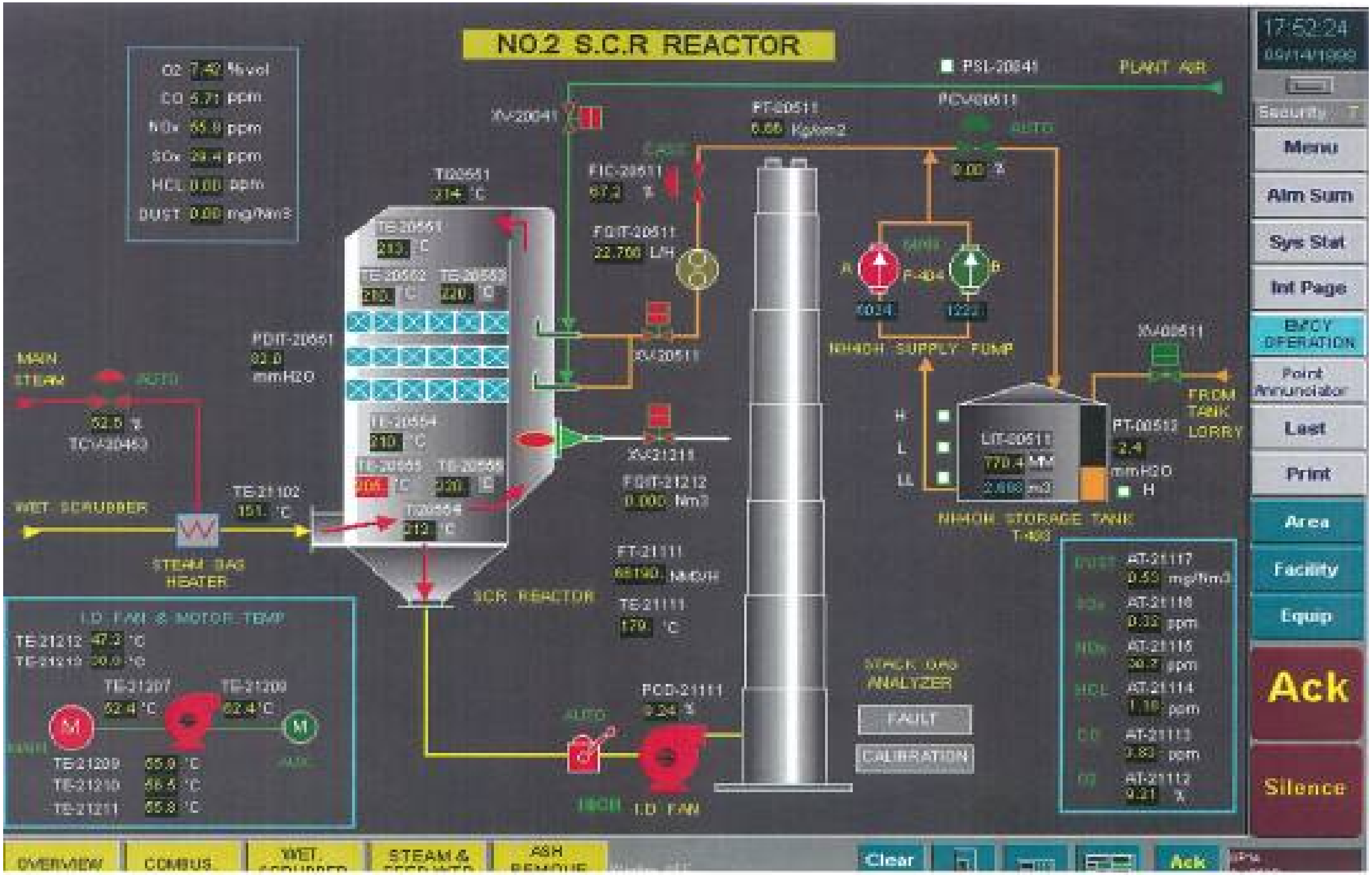

성남(600톤)폐기물 소각시설 계통도
쓰레기 흐름
공기의 흐름
연소가스의 흐름
연소재의 흐름
보일러 급수의 흐름
증기의 흐름
1호기
2호기
소음기
주증기 배관
증기터빈
고압증기 복수기
저압증기 복수기
발전기
보일러 급수 펌프
탈기기
탈기기 급수펌프
순수 처리설비
쓰레기 호퍼
쓰레기 투입구
쓰레기 크레인 운전실
쓰레기 반입장
쓰레기 투입문
쓰레기 저장조
쓰레기 계량대
재크레인
화격자
재 처리기
오수정화
재처리 설비
배수처리조
생물학적처리조
최종처리조
모래여과기
우수 증발장
성남시 하수 처리장
SCR촉매탑
습식세정탑
전기집진기
연소가스 예열기
유인 송풍기
굴뚝
가스분석기


NO.1 S.C.R REACTOR
BOILER OUTLET FLUE GAS
PLANT AIR
NH4OH SUPPLY PUMP
NH4OH STORAGE TANK
T-401
WET SCRUBBER
STEAM GAS HEATER
SCR REACTOR
I.D FAN & MOTOR TEMP
STACK GAS ANALYZER
FAULT
CALIBRATION
21:50:13
Menu
Alm Sum
Sys Stat
Int Page
Point Annunciator
Last
Print
Area
Facility
Equip
Ack
Silence
OUT

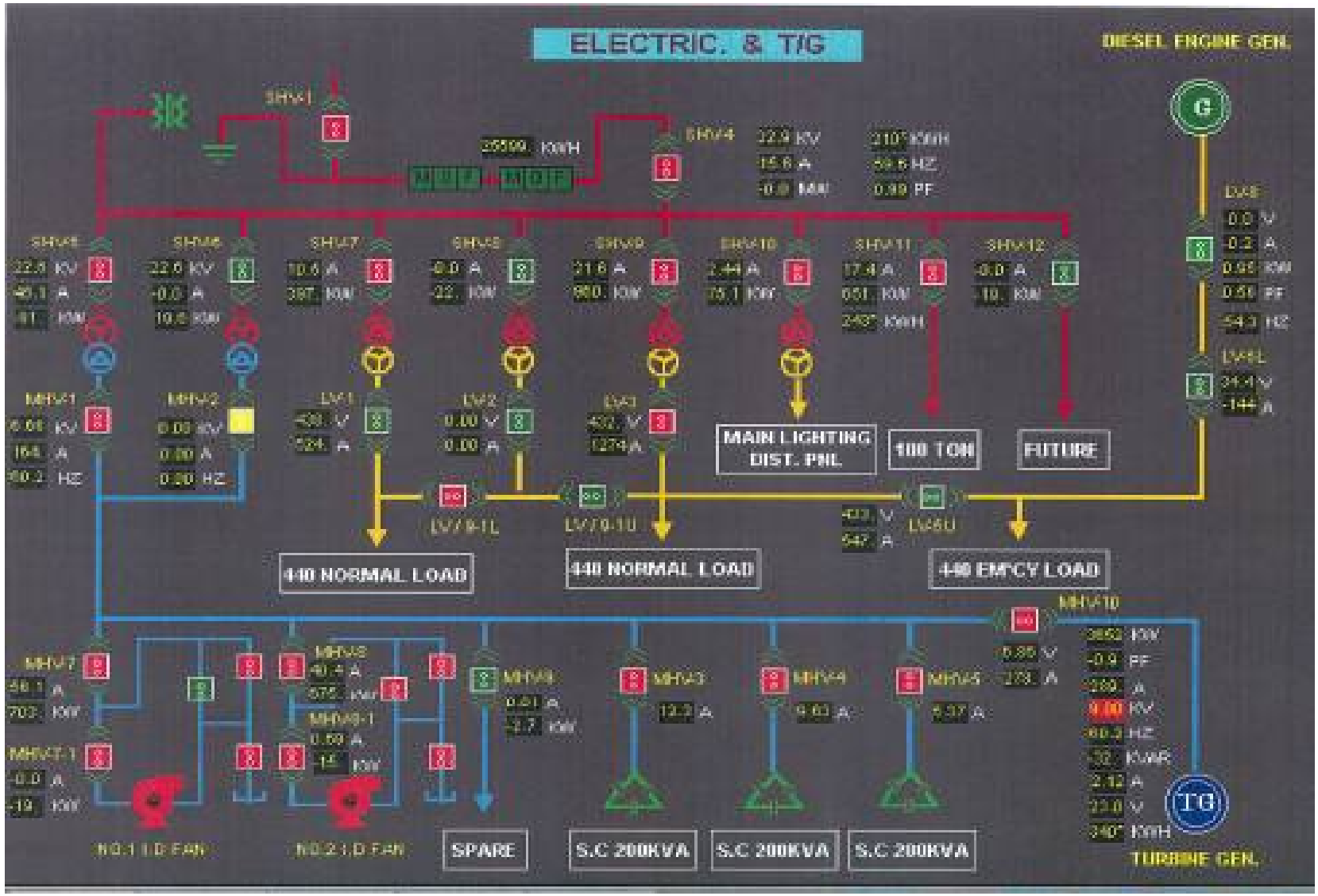
Case 3


NO.1 S.C.R REACTOR
HS-11111.SCR
HS-11111
#1 INV MODE
FAN ALARM
START
STOP
EM'CY STOP
PTDANALG SCR
SPO-10001
#1 GP DMD
MAN
Out 30.00000
HZ
PLANT AIR
21:51:17
11/28/1991
Security
Menu
Alm Sum
Sys Stat
Int Page
EM'CY OPERATION
Point Annunciator
Last
Print
Area
Facility
Equip
Ack
Silence
MAIN STEAM
TCV-10451
WET SCRUBBER
STEAM GAS HEATER
SCR REACTOR
NH4OH STORAGE TANK
FROM TANK LORRY
I.D FAN & MOTOR TEMP
HSR11111.SCR
HSR-11111
I.D FAN L/S
HSR-11113
I.D FAN H/S
REMOTE
START
STOP
I SPEED
II SPEED
OVERVIEW
COMBUS.
WET SCRUBBER
STEAM &
ASH

Case 3


NO.2 S.C.R REACTOR
O2 7.42 %vol
CO 5.71 ppm
NOx 55.8 ppm
SOx 29.4 ppm
HCL 0.00 ppm
DUST 0.00 mg/Nm3
PLANT AIR
PT-20511
PCV-20511
AUTO
FIC-20511
FQIT-20511
NH4OH SUPPLY PUMP
FROM TANK LORRY
NH4OH STORAGE TANK
MAIN STEAM
WET SCRUBBER
STEAM GAS HEATER
SCR REACTOR
I.D. FAN & MOTOR TEMP
STACK GAS ANALYZER
FAULT
CALIBRATION
I.D. FAN
17:52:24
Menu
Alm Sum
Sys Stat
Last
Print
Area
Facility
Equip
Ack
Silence
Clear
OVERVIEW
COMBUS.
STEAM &

Case 3


ELECTRIC & T/G
DIESEL ENGINE GEN.
SHV1
SHV4
SHV5
SHV6
SHV7
SHV8
SHV9
SHV10
SHV11
SHV12
MHV1
MHV2
LV1
LV2
LV3
LV/P-IL
LV/P-1U
LV/P-2U
MAIN LIGHTING DIST. PNL
100 TON
FUTURE
440 NORMAL LOAD
440 NORMAL LOAD
440 EM'CY LOAD
MHV7
MHV8
MHV8-1
MHV3
MHV4
MHV5
MHV10
NO.1 I.D FAN
NO.2 I.D FAN
SPARE
S.C 200KVA
S.C 200KVA
S.C 200KVA
TURBINE GEN.

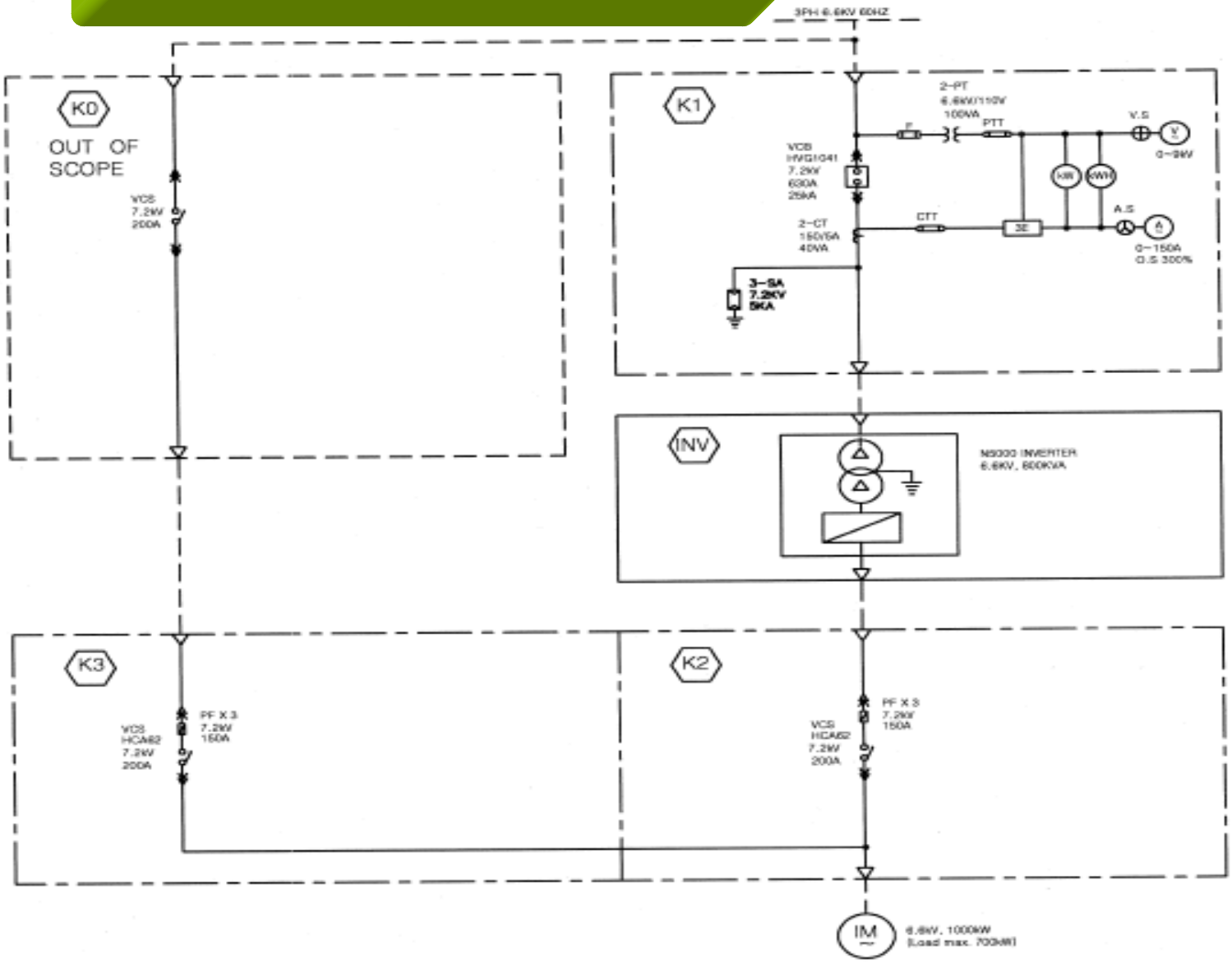
Case 3

1. Motor / Application

- Voltage : 6600V,60HZ
- Output : 1000KW
- Current : 97.8A
- Pole : 4/8 pole
- ID Fan

Case 3

Single Line Diagram



2. Inverter
- 6.6KV, 800KVA, 70A

Case 3

Case 3

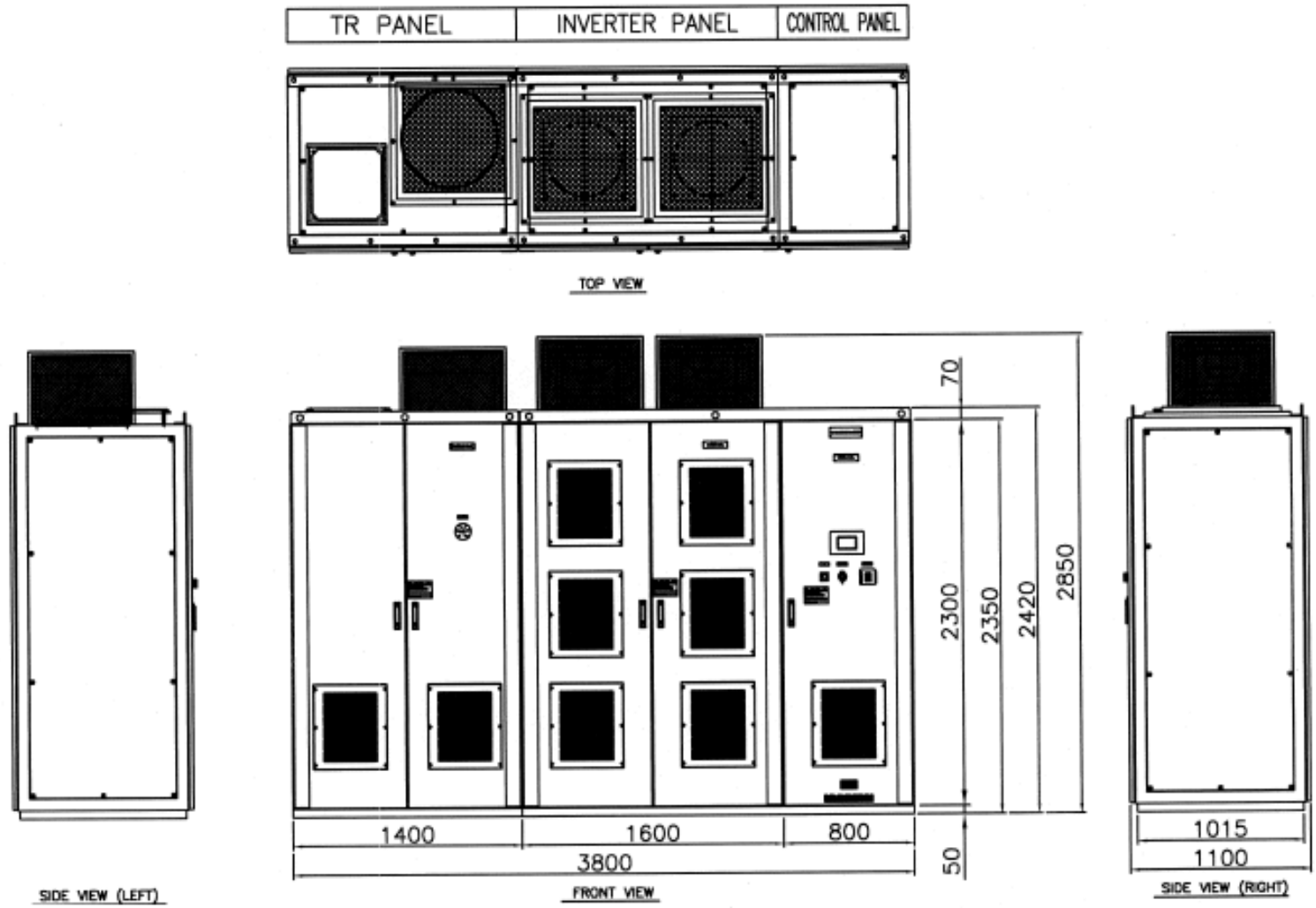
Case 3

Case 3

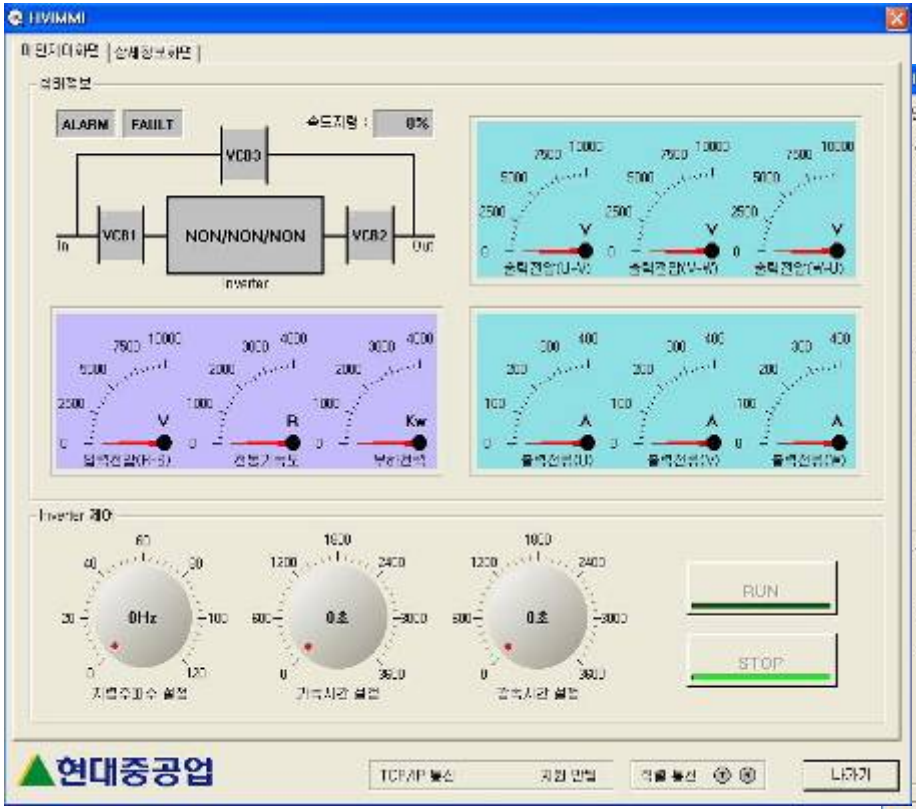
Inverter Input VCB

Inverter / Bypass & Output VCS

Outline Dimension

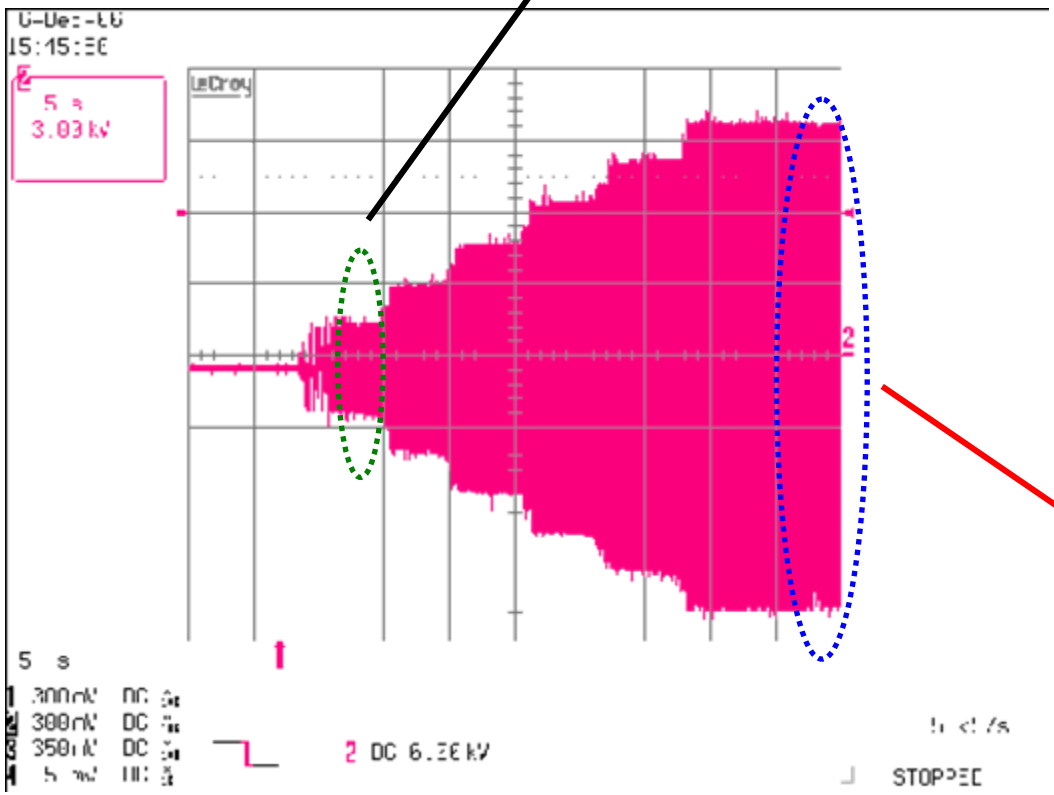


MMI Display

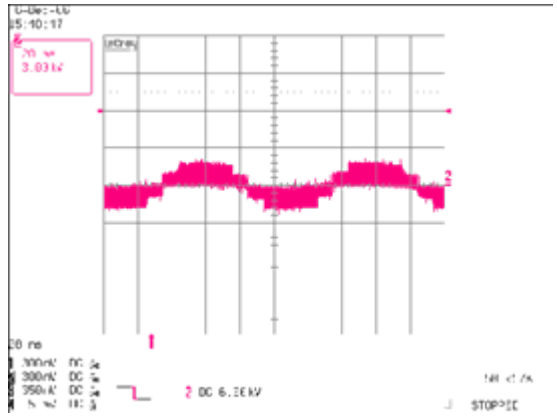

HVIMMI
ALARM
FAULT
VCB3
VCB1
NON/NON/NON
VCB2
Inverter
RUN
STOP
현대중공업
TCP/IP 통신
나가기


HVIMMI
INV. RUN
VCB1
VCB2
VCB3
현대중공업
TCP/IP 통신

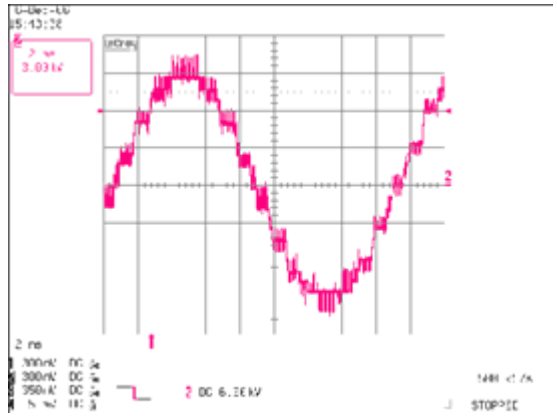
Case 3



Inverter Output 0V→ 6600V

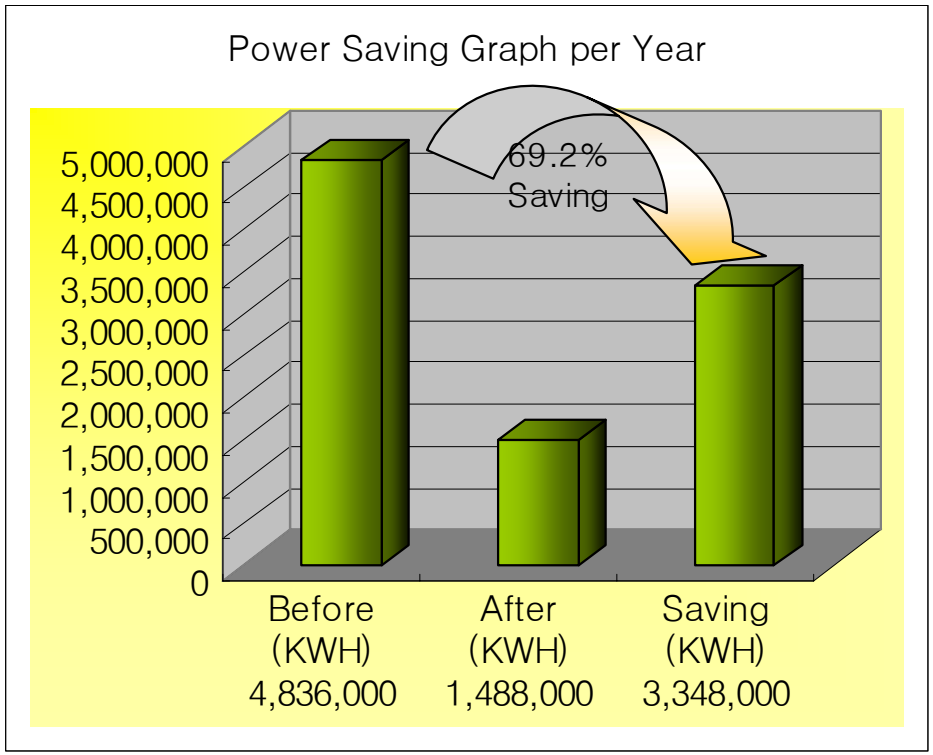


Inverter Output 1100V



Inverter Output 6600V

Case 3



1. Saving Amount per Year
   (1 & 2 ID Fan)
   =3,348,000KWH X 70KRW X 2 Sets
   =468,720,000KRW

2. Investment Breakdown
   - Inverter : 2 Sets
   - VCB/VCS Panel : 3 Sets
   - DCS Connection

Additional Effect부가 효과

1. Reduce Motor Noise and Vibration
2. Reduce Starting Current -> Extend Motor life span

N5000 Case 4

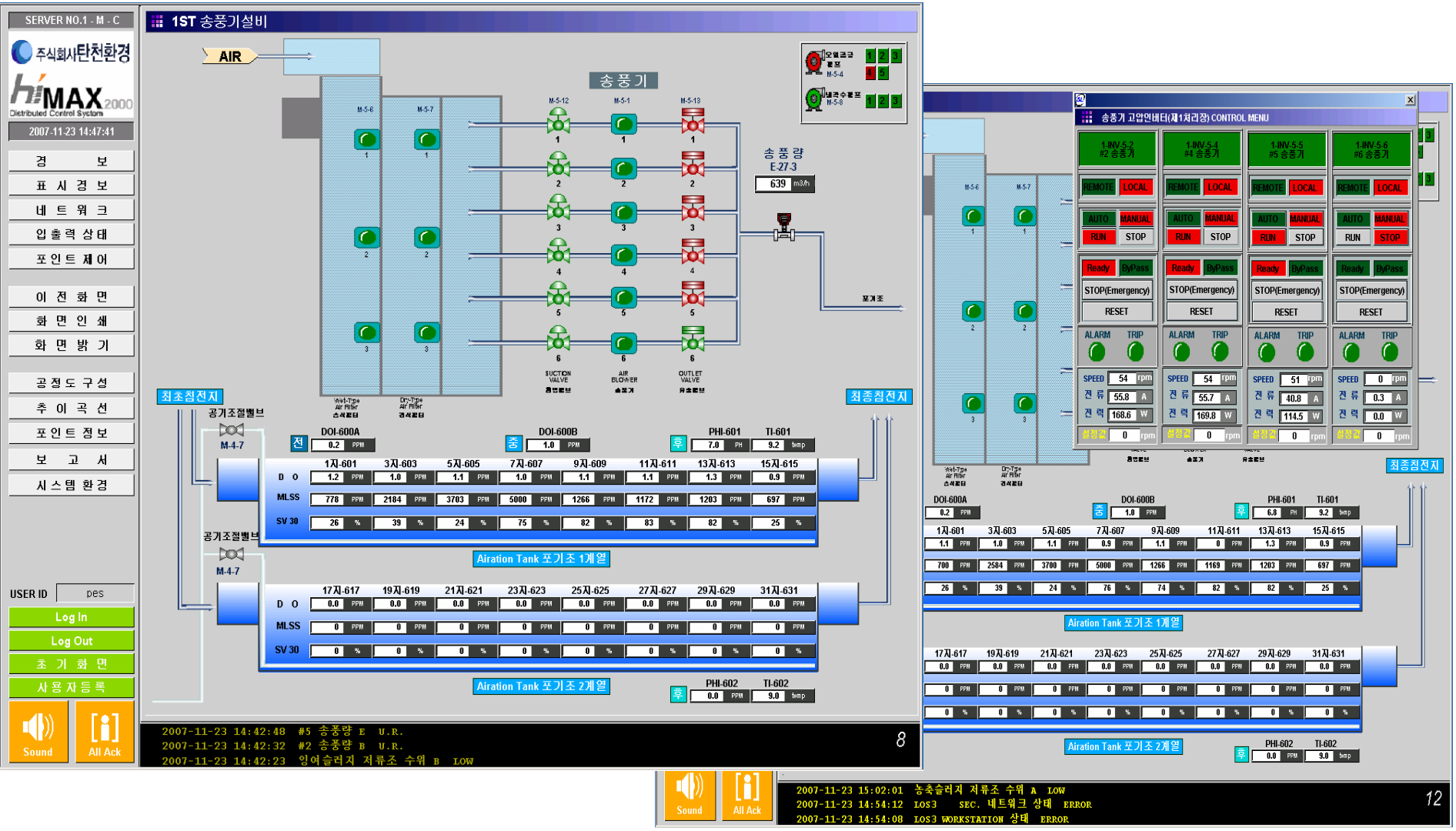
1. Inverter
   - Place : Tancheon Sewage Treatment Center In Seoul
   - Voltage & Capacity: 3300V, 750KVA(6sets),1000KVA(3sets)
   - Q'ty : 9 sets
   - Date : 2007. 11
2. Motor
   - 3300V,60HZ, 500KW(1) ,550KW(5),650KW(3),2P
3. Application
   - ID Fan


서울특별시 물재생센터 현황
SEWAGE TREATMENT CENTER IN SEOUL
명 칭
PLANT NAME
시설용량
CAPACITY
계 TOTAL 581
탄 천 TANCHOEN 110
중 랑 JOONGNANG 171
서 남 SEONAM 200
난 지 NANJI 100
난지물재생센터
Nanji S.T.C
서남물재생센터
Seonam S.T.C
중랑물재생센터
Joongang S.T.C
탄천물재생센터
Tancheon S.T.C
경기도
시 청
안 양 천
도 림 천
국 립 묘 지
반 포 천
사 당 천
양 재 천
탄 천
성 내 천
고 덕 천
성 북 천
청 계 천
• 위 치 : 강서구 마곡동 91번지
• 처리면적 : 120.07km²
• 시설용량 : 200만 m³/일
• 위 치 : 강남구 일원동 580번지
• 처리면적 : 70.53km²
• 시설용량 : 110만 m³/일

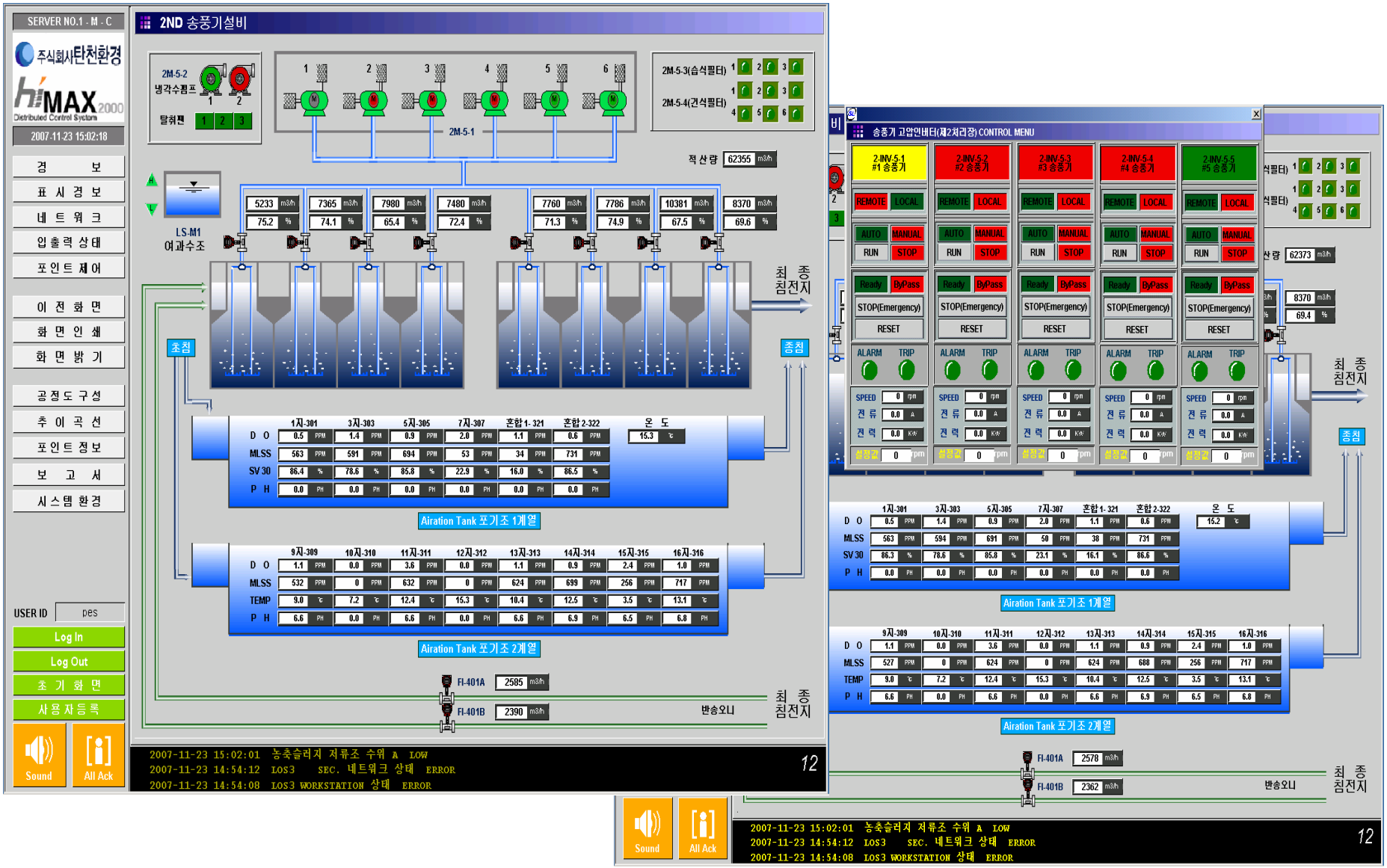
Case 4


서울특별시 탄천물재생센터 (주)탄천환경
서울특별시 물재생센터 현황
SEWAGE TREATMENT CENTER IN SEOUL

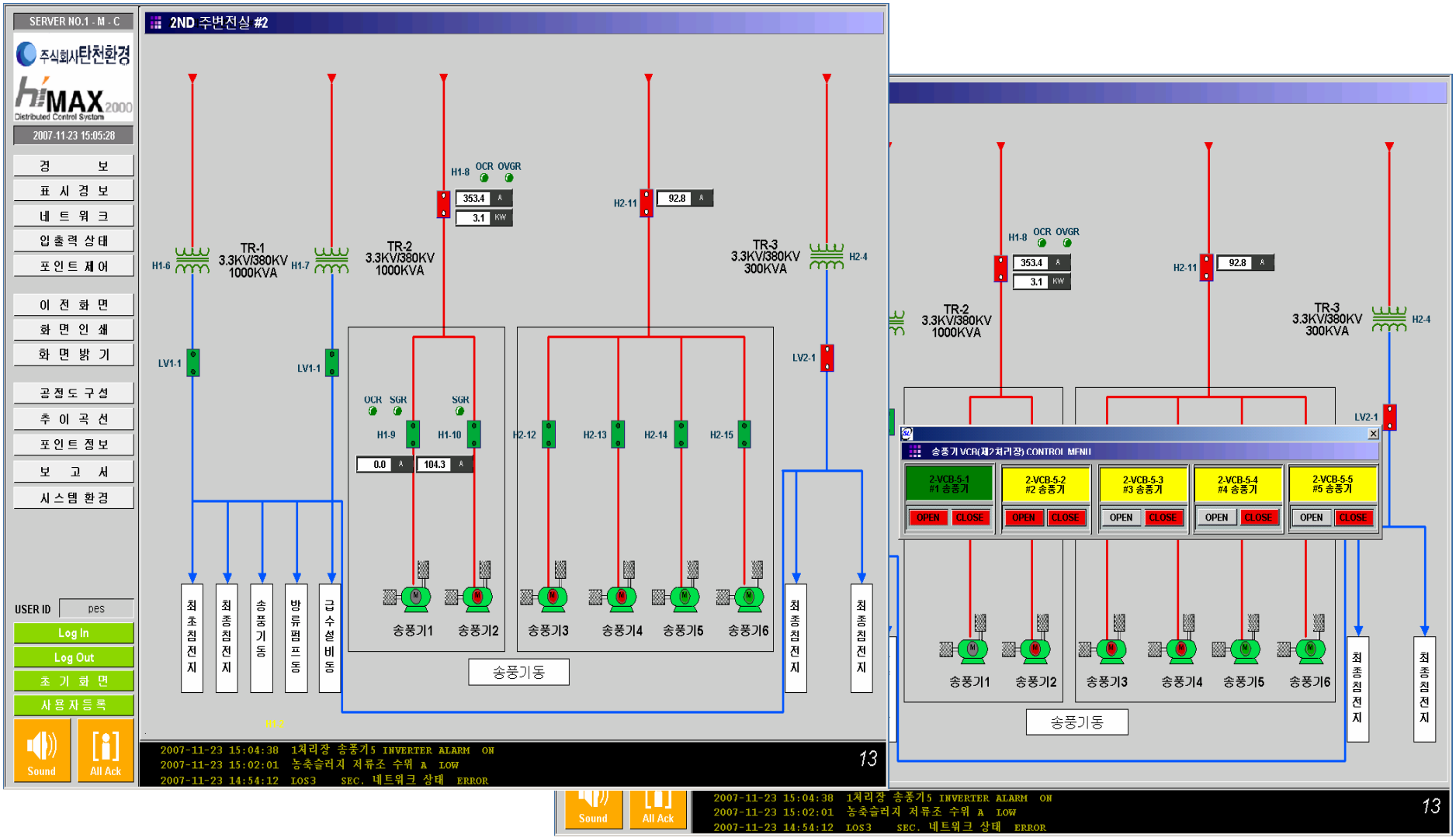
Case 4


SERVER NO.1 - M - C
주식회사탄천환경
hiMAX 2000
Distributed Control System
2007-11-23 14:47:41
경 보
표 시 경 보
네 트 워 크
입출력 상태
포인트 제어
이 전 화 면
화 면 인 쇄
화 면 밝 기
공정도구성
추 이 곡 선
포인트 정보
보 고 서
시스템 환경
USER ID
pes
Log In
Log Out
초 기 화 면
사용자등록
Sound
All Ack
1ST 송풍기설비
AIR
송풍기
송 풍 량
E-27-3
639 m3/h
최초침전지
최종침전지
공기조절밸브
M-4-7
DOI-600A
DOI-600B
PHI-601
TI-601
1지-601 3지-603 5지-605 7지-607 9지-609 11지-611 13지-613 15지-615
D O
MLSS
SV 30
Airation Tank 포기조 1계열
17지-617 19지-619 21지-621 23지-623 25지-625 27지-627 29지-629 31지-631
Airation Tank 포기조 2계열
PHI-602
TI-602
2007-11-23 14:42:48 #5 송풍량 E U.R.
2007-11-23 14:42:32 #2 송풍량 B U.R.
2007-11-23 14:42:23 임어슬러지 저류조 수위 B LOW
8
송풍기 고압인버터(제1처리장) CONTROL MENU
1-INV-5-2 #2 송풍기
1-INV-5-4 #4 송풍기
1-INV-5-5 #5 송풍기
1-INV-5-6 #6 송풍기
REMOTE LOCAL
AUTO MANUAL
RUN STOP
Ready ByPass
STOP(Emergency)
RESET
ALARM TRIP
SPEED
전 류
전 력
2007-11-23 15:02:01 농축슬러지 저류조 수위 A LOW
2007-11-23 14:54:12 LOS3 SEC. 네트워크 상태 ERROR
2007-11-23 14:54:08 LOS3 WORKSTATION 상태 ERROR
12

Case 4

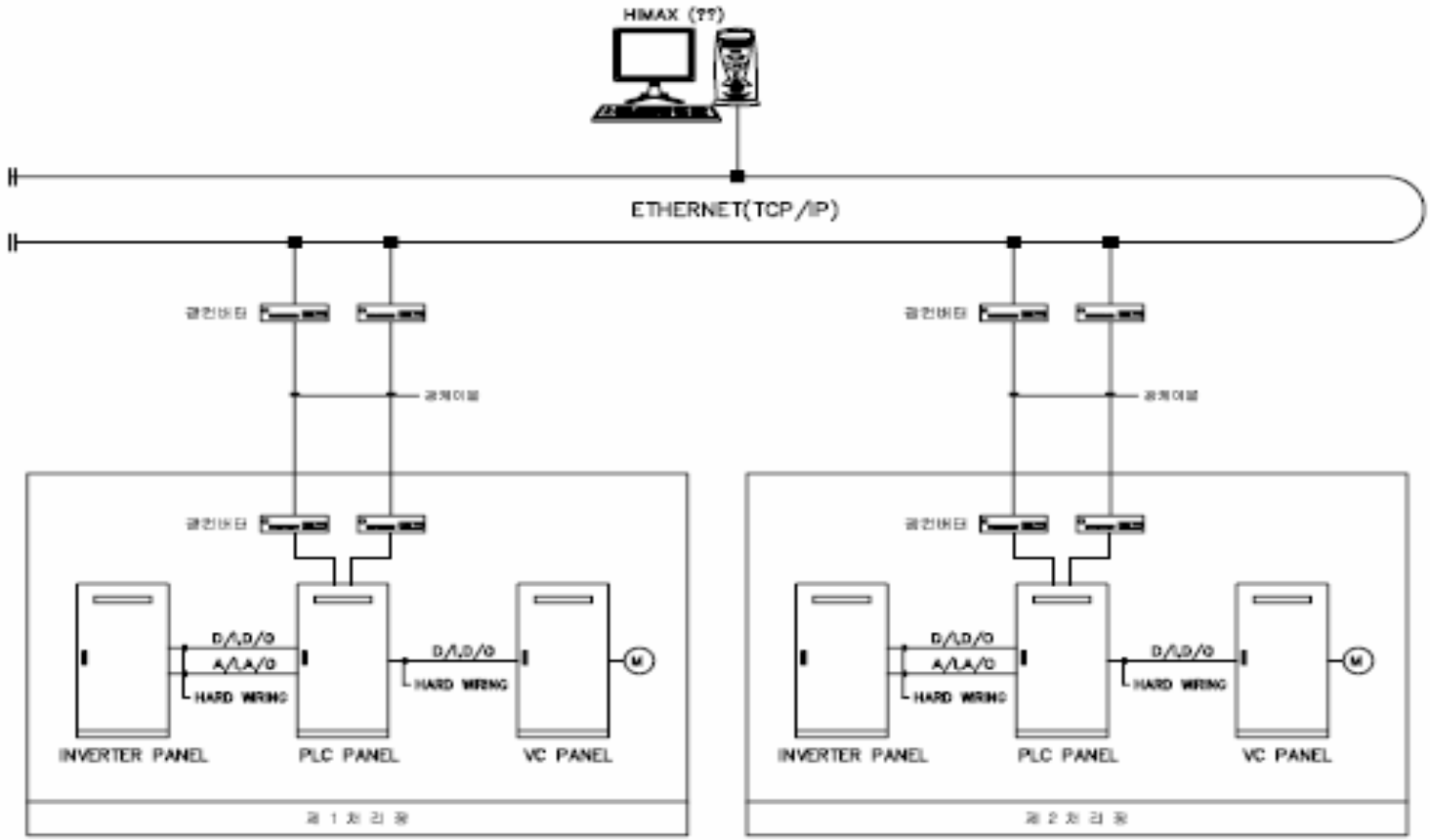

SERVER NO.1 - M - C
주식회사탄천환경
hiMAX 2000
Distributed Control System
2007-11-23 15:02:18
경 보
표 시 경 보
네 트 워 크
입 출력 상 태
포 인 트 제 어
이 전 화 면
화 면 인 쇄
화 면 밝 기
공 정 도 구 성
추 이 곡 선
포 인 트 정 보
보 고 서
시 스 템 환 경
USER ID
pes
Log In
Log Out
초 기 화 면
사 용 자 등 록
Sound
All Ack
2ND 송풍기설비
2M-5-2
냉각수펌프
탈취팬
2M-5-1
2M-5-3(습식팰타)
2M-5-4(건식팰타)
적 산 량
62355
LS-M1
여과수조
5233
7365
7980
7480
7760
7786
10381
8370
75.2
74.1
65.4
72.4
71.3
74.9
67.5
69.6
최 종
침전지
초침
종침
1지-301
3지-303
5지-305
7지-307
혼합1-321
혼합2-322
온 도
D O
MLSS
SV 30
P H
Airation Tank 포기조 1계열
9지-309
10지-310
11지-311
12지-312
13지-313
14지-314
15지-315
16지-316
TEMP
Airation Tank 포기조 2계열
FI-401A
2585
FI-401B
2390
반송오니
2007-11-23 15:02:01 농축슬러지 저류조 수위 A LOW
2007-11-23 14:54:12 LOS3 SEC. 네트워크 상태 ERROR
2007-11-23 14:54:08 LOS3 WORKSTATION 상태 ERROR
12
송풍기 고압인버터(제2처리장) CONTROL MENU
2-INV-5-1 #1 송풍기
2-INV-5-2 #2 송풍기
2-INV-5-3 #3 송풍기
2-INV-5-4 #4 송풍기
2-INV-5-5 #5 송풍기
REMOTE
LOCAL
AUTO
MANUAL
RUN
STOP
Ready
ByPass
STOP(Emergency)
RESET
ALARM
TRIP
SPEED
전 류
전 력
설정값
62373
8370
69.4
15.2
594
691
50
38
731
23.1
16.1
527
688
2578
2362

Case 4


SERVER NO.1 - M - C
주식회사탄천환경
HiMAX 2000
Distributed Control System
2007-11-23 15:05:28
경 보
표 시 경 보
네 트 워 크
입출력 상태
포인트 제어
이 전 화 면
화 면 인 쇄
화 면 밝 기
공정도 구성
추 이 곡 선
포인트 정보
보 고 서
시스템 환경
USER ID
DBS
Log In
Log Out
초 기 화 면
사용자등록
Sound
All Ack
2ND 주변전실 #2
TR-1 3.3KV/380KV 1000KVA
TR-2 3.3KV/380KV 1000KVA
TR-3 3.3KV/380KV 300KVA
H1-6
H1-7
H1-8
OCR OVGR
353.4 A
3.1 KW
H2-11
92.8 A
H2-4
LV1-1
LV2-1
OCR SGR
SGR
H1-9
H1-10
0.0 A
104.3 A
H2-12
H2-13
H2-14
H2-15
최초침전지
최종침전지
송풍기동
방류펌프동
급수설비동
송풍기1
송풍기2
송풍기3
송풍기4
송풍기5
송풍기6
송풍기동
2007-11-23 15:04:38 1처리장 송풍기5 INVERTER ALARM ON
2007-11-23 15:02:01 농축슬러지 저류조 수위 A LOW
2007-11-23 14:54:12 LOS3 SEC. 네트워크 상태 ERROR
13
송풍기 VCR(제2처리장) CONTROL MENU
2-VCB-5-1 #1 송풍기
2-VCB-5-2 #2 송풍기
2-VCB-5-3 #3 송풍기
2-VCB-5-4 #4 송풍기
2-VCB-5-5 #5 송풍기
OPEN
CLOSE

PLC System Configuration

SYSTEM CONFIGRATION

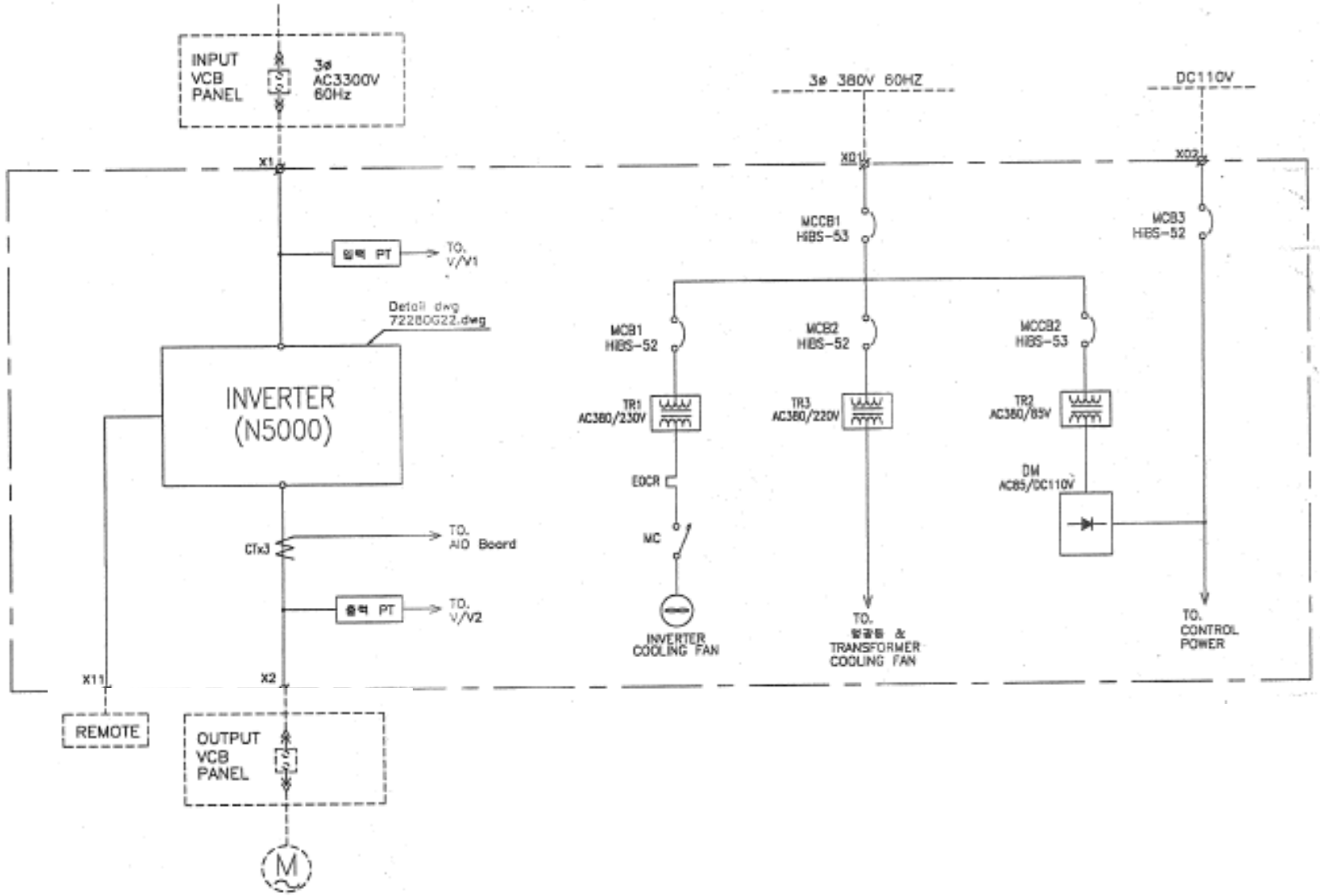


Case 4

Case 4

1. Motor / Application
   - Voltage : 3300V,60HZ
   - Output
     500KW,
     550KW
     650KW
   - Pole : 2 pole

Case 4


INPUT
VCB
PANEL
3ø
AC3300V
60Hz
X1
입력 PT
TO.
V/V1
Detail dwg
72280G22.dwg
INVERTER
(N5000)
CTx3
TO.
AIO Board
출력 PT
TO.
V/V2
X11
X2
REMOTE
OUTPUT
VCB
PANEL
M
3ø 380V 60HZ
X01
MCCB1
HBS-53
MCB1
HBS-52
TR1
AC380/230V
EOCR
MC
INVERTER
COOLING FAN
MCB2
HBS-52
TR3
AC380/220V
TO.
냉각팬 &
TRANSFORMER
COOLING FAN
MCCB2
HBS-53
TR2
AC380/85V
DM
AC85/DC110V
DC110V
X02
MCB3
HBS-52
TO.
CONTROL
POWER

2. Inverter
 – 3300V,750KVA /1000KVA : 4 sets

Case 4

Case 4

2. Inverter
 – 3300V,750KVA /1000KVA : 5 sets

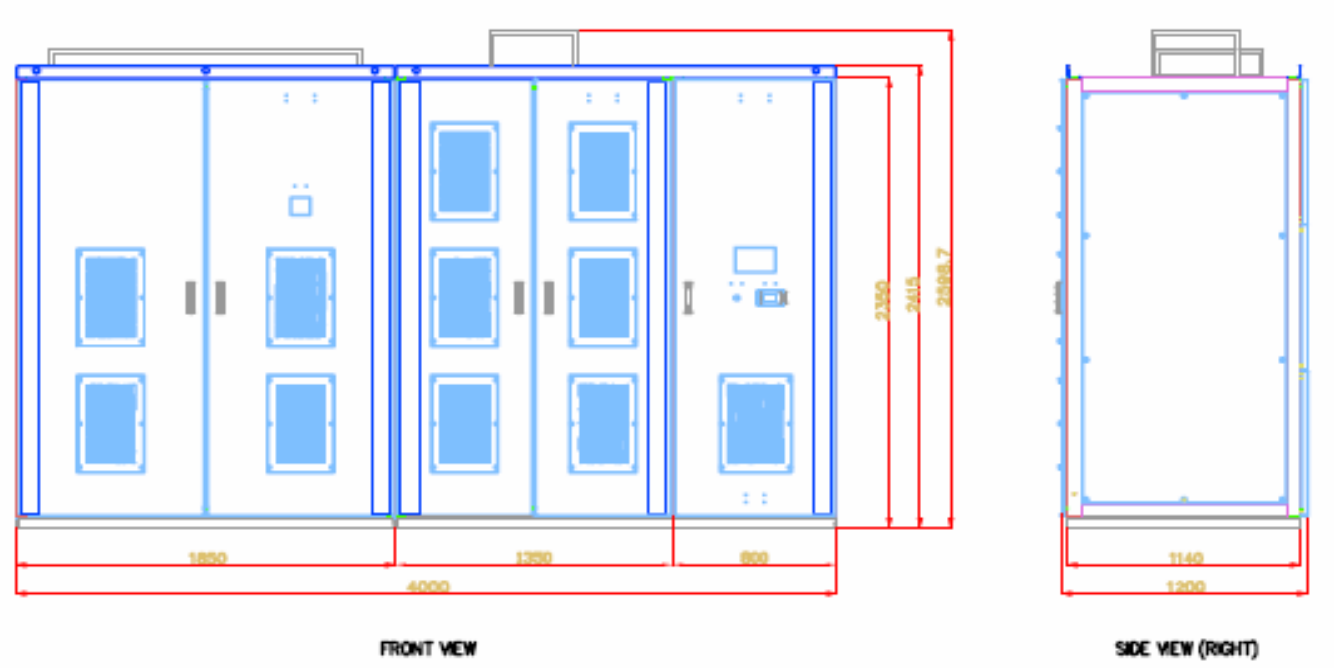
Case 4

Case 4

Inverter Input VCB

Inverter / Bypass & Output VCS

Outline Dimension



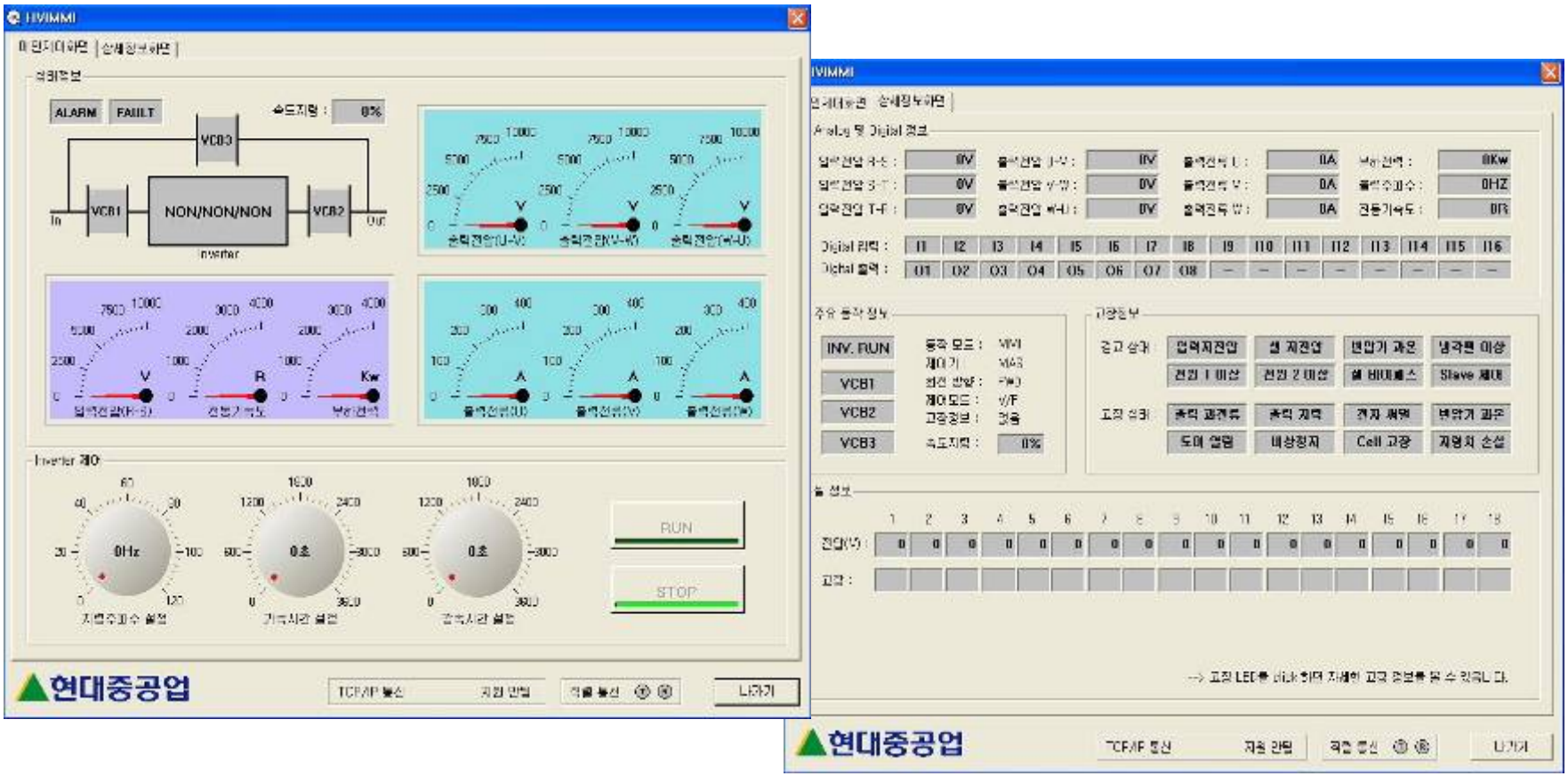

운전감시반
HiRUN-N5000
지령 주파수 55.0 Hz
출력 주파수 55.0 Hz
운전 상태 FWD
출력 전류 101 A
출력 전압 3024 V
전동기 속도 3300 RPM
부스트 주파수 6.0 Hz
부스트 전압 33 V
MAS
출력 전력 470 kW
운전누적시간 4시 3분
투입누적시간 75시58분
1 2 3 4 5 6 7 8
DI1
DI2
DO
Up
고장
RUN
STP
정지
Dn


운전조작반
HiRUN-N5000
출력주파수 60.0 Hz
MASTER
운전 상태 FWD
전동기속도 3600 RPM
경고 해제
고장 해제
지령 주파수 60.0 Hz
방향 설정 1 FWD
가속 시간 180 Sec
감속 시간 360 Sec
Up
고장
RUN
STP
정지
Dn


CTPT감시반
HiRUN-N5000
3상 입력전압
3상 출력전압
3상 출력전류
Vrs 3286 V
Vst 3560 V
Vtr 3423 V
Vuv 3299 V
Vvw 3299 V
Vwu 3299 V
Iu 122 A
Iv 125 A
Iw 120 A
Up
고장
RUN
STP
정지
Dn


CELL감시반
HiRUN-N5000
V_U1 833 V
V_U2 832 V
V_U3 837 V
V_U4 0 V
V_U5 0 V
V_U6 0 V
V_U1 828 V
V_U2 830 V
V_U3 829 V
V_U4 0 V
V_U5 0 V
V_U6 0 V
V_W1 831 V
V_W2 820 V
V_W3 808 V
V_W4 0 V
V_W5 0 V
V_W6 0 V
Up
고장
RUN
STP
정지
Dn

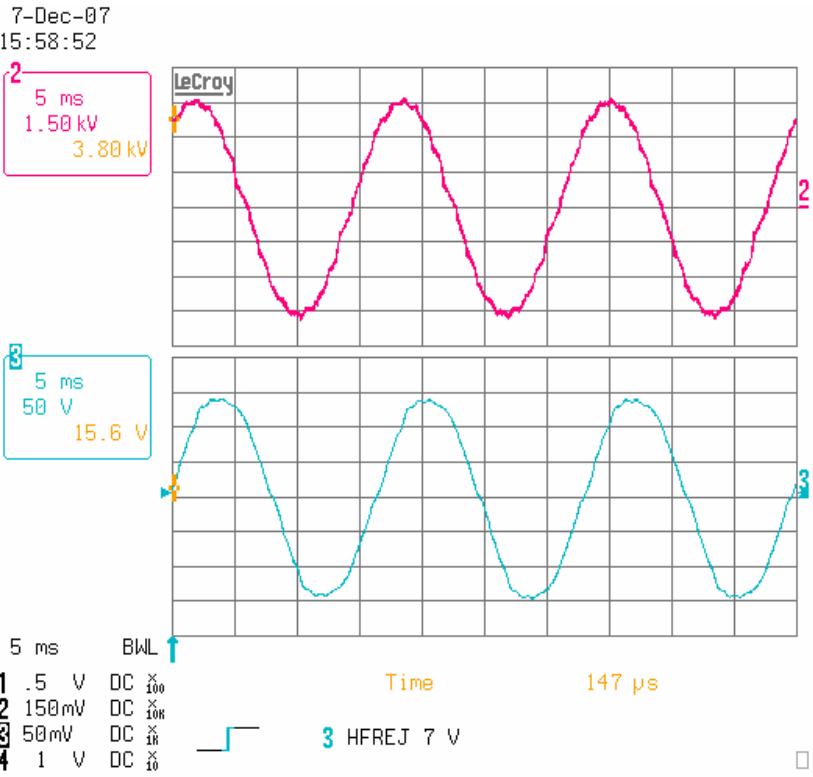
MMI Display

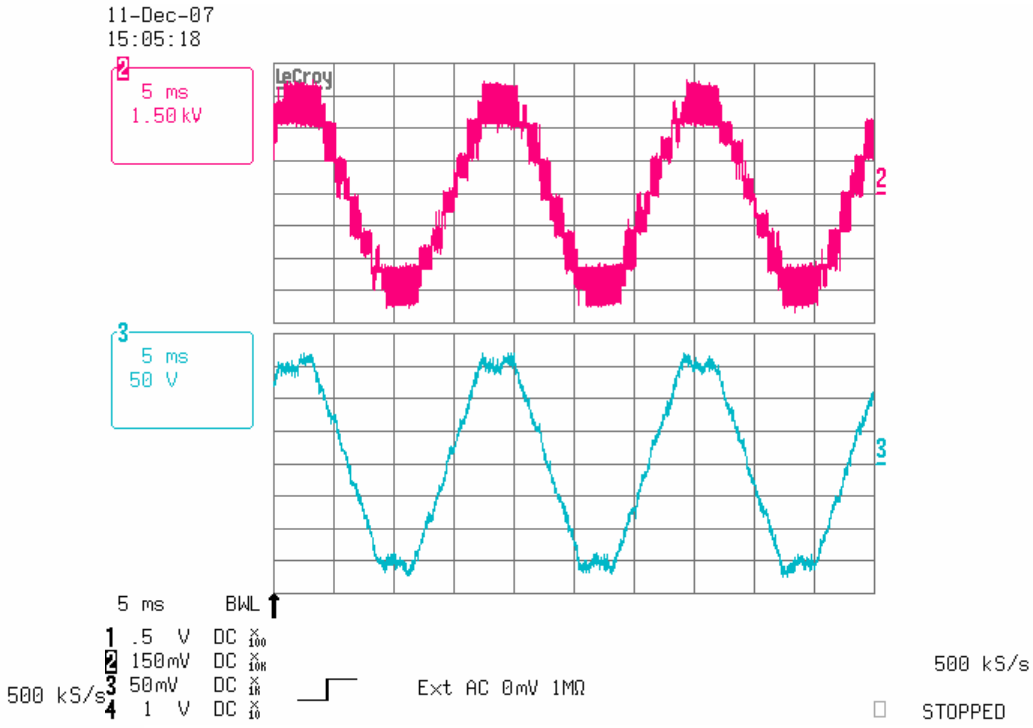


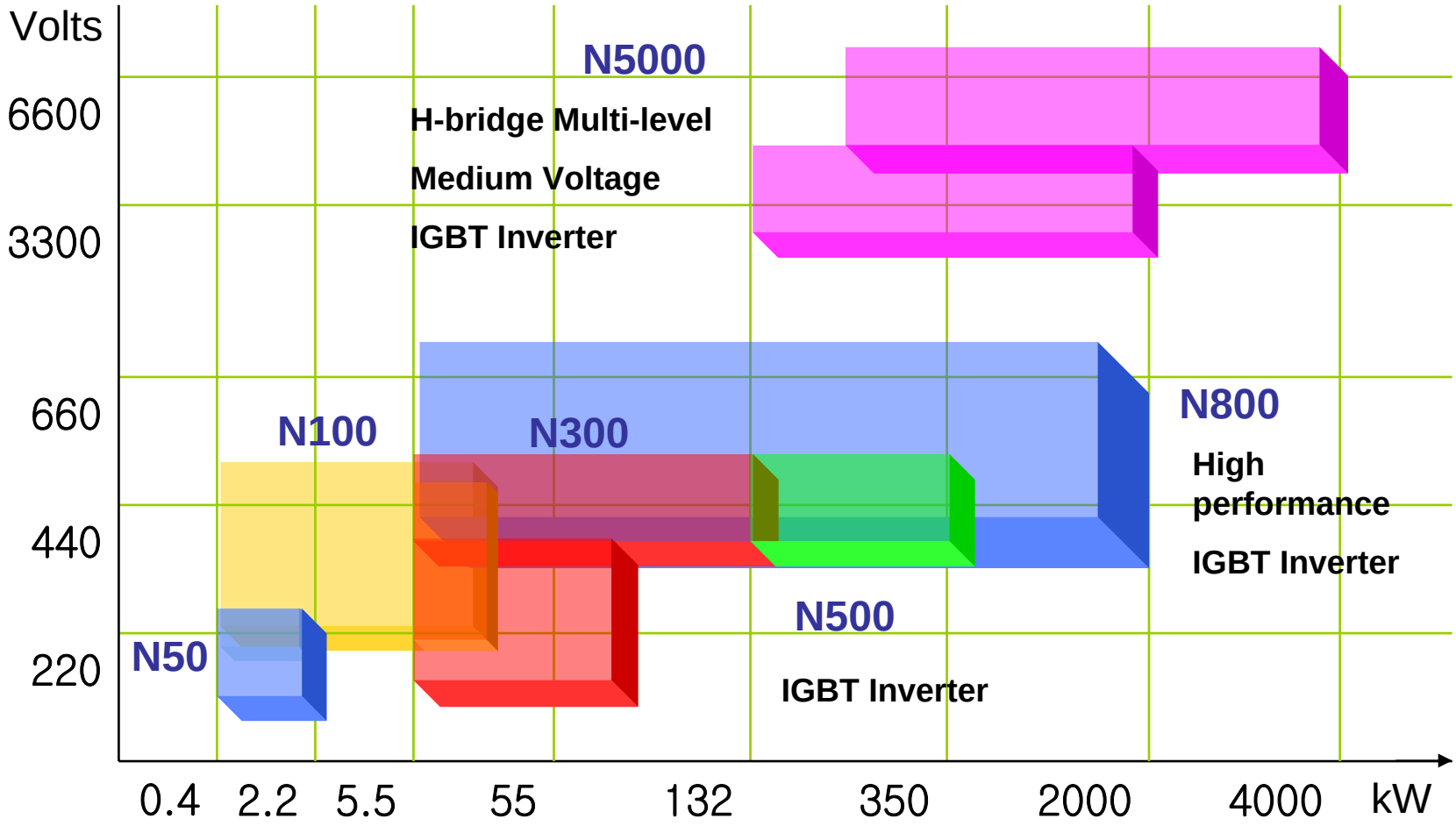
Inverter Operating Curve

Case 4

Output Voltage & Current






Volts
6600
3300
660
440
220
N5000
H-bridge Multi-level
Medium Voltage
IGBT Inverter
N100
N300
N800
High
performance
IGBT Inverter
N50
N500
IGBT Inverter
0.4
2.2
5.5
55
132
350
2000
4000
kW