- PROPOSAL-

◆ STEAM–TURBINE POWER GENERATION EQUIPMENT (SALES)

POWER 97.5Mw (97,500kw)

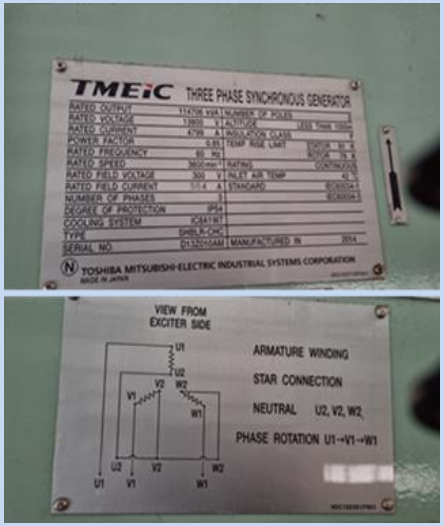
97.5 Mw Steam-Turbine Power Generation Plant

POWER 97.5Mw (97,500kw)

◆ Steam -Turbine Power Generation
97.5MW (sale equipment)

- **Specifications: Steam Turbine**
  -.Mitsui-Alstom
  -.Steam turbine 97.5Mw
  -. Year Of BUILT 2014
  (Manufactured: 2014)

- **Specifications: Generation**
  -.Toshiba-Mitsubishi Electric
  Industrial System.
  -.OUTPUT: 114,706KVA
  -. Voltage: 13800V
  -. Frequency: 60 Hz
  -. Year Of BUILT 2014
  (Manufactured: 2014)



97.5 Mw Steam-Turbine Power Generation Plant

◆ Steam Turbine Specification

- Manufacture : MES (Mitsui engineering shipbuilding)
- Manufacturing Date : 2014
- Operating : Generator Output Power
  - Max. : 97.5Mw x 3600 rpm (steam 428.1 t/h x 70 bar,g)
  - Nor. : 85 Mw x 3600 rpm (steam 385.3 t/h x 70 bar,g)

◆ Generator Specification

- Manufacture : TMEIC (Toshiba Mitsubishi-electric Industrial Sys. Corp.)
- Manufacturing Date : 2014
- Output : 114,706 kVA(97.5Mw) x 3 phase 3 wire
- Type : Totally Enclosed Water to Air Cooled(IC81W), Cylindrical type rotor, Brushless type with PMG
- Voltage & Frequency : 13,800V x 60Hz x 2P
- Speed & Current : 3600rpm & 4,799A

97.5 Mw Steam-Turbine Power Generation Plant

◆ Steam boiler facilities are manufactured separately.

◆ Manufacture of Steam Boiler Equipment Required for Steam Power Generation Materials

- Review of raw materials for power generation

a. Coal Steam Boiler

b. LNG Steam Boiler

C. Heavy oil Steam boiler

d. Renewable Energy & Wood Pallet Steam boiler

- Power plant installation and completion. Total cost up to normal operation.
- Submit detailed information after buyer review.

97.5 Mw Steam-Turbine Power Generation Plant

Generator Specification

SPECIAL PURPOSE STEAM TURBINE DATA SHEET (API 612-6th)

CLIENT: POSCO Engineering & Construction ITEM NO. :
UNIT: Steam Turbine Generator for SNG proj. LOCATION: POSCO Gwangyang steel work, KOREA

EQUIPMENT NAME: Steam Turbine NUMBER REQUIRED: One
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER ☐ BY MANUFACTURER
APPLICABLE TO: ○ PROPOSAL ☒ PURCHASE ☐ AS BUILT
MANUFACTURER: MES MODEL: CD 30.46 SERIAL NO.
DRIVEN EQUIPMENT ITEM No.
DRIVEN EQUIPMENT TYPE: ○ CENT. COMPRESSOR ☒ GENERATOR ○ ROTARY COMPRESSOR ○ OTHER

PERFORMANCE

OPERATING POINTS	GENERATOR		INLET			INDUCT. / EXTRACT.			EXHAUST		
☒ AS APPL	OUTPUT POWER	SPEED	FLOW	PRESS	TEMP	FLOW	PRESS	TEMP	PRESS	TEMP	ENTHALPY
	kW	RPM	t/h	barG	°CTT	kg/h	kg/cm²g	°CTT	barA	°CTT	kJ/kg
MAXIMUM Case 5-1	97500	3600	428.1	70	490	-	-	-	0.11	47.7	2318
GUARANTEE Case 1-1	85080	3600	385.3	70	490	-	-	-	0.11	47.7	2340
GUARANTEE Case 1-2	82030	3600	385.3	70	490	-	-	-	0.11	47.7	2346
MINIMUM Turndown 2	20160	3600	134.9	70	490	-	-	-	0.11	47.7	2596

UNLESS OTHERWISE SPECIFIED, ALL PRESSURE UNITS ARE "GAUGE"

☐ STEAM RATE (3.44) NORMAL RATED kg/kW-hr
☐ POTENTIAL MAXIMUM POWER (3.30) kW

INDUCTION ○ CONTROLLED ○ UNCONTR
No.1 EXTRACT ☒ CONTROLLED ○ UNCONTR
No.2 EXTRACT ☒ CONTROLLED ○ UNCONTR

STEAM CONDITIONS

		☒ INLET	☒ EXHAUST	☒ No.1EXTRACT INDUCTION	☒ No.2EXTRACT INDUCTION	○ EXTRACTION INDUCTION
FLOW t/h	MAXIMUM Case 5-1	428.1	300.51	70.84	56.64	
	GUARANTEE Case 1-1	385.3	266.12	65.03	54.04	
	GUARANTEE Case 1-2	385.3	247.98	65.03	72.2	
	MINIMUM	134.9	90.10	21.76	22.93	
PRESSURE barG	MAXIMUM Case 5-1	70	0.11 barA	31.50	5.5	
	GUARANTEE Case 1-1	70	0.11 barA	31.50	5.5	
	GUARANTEE Case 1-2	70	0.11 barA	31.50	5.5	
	MINIMUM	70	0.11 barA	31.50	5.5	
TEMPERATURE °CTT	MAXIMUM Case 5-1	490	47.7	385.7	216.2	
	GUARANTEE Case 1-1	490	47.7	388.6	223.3	
	GUARANTEE Case 1-2	490	47.7	388.5	220.5	
	MINIMUM	490	47.7	442.8	339.1	

SITE AND UTILITY DATA (See Sheet 1 for General & Site Information)

LOCATION : (6.1.17)
○ INDOOR ○ HEATED ○ UNHEATED
○ OUTDOOR ☒ UNDER ROOF ○ PARTIAL SIDES
○ GRADE ○ MEZZANINE ○ OTHER
○ WINTERIZATION REQ'D ○ TROPICALIZATION REQ'D
○ LOW TEMPERATURE ○ CORROSIVE AGENTS
☒ ELECTRICAL AREA CLASSIFICATION: Non-Hazardous
CLASS GROUP DIVISION
ZONE GROUP TEMPERATURE RATING
☒ ELEVATION 5.5 m BAROMETER kg/cm2
☒ WINTER TEMP Min.-15.5 °C SUMMER TEMP Max.37.2 °C
○ REL HUMIDITY % DESIGN WET BULB °C
○ UNUSUAL CONDITIONS ○ DUST ○ FUMES
○ OTHER

UTILITY CONDITIONS:

☒ AUXILIARY STEAM	MAX	NORM	MIN
INIT.PRESS barG		5	
INITIAL TEMP °CTT		159	
EXH PR kg/cm²g		-	
INSTRUMENT AIR barG		7	
INSTRUMENT AIR DEW POINT:			

☒ ELECTRIC :	DRIVERS	HEATING	INSTR / CTRL	ALARM / SHUTDOWN
VOLTS	AC440	A.C.220	DC110/AC110	DC110/AC110
PHASE	3	1	- / 1	- / 1
HERTZ	60	60	- / 60	- / 60
○ kW AVAIL				

☒ COOLING WATER

PRESS, NORM 4.0 DESIGN 6.0 barG
MIN RETURN PRESS 2.5 barG
MAX ALLOWABLE PRESS DROP bar
WATER SOURCE Cooling water
VELOCITY MIN MAX m / s
FOULING FACTOR h m2 / kcal

☒ UTILITY CONSUMPTION

COOLING WATER app.300 m³/h INSTR. AIR app.50 Nm³/h
AUX STM : NORMAL app.500 kg/h MAX kg/h
AUX DRIVERS : ELEC kW STEAM kg/h
HEATER(S) kW OTHER :
COOLING WATER 40 t/h for gland condenser

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1. GENERATOR

(1) Quantity : 1(one)
(2) Type form : Totally Enclosed Water to Air Cooled (IC81W), Cylindrical type rotor, brushless type with PMG
(3) Enclosure : IP 54, Generator frame and terminal boxes
(4) Output : 114,706kVA (97.500kW)
(5) Phase : Three (3) phase three(3) wire
(6) Power factor : 85% Lagging (Operation range: 85% Lagging ~ 95% Leading)
(7) Voltage : 13,800V
(8) Frequency : 60Hz
(9) No. of pole : 2
(10) Speed : 3,600min^{-1}
(11) Current : 4,799A
(12) Rating : Continuous
(13) Connection : Star (Neutral brought out)
(14) Insulation class : Class F (Temp. rise: Class B)
(15) Bearing : Sleeve metal, forced lubrication and oil jacking
(Lub. oil shall be supplied by turbine side)
(Lub. oil inlet temp. : Max. 45 ℃, Pressure: [0.15 --Normal]MPa,
Q'ty: 340 litter/min, Type: ISO VG32)
(16) Excitation system : Brush-less type with PMG
(17) Applicable standard : IEC 60034-1, -3
(18) Cooling Water : Industrial water is supplied for cooling system

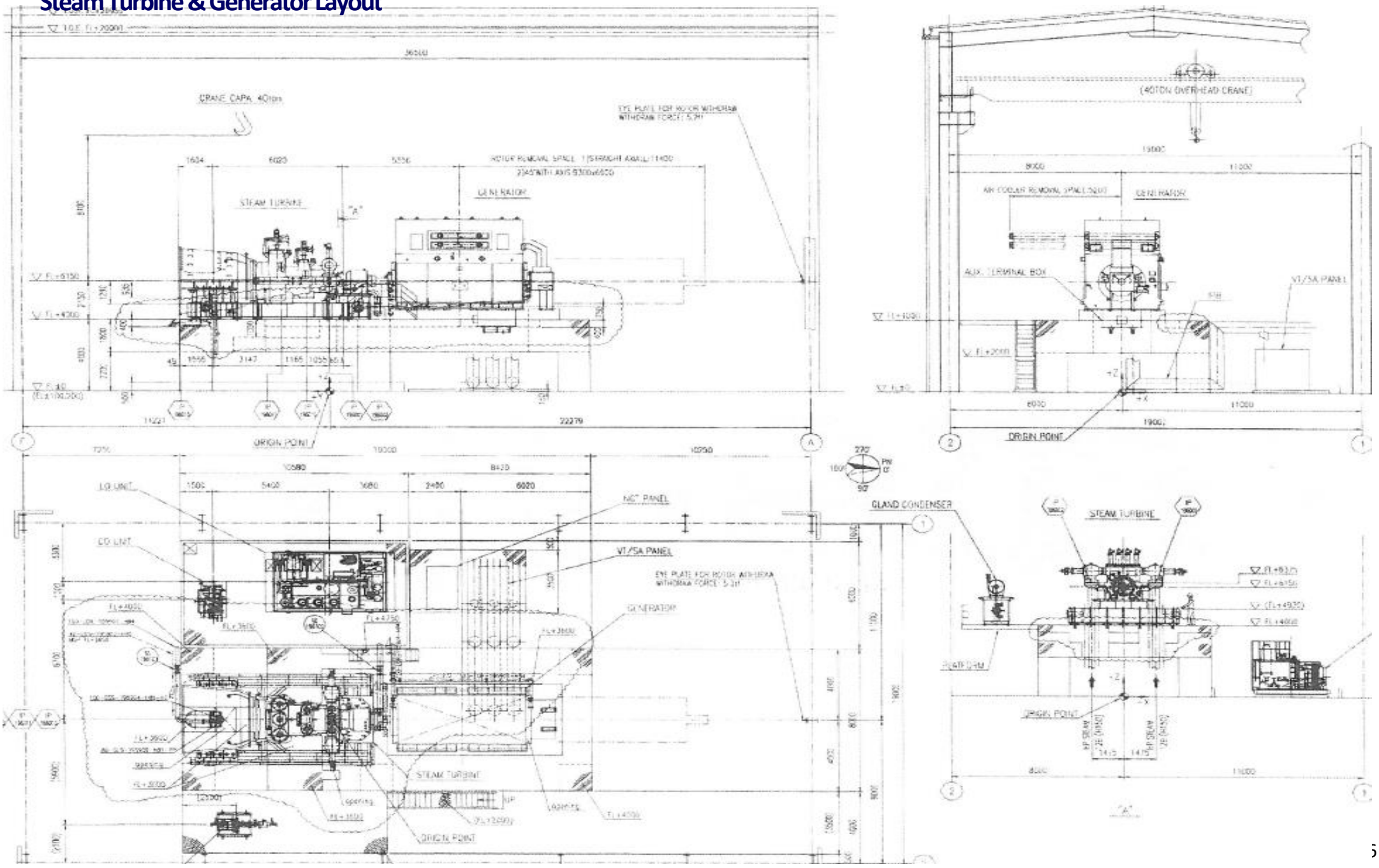
Inlet temperature	: 32℃,
Maximum outlet temperature	: Approx. 41℃ at 2 coolers running
Pressure	: [0.5] MPa , Operation pressure 4barG(0.4MPa)
Q'ty	: 220m³/hour (110m³/hour x 2)
Water quality	: fresh water
Material of Cooling Water Pipe	: 90-10 Cupronickel
Capacity of one(1) set of cooler	: 67% × 2 cooler(s)

(19) Installation : indoor
(20) Noise Limit : Less than 97 dB (at 1m from machine's surface and no load)
(21) Painting procedure : Refer to APPENDIX-1

(22) Generator data (design value)
Efficiency : 98.26% with tolerance at 100% load and PF=0.85
Efficiency shall not fall below 98.06 %(limit of tolerance)
Xd = 212% (Unsaturation)
Xd' = 30% (Saturation)
Xd" = 17% (Saturation)
Tdo' = 7.2sec
Tdo" = 0.06sec
SCR = 0.45 and over
(23) Over Speed Strength : 120% - 2 min

97.5 Mw Steam-Turbine Power Generation Plant

Steam Turbine & Generator Layout



97.5 Mw Steam-Turbine Power Generation Plant

◆ Sales Spec. (900U-Utility)

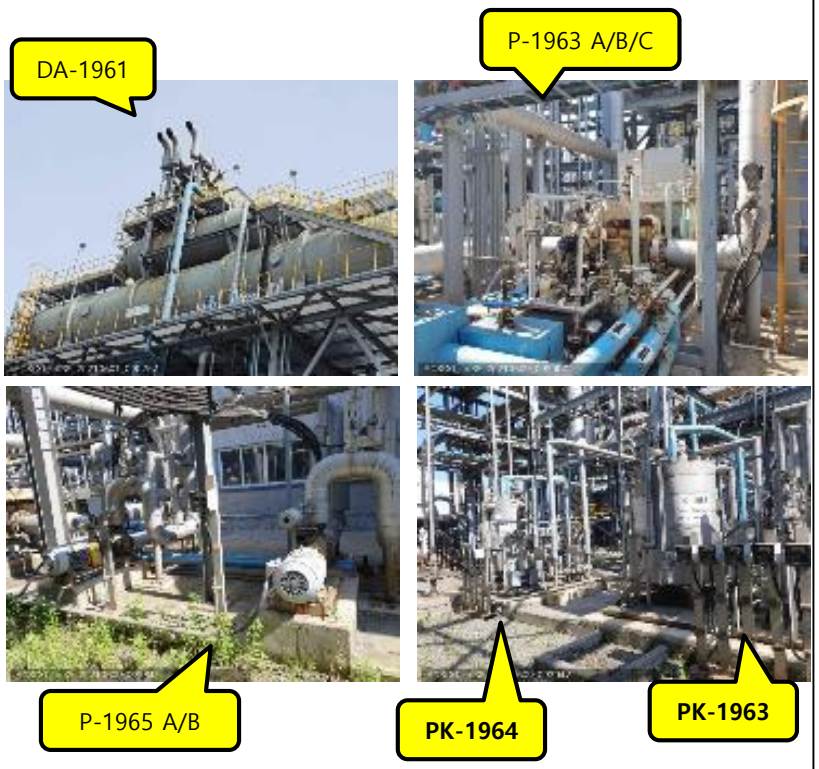
◆ Index (U-960 BOILER FEED WATER)

Unit(U-960)	Section	Condition	Remark
1. BOILER FEED WATER	1. DA-1961	Pump Lube Oil Charging	
	2. P-1963 A/B/C		
	3. P-1965 A/B		
	4. PK-1963-T1		
	5. PK-1964-T1		
	6. PK-1963-P1 A/B		
	7. PK-1963-P2 A/B		
	8. PK-1964-P1 A/B		
	9. PK-1964-P2 A/B		
2. CONDENSATE RECOVERY	10 E-1961	Pump Lube Oil Charging	
	11. E-1962		
	12. V-1962		
	13. P-1962 A/B		
	14. E-1963		
	15. E-1965		
	16. V-1965		
	17. P-1966		
	18. E-1966		

97.5 Mw Steam-Turbine Power Generation Plant

◆ Sales Spec. (900U-Utility)

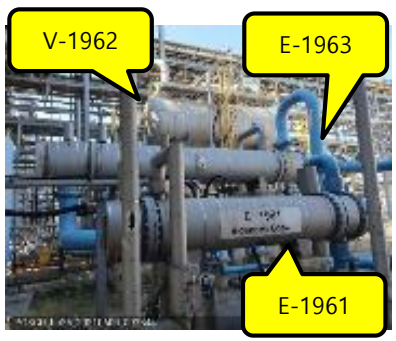
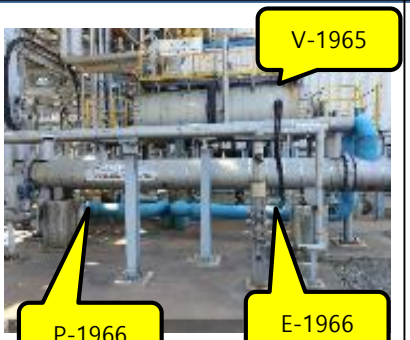
■ **Detail Spec. U-960 (BOILER FEED WATER)**

Device Name	Functioning	Photo	Specification
U-960 - DA-1961 - P-1963 A/B/C - P-1965 A/B - PK-1963-T1 - PK-1964-T1 - PK-1963-P1 A/B - PK-1963-P2 A/B - PK-1964-P1 A/B - PK-1964-P2 A/B	DEMI WATER를 승온, 탈기 후 약품처리하여 고압의 BOILER FEED WATER 공급 Raise the temperature of DEMI WATER and remove it and then though the chemical treatment to supply high pressure BOILER FEED WATER		**- DA-1961 (DEAERATOR)** : SIZE : 4600 mm ID × 15600 mm T/T DESING P&T : 2.5 bar/FV, 165C / -15.5C **- P-1963 A/B/C (HP BFW PUMP)** **:** 446 ㎥ × 98 barg / 1700 KW **- P-1965 A/B (LP BFW PUMP)** : 49.5 ㎥ × 8.8 barg / 30 KW **- PK-1963-T1 (OXYGEN SCAVENGER INJECTION TANK)** :CAPACITY : 2.3 ㎥ SIZE : 1500 mm ID × 1524 mm HT **- PK-1964-T1 (CORROSION INHIBITOR INJECTION TANK)** **:** CAPACITY : 1.3 ㎥ SIZE : 1200 mm ID × 1524 mm HT **- PK-1963-P1 A/B (OXYGEN SCAVENGER INJECTION PUMP-HP)** **:** CAPACITY : 2 L/hr × 10 barg / 0.4KW **- PK-1963-P2 A/B (OXYGEN SCAVENGER INJECTION PUMP-LP)** **:** CAPACITY : 0.17 L/hr × 10 barg / 0.4KW **- PK-1964-P1 A/B (CORROSION INHIBITOR INJECTION PUMP-HP)** **:** CAPACITY : 4 L/hr × 10 barg / 0.4KW **- PK-1964-P2 A/B (CORROSION INHIBITOR INJECTION PUMP-HP)** **:** CAPACITY :0.54 L/hr × 10 barg / 0.4KW **※ Agitator, Pump Lube Oil Charging상태**

97.5 Mw Steam-Turbine Power Generation Plant

◆ Sales Spec. (900U-Utility)

■ **Detail Specification U-960 (CONDENSATE RECOVERY)**

Device Name	Functioning	Photo	Specification
U-960 - E-1961 - E-1962 - V-1962 - P-1962 A/B - E-1963 - E-1965 - V-1965 - P-1966 - E-1966	CONDENSATE를 냉각하여 DEMI' TANK로 회수하는 설비 Cooling CONDENSATE and collect it to DEMI' TANK	    	**- E-1961 (BLOWDOWN COOLER)** : TEMA TYPE...AEM DUTY.....1106 × 1.1 KW AREA.....77.95 m2 **- E-1962 (FLASH STEAM VENT CONDENSER)** **:** DUTY.....1106 × 1.1 KW AREA.....77.95 m2 **- V-1962 (LP CONDENSATE FLASHDRUM)** : SIZE : 3000 mm ID × 8200 mm T/T **- P-1962 A/B (CONDENSATE RECOVRY PUMP)** : CAPACITY : 137 ㎥/hr × 5.65 barg / 45 KW **- E-1963 (CONDENSATE COOLER)** **:** TEMA TYPE...AEM DUTY.....1095 × 1.1 KW AREA.....461.01 m2 **- E-1965 (LP STEAM CONDENSER)** **:** DUTY.....35239 KW AREA.....21679 m2 **- V-1965 (CONDENSATE DRUM)** **:** SIZE : 1600 mm ID × 5000 mm T/T **- P-1966 (CONDENSATE PUMP)** **:** CAPACITY : 59.2 ㎥/hr × 3.7 barg / 15 KW **- E-1966 (CONDENSATE TRIM COOLER)** DUTY.....2079 KW AREA.....92.4 m2 **※ Agitator, Pump Lube Oil Charging상태**

97.5 Mw Steam-Turbine Power Generation Plant

◆ Sales Spec. (900U-Utility)

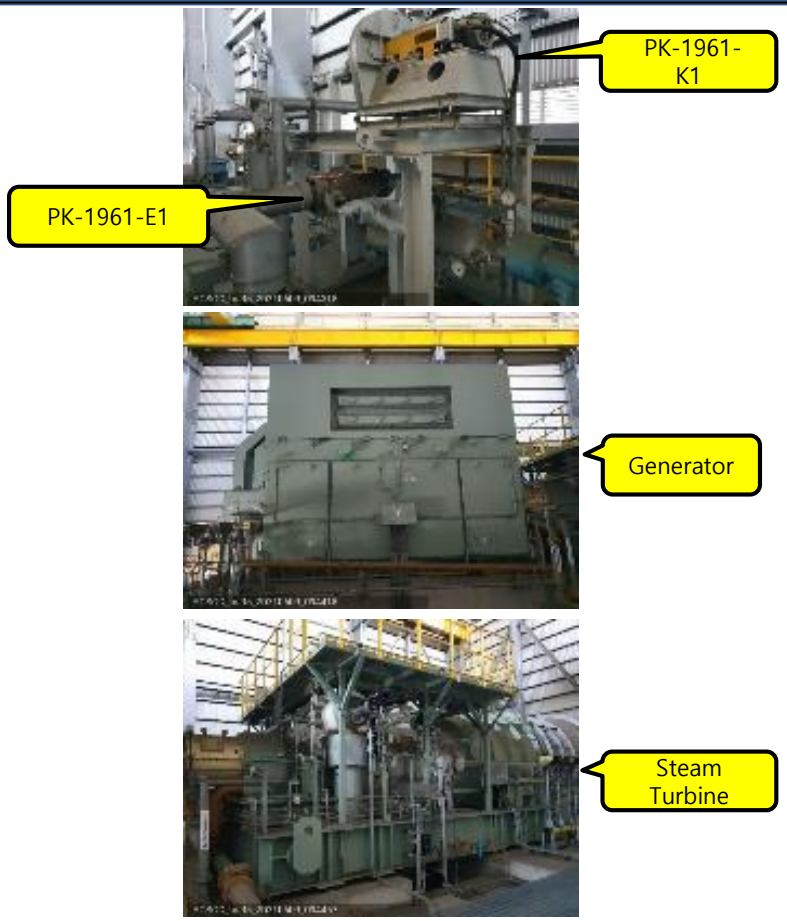
■ Sales Specification Index (PK-1961 Steam Turbine Generator)

Unit(PK-1961)	Section	Condition	Remark
1. Steam Turbine Generator	1. PK-1961	Pump Lube Oil Charging	
	2. PK-1961-E1		
	3. PK-1961-K1		
2. OIL SYSTEM	4. PK-1961-T1	Pump Lube Oil Charging	
	5. PK-1961-K2		
	6. PK-1961-P1 A/B		
	7. PK-1961-P2		
	8. PK-1961-P3 A/B		
	9. PK-1961-T2		
	10. PK-1961-P4 A/B		

97.5 Mw Steam-Turbine Power Generation Plant

◆ Sales Spec. (900U-Utility)

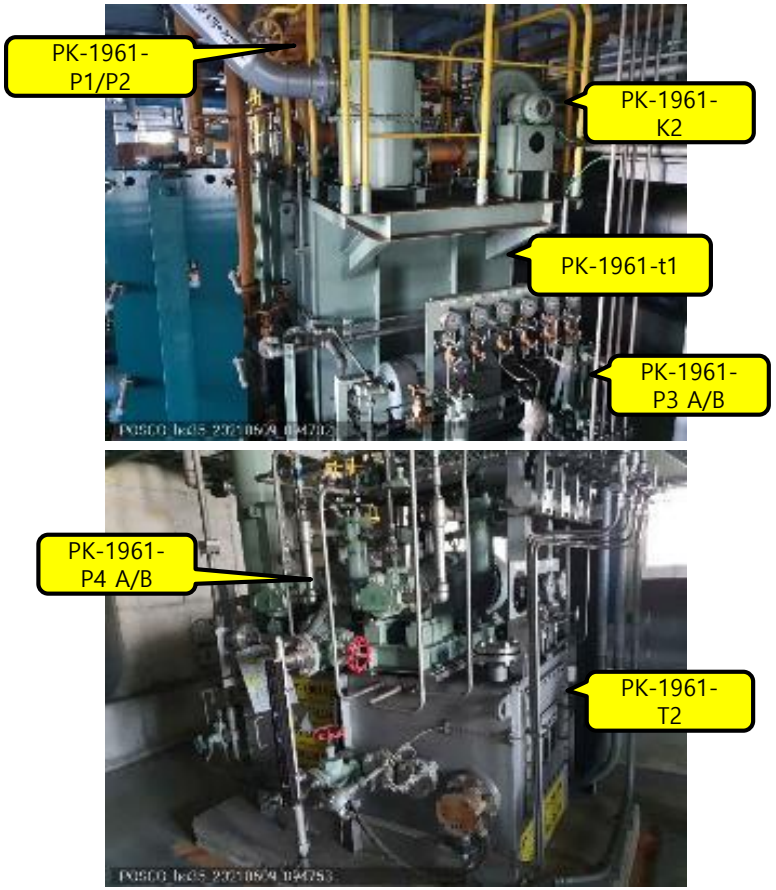
■ Detail Specification **PK-1961 (Steam Turbine Generator)**

Device Name	Functioning	Photo	Specification
PK-1961 - PK-1961 - PK-1961-E1 - PK-1961-K1	고온(490℃) 고압(70 bar) 의 스팀을 발생시켜 Steam Turbine을 이용하 여 열에너지를 운동 에너지로 변환하여 발전 기를 회전시켜 전력을 생산 Generate the high Temp.(490℃) and high pressure(70 bar) steam, and then rotate the steam turbine and produce the electric power		**- PK-1961 (Steam Turbine Generator)** - 제작사 :MES(Mitsui Engineering & Shipbuilding) - Model : CD 30.46 - Continuous Speed : 3,600rpm - Critical Speed : 1,600rpm - Voltage : 13,800 V - Frequency : 60Hz - Stage : 16 (HP 5Stage, MP 5Stage, LP 6Stage) - STEAM FLOW.....385.3 ton/hr PRESS.....70 barg TEMP.....490 ℃ POWER....85 MW/hr **-PK-1961-E1(GLAND STEAM CONDENSER)** **:** DUTY.....141053 KW AREA.....4.49 m2 **- PK-1961-K1 (GLAND CONDENSATE VENT FAN)** : CAPACITY : 9 CMM × 500 mmAq / 3.7 KW **※ Oil Unit Lube Oil Charging**

97.5 Mw Steam-Turbine Power Generation Plant

◆ Sales Spec. (900U-Utility)

■ **Detail Specification PK-1961 (Steam Turbine Generator)**

Device Name	Functioning	Photo	Specification
PK-1961 (OIL SYSTEM) - PK-1961-T1 - PK-1961-K2 - PK-1961-P1 A/B - PK-1961-P2 - PK-1961-P3 A/B - PK-1961-T2 - PK-1961-P4 A/B	TURBINE OIL supplying Equipment		- **PK-1961-t1 (LO TANK)** : CAPACITY : 7570 L - **PK-1961-K2** (**LO TANK VENT PAN**) **:** CAPACITY : : 600 ㎥/hr × 300 mmAq - **PK-1961-P1 A/B (LO PUMP)** : CAPACITY : 1100 L/min × 4.5 barg - **PK-1961-P2 (EMER' LO PUMP** : CAPACITY : 350 L/min × 1.5 barg - **PK-1961-P3 A/B (JACKING OIL PUMP)** : CAPACITY : 49.2 L/min × 210 barg - **PK-1961-T2 (CO TANK)** : CAPACITY : 7570 L - **PK-1961-P4 A/B (CO PUMP)** : CAPACITY : 40 L/min × 130 barg **※ Lube Oil Charging상태**

97.5 Mw Steam-Turbine Power Generation Plant

◆ Sales Spec. (900U-Utility)

■ Specification Index (PK-1965 AIR COOLED CONDENSATE)

Unit(PK-1965)	Section	Condition	Remark
1. PK-1965	1. HE-1965	Pump Lube Oil Charging	
	2. PK-1965-T3		
	3. PK-1965-P1 A/B		
	4. P-1961 A/B/C		
	5. P-1961 A/B/C		

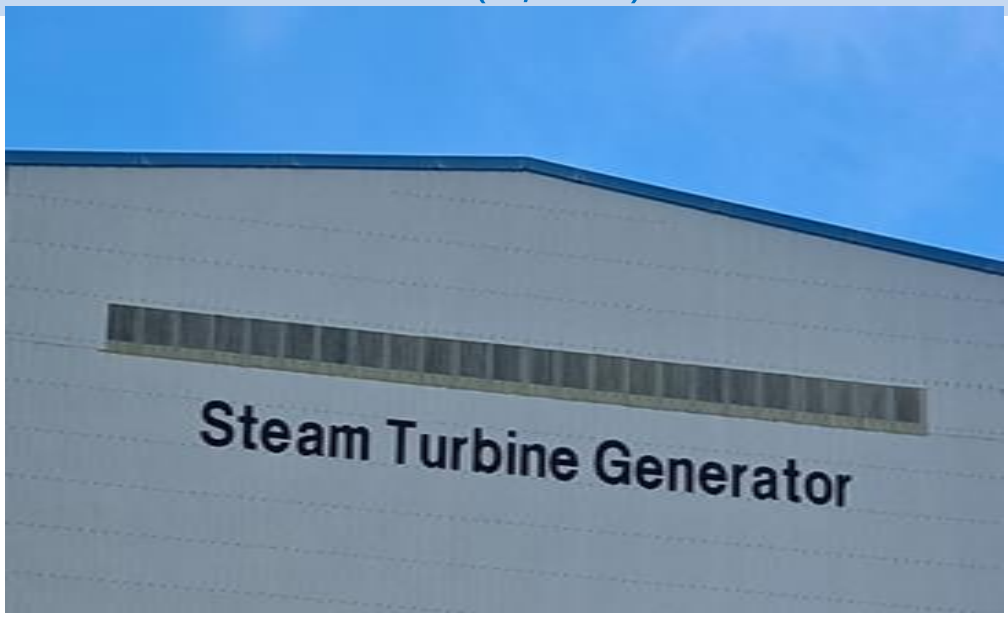
97.5 Mw Steam-Turbine Power Generation Plant

◆ Sales Spec. (900U-Utility)

■ Specification PK-1965 (AIR COOLED CONDENSATE)

Device Name	Functioning	Photo	Specification
PK-1965 - HE-1965 - PK-1965-T3 - PK-1965-P1 A/B - PK-1965-T2 - P-1961 A/B/C	turbine exhaust steam을 ACC 를 통과하면서 온도와 용적을 급격하게 응축시켜 TURBINE 효율을 향상 시키는 설비 Turbine exhaust steam passing the ACC to drop down the temperature and condensate the volume to improve the efficiency of turbine	HE-1965  PK-1965-T3  PK-1965-P1 A/B PK-1965-T2  P-1961 A/B/C 	**- HE-1965 (AIR COOLED CONDENSER)** : STEAM FLOW : 300,500 Kg/hr AIR INNET DBT : 32 ℃ STEAM ENTHALPY : 3,316.3 KJ/Kg DESIGN PRESSURE : FULL VACUUM TO 0.5 barg HEAT EXCHANGED : 177,175.6 KW SURFACE : 717,640.5 m2 / 4 TRAIN / 20 CELL FAN DIAMETER :10,363 mm / 110 RPM / FRP MOTOR : 440 V/149 KW/1750 RPM × 20 NoS **- PK-1965-T3 (DUCT DRAIN POT)** : **- PK-1965-P1 A/B (DUCT DRAIN POT PUMP)** : **- PK-1965-T2 (CONDENSATE TANK)** **:** **-P-1961 A/B/C (STEAM TURBINE CONDENSATE PUMP)** **:** CAPACITY : 153.3 ㎥/hr × 3.90 barg / 45KW **※ Lube Oil Charging**

STEAM–TURBINE POWER GENERATION EQUIPMENT (SALES) POWER 97.5Mw (97,500kw)



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