Power Train Siemens design based 440 MW - 50 Hz dual fuel (gas/oil) fired

Unused, orginally packed, full warranty/guaranty

PRESENTED BY:

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ATRIUM on 5TH
9th Floor
Sandton City
Gauteng
South Africa
2091

MBA NORTH

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- CCGT-440 MW main technical features
- Technical descriptions:
  - GT description
  - HRSG description
  - ST description

CCGT- 440 MW Main technical features

- Brand new base load power train CCGT - 440 MW
- Manufacturing of all main components **completed in 2013**
- All components **stored** under conservation and ready for timely shipment:
- Heat Balance Diagram composed as block type unit: one GT + one HRSG + ST

GAS TURBINE	
EU Manufacturer	291 MW Gas Turbine, single shaft, cold end drive, annular combustor, heavy duty

STEAM TURBINE	
EU Manufacturer	167 MW Steam Turbinethree cylinder type

HRSG	
EU Manufacturer	HRSG horizontal flow type, equipped with natural gas post-firing

- Direct contracts with power train manufacturers
- Equipment with its basic design fully approval
- The system can potentially work for district heating

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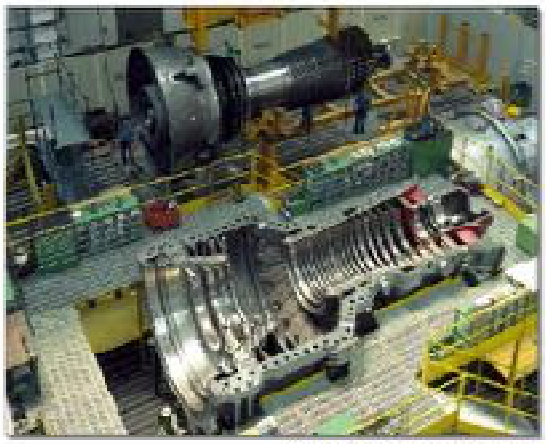
CCGT-440 MW Main technical features

GT set includes:

- Electrical generator
- Static starter (SFC)
- Excitation system

Operation mode:

- Heat balance diagram allows to start operation depending on unit thermal condition:
  - **Cold startup** (after 36 hours outage) – less than 100 times during total operation life
  - **Warm startup** (less than 36 hours of outage) – less than 1900 times during total operation life
  - **Hot startup** (within 1-8 hours of outage) – less than 8000 times during total operation life)
- Main fuel : gas; reserve fuel: diesel
- Isolated operation of GT is not envisaged
- The CCGT operates on variable pressures' mode



AE94.3A final assembly area

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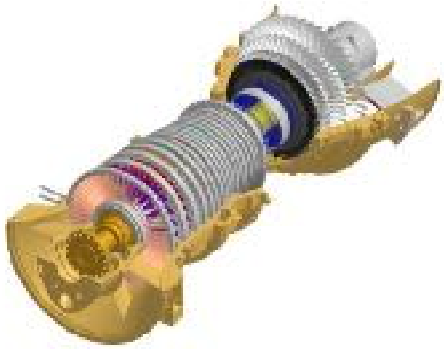
Technical description: Gas Turbine 94.3A4

Single shaft GT comprising :



- 15 stage compressor
- 4 turbine stages
- Single shaft rotor with central tie rod
- 2 bearings
- Axial discharge
- Generator driven at compressor side
- Hydraulic Clearance Optimization system
- Annular type combustion chamber lined with individual and replaceable ceramic tiles
- 24 hybrid burner for fuel gas and fuel oil
- Variable Inlet Guide Vanes
- All vanes and blades replaceable with rotor in place

The GT shall be with dual fuel burners; dry low NOx burners for natural gas operation and water injected for low NOx emission during light oil operation

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Technical description: HRSG

- HRSG – horizontal three-flow HRGS.
- HRGS: with horizontal profile, drum-type, three pressures mode (HP, IP, LP) with natural circulation at steam generating circuit with intermediate reheating.
- Discharge of wasted gas is through dedicated chimney.

Ambient t°	°C	- 47	+ 1,2	+ 15
Relative GT load factor	%	100	100	100
Exhaust Gas Temperature after GT	°C	536	557	572
Exhaust Gas Flow Rate after GT	kg/s	713	717	675
Natural gas (NG) consumption for re-combustion at HRSG	m^3/h	9120,56	7233,55	7233,55
NG net heating value	kJ/kg	48675,89	48675,89	48675,89
Exhaust gas t° at HRSG inlet section (after re-combustion)	°C	633,3	632,9	652
Exhaust gas flow rate at HRST inlet section (after re-combustion)	kg/s	714,74	718,38	676,39
High Pressure Loop				
Steam pressure after HP re-heating	MPa	13,43	13,49	13,40
Steam t° after HP re heating	°C	578,6	578,6	578,6
Steam flow rate after HP re-heating	t/h	323,787	325,408	323,184
Intermediate pressure loop				
Steam pressure after IP re-heating	MPa	3,410	3,430	3,400
Steam t° after IP re-heating	°C	338,2.2	338,8	338,9
Steam flow rate after IP re-heating	t/h	47,628	47,484	43,992

Technical description: HRSG

Low pressure loop				
Steam pressure after LP re-heating	MPa	0,518	0,506	0,499
Steam t° after LP re-heating	°C	276,2	268,7	267,3
Steam flow rate after LP re-heating	t/h	47, 552	47,484	45,768
Reheating loop (Cool Re-heating)				
Steam Pressure at HRSG re-heating section inlet	MPa	3,41	3,43	3,40
Steam t° at HRSG re-heating section inlet	°C	381,7	381,5	381,4
Steam flow rate at re-heating section inlet	t/h	317,484	319,104	316,908
Reheating loop (Hot Re-heating)				
Steam Pressure at HRSG re-heating section outlet	MPa	3,28	3,30	3,27
Steam t° at HRSG re-heating section outlet	°C	575,6	575,4	583,0
Steam flow rate at re-heating section outlet	t/h	365,136	366,588	362,676
Exhaust gas t° at HRSG chimney inlet	°C	90,8	91,9	91,7
Steam pressure after IP re-heating	MPa	3,410	3,430	3,400
Steam t° after IP re-heating	°C	338,2.2	338,8	338,9
Steam flow rate after IP re-heating	t/h	47,628	47,484	43,992

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Technical description: Steam Turbine RT20-33

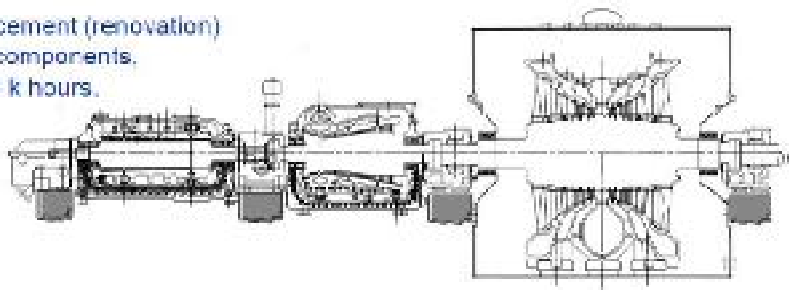
Steam Turbine RT20-33 is n°1 tandem-compound reheat steam turbine and consists of a high pressure (HP) section, an intermediate pressure (IP) section and a low pressure (LP) section, double flows type, with vertical downward exhaust.

The steam turbine has one connection for district heating purpose that operates as controlled extraction in district heating mode by means of a butterfly valve, hydraulically operated, installed in the cross over pipe.

The main components of the steam turbine are:

- Turbine outer and inner casings of HP, IP and LP sections
- Reaction type blading
- Precision forged last stage b ades
- HP, IP and LP rotor
- Integral expansion sleeve coupling

Total life cycle – 25 years with replacement (renovation) of spare parts and components.
Heatproof elements life cycle = 200 k hours.



Presentation title
Place, day month year

SUMMARY

Gas Turbine / Steam Turbine - Made by Siemens / Ansaldo Energia
HRSG - Made by NOOTER ERICKSSEN

Year: 2013 - New Unused

Location: Europe, available immediately

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9th Floor
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