Monitoring Report

Voluntary Carbon Standard 2007

Aydin Salavatli Dora-1 Geothermal Power Plant

Monitoring Period: 01/08/2009 – 31/07/2010
Date: 25/10/2010
Voluntary Carbon Units (VCUs): 29,375 tCO_2e

Version: 02

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1. Project Background

By means of this Monitoring Report greenhouse gas emission reductions achieved by the project activity “Aydin Salavatli Dora-I Geothermal Power Plant” are being verified and certified as per requirements of the Voluntary Carbon Standard, Version 2007.

Further background information on the project activity can be found in the Project Document (VCS PD) and associated documents, which had already been submitted for validation as per requirements of the Voluntary Carbon Standard 2007and had a positive validation opinion. The VCS PD and associated documents are available upon request.

The project is the first private investment employing the specific “Organic Rankine Cycle & Binary Technology in Turkey. The list of equipments is given in table below and the system processing schema is given in Annex.1:

Project Technical Characteristics

No.	Name	Quantity
1	Organic Turbine	2
2	Generator	1
3	12” control valve	3
4	Actuator	7
5	Positioner	9
6	16” control valve	4
7	6” control valve	4
8	4” control valve	2
9	8” control valve	3
10	10” control valve	1
11	Actuator	1
12	Positioner	6
13	12” control valve	4
14	Actuator	1
15	Positioner	1
16	Pentan Pump 1	1
17	Motor	1
18	Pentan Pump 2	1
19	Motor	1
20	O.E.C. Internal Use Transformator	1

2. Monitoring Background

Section 2.3.4 of the VCS PD (Application of the baseline and monitoring methodology) provides all details in regard to calculation of emission reductions and the monitoring plan to be followed by the project activity. Both the emission reduction calculations and the monitoring plan are based on the approved UNFCCC Methodology AMS-I.D, Version 13.

Monitoring data is collected in accordance with the agreement[1] done between the project owner and Turkish Electricity Distribution Company (TEDAS) which provides the infrastructure for the connection to the national grid. The metering system is defined in the agreement as two groups: main counter and back up counter. The design of the metering system is checked and approved by TEDAS before commissioning of the plant. The technical specifications of the power meters should be in line with Measure and Metering Devices Regulation[2] by Ministry of Industry and Trade. In addition, the Communiqué for Power Meters announced by Energy Market Regulations Authority (EMRA)[3] requires all meters to be in line with either Turkish Standards Institution[4] or International Electrotechnical Commissions Standards. The meters are placed at the point the electricity is fed to the grid and sealed on behalf of the both parties.

For the sale of the electricity generated, TEDAS officers, accompanied by a representative of the project owner, do readings of two power meters at the end of each month. The project owner monitors the gross electricity generated and internal consumption on an hourly basis by a internal SCADA system. Those records include electricity generated before connecting to the transformer, excluding the transmission losses. Subtracting the internal consumption, the project owner has the balanced electricity generated in the plant for crosschecking. If no dispute is in question, the project owner issues an invoice for the sale of net electricity exported to the grid as the same amount printed in the official report.

Starting from December 2009, a new system of monitoring the electricity export has been introduced all across Turkey. Under the new procedures, the energy meters measuring electricity export are connected to the TEDAS system and online meter reading are taken by TEDAS officials. Copies of the periodic break-up of electricity data are also provided to the project owner in a soft copy format, based on which an invoice is raised by the company. Occasional visits are also made by the TEDAS officials to the site for inspection and performance checking of the energy meters. This method of online meter reading is comparatively more efficient, reliable, consistent and accurate, as it eliminates the degree of human error and ensures consistency of monitoring practices as well as effective management of time and resources.

The project activity has also made positive contributions to the local populace on a socio-economic level by means of several activities including employment of personnel from the region, provision of infrastructure and amenities to a local school, as well as augmentation of the technical knowledge of the people by provision of trainings.

[1] http://www.tedas.gov.tr/7,Basvuru_Detay.html

[2] http://www.mevzuat.adalet.gov.tr/html/21179.html

[3] http://www.epdk.gov.tr/mevzuat/teblig/elektriksayac.htm

[4] http://www.tse.org.tr/english/tsedefault1.asp

3. Monitoring Results

3.1. Monitoring period

This is the second monitoring report of this project activity. It covers the period 01/08/2009 to 31/07/2010.

3.2. Presentation of monitoring results

All monitoring data is available in an Excel spreadsheet. The spreadsheet includes:

1) Hourly monitoring data for gross electricity generation and internal electricity consumption in the plant from the plant SCADA system.

2) Monthly power meter reading reports issued by TEDAS in accordance with day, peak and night hours.

3) Monthly net electricity fed into the grid and invoiced in accordance with day, peak and night hours.

4) Operating hours of the back-up engine

3.3. Monitoring data used

The net electricity exported to the grid has been monitored by TEDAS (Turkish Electricity Distribution Company) by monthly power meter readings. As the power meters are placed in the connection point to the grid, the net electricity metering including the transmission losses are available within the reports.

The amounts of net electricity exported in the official report are cross-checked by the hourly SCADA data. The internal consumption is subtracted from gross electricity generated to find the electricity fed to the transmission line. When comparing with the net electricity reported, transmission losses are taken into account.

Invoices are also checked for any differences with the metered amount by TEDAS. Consequently, the net electricity metered by the distribution company has been taken as the basis to the emission calculations. In order to be conservative, the electricity imported is subtracted from the electricity exported before emission reduction calculations although it is considered as negligible during invoicing.

Data / Parameter:	**EGy**
Data unit:	**MWh**
Description:	**Net electricity exported to the grid in the year y**
Source of data to be used:	Monthly official electricity metering reports issued by TEDAS officers and signed by both parties. The calculation of emission reductions in the monitoring protocols shall be based on the net electricity fed to the grid which is calculated by subtracting the net import from net export.
Description of measurement methods and procedures to be applied:	Measured continuously by a power meter and recorded monthly by monitoring employees. Only the net electricity export to the grid shall be taken into account. This means that the monitoring measurement method shall exclude electricity imported from the grid by the project activity and possible transmission losses.
QA/QC procedures to be applied:	• Exported electricity to the grid is measured by a kilowatt meter which is controlled by the electricity distribution company (TEDAS). • Trained and qualified staff is responsible for recording electricity export data from the kilowatt meter. • A spare meter is used for crosschecking the accuracy and both meters are calibrated if required.

	• Meters will be maintained periodically according to national regulations. • Data measured by meters and will be crosschecked with the data collected by the PO thanks to their own internal SCADA system at the plant. • As mentioned earlier in section 2, since December 2009, TE-DAS officials have commenced a comparitively more reliable and accurate procedure of online electricity meter readings on a monthly basis and provide a soft copy of the break-up to the project owner.
Any comment:	

Data / Parameter:	**PE_{Dcons}**
Data unit:	**Tons**
Description:	**Diesel consumed from running the diesel generator**
Source of data to be used:	Plant Records
Value of data	Value of data would be used to calculate project emissions only if emissions contribute to more than 1%.
Description of measurement methods and procedures to be applied:	Diesel Consumption will be calculated on the basis of monitored operating hours on the diesel generator engine and its default consumption.
QA/QC procedures to be applied:	Data will be collected by qualified plant staff monthly.
Any comment:	Consumption from the engine is expected to be negligible (below 1% of the total emission reductions)

3.4. Metering equipment accuracy

The calibration and maintenance of the two power meters in the Aydin Salavatli Dora-1 Geothermal Power Plant are done by Turkish Electricity Distribution Company (TEDAS). Both meters are jointly inspected and sealed on behalf of the officers and the plant operator. They are not interfered with by either party except in the presence of the other party.

The model and the technical characteristics of the power meters are summarized in the table below.

Specification	Explanation
Brand Name	ACTARIS (Schlumberger)
Type	SL761B+(Full I/O+1 RS232+ 1 RS485)+Aux Supply+ Voltage Quality
Serial Number	36043721 (main meter)/ 3643722 (spare meter)
Connection Type	3 phases-4 wires
Accuracy Class	Active Cl 0.5S; Reactive Cl 2.0
Voltage (Volt)	3 x 57.7/100V
Current (Amper)	1(10) A

Third chapter of the Communiqué for power meters defines the standard and accuracy classes of the power meters in accordance with the transmission line capacity.

Capacity of the transmission line	Greater than 100 MVA	100 MVA -10 MVA	Lower than 10 MVA
Active power meters	IEC-EN 60687 0.2S class	IEC-EN 60687 0.5S class	IEC-EN 60687 0.5 class
Reactive power meters	IEC-EN 61268 2 class	IEC-EN 61268 2 class	IEC-EN 61268 2 class

The capacity of the transmission line connected is 34.5 kVA, therefore the power meters should have the accuracy class 0.5S for active meters and 2 for reactive meters. The power meters used in the plant are in line with the requirements as presented in the table above.

The main and spare meter readings are recorded monthly and cross-checked whether calibration is required. During the present monitoring period, no calibration has been conducted, as the meters were observed to be working at the desired accuracy levels. Furthermore, for the monitoring period under consideration, there was no malfunctioning of the main meter and hence no alterations have been done on it. There was a minor problem with the check meter relating to its accuracy, which was immediately checked and fixed by TEDAS officials.

The periodical maintenance is under the responsibility of TEDAS and has been fixed as once in 10 years in accordance with Article.9 of Measure and Metering Devices Regulation[5].

3.5. Calculation methodology

The emission reductions of the Project have been calculated in accordance with the approved small scale CDM-methodology AMS-I.D.: "Grid connected renewable electricity generation", version 13. For baseline calculations the AMS-I.D refers to the "Tool to calculate the emission factor for an electricity system", which offers two options of which the Combined Margin (CM) approach has been chosen. The CM consists of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the above-mentioned tool.

Emission Reductions = Baseline Emissions – Project Emissions

Baseline Emissions:

$$BE_y = (EG_y - EG_{baseline}) * EF_{grid,CM,y}$$

Where,

Parameter	***SI Unit***	***Description***
BE_y	tCO_2e	*Beaseline Emission in year y*
$EF_{grid,CM,y}$	tCO_2e/MWh	*Combined margin CO_2 emission factor for grid connected power generation in year y*
EG_y	*MWh*	*Electricity supplied by the project activity to the grid*
$EG_{baseline}$	*MWh*	*Baseline electricity supplied to the grid in the case of modified or retrofit facilities*

[5] http://www.mevzuat.adalet.gov.tr/html/21179.html

$EF_{grid, CM}$ has been calculated as 0.591 tCO_2/MWh for the crediting period. The detailed calculations could be found on the validated VCS PD.

Project Emissions:

The project emissions comprise the emissions from diesel generator and are accountable only if they contribute to more than 1% of baseline emissions.

The technical specifications of the generator could be found in Annex.2. The generator has an installed power of 250 kW and consumes 200 g fuel per kWh in full load.

The diesel consumption is calculated by the formula below:

$PE_{Dcons} = Cap_{DE} * T * CF$

Where,

Parameter	***SI Unit***	***Description***
PE_{Dcons}	*t*	*Diesel consumed from running the diesel generator*
Cap_{DE}	*kW*	*Installed capacity of the diesel engine*
T	*h*	*Operating time of the engine*
CF	*t/kWh*	*Consumption factor for fuel.*

Project emission is calculated by multiplying the fuel consumption by the emission factor which is calculated in accordance with the values for gas/diesel oil printed in IPCCC guidelines[6].

$EF_{diesel} = NCV * COEF_{diesel}$

Where,

Parameter	***SI Unit***	***Description***
EF_{diesel}	*tCO2e/t*	*Tonne of CO_2 produced per tonne of fuel consumed.*
NCV	*TJ/kg*	*Net calorific value for diesel*
$COEF_{diesel}$	*kg/TJ*	*Tonne of CO_2 produced per energy produced.*

Calculations:

Parameter	Unit	Value	Comments
Initial Operating hours	hrs	242.23	Plant Records
Final Operating hours	hrs	306.87	Plant Records
Operating hours	hrs	64.64	Calculated
Capacity of Engine	kW	85	Technical Data
Consumption Factor	tonnes/ kWh	0.0002	Technical Data
Diesel Consumption	tonnes	1.09888	Calculated
NCV of Diesel	TJ/Gg	43	IPCC
Carbon Emission factor of Diesel	kg/TJ	74100	IPCC
Emission Factor for Diesel	tCO2/ ton	3.186	Calculated
GHG Emissions from Diesel	tCO2	4	Calculated

[6] Table 1.2. Default NCVs and Table 1.4 .Default CO_2 Factors for Combustion in the Energy Industries, Vol.2. Energy, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf)

As a percentage of total Emission Reductions	%	0.01	Calculated

This amount constitutes only 0.01 % of total GHG emission reductions achieved by the project. Therefore; project emissions are negligible and taken as zero, as established ex-ante in the VCS PD.

3.6. Emission reductions

Emission Reductions = Baseline Emissions – Project Emissions

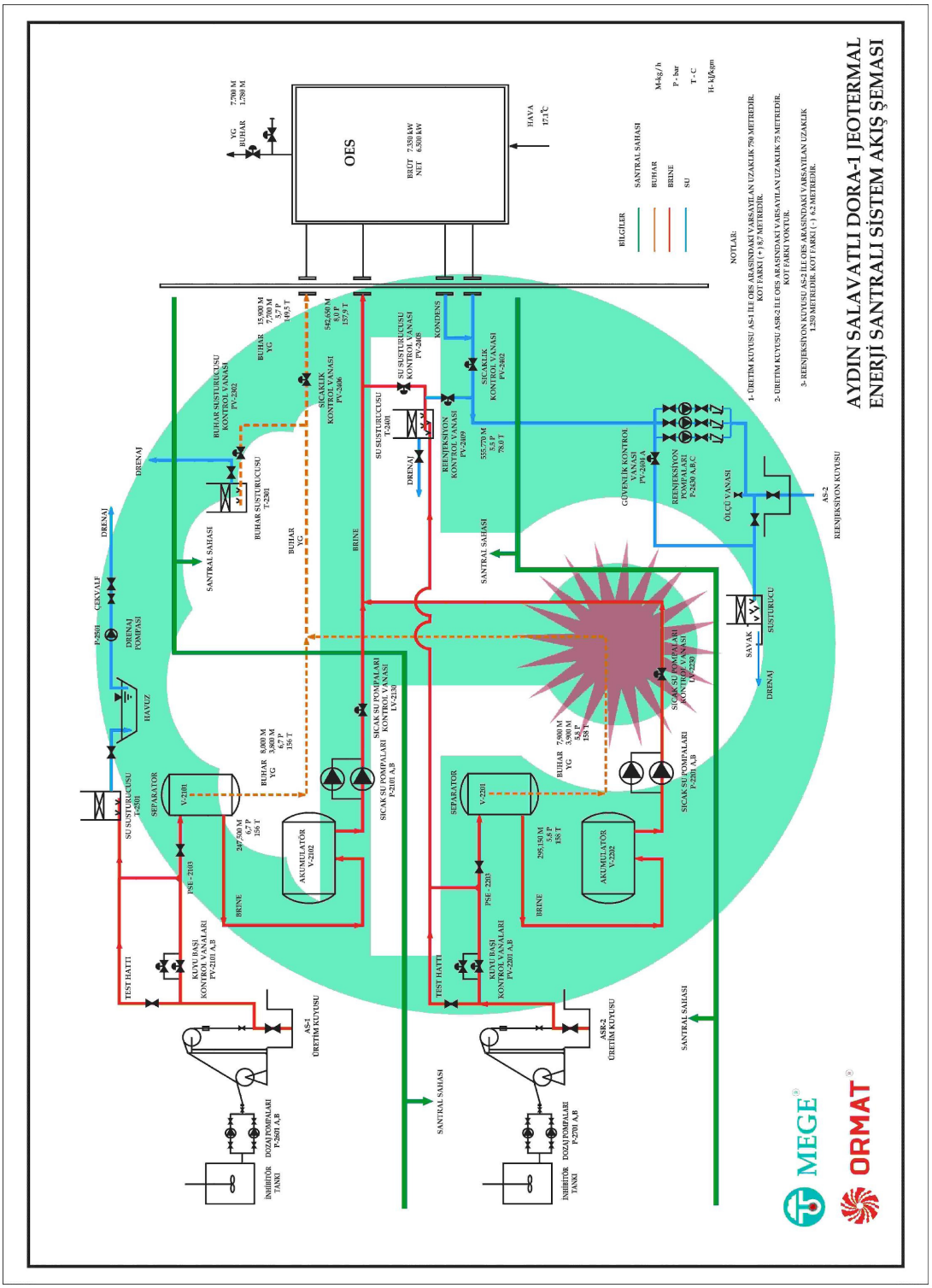
The calculated emission reductions achieved by the project activity within the present monitoring period amount to 29,375 t CO_2e.

4. Summary of Monitoring Data and Results

A summary of monitoring data and emission reductions based on aggregated data on a monthly basis are provided in the table below:

			SCADA		Official Records		Calculations		
			A		B				
Sl. No.	Year	Month	Gross Electricity generated (MWh)	Balance of Electricity generation (MWh)	Net Electricity exported (kWh)	Net electricity imported (kWh)	Balance of Net electricity Exported to the Grid (kWh)	GHG Emission Factor (tCO2/MWh)	Emission Reductions (tCO2e)
1	2009	August	4,261	3,637	3,636,864	378	3,636,486	0.591	2,149
2		September	4,692	3,948	3,948,210	378	3,947,832	0.591	2,333
3		October	4,830	4,051	4,050,774	1,260	4,049,514	0.591	2,393
4		November	5,752	4,873	4,872,546	1,260	4,871,286	0.591	2,879
5		December	5,521	4,765	4,765,497	2,722	4,762,775	0.591	2,815
Sub-Total-2009			**25,056**	**21,274**	**21,273,891**	**5,998**	**21,267,893**		**12,569**
6	2010	January	5,783	4,930	4,930,267	869	4,929,398	0.591	2,913
7		February	4,916	4,173	4,173,095	1,235	4,171,860	0.591	2,466
8		March	5,423	4,615	4,614,989	2,923	4,612,066	0.591	2,726
9		April	4,862	4,119	4,119,305	2,393	4,116,912	0.591	2,433
10		May	4,669	3,895	3,895,227	844	3,894,383	0.591	2,302
11		June	4,125	3,424	3,424,000	3,150	3,420,850	0.591	2,022
12		July	4,033	3,292	3,292,304	1,751	3,290,553	0.591	1,945
Sub-Total-2010			**33,810**	**28,449**	**28,449,187**	**13,165**	**28,436,022**		**16,806**
Total			**58,866**	**49,723**	**49,723,078**	**19,163**	**49,703,915**		**29,375**

Annex.1 Process Flow Chart



Annex.2. Technical Specifications of the Generator

TAD740GE

Technical Data

General

Engine designation	TAD740GE
No. of cylinders and configuration	in-line 6
Method of operation	4-stroke
Bore, mm (in.)	107 (4.21)
Stroke, mm (in.)	135 (5.31)
Displacement, l (in³)	7.28 (445)
Compression ratio	17.2:1
Dry weight, kg (lb)	901 (1987)
With Gen Pac, kg (lb)	1128 (2487)
Wet weight, kg (lb)	964 (2126)
With Gen Pac, kg (lb)	1196 (2637)

Performance

with fan, kW (hp)	1500 rpm	1800 rpm
Prime Power	220 (299)	228 (310)
Max Standby Power	242 (329)	251 (341)

Lubrication system

Oil consumption, liter/h (US gal/h)	1500 rpm	1800 rpm
Prime Power	0.04 (0.011)	0.05 (0.013)
Max Standby Power	0.05 (0.013)	0.06 (0.016)

Oil system capacity incl filters, liter (US gal)	29 (7.7)
Oil change intervals at specification	
VDS-2, h	600
VDS, ACEA E3, h	400
ACEA E1, E2, API CD, CF, CF-4, CG-4, h	200

Fuel system

Spec. fuel consumption at Prime Power, g/kWh (lb/hph)	1500 rpm	1800 rpm
25 %	227 (0.368)	230 (0.373)
50 %	200 (0.324)	205 (0.330)
75 %	198 (0.321)	199 (0.323)
100 %	200 (0.324)	200 (0.324)
Max Standby Power, g/kWh (lb/hph)		
25 %	219 (0.355)	230 (0.373)
50 %	200 (0.324)	203 (0.329)
75 %	198 (0.321)	199 (0.323)
100 %	201 (0.326)	202 (0.328)

Intake and exhaust system

Air consumption at 27°C, m³/min (cfm)	1500 rpm	1800 rpm
Prime Power	14.7 (519)	17.6 (622)
Max Standby Power	15.6 (551)	18.6 (657)

Max allowable air intake restriction, kPa (in wc)	5 (20.1)

Heat rejection to exhaust, kW (BTU/min)	1500 rpm	1800 rpm
Prime Power	160 (9099)	164 (9327)
Max Standby Power	180 (10237)	184 (10464)

Exhaust gas temperature after turbine, °C (°F)	1500 rpm	1800 rpm
Prime Power	525 (977)	470 (878)
Max Standby Power	540 (1004)	485 (905)

Max allowable back-pressure in exhaust line, kPa (in wc)	10 (40.2)

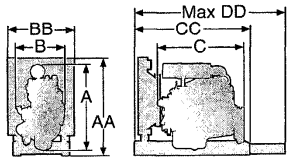
Exhaust gas flow, m³/min (cfm)	1500 rpm	1800 rpm
Prime power	39.2 (1384)	43.0 (1519)
Max Standby Power	41.8 (1476)	46.3 (1635)

Cooling system

Heat rejection radiation from engine, kW (BTU/min)	1500 rpm	1800 rpm
Prime Power	13 (737)	13 (737)
Max Standby Power	15 (850)	15 (850)
Heat rejection to coolant, kW (BTU/min)		
Prime Power	99 (5630)	99 (5630)
Max Standby Power	106 (6028)	110 (6256)
Fan power consumption, kW (hp)	5 (7)	8 (11)

Standard equipment	Engine	Gen Pac
Engine		
Automatic belt tensioner	•	•
Lift eyelets	•	•
Flywheel		
Flywheel housing with conn. acc. to SAE 2	•	•
Flywheel for 11.5" flex. plate and flexible coupling	•	•
Vibration damper	•	•
Engine suspension		
Fixed front suspension	-	•
Lubrication system		
Oil dipstick	•	•
Full-flow oil filter of spin-on type	•	•
By-pass oil filter of spin-on type	•	•
Oil cooler, side mounted	•	•
Fuel system		
Twin fuel filters of disposable type	•	•
Flexible fuel lines	-	•
Fuel injection pump, Bosch, with electronic actuator	•	•
Intake and exhaust system		
Air filter with replaceable paper insert	•	•
Air restriction indicator	•	•
Air cooled exhaust manifold	•	•
Connecting flange for exhaust line	•	•
Turbo charger	•	•
Heat guard for exhaust pipe and turbo	•	•
Crankcase ventilation	•	•
Cooling system		
Tropical radiator including intercooler	•1)	•
Radiator guard	-	•
Gear driven coolant pump	•	•
Fan hub	•	•
Thrust fan	-	-
Fan guard	-	•
Belt guard	-	•
Alternator		
Alternator 60A / 24V low, right side	•	•
Starting system		
Starter motor, Bosch 5.4kW / 24V	•	•
Electrical wiring		
Cable iron	•	•
Instruments and senders		
Temp.- and oil pressure for automatic stop/alarm 103°C	-	•
Other equipment		
Expandable base frame	-	•
Engine Packing		
Plastic wrapping	•	•

1) must be ordered, se order specification - optional equipment
– optional equipment or not applicable
• included in standard specification



A* = 1375 mm / 54.0 in
B* = 945 mm / 37.2 in
C* = 1697 mm / 66.8 in
*Incl. radiator & intercooler

AA = 1490.5 mm / 58.7 in
BB = 945 mm / 37.2 in
CC = 1732 mm / 68.2 in
DD = 2722 mm / 107.2 in

Note! The engine illustrated may not be entirely identical to production standard engines.

Power Standards
The engine performance corresponds to ISO 3046, BS 5514 and DIN 6271. The technical data applies to an engine without cooling fan and operating on a fuel with calorific value of 42.7 MJ /kg (18360 BTU/lb) and a density of 0.84 kg/liter (7.01 lb/US gal), also where this involves a deviation from the standards. Power output guaranteed within 0 to +2% att rated ambient conditions at delivery. Ratings are based on ISO 8528.
Engine speed governing in accordance with ISO 3046/IV, class A1 and ISO 8528-5 class G3

Exhaust emissions
The engine complies with EPA / CARB - Tier 1 and TA-luft exhaust emission regulations.

Rating Guidelines
PRIME POWER rating corresponds to ISO Standard Power for continuous operation. It is applicable for supplying electrical power at variable load for an unlimited number of hours instead of commercially purchased power. A10 % overload capability for governing purpose is available for this rating.
MAXIMUM STANDBY POWER rating corresponds to ISO Standard Fuel Stop Power. It is applicable for supplying standby electrical power at variable load in areas with well established electrical networks in the event of normal utility power failure. No overload capability is available for this rating.
1 hp = 1 kW x 1.36

Information
For more technical data and information, please look in the Generating Set Engines Sales Guide.

VOLVO PENTA

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