

COGENERATION PLANT M.S.M. - VALVE REPLACEMENT HISTORY

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On the occasion of their reaching 25,000-26,000 hours in operation, this document details the maintenance history of the inlet and exhaust valves of the three Deutz engines (four-stroke, producing 6.3 MWhe each, running on fuel oil), installed at the cogeneration plant at their works at Belorado (Burgos) in Spain, brought into service in March 1995. The source data have been taken from our historical archives covering all periods from the initial start-up until the most recent overhaul of the engines.

During the months of May and June of the current year (1998) the general overhaul of all three engines was carried out, with the total hours in operation as follows:

Engine No. 1 : 25,512 hours

Engine No. 2 : 25,012 hours

Engine No. 3 : 26,074 hours

Following the first 3,000 hours in operation, when severe corrosion was observed on exhaust valves in all three engines, treatment of the fuel oil was commenced, using additives from “**rb bertomeu**”, whereby the problem was immediately remedied. The maintenance procedures implemented by M.S.M. have consisted in performing the mandatory general overhauls at approximately every 3,000 – 3,500 hours of operation, reinstalling the valves that conform to functional specifications in their original position after reconditioning, and monitoring the number and position of valves that are not serviceable due to failure to conform to size, thermal fatigue, or excessive corrosion.

At present, following the most recent overhaul at a total of **25,000-26,000 hours in operation (around three years in operation)**, the statistics for replacements are detailed in the concluding table. As can be seen in the table, it is of special interest to note the low level of replacements necessary and the greater duration of the valves in comparison to the figure given by the engine manufacturer:

	<u>% Replacement</u>	<u>Average operational life (hours)</u>
Inlet Valves (Note 1)	36.5	23,289
Exhaust Valve Cones	39.6	24,916
Exhaust Valve Baskets	15.6	25,159

Given that the average life estimated by the manufacturer for valves is 12,000 – 15,000 hours, it may be considered a highly significant result that the forecasted values have been doubled. In our opinion, this achievement may be attributed to the correct operation of the plant by the personnel at M.S.M. throughout this period, and accredited to the treatment of the fuel oil that has been applied from the point of 3,000 hours in operation, using additives from “**rb bertomeu**”.

STATISTICS FOR REPLACEMENTS MADE IN THE PERIOD 03/95 – 05/98

	<u>Engine no. 1</u>	<u>Engine no. 2</u>	<u>Engine no. 3</u>	<u>Total</u>
Qty. Inlet Valves	32	32	32	96
Qty. Exhaust Valves	32	32	32	96
Qty. Inlet valves replaced	3	0	32	35
% of total in engine (32)	9.3	0	100	36.5
Replaced due to breakage	1	0	0	1
Replaced due to distortion	2	0	0	2
Exceptional replacement by Deutz (Note 1)	0	0	32	32
Qty. exhaust valve cones replaced	12	13	13	38
% of total in engine (32)	37.5	40.6	40.6	39.6
Replaced due to blowouts	1 (8%)	1 (8%)	2 (15%)	4 (11%)
Replaced due to failing size	0 (0%)	1 (8%)	0 (0%)	1 (3%)
Replaced due to thermal fatigue	11 (92%)	11 (84%)	11 (85%)	26 (86%)
Qty. exhaust valve baskets replaced	5	8	2	15
% of total in engine (32)	15.6	25.0	3.1	15.6
Replaced due to blowouts	1 (20%)	1 (12%)	2 (100%)	4 (27%)
Replaced due to failing size	4 (80%)	7 (88%)	0 (0%)	15 (73%)
Hours of average operational life of original inlet valves up to June '98 (Note 2)	25,125	25,012	19,730	23,289
Hours of average operational life of original exhaust valve cones up to June '98 (Note 2)	24,898	23,820	26,030	24,916
Hours of average operational life of original exhaust valve baskets up to June '98 (Note 2)	25,044	24,362	26,070	25,159

Note 1 Exceptional replacement performed by Deutz, only in engine no. 3, at 19,730 hours in operation.

Note 2 We wish to emphasise that we hope to increase further the average values for operational life obtained, given that 64% of the inlet valves, 60% of the exhaust valve cones, and 84% of the original valve baskets have been reinstalled once more, after being reconditioned, in their original engines in the most recent overhauls performed in May and June.

Note 3 For the plant as a whole, 60% of replacements of valve cones and exhaust valve baskets were made after the most recent overhaul at 25,000 – 26,000 hours, and 30% of the replacements were made in the overhauls at 20,000 – 21,000 hours.