

# The Light company

Houston Lighting & Power

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December 26, 1990

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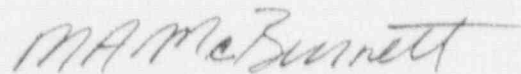
10CFR50

U. S. Nuclear Regulatory Commission  
Attention: Document Control Desk  
Washington, DC 20555

South Texas Project Electric Generating Station  
Units 1 and 2  
Docket Nos. STN 50-498, STN 50-499  
DSEER Confirmatory Item 3.5-1,  
Turbine System Maintenance  
Program - Additional Information

Pursuant to a telephone conversation held October 4, 1990, Houston Lighting & Power Company submits the attached information in support of our letter of August 28, 1990, regarding the Turbine System Maintenance Program for the South Texas Project Electric Generating Station.

If there are any questions, please contact either Mr. P. L. Walker at (512) 972-8392 or myself at (512) 972-8530.



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Manager,  
Nuclear Licensing

PLW/sgs

- Attachments: 1) Calculated turbine rotor inspection intervals  
2) Calculation of missile generation probabilities

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A Subsidiary of Houston Industries Incorporated

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Revised 10/08/80

SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION  
CALCULATED TURBINE ROTOR INSPECTION INTERVALS

<u>Rotor Designation</u>	<u>Maximum Operating Time Between Inspections (Hours)</u>
Unit 1 LP1	15,660 *
LP2	20,670
LP3	35,350
Unit 2 LP1	32,660
LP2	34,810
LP3	34,340
Spare	66,990 *

\* The spare has since been swapped out with the Unit 1 LP1.

SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION  
CALCULATION OF MISSILE GENERATION PROBABILITIES

The Probability of Missile Generation for each disc of each LP rotor has been calculated by Westinghouse for both Rated Speed and Design Overspeed conditions. Probabilities are given for 1, 2, 3, 4, 5, and 10 years total operating time between inspections. The probability of missile generation for a given rotor with a given total operating time is approximately the sum of the probabilities of the individual discs in the rotor.

PROB(R) is the probability of missile generation at rated speed. This value includes the probability of disc rupture at rated speed and the probability of the disc segment penetrating the turbine casing.

PROB(O) is the probability of missile generation at design overspeed. This value includes the probability of control system failure causing a design overspeed condition, the probability of disc rupture at the design overspeed condition, and the probability of disc segment penetration of the turbine casing.

The values given by Westinghouse for the individual discs were entered into a LOTUS 1-2-3 spreadsheet (See Appendix A for input). PROB(R) and PROB(O) for individual rotors at each inspection interval were determined by summing the values for each disc in the rotor, and the total probability of missile generation for each rotor at each inspection interval was determined by summing PROB(R) and PROB(O). See Appendix B for spreadsheet results.

Total PROB(R) and PROB(O) values for each turbine at each inspection interval are determined by adding the individual rotor values. This is used herein only to check the accuracy of the data input to the spreadsheet and accuracy of the summing equations used to add the individual disc values. The values calculated generally agree with the totals provided by Westinghouse. Linear interpolation was used between the LOG of inspection interval and LOG of total probability to determine the inspection interval required to maintain the probability of missile generation of each rotor at or below  $3.33 \times 10^{-5}$ .

APPENDIX A  
 SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION  
 CALCULATION OF MISSILE GENERATION PROBABILITIES  
Spreadsheet Input

DISK	LP	END	DEL	T	UNIT 1		UNIT 2	
					PROB(R)	PROB(O)	PROB(R)	PROB(O)
1	1	GEN		1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				2	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				4	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				5	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1	2	GEN		10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				2	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				4	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1	3	GEN		5	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				6	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				7	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				8	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				9	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1	1	GOV		10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				2	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				4	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1	2	GOV		5	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				6	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				7	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				8	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				9	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1	3	GOV		10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				2	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
				4	0.00E+00	0.00E+00	0.00E+00	0.00E+00



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Spreadsheet Input

DISK	LP	END	DEL	T	UNIT 1		UNIT 2					
					PROB(R)	PROB(O)	PROB(R)	PROB(O)				
2	1	GEN		1	0.00E+00	1.14E-07	0.00E+00	3.37E-09				
				2	0.00E+00	3.60E-06	0.00E+00	2.84E-07				
				3	0.00E+00	1.73E-05	0.00E+00	2.27E-06				
				4	0.00E+00	4.36E-05	0.00E+00	7.97E-06				
				5	0.00E+00	8.07E-05	0.00E+00	1.87E-05				
				10	0.00E+00	3.21E-04	0.00E+00	1.41E-04				
				2	2	GEN		1	0.00E+00	7.22E-09	0.00E+00	1.30E-08
								2	0.00E+00	4.96E-07	0.00E+00	7.86E-07
								3	0.00E+00	3.55E-06	0.00E+00	5.25E-06
								4	0.00E+00	1.16E-05	0.00E+00	1.64E-05
5	0.00E+00	2.59E-05	0.00E+00					3.52E-05				
2	3	GEN		10	0.00E+00	1.70E-04	0.00E+00	2.06E-04				
				1	0.00E+00	9.81E-10	0.00E+00	5.41E-09				
				2	0.00E+00	1.07E-07	0.00E+00	4.01E-07				
				3	0.00E+00	9.89E-07	0.00E+00	2.99E-06				
				4	0.00E+00	3.83E-06	0.00E+00	1.01E-05				
				5	0.00E+00	9.71E-06	0.00E+00	2.29E-05				
				10	0.00E+00	9.17E-05	0.00E+00	1.58E-04				
				2	1	GOV		1	0.00E+00	1.75E-07	0.00E+00	8.49E-10
								2	0.00E+00	4.74E-06	0.00E+00	9.81E-08
								3	0.00E+00	2.11E-05	0.00E+00	9.31E-07
4	0.00E+00	5.11E-05	0.00E+00					3.67E-06				
5	0.00E+00	9.21E-05	0.00E+00					9.41E-06				
2	2	GOV		10	0.00E+00	3.41E-04	0.00E+00	9.10E-05				
				1	0.00E+00	3.92E-09	0.00E+00	3.01E-09				
				2	0.00E+00	3.16E-07	0.00E+00	2.60E-07				
				3	0.00E+00	2.47E-06	0.00E+00	2.10E-06				
				4	0.00E+00	8.55E-06	0.00E+00	7.44E-06				
				5	0.00E+00	1.99E-05	0.00E+00	1.76E-05				
				10	0.00E+00	1.46E-04	0.00E+00	1.35E-04				
				2	3	GOV		1	0.00E+00	6.44E-09	0.00E+00	9.76E-09
								2	0.00E+00	4.38E-07	0.00E+00	6.28E-07
								3	0.00E+00	3.14E-06	0.00E+00	4.34E-06
4	0.00E+00	1.03E-05	0.00E+00					1.38E-05				
5	0.00E+00	2.31E-05	0.00E+00					3.03E-05				
10	0.00E+00	1.56E-04	0.00E+00					1.87E-04				

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CALCULATION OF MISSILE GENERATION PROBABILITIES  
Spreadsheet Input

DISK LP END DEL T		UNIT 1		UNIT 2		
		PROB(R)	PROB(O)	PROB(R)	PROB(O)	
3 1 GEN	1	7.67E-07	3.36E-08	6.85E-10	2.36E-11	
	2	5.26E-05	1.07E-06	2.45E-07	5.10E-09	
	3	3.82E-04	5.26E-06	4.35E-06	6.86E-08	
	4	1.28E-03	1.38E-05	2.63E-05	3.44E-07	
	5	2.92E-03	2.67E-05	9.29E-05	1.05E-06	
	10	2.18E-02	1.29E-04	2.29E-03	1.75E-05	
	3 2 GEN	1	6.23E-11	2.50E-12	2.67E-11	1.05E-12
		2	3.51E-08	8.54E-10	1.77E-08	4.30E-10
		3	8.05E-07	1.48E-08	4.44E-07	8.23E-09
		4	5.80E-06	8.80E-08	3.40E-06	5.24E-08
5		2.34E-05	3.07E-07	1.44E-05	1.92E-07	
10	8.48E-04	7.38E-06	5.98E-04	5.34E-06		
3 3 GEN	1	1.21E-10	4.49E-12	1.86E-10	7.31E-12	
	2	6.14E-08	1.40E-09	8.56E-08	2.02E-09	
	3	1.32E-06	2.30E-08	1.75E-06	3.11E-08	
	4	9.14E-06	1.32E-07	1.17E-05	1.71E-07	
	5	3.56E-05	4.47E-07	4.43E-05	5.61E-07	
10	1.17E-03	9.81E-06	1.35E-03	1.13E-05		
3 1 GOV	1	1.16E-08	4.46E-10	1.44E-10	4.90E-12	
	2	2.24E-06	4.77E-08	7.10E-08	1.51E-09	
	3	2.83E-05	4.38E-07	1.51E-06	2.47E-08	
	4	1.36E-04	1.71E-06	1.03E-05	1.41E-07	
	5	4.06E-04	4.36E-06	3.98E-05	4.76E-07	
10	6.22E-03	4.36E-05	1.27E-03	1.05E-05		
3 2 GOV	1	1.05E-07	3.82E-09	1.99E-11	7.87E-13	
	2	1.22E-05	2.36E-07	1.39E-08	3.40E-10	
	3	1.18E-04	1.63E-06	3.60E-07	6.71E-09	
	4	4.71E-04	5.25E-06	2.81E-05	4.36E-08	
	5	1.23E-03	1.17E-05	1.21E-05	1.63E-07	
10	1.29E-02	8.09E-05	5.25E-04	4.73E-06		
3 3 GOV	1	1.01E-10	3.64E-12	3.25E-12	1.63E-13	
	2	5.27E-08	1.18E-09	3.09E-09	9.31E-11	
	3	1.16E-06	1.98E-08	9.54E-08	2.15E-09	
	4	8.10E-06	1.15E-07	8.43E-07	1.56E-08	
	5	3.19E-05	3.96E-07	3.96E-06	6.34E-08	
10	1.08E-03	8.99E-06	2.27E-04	2.36E-06		

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Spreadsheet Input

DISK LP END DEL T	UNIT 1		UNIT 2		
	PROB(R)	PROB(O)	PROB(R)	PROB(O)	
4 1 GEN	1	3.11E-11	2.21E-12	1.13E-11	7.72E-13
	2	1.32E-08	4.65E-10	5.86E-09	2.03E-10
	3	2.63E-07	6.27E-09	1.29E-07	3.10E-09
	4	1.73E-06	3.19E-08	9.16E-07	1.71E-08
	5	6.52E-06	9.99E-08	3.65E-06	5.69E-08
4 2 GEN	10	2.01E-04	1.85E-06	1.32E-04	1.25E-06
	1	1.19E-15	5.64E-17	2.16E-14	1.24E-15
	2	3.17E-12	9.83E-14	3.62E-11	1.25E-12
	3	1.76E-10	4.27E-12	1.54E-09	3.98E-11
	4	2.34E-09	4.79E-11	1.71E-08	3.61E-10
4 3 GEN	5	1.50E-08	2.70E-10	9.50E-08	1.73E-09
	10	2.16E-06	2.63E-08	8.99E-06	1.06E-07
	1	7.22E-16	3.72E-17	9.72E-14	5.51E-15
	2	2.08E-12	6.89E-14	1.27E-10	4.22E-12
	3	1.21E-10	3.10E-12	4.69E-09	1.16E-10
4 1 GOV	4	1.65E-09	3.57E-11	4.69E-08	9.47E-10
	5	1.08E-08	2.05E-10	2.43E-07	4.20E-09
	10	1.67E-06	2.12E-08	1.84E-05	2.05E-07
	1	2.56E-11	2.16E-12	3.98E-12	3.70E-13
	2	1.10E-08	4.42E-10	2.44E-09	1.09E-10
4 2 GOV	3	2.20E-07	5.86E-09	5.94E-08	1.78E-09
	4	1.46E-06	2.95E-08	4.49E-07	1.02E-08
	5	5.54E-06	9.18E-08	1.89E-06	3.52E-08
	10	1.75E-04	1.69E-06	7.95E-05	8.57E-07
	1	1.26E-13	8.01E-15	9.35E-15	6.75E-16
4 3 GOV	2	1.55E-10	5.53E-12	1.76E-11	7.23E-13
	3	5.51E-09	1.43E-10	8.02E-10	2.40E-11
	4	5.40E-08	1.13E-09	9.29E-09	2.25E-10
	5	2.74E-07	4.89E-09	5.38E-08	1.10E-09
	10	1.99E-05	2.23E-07	5.71E-06	7.33E-08
4 3 GOV	1	4.91E-14	2.72E-15	7.06E-14	3.91E-15
	2	7.17E-11	2.35E-12	9.70E-11	3.17E-12
	3	2.82E-09	6.91E-11	3.69E-09	8.99E-11
	4	2.95E-08	5.92E-10	3.77E-08	7.51E-10
	5	1.58E-07	2.73E-09	1.98E-07	3.39E-09
10	1.32E-05	1.48E-07	1.57E-05	1.74E-07	



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Spreadsheet Input

DISK LP END DEL T	UNIT 1		UNIT 2		
	PROB(R)	PROB(O)	PROB(R)	PROB(O)	
5 1 GEN	1	1.74E-13	1.55E-14	1.53E-13	1.28E-14
	2	1.84E-10	8.28E-12	1.70E-10	7.33E-12
	3	6.09E-09	1.88E-10	5.76E-09	1.72E-10
	4	5.69E-08	1.36E-09	5.46E-08	1.28E-09
	5	2.79E-07	5.54E-09	2.71E-07	5.30E-09
	10	1.86E-05	2.18E-07	1.85E-05	2.17E-07
5 2 GEN	1	3.01E-15	1.48E-16	1.86E-14	1.22E-15
	2	6.79E-12	2.13E-13	3.07E-11	1.15E-12
	3	3.42E-10	8.31E-12	1.30E-09	3.55E-11
	4	4.25E-09	8.64E-11	1.43E-08	3.16E-10
	5	2.59E-08	4.60E-10	7.92E-08	1.50E-09
	10	3.18E-06	3.79E-08	7.43E-06	8.92E-08
5 3 GEN	1	6.56E-15	4.12E-16	2.32E-14	1.94E-15
	2	1.29E-11	4.76E-13	3.56E-11	1.58E-12
	3	6.01E-10	1.65E-11	1.45E-09	4.54E-11
	4	7.08E-09	1.59E-10	1.56E-08	3.85E-10
	5	4.14E-08	7.97E-10	8.51E-08	1.76E-09
	10	4.53E-06	5.59E-08	7.68E-06	9.64E-08
5 1 GOV	1	4.95E-15	3.62E-16	2.03E-13	1.52E-14
	2	1.00E-11	4.13E-13	2.16E-10	8.54E-12
	3	4.75E-10	1.43E-11	7.15E-09	1.99E-10
	4	5.67E-09	1.37E-10	6.66E-08	1.46E-09
	5	3.35E-08	6.89E-10	3.27E-07	6.01E-09
	10	3.80E-06	4.89E-08	2.14E-05	2.40E-07
5 2 GOV	1	7.29E-16	3.71E-17	4.12E-13	3.54E-14
	2	2.05E-12	6.71E-14	3.77E-10	1.63E-11
	3	1.17E-10	2.98E-12	1.15E-08	3.39E-10
	4	1.58E-09	3.40E-11	1.01E-07	2.32E-09
	5	1.03E-08	1.94E-10	4.76E-07	9.05E-09
	10	1.55E-06	1.96E-08	2.79E-05	3.15E-07
5 3 GOV	1	6.10E-13	5.21E-14	1.21E-14	8.07E-16
	2	5.08E-10	2.17E-11	2.14E-11	8.07E-13
	3	1.47E-08	4.27E-10	9.36E-10	2.67E-11
	4	1.26E-07	2.81E-09	1.06E-08	2.37E-10
	5	5.77E-07	1.07E-08	5.98E-08	1.15E-09
	10	3.17E-05	3.47E-07	5.97E-06	7.23E-08

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Spreadsheet Input

DISK LP END DEL T	UNIT 1		UNIT 2		
	PROB(R)	PROB(O)	PROB(R)	PROB(O)	
6 1 GEN	1	9.13E-16	5.47E-18	6.59E-16	3.92E-18
	2	3.90E-12	1.58E-14	2.22E-12	1.19E-14
	3	1.78E-10	9.20E-13	1.39E-10	7.13E-13
	4	2.54E-09	1.26E-11	2.01E-09	9.98E-12
	5	1.72E-08	8.29E-11	1.38E-08	6.66E-11
6 2 GEN	10	2.90E-06	1.28E-08	2.45E-06	1.08E-08
	1	2.37E-13	1.56E-15	8.93E-16	5.79E-18
	2	3.04E-10	1.75E-12	2.85E-12	1.66E-14
	3	1.11E-08	5.94E-11	1.75E-10	9.56E-13
	4	1.11E-07	5.62E-10	2.49E-09	1.31E-11
6 3 GEN	5	5.71E-07	2.79E-09	1.69E-08	8.55E-11
	10	4.30E-05	1.89E-07	2.86E-06	1.31E-08
	1	4.31E-15	2.69E-17	6.17E-16	3.75E-18
	2	1.08E-11	6.09E-14	2.08E-12	1.15E-14
	3	5.81E-10	3.08E-12	1.32E-10	6.89E-13
6 1 GOV	4	7.53E-09	3.83E-11	1.92E-09	.67E-12
	5	4.74E-08	2.34E-10	1.33E-08	6.47E-11
	10	6.45E-06	2.89E-08	2.36E-06	1.05E-08
	1	4.59E-16	3.02E-18	1.60E-14	9.91E-17
	2	1.61E-12	9.51E-15	3.25E-11	1.81E-13
6 2 GOV	3	1.05E-10	5.80E-13	1.55E-09	8.05E-12
	4	1.55E-09	8.23E-12	1.84E-08	9.19E-11
	5	1.08E-08	5.55E-11	1.09E-07	5.25E-10
	10	2.01E-06	9.29E-09	1.22E-05	5.35E-08
	1	1.46E-15	8.98E-18	1.34E-16	8.26E-19
6 3 GOV	2	4.31E-12	2.41E-14	5.64E-13	3.17E-15
	3	2.54E-10	1.34E-12	4.07E-11	2.16E-13
	4	3.52E-09	1.78E-11	6.50E-10	3.32E-12
	5	2.33E-08	1.15E-10	4.80E-09	2.38E-11
	10	3.69E-06	1.66E-08	1.06E-06	4.79E-09
6 1 GOV	1	5.80E-14	3.58E-16	4.76E-17	3.18E-19
	2	9.65E-11	5.34E-13	2.33E-13	1.40E-15
	3	4.09E-09	2.12E-11	1.84E-11	1.04E-13
	4	4.50E-08	2.24E-10	3.11E-10	1.68E-12
	5	2.50E-07	1.20E-09	2.40E-09	1.26E-11
6 2 GOV	10	2.33E-05	1.02E-07	6.07E-07	2.87E-09

APPENDIX B  
SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION  
CALCULATION OF MISSILE GENERATION PROBABILITIES  
Spreadsheet Results

DISK LP END DEL T	UNIT 1			UNIT 2			
	PROB(R)	PROB(O)	TOTAL	PROB(R)	PROB(O)	TOTAL	
LP1	1	7.79E-07	3.23E-07	1.10E-06	8.45E-10	4.25E-09	5.09E-09
	2	5.49E-05	9.46E-06	6.43E-05	3.25E-07	3.89E-07	7.14E-07
	3	4.11E-04	4.41E-05	4.55E-04	6.06E-06	3.30E-06	9.36E-06
	4	1.42E-03	1.10E-04	1.53E-03	3.81E-05	1.22E-05	5.03E-05
	5	3.34E-03	2.04E-04	3.54E-03	1.39E-04	2.97E-05	1.69E-04
LP2	10	2.82E-02	8.37E-04	2.91E-02	3.75E-03	2.62E-04	4.01E-03
	1	1.05E-07	1.50E-08	1.20E-07	4.71E-11	1.60E-08	1.61E-08
	2	1.22E-05	1.05E-06	1.33E-05	3.21E-08	1.05E-06	1.08E-06
	3	1.19E-04	7.67E-06	1.26E-04	8.19E-07	7.37E-06	8.18E-06
	4	4.77E-04	2.55E-05	5.02E-04	6.35E-06	2.39E-05	3.03E-05
LP3	5	1.25E-03	5.78E-05	1.31E-03	2.72E-05	5.32E-05	8.04E-05
	10	1.38E-02	4.05E-04	1.42E-02	1.17E-03	3.52E-04	1.52E-03
	1	2.23E-10	7.43E-09	7.65E-09	1.89E-10	1.52E-08	1.54E-08
	2	1.15E-07	5.48E-07	6.62E-07	8.90E-08	1.03E-06	1.12E-06
	3	2.50E-06	4.17E-06	6.68E-06	1.86E-06	7.36E-06	9.22E-06
TOTAL-ORIGI	4	1.75E-05	1.44E-05	3.18E-05	1.27E-05	2.41E-05	3.67E-05
	5	6.86E-05	3.37E-05	1.02E-04	4.89E-05	5.38E-05	1.03E-04
	10	2.32E-03	2.67E-04	2.58E-03	1.61E-03	3.59E-04	1.97E-03
	1	8.84E-07	3.45E-07	1.23E-06	1.08E-09	3.54E-08	3.65E-08
	2	6.72E-05	1.11E-05	7.83E-05	4.46E-07	2.47E-06	2.91E-06
SPAR MOTOR	3	5.32E-04	5.59E-05	5.88E-04	8.74E-06	1.80E-05	2.68E-05
	4	1.91E-03	1.50E-04	2.06E-03	5.71E-05	6.02E-05	1.17E-04
	5	4.66E-03	2.96E-04	4.96E-03	2.15E-04	1.37E-04	3.52E-04
	10	4.44E-02	1.51E-03	4.59E-02	6.53E-03	9.72E-04	7.50E-03
	1	9.9E-13	2.0E-13	1.20E-12			
SPAR MOTOR	2	1.18E-09	1.46E-10	1.33E-09			
	3	4.23E-08	3.94E-09	4.62E-08			
	4	4.23E-07	3.20E-08	4.53E-07			
	5	2.18E-06	1.42E-07	2.32E-06			
	10	1.72E-04	6.88E-06	1.79E-04			