

Implementation of the EC Sulphur Content of Liquid Fuels Directive 1999/32/EC (as amended by 2005/33/EC) in the UK

2012 Report



Report for Defra

Ricardo-AEA/R/ED3369

Issue Number 1

Date 28/05/2013

Customer:

Department for Environment, Food and Rural Affairs

Customer reference:

RMP 5389

Confidentiality, copyright & reproduction:

This report is the Copyright of the Department of Environment, Food and Rural Affairs and has been prepared by Ricardo-AEA Ltd under contract to the Department of Environment, Food and Rural Affairs dated 02/11/2009. The contents of this report may not be reproduced in whole or in part, nor passed to any organisation or person without the specific prior written permission of the Department of Environment, Food and Rural Affairs. Ricardo-AEA Ltd accepts no liability whatsoever to any third party for any loss or damage arising from any interpretation or use of the information contained in this report, or reliance on any views expressed therein.

Ricardo-AEA reference:

Ref: ED3369- Issue Number 1

Contact:

Mr Jason Southgate
Ricardo-AEA Ltd
Gemini Building, Harwell, Didcot, OX11 0QR
t: 01235 753 605
e: Jason.Southgate@ricardo-aea.com
Ricardo-AEA is certificated to ISO9001 and ISO14001

Author:

Jason Southgate

Approved By:

Dr Ian Marshall

Date:

28 May 2013

Signed:

Executive summary

This report describes the Sampling and Analysis Programme carried out to demonstrate the extent of compliance with the limits set by Directives 1999/32/EC and 2005/33/EC for the sulphur content of liquid fuel supplied and used in the UK during the calendar year 2012.

The following data are reported:

- Sulphur content of heavy fuel (37 samples) and gas oil/kerosene (59 samples) collected by end users and analysed by an accredited laboratory.
 - 36 of the 37 results for heavy fuel oil used in 2012 were at or below the sulphur limit value of 1%.
 - 52 of the 59 results for gas oil used in 2012 were at or below the sulphur limit of 0.1%.
 - All of the 7 gas oil samples that exceeded the current limit would have met the previous limit. On further investigation it was established that users had purchased 0.1% compliant gas oil and are mixing it with older stocks of fuel oil purchased prior to 2008. The user programme advises users who have provided non-compliant sample data how to return to compliance.

- Sulphur content of heavy fuel and gas oil sampled and analysed at production refineries and reported through the UK Petroleum Industry Association (UKPIA) relating to output for internal UK sales during 2012.
 - Production refineries analysed 155 samples of heavy fuel oil during 2012, the results of which exhibited maximum and minimum sulphur contents of 1.00% and 0.51% respectively, with a mean value of 0.77% compared with the Directive limit value of 1%.
 - Production refineries also analysed 1256 samples of gas oil during 2012 and exhibited maximum and minimum sulphur contents of 0.1% and 0.0003% respectively, with a mean value of 0.051%, compared with a Directive limit value of 0.1%.

- Sulphur content of marine fuels bunkered at UK ports.
 - Most marine low sulphur heavy fuel oil (97.6%) bunkered at UK ports and subject to the 1% sulphur limit as revised in the MARPOL Annex VI was compliant. All low sulphur marine gas oil that was subject to the 0.1% sulphur limit in the Directive was compliant. There were no cases where high sulphur marine fuels exceeded the global sulphur limit (4.5%) set out in MARPOL Annex VI regulation 14.1.1.

Table of contents

1	INTRODUCTION.....	0
1.1	Directives 1999/32/EC and 2005/33/EC	0
1.2	Sampling requirements of the Directives	0
1.3	Reporting requirements of the Directive	1
1.4	Sampling and analysis report	1
2	SAMPLING AND ANALYSIS PROGRAMME.....	2
2.1	Overview	2
2.2	User Programme (land based fuel use).....	3
2.3	Supplier Programme (land based fuel use)	8
2.4	Marine Fuel Programme.....	9
3	CONCLUSION.....	11
4	REFERENCES.....	12

Appendices

Appendix 1 Supplier Programme Data Supplied by UKPIA

1 INTRODUCTION

1.1 Directives 1999/32/EC and 2005/33/EC

Directive 1999/32/EC [1] specifies limits for the sulphur content of certain liquid fuels (SCLF), viz., heavy fuel oil and gas oil (including marine gas oil). Directive 1999/32/EC came into force on 12 May 1999 with the purpose of reducing emissions of sulphur dioxide resulting from the combustion of certain liquid fuels. In particular, Articles 3 and 4 of the Directive respectively set maximum permissible levels for the sulphur content of heavy fuel oil (1% from 1 January 2003) and of gas oil, including marine gas oil (0.2% from 1 July 2000 and 0.1% from 1 January 2008).

Directive 1999/32/EC was amended by Directive 2005/33/EC [2] to include new provisions relating to the limits for the sulphur content of marine fuels (SCMF). Amongst other provisions:

- Article 4a was inserted to set maximum permissible levels for the sulphur content of marine fuels used in SO_x Emission Control Areas and by passenger ships operating on regular services to and from EU ports.
- Article 4b was inserted to set, from 1 January 2010, maximum permissible levels for the sulphur content of marine fuels (0.1% by mass) used by vessels in inland waterways and ships at berth in European Community ports.
- Article 4b also sets, 1 January 2010, the maximum permissible levels for the sulphur content of marine gas oils placed on the market (0.1% by mass).

Directive 1999/32/EC and the land based elements of Directive 2005/33/EC have been implemented separately in England and Wales [3 & 4], in Scotland [5 & 6] and in Northern Ireland [7 & 8]. The marine elements of the Directive have been implemented UK wide [9].

1.2 Sampling requirements of the Directives

Article 6(1) of Directive 1999/32/EC (which applies to SCLF) states that:

For land based fuels

“Member States shall take all necessary measures to check by sampling that the sulphur content of fuels used complies with Articles 3 and 4. The sampling shall commence within six months of the date on which the relevant limit for maximum sulphur content in the fuel comes into force ...”, that is, from 1 January 2001, and 1 July 2008, for gas oil, and from 1 July 2003 for heavy fuel oil.

For marine fuels

“Member States shall take the necessary measures to ensure that the sulphur content of marine fuels complies with the relevant provisions of Articles 4a and 4b..... Sampling shall commence on the date on which the relevant limit for maximum sulphur content in the fuel comes into force.....” that is, from 11 August 2007 for ships operating in the North Sea SECA and from 1st January 2010 for inland waterway vessels and ships at berth in community ports.

“Member States shall also take reasonable measures, as appropriate, to monitor the sulphur content of marine fuels other than those to which Articles 4a and 4b apply.” That is, marine fuel with a sulphur content within the 4.5% sulphur limit set out in MARPOL Annex VI **[10]**.

The 2010 monitoring programme also saw the implementation of the revised MARPOL Annex VI which supersedes the EU directive where by the limit for marine fuel oil at EU ports were reduced from 1.5% to 1.0% from the 1st of July.

1.3 Reporting requirements of the Directive

Article 7 (as replaced by Directive 2005/33/EC) of Directive 1999/32/EC requires that:

“On the basis of the results of the sampling and analysis and inspections carried out in accordance with Article 6, Member States shall by 30 June of each year provide the Commission with a short report on the sulphur content of the liquid fuels falling within the scope of this Directive and used within their territory during the preceding calendar year.... ”

1.4 Sampling and analysis report

This report has been prepared by Ricardo-AEA for Defra and the Devolved Administrations to describe the outcome of the land-based SCLF Sampling and Analysis Programme during the calendar year 2012 to fulfil the requirements of Article 7 of the Directive (see section 1.3 above) for the UK.

2 SAMPLING AND ANALYSIS PROGRAMME

2.1 Overview

For the calendar year 2012 and in accordance with Article 7 of the Directive, the scope of the SCLF Sampling and Analysis Programme was to determine the extent of compliance of the sulphur content of gas oil, heavy fuel oil and marine fuel supplied and used in the UK during that period.

The land-based elements of the Directive have been implemented separately in the various countries of the UK. However, collectively, the Department for the Environment, Food and Rural Affairs (Defra) and the Devolved Administrations (Welsh Government, Scottish Government and the Department of Environment Northern Ireland) agreed that a UK-wide sampling regime could be justified on cost grounds.

For the calendar year 2012, Defra contracted Ricardo-AEA to undertake a sampling and analysis programme based on the programmes undertaken in previous years. The approach was for:

- Users of fuel oils that were contacted to obtain, where possible, samples of fuel oils delivered in 2012 and to obtain analysis of delivered fuel oils (the user programme).
- The UK Petroleum Industry Association (UKPIA) was contacted to access analysis data for fuels supplied by refineries to the UK market (the supplier programme).

The UKPIA data were based on analysis of fuel batches by refineries to assure compliance with the Directives before release to the market and comprise a considerably larger sampling programme than the user programme. The use of supplier data in conjunction with user data is considered to be a representative, robust and cost effective means of assuring compliance with the Directives.

For the calendar year 2012, the Maritime and Coastguard Agency contracted Lloyds Register Environmental Services to carry out the marine fuel sampling and analysis programme. Through its global Fuel Oil Bunker Analysis Services (FOBAS), Lloyds Register was able to collect and analyse marine fuel sampling data for sulphur content and provide statistical data on sulphur levels in marine heavy fuel oils and marine gas oils bunkered and placed on the market in UK ports. This included marine fuels not subject to the sulphur content limits set out in the Directive. As part of the analysis, the sulphur content data provided FOBAS was compared with sulphur content information contained within the bunker delivery notes for the marine fuel sampled.

2.2 User Programme (land based fuel use)

2.2.1 Number of samples taken

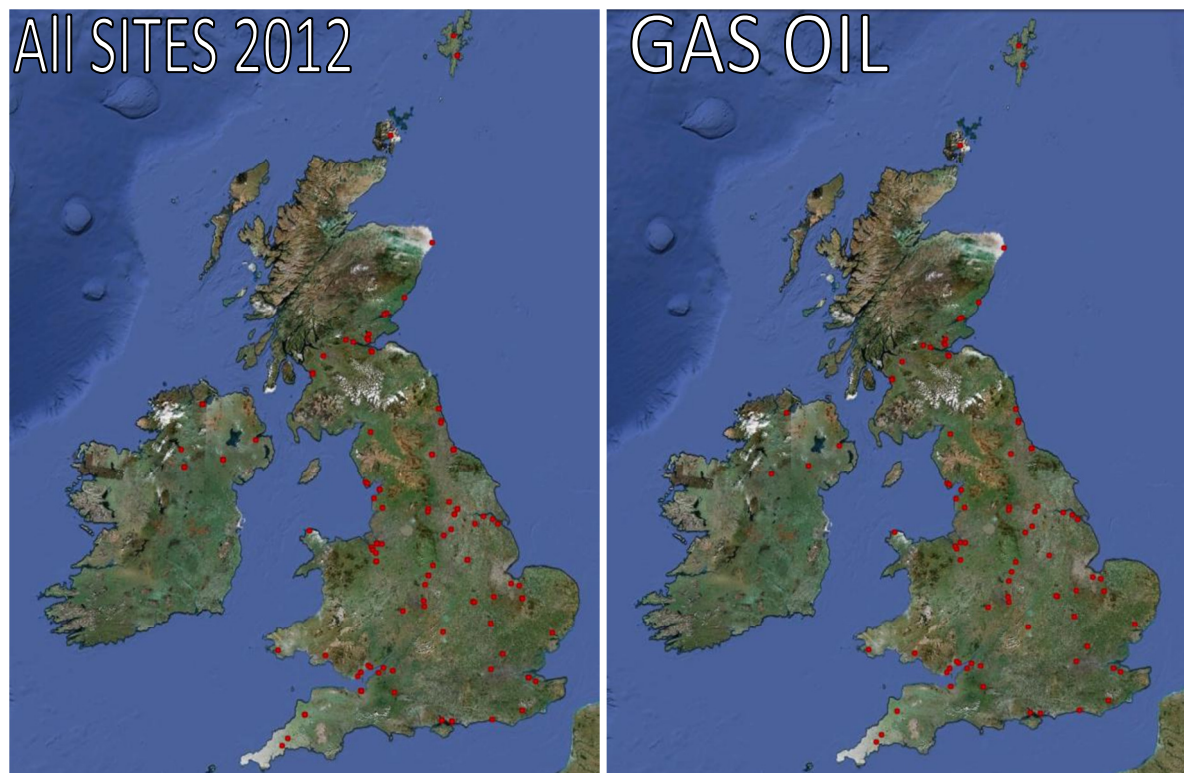
For the 2012 Programme, users of fuel oils were contacted and asked to provide analysis data for samples from fuel oils delivered and used in 2012 where available.

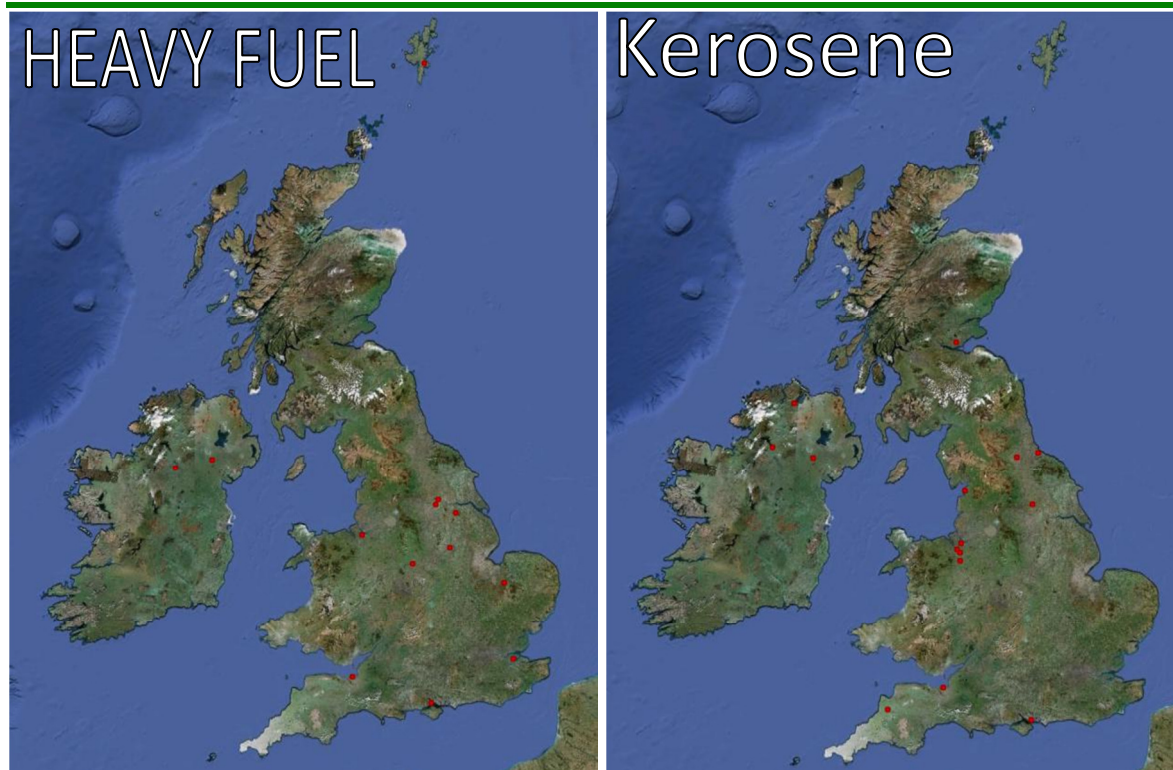
Results from 37 samples of heavy fuel oil are reported, originated from 6 different users, with several users each supplying data for fuel from several of their sites. The remaining 10 users who responded, did not perform any analysis as part of their process.

Results from 59 samples of gas oil/kerosene are reported. These originated from 13 different users, with several users each supplying data for fuel from several of their sites. The remaining 70 users who responded, did not perform any analysis as part of their process.

These users were chosen to give a representative spread from the geographical distribution of the UK as shown in Figure 2.1.

Figure 2.1 Geographical distribution of Data Received in the 2012 program





Of the 90 responses for the 2012 programme, 13 users reported 95 analysis results, of which 53 originate from England, 12 originate from Wales, 15 originate from Scotland and 16 originate from Northern Ireland. The reported data related to 47 Gas Oil, 12 Kerosene and 37 Heavy Fuel Oil analysis results.

2.2.2 Results of user programme

The results of the 2012 user programme for sulphur content of heavy fuel oil and gas oil are set out in Tables 2.1 and 2.2.

- 36 of the 37 results for heavy fuel oil used in 2012 were at or below the sulphur limit value of 1%.
- 52 of the 59 results for gas oil used in 2012 were at or below the sulphur limit of 0.1%.

All of the 7 gas oil and 1 heavy fuel oil samples above the limit would have met the previous heavy fuel oil and gas oil limits. On further investigation it was established that users had purchased compliant fuel and are mixing it with older stocks of fuel oils oil purchased prior to 2009. The user programme advises users who have provided non-compliant sample data how to return to compliance.

Fuel oil usage during 2012 is also reported in Tables 2-1 and 2-2 for those users who recorded the data. Use-weighted means of sulphur content are 0.93% (m/m) and 0.048 % (m/m) for heavy fuel oil and gas oil respectively.

Table 2.1 Summary of heavy fuel oil analysis

Site Ref No.	Location	Analysis Result		2012 Usage (tonnes)
		(%)	Uncertainty (±)	
4	England	0.93	0.005	Not Recorded
17	Scotland	0.90	0.006	20.1
		0.88	0.006	
		0.80	0.006	
		0.94	0.005	
		0.93	0.005	
		0.95	0.005	
		0.87	0.006	
		0.97	0.005	
		0.90	0.006	
		0.99	0.005	
		0.99	0.005	
77	England	0.94	0.005	14.5
		0.93	0.005	
		0.93	0.005	
		0.92	0.005	
		0.90	0.006	
		0.93	0.005	
		0.90	0.006	
		0.89	0.006	
143	England	0.97	0.005	4.5
		0.98	0.005	
		0.98	0.005	
		0.97	0.005	
156	England	0.98	0.005	Not Recorded
		0.98	0.005	
		0.96	0.005	
		0.88	0.006	
		0.96	0.005	
		0.97	0.005	
		0.90	0.006	
		0.97	0.005	
		0.97	0.005	
		0.99	0.005	
0.94	0.005			
174	England	0.80	0.006	Not Recorded

Analysis marked '**' are above the sulphur limit value of 1% for heavy fuel oil.

Table 2.2 Summary of gas oil analysis

Site Ref No.	Location	Analysis Result		2012 Usage (tonnes)
		(%)	Uncertainty (±)	
4	England	0.100	0.005	0.7
16	Northern Ireland	0.023	0.022	0.7
		0.039	0.013	
		0.026	0.019	
		0.037	0.014	
		0.027	0.019	
		0.030	0.017	
		0.032	0.016	
		0.030	0.017	
		0.105*	0.005	
		0.001	0.500	
		0.108*	0.005	
		0.001	0.500	
		0.109*	0.005	
		0.010	0.050	
0.030	0.017			
17	Scotland	0.087	0.006	0.9
		0.073	0.007	
		0.076	0.007	
77	England	0.020	0.025	0.8
		0.020	0.025	
		0.020	0.025	
		0.040	0.013	
		0.020	0.025	
		0.040	0.013	
0.010	0.050			
119	England	0.174*	0.003	Not Recorded
		0.085	0.006	
		0.167*	0.003	
143	England	0.001	0.667	0.3
156	England	0.087	0.006	0.0
		0.087	0.006	
		0.085	0.006	
158	England	0.074	0.007	0.2
174	England	0.090	0.006	0.1
187	England	0.110*	0.005	Not Recorded
		0.100	0.005	
507	Wales	0.100	0.005	0.2

		0.100	0.005	
		0.100	0.005	
		0.100	0.005	
		0.100	0.005	
		0.100	0.005	
		0.100	0.005	
		0.100	0.005	
		0.100	0.005	
		0.100	0.005	
		0.100	0.005	
669	England	0.100	0.005	Not Recorded
684	England	0.001	0.500	2.0
		0.001	0.500	
		0.001	0.500	
		0.001	0.500	
		0.045	0.011	
		0.046	0.011	
		0.045	0.011	
		0.045	0.011	

Analyses marked “*” are above the sulphur limit value of 0.1% for gas oil.

2.3 Supplier Programme (land based fuel use)

2.3.1 Number of samples taken

Samples of both fuel oil and gas oil are regularly taken and analysed at production refineries for product intended for 'inland' sale. Over the 2012 calendar year 155, 1256 and 671 samples of heavy fuel oil, gas oil and kerosene respectively were taken and analysed. Results from the analysis of the 2012 samples are set out in Appendix 1.

2.3.2 Results of supplier monitoring programme

The summarised results of the UK 2012 supplier programme for the sulphur content of heavy fuel oil and gas oil are set out in Table 2.3.

Table 2.3 Monitoring results from UKPIA

	2012		2011	
	Permitted level %	Sulphur %	Permitted level %	Sulphur %
Fuel oil	1.0	0.77 ± 0.15	1.0	0.89 ± 0.05
Gas oil	0.1	0.051 ± 0.008	0.1	0.040 ± 0.008
Kerosene	0.1	0.017 ± 0.012	0.1	0.024 ± 0.017

More detailed data from the supplier programme are set out in Appendix 1.

All analysis results were at or below the limit values of 1% and 0.1% applied to heavy fuel oil and gas oil/kerosene produced for 'inland' sale in 2012 respectively.

2.4 Marine Fuel Programme

2.4.1 Number of samples taken

Samples were available from 47 different UK ports [11]. Out of these 11 ports covering 83% of the quantity bunkered are included in the 2012 program. No samples were included from Gibraltar.

In 2012, a total of 166 samples of low sulphur heavy fuel oil ($\leq 1.0\%$ sulphur) were analysed for sulphur content from 9 UK ports. A further 63 samples were taken for high sulphur heavy fuel oil ($> 1.0\%$ sulphur) from 6 UK ports. This higher sulphur fuel is used outside Emission Control Areas and is not subject to the sulphur limits in the Directive. The fuel is instead subject to the current 4.5% global sulphur limit specified by MARPOL Annex VI.

53 samples of Low Sulphur Marine Gas Oil ($\leq 0.1\%$ sulphur) were analysed for sulphur content from 7 UK ports. No samples of High Sulphur Marine Gas Oil ($> 0.1\%$ sulphur Fuel) were taken during the 2012 program.

2.4.2 Results of Monitoring Programme

The results of the 2012 monitoring programme are set out in Table 2.4 below. For 2012, 162 of the 166 low sulphur marine heavy fuel oil results (97.6%) were compliant under the current 1.0% sulphur limit. The average value across all 9 ports was 0.90%. There were no cases where high sulphur fuel oil supplied exceeded the global sulphur limit of 4.5% as per MARPOL Annex VI regulation 14.1.1.

For low sulphur marine gas oil all of the 53 samples were compliant with the 0.1% sulphur limit specified in the directive.

It was noted that no Marine diesel fuels are being supplied at UK ports.

Table 2.4 Marine fuel samples at UK Ports in 2012

	Marine fuel subject to the Directive's sulphur limit		Other marine fuel subject to MARPOL Annex VI sulphur limits HFO HS ³
	1.00% HFO LS ¹	0.10% MGO LS ²	
Number of samples	166	53	63
Number of Ports Tested	9	7	6
Average sulphur level from samples analysed	0.90%	0.073%	1.77%
Bunker Delivery Note average sulphur level	0.92%	0.077%	1.88%
Average bunker quantity (T)	284.55	178.75	907.33
Max bunker quantity (T)	1,400.50	400.00	1,815.37
Number of samples that tested above limit	4	0	0

¹ Marine diesel oil, Low Sulphur – Sulphur content less than or equal to 1.0% m/m (MARPOL Annex VI)

² Marine gas oil, Low sulphur – Sulphur content less than or equal to 0.1% m/m

³ Heavy fuel oil, High Sulphur – Sulphur content greater than 4.5% m/m (MARPOL Annex VI)

3 CONCLUSION

This report shows that 97% of heavy fuel oil and 88% of gas oil used in the UK during 2012 (land based fuel use) was at or below the limits specified in the Directive. In addition, fuel supplier data shows that all fuel for land based use placed on the market in 2012 was compliant with the limits in the Directive.

Most marine low sulphur heavy fuel oil (97.6%) bunkered at UK ports and subject to the 1% sulphur limit as revised in the MARPOL Annex VI was compliant. All low sulphur marine gas oil that was subject to the 0.1% sulphur limit in the Directive was compliant. There were no cases where high sulphur marine fuels exceeded the global sulphur limit (4.5%) set out in MARPOL Annex VI regulation 14.1.1.

4 REFERENCES

- [1] Council Directive 1999/32/EC of 26 April 1999 relating to a reduction in the sulphur content of certain liquid fuels and amending Directive 93/12/EEC
- [2] Directive 2005/33/EC of the European Parliament and of the Council of 6 July 2005 amending Directive 1999/32/EC as regards the sulphur content of marine fuels
- [3] The Sulphur Content of Liquid Fuels (England and Wales) Regulations 2000 Statutory Instrument 2000 No.1460
- [4] The Sulphur Content of Liquid Fuels (England and Wales) Regulations 2007 Statutory Instrument 2007 No.79
- [5] The Sulphur Content of Liquid Fuels (Scotland) Regulations 2000 Statutory Instrument SI 2000 No. 169
- [6] The Sulphur Content of Liquid Fuels (Scotland) Regulations 2007 Statutory Instrument SI 2007 No. 27
- [7] The Sulphur Content of Liquid Fuels (Northern Ireland) Regulations 2002 Statutory Rules of Northern Ireland 2002 No. 28
- [8] The Sulphur Content of Liquid Fuels (Northern Ireland) Regulations 2007 Statutory Rules of Northern Ireland 2007 No. 272
- [9] The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2010 No. 895
- [10] 1978 MARPOL Protocol under the 1973 International Convention for the Prevention of Pollution from Ships. MARPOL Annex VI: Prevention of Air Pollution from Ships [adopted Sept 1997, entered into force May 2005]
- [11] Statistical Data and Other Information to MCA on Sulphur Contents in Marine Fuels Supplied in UK Ports Excluding Gibraltar, FOBAS-EX/25032013, Lloyd's Register, May 2013.

Appendix

Appendix 1: Supplier Programme Data Supplied by UKPIA

Appendix 1: Supplier Programme Data Supplied by UKPIA

Table A.1 Results of the Supplier Programme from UKPIA for 2012

2012 Product	Units	No of Samples	Minimum	Mean	Maximum	Standard Deviation	Test Method
Fuel Oil	%(m/m)	155	0.51	0.77	1.0	0.15	IP336
Gas Oil	%(m/m)	1256	0.0003	0.051	0.10	0.008	IP336
Domestic Kerosene	%(m/m)	671	0.0001	0.017	0.10	0.012	IP336

Table A.2 Results of the Supplier Programme from UKPIA for 2011

2011 Product	Units	No of Samples	Minimum	Mean	Maximum	Standard Deviation	Test Method
Fuel Oil	%(m/m)	48	0.71	0.89	1.0	0.05	IP336
Gas Oil	%(m/m)	1157	0.0002	0.040	0.10	0.008	IP336
Domestic Kerosene	%(m/m)	727	0.0001	0.024	0.10	0.017	IP336

RICARDO-AEA

The Gemini Building
Fermi Avenue
Harwell
Didcot
Oxfordshire
OX11 0QR

Tel: 01235 753605

www.ricardo-aea.com