Research report

Viability of using direct toxicity assessment for petroleum refinery effluent toxicity assessment

RESEARCH REPORT

VIABILITY OF USING DIRECT TOXICITY ASSESSMENT FOR PETROLEUM REFINERY EFFLUENT TOXICITY ASSESSMENT

1st edition

November 2010

Published by
ENERGY INSTITUTE, LONDON
The Energy Institute is a professional membership body incorporated by Royal Charter 2003
Registered charity number 1097899

The Energy Institute (EI) is the leading chartered professional membership body supporting individuals and organisations across the energy industry. With a combined membership of over 14 000 individuals and 300 companies in 100 countries, it provides an independent focal point for the energy community and a powerful voice to engage business and industry, government, academia and the public internationally.

As a Royal Charter organisation, the EI offers professional recognition and sustains personal career development through the accreditation and delivery of training courses, conferences and publications and networking opportunities. It also runs a highly valued technical work programme, comprising original independent research and investigations, and the provision of EI technical publications to provide the international industry with information and guidance on key current and future issues.

The EI promotes the safe, environmentally responsible and efficient supply and use of energy in all its forms and applications. In fulfilling this purpose the EI addresses the depth and breadth of energy and the energy system, from upstream and downstream hydrocarbons and other primary fuels and renewables, to power generation, transmission and distribution to sustainable development, demand side management and energy efficiency. Offering learning and networking opportunities to support career development, the EI provides a home to all those working in energy, and a scientific and technical reservoir of knowledge for industry.

This publication has been produced as a result of work carried out within the Technical Team of the EI, funded by the EI's Technical Partners. The EI's Technical Work Programme provides industry with cost-effective, value-adding knowledge on key current and future issues affecting those operating in the energy sector, both in the UK and internationally.

For further information, please visit **http://www.energyinst.org**

The EI gratefully acknowledges the financial contributions towards the scientific and technical programme from the following companies

BG Group
BP Exploration Operating Co Ltd
BP Oil UK Ltd
Centrica
Chevron
ConocoPhillips Ltd
EDF Energy
ENI
E. ON UK
ExxonMobil International Ltd
Kuwait Petroleum International Ltd
Maersk Oil North Sea UK Limited
Murco Petroleum Ltd
Nexen
Saudi Aramco
Shell UK Oil Products Limited
Shell U.K. Exploration and Production Ltd
Statoil Hydro
Talisman Energy (UK) Ltd
Total E&P UK plc
Total UK Limited

However, it should be noted that the above organisations have not all been directly involved in the development of this publication, nor do they necessarily endorse its content.

ISBN 978 0 85293 582 8

Published by the Energy Institute

Further copies can be obtained from: Portland Customer Services, Commerce Way, Whitehall Industrial Estate, Colchester CO2 8HP, UK.
t: +44 (0)1206 796 351 e: **sales@portland-services.com**

Electronic access to EI and IP publications is available via our website, **www.energyinstpubs.org.uk**.
Documents can be purchased online as downloadable pdfs or on an annual subscription for single users and companies.
For more information, contact the EI Publications Team.
e: **pubs@energyinst.org**

CONTENTS

FOREWORD

This Research Report summarises a project in which example levels of petroleum refinery effluent toxicity were measured and tested so as to investigate the viability of using direct toxicity assessment (DTA) for UK petroleum refinery effluent toxicity assessment.

The project comprised:

- A desk-based review of the petroleum refining sector EEL *A review of oil refining industry operations in the UK with reference to direct toxicity assessment* (DTA) and consideration of the implications of EA *Guidance on the use of direct toxicity assessment in PPC impact assessments* should it be used by this sector in the future.
- A pilot study undertaking DTA testing on three effluent outfalls selected from two petroleum refineries, which are considered representative of the UK petroleum refining sector (see EEL *Direct toxicity assessment (DTA) of the [Refinery A] effluents: 2009* and *Direct toxicity assessment (DTA) of the [Refinery B] effluents: 2009*).

The project concluded that:

- UK petroleum refining operations use similar generic processes to manufacture a portfolio of common products. Since similar effluent treatment systems are also employed at most petroleum refineries, it is reasonably likely that the effluents produced will exhibit similar toxicity. However, it should be noted that only slight differences in the chemical composition of an effluent could affect its toxicity.
- If EA *Guidance on the use of direct toxicity assessment in PPC impact assessments* were to be applied to effluents from the UK petroleum refining sector, as they have been to other sectors of the chemical manufacturing industry, the majority of the outfalls would meet the criteria to undertake DTA testing.
- All the effluents tested in the pilot study were of low toxicity (without consideration of local risk assessment).
- These effluents tested represented a range of conditions and many of the variables likely to be encountered across the petroleum refining sector. For any specific outfall the environmental risk assessment determined using EA *Guidance on the use of direct toxicity assessment in PPC impact assessments* would vary significantly from site to site due to a number of variables, but principally initial dilution.
- This study used dilution values derived from EA *Environmental assessment and appraisal of BAT* because data on initial dilution for discharges in the pilot study sites were not available. These values were not designed for use with this type of discharge and give a very simplified risk assessment. No conclusions should therefore be drawn about the specific risk at the individual sites studied, but only an indication of the general toxicity profile of UK petroleum refinery effluent discharges.

This Research report may be further reviewed from time to time. It would be of considerable assistance in any future revision if users would send comments or suggestions for improvement to the Technical Department, Energy Institute, 61 New Cavendish Street, London, W1G 7AR, e: technical@energyinst.org.

ACKNOWLEDGEMENTS

The Research Report was commissioned by the Energy Institute's (EI's) Emissions Working Group and prepared by Matt Hutchings (Ecospan Environmental Ltd.).

The Emissions Working Group provided technical direction to the project and comprised:

Steve Cross	Shell
Kevin Lenthall	Total
Dr Jenny Lyn	EI
Graham Neal	ExxonMobil (Chairperson)
Paul Shawcross	ConocoPhillips
Brian Smithers	Consultant
Alison Walker	ConocoPhillips

Affiliations refer to the time of participation.

The project was managed by Dr Jenny Lyn, and latterly by Dr Mark Scanlon (EI). Technical editing was carried out by Dr Mark Scanlon and assisted by Kerry Sinclair (EI).

1 INTRODUCTION

The EI's Emissions Working Group commissioned Ecospan Environmental to determine example levels of effluent toxicity by direct toxicity assessment (DTA) within the UK petroleum refining sector. This project was initiated at the end of the Integrated Pollution Prevention and Control (IPPC) re-permitting process for the petroleum refining sector in response to a request from the Environment Agency (EA) petroleum refinery sector specialist that the toxicity levels of petroleum refinery effluents be assessed using DTA in order to inform EA on whether use of this technique was warranted for the sector.

This project comprised two main components. The first was a desk-based review to assess the UK petroleum refining sector's effluent outfalls in relation to EA *Guidance on the use of direct toxicity assessment in PPC impact assessments*. The resultant report EEL *A review of oil refining industry operations in the UK with reference to direct toxicity assessment (DTA)* also included a more detailed assessment of the chemical composition, variability and discharge volumes for the three outfalls selected for the pilot study. This information was then used to develop a DTA sampling strategy and testing programme for three pilot study effluents and formed the second main component of the project (see EEL *Direct toxicity assessment (DTA) of the [Refinery A] effluents: 2009* and *Direct toxicity assessment (DTA) of the [Refinery B] effluents: 2009*).

This Research Report summarises the findings from the whole project: it discusses the viability of using DTA for UK petroleum refinery effluent toxicity assessment.