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AIR PRODUCTS (BR) LTD

PROJECT NUMBER: A3145

INSTALLATION: LLANWERN HYDROGEN INSTALLATION (BL 2459)

TITLE: Improvement Opportunities Report

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Air Products (BR) Ltd Document No: A3145 – Improvement Opportunities Report

Llanwern Hydrogen Installation Improvement Opportunities

1.0 Objective

This report has been produced to satisfy condition 4.1.3 of the permit namely that "*the Operator shall, within 36 months of the issue of this Permit, submit a report on potential environmental improvements to the Permitted Installation.*"

A review was undertaken of the plant performance to date and changes, if any, in indicative BAT given in the guidance notes and other development is technology or systems, so that potential environmental improvements could be identified.

1.1 General

The plant was first commissioned in April 2002, and since then the plant has run to design and without incident. The design parameters were met or exceeded and the environmental performance of the plant is better than design.

1.2 Plant Performance vs Design

A plant performance test was carried out in September 2013. This showed the plant to be performing as specified in terms of production and process conditions. This was completed after change out of the reformer tubes , catalyst and a like for like change on the burners.. Since then there has been no significant deterioration in plant performance with respect to the parameters set out in the PPC permit application.

2.0 Review and improvement opportunities

2.1 A review was carried out against indicative BAT in the revised guidance notes and against any other developments in technology and techniques since the plant commissioning.

Appendix 1 shows the original reference documents and revised versions where applicable.

2.2 BAT for plant selection

Steam methane reforming remains the technology of choice for the required hydrogen production, purity and reliability. No significant advances have been made in electrolyser or other competing technologies (references 2,3). In addition, considering the plant expected life of 15 or more year's complete replacement is unlikely to be economic. Plant selection is still in line with indicative BAT. The assumptions made in the original PPC application were also reviewed and remained valid. All the relevant techniques identified in the guidance notes have been implemented in the plant design

2.2.1 BAT for abatement of point source air emissions

The main abatement technique for air emissions is the use of low NOx burner systems. Whilst here have been some advances in this area the current burners offer a better than design performance as shown in table 1. A planned maintenance regime is in place to maintain burner performance and if replacement proves to be necessary

later in the life of the plant, latest technology will be considered for use. This was considered for the contract roll for Fiscal 2017.

There is no environmental or economic reason to consider replacement of the current burners with new ones.

The catalyst replacement (see below) at the anticipated 3-5 year interval should also contribute to improved plan performance, as seen after change out in 2007.

Table 1

	Limits Ref 3	Limits Ref 4	A1 Plant vent Design	A1 Plant vent	A1 Plant vent	A1 Plant vent
	(mg/m^3)	(mg/m^3)	(mg/m^3)	(mg/m^3)	(mg/m^3)	(mg/m^3)
Date				12/11/2008	13/11/2009	07/01/2011
	140	145	76.4	30.3	33.4	27.5
	100	100	1.44	10	8.9	31.1

all at 3% excess o2
dry basis

Regular reports are sent to the NRW see reference 19.

2.2.2 BAT for abatement of water emissions

The water emissions are small and low hazard, the only available option is to send these to Corus waste water system and thence to the Seven Estuary. Additional treatment is still not justified given the negligible impact of these releases.

The installation of the new 'shared' cooling tower in 2003 has lead to more efficient use of water for the site as a whole and lower emissions to water, but the cooling tower is mainly used by the oxygen plant on site so is not part of the hydrogen plant installation

2.2.3 Emissions to groundwater

There are no planned and have been no accidental emissions to groundwater. Current arrangements meet the indicative BAT.

2.2.4 BAT for abatement of fugitive air emissions

Regular checks and leak patrols have not identified significant fugitive emissions, and there are no opportunities for improvements. The plant was designed to have low fugitive emissions and the planned maintenance regime and leak patrols are in place to ensure this continues to be the case.

2.2.5 BAT for abatement of fugitive water emissions

There have been no incidents or near misses and Current arrangements meet the indicative BAT.

2.2.6 Odour Nuisance

There have been no incidents or near misses and Current arrangements meet the indicative BAT.

2.3 MANAGEMENT TECHNIQUES

Air Product internal EHS audits and self assessments have not identified significant weaknesses in the management arrangements for the site, and the permit conditions are being complied with in full.

The EA OMA audit in 2004 did suggest addtional training for the site manager and confirmation of the site managers responsibilities for monitoring. Air Products feels that the current arrangements and training are appropriate to the plant size and environmental impact, given that environmental professionals are available to support the plant manager as needed.

Management systems were reviewed and remote operation of the plant agreed with the EA (reference 21,22)

2.4 Raw materials including water specification and usage

2.4.1 Raw Material selection

The selection of water treatment chemicals and other raw materials remains unchanged and is still in line with the indicative BAT.

In July 2007 the existing catalyst was changed for KATALCO 57-4MQ, a higher efficiency and longer life catalyst. This follows development work on other similar installations showing improvements in plant performance and increase in catalyst change out times.

2.4.2 Waste Minimisation

The main waste form the process is from periodic catalyst change outs every 3-5 years, so that plant performance can be maintained.

2.4.3 Water Usage

See 2.2.2 above.

2.5 Waste Management

Waste management arrangements are still inline with indicative BAT.

2.6 Details of waste stream disposal routes

Disposal routes were reviewed and no changes proposed, catalyst will be recycled if economically possible, but given the small amounts involved this may not prove to be practical. Catalyst disposal carried out by authorised contractor as required

2.7 Energy efficiency

Energy efficiency reviews are regularly carried out as documented in reference 20 and no opportunities for improvements have been identified.

2.8 Accident Risks
There have been no process safety near misses or incidents and the emergency arrangements are kept under regular review, in line with the indicative BAT.

2.9 Noise and Vibration Control
Noise and vibration review was carried out (reference 23) and no additional improvements were identified.

2.10 Monitoring
An EA OMA audit in 2004 identified some areas of improvement, subsequently AP has replaced our air emissions monitoring contractor with an MCERTS registered contractor. This has improved the traceability and assurance, no further actions are proposed.

Addtional monitoring arrangements were reviewed (reference 24) and no addtional improvements were identified.

2.11 DECOMMISSIONING
The decommissioning plan was reviewed and no changes are proposed.

2.12 Site report
Since the pemit application was made the Agency has made significant changes to its policy in this area (reference 15). However the full site report undertaken for the plant exeeds the EA current requirements and no further action is necessary.

3. Improvement programme

A summary of the improvement programme items is given below and they are all completed.

9.1	A report shall be sent to the Agency on establishing an Environmental Management System having regard to section 2.1 of the relevant IPPC Sectorial or other Technical Guidance. The report shall include any proposals to implement such a programme	31st December 2003	Complete, EA accepted
9.2	Submit an energy efficiency plan to the Agency that lists all available techniques and the estimated CO_2 reductions associated with these.	31st January 2003	Complete, EA accepted
9.3	When the plant has been commissioned and routine steady operation established, undertake a noise survey and assessment. Agree scope of the work with the Agency before undertaking it. Provide written report to the Agency on the completed work.	31st October 2002	Complete, EA accepted
9.4	A report shall be sent to the Agency reviewing emissions to water from the installation considering emissions since start-up, BAT and impacts. Discuss with the Agency before starting the review.	31st December 2003	Complete, EA accepted
9.5	A report shall be sent to the Agency reviewing emissions to air after the installation has been commissioned. The report shall also review the proposed monitoring arrangements against the need to demonstrate the process is achieving BAT without deteriorating.	31st December 2002	Complete

4. Conclusions

The following new environmental improvements were identified during the review

- Replacement of existing catalyst with higher efficiency, longer life catalyst, planned for July 2007. Completed

Other arrangements are still in line with the indicative BAT.

Appendix 1 Reference Documents

References – original Application	Current References
1. Charging Scheme for Pollution Prevention and control v2 – Environment Agency May 2001	Charging Scheme for PPC – Environment Agency 2004-2005
2. Chief Inspectors Guidance note (CIGN) S2 1.01 Combustion Processes:.'– Environment Agency 1995.	Combustion Activities Pollution Prevention Control (PPC) Guidance Consultation
3. CIGN S2 4.04 Inorganic chemicals – Environment Agency 1999.	IPPC GN 4.03 Inorganic Chemicals - Environment Agency 2002
4. IPC S3 1.02 Oil and Gas Processes Supplementary guidance note - Environment Agency 2000.	
5. "Integrated Pollution Prevention and Control: A Practical Guide" DETR 2001.	Integrated Pollution Prevention and Control: A Practical Guide" DETR April 2004
6. Technical Guidance Note D1 Guidelines on discharge stack heights for polluting emissions - Environment Agency 1993.	
7. EPA-453/R-93-026, p. 2-10–US Environmental Protection Agency June 1993.	No change
8. Best Environmental Management Practices - European Industrial Gases Association draft publication 2001.	Best Environmental Management Practices - European Industrial Gases Association document 88/02 E
9. Pollution Prevention Guidance (PPG) series – Environment Agency.	No change
10. IPPC Energy Efficiency guidance note H2 – Environment Agency.	H2 Horizontal guidance energy efficiency v3 February 2002 August 2003– Environment Agency
11. "CCPS Guidelines for Safe Automation of Chemical Processes."- AIChE	No change
12. Draft IPPC Noise guidance note H3 - Environment Agency.	H3 Horizontal guidance for noise (vol 1 & 2) v2 September 2002 Environment Agency

13. Design for Decommissioning (David Hicks IChemE TCE July 2001).	No change
14. US EPA Publication AP-42 natural gas, commercial-boiler combustion emission factors.	No change
15. IPPC X2 Guidance on preparation of a site report in an IPPC permit application – Environment Agency.	H7 Horizontal guidance land contamination v1 August 2003– Environment Agency
16. IPPC part (A) 1 Installations: Guide for applicants – Environment Agency.	IPPC part (A) 1 Installations: Guide for applicants – v3 April 2004– Environment Agency
17. IPPC H1 Environment Appraisal of BAT – Environment Agency	H1 Environmental Assessment and Appraisal of BAT Issue 6 July 2003 - Environment Agency
18.	A3145 IPPC permit application - Air Products application to EA
19.	A3145 Air Emissions report – Air Products report to EA
20.	A3145 energy report - Air Products report to EA
21.	A3145 management systems – Air Products report to EA
22.	A3145 remote operation – Air Products report to EA
23.	A3145 Noise report – Air Products report to EA
24.	A3145 monitoring report – Air Products report to EA