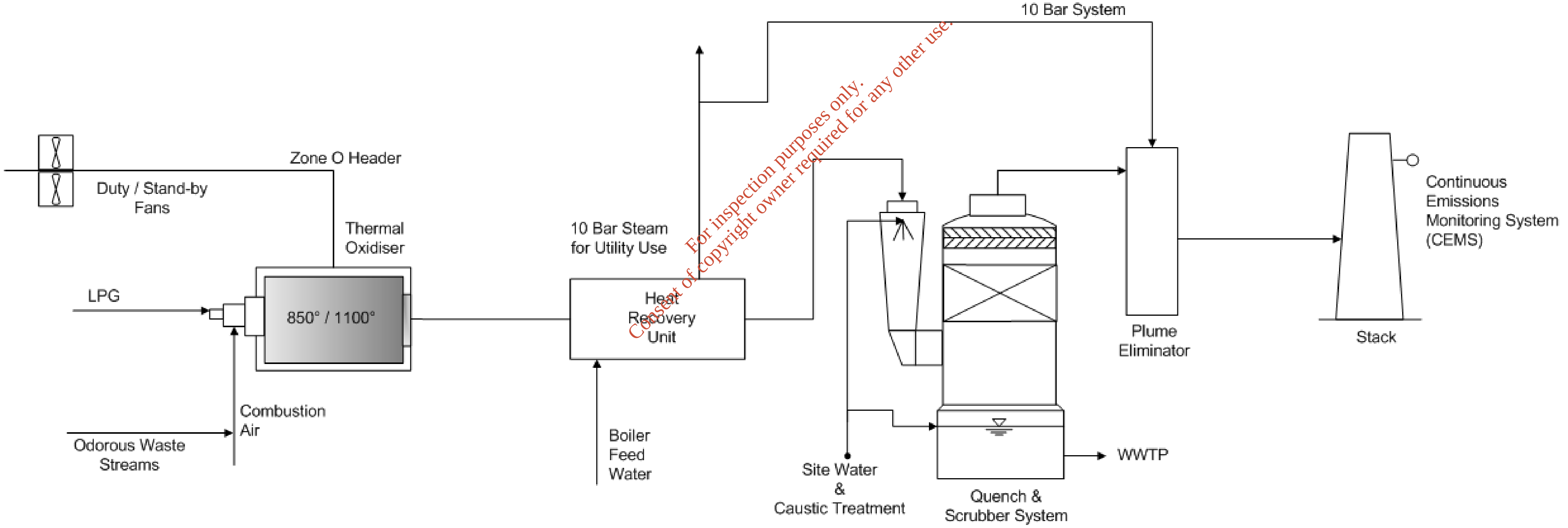
VOC Abatement Project

Flow Diagram for Proposed Thermal Oxidiser Plant



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VALIDATION OF ENVIRONMENTAL COMPLIANCE FOR DIRECT FIRED THERMAL OXIDISER AND SCRUBBER UNIT AT ABBVIE SLIGO

Prepared For

Abbvie

Prepared By

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Our Reference

FC/15/8539

Date Of Issue

15 July 2015

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1.0 INTRODUCTION

Abbvie has installed a Direct Fired Thermal Oxidiser (DFTO) System supplied by DÜRR Systems GmbH, Clean Technology Systems Division.

The EPA require that Abbvie shall prepare to the satisfaction of the Agency a test programme for the DFTO installed to abate emissions to atmosphere. This programme shall be submitted to the Agency in advance of implementation.

Once abatement equipment is newly installed on an existing site or if a site is newly licensed and already has preinstalled abatement equipment on it, the licensee must prove to the EPA that equipment is suitable and capable for use to meet the demands of the licence.

In order to demonstrate this, Abbvie have commissioned AWN to prepare this document which explains how Abbvie proposes to prove the abatement equipment's suitability and capability.

The test programme ensures that Abbvie can assess the performance of any monitors on the abatement system and establish a maintenance and calibration programme for each monitor.

The test programme for any piece of abatement equipment is not just limited to how that item operates in isolation; rather its impact on other plant and equipment must also be assessed. The licence Condition requires that any monitor (thermocouple, flow metre, flue gas analyser etc) is also capable of operating across the performance range in which the abatement equipment is being tested and this is considered in this Plan also.

As a consequence of the manner in which these related items perform during the test programme, this plan will ensure that Abbvie will ensure that they are maintained and calibrated so that changes in the abatement equipment do not have an adverse or an unknown impact on the relevant monitors.

A documented maintenance and calibration programme (including a schedule), for any monitor associated with the abatement equipment is an essential and compulsory output of the test programme.

The criteria for the operation of the abatement equipment as determined by the test programme, shall be incorporated into the standard operating procedures. (SOPs) by Abbvie once the System is commissioned and fully operational.

The findings of the completed test programme will be recorded and implemented. All relevant licensee SOPs will, following the completion of the test programme, be updated to account for the knowledge gained from assessing the results obtained from the test programme.

The test programme shall as a minimum:

Establish all criteria for operation, control and management of the abatement equipment to ensure compliance with the emission limit values specified in this licence.

Abbvie understand that a successfully completed test programme will provide the operator with the knowledge of how best to operate, control and manage the relevant abatement equipment in order to comply with the requirements of the EPA licence.

Therefore when compiling the test programme proposal Abbvie will ensure that once the actions contained in the programme are undertaken, they will then know how best to run that piece of abatement equipment so as to ensure compliance with the EPA licence.

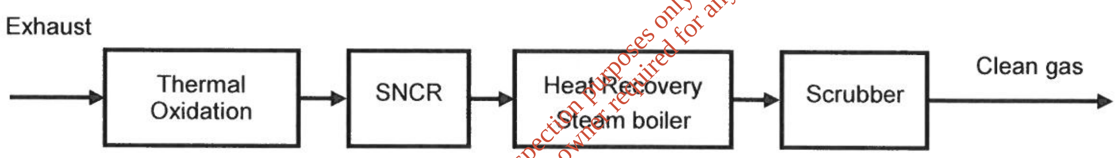
This document is the "Validation of Environmental Compliance Report" for the Unit and is intended to explain to the EPA how Abbvie will prove the installed equipment is suitable and capable for use to meet the demands of the site EPA licence.

This Report has been prepared by AWN Consulting Ltd on behalf of Abbvie.

This Report includes reference to the Manufacturers requirements for maintenance, operational procedures and training requirements and describes how Abbvie will ensure compliance with these requirements.

The unit is described by Durr as an "Ecopure VAR thermal oxidiser with SNCR" denitrification equipment, heat recovery and flue gas cleaning for abatement of solvent laden air from the manufacturing process.

The processes are shown schematically as follows and are hereinafter termed "the System":



In order for the System to meet its performance requirements, each of the System components must meet their defined performance criteria. In order to demonstrate Environmental Compliance (that is defined as compliance with emission limit values) the performance of each component of the System must be confirmed, demonstrated and recorded, and the aim of this report is to define how this will be achieved over the first two months of validation and operation of the System.

The off-gas contain hydrocarbons (VOC - volatile organic compounds), halogenated hydrocarbons (HOC - halogenated organic compounds) and organic nitrogen compounds. The presence or otherwise of Chlorinated gas in the waste stream will be determined by the specific products being manufactured. Two operating parameters have been programmed to reflect this. Non chlorinated products will direct the TO to operate at ≥800°C. Chlorinated products direct the TO to increase the reaction temperature to ≥1100°C.

The System is located external to existing buildings at the Abbvie site and consists of the following component parts:

Thermal oxidation Unit (Direct Fired)

- Offgas control system MA132
- LPG control system with pressure reduction and burner MG551, MG552 and WG553
- Combustion chamber BK 126
- Kerosene control system MF150

- Liquid solvent high CV control system MF250
- Liquid solvent NOx control system MF350
- Aqueous solvent control system MF450
- Combustion/supplementary air supply VV141 / V217
- Supplementary air control system KL140
- Compressed air supply MD107
- Partial Quench QL184
- Emergency Bypass Off Gas KA163

Selective non-catalytic reduction (SNCR)

- SNCR equipment with ammonia injection CN168

Steam boiler plant

- Steam boiler DK170
- Feed water pump group PG142
- Blow-down system BA174

Scrubber

- Wet quencher WQ 180
- Scrubber AW181
- Emergency water BW186
- Scrubber pump group PG542
- Dosing station DS183
- Induced Draught Fans VR117 / VR217
- Plume eliminator WT148
- Clean gas stack KA190

The solvent streams likely to be treated by the System are described in Table 1.1 below.

Solvents	Max Exhaust Gas Flow (Nm^3/h)	Max. Solvent Rate (kg/h)
DCM	1000	88,6
THF		86,4
Ethyl Acetate		9,7
Methanol		2,0
DMF		0,0
Acetone		5,7
IPA		0,6
MTBE		3,4
Ethanol		0,4
MIBK		0,4
Hepane		2,2
Total		**199,5**

Table 1.1 Maximum Solvent Design Loadings

1.1 Process Description

The process can be described as follows:

The solvent containing exhaust gas with the required safety equipment will be sent via lances to the combustion chamber.

Additional fresh air will be used as combustion air. The system is designed to guarantee the normal operation of the thermal oxidizer with a turn-down from 100% duty to 0%.

Air from the surroundings will be added into the waste gas line when flow drops below the figure necessary to maintain effectiveness of flame flash back efficiency or oxidation efficiency.

The combustion chamber defines a residence time of 2 seconds and an oxidation chamber temperature of 1,100°C, according to EU regulations for Chlorinated products. The TO will operate at 800°C for Non Chlorinated wast streams

The combustion will be performed under vacuum conditions (-70 to -90mbar).

1.2 PCDD/F (commonly called "Dioxin") Emission Control

PCDD/F will not be emitted by the manufacturing processes at Abbvie but the combustion of organic solvent which contains carbon, furans and chlorine atoms can lead to the formation of PCDD/F if correct temperature control is not maintained.

Polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzofurans PCDF) are a group of tricyclic aromatic compounds with similar chemical and physical properties and are ubiquitous in the modern environment. Mixtures of the two groups of compounds are normally referred to as PCDD/F.

The ability of chlorine atoms to substitute at various positions on the benzene ring structures of these compounds allows numerous positional isomers to be formed. In total, there are 210 no. positional isomers of both groups, 75 no. for PCDD and 135 no. for PCDF. The majority of these compounds are of no concern with respect to ecological and human toxicity, with the exception of 17 no. compounds (7 no. PCDD and 10 no. PCDF) which have chlorine substitution in the 2,3,7,8 positions. These are (in decreasing toxicity):

PCDDs - Dioxins (7 no.):

- 2,3,7,8-TCDD
- 1,2,3,7,8-PeCDD
- 1,2,3,4,7,8-HxCDD
- 1,2,3,6,7,8-HxCDD
- 1,2,3,7,8,9-HxCDD
- 1,2,3,4,6,7,8-HpCDD
- OCDD

PCDFs - Furans (10 no.):

- 2,3,7,8-TCDF
- 1,2,3,7,8-PeCDF
- 2,3,4,7,8-PeCDF
- 1,2,3,4,7,8-HxCDF
- 1,2,3,6,7,8-HxCDF
- 2,3,4,6,7,8-HxCDF
- 1,2,3,7,8,9-HxCDF
- 1,2,3,4,6,7,8-HpCDF
- 1,2,3,4,7,8,9-HpCDF
- OCDF

2,3,7,8-tetrachloro-*p*-benzodioxin (2,3,7,8-TCDD) is the most studied dioxin and is considered to be the most toxic by far of the 17 no. congeners.

As data began to accumulate in the 1970's and early 1980's of the toxic effects of 2,3,7,8-TCDD, a number of systems for assessing the toxicity of other PCDD/Fs were developed, all using the concept of toxic equivalence (TEQ)

This concept assesses the toxicity of other PCDD/F congeners and assigns a weighting compared to the known toxicity of 2,3,7,8-TCDD. Examples of the systems which developed at that time include the Swiss system (published in 1982), the German system (published in 1985), the Danish system (published in 1984) and the Canadian system (published in 1983). However, these systems applied slightly different weighting factors for calculating TEQ expressed as units of 2,3,7,8-TCDD. For example, 1,2,3,4,6,7,8 HpCDD (non-2,3,7,8) was assigned a Toxic Equivalency Factor (TEF) of 0.1 by the Swiss system but was given a TEF of 0.001 by the German system, two orders of magnitude difference.

In recent years, TEFs developed by the US EPA, the North Atlantic Treaty Organisation Committee on the Challenges of Modern Society (NATO/CCMS), the European Community (EC) and the WHO have been aligned allowing for easier comparability of TEQ values. The NATO/CCMS TEFs (giving a result identified as I-TEQ), which correspond exactly with the US EPA and EC TEFs.

A re-evaluation of the TEFs by the WHO in 2005 made some slight changes to individual compounds and these TEFs will be used by the laboratory to be used by Abbvie.

1.3 PCDD/F Formation

The general reaction in the formation pathway is an interaction between an aromatic precursor compound and chlorine.

Examples of well-studied precursor compounds include chorobenzenes, chlorophenols, phenol, and benzene.

Gaseous hydrogen chloride (HCl), free chorine (Cl_2), and chlorine radicals (ClA) are the chlorinating agents within the combustion gases.

PCDD/F formation results from heterogeneous gas-phase reactions involving chlorinated precursor compounds and a source of chlorine.

Precursors are carried from the furnace to the flue duct as products of incomplete combustion. These compounds can entrain in the gas phase within the flue gases.

Thus, the formation pathway from precursor compounds consists of homogeneous gas-phase reactions. In the post-combustion region outside the furnace, reactions can occur which form PCDD/Fs from the precursor compounds.

This occurs at the cool down temperatures of 200 to 450 °C. Heterogeneous gas-phase reactions occur from the breakdown and molecular rearrangement of precursor compounds followed by condensation and chlorination at the higher temperatures of 500 to 800 °C.

Therefore, in order to minimise the risk of PCDD/F formation, two key design criteria of the System must ensure that:

- Combustion is as complete as possible (by maintaining 2 second retention time at ≥1100 °C) – this minimises the risk of pre-cursor organic compounds being emitted from the combustion chamber.
- The temperature reduction from 1100 °C to 200 °C is achieved in as rapid and controlled a manner as possible to ensure the flue gas spends the minimum time within this temperature range.

This process occurs in the Heat Recovery System (also called the Boiler). The fact that the unit is treating all gaseous material means that the combustion process is going to be more complete

1.4 SNCR and NOX Control

The exhaust contains nitrogen compounds. These are converted into NOx (nitrous oxides) during the combustion process and must be treated. A SNCR process, selective non-catalytic reduction is used for this function. The process takes place in an SNCR stage integrated in the combustion chamber, in which Ammonium hydroxide solution (NH_4OH) is sprayed in the exhaust flow.

The atomisation of the ammonium hydroxide solution causes a large phase boundary area to be formed between the evaporated Ammonium hydroxide solution and the exhaust flow, at which the nitrogen oxides (NOX) react to form elementary nitrogen (N_2), water (H_2O) and oxygen.

For optimum implementation, the temperature in the SNCR stage may not exceed 1000°C and may not fall below 900°C.

The Ammonium hydroxide is dosed via nitrogen oxide measurement in the duct system.

1.5 Chlorine and Hydrochloric Acid Emissions

The exhaust can contain chlorine "Cl", which is converted into HCl and Cl_2 in the combustion chamber. These emissions are removed in a downstream absorption process, flue gas scrubbing.

The hot flue gases are first cooled by water injection in a wet quencher. The injected water evaporates up to the saturation point of the flue gas and cools the flue gas to the corresponding saturation temperature. The flue gas and cycle water are fed in the parallel flow from the top down through the scrubber.

The wet quenching itself is formed as sprayed quenching, i.e. the quenching liquid is fed in via spraying nozzles. In this way, a defined dry-moist transition is achieved and the scrubber is protected against contact with hot flue gas.

The chemicals used are each intermediately stored in a tank (for NaOH and for $NaHSO_3$) and are each fed to the washing cycle via a dosing pump.

The salt solution produced by the process described above is ejected, depending on the conductivity of the cycle water. The ejected quantity of water is added to the alkaline wastewater.

To reduce the temperature and therefore the water fraction in the flue gas again, the washing cycle of the second washing stage is cooled with a cooler.

The flue gas leaves the second washing stage via a demister, in which fine droplets contained in the flue gas are separated out.

The flue gas treatment system is equipped with an emergency water supply, which is intended to wet the wet quencher in the event of a cycle-side water failure, e.g. due to power failure. The capacity of the emergency water supply is designed so that water is available for 20 minutes. During this time, an alternative water source must be made available (e.g. by the factory fire service, hydrants, or similar.).

2.0 BACKGROUND

The manufacturing process at Abbvie generates solvent laden exhaust which requires abatement to minimise VOC emissions to atmosphere.

2.1 Source

The principal emissions are VOC compounds as defined in Section 1.0 however the combustion process generates NOX (Nitrous Oxides), HCl (Hydrochloric acid gas) and Cl2 (chlorine gas) and has the potential to generate PCDD/F.

Therefore this plan must ensure that not only can it be demonstrated that the System can achieve destruction of VOCs but that the System can also achieve Emission Limit Values for these other compounds also.

2.2 Pathway

The pathway to the atmosphere is via an emissions stack, which will be continuously monitored by a Siemens GASMET CEMS (Continuous Emissions Monitoring System) using FTIR (Fourier Transform Infra Red). The CEMS is designed for continuous emissions monitoring measurements, measuring the following gasses in the flue gas emission :

CO_2,

CO,

N_2O,

NO,

NO_2,

SO_2,

HCl,

2.3 Receptor

The Target receptors are:

The receiving atmosphere at the site boundary.

Target ELVs are defined by the EPA for emissions from the stack

3.0 ENVIRONMENTAL COMPLIANCE VALIDATION PLAN

3.1 Environmental Compliance Validation Criteria

Validation is defined as:

Confirmation by examination and provision of objective evidence that the particular requirement for a specific intended use can be consistently fulfilled.

The "intended use" for the System comprises the following:

- Ensure that all emission limit values (ELVs) defined by the EPA are met in compliance with the licence conditions.
- System design temperature in the combustion chamber shall be met
- System design retention time in the combustion chamber shall be met
- System design retention time in the 1000 deg C to 200 deg C zone shall be met
- System design temperature of 200 deg C or less exiting the boiler shall be met
- Scrubber pH and conductivity shall remain within set point values

This equipment, supplied with the System comprises:

- Controlling
- Measuring
- Monitoring Equipment

The Duration of this Plan shall be a 2 month period from the date of completion of commissioning.

The Indicators Described in attachment A shall be used to determine the performance of the System over the 2 month period.

3.2 Validation Air Emissions Testing

The System shall be subject to the loads normally seen from the manufacturing process, over a 2 month period and emissions monitoring at the Stack shall be conducted by a suitably qualified Air Quality and Emissions Monitoring Team, on 3 number occasions over the 2 month period for the ELVS defined by the site EPA Licence.

Any deviations from ELVs noted during this testing programme shall be investigated and subject to Root Cause Analysis, the fault shall be identified and remedied and the testing re-done.

4.0 CRITERIA FOR DEEMING THE SYSTEM TO BE ACCEPTED

The System performance will be deemed to be acceptable if over the two month period:

- All emission limit values (ELVs) defined by the EPA are met in compliance with the licence conditions on each monitoring occasion and on the CEMS Unit for those parameters measured by CEMS, in compliance with the licence conditions.

  AND (for the following continuously recorded parameters):

- System design temperature in the combustion chamber shall be met at all times
- System design retention time in the combustion chamber shall be met at all times
- System design retention time in the 1000 deg C to 200 deg C zone shall be met at all times
- System design temperature of 200 deg C or less exiting the boiler shall be met at all times
- Scrubber conductivity shall remain within set point values at all times

5.0 AIR EMISSIONS SAMPLING

Air emissions sampling shall be conducted by a suitably qualified and experienced monitoring team with relevant MCERTS qualifications are required by the EPA.

6.0 MAINTENANCE, OPERATION AND TRAINING

Durr shall ensure that Abbvie personnel receive appropriate training on the maintenance and operation of the system.

Durr shall ensure that at the end of the training programme sufficient Abbvie personnel shall be trained in how to maintain and operate the System such that criteria defined in Section 4.0 can be met.

7.0 CONCLUSION

At the end of the 2 month period, should all of the criteria defined in Section 4.0 be met,the System shall be deemed to be compliant.

ATTACHMENT A

ENVIRONMENTAL COMPLIANCE INDICATORS

	Indicator No.1	Indicator No.2
I. Indicator	Combustion Chamber Temperature	Combustion Chamber Temperature
Measurement Approach	The chamber temperature is measured with a series of thermocouples	Inspection and maintenance of the burner; observation of the burner flame.
II. Indicator Range	An excursion is defined as temperature reading less than 1100 Degrees C when running with Chlorinated and less than 800°C on non-chlorinated; an excursion triggers an inspection, corrective action and a reporting requirement.	An excursion is defined as a failure to perform and record required inspection or daily flame observation.
Threshold	No excursions are permitted	Not applicable
III. Performance Criteria A. Data representativeness	The sensor is located in the burner chamber as an integral part of the incinerator design. The minimum tolerance of the thermocouple is deemed to be ±0.75% (of temperature measured in degrees Celsius)	Thermocouple electrical signal
B. Verification of Operational Status	Verified by checking to determine if any alarms are shown	Electrical signal from alarm
C. QA/QC Practices and Criteria	Accuracy of the Thermocouple will be verified by a second Thermocouple to be inserted in the combustion chamber	Availability of second thermocouple
D. Monitoring Frequency	Measured continuously	Daily inspection of flame
Data Collection Procedure	Recorded Continuously	Record results of daily inspections
Averaging Period	Not Applicable	Not Applicable

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	Indicator No.3	Indicator No.4
IV. Indicator	Combustion Chamber Retention Time	Combustion Chamber Retention Time
Measurement Approach	The flow rate is measured by exhaust flow meter	Inspection and maintenance of the Meter
V. Indicator Range	An excursion is defined as retention time of less than 2 seconds.	An excursion is defined as a failure to perform and record required inspection
Threshold	No excursions are permitted	Not applicable
VI. Performance Criteria E. Data representativeness	The sensor is located in flue gas system. The minimum tolerance of the sensor is to be provided by Durr.	Flow sensor electrical signal
F. Verification of Operational Status	Verified by checking to determine if any alarms are shown	Electrical signal from alarm
G. QA/QC Practices and Criteria	Accuracy of the sensor will be verified by a second calibrated flow sensor to be inserted in the exhaust	Availability of second flow sensor
H. Monitoring Frequency	Measured continuously	Daily inspection of signal
Data Collection Procedure	Recorded Continuously	Record results of daily inspections
Averaging Period	Not Applicable	Not Applicable

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	Indicator No.5	Indicator No.6
VII. Indicator	Combustion Chamber Operating Vacuum	Combustion Chamber Operating Vacuum
Measurement Approach	The vacuum is measured by pressure sensor	Inspection and maintenance of the Sensor
VIII. Indicator Range	An excursion is defined vacuum less than 70 mbar	An excursion is defined as a failure to perform and record required inspection
Threshold	No excursions are permitted	Not applicable
IX. Performance Criteria I. Data representativeness	The sensor is located in flue gas system. The minimum tolerance of the sensor is to be provided by Durr.	Flow sensor electrical signal
J. Verification of Operational Status	Verified by checking to determine if any alarms are shown	Electrical signal from alarm
K. QA/QC Practices and Criteria	Accuracy of the sensor will be verified by a second calibrated pressure sensor to be inserted in the exhaust	Availability of second flow sensor
L. Monitoring Frequency	Measured continuously	Daily inspection of signal
Data Collection Procedure	Recorded Continuously	Record results of daily inspections
Averaging Period	Not Applicable	Not Applicable

	Indicator No.7	Indicator No.8
X. Indicator	Ammonium Hydroxide flow to SNCR System	Ammonium Hydroxide flow to SNCR System
Measurement Approach	The required flow rate is driven from a signal supplied by the NOX sensor	Inspection and maintenance of the Sensor
XI. Indicator Range	An excursion is defined as an event where the NOX rises above the set point value	An excursion is defined as a failure to perform and record required inspection
Threshold	No excursions are permitted	Not applicable
XII. Performance Criteria	The sensor is located in flue gas system. The minimum tolerance of the sensor is to be provided by Durr.	Flow sensor electrical signal
M. Data representativeness		
N. Verification of Operational Status	Verified by checking to determine if any alarms are shown	Electrical signal from alarm
O. QA/QC Practices and Criteria	Accuracy of the sensor will be verified by a second calibrated NOX sensor to be inserted in the exhaust	Availability of second flow sensor
P. Monitoring Frequency	Measured continuously	Daily inspection of signal
Data Collection Procedure	Recorded Continuously	Record results of daily inspections
Averaging Period	Not Applicable	Not Applicable

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	Indicator No.9	Indicator No.10
XIII. Indicator	Scrubber Conductivity and pH	Scrubber Conductivity and pH
Measurement Approach	The conductivity and pH are measured by a probes in the scrubber system	Inspection and maintenance of the Sensors
XIV. Indicator Range	An excursion is defined as an event where the conductivity or pH is outside the set range required by the manufacturer	An excursion is defined as a failure to perform and record required inspection
Threshold	No excursions are permitted	Not applicable
XV. Performance Criteria	The sensors are located in scrubber reservoir. The minimum tolerance of the sensor is to be provided by Durr.	Sensor electrical signal
Q. Data representativeness		
R. Verification of Operational Status	Verified by checking to determine if any alarms are shown	Electrical signal from alarm
S. QA/QC Practices and Criteria	Accuracy of the sensor will be verified by a second calibrated probe inserted into the reservoir	Availability of second sensor
T. Monitoring Frequency	Measured continuously	Daily inspection of signal
Data Collection Procedure	Recorded Continuously	Record results of daily inspections
Averaging Period	Not Applicable	Not Applicable

	Indicator No.11	Indicator No.12
XVI. Indicator	Exhaust Temperature Exiting the Boiler	Exhaust Temperature Exiting the Boiler
Measurement Approach	Measured by a thermocouple in the exhaust	Inspection and maintenance of the Sensor
XVII. Indicator Range	An excursion is defined as an event where the temperature is above the 200 ° C set point	An excursion is defined as a failure to perform and record required inspection
Threshold	No excursions are permitted	Not applicable
XVIII. Performance Criteria	The thermocouple is located downstream of the boiler. The minimum tolerance of the sensor is to be provided by Durr.	Sensor electrical signal
U. Data representativeness		
V. Verification of Operational Status	Verified by checking to determine if any alarms are shown	Electrical signal from alarm
W. QA/QC Practices and Criteria	Accuracy of the sensor will be verified by a second thermocouple inserted into the exhaust	Availability of second sensor
X. Monitoring Frequency	Measured continuously	Daily inspection of signal
Data Collection Procedure	Recorded Continuously	Record results of daily inspections
Averaging Period	Not Applicable	Not Applicable

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	Indicator No.13	Indicator No.14
XIX. Indicator	CEMS System	CEMS System
Measurement Approach	Measured by a sample inlet port in the exhaust	Inspection and maintenance of the CEMS
XX. Indicator Range	An excursion is defined as an event where the CEMS fails to respond correctly to the relevant calibration gas, calibration and testing to be undertaken for the full range of CEMS parameters	An excursion is defined as a failure to perform and record required inspection
Threshold	No excursions are permitted	Not applicable
XXI. Performance Criteria Y. Data representativeness	The CEMS unit is located downstream of the scrubber The minimum tolerance of the CEMS is to be provided by Durr.	CEMS electrical signal
Z. Verification of Operational Status	Verified by checking to determine if any alarms are shown	Electrical signal from alarm
AA. QA/QC Practices and Criteria	Accuracy of the sensor will be verified by independent air quality sampling on 4 separate occasions over the 2 month period	Air quality sampling
BB. Monitoring Frequency	Measured continuously	Daily inspection of signal
Data Collection Procedure	Recorded Continuously	Record results of daily inspections
Averaging Period	Not Applicable	Not Applicable

END OF DOCUMENT

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ISSUE	AMENDMENT	DATE	NAME
E	REVISED (OFF GAS, PIPE STEEL WORK)	2014-10-02	DEBIEJAG
D	REVISED ACCORDING TO OPTION 4	2014-08-11	DEBIEJAG
C	REVISED (NEW VERSION)	2014-07-03	DEBIEJAG
B	REVISED	2014-06-12	DEBIEJAG
A	REVISED	2014-06-12	DEBIEJAG

STATE 2014-10-24
ORIGINAL
REPLACEM. FOR
REPLACED WITH
DOCUMENT TYPE DWG

DRAWN	2014-03-10	DEBIEJAG
CHECKED	--	
RELEASED	2014-10-24	DEBIEJAG
STATUS	RELEASED	

MATERIAL-NO.

SCALE 1:50

LAYOUT
VAR BRENNKAMMER
ABBVIE, SLIGO / IRELAND

DOCUMENT-NO. 500220823

DOCUMENT-NO.
IE0311237-S-42-6902-D21-0001-E

VERSION 07 | DOC. PART 001
REVISION E | SHEET/TOTAL 1 / 1

A1

500220823_DWG_001_07:0fq8l gtl-s2921 DEBIEJAG 2014-10-24T11:58:11 1.000

Energy Policy

AbbVie Ireland NL B.V. is committed to maintaining energy management as a key business goal. To develop a proactive and effective approach to energy management, the site is committed to implementing and maintaining a standardised management system in which energy is managed. Within this context, the management and employees are committed to achieving the following as part of a structured Energy Management Strategy:

- *Implement and maintain the IS ISO 50001 Energy Management System's standard as an enabling means of establishing, documenting, implementing, maintaining and continually improving energy management activities*
- *Maintain membership of Sustainable Energy Authority of Ireland's Energy Agreements Program to signify a commitment and to provide a framework to address energy management. This includes participation in Benchmarking and Best-Practice Programs in line with the objectives of the agreements program, where applicable*
- *Participate in Benchmarking Programs with the Large Industry Energy Network (LIEN), with IBEC and with the American Chamber of Commerce*
- *Comply with all applicable legislation, regulations and corporate standards with respect to Energy*
- *Ensure the availability of applicable information and all necessary resources to achieve objectives and targets*
- *Actively encourage and maintain a philosophy of continuous improvement to ensure ongoing energy efficiency and energy performance improvements*
- *Identify, promote and fund energy efficient products and services, heat recovery projects, renewable energy, and cogeneration projects where it makes sense to do so and in order to deliver increased energy efficiency, energy cost reduction and a reduction in the CO_2 footprint*
- *Promote increased learning and awareness internally and externally with applicable stakeholders and business partners*
- *Recognize energy management work by individual employees and teams through recognition and award programs thereby providing incentives for improved performance*
- *Regularly set, document, and review energy objects and targets in line with corporate and site requirements as well as strategic energy reviews*

AbbVie Ireland NL B.V. has set an energy reduction target of 20% CO_2 and Water from baseline year 2013 to end of 2020.

The scope of the Energy Management System is inclusive of electricity, kerosene, LPG and water.

The boundary relates to the physical boundaries of the site.

The contents of the energy policy and commitments therein are fully endorsed by all management and employees at AbbVie Ireland NL B.V. The policy is made effective on signature of the Site Director.

Marc O'Donoghue Site Director
AbbVie Ireland NL B.V.

Date

CERTIFICATION EUROPE™

This is to certify that the

Energy Management System

Of

AbbVie Ireland NL B.V.

At

Manorhamilton Road, Sligo, Ireland

Has been assessed by Certification Europe and deemed to comply with the requirements of

ISO 50001:2011

This certificate is valid for the activities specified below:

The manufacture of active pharmaceuticals

Certification of Registration remains the property of Certification Europe Ltd.
The validity of this Certificate is maintained on the condition that the Management System is assessed through an on-going surveillance programme and continues to adequately meet the requirements of the standard.
To verify this certificate validity please contact us at info@certificationeurope.com

Date of initial certification: 30th January 2008

This certificate is valid until: 29th January 2017

Chief Executive: Michael Brophy

Signature: M. Brophy

Chairman: Padraic A. White

Signature: Padraic A. White

Client Registration No.: 2008/454
Certificate Reference No.: A/8

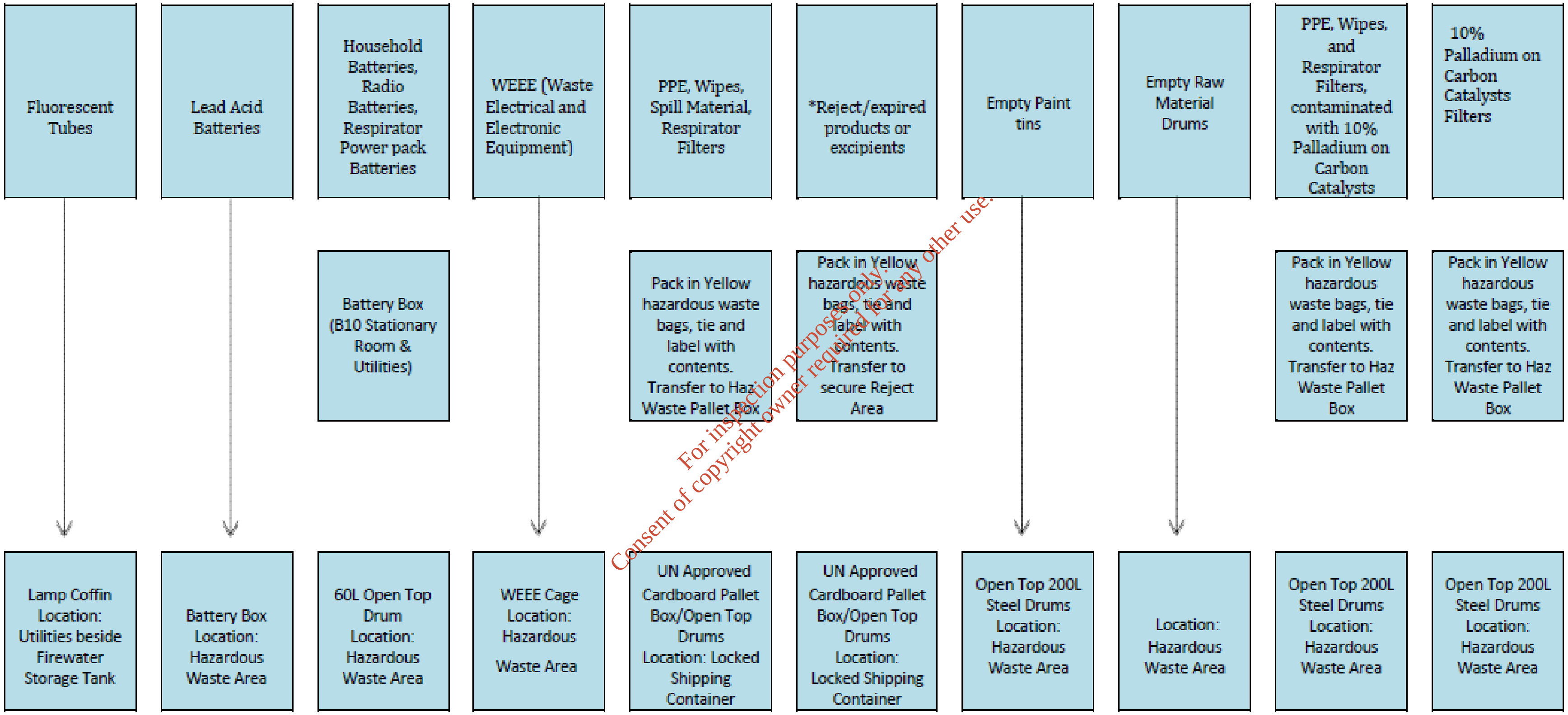
Date of Certificate issue: 5th September 2014

ISO 50001 CERTIFICATION EUROPE

INAB

Certification Europe Ltd
Block 20A Beckett Way, Park West Business Park,
Dublin 12, Ireland
info@certificationeurope.com

Hazardous Waste Segregation Chart



Non-hazardous Waste Segregation Chart