

ABBVIE BIOCHEMICAL AND MEDICAL DEVICES FACILITY – ASSESSMENT OF COMPLIANCE WITH REFERENCE DOCUMENT (REF) ON BEST AVAILABLE TECHNIQUES FOR ENERGY EFFICIENCY, FEBRUARY 2009

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Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
4.2.1 Energy Efficiency Management		
<p>BAT 1. BAT is to implement and adhere to an energy efficiency management system (ENEMS) that incorporates, as appropriate to the local circumstances, all of the following features (see Section 2.1).</p> <ol style="list-style-type: none"> Commitment of top management (commitment of the top management is regarded as a precondition for the successful application of energy efficiency management). Definition of an energy efficiency policy for the installation by top management. Planning and establishing objectives and targets (see BAT 2, 3 and 8). Implementation and operation of procedures paying particular attention to: <ul style="list-style-type: none"> Structure and responsibility Training, awareness and competence (see BAT 13) Communication Employee Involvement Documentation Effective control of processes (see BAT 14) Maintenance (see BAT 15) Emergency preparedness and response Safeguarding compliance with energy efficiency-related legislation and agreements (where such agreements exist). 	<p>Applicable – oversight for the consumption of energy and utilities is included within the responsibilities of a member of the site engineering team.</p> <p>The facility is operated in accordance with an Environmental Management System (EMS) which will be upgraded to incorporate the new bio-chemical suite.</p> <p>The EMS sets out AbbVie’s policies for energy and includes procedures for training, maintenance, documentation, and emergency response. The EMS is accredited to ISO 50001 standard.</p> <p>AbbVie also maintain an Environmental Health & Safety (EHS) & Energy Sustainability Long Range Plan which sets out targets for energy efficiency and persons responsible for monitoring and</p>	<p>In place – revised EMS document to be produced following approval of Industrial Emissions (IE) licence</p>

<p>e. Benchmarking: the identification and assessment of energy efficiency indicators over time (see BAT 8), and the systematic and regular comparisons with sector, national or regional benchmarks for energy efficiency, where verified data are available (see Sections 2.1(e), 2.16 and BAT 9).</p> <p>f. Checking performance and taking corrective action paying particular attention to:</p> <ul style="list-style-type: none"> • Monitoring and measurement (see BAT 16) • Corrective and preventive action • Maintenance of records • Independent (where practical) internal auditing in order to determine whether or not the energy efficiency management system conforms to planned arrangements and has been properly implemented and maintained (see BAT 4 and 5) <p>g. Review of the ENEMS and its continuing suitability, adequacy and effectiveness by top management.</p>	<p>measuring those targets and documenting successes. This document includes short term and long-term targets. This strategic plan is a four year rolling document.</p> <p>AbbVie has established Environmental Health & Safety (EHS) management requirements that conform to the ISO14001, ISO 50001, ISO 55001 and OHSAS18001 management system standards.</p> <p>Further details of the sustainable measures to be taken are provided in Section 9 of the IE licence.</p>	
<h2>4.2.2 Planning and establishing objectives and targets</h2>		
<h3>4.2.2.1 Continuous environmental improvement</h3>		
<p>BAT 2. BAT is to continuously minimise the environmental impact of an installation by planning actions and investments on an integrated basis and for the short, medium and long term, considering the cost-benefits and cross-media effects.</p>	<p>Applicable - The facility is operated in accordance with a number of Standard Operating Procedures (SOPs) which address energy efficiency as well as a sustainability statement which outlines how the use of energy will be minimised. All staff are trained in the SOPs.</p> <p>AbbVie also maintain an EHS & Energy Sustainability Long Range Plan which sets out targets for energy efficiency and persons responsible for monitoring and measuring those targets and documenting successes. This document</p>	<p>In place – revised Integrated Management System (IMS) document to be produced following approval of IE licence</p>

	includes short term and long-term targets. This strategic plan is a four year rolling document.	
4.2.2.2 Identification of energy efficiency aspects of an installation and opportunities for energy savings		
<p>BAT 3. BAT is to identify the aspects of an installation that influence energy efficiency by carrying out an audit. It is important that an audit is coherent with a systems approach (see BAT 7).</p>	Applicable - Energy audits will be carried out in accordance with relevant EPA guidance and ISO standards to identify further opportunities for energy efficiency improvement as part of facility management systems.	BAT to be in place upon commencement.
<p>BAT 4. When carrying out an audit, BAT is to ensure that the audit identifies the following aspects (see Section 2.11):</p> <ol style="list-style-type: none"> Energy use and type in the installation and its component systems and processes Energy-using equipment, and the type and quantity of energy used in the installation Possibilities to minimise energy use, such as: <ul style="list-style-type: none"> controlling/reducing operating times, e.g. switching off when not in use (e.g. see Sections 3.6, 3.7, 3.8, 3.9, 3.11) ensuring insulation is optimised, e.g. see Sections 3.1.7, 3.2.11 and 3.11.3.7 optimising utilities, associated systems, processes and equipment (see Chapter 3) Possibilities to use alternative sources or use of energy that is more efficient, in particular energy surplus from other processes and/or systems, see Section 3.3 Possibilities to apply energy surplus to other processes and/or systems, see Section 3.3 Possibilities to upgrade heat quality (see Section 3.3.2) 	Applicable - Energy audits will be carried out in accordance with relevant EPA guidance and ISO standards to identify further opportunities for energy efficiency improvement as part of facility management systems. The results of these audits will be reported annually in the facility's AER.	BAT to be in place upon commencement.
<p>BAT 5. BAT is to use appropriate tools or methodologies to assist with identifying and quantifying energy optimisation, such as:</p> <ul style="list-style-type: none"> Energy models, databases and balances (see Section 2.15) 	Applicable – An energy database will be developed to assist in identifying opportunities for energy optimisation.	BAT to be in place upon commencement.

<ul style="list-style-type: none"> • A technique such as pinch methodology (see Section 2.12) exergy or enthalpy analysis (see Section 2.13), or thermoeconomics (see Section 2.14) • Estimates and calculations (see Sections 1.5 and 2.10.2) 	<p>At the micro-level, specific unit operations such as heating, cooling or lighting systems will be subject to energy efficiency assessment as part of design stage and procurement for new production facility</p>	
<p>BAT 6. BAT is to identify opportunities to optimise energy recovery within the installation, between systems within the installation (see BAT 7) and/or with a third party (or parties), such as those described in Sections 3.2, 3.3 and 3.4.</p>	<p>Applicable – The facility is operated in accordance with a number of SOPs which address energy efficiency as well as a sustainability statement which outlines how the use of energy will be minimised. All staff are trained in the SOPs.</p> <p>AbbVie also maintain an EHS & Energy Sustainability Long Range Plan which sets out targets for energy efficiency and persons responsible for monitoring and measuring those targets and documenting successes.</p> <p>An energy database will be developed to assist in identifying opportunities for energy optimisation.</p> <p>At the micro-level, specific unit operations such as heating, cooling or lighting systems are subject to energy efficiency assessment as part of design stage and procurement for the new facility.</p>	<p>BAT to be in place upon commencement.</p>

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4.2.2.3 A systems approach to energy management		
<p>BAT 7. BAT is to optimise energy efficiency by taking a systems approach to energy management in the installation. Systems to be considered for optimising as a whole are, for example:</p> <ul style="list-style-type: none"> • Process units (see sector BREFs) • Heating systems such as: <ul style="list-style-type: none"> ○ steam (see Section 3.2) ○ hot water • Cooling and vacuum (see the ICS BREF) • Motor driven systems such as: <ul style="list-style-type: none"> ○ compressed air (see Section 3.7) ○ pumping (see Section 3.8) • Lighting (see Section 3.10) • Drying, separation and concentration (see Section 3.11) 	<p>Applicable –</p> <p>AbbVie Ballytivnan has an extensive energy management system, governed by its ISO 50001 and 55001 certifications. Equipment is classified by virtue of its function and criticality. An energy monitoring system called EFT is in place which records electrical consumption in 15 minute intervals and provides a daily report each morning. This data is provided on each piece of equipment and also on each classification of equipment e.g. chiller system. In addition, it reports each classification against set targets to monitor performance. This tool is then used to generate projects for inclusion in our Energy Reduction Programme, managed through the Quarterly Energy Management Reviews to meet the sites commitments to its ISO 50001 programme.</p> <p>Section 9 of the IE Licence application form provides a summary of the many energy efficiency measures proposed at the new facility.</p> <p>At design stage, each unit operation for the new suite has been assessed for energy efficiency most notably process, heating, cooling, Heating, Ventilation, Air</p>	<p>In place for existing facility– BAT as it applies to the new suite to be in place upon commencement.</p>

	<p>Conditioning (HVAC), motors / transformers and lighting.</p> <p>Operational control – the control system only turns on equipment as needed to optimise energy use. Air Handling Units (AHU's) are programmed to turn on, manufacturing equipment turn on as required in the existing facility.</p> <p>Chillers have variable speed drives which give a high co-efficient of performance (COPs) for energy.</p> <p>Energy recovery on all recently installed ventilation systems. As per COMMISSION REGULATION (EU) 2016/2281 of 30 November 2016 implementing Directive 2009/125/EC all units will be equipped with heat exchanges to recover at least 68% of available (non-electrical) energy from the HVAC units' exhausts (run around coil type HVAC units).</p> <p>Steam generators will be used which are higher efficiency than standard boilers.</p> <p>All motors are supplied as Variable Frequency Drive (VFD). High efficiency motors (IE 2 or IE 3) are used.</p> <p>High efficiency (LED Light Emitting Diode) lighting is used. Passive Infra-red (PIR) or</p>	
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	'smart lighting' in place where possible including all mezzanines and support buildings. PIRs/Photo sensors combination used on LED car park lights.	
4.2.2.4 Establishing and reviewing energy efficiency objectives and indicators		
<p>BAT 8. BAT is to establish energy efficiency indicators by carrying out all of the following:</p> <ol style="list-style-type: none"> Identifying suitable energy efficiency indicators for the installation, and where necessary, individual processes, systems and/or units, and measure their change over time or after the implementation of energy efficiency measures (see Sections 1.3 and 1.3.4) Identifying and recording appropriate boundaries associated with the indicators (see Sections 1.3.5 and 1.5.1) Identifying and recording factors that can cause variation in the energy efficiency of the relevant process, systems and/or units (see Sections 1.3.6 and 1.5.2) 	<p>Applicable – The efficient use of energy will be monitored as part of the site continuous improvement programme to ensure all colleagues on site actively participate in the programme. The energy monitoring system will be accessible in real time so that future decisions on energy management/optimisation can be made on a fully informed basis.</p> <p>AbbVie also implements an EHS & Energy Sustainability Long Range Plan which sets out targets for energy efficiency and persons responsible for monitoring and measuring those targets and documenting successes.</p>	<p>In place for existing facility– BAT as it applies to the new suite to be in place upon commencement.</p>
4.2.2.5 Benchmarking		
<p>BAT 9. BAT is to carry out systematic and regular comparisons with sector, national or regional benchmarks, where validated data are available.</p>	<p>Applicable.</p> <p>The Sustainable Energy Authority of Ireland (SEAI) maintains benchmark records of energy performance broken down by sector which AbbVie Ballytivnan submits its performance on an annual basis for inclusion and subsequent evaluation.</p>	<p>In place for existing facility– BAT as it applies to the new suite to be in place upon commencement.</p>

4.2.3 Energy efficient design (EED)		
<p>BAT 10. BAT is to optimise energy efficiency when planning a new installation, unit or system or a significant upgrade (see Section 2.3) by considering all of the following:</p> <ol style="list-style-type: none"> The energy efficient design (EED) should be initiated at the early stages of the conceptual design/basic design phase, even though the planned investments may not be well-defined. The EED should also be taken into account in the tendering process The development and/or selection of energy efficient technologies (see Sections 2.1(k) and 2.3.1) Additional data collection may need to be carried out as part of the design project or separately to supplement existing data or fill gaps in knowledge The EED work should be carried out by an energy expert The initial mapping of energy consumption should also address which parties in the project organisations influence the future energy consumption and should optimise the energy efficiency design of the future plant with them. For example, the staff in the (existing) installation who may be responsible for specifying design parameters. 	<p>Applicable – The purchase of new capital equipment is evaluated as per documented procedure for energy performance which is included as part of equipment evaluation before purchase.</p> <p>Energy effect design (EED) also included in design of new suite. EED developed and incorporated by electrical, mechanical, and process design teams. Facility adheres to EU energy directive (2016). Energy efficient technologies have been selected for plant operation. Metering of energy use will indicate losses. Reduction of air changes in existing cleanrooms in 2017 gave 17% reduction in carbon footprint. Planning application has also been submitted for a Solar Power Farm.</p> <p>Further details are provided in Section 9 of the IE licence application.</p>	<p>In place for existing facility– BAT as it applies to the new suite to be in place upon commencement.</p>
4.2.4 Increased process integration		
<p>BAT 11. BAT is to seek to optimise the use of energy between more than one process or system (see Section 2.4), within the installation or with a third party.</p>	<p>Applicable – Heat recovery in all non-process ventilation units. Per COMMISSION REGULATION (EU) 2016/2281 of 30 November 2016 implementing Directive 2009/125/EC all units are equipped with heat exchanges to recovery at least 68% of available</p>	<p>In place for existing facility– BAT as it applies to the new suite to be in place upon commencement. commencement in 2018.</p>

	<p>(Non-electrical) energy from the HVAC units' exhausts (Run around coil type HVAC units).</p> <p>Hot condensate will be recovered in the plant stream make up to optimise heat usage in the new facility. An economizer will be used on the boilers and preheat of boiler feed water.</p>	
4.2.5 Maintaining the impetus of energy efficiency initiatives		
<p>BAT 12. BAT is to maintain the impetus of the energy efficiency programme by using a variety of techniques, such as:</p> <ol style="list-style-type: none"> Implementing a specific energy efficiency management system (see Section 2.1 and BAT 1) Accounting for energy usage based on real (metered) values, which places both the obligation and credit for energy efficiency on the user/bill payer (see Sections 2.5, 2.10.3 and 2.15.2) The creation of financial profit centres for energy efficiency (see Section 2.5) Benchmarking (see Section 2.16 and BAT 9) A fresh look at existing management systems, such as using operational excellence (see Section 2.5) Using change management techniques (also a feature of operational excellence, see Section 2.5) 	<p>Applicable – a number of these measures are included in the design of the new suite and have been addressed above including management systems, real time monitoring of energy usage, etc. These are controlled by the Building Management System (BMS). Recording of energy use by EFT Energy Management System.</p> <p>Additional measures may be considered as part of continual improvement programme.</p>	<p>In place for existing facility– BAT as it applies to the new suite to be in place upon commencement.</p>
4.2.6 Maintaining expertise		
<p>BAT 13. BAT is to maintain expertise in energy efficiency and energy-using systems by using techniques such as:</p> <ol style="list-style-type: none"> Recruitment of skilled staff and/or training of staff. Training can be delivered by in-house staff, by external experts, by formal courses or by self-study/development (see Section 2.6) 	<p>Applicable – Facility will be staffed by suitably skilled and qualified staff. All staff will be given necessary training to complete their duties with additional training for energy management as required depending on role.</p>	<p>In place for existing facility– BAT as it applies to the new suite to be in place upon commencement.</p>

<ul style="list-style-type: none"> b. Taking staff off-line periodically to perform fixed term/specific investigations (in their original installation or in others, see Section 2.5) c. Sharing in-house resources between sites (see Section 2.5) d. Use of appropriately skilled consultants for fixed term investigations (e.g. see Section 2.11) e. Outsourcing specialist systems and/or functions 	<p>It is anticipated that the site will actively participate in sustainability and energy management/efficiency working groups.</p>	
4.2.7 Effective control of processes		
<p>BAT 14. BAT is to ensure that the effective control of processes is implemented by techniques such as:</p> <ul style="list-style-type: none"> a. Having systems in place to ensure that procedures are known, understood and complied with (see Sections 2.1(d)(vi) and 2.5) b. Ensuring that the key performance parameters are identified, optimised for energy efficiency and monitored (see Sections 2.8 and 2.10) c. Documenting or recording these parameters (see Sections 2.1(d)(vi), 2.5, 2.10 and 2.15) 	<p>Applicable – The facility is operated in accordance with a number of SOPs which address energy efficiency as well as a sustainability statement which outlines how the use of energy will be minimised. All staff are trained in the SOPs.</p> <p>AbbVie also implement an EHS & Energy Sustainability Long Range Plan which sets out targets for energy efficiency and persons responsible for monitoring and measuring those targets and documenting successes.</p>	<p>In place for existing facility– BAT as it applies to the new suite to be in place upon commencement.</p>
4.2.8 Maintenance		
<p>BAT 15. BAT is to carry out maintenance at installations to optimise energy efficiency by applying all of the following:</p> <ul style="list-style-type: none"> a. Clearly allocating responsibility for the planning and execution of maintenance b. Establishing a structured programme for maintenance based on technical descriptions of the equipment, norms, etc. as well as any equipment failures and consequences. Some maintenance activities may be best scheduled for plant shutdown periods 	<p>Applicable – A comprehensive preventative maintenance regime known as Maximo will be implemented at the facility. Oversight of the regime will be the responsibility of a member of the site engineering team. Appropriate records will be maintained, and audits conducted as required.</p>	<p>In place for existing facility– BAT as it applies to the new suite to be in place upon commencement.</p>

<p>c. Supporting the maintenance programme by appropriate record keeping systems and diagnostic testing</p> <p>d. Identifying from routine maintenance, breakdowns and/or abnormalities possible losses in energy efficiency, or where energy efficiency could be improved</p> <p>e. Identifying leaks, broken equipment, worn bearings, etc. that affect or control energy usage, and rectifying them at the earliest opportunity.</p>		
<p>4.2.9 Monitoring and measurement</p>		
<p>BAT 16. BAT is to establish and maintain documented procedures to monitor and measure, on a regular basis, the key characteristics of operations and activities that can have a significant impact on energy efficiency. Some suitable techniques are given in Section 2.10</p>	<p>Applicable - The facility is operated in accordance with a number of SOPs which address energy efficiency as well as a sustainability statement which outlines how the use of energy will be minimised. All staff are trained in the SOPs.</p> <p>AbbVie also maintain an EHS & Energy Sustainability Long Range Plan which sets out targets for energy efficiency and persons responsible for monitoring and measuring those targets and documenting successes. This strategic plan is a four year rolling document.</p>	<p>In place for existing facility– BAT as it applies to the new suite to be in place upon commencement.</p>
<p>4.3 Best available techniques for achieving energy efficiency in energy-using systems, processes, activities or equipment</p>		
<p>4.3.1 Combustion</p>		
<p>BAT 17. BAT is to optimise the energy efficiency of combustion by relevant techniques such as:</p> <ul style="list-style-type: none"> • Those specific to sectors given in vertical BREFs • Those given in Table 4.1 (of the BREF document). 	<p>Applicable – Applicable – The only combustion processes at the process facility are the LPG fired boilers. The facility has been refurbished to maximise heat use efficiency and minimise heat loss at the facility. Most of the items</p>	<p>In place for existing facility– BAT as it applies to the new suite to be in place upon commencement.</p>

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	<p>listed in Table 4.1 have been incorporated.</p> <p>Pre-heating of fuel gas for boilers is not required due to efficiency of the boilers (designed to run off cold gas).</p> <p>Hot condensate used to pre heat feed water to boilers.</p> <p>Steam generators will be used which are higher efficiency than standard boilers.</p>	
<p>4.3.2 Steam Systems</p>		
<p>BAT 18. BAT for steam systems is to optimise the energy efficiency by using techniques such as:</p> <ul style="list-style-type: none"> • Those specific to sectors given in vertical BREFs • Those given in Table 4.2 (of the BREF document). 	<p>Applicable (new facility only). Steam is not used in the existing facility.</p> <p>Techniques from Table 4.2 have been incorporated.</p> <p>The steam generation and transfer system design has been optimised and, combined with preventative maintenance, will ensure maximum operable energy efficiency at all times.</p> <p>Sequential boiler controls will be used to optimise energy savings. Boiler controls will use efficient design. Steam pipes and condensate return pipes will be heat conservation insulated.</p>	<p>BAT as it applies to the new suite to be in place upon commencement.</p>

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	<p>Steam generation system blowdown will be minimized. The steam boilers will be designed with TDS control and the blowdown will be recovered (used to preheat the feed water). Condensate will be collected and returned for boiler re-use.</p> <p>Prevention and removal of scale deposits on heat transfer surfaces will be carried out by maintaining a high-quality water supply from continuous treatment. Routine maintenance will be undertaken by the Site team. For steam transfer units, routine blow down will be used (GMP best practices used on site)</p> <p>Steam boilers will be run with one as duty and one in hot standby, and will be cycled on/off as duty unit as required. Units will not be started up / shut down out of sequence and units will be ramped up to full capacity and ramped down (i.e. will not be turned on/off). Units will be changed over routinely (i.e. weekly) to prevent over running one of the units.</p> <p>Steam distribution lines will be optimized on the design to reduce heat losses. Steam will be designed to allow isolation from unused lines manually if required.</p>	
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4.3.3 Heat Recovery		
<p>BAT 19. BAT is to maintain the efficiency of heat exchangers by both:</p> <ol style="list-style-type: none"> Monitoring the efficiency periodically, and Preventing or removing fouling 	<p>Applicable – AbbVie to check periodically and undertake preventative maintenance.</p> <p>The systems are designed to exceed the minimum efficiencies required by the directive (around 68% currently).</p>	<p>BAT as it applies to the new suite to be in place upon commencement.</p>
4.3.4 Cogeneration		
<p>BAT 20. BAT is to seek possibilities for cogeneration, inside and/or outside the installation (with a third party).</p>	<p>Not Applicable - No cogeneration.</p>	<p>N/A</p>
4.3.5 Electrical Power Supply		
<p>BAT 21. BAT is to increase the power factor according to the requirements of the local electricity distributor by using techniques such as those in Table 4.3 (of the BREF document), according to applicability (see Section 3.5.1).</p>	<p>Applicable - Motors, Fans and Compressors will generally be fitted with variable speed drives to minimise losses typically above 5KW. This is standard practice for the existing facility.</p>	<p>In place for existing facility– BAT as it applies to the new suite to be in place upon commencement.</p>
<p>BAT 22. BAT is to check the power supply for harmonics and apply filters if required (see Section 3.5.2)</p>	<p>Not Applicable - No harmonics expected however monitoring system will identify and measures will be taken to filter as required.</p>	<p>N/A</p>
<p>BAT 23. BAT is to optimise the power supply efficiency by using techniques such as those in Table 4.4 (of the BREF document), according to applicability.</p>	<p>Applicable - Section 9 of the IE Licence application form provides a summary of the many energy efficiency measures proposed at the facility. At design stage for the new suite, each unit operation has been assessed for energy efficiency and factors such as location of high electrical load items relative to supply connection</p>	<p>In place for existing facility– BAT as it applies to the new suite to be in place upon commencement.</p>

	<p>point, sizing of electrical transformers etc have been incorporated into the design. All measures listed in Table 4.4 have been incorporated.</p> <p>Existing facility has varied external recognition for its demonstrated commitment to energy conservation and sustainability.</p>	
4.3.6 Electric motor driven sub-systems		
<p>BAT 24. BAT is to optimise electric motors in the following order (see Section 3.6):</p> <ol style="list-style-type: none"> 1. Optimise the entire system the motor(s) is part of (e.g. cooling system, see Section 1.5.1) 2. Then optimise the motor(s) in the system according to the newly-determined load requirements, by applying one or more of the techniques in Table 4.5 (of the BREF document), according to applicability 3. When the energy-using systems have been optimised, then optimise the remaining (non-optimised) motors according to Table 4.5 (of the BREF document) and criteria such as: <ul style="list-style-type: none"> • Prioritising the remaining motors running more than 2000 hrs per year for replacement with EEMs • Electric motors driving a variable load operating at less than 50 % of capacity more than 20 % of their operating time and operating for more than 2000 hours a year should be considered for equipping with variable speed drives. 	<p>Applicable - All motors are supplied as Variable Frequency Drive (VFD) and high efficiency motors (IE2 or IE3) will be used. All measures listed in Table 4.5 have been incorporated (other than direct coupling which is not applicable). This is standard practice and is in place in the existing facility.</p>	<p>In place for existing facility– BAT as it applies to the new suite to be in place upon commencement.</p>
4.3.7 Compressed air systems (CAS)		
<p>BAT 25. BAT is to optimise compressed air systems (CAS) using the techniques such as those in Table 4.6 (of the BREF document), according to applicability.</p>	<p>Applicable - Compressors will have variable speed drives to maximize efficiency. All compressors specified will be high energy efficiency units with sizing of pipework optimised to minimise losses</p>	<p>In place for existing facility– BAT as it applies to the new suite to be in place upon commencement.</p>

	due to friction etc, as listed in table 4.6. This is standard practice at the existing facility with an annual compressed air leak programme in place.	
4.3.8 Pumping Systems		
BAT 26. BAT is to optimise pumping systems by using the techniques in Table 4.7 (of the BREF document), according to applicability (see Section 3.8)	Applicable - Pumps will be supplied with variable speed drives to minimise losses. All measures listed in Table 4.7 have been incorporated. This is standard practice and is in place at existing facility.	In place for existing facility– BAT as it applies to the new suite to be in place upon commencement.
4.3.9 Heating, ventilation and air conditioning (HVAC) systems		
BAT 27. BAT is to optimise heating, ventilation and air conditioning systems by using techniques such as: <ul style="list-style-type: none"> • for ventilation, space heating and cooling, techniques in Table 4.8 (of the BREF document) according to applicability • for heating, see Sections 3.2 and 3.3.1, and BAT 18 and 19 • for pumping, see Section 3.8 and BAT 26 • for cooling, chilling and heat exchangers, see the ICS BREF, as well as Section 3.3 and BAT 19 	Applicable. A BMS has been incorporated into the design to automatically adjust the setting of HVAC plant optimally. The overall system design includes identified areas and specified equipment which will be designated separately for process ventilation, specific ventilation, and general ventilation. The number, shape and size of intakes has been optimised. Pressure losses from intakes and exhausts have been minimised by sizing the ductwork and connections appropriately.	In place for existing facility– BAT as it applies to the new suite to be in place upon commencement.

	<p>Energy recovery has been included on all recently installed ventilation systems (since July 2016). As per COMMISSION REGULATION (EU) 2016/2281 of 30 November 2016 implementing Directive 2009/125/EC all units are equipped with heat exchanges to recovery at least 68% of available (Non-electrical) energy from the HVAC units' exhausts (Run around coil type HVAC units).</p> <p>EC (equivalent to IE4) fans with integral motors have been selected for the new facility. VSD is not required on the HVAC EC Fans (speed is variable without a VSD leading to reduced energy losses).</p> <p>Intelligent demand lead utility systems and process systems have been incorporated including high efficiency boilers, chillers and compressors.</p> <p>Air system design as per table 4.8.</p> <p>Air filters integrated into air duct system. Heat recovery from exhaust air is integrated.</p> <p>Heating/cooling needs reduced by: destratification, low temperature set point during non-productive periods (Where practical, not applicable to GMP cleanrooms due to industrial standards),</p>	
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	<p>reduction of the set point for heating and raising it for cooling.</p> <p>Humidification steam used to humidify the HVAC air has been optimised for summer and winter conditions to reduce the total quantity of humidification steam used annually. Waste heat recovered in HVAC.</p> <p>Routine preventative maintenance activities will be undertaken to optimise systems and reduce energy losses</p>	
<p>4.3.10 Lighting</p>		
<p>BAT 28. BAT is to optimise artificial lighting systems by using the techniques such as those in Table 4.9 (of the BREF document) according to applicability</p>	<p>Applicable - The buildings are designed to maximise the use of natural light while minimising artificial lighting.</p> <p>Intelligent lighting and power systems, including high efficiency LED lighting included as part of design.</p> <p>There is LED lighting site wide, activated by PIRs, including car parks. Skylights fitted in offices where feasible, daylight harvesting system with light level sensing lights fitted in rooms with windows to maintain a constant lux level. Emergency exit signs have been upgraded with LED style.</p>	<p>In place for existing facility– BAT as it applies to the new suite to be in place upon commencement.</p>

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4.3.11 Drying, separation and concentration processes		
<p>BAT 29. BAT is to optimise drying, separation and concentration processes by using techniques such as those in Table 4.10 (of the BREF document) according to applicability, and to seek opportunities to use mechanical separation in conjunction with thermal processes</p>	<p>Not Applicable – no (conventional) drying, separation or concentration processes at either the new or existing facility.</p>	<p>N/A</p>

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