TECHNICAL DOCUMENT

APPLICATION FOR A VARIATION TO THE ENVIRONMENTAL PERMIT FOR THE BARROW PAPER MILL

KIMBERLY-CLARK

CURRENT PERMIT REFERENCE – BJ7611IY/V010

VARIATION V012

NEW BOILER PLANT PROJECT

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

AEPL	-	Associated Performance Levels
ATEX	-	“Atmospheres Explosibles”
BAT	-	Best Available Techniques
BOP	-	Balance of Plant
CAR	-	Compliance Assessment Report
CH_4	-	Methane
CCTV	-	Closed Circuit Television
CHP	-	Combined Heat & Power
CO	-	Carbon Monoxide
CO_2	-	Carbon Dioxide
COMAH	-	Control of Major Accident Hazards
COSHH	-	Control of Substances Hazardous to Health
D/D/S	-	Duty/Duty/Standby configuration for existing boilers
EA	-	Environment Agency
ECO 1/2	-	Economiser
ELV	-	Emission Limit Value
EMS	-	Environmental Management Systems
EPR	-	Environmental Permitting Regulations
ETP	-	Effluent Treatment Plant
EU	-	European Union
GHG	-	Green House Gas
H_2	-	Hydrogen
H_2O	-	Water
H_2S	-	Hydrogen Sulphide

HAZOP	-	Hazard and Operability Study
HHV	-	Higher Heating Value
HPBH	-	High Pressure Boiler House
HPF	-	Hydrogen Production Facility
HVAC	-	Heating, Ventilation and Air Conditioning
IBC	-	Intermediate Bulk Container
IED	-	Industrial Emissions Directive
ISO14001	-	The Standard for Environmental Management Systems (EMS)
KC	-	Kimberly-Clark
LHV	-	Lower Heating Value
LPBH	-	Low Pressure Boiler House
M1	-	EA guidance note on Monitoring System Locations
MCC	-	Motor Control Centre
MCERTS	-	Monitoring Certification Scheme
MCR	-	Maximum Continuous Rating
MEWP	-	Mobile Elevating Work Platform
MSDS	-	Material Safety Data Sheet
MWth	-	MegaWatt thermal
N	-	Nitrogen
N_2	-	Nitrogen
NG	-	Natural Gas
NOx	-	Oxides of Nitrogen
O_2	-	Oxygen
P	-	Phosphorus
PCR	-	Pressurised Condensate Return
PLC	-	Programmable Logic Controller

PRMS	-	Pressure Reduction & Monitoring Station
Q1/2/3/4	-	Quarter 1/2/3/4 etc
RAAC	-	Reinforced Autoclaved Aerated Concrete
RHS	-	Relevant Hazardous Substance
RO	-	Reverse Osmosis
SMOC	-	Safety Management of Change
SOx	-	Oxides of Sulphur
SCR	-	Site Condition Report
TM	-	Tissue Machine
t/h	-	Tonnes per hour
WHSG	-	Waste Heat Steam Generator

NON-TECHNICAL SUMMARY – SUBSTANTIAL VARIATION APPLICATION – NEW BOILER PLANT - BJ7611IY/V012

The proposed development consists of the installation of replacement boilers, exhaust stacks and associated pipework/infrastructure at the Kimberly-Clark Limited (KC) existing manufacturing site in Barrow-in-Furness, Cumbria.

The initial scope of the boiler replacement project was to replace the boilers due to their age and condition, with energy saving being a by-product of the installation.

Currently steam for the site is provided by the existing boiler plant which is located in the High Pressure Boiler House (HPBH) that is located at the southern end of the site approximately 100 m from the main production building which contains the Tissue Machines TM3 and TM5.

TM3 and TM5 are the main users of steam on-site. The manufacture of tissue requires a large steam filled cast iron cylinder (Yankee Dryer) to be rotated at high speed to dry the tissue.

The tissue-making process primarily drives the demand for steam. Additionally, there is an increased demand for ancillary items, such as HVAC, during the winter months.

The three current boilers were installed in the High Pressure Boiler House in 1984. These were originally coal-fired. The boilers were converted to natural gas/gas oil in 1994 but the use of gas oil ceased in the 2000s.

The HPBH consists of 3 x 16.7 MWth (currently restricted to 13.3 MWth) input natural-gas boilers all of which discharge through a common stack with windshield at a height of 45m above ground level. They are each capable of producing 18t/h of steam for supply to the site. The existing boilers are identified as emission points to air AB1/AB2 and AB3 in the current permit.

The three existing boilers in the HPBH are controlled to satisfy the site steam demand which varies according to site operational demands. Over-production/supply of steam is avoided since the production of excess steam has to be vented which is costly and wasteful.

The existing boiler system still has many features associated with the original design (designed for coal and coal handling equipment still exists) but as they were not originally designed for natural gas their efficiency is assumed to be low (80-85%) by comparison to modern standards.

For reasons of equipment age and efficiency outlined in the preceding sections, KC has decided to replace the existing boiler plant at Barrow with a new boiler plant system.

At Barrow the new boiler plant will be located in the refurbished existing Low Pressure Boiler House and will contain three new boilers capable of each producing 16 t/h of steam (each boiler will be rated at 10.2MWth input). Each new boiler will have an individual stack and the system will be operated as duty/duty/standby.

Each new boiler will have dual-fuel capability (natural gas and hydrogen) and also have the capability to operate on a mix of hydrogen and natural gas if required.

The new boiler plant will be more efficient, more reliable and will align with KC's future sustainability plans and will contribute towards KC's target of using 100% renewable energy by 2030. The new boiler plant will assist in reducing KC's Carbon Dioxide (CO_2) emissions by burning green hydrogen.

The proposed changes require a permit variation for the installation of the new boiler plant and the provision of new point source emissions to air - to be designated AB7, AB8 & AB9. The existing emission point AB6 is to be removed from the permit as the standby boiler is no longer in use and is to be removed from site.

Hydrogen is to be provided by a new hydrogen production facility (HPF) to be constructed on an area of land located south of the Barrow Mill. The distance from the centre of the HPF site to the LPBH on the KC site is approximately 500m. The new facility is to be operated by a 3rd party who will supply hydrogen solely for use by KC via a dedicated pipeline.

The HPF scope includes the provision of a dedicated hydrogen supply pipeline from their site area to the new boiler plant.

The HPF made an environmental permit application (EPR/VP3128LT) in February 2026 for the operation of the HPF.

For the purposes of this variation the BAT-C requirements have been reviewed in order to ensure that following the modifications compliance will be achieved and that any specific requirements for new plant have been addressed during the design process/specification of the new equipment/facilities.

The assessment concludes that due to the proposed modification (Installation of a new boiler plant) KC's operations at Barrow will continue to meet the relevant BAT-Conclusions requirements.

Overall the provision of new boiler plant to satisfy the existing site steam requirements is considered to represent BAT for the installation.

1. INTRODUCTION – NEW BOILER PLANT PROJECT

The proposed development consists of the installation of replacement boilers, exhaust stacks and associated pipework/infrastructure at the Kimberly-Clark Limited (KC) existing manufacturing site in Barrow-in-Furness, Cumbria.

This report is prepared in support of an application to vary the environmental permit EPR/BJ7611IY/V010 for the KC facility located at Barrow Mill, Park Road, Barrow-in-Furness, Cumbria, LA14 4QX ('Barrow Mill').

Barrow Paper Mill is located in Barrow-in-Furness on the southwest coast of the Furness Peninsula at National Grid Reference SD 1957 7272.

Site location plans/details have been included in Appendix A.

Note: Variation V011 has been submitted and is also for a variation to the existing permit V010. Variation V011 is for changes to the existing Convertor Line operations which are separate from the new boiler plant proposals.

1.1 Site Location/Background

The Barrow Mill was established in 1967 on a green-field site and is part of the Sowerby Woods Industrial Estate on the north-western edge of Barrow-in-Furness.

The site is located in Barrow-in-Furness on the south west coast of the Furness Peninsula and approximately 3.5 km from the town centre.

The site is surrounded by the following:

To the north	Woodland and beyond an industrial estate.
To the east	The A590 is directly adjacent, beyond are industrial units (mechanic workshops/ Wicks clothing store etc) and beyond them is a golf course and undeveloped agricultural land.
To the south and southeast	Commercial/industrial units and a large solar farm (southwest). The proposed Hydrogen Production Facility (HPF) is to be located in this area. It is approximately 500m from the location of the KC boiler plant to the centre of the HPF site. To the southeast is a large residential area.

To the west	A railway line aligned northeast to southwest between the main manufacturing site and the effluent treatment plant. Beyond the treatment plant is undeveloped agricultural land and then the Walney Channel off the Irish Sea (approx. 500m from site).

The nearest residential receptors are located on Middlefield and Bank Lane to the east, over 200m from the Barrow Mill site. The A590, the main road into Barrow, is in between site and these properties.

The site is located within flood zone 1. The site is not located within an Air Quality Management Zone.

There are designated habitat sites within the relevant screening criteria of the installation (see Air Quality Impact Assessment).

The process conducted at Barrow Mill involves the production of soft tissue products. No mechanical or chemical pulping processes are used on the site.

The plant manufactures tissue products and has a capacity of approximately 120,000 Air Dry Tonnes per annum combined for the two current tissue machines – TM3 and TM5. KC currently directly employs approximately 385 people in a variety of different roles at the site. (This figure excludes contract employees).

The permitted installation boundary area (in green) covered by the current permit EPR/BJ7611IY/V010 is shown in Schedule 7 of the existing permit and presented in Appendix A.

The site ownership extends beyond the permitted installation boundary to cover a contractor laydown area located to the south of the site. However, no operational activities are undertaken in this area and this area is not included in the permitted installation boundary.

1.2 Permitted Activities

The installation produces soft tissue paper under the following IED Schedule 1 listed activities:

- AR1 - Section 6.1 Part A(1)(a) - Producing, in industrial plant, pulp from timber or other fibrous materials – operation of a de-inking plant;

- AR2 - Section 6.1 Part A(1)(b) - Producing, in industrial plant, paper and board where the plant has a production capacity of more than 20 tonnes per day;
- AR3 - Section 1.1 Part A(1)(a) - Burning any fuel in an appliance with a rated thermal input of 50 megawatts or more;
- AR4 - Section 5.4 Part A(1)(a)(i) - Disposal of non-hazardous waste in a facility with a capacity exceeding 50 tonnes per day by biological treatment (D8).

Directly Associated Activities include:

- AR5 - Treatment of sludge from effluent treatment activity.
- AR6 - Treatment of abstracted water.

1.3 Current Boiler Plant/Steam Generation

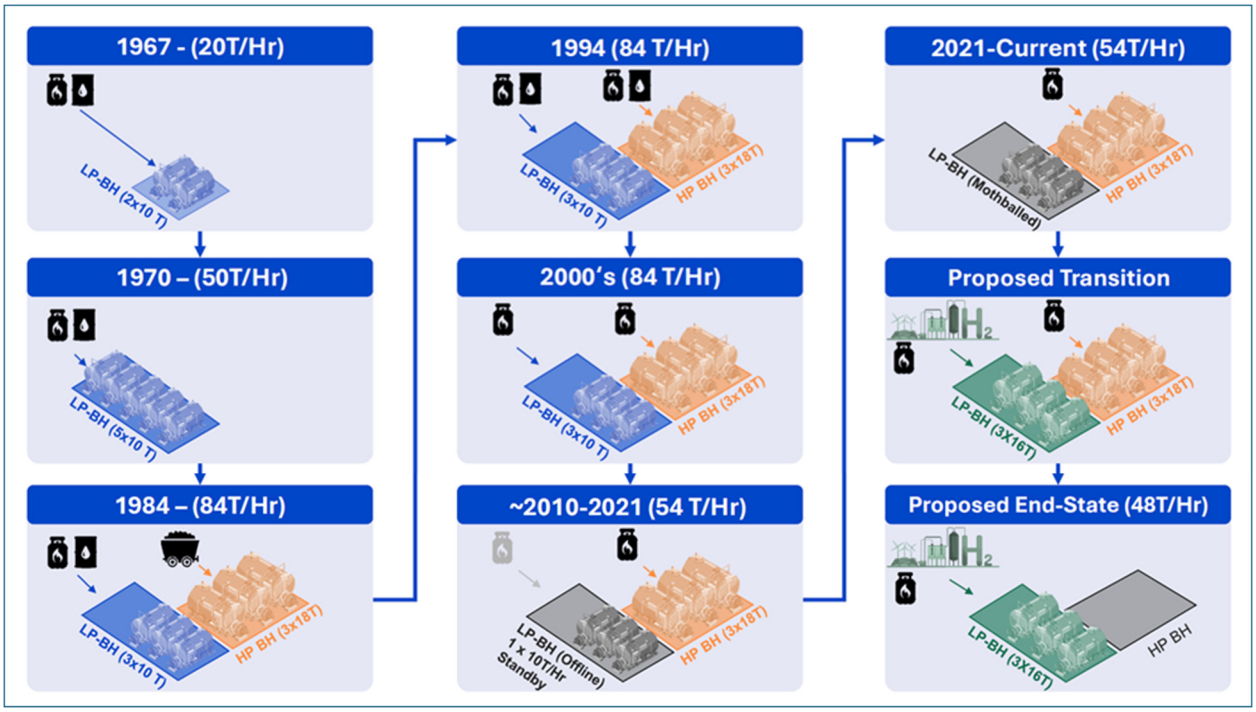
The initial scope of the boiler replacement project was to replace the boilers due to their age and condition, with energy saving being a by-product of the installation.

Currently steam for the site is provided by the existing boiler plant which is located in the High Pressure Boiler House (HPBH) that is located at the southern end of the site approximately 100 m from the main production building which contains the Tissue Machines TM3 and TM5.

TM3 and TM5 are the main users of steam on-site. The manufacture of tissue requires a large steam filled cast iron cylinder (Yankee Dryer) to be rotated at high speed to dry the tissue.

The tissue-making process primarily drives the demand for steam. Additionally, there is an increased demand for ancillary items, such as HVAC, during the winter months.

The diagram below shows the history of the boilers on-site at Barrow.



Two gas/gas-oil fired boilers (10t/h of steam) were originally installed in the Low Pressure Boiler House (LPBH) in 1967. This was increased to five boilers in 1970 before being reduced to three boilers in 1984 when the HPBH was constructed. The three current boilers were installed in the HPBH in 1984. These were originally coal-fired. The boilers were converted to natural gas/gas oil in 1994. The use of gas oil ceased in the 2000s for both the HPBH and the LPBH. These three boilers have the capability of running on heavy fuel oil however the fuel storage system was removed some years ago.

The HPBH consists of 3 x 16.7 MWth (currently restricted to 13.3 MWth) input natural-gas boilers all of which discharge through a common stack with windshield at a height of 45m above ground level. They are each capable of producing 18t/h of steam for supply to the site. The existing boilers are identified as emission points to air AB1/AB2 and AB3 in the current permit.

Up to 1995 there were four Tissue Machines on-site. TM2 was the first to shut down in 1996/7. Over the years the site steam requirements have reduced as the production facilities have changed. TM1 was rebuilt to a different technology in 2003 and was finally removed from service (scrapped) in 2020 to make way for the new TM5 which started up in 2021. Once TM5 was operational, TM4 was removed (scrapped) in 2022 leaving two Tissue Machines on site, TM3 and TM5.

The three existing boilers in the HPBH are controlled to satisfy the site steam demand which varies according to site operational demands. Over-production/supply of steam is

avoided since the production of excess steam has to be vented which is costly and wasteful.

The existing boiler system still has many features associated with the original design (designed for coal and coal handling equipment still exists) but as they were not originally designed for natural gas their efficiency is assumed to be low (80-85%) by comparison to modern standards.

The LPBH contains three standby boilers that used to be operational on natural gas/gas-oil. Each boiler is rated at 7.32MWth and has a 20m high stack. Although currently in-situ none of these boilers are operational. They were originally designated as emission points AB4/AB5 and AB6 in the permit but only AB6 is still included in the current permit. All three boilers have been air-gapped.

The current site steam demand is approximately 19 t/h (max 21t/h) – see Table below - which means that the existing system (capable of producing up to max 54t/h of steam) is significantly over-designed for the current duty. Current boilers are used in a duty/duty/standby configuration with the standby boiler being used when the weekly low water test is carried out, and when a boiler is shutdown for annual statutory inspection, or in the case of another boiler breakdown.

Current Barrow Steam Consumption (t/h) is as follows:

Feature	TM3	TM5	Converting Heating	Notes
Nominal Consumption (t/h)	8	8	3	
Steam box (t/h)	N/A	2	N/A	TM5 steam box has not been used for > one year (running cost exceeds benefit)
Waste Heat Steam Generator (WHSG) (t/h)	N/A	-2 *	N/A	* WHSG is a “negative consumer” as it produces steam
Maximum Consumption (t/h)	8	10 (+ steam box, - WHSG)	3 (winter)	Total = 21
Minimum Consumption (t/h)	8	6 (- steam box, + WHSG)	0 (summer)	Total = 14
Typical Consumption (t/h)	8	6 (- steam box, + WHSG)	3 (~8/12 months/year)	Total = 17
Typical Consumption (no TM5 WHSG) (t/h)	8	8 (- steam box, - WHSG)	3 (~8/12 months/year)	Total = 19 (WHSG offline e.g. for annual inspection)

Typical Consumption (no TM5 WHSG) is 19 t/h. TM3 used to have a steam box but it has been physically removed so is not included in the table above. TM5 has a steam box (installed) but the cost of running it outweighs the benefit so has been left idle for more than a year. Everything possible is done to keep the WHSG online due to the savings it generates, however it does need to be offline for statutory inspections.

The existing boilers are also old and are inefficient by modern standards which leads to higher emissions. They require regular maintenance (high costs) to ensure they continue to operate and comply with current statutory requirements (inspection frequency is currently at 9 months compared to a normal 12 month inspection requirement). There is also the potential for a significant impact on the business/production in the event of a major breakdown.

Boiler feedwater is provided from the existing site potable water supply (mains water). The potable water is treated to ensure the appropriate water quality supply for the existing boilers.

Water treatment chemicals are required in this treatment process which comprises an ion exchange system.

The current boiler plant produces superheated steam at 19barg @ 212^{o}C.

The existing system produces steam for supply to the site and condensate is returned to the boiler plant for reuse. All lines are thermally insulated and some sections of pipework are located underground and/or within trenches including sections which run beneath existing internal site access roads. The existing steam supply pipework and condensate return pipework is old and in places difficult to inspect and test. Due to the distance involved steam loses heat from the pipework supply to the Mill and the condensate loses heat on the return. Condensate is currently collected in an uncovered hot well located open to the atmosphere that is external to the Mill building before being pumped back to the HPBH.

Blowdown occurs and make-up water is required for the system. The discharges are into the existing site drainage system which is routed to the on-site Effluent Treatment Plant (ETP) (Biological secondary treatment) where it is mixed with other discharges from the site, the surface water drains etc. and treated as required prior to final discharge to the Walney Channel via discharge point W1 designated in the existing permit.

Discharges from the boiler house are low and overall not significant in terms of the total volumes treated by the ETP which mainly deals with the discharges from the paper

production facilities. The ETP was originally designed to handle wastewater from the original paper mills and has significant over-capacity for current loadings.

The quantities of solid waste produced from the existing boiler plant operations is not significant and comprises mainly waste generated from periodic maintenance activities.

Any solid wastes generated are disposed of in accordance with existing site waste management procedures.

1.4 New Boiler Plant Project

For reasons of equipment age and efficiency outlined in the preceding sections, KC has decided to replace the existing boiler plant at Barrow with a new boiler plant system.

A similar project is simultaneously being undertaken at the KC Northfleet site to replace their existing boilers for the same reasons. The KC Barrow and KC Northfleet projects are in close liaison and have regular discussions. The new boiler supplier is the same at each location. There are regular discussions between the project teams for each site and design information has been shared. There are many similarities between the two projects and lessons are being learnt and shared between the two projects. At KC Northfleet unlike at Barrow, the HPF is to be constructed on land within the existing KC Northfleet site. KC Northfleet initially sought pre-application advice in 2024 and this has been taken into consideration for the KC Barrow project. At KC Barrow the HPF is to be located off-site with a pipeline connection between the HPF and the KC Barrow site.

At Barrow the new boiler plant will be located in the refurbished existing LPBH – and will contain three new boilers capable of each producing 16 t/h of steam (each boiler will be rated at 10.2MWth input). Each new boiler will have an individual stack and the system will be operated as duty/duty/standby. As part of KC's commitment to sustainability, decarbonization options have been explored. One of which is that KC specify new boilers to be provided with the capability to operate 100% hydrogen firing without derating capacity.

Each new boiler will have dual-fuel capability (natural gas and hydrogen) and also have the capability to operate on a mix of hydrogen and natural gas if required. At this stage operating on a mix is currently considered unlikely (but it cannot be ruled out). KC's preference will be to operate using 100% hydrogen all the time when it is available.

The new boiler plant will be more efficient, more reliable and will align with KC's future sustainability plans and will contribute towards KC's target of using 100% renewable

energy by 2030. The new boiler plant will assist in reducing KC's Carbon Dioxide (CO_2) emissions by burning green hydrogen.

KC has engaged vendors with experience in hydrogen combustion systems. "Hydrogen Ready" boilers as described by vendors are designed to seamlessly change from natural gas to hydrogen without compromising output.

KC evaluated alternative potential boiler suppliers prior to the final selection of Cannon Bono boilers. These boilers offer modern technology and incorporate energy efficient/energy saving opportunities and design measures (flue gas recirculation, high pressure condensate return, economisers, blowdown heat recovery, combustion air preheat) and were considered following detailed evaluation to fulfil all KC requirements and to fulfil the Best Available Technique (BAT) requirements for new boiler design. Other suppliers were unable to demonstrate similar consideration and technical familiarity with overall energy efficiency/energy saving opportunities and considerations.

KC has selected standard boiler sizing from the manufacturer to avoid potential issues with having to design bespoke boilers and systems. Three boilers are required to provide duty/duty/standby capability since the steam supply is critical for site operations to continue. Two boilers each operating at maximum load (16 t/h per boiler) would exceed the current steam supply requirements for the site (19-21t/h) so when load sharing the duty boilers will be operating well within design capacity.

Individual stacks have been selected in accordance with the standard supply offering/recommendation from the manufacturer and to provide flexibility/simplicity in design and for environmental monitoring. (Note: it is possible that the two duty boilers could be set up to operate with one on hydrogen and the other on natural-gas so individual stacks are also considered more appropriate for compliance purposes).

The option of connecting the exhausts from the new boiler plant into the existing 45m stack was considered but the existing stack will also be in need of replacement due to being more than 40 years old and the project team not wishing to commit the mill to replacing the stack within the lifespan of the new boilers. The duct routing from new boilers to the current stack would involve several bends/elbows plus a longer duct run, all of which introduces restrictions to the flow of exhaust gases.

An alternative location for a new single stack was considered but no suitable location could be identified due to access requirements. The existing LPBH roof is too weak for the installation of a single stack and would require extensive additional construction work.

The installation of the new boiler plant will enable the source of the steam required on-site to be changed from the existing boiler plant to the new boiler plant. Some steam supply pipework modifications will be required on-site (for example a new pipe bridge to replace a current section that runs belowground and is difficult to inspect and maintain) but there should be no change to the steam users and they should continue to operate as currently. No changes in the operation of the site are envisaged other than those associated with the steam supply system changes.

It is currently envisaged that the quantity and type of water treatment chemicals required for the new boiler plant will be similar to the existing boiler plant. Steam requirements for the site are the same so water usage/chemical usage should be similar.

The new system will produce steam for supply to the site and condensate will be returned to the boiler plant for reuse. All lines will be thermally insulated and located aboveground from the new boiler plant to the main production building including sections on pipe bridges as appropriate. Inspection of the pipework will therefore be easier than at present as confined space access (high risk) is not required. Steam heat losses will be significantly reduced due to new design and the condensate on return should retain more heat. These changes will improve the overall efficiency of the new system compared to the existing system.

Blowdown will occur (1t/h) and make-up water will be required for the system (up to 7t/h). The discharges will be into the existing site drainage system via new connections and be routed to the on-site ETP as currently.

As per the current situation the discharges from the new boiler house will be low and overall not significant in terms of the total volumes treated by the ETP which mainly deals with the discharges from the paper production facilities.

NB Except for a short transient period during commissioning process discharges from both the existing boiler plant and the new boiler plant will not occur simultaneously. The capacity of the existing ETP is sufficient to cope with such a scenario.

1.5 Permit Variation Requirements

The proposed changes require a permit variation for the installation of the new boiler plant and the provision of new point source emissions to air - to be designated AB7, AB8 & AB9. The existing emission point AB6 is to be removed from the permit as the standby boiler is no longer in use and is to be removed from site.

Activity AR3 will be affected by the proposals due to the changes to the installed MWth input for the site - see later table.

The treatment of abstracted water (AR6) for use on site will be similar to the existing requirements. Abstracted (borehole) water is not normally used in the existing boiler plant and not envisaged to normally be used in the future for the new boiler plant. A potable water supply is currently used.

The other activities identified in the current permit (AR1, AR2, AR4, and AR5) are not affected by the boiler plant proposals.

However as part of this permit variation AR1 can be removed from the permit as the de-inking plant is no longer operational.

The cessation of the de-inking plant operations is permanent, with some of the original infrastructure being decommissioned .

1.6 Enhanced Pre-application Advice

KC applied for Enhanced pre-application advice for the new Boiler Plant Project in January 2026 (EPR/BJ7611IY/P002). At that stage advice on the Converting Lines was also included in this request. Subsequently however (March 2026) a separate application for the Converting lines odour abatement systems has been submitted – variation V011.

The requirement for a new boiler plant has also been discussed and recorded in CAR forms with the local site inspectors over a period of many years.

During the Enhanced pre-application discussions the issue of whether the combination of the hydrogen production facility (HPF) and the KC site (as the sole user of the hydrogen produced at the HPF) would result in a direct technical connection between the two sites and hence a multi-operator installation should be designated.

However the HPF had already had discussions with the EA on this subject (EPR/VP3128LT/P001) and has subsequently applied for a permit as a single installation on the basis that the connecting hydrogen pipeline was likely to be under the full control of a 3rd party operator and this would thus break the direct link between the two sites (KC and the HPF).

Accordingly this application is made on a similar basis that the provision of hydrogen does not result in a multi-operator designation due to the operation of the connecting hydrogen pipeline coming under the full control of a 3rd party. The 3rd party operator agreement

however has yet to be fully determined at this stage and discussions are on-going with the HPF and potential operators of the pipeline.

Note: The new boiler plant project at KC Northfleet, which has many similarities to the KC Barrow proposals, sought pre-application advice in July 2024. At Northfleet due to the location of the hydrogen production facility being located within the KC Northfleet site boundary the EA has designated the activities to be a Multi-Operator installation.

1.7 Planning

The proposed development which consists of the installation of replacement boilers, exhaust stacks and associated pipework/infrastructure at the manufacturing site in Barrow-in-Furness requires planning permission from Westmorland and Furness Council.

Pre-application advice for planning was sought (letter dated 22/12/25). A full planning application was subsequently submitted to the Council on 14/04/26 and validated on 17/04/26 (Ref. B15/2026/0167).

2. DETAILED PROCESS DESCRIPTION

2,1 Boiler Plant

KC are proposing to install three "steammatic" two pass wet back fire tube steam boilers (model SG 1600/22/CH4+H2/HE/72h/OPTI) provided by Cannon Bono at the Barrow Mill site. Each boiler is capable of producing up to 16 tonnes of steam per hour @ 19barg for use on site and operating on natural gas, hydrogen or a mixture of both fuels. Each boiler is rated at 10.2MWth input capacity.

Cannon Bono are an Italian company dedicated to the design, manufacturing, installation, service, and maintenance of industrial boilers for standard and special applications including plug-in solutions, package solutions, and site-erected plants. All products are manufactured in Italy.

Further details on Cannon Bono and the SG series of boilers can be found by following the links below.

https://www.cannonbonoenergia.com

https://www.cannonbonoenergia.com/products/steam-generators/fire-tube-boilers-sg-series/

The boilers will be supplied packaged and assembled at Barrow Mill, complete with burners, equipment, instruments and safety devices. The boilers will be extensively fire tested in Italy before shipment to minimize on site activities for connection and start-up.

The boilers will be equipped with the latest technology (HE Smart ®) to pre-heat the boiler feed water and combustion air to increase the thermal efficiency up to 97.5%. The boilers will be thermally insulated.

2.2 New Boiler Plant Building

The new boiler plant will be located within the refurbished LPBH building as shown on the attached drawing – see Appendix B.

The LPBH is currently within the existing site permitted area under the current environmental permit (EPR/BJ7611IYV010) – see Appendix A.

The boiler house will include three exhaust stacks at a total height of 20 metres above ground terminating above the roof. Sample monitoring points with access will be provided to each stack. Each stack will be fitted with an integral silencer for noise reduction and a rain cowl to prevent rainwater ingress.

2.3 Boiler Design Data

Steam supply = 16000 kg/h from each boiler

Design pressure = 22barg

Operating pressure = 19barg

Fuel supply – natural gas and/or hydrogen @ 300mbar

Oxides of Nitrogen (NOx) emission limit (@ 3% O_2, dry) = 100mg/Nm^3 for natural gas

Oxides of Nitrogen (NOx) emission limit (@ 3% O_2, dry) =137mg/Nm^3 for hydrogen

Carbon Monoxide (CO) emission limit (@ 3% O_2, dry) = 50mg/Nm^3 for both natural gas and hydrogen

Dunphy Burners have been selected as Dunphy, who are located in Rochdale, have experience with hydrogen as well as burning multiple gases. KC had several meetings with Dunphy directly as part of the overall vendor selection process, to understand their capabilities with hydrogen & gas supply switching.

The burner head will comprise two rings of jets, one for natural gas, one for hydrogen. In theory, all the time there is a flame (Hydrogen or Natural gas), the ratio of hydrogen: natural gas can be varied from 0:100 to 100:0. If the flame is lost, the system needs to be purged of fuel prior to re-lighting.

The HPF is reliant on electrical supply being "green" to make green hydrogen, so the likelihood is most will be made at night & stored; However KC need to draw off hydrogen on a 24/7 basis. In the event of the hydrogen supply getting low, KC will need to switch to natural gas (and then back to hydrogen once the supply builds up again).

2.4 Boilers

Each boiler will be supplied with the following features:

- Modulating feedwater system;
- Heat recovery systems;
- Industrial dual block burner system suitable for both fuels with modulating combustion regulation;
- Burner management system;
- Combustion air fan with motor and frequency converter;
- O_2 and CO probes for combustion optimization;
- Forced flue gas recirculation;
- MCC power cabinet (to be located in a safe area) and boiler control panels;
- Each boiler has 2 passes;
- Optispark ® F3 boiler control system based on Siemens PLC – predictive control for improved control and increase efficiency;
- Safety and control devices;
- Hot standby system to guarantee a faster start-up when required. *(Steam is injected into the water side of the boiler to keep the boiler hot and thus avoid intermittent firing of the burner system which is detrimental to the burner and the boiler due to long-term cyclic stresses);*
- Approximate dimensions - Length = 9750mm, Width = 3900mm (large diameter assists in reducing NOx emissions), Height = 4900mm.

- Steam quality > 99.5%.

2.4.1 Heat Recovery System

The HE-Smart ® system is a patented heat recovery system which increases the overall efficiency of the boiler by recovering heat from the combustion flue gases keeping flue gas temperatures low even with high feedwater temperatures.

2.4.2 Forced Flue Gas Recirculation

Oversized fans ensure recirculation of up to 15% of flue gases to ensure a reduction in NOx emissions.

2.4.3 Boiler Feed Water System

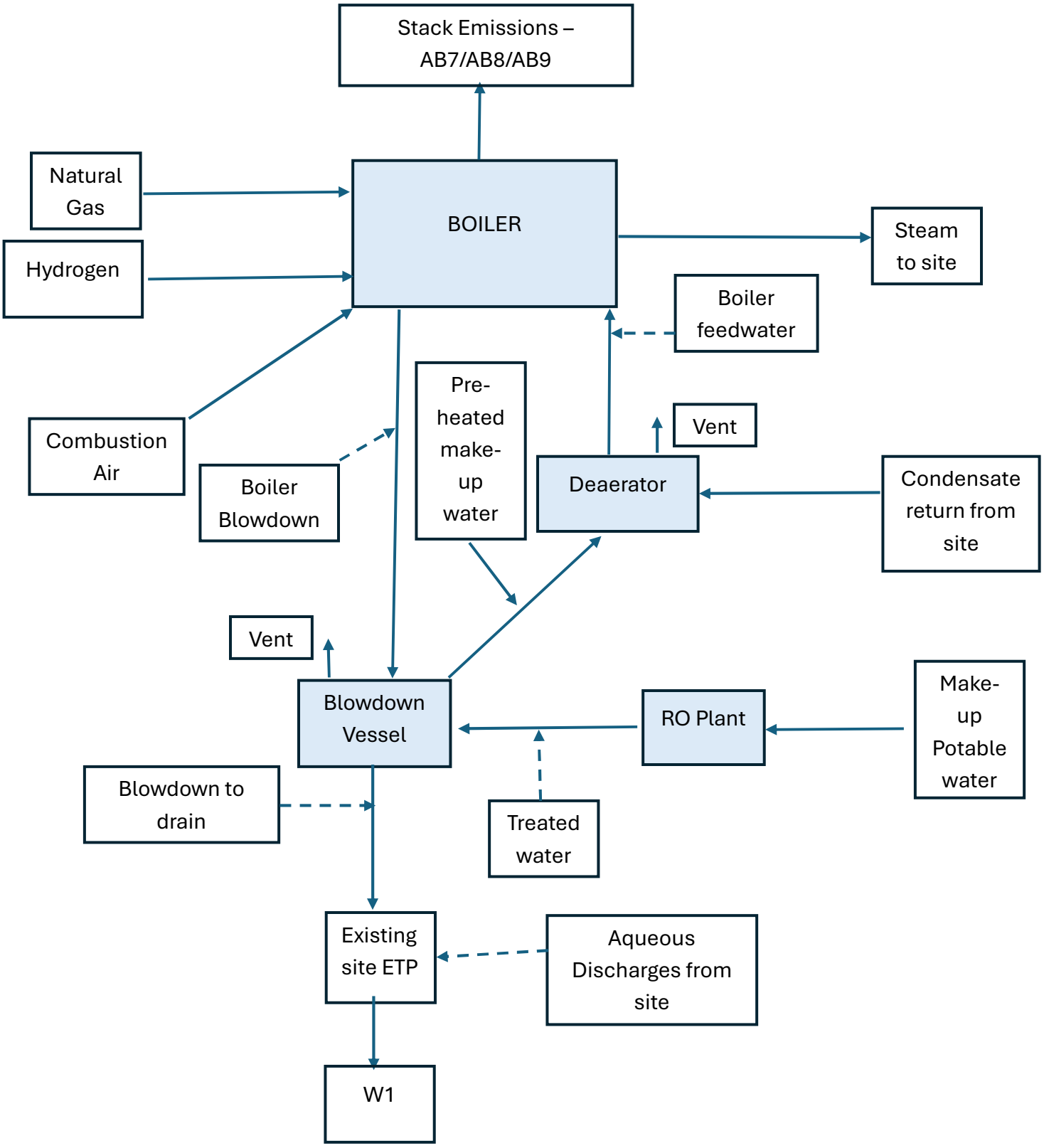
The boiler feed water system will comprise the following:

- 1 x Water softener – reverse osmosis unit for continuous supply. Rated for 20% of make-up water.
- 1 x Water pump – centrifugal type rated for 6 tonnes per hour.
- 2 x Deaerator – (ZEROGAS ® Spray Smart Deaerator)
    - 8 barg design pressure.
    - 30 tonnes per hour capacity for deaerated water.
    - Rated for 80% condensate return at 150°C and 20% make-up water at 10-15°C. (up to 25.6 t/h).
    - Insulation provided.
    - The deaerators will be vented to atmosphere locally.
- 1 x Chemical Dosing station. 4 Centrifugal feed water pumps (duty/standby) for each deaerator rated at 25m^3/h @ 250m, rated for high temperatures (up to 150°C).
- 1 x Blowdown tank – 2m^3 with heat recovery system including pipework to/from the water treatment plant.
- The blowdown tank will be vented to atmosphere locally.

2.4.4 Deaerator

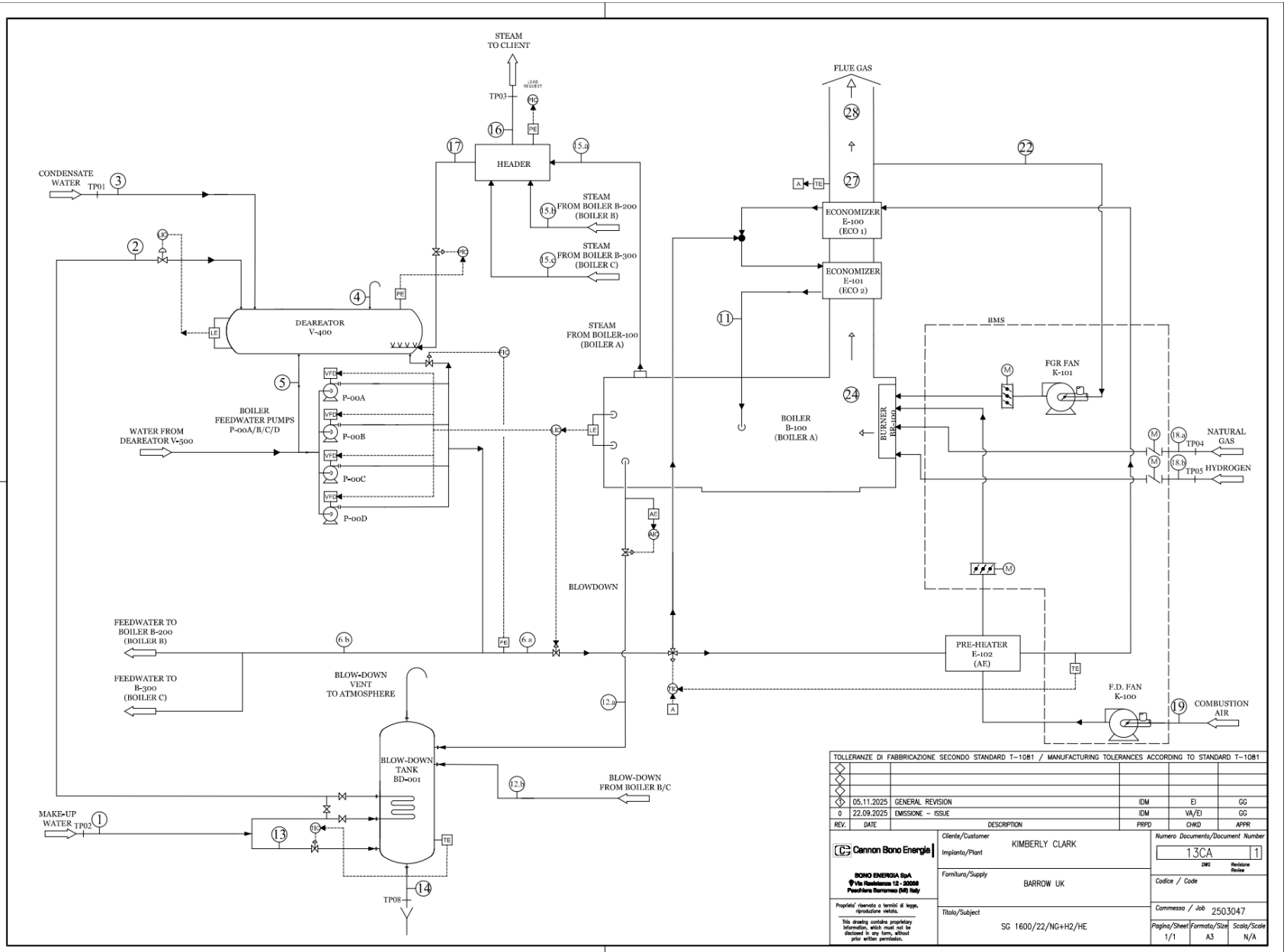
The thermo-physical deaerator removes oxygen from the boiler feed water. Oxygen and dissolved carbon dioxide are catalysts for the corrosive process on metal surfaces. The deaerator ensures that the boiler is fed with water at a high and constant temperature thus improving its efficiency and protecting it from thermal shocks. The Zerogas System allows the recovery of heat from condensation fumes.

A simplified block flow diagram of the new boiler system is presented below.


Stack Emissions – AB7/AB8/AB9
Natural Gas
Hydrogen
BOILER
Steam to site
Boiler feedwater
Combustion Air
Boiler Blowdown
Pre-heated make-up water
Vent
Deaerator
Condensate return from site
Vent
Blowdown Vessel
RO Plant
Make-up Potable water
Blowdown to drain
Treated water
Existing site ETP
Aqueous Discharges from site
W1

2.4.5 Technical Data

Item	Unit	100% Natural Gas	100% Hydrogen	Mix 50/50% NG/H_2
Feedwater temperature	°C	130		
Ambient temperature	°C	25		
Relative humidity of ambient air	%	60		
Boiler load	%	100		
Steam capacity	kg/h	16000		
Operating pressure	barg	19		
Steam quality	-	Saturated (>99.5%)		
Fuels				
C1	% mol	90	0	45
C2	% mol	3	0	1.5
C3	% mol	2	0	1
Hydrogen	% mol	0	99.9	49.95
Nitrogen	% mol	5	0.1	2.55
Molecular Weight	g/mol	17.69	2.04	9.86
Fuel Density	kg/Nm^3	0.789	0.091	0.440
LHV – Lower Heating Value - w	kJ/kg	45.733	118.297	53.240
LHV – Lower Heating Value - vol	kJ/Nm^3	36.089	10.772	23.431
HHV – Higher Heating Value - vol	kJ/Nm^3	39.971	12.733	26.352
Flue gas composition at stack				
Carbon dioxide	% vol	8.3	0	6.6
Sulphur dioxide	% vol	0	0	0
Nitrogen	% vol	70.6	64.9	69.4
Argon	% vol	0.8	0.8	0.8
Oxygen	% vol	2.5	2.0	2.4
Water vapour	% vol	17.8	32.3	20.8
Flue Gas flowrate at stack	kg/h	15.564	12.436	14.852
Thermal efficiency	%	97.0 +- 0.5	96.5 +- 0.5	96.7 +- 0.5


STEAM TO CLIENT
TP03
FLUE GAS
HEADER
CONDENSATE WATER
TP01
STEAM FROM BOILER B-200 (BOILER B)
STEAM FROM BOILER B-300 (BOILER C)
ECONOMIZER E-100 (ECO 1)
ECONOMIZER E-101 (ECO 2)
DEAERATOR V-400
STEAM FROM BOILER-100 (BOILER A)
BMS
FGR FAN K-101
BOILER FEEDWATER PUMPS P-00A/B/C/D
P-00A
P-00B
P-00C
P-00D
WATER FROM DEAERATOR V-500
BOILER B-100 (BOILER A)
BURNER BR-100
NATURAL GAS
TP04
HYDROGEN
TP05
BLOWDOWN
FEEDWATER TO BOILER B-200 (BOILER B)
FEEDWATER TO B-300 (BOILER C)
PRE-HEATER E-102 (AE)
F.D. FAN K-100
COMBUSTION AIR
BLOW-DOWN VENT TO ATMOSPHERE
BLOW-DOWN TANK BD-001
BLOW-DOWN FROM BOILER B/C
MAKE-UP WATER
TP02
TP08
TOLLERANZE DI FABBRICAZIONE SECONDO STANDARD T-1081 / MANUFACTURING TOLERANCES ACCORDING TO STANDARD T-1081
05.11.2025 GENERAL REVISION IDM EI GG
0 22.09.2025 EMISSIONE - ISSUE IDM VA/EI GG
REV. DATE DESCRIPTION PRPD CHKD APPR
Cannon Bono Energia
BONO ENERGIA SpA
Via Resistenza 12 - 20068
Peschiera Borromeo (MI) Italy
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Cliente/Customer KIMBERLY CLARK
Impianto/Plant
Fornitura/Supply BARROW UK
Titolo/Subject SG 1600/22/NG+H2/HE
Numero Documento/Document Number 13CA 1
DWG Revisione Review
Codice / Code
Commessa / Job 2503047
Pagina/Sheet 1/1
Formato/Size A3
Scala/Scale N/A

Legend

Line number	Description	At 100% Maximum Continuous Rating (MCR) – 100% Natural Gas
1	Make-up Water	Max 6913kg/h
2	Pre-heated make-up water	
3	Condensate	Max 25633/h
4	Deaerator vent	Max 31kg/h
5	Deaerated water to Boiler Feedwater pump	
6	Feed water to Boiler	
11	Feedwater at Economizer (ECO 2) outlet	
12	Blow down (surface) from boiler	
13	Cooling water to blowdown tank	
14	Continuous blowdown water at cooling outlet	Max 956kg/h
15	Steam from boiler	Max 16000kg/h
16	Steam to process	
17	Steam to deaerator inlet	
19	Combustion air upstream of air fan	Max 14787kg/h
22	Flue gas recirculation upstream of Flue Gas Recirculation (FGR) fan	
24	Flue gas at burner outlet	
27	Flue gas at Economizer (ECO 1) outlet	
28	Flue gas at stack	Max 15594kg/h

2.4.6 Natural Gas Supply

Natural gas is currently supplied to the existing boiler plant, the existing standby boiler plant and to the Barrow Mill for use primarily on TM3 & TM5 along with heating (HVAC) for the Mill. Modifications to the existing natural gas supply pipework will be required to connect to the new boiler plant.

The route of the existing supply pipework will be amended slightly to feed the new boiler plant location. Two new pressure reducing stations for the natural gas supply (one for the boiler house and the other for the Mill) will be located as shown on the attached drawing - see Appendix B. The pressure reduction and monitoring stations (PRMS) will reduce the natural gas supply pressure from 2 barg to 300mbarg.

From the new PRMS for the boiler house natural gas supply pipework will be routed in a short section underground and then on an overhead pipe bridge into the LPBH. The existing section of the natural gas supply pipework which runs underground will be left in-situ. *Note due to a recent issue a temporary section of stainless steel above ground pipework has been installed to replace the existing supply system. This temporary section will be removed when the new pipework system is installed.*

The existing PRMS at the front (east) of the mill will also become redundant and be replaced by a new PRMS as shown on the attached drawing - see Appendix B. The natural gas supply will then run underground into the Mill to the TM3 & TM5 drying hoods. Minor modifications will be required at the TM3 & TM5 hoods for the new gas supply. The existing installation adjacent to the Compressor House will become redundant.

For the foreseeable future natural gas will continue to be used in the combustion systems at TM3 & TM5 as per current but natural gas usage in the boilers should reduce firstly due to the more modern and efficient new boilers and then as hydrogen becomes available and is used in preference to natural gas whenever possible.

The use of hydrogen will reduce KC's use of natural gas and is in alignment with KC's global decarbonization strategy to reduce the use of fossil fuels.

Maximum natural gas usage for the boilers will be approximately 1.6 t/h. (Based on two boilers).

2.4.7 Hydrogen Supply

Hydrogen is to be provided by a new hydrogen production facility (HPF) to be constructed on an area of land located south of the Barrow Mill. The distance from the centre of the HPF site to the LPBH on the KC site is approximately 500m. The new facility is to be

operated by a 3rd party who will supply hydrogen solely for use by KC via a dedicated pipeline.

The hydrogen will be supplied by pipeline from the HPF to a new PRMS which will be located external to the new boiler plant as shown on the attached drawing - See Appendix B. The pipeline will run adjacent to the A590.

The pressure reducing station will reduce the supply pressure from 3-6 barg to 300mbarg. The hydrogen pipework will run above ground from the PRMS and over a pipe bridge across the road into the LPBH.

Pressure and flow monitoring will be installed on the hydrogen supply pipework.

There will be no designated storage of hydrogen on the KC Barrow Mill site; the only hydrogen present on site will be in the supply pipework.

The HPF has obtained government funding for the project and the proposals obtained planning permission (Planning Ref B09/2022/0869 - Westmorland & Furness Council) in June 2023. The HPF will require a separate environmental permit (this is not the responsibility of KC). The HPF made an application (EPR/VP3128LT) for an environmental permit in February 2026.

Operation of the HPF however is not currently expected to commence until Q3 2027.

Close liaison will be required between KC and the HPF concerning the availability and supply of hydrogen for the boilers. Detailed discussions are on-going between KC and the HPF to determine the operational requirements for both facilities and to ensure appropriate co-ordination/liaison. Arrangements for the switchover from natural gas to hydrogen and vice versa are to be determined. The HPF will only be able to supply hydrogen if available and that is dependent upon the availability of the supply of green energy for the electrolysis process. There are limited hydrogen storage facilities located at the HPF. Should the supply of hydrogen need to be interrupted then switchover of the boilers to run on natural gas will be required. Similarly when a supply of hydrogen becomes available KC will want to maximise the operation of the boilers on hydrogen so transition from natural gas to hydrogen will be required.

The environmental management system for the KC site will be modified to include appropriate procedures and include liaison requirements with the HPF.

The use of hydrogen will save up to 21,800 tonnes of CO_2e per year once operational, which represents a significant saving on the paper mill's current greenhouse gas emissions. (Current emissions are estimated as 45,000 tonnes of CO_2e per year).

Maximum hydrogen usage for the boilers will be approximately 0.6 t/h. (Based on two boilers).

2.4.8 Electricity

Electricity will be provided from the existing site supply which will be modified. A new transformer for the new boiler house is to be installed and the electrical system within the LPBH & HPBH will be replaced due to its current age.

Electrical Load

Item	Rated power
Combustion air fans	3 x 75kW
Recirculation flue gas fans	3 x 15kW
Feedwater pumps	4 x 30kW
Dosing pumps	9 x 0.55kW
Softener	0.55kW
Make-up water pump at softener	2.2 kW
Boiler Power panels	3 x 90kW, 3 x 2kW
Balance of Plant (BOP) power & PLC panels	130kW, 2 x 2kW

2.4.9 Water Supply

Water for the new boiler plant will be provided from the existing potable water supply to site. Existing water supply pipework will be amended to provide a supply to the new boiler plant. Max demand for make-up water will be approximately 7 t/h. (Make-up water is also used for cooling the blowdown tank).

2.4.10 Water Treatment Chemicals

The potable water supply will need to be treated to ensure the quality of the boiler feedwater is suitable for the new boiler plant. This will be undertaken in a reverse osmosis system to produce the quality of water required in the new boiler system.

Reverse osmosis (RO) is a water purification process that uses a semi-permeable membrane to separate water molecules from other substances. RO removes dissolved or suspended chemical species as well as biological substances (principally bacteria), and is commonly used in industrial processes for water treatment.

An alternative Ion Exchange system similar to that currently used on site was considered but rejected on the basis that production of water at the required quality for the new boiler system could not be guaranteed. The purer the water provided to the boiler the fewer contaminants will build-up in the boiler ensuring efficiency and longevity of the equipment.

Water treatment chemicals (similar to those currently used on-site) will be required and these will be delivered to site by road tanker and unloaded directly into the new boiler plant and stored in bulk within the boiler house LPBH.

The main chemicals envisaged to be used are:

- Optisperse ADJ 5150 – Alkalinity builder;
- Cortrol OS5301 – Oxygen scavenger;
- Solus AP26 – Boiler scale inhibitor;
- Steamate NA0880 – Condensate treatment.

MSDS for these chemicals are available in Appendix C.

Annual usage of these chemicals is estimated below:

- Optisperse ADJ 5150 – approx. 625kg;
- Cortrol OS5301 – approx. 600kg;
- Solus AP26 – approx 230kg;
- Steamate NA0880 – approx 960kg.

Water treatment chemicals will be pumped from the bulk storage facilities as required into mixing vessels from where they will then be dosed as required.

2.4.11 Instrument Air

Instrument air will be required at the new boiler plant and will be provided from the existing site supply. Existing pipework routing will be modified to feed the new boiler plant.

The existing system has sufficient capacity available to accommodate the new boiler plant requirements (LPBH) whilst still supplying the existing boiler plant (HPBH) during the interim transition period. An existing back-up instrument air compressor will be used to ensure a supply of instrument air to the boilers in the unlikely event of loss of the mill air system. Normal usage will be approximately 150 – 200 Nm^3/h. Peak usage will be up to 280Nm^3/h during start up/shutdown of the boilers.

2.4.12 Condensate Return

Condensate will be returned from the Mill to the new boiler plant via new overground pipework as shown on the attached drawing – See Appendix B. The condensate return pipework will be thermally insulated to minimize heat loss. The route will enable easy access for inspection and identification of any leaks.

Currently condensate from the Mill is routed into an open topped vessel (atmospheric hot well) located externally. In this location heat loss is significant. Pressure is atmospheric and the temperature is < 100°C.

As part of the modifications a new condensate collection vessel is to be installed within the Barrow Mill. The new condensate vessel will enable condensate to be collected and returned to the new boiler plant under pressure and at a higher temperature.

The new system allows for pressurised condensate recovery (PCR) - 5 barg @ 140-150°C. By controlling the pressure on the condensate return lines from the processes where steam is used to above atmospheric, flash steam losses are reduced resulting in benefits such as a reduction in gas consumption, steam usage for deaerators, make-up water and boiler water chemical treatment.

Overall condensate heat and mass losses will be reduced and the condensate return system efficiency will be improved significantly leading to a reduction in water make-up and water treatment chemicals usage. Pipework modifications will be required for the condensate return system from the Mill.

2.4.13 Steam Supply

Steam will be supplied from the new boiler plant to the Barrow Mill via a new overground steam header as shown on the attached drawing - see Appendix B. The new steam header will be thermally insulated to minimize heat loss. The route will enable easy access for inspection and identification of any leaks. The new section from the LPBH will run on a pipe bridge alongside the external wall of the LPBH and across the yard before connecting into the existing ground level steam supply pipework which feeds TM3 & TM5.

Currently the steam supply pipework system from the current boilers (HPBH) to the site users is routed via a pipe trench into the Barrow Mill before being distributed to the various users.

The pipework within the pipe trench is difficult to access and inspect.

This new routing will enable the steam pipework to be inspected more easily. The existing route through a trench is currently full and has no further capacity for additional pipework. Access to the existing trench requires confined space entry control measures for inspection and repair purposes. The new routing can be accessed if necessary by scaffolding/MEWP and is considered to be easier and safer as confined space access is not required.

The existing pipework located in the trench will be removed as part of the HPBH decommissioning programme.

2.4.14 Connections to Drain

Connections to drain will be provided from the new boiler plant location for boiler blowdown.

The blowdown to open drain from the blowdown tank will be approximately 1 t/h.

There is an existing drainage system on site which is routed to the on-site ETP. New drainage connections will be made into the existing system as necessary.

2.4.15 Commissioning of New Boiler Plant

The current proposal is to install and commission the new boilers on natural gas in Q1 2027 and then when hydrogen is available to commission on hydrogen (Target Q3 2027).

The KC Barrow site is to continue to operate throughout for the production of tissue.

The existing boiler plant will operate whilst the LPBH is refurbished. This will involve the following prior to the installation of the new boilers:

- removal of old boilers,
- replacement of the reinforced autoclaved aerated concrete (RAAC) roof with a new roof,
- removal of asbestos,
- removal of redundant electrical supplies and redundant pipework etc.,
- remodelling of the internal layout of the LPBH to provide new electrical rooms and working space for the Utilities team.

Since the old boilers in the LPBH are all currently disconnected, this work can start and finish without interruption to the HPBH and therefore there will be no interruption to the current steam supply whilst the new boiler plant is installed.

The steam and condensate tie-ins into the main utility headers (steam and condensate) will need to be scheduled (provisionally during Q3 when TM5 is planned to be shutdown for routine maintenance/project work to minimize impact on site production).

Once the new boilers are ready they will be commissioned one at a time by replacing one of the existing boilers for the provision of steam to the site. Steam produced during the commissioning will be used on-site and no large scale venting of steam will be required during commissioning. There may be some short-term intermittent venting of steam

required initially to clear lines after construction and before supply to the Barrow Mill commences.

Once the steam supply from each of the new boilers has been successfully commissioned the steam supply to the site can then be switched completely from the existing boiler plant to the new boiler plant. The intention however is that the existing boilers will be retained in operational readiness for a period (currently estimated at 1-2 months) in case of problems with the new boiler plant. After this the existing boiler plant can then be designated as “no longer required” and can be decommissioned.

The local site Environment Agency inspector will be informed when this occurs so that an agreement can be reached that the regular reporting requirements for the existing boiler plant (HPBH) and emission points AB1/AB2 &AB3 can be suspended.

When the hydrogen supply is available the new boilers can then be commissioned on hydrogen one at a time. The detailed commissioning plan is to be determined but the expectation is that one new boiler will be switched to hydrogen while the other one (or two) continue to run on natural gas. Both the burner manufacturer and the boiler manufacturer are confident with this approach, i.e. the two natural gas boilers will modulate to maintain steam supply while the hydrogen boiler is started up.

It is currently envisaged that the decommissioning of the existing boiler plant (including removal of the existing 45m tall stack) will be undertaken as a separate project at a later stage. The future of the existing boiler plant building (i.e. the HPBH) and the surrounding area to the plant are currently under consideration and there is no proposed future use for this building at this time.

It is currently planned to leave the HPBH in a good state of repair (low level lighting, fire protection, no sharp edges / trip hazards).

Removal of the three existing boilers from the environmental permit will be requested at a later date. At that stage emission points to air AB1/AB2/AB3 can be removed from the permit along with all associated reporting requirements.

The change in the installed thermal capacity at the site over time is shown in the Table below.

Permit Emission Point to air reference	Current – Existing Boilers Only MWth	Interim - Both Existing & New Boilers MWth	Long Term – New Boilers Only MWth
AB1 – existing boiler	13.3	13.3	-
AB2 – existing boiler	13.3	13.3	-
AB3 – existing boiler	13.3	13.3	-
AB6 -Standby	7.32	-	-
A13 (TM3 – drying hood)	2 x 6.54	2 x 6.54	2 x 6.54
A21 (TM5 – drying hood)	2 x 6.6	2 x 6.6	2 x 6.6
AB7 – new boiler	-	10.2	10.2
AB8 – new boiler	-	10.2	10.2
AB9 – new boiler	-	10.2	10.2
TOTAL	**73.5**	**96.78**	**56.88**
➢ 50MWth	YES	YES	YES

Note – Current = existing permit V010, Interim = as a result of this variation V012, Long Term = as a result of a future variation

Timescales

The following timescales are proposed for the new boiler plant.

From Q1 (January 2027) – Installation/Commissioning of the new boiler plant on natural gas

Q3 2027 – Commissioning of the new boiler plant on hydrogen.

2.4.16 Operational Scenarios

Current – 3 existing operational boilers - operated as 2 duty/1 hot standby (pressurised and ready to run if one of duty boiler fails)/ (or undergoing maintenance). Emission points to air AB1/AB2/AB3.

Commissioning new boilers on natural gas – 1 existing boiler as duty + 1 new boiler being commissioned as duty, 1 existing boiler as standby. New discharge points for air emissions AB7/AB8/AB9.

Interim (New boilers on natural gas) – 3 new boilers – operated as 2 duty/1 standby. Existing boiler plant maintained in operational readiness in case of problems.

Commissioning new boilers on hydrogen - new boilers are to be commissioned on hydrogen one at a time whilst the others are operating on natural gas. Existing boilers on standby if not already taken out of service – to be determined.

Long Term – new boilers operational – duty/duty/standby – on natural gas/hydrogen as available. Emission points AB7/AB8/AB9. Existing boiler plant decommissioned. Emission points AB1/AB2/AB3 can then be removed from the permit.

2.5 Environmental Management Systems

The operation of the current boiler plant (HPBH) is covered by existing operational & maintenance procedures. New procedures will be generated as required for the operation of the new boiler plant in LPBH. The site environmental management system (EMS) is currently certified to ISO 14001 (see Appendix D). A summary of the existing EMS is given in Appendix D. The site is also certified to ISO 9001 – Quality Management Systems.

2.6 Monitoring

Natural gas and hydrogen usage will be monitored and recorded for the new boiler plant.

The quantities of water & water treatment chemicals used will be recorded.

The operating hours for each boiler will also be recorded.

Monitoring of emissions to air will be undertaken during commissioning. After the system has been commissioned independent 3rd party monitoring will be undertaken by an MCERTS approved contractor to verify the performance of boilers and emissions to air. Other emissions points are already monitored on-site and it is currently envisaged that the new boiler plant will be added to the existing schedule/agreement.

Monitoring points are to be installed in each stack in accordance with EN 15259 and the EA's guidance note M1. The sample points can be reached from the roof of the LPBH which will be strengthened as part of the civil scope of work, and access walkways will be provided.

3. IMPACTS

3.1 Emissions to Air (including Odour)

There will be an emission point to air resulting from each of the new boilers. These emissions to air will be at a height of 20m from individual stacks.

When firing on natural gas the emissions will be combustion gases (NOx, CO, CO_2 etc). No sulphurous compounds are present in natural gas supplies so Oxides of Sulphur (SO_X) are not considered to be present. The combustion of natural gas also does not generate emissions of dust/particulate matter.

When firing on hydrogen the emissions will be NOx, H_2O. There will be no emissions of CO or CO_2. No sulphurous compounds will be present in the hydrogen supply so Oxides of Sulphur (SO_X) are not considered to be present. The combustion of hydrogen also does not generate emissions of dust/particulate matter.

The NOx ELVs identified in the Table below have been considered for design purposes.

Substitution of hydrogen (% v/v)	**ELV – NOx mg/Nm^3**
0 – 20 %	100
>20 – 50 %	107
>50 – 75 %	115
>75 – 90 %	125
>90 – 95 %	130
>95 – 100 %	137

An Air Quality Impact Assessment has been prepared (See Appendix E) to evaluate the potential impact of emissions from the new boiler plant operations.

The combustion of natural gas and hydrogen will not lead to any odorous emissions from site. In the event of a leak of natural gas an odour will be present but any such leak can be anticipated to be detected and resolved as a matter of priority. Long-term odorous emissions are not therefore considered likely to occur from the new boiler plant operations. Hydrogen is inherently odourless.

Monitoring point locations in accordance with the EA's guidance will be installed to enable the emissions to be periodically monitored by an independent 3rd party organization with MCERTS accreditation.

3.2 Emissions to Water

Emissions to water associated with the new boiler plant operations will result from the periodic blowdown of the boiler treatment water to drain. However existing emissions from the current boiler plant will no longer be present once existing boilers are taken out of service so the overall impact is not envisaged to change from the current situation. By using RO water blowdowns should be less frequent so there should be less impact in the future. The water treatment chemicals to be used for the new boiler plant are currently envisaged to be the same as those currently used for the boiler plant water treatment facilities at Barrow.

3.3 Emissions to Land

There are no direct emissions to land associated with the operation of the new boiler plant.

3.4 Noise

Noise will be generated as a result of the operation of the new boiler plant. Mitigation measures are being included as part of the refurbishment/design of the LPBH including the inclusion of silencers in the exhaust stacks from the new boiler plant. As the new boiler plant becomes operational the existing boiler plant will no longer be used. The overall site noise profile should not increase as a result of these proposals.

A Noise Impact Assessment has been prepared (See Appendix F) to evaluate the potential impact of noise generated from the new boiler plant operations.

3.5 Waste Management

The quantities of wastes generated from the new boiler plant operations are not significant.

Wastes are not generated as a result of the combustion of natural gas or hydrogen.

Some wastes will be generated as a result of the use of water treatment chemicals and the operation of water treatment plant (chemical containers etc.) but these are envisaged as being similar in quantity to the wastes currently generated by the operation of the existing boiler plant. Overall no significant increase in the quantities of waste generated are envisaged.

All wastes generated will be sent for disposal in accordance with existing waste management procedures, The quantities to be removed are not significant.

Waste generation on-site is minimized as far as possible.

3.6 Site Condition Report Update

The new boiler plant operations are all to be undertaken within the existing permitted site installation boundary and this variation application does not involve any additional land-take.

There will be no direct emissions to ground and groundwater from the new facilities. No such discharges exist from the existing facilities.

There is no foreseen significant impact on the existing ground conditions as a result of the proposals with the majority of the installation being undertaken within an existing building.

For the purposes of supporting the planning application a site investigation was undertaken by Dunelm Associates (January 2026). The information from this investigation provides additional information for incorporation into the Site Condition Report (SCR) for the Barrow site.

Note: A ground investigation has also recently been undertaken in November 2025 for the Finished Product warehouse extension project and the findings from this investigation also provides additional information.

For the purposes of this variation application the chemicals to be used in the new boiler plant (LPBH) have been reviewed and a stage 1-3 assessment undertaken as appropriate, see Appendix G – Site Condition Report Update - for further details.

Hydrogen and natural gas have been assessed as relevant hazardous substances (RHS) but not having an actual pollution risk to ground. The usage of hydrogen, natural gas and the water treatment chemicals in the LPBH has been categorized as low risk.

An SCR was prepared in 2021 for the whole of the existing Barrow site and considered the installation and the chemicals in use at that time. Baseline ground contamination data is already available for the site including the boiler plant location. The SCR is due to be revised in 2026 in accordance with condition 3.1.4 of the permit which requires periodic monitoring to be undertaken at least once every 5 years for groundwater.

The SCR is an on-going “live” document that should be regularly reviewed and updated as required. The current version is available if requested.

3.7 Energy Efficiency

Energy efficiency/energy usage was considered during the selection of the new boiler plant. The new equipment will be significantly more efficient that the existing plant which is over 40 years old and which was originally designed for the combustion of coal. The new boiler plant has been specified to satisfy the site steam requirements with suitable installed spare capacity in the event of equipment failure to be able to maintain the site steam supply. The recovery/re-use of heat for inlet combustion air pre-heating is integral to the design along with the return/reuse of condensate.

3.8 Climate Change

There is an umbrella climate change agreement sector agreement for the paper sector – dated 14 February 2022. See Appendix H.

The site also has a Greenhouse gas emissions permit (UK-E-IN-11601 v19 (1)) that will also need to be revised as a result of the new boiler plant installation. See Appendix H.

3.9 Safety

KC operates a Safety Management of Change (SMOC) procedure which ensures that all changes are fully assessed prior to being implemented. These procedures apply to the proposed modifications and the Project team have been required to follow the procedures.

KC also has Chemical Management Procedures and COSHH procedures which govern any changes or new chemicals to be used on-site.

Both natural gas and hydrogen present a significant risk if loss of containment should occur from supply pipework to the boiler plant. However KC are already familiar with the issues and requirements of handling natural gas on-site and have appropriate systems and procedures available.

Boiler plant operation at elevated temperatures and pressures, and steam and condensate at elevated temperature and pressures also represent significant hazards.

Accordingly KC has undertaken detailed evaluation of the potential safety issues associated with the new boiler plant operation. This was based on their own knowledge along with consultants in the fields of boilers, process engineering and process safety

and understanding of the potential risks associated with boiler plant operation and the use of natural gas, steam and condensate along with the knowledge and understanding of the new boiler plant design and operation from Cannon Bono.

A detailed HAZOP was undertaken in January 2026 to identify any potential safety and/or environmental issues and to ensure that the risks were acceptable.

A preliminary study has identified that ATEX requirements are not applicable.

No hydrogen or natural gas is to be stored on-site. They are only present in the supply pipework to the boilers. Accordingly the site will operate below the relevant Hazardous Substances Consent and COMAH (Control of Major Accident Hazards) substance thresholds and no specific requirements are required.

Hydrogen is lighter than air so although highly flammable is “buoyant” and will readily disperse into the atmosphere. Accordingly hydrogen supply into the boiler house will be at a high level. Increased ventilation will also be provided at high level to vent any leaked hydrogen. The ceiling design is being considered to prevent pockets of hydrogen collecting.

Hydrogen detectors will be installed at appropriate locations.

Hydrogen awareness training will be provided to operational staff for the boilers.

4. ENVIRONMENTAL IMPACT ASSESSMENT

Hazard	Pathway	Receptor	Risk Management Techniques	Probability of Exposure	Consequence	Overall Risk (following mitigation)
Emissions to air - Odour	Airborne	Local residents	There is no odour associated with boiler plant operations and the combustion of natural gas and hydrogen. There are no sulphurous compounds present in the natural gas or hydrogen supplies in quantities likely to result in an odour from the products of combustion. No odour is envisaged as being present either inside or outside the new boiler plant.	N/A	N/A	N/A
Emissions to air - Dust	Airborne	Local residents; Nature and Conservation Sites	There will be no dust/particulate matter generated from the combustion of natural gas or hydrogen.	N/A	N/A	N/A
Emissions to air – Combustion products (NOx etc)	Airborne	Local residents; Nature and Conservation Sites	The products of combustion from natural gas and hydrogen include NOx, CO, CO_2, water vapour. These products of combustion will be discharged from individual stacks at an elevation of 20m. An Air Quality Impact Assessment has been prepared – see Appendix E. New burner systems have been specified to achieve low levels of emissions. The emissions from the new boiler plant should be reduced by comparison to those from the existing boiler plant resulting in an overall reduction in emissions and hence impact. Routine inspection, monitoring and maintenance will be undertaken to ensure equipment performance and efficiency is maintained.	Low	Nuisance/human health	Low

Hazard	Pathway	Receptor	Risk Management Techniques	Probability of Exposure	Consequence	Overall Risk (following mitigation)
Emissions to air - others	Airborne	Local residents; Nature and Conservation Sites	Steam/water will be vented to atmosphere from relief valves and as a result of routine venting. However whilst the release of steam may result in short-term noise and visually a white cloud only water will be released and this has no overall environmental impact. Releases will be minimised as far as possible and are envisaged to be similar to those which already occur as a result of the operation of the existing boiler plant. In the event of complaints concerning emissions to air from the new boiler plant, these would be dealt with in accordance with the existing complaints procedure for the site.	Low	Nuisance	Low
Noise from plant	Airborne	Local residents; Nature and Conservation Sites	Noise will be generated by the operation of the new boiler plant. However the new boiler plant will be located within the refurbished LPBH and appropriate noise mitigation is being installed to minimize the external noise that is generated. Silencers are being installed in the stacks to mitigate the noise produced. A noise impact assessment has been prepared - see Appendix F. All equipment has been designed in accordance with best practice and to ensure that noise does not present an issue to the employees and the identified sensitive receptors. The majority of potentially noisy plant will be enclosed within buildings. Plant located in outdoor areas will be acoustically enclosed and/or fitted with attenuation/silencers.	Low	Nuisance	Low

Hazard	Pathway	Receptor	Risk Management Techniques	Probability of Exposure	Consequence	Overall Risk (following mitigation)
			The site preventive maintenance plan will be revised to include the new facilities in order to maintain operational performance and control noise. In the event of noise complaints, these would be dealt with in accordance with the existing complaints procedure for the site.			
Accident - Leaks and spillages from the new Boiler plant operations	Airborne	Local residents; Nature and Conservation Sites	Spillage of water treatment chemicals within the new boiler plant could potentially cause an emission in the workplace areas. This would naturally disperse and/or be discharged to atmosphere via building extraction ventilation and discharged at roof level. Water treatment chemicals are only present in limited quantities. Limited storage facilities for water treatment chemicals are present on site. Some water treatment chemicals are potentially odorous but any emissions to air would be minimal. Any incidents on-site are recorded and investigated according to the site incident management procedures and reporting requirements of the environmental permit.	Low	Nuisance	Very Low
Accident - Leaks and spillages from the new Boiler plant operations	Migration through hardstanding surfaces	Water; ground; and groundwater	The water treatment chemicals will be used/stored inside the LPBH. In this location there is a hardstanding floor. In the LPBH the water treatment chemicals will be located in bunded facilities.	Low	Contamination	Very Low

Hazard	Pathway	Receptor	Risk Management Techniques	Probability of Exposure	Consequence	Overall Risk (following mitigation)
			In the event of a spillage occurring clean-up kits are available and would be used. Contaminated clean-up material would then be disposed of as a waste in accordance with existing site waste disposal procedures. Internal hardstanding floors are maintained in good condition and contamination of the ground/groundwater beneath the site is considered unlikely. Any incidents on-site are recorded and investigated according to the site incident management procedures and reporting requirements of the environmental permit.			
Accident - Leaks and spillages from the transport of water treatment chemicals for the boiler plant around site	Ground	Water; ground; and groundwater	Only limited quantities of water treatment chemicals are required when deliveries are received. In the event of the water treatment chemicals being released spillage could occur to ground and/or enter a local surface water drain and be discharged off-site. In the event of a spillage local drains would be isolated and spillage contained to minimise the off-site impact. It would then be removed for off-site disposal in accordance with existing waste disposal procedures.	Low	Contamination	Very Low
Emissions to controlled waters – Process effluent	Drainage	Water	Discharge to drain of blowdown from the boiler water circuit will occur on a continuous basis. This will be directed into the existing site process drainage system which is routed to the on-site ETP. In the ETP the discharges are mixed with effluent from the paper processing facilities and surface water from site prior to treatment before final discharge off-site into the Walney Channel.	Low	Contamination	Very Low

Hazard	Pathway	Receptor	Risk Management Techniques	Probability of Exposure	Consequence	Overall Risk (following mitigation)
			The quantities of water to be discharged from the new boiler plant are envisaged as being less than currently discharged from the existing boiler plant due to the improvements in the design, efficiency, improved condensate return/re-use etc. The existing ETP has significant storage and processing capacity having previously been designed for when the site had additional operational paper mills.			
Litter / Waste	Blown by the wind	Local residents; Nature and Conservation Sites	Good housekeeping procedures will be implemented indoors around the new boiler plant (LPBH). All waste generated is stored and disposed of following the existing site waste management procedures.	Low	Contamination	Very Low
Waste	Ground	Water; ground; and groundwater	The operation of the new boiler plant will not generate significant quantities of waste for disposal. Other wastes will be generated from periodic maintenance activities and cleaning. The types of waste and quantities generated are envisaged as being similar to those currently generated from existing boiler plant operations. All waste generated will be stored and disposed of following the existing site waste management procedures.	Low	Contamination	Very Low

Hazard	Pathway	Receptor	Risk Management Techniques	Probability of Exposure	Consequence	Overall Risk (following mitigation)
Pests	Airborne; ground	Local residents	Pests are not likely to be a problem on-site due to the new boiler plant operations and the lack of food/organic wastes generated and stored on-site. A pest prevention plan has been implemented on-site as part of food safety requirements.	Low	Nuisance; Contamination	Very Low
Arson / Vandalism – contaminated firewater, smoke	Water run-off through drainage; airborne	Local residents; Nature and Conservation Sites	The site is in operation and manned 24/7, with CCTV systems installed across several areas. Unauthorised access is prohibited onsite and controlled access is enforced. A fire risk assessment has been undertaken for the wider area occupied by the site. Preventive and control actions have been implemented accordingly.	Low	Nuisance; contamination	Very Low
Operator error	Air / water / ground	Local residents; Nature and Conservation Sites	Processing activities carried out within the site are well understood and controlled. The potential for operator error exists but training, documentation, supervision should mitigate the potential for this to occur. All operational staff are periodically trained/re-trained on the site operating procedures. All incidents are recorded and investigated appropriately according to the site incident procedure.	Low	Nuisance; contamination	Very Low

5. BAT JUSTIFICATION

Activities in the pulp, paper & board sector, and hence the KC operations are covered by the following document:

2014/687/EU – BAT -Conclusions for the production of pulp, paper and board.

For the purposes of this variation the BAT-C requirements have been reviewed in order to ensure that following the modifications compliance will be achieved and that any specific requirements for new plant have been addressed during the design process/specification of the new equipment/facilities.

As this variation is for the installation of new boiler plant and the remainder of the Mill operations (tissue manufacture, converting, operation of the onsite effluent treatment plant etc.) will continue as per the existing arrangements only those BAT-C requirements relevant to the boiler plant project have been considered – see Appendix I.

This assessment concludes that due to the proposed modification (Installation of a new boiler plant) KC's operations at Barrow will continue to meet the relevant BAT-Conclusions requirements.

Overall the provision of new boiler plant to satisfy the existing site steam requirements is considered to represent BAT for the installation.