TEST PROGRAMME PROPOSAL

FOR THE CO-FIRING OF

MEAT AND BONE MEAL

AT

IRISH CEMENT LIMERICK WORKS

P0029-06

March 2024

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1. PROPOSAL

In accordance with Condition 6.3 Co-incineration – Test Programme of IE Licence P0029-06, please find attached details of the Test Programme Proposed for the co-incineration of Meat and Bone Meal (MBM), also known as animal-tissue waste LoW Code 02 01 02 at Irish Cement Limited (ICL), Limerick Works. The objective of the proposed test programme is to demonstrate full compliance with the IE licence and test programme conditions for the use of MBM; thereby allowing ICL Limerick Works to reduce the greenhouse gas emissions from its facility and its dependence on imported fossil fuels.

ICL is seeking approval from the Agency for a time duration of up to 8 months to complete the proposed test programme to facilitate its strategy of a deliberate orderly ramp up in MBM substitution rates to ensure the delivery of its dual objectives, namely (i) assuring environmental emissions compliance with the IE licence and test programme conditions; and (ii) ensuring product quality consistency and compliance with applicable product quality standards. The increase in the substitution rate of MBM will not compromise the ability of Irish Cement to adhere to these dual operating objectives.

The primary advantages of using MBM in the cement manufacturing process are:

1. Complete recovery of the energy value of the material due to the efficiency of the combustion process in the cement kilns
2. Reduction in CO2 emission due to the fuels lower carbon intensity
3. Reduction in the dependency on imported fossil fuels. The use of MBM will contribute to improving Irelands energy security by the phasing out of traditional fossil fuels in energy generation of heat.
4. No residual wastes are produced from the cement manufacturing process.
5. Complete destruction of the fuels due to the high temperatures, long residence times and high thermal inertia (i.e. retention of heat for a period even after the fuel supply is switched off) and full compliance with condition 3.19 of P0029-06 requirements.
6. Contribution to Ireland's national and international regulatory obligations:
    a. Provides the most efficient energy recovery option without the need to export
    b. Assists in meeting greenhouse gas reduction obligations
7. Reduction in global transport effects by indigenously sourcing fuel supply.
8. Development of jobs in Irish companies producing and supplying MBM

The Kiln 6 system is ideally suited to achieve additional greenhouse reductions with the introduction of alternative fuels. It is proposed to replace a proportion of the traditional fossil fuels used to fire the kiln with MBM. The following sections outline details of how the proposed test programme will, at a minimum, comply with the relevant clauses of the IE licence.

Irish Cement manufactures and supplies cement products which comply with EN 197-1, the harmonised European cement standard, and operates its cement facility at Limerick Works in compliance with the IE licence issued from the Environmental Protection Agency (EPA) to comply with relevant environmental legislation.

The introduction of MBM will not compromise the ability of Irish Cement to adhere to these dual operating objectives – complying with the environmental requirements of our operating licences whilst meeting the customer product quality requirements.

2. TEST PROGRAMME REQUIREMENTS

At Irish Cement, MBM will be phased in over a period of time in a controlled manner. It is envisaged that this test programme will encompass the ramp up of MBM substitution over a period of approximately 8 months as per Condition 6.3.4 (1 - 5) Co Incineration – Requirements of Test Programme. The target of the test programme is to gradually increase the use of MBM every month in a controlled manner so as to demonstrate compliance with the conditions of this test programme at each stage. A maximum MBM t/h limit will be in place every month to ensure there is an additional control to the fuel being added to the kiln along with the fuel control loop. Additionally, the MBM system will not be operated above its rating and therefore the test programme will test to this maximum t/h limit of 5 t/h. In order to show sufficient operation time at each addition rate, a minimum of 5 24 hour periods of each t/h rate will be carried out. This is to provide the agency with sufficient data for each stage of the addition rate ramp up. Each stage of the MBM addition rate will comply with the conditions of this test programme along with the conditions of the IE Licence.

> ***6.3.4 The test programme shall as a minimum:***
> *(1) Verify the residence time, the minimum temperature and the oxygen content of the exhaust gas which will be achieved during normal operation and under the most unfavourable operating conditions anticipated.*
> *(2) Establish all criteria for operation, control and management of the abatement equipment to ensure compliance with the emission limit values specified in this licence.*
> *(3) Assess the performance of any monitors on the abatement system and establish a maintenance and calibration programme for each monitor.*
> *(4) Establish criteria for the control of all waste input; and*
> *(5) Confirm that all measurement equipment or devices (including thermocouples) used for the purpose of establishing compliance with this licence have been subjected, in situ, to normal operating temperatures to prove their operation under such conditions.*

> ***Condition 6.3.4.1: Verification of the Control Parameters***
> "*Verify the residence time, the minimum temperature and the oxygen content of the exhaust gas which will be achieved during normal operation and under the most unfavourable operating conditions anticipated*."

Limerick Works will comply with EU Directive 2000/76/EC, referred to as the Industrial Emissions Directive (IED). The principal operating conditions established in the IED are that material must be processed within the system for at least 2 seconds (residence time) at 850°C (temperature).

In the main burner, the flame temperature exceeds 2000°C (as shown on the diagram in Appendix I). This high temperature is necessary to ensure that the raw materials reach temperatures of 1450°C in order to form clinker, the primary ingredient in the production of cement. The stability of the kiln burner flame is monitored using the burning zone temperature along with the preheater tower temperature probes and preheater tower exit analyser to ensure correct conditions are maintained for clinker formation. The oxygen content of the kiln gas is controlled and is verified by changes in gas

concentration observed at the Preheater Exit Analyser (644XQ02) and the Secondary Analyser (644XQ06). The locations of the monitoring points are indicated on the schematic shown in Appendix I.

In order to verify the residence time, a range of scenarios were modelled to simulate expected operating conditions. The original equipment designer and manufacturer of Kiln 6, FLSmidth, were employed to model this data. A copy of the FLSmidth memo is provided for reference in Appendix II. The calculations indicate that the minimum gas residence time under even the worst-case scenario is 6.64 seconds. The table below summarises the residence time when operating at a minimum temperature of 855°C:

Scenario	Main Burner Fuel Mix	Back End Fuel Mix	Back End Residence Time (s)	Residence Time from Main Burner (s)	Total Residence Time
1	80% Pet Coke	20% Pet Coke	3.77	3.42	7.19
2	5% MBM+20% SRF +55% Pet Coke	20% Pet Coke	3.70	3.32	7.02
3	15% MBM+20% SRF+45% Pet Coke	20% Pet Coke	3.69	3.30	6.99
4*	40% MBM+40% SRF	20% SRF	3.56	3.08	6.64

Table 1: Summary for Operating Scenarios as modelled by FLSmidth

**Scenario 4 is to show the worst-case scenario*

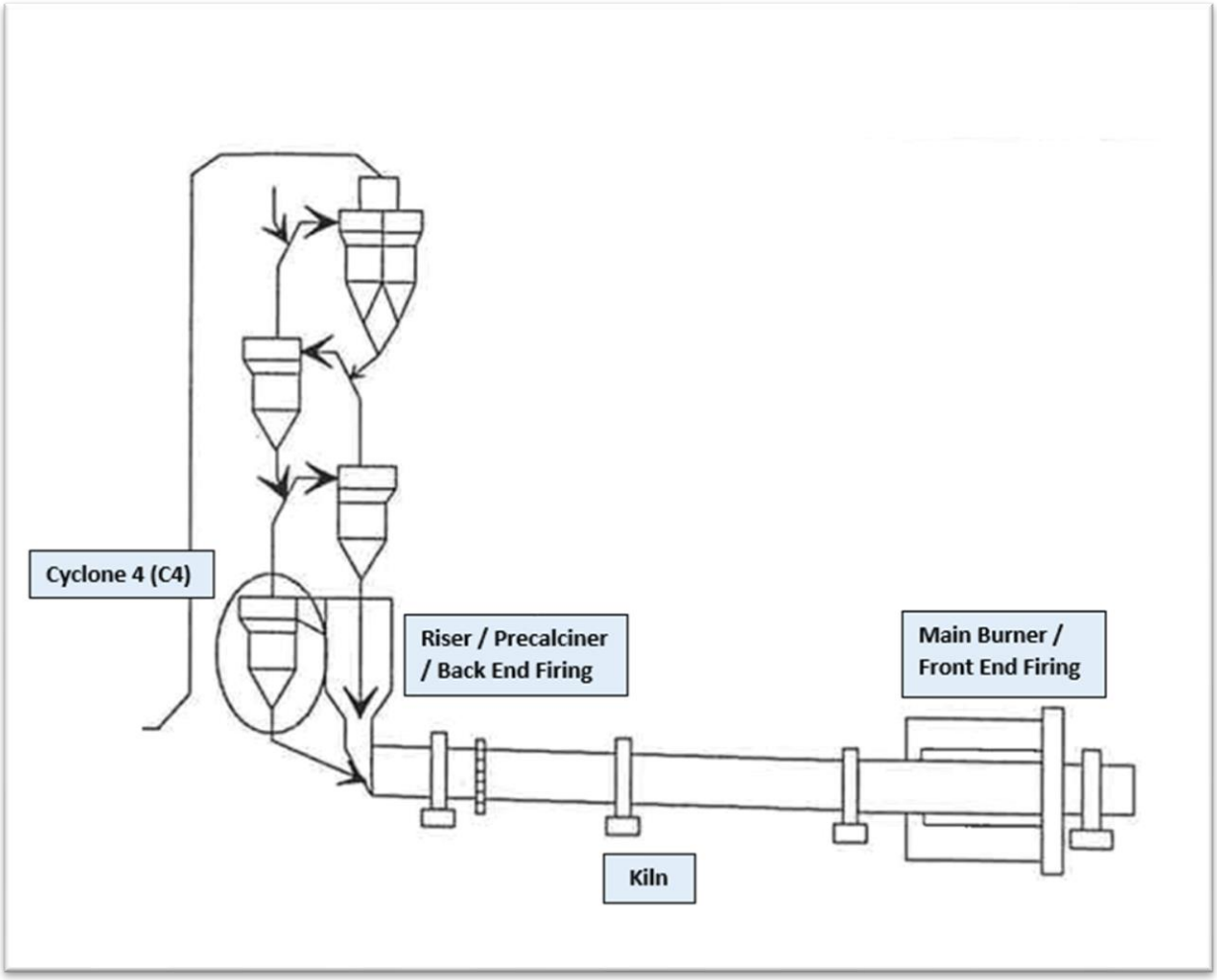


Figure 1: Schematic of Kiln 6 process

Condition 6.3.4.2: Abatement Equipment Operation

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

Emission abatement is an integral part of the cement manufacturing process. The Kiln 6 investment includes the Best Available Technology (BAT) fabric filters and ensures that Limerick can abate emissions to BAT emission levels. Limerick also installed a Selective Non-Catalytic Reduction (SNCR) for NOx abatement and has lime injection for SOx abatement.

Limerick Works installed an FLS Fabric Filter for Kiln 6 in 2010 for the abatement of particulates. Limerick Works will continue to monitor the performance of the bag filter using the differential pressure monitor installed and the PCME QAL 181 dust monitor on the Kiln 6 stack to ensure continued compliance with the Emission Limit Values for particulate emissions.

The NOx abatement equipment installed on Kiln 6 is primarily ABC&I Selective Non-Catalytic Reduction (SNCR) technology. The SNCR technology was commissioned in a test programme and was commissioned in 2007. Limerick Works will continue to monitor the performance of the SNCR abatement system and the ABB ACF5000 Continuous NOx Analyser in the Kiln 6 Stack to ensure compliance with the Emission Limit Value. Two ACF5000 analysers will be in operation (one as a standby), and both will operate in compliance with EN 14181.

In 2021 Limerick Works commissioned a lime injection system for the abatement of SO_2. A high-quality lime powder is injected into the kiln gas stream before the gas enters the cooling tower to reduce emissions of SO_2. Hydrated lime is used to neutralise the acidic gases and remove sulphur dioxide from flue gases.

Limerick Works dedicate significant time and resources to ensure the continued management of the abatement systems. The operation and performance of these systems are monitored on an ongoing basis. In addition, emission values are assessed on a daily basis using data from the data acquisition and handling system (DAHS) at Limerick Works. This practice will continue going forward as per the relevant schedule under IEL P0029-06.

Standard Operating Procedures for the abatement system, including operating with the co-firing of MBM, form part of Limerick's controlled documented procedures. These procedures will be revised as necessary during the commissioning and ramp up phase for MBM over the 8-month test period. Full copies of these procedures are available to the Agency upon request.

Condition 6.3.4.3: Performance of Abatement Systems

The test programme shall as a minimum:

Assess the performance of any monitors on the abatement system and establish a maintenance and calibration programme for each monitor.

As required under the Industrial Emissions Directive (IED), Limerick Works will comply with the requirements of the International Standard EN 14181:2004 "Stationary Source Emissions – Quality Assurance of Automated Measuring Systems". This requires Quality Assurance Levels (QALs) and an additional annual surveillance test (AST) be carried out on each continuous emissions measuring system (CEMS). Two ABB ACF5000 analysers are in place for continuous monitoring (one as a standby). Both analysers will be subject to QAL 2 testing when burning MBM. Limerick Works will carry out the QAL2 and ongoing QAL3 tests for both analysers during the 8-month test programme for MBM in accordance with the "Air Guidance Note on the Implementation of I.S. EN 14181 (AG3)" issued by the EPA and to meet the requirements of Condition 4.1.3 of IE Licence P0029-06. The results of the tests will be included in the test programme report to the Agency. The monitors for Kiln 6 combustion gases listed in table 2 below will be included in the programme for the QALs and the AST thereafter:

Operating Parameter	Measurement Device	Manufacturer	Instrument ID
Stack Temperature	Temperature Probe	DURAG	64201
Stack Pressure	Pressure Probe	ABB	644XP25
Stack Sulphur Dioxide	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482
Stack Nitrogen Dioxide	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482
Stack Carbon Monoxide	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482
Stack Exhaust Volume	Gas Flowmeter	DURAG	64406
Stack Humidity	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482
Stack Oxygen	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482
Stack Carbon Dioxide	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482
Stack Hydrogen Chloride	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482
Stack Hydrogen Flouride	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482
Stack Total Organic Carbon	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482
Stack Total Dust	Online Particulates Monitor	PCME	64407

Table 2: List of Monitors to meet requirements of I.S. EN 14181

In addition, an internal maintenance and calibration programme is indicated for the Kiln 6 monitors listed in table 3 below. The detailed programme and schedule as above are included in Appendix III.

Operating Parameter	Measurement Device	Manufacturer	Instrument ID
C4 Temperature	Temperature Probe	ITS	64104
BZT Temperature	Temperature Probe	Siemens	64201
Stack Temperature	Temperature Probe	DURAG	64485
Stack Pressure	Pressure Probe	ABB	644XP25
Stack Sulphur Dioxide	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482
Stack Nitrogen Dioxide	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482
Stack Carbon Monoxide	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482
Stack Exhaust Volume	Gas Flowmeter	DURAG	64406
Stack Humidity	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482
Stack Oxygen	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482
Stack Carbon Dioxide	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482
Stack Hydrogen Chloride	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482
Stack Hydrogen Flouride	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482
Stack Total Organic Carbon	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482
Stack Total Dust	Online Particulates Monitor	PCME	64407

Table 3: List of Monitors included in the monitoring and calibration programme

Condition 6.3.4.4: Control of MBM Input

"Establish criteria for the control of all waste input"

Kiln control systems are designed to monitor and control a range of variables to produce stable operating conditions. These controls allow for the increase or decrease of fuel or raw meal inputs as required. Under normal operating conditions alternative fuels are the final input to be added once stable kiln operation has been established. For all shutdowns the alternative fuels will be the first input to be stopped. The high thermal inertia or heat load of the kiln system means that even after the kiln is 'shut-down' the system maintains temperature for an extended period of time and all fuel will be fully combusted.

The fuel injection to the kiln is controlled to maintain a stable temperature and constant specific heat consumption. The alternative fuel injection is interlocked with the temperature in the fuel burning zone to maintain a minimum temperature of 855°C. (A detailed description of the control interlock is provided under clause 3.19.6.2 below). Fossil fuel (coal or pet coke) will remain the primary control fuel for the kiln to maintain this temperature (855°C). The control loop will regulate the balance of fossil fuel, SRF and MBM injection to the kiln to ensure constant specific heat consumption. A minimum input of fossil fuel will be maintained at all times. The alternative fuel injection is interlocked with the temperature to maintain a minimum temperature of 855°C. The MBM will be incrementally increased throughout the test program. A maximum setpoint for MBM injection will also be interlocked at each stage so as to limit the MBM maximum tonnes/hour which can be fired into the kiln. Control of the temperature is ensured by control of the gas analysis at the Preheater Exit Analyser (644XQ02) and Secondary Analyser (644XQ06). The kiln camera and Burning Zone Temperature (pyrometer) provides further temperature information.

The maximum calorific value of the fuel input, including MBM, will be established by controlling the temperature in the fuel burning zones. These temperatures are used in control system interlocks to limit the maximum flow of MBM. A copy of the control logic and evidence of the limits on MBM will be provided in the test programme report to the Agency.

Condition 6.3.4.5: Measurement Devices

"Confirm that all measurement equipment or devices (including thermocouples) used for the purpose of establishing compliance with this licence have been subjected, in situ, to normal operating temperatures to prove their operation under such conditions."

All measurement equipment devices, including thermocouples, installed are specified with accuracy in accordance with the International Standard for a Type K Thermocouple. Independent temperature and pressure measurements will be taken to verify that measurement devices are reading correctly.

In addition, a number of further requirements under the IE licence P0029-06 will be addressed as part of this test programme below.

3. CO-INCINERATION – OPERATIONAL CONTROLS

The following sub-sections address how full compliance with the relevant parts of Clause 3.19 of IE licence P0029-06 will be demonstrated during the proposed test programme period.

3.1 Standard Operating Procedures

Condition 3.19.1:

The licensee shall maintain standard operating procedures for the operation of the co-incineration plant.

Standard Operating Procedures for kiln operation, including operating with the co-firing of MBM, form part of Limerick's controlled documented procedures. These procedures will be revised as necessary during the commissioning and ramp up phase for MBM over the 8-month test period. Full copies of these procedures will be available to the Agency upon request.

3.2 Co-incineration

Condition 3.19.2:

The installation, when co-incinerating waste, shall be operated in such a way that the gas resulting from the process is raised, after the last injection of combustion air, in a controlled and homogeneous fashion and even under the most unfavourable conditions, to a temperature of 850°C, as measured near the inner wall or at another representative point of the combustion chamber as may be authorised by the Agency, for two seconds.

Condition 3.19.3:

Waste shall be charged into the plant only when these operating conditions are being complied with and when the emission limit values which are subject to continuous monitoring are not being exceeded.

The MBM fuel injection will be interlocked with the temperature in the fuel burning zone to ensure stable specific heat consumption in the kiln. The minimum residence time and temperature required to burn alternative fuels is 2 seconds and 850°C respectively. Injection of MBM will only be possible if the temperature is in excess of 855°C. This will be controlled automatically by means of a control system interlock.

MBM will not be used as a start-up fuel and use in the kiln will not be possible until the kiln is no longer in start up or shut down mode and interlocks will be in place to ensure this. MBM cannot be fired until the kiln temperatures have reached the interlocked temperature limit of 855°C for the co-firing of MBM.

Furthermore, injection of MBM will not be possible unless the emission limit values, which are subject to continuous monitoring, are not being exceeded. Interlocks are in place within the control system

to stop the kiln before any emission limit value is exceeded. The MBM will be stopped automatically when the kiln stops.

3.3 Provision for Auxiliary firing

Condition 3.19.4:

The burner and kiln shall be equipped with at least one auxiliary burner. The auxiliary burner shall be switched on automatically when the temperature of the combustion gases after the last injection of combustion air falls below 850°C. The auxiliary burners shall also be used during plant start-up and shut-down operations in order to ensure the temperature of >850°C is maintained at all times during the co-incineration of waste and as long as there is unburned waste in the combustion chamber.

Introduction and continued firing of alternative fuels into the kiln process will be interlocked with stable process conditions and as such can only occur when the following conditions exist:

- Pet coke (or Coal) is being fed to the Kiln
- Raw meal is being fed to the Kiln system
- A minimum temperature of 855°C

During the start-up sequence the use of MBM will not be permitted until the same conditions specified above, as a minimum, have been achieved. MBM will not be used as a start-up fuel and interlocks will be in place to ensure this.
In effect, the kiln system will only be started up and stable operation established using Diesel Oil, Pet coke or Coal as the fuel input. Only when the kiln is in normal production mode (i.e. out of start-up and/or shut down mode and temperature >855°C) will MBM be introduced. As the volume of alternative fuels increases, the volume of fossil fuels can be gradually reduced, maintaining stable plant operation at all times. The fuel input in the Kiln is a function of both clinker quality and achieving the correct quality targets for product optimisation. This will be achieved by means of a fuel control loop.

MBM injection will stop automatically should the kiln become unstable, the temperature in the fuel burning zone is below 855°C or the kiln stops. This will be controlled by means of a control system interlock. Should the kiln stop, whether it be planned or unplanned, MBM will automatically be shut off immediately.

3.4 Start-Up and Shut-Down Scenarios

Condition 3.19.5:

During start up or shut down or when the temperature of the combustion gas falls below 850°C, the auxiliary burner shall be fed with coal, oil or gas.

Condition 3.19.6:

The licensee shall maintain and operate an automatic system to prevent waste feed:

3.19.6.1 at start-up, until a temperature of ≥850°C has been reached;

3.19.6.2 whenever the temperature falls below 850°C;

3.19.6.3 whenever the continuous measurements show that any emission limit value is exceeded;

3.19.6.4 whenever stoppages, disturbances or failure of the purification devices or the measurement devices may result in the exceedance of the emission limit values; or

3.19.6.5 in the case of a breakdown or incident.

As described above, the introduction and continued firing of MBM will be interlocked with stable process conditions and a minimum temperature of 855°C maintained. For all shutdowns or other kiln stops, the alternative fuels will be the first input to be stopped. The high thermal inertia or heat load of the kiln system means that even after the kiln is 'shut-down' the system maintains temperature for an extended period of time and all fuel will be fully combusted. Additionally in the event of a kiln stop, MBM injection will automatically stop. This will be controlled by means of a control system interlock.

Furthermore, injection of MBM will not be possible unless the emission limit values are not being exceeded. A control system interlock will be implemented to ensure these conditions are met. ICL has put in place safety measures and interlocking systems which will result in the Kiln being automatically shut down prior to the exceeding the ELV.

Emission limit values are monitored on a daily and half hourly basis. In the event of the parameter that is continuously monitored approaching the ELV, the MBM firing is stopped. Prior to a breach of the ELV, the kiln is stopped at a point below the relevant ELV so as not to breach the ELV. This takes place automatically. As per licence P0029-06, schedule C.1.1 lists the parameters that have 24-hour limits (NOx, SOx, Dust, TOC, CO, NH3, HCl, HF). There are also ½ hour average limits for these parameters. In addition, an automatic interlock for ½ hour average limits is present such that the kiln is stopped at a point below the relevant ELV so as not to breach the ELV. This is also true for MBM firing. From a programming point of view technically MBM can be re-started when either the half hourly or daily average drops below the automatic stop points. However, in practice MBM would not be re-started until the emission trend is understood by the production team.

Condition 3.19.7:

There shall be no bypass of any electrostatic precipitator and/or bag filter

All gas flow leaving the preheater tower is taken through the cooling tower and a bag filter by a fan before it can leave the kiln system through the kiln stack, which is monitored continuously by an ABB ACF5000, particulates monitor, gas flowrate monitor and also for temperature and pressure. There are no facilities in place to allow for the bag filter to be bypassed and the kiln cannot operate unless it complies with the licenced ELV for particulates and all other licensed parameters at the kiln stack.

4. ADDITIONAL REQUIREMENTS RELATING TO MBM

The following sub-sections address how full compliance with other relevant Clauses of IE licence P0029-06 will be demonstrated during the proposed test programme period.

4.1 Spillage and Containment

Condition 3.11:

Prior to the acceptance of waste at the installation, the licensee shall provide dedicated unloading and, where appropriate, storage areas

All alternative fuels used on site will be sourced from pre-approved suppliers. All safety, environmental and unloading procedures will be agreed and discussed with the supplier prior to coming to site. A dedicated unloading area will be in place adjacent to the storage facilities for the MBM. Each area will be clearly marked and will be communicated with the MBM suppliers.

4.2 Continuous Operational Parameter Monitoring

Condition 6.4:

The licensee shall ensure that the following operating parameters are continuously monitored and recorded when co-incinerating waste:

(i) the temperature near the inner wall of the combustion chamber (or other representative location agreed by the Agency);

(ii) the exhaust gas oxygen concentration;

(iii) the exhaust gas temperature;

(iv) the exhaust gas pressure; and

(v) if the gases are not dried prior to analysis, the exhaust gas water vapour content.

Continuous monitoring of the temperature and the oxygen content, as well as temperature, pressure and humidity of the exhaust gas in the kiln 6 stack will be implemented. These values are automatically

transferred to the Siemens Process Control System (PCS7). Thereafter the data is transferred and recorded on the data acquisition and handling system (DAHS).

4.3 Dust and Odour

Condition 6.18.5:

The licensee shall within one month of acceptance of each individual or combination of waste as the installation, undertake an odour assessment in accordance with the EPA guidance. An odour impact assessment shall thereafter be undertaken at a frequency to be approved by the agency and in any case no less than annually. The assessment shall be undertaken by the appropriate qualified professional and shall identify and quantify all significant odour sources at the installation, in particular the waste storage buildings and hardstanding areas, and shall include an assessment of the suitability and adequacy of the odour control system. Recommendations for improvement arising from the odour impact assessment shall be implemented.

An odour assessment will be carried out by an approved contractor during the test programme and will include all MBM buildings including offloading, storage and transport.

4.4 Materials Handling

Condition 8.9:

No waste imported from outside Ireland shall be accepted for co-incineration at the installation

Only alternative fuels sourced from the Republic of Ireland will be used in Irish Cement Limerick.

Condition 8.10:

All meat and bone meal accepted for co-incineration shall be passed through a 20mm screen prior to entering the meat and bone meal silos. Oversize material shall be temporarily stored and dispatched to an appropriate facility.

All alternative fuels accepted into site will be from a pre-approved supplier where specifications for the fuel will have been agreed in advance. This will include the particle size of the material. These specifications are required for the final product and therefore the material arriving to the site will comply with the above condition as a minimum. Regular testing will be carried out on the fuel to ensure that all agreed specifications have been complied with.

Condition 8.11:

No waste that contains more than 1% halogenated organic compounds, expressed as chlorine, shall be accepted for co-incineration, or otherwise introduced to the kiln

All alternative fuels accepted into site will be from a pre-approved supplier where specifications for the fuel's chlorine, moisture and NCV, as a minimum, will have been agreed. When agreeing specification with suppliers, ICL will take note of this condition.
Regular testing will be carried out on the fuel to ensure that all agreed specifications have been complied with.

4.5 Acceptance of Waste

Condition 8.12:
No waste other than the List of Waste codes listed in Schedule A: Limitations of this licence shall be accepted at the installation

This test programme is for the use of MBM. No other alternative fuels other than those listed in licence P0029-06 in Schedule A and until the test programmes have been agreed with the agency will be accepted to site.

Condition 8.13:
The acceptance of waste at the installation for co-incineration shall be for the purposes of:
- *Waste fuels with significant calorific value;*
- *Waste materials without significant calorific values but with mineral components used as raw materials that contribute to the intermediate product clinker; and*
- *Waste materials that have both a significant calorific value and mineral components*

All alternative fuels accepted into site will be from a pre-approved supplier where specifications for the fuel's chlorine, moisture and NCV, at a minimum, will have been agreed.
Regular testing will be carried out on the fuel to ensure that all agreed specifications have been complied with.

Condition 8.14.1:
Waste accepted at the installation shall be subject to a technical specification agreed between the licensee and the supplier. The technical specification shall set out criteria to be met in order that combustion or use of the material will not lead to failure to comply with the conditions of this licence. The technical specification shall have regard to any published or, as appropriate, Irish or international standard relevant to the supply of that material and any departure from such a standard shall be approved by the Agency. The technical specification shall conform to relevant best available techniques in Commission Implementation Decision 2013/163/EU for the production of cement, lime and magnesium oxide.

All alternative fuels accepted into site will be from a pre-approved supplier where technical specifications for the fuel's will have been agreed. This will include at a minimum chlorine, moisture and NCV. MBM will only be accepted to site once it complies with these specifications from the

Regular testing will be carried out on the fuel to ensure that all agreed specifications have been complied with. Continuous quality checks will also be carried out during the cement manufacturing process as well as on the final cement product to ensure that all standards are continued to be complied with when using alternative fuels.

Condition 8.14.2:

The quantity of waste to accepted at the installation on a daily basis shall not exceed the storage capacity available.

Only waste which can be stored in the purpose-built storage areas will be accepted to site. No other location on site will be permitted to store the material.

Condition 8.14.3:

The licensee shall maintain a record of the quantity of each waste type co-incinerated at the installation, introduced into the kiln or otherwise used in the manufacture of cement.

All material accepted to site will be weighed over calibrated and certified weigh bridges and recorded on the material data base.
Any material used in the kiln will be recorded on a weighted basis and will be recorded on the data acquisition and handling system (DAHS).

Condition 8.14.4:

Waste shall only be accepted at the installation from known suppliers or new suppliers subject to initial waste profiling, analysis, characterisation off site and demonstration of compliance with the technical specification

Commercial contracts for the supply of these fuels to defined specifications will be adjudicated through the Irish Cement ISO 9001 quality control system in a similar manner to the supply of other raw materials or fossil fuels. The contracts will require that all suppliers' material must conform to the agreed specifications and are produced in compliance with the relevant environmental requirements. A pre-determined programme of testing will also be a condition of the contract. Sampling and testing will be performed by both the supplier and Irish Cement (or an approved contractor on behalf of Irish Cement).
Details of each fuel will be entered into the site material database and full safety reviews and risk assessments will be performed in accordance with standard materials handling procedures. Characterisation of the fuels will be carried out over a period of time to ensure that all parameters are in compliance with the Irish Cement fuel specification.
Prior to acceptance of any MBM on site, Irish Cement will commission independent analysis of the sample in an ISO 17025 laboratory to ensure that it meets the technical specification for MBM. In addition, the MBM will be tested for trace elements and heavy metals to ensure that the conditions of the IE licence can be complied with when using of the material.

Condition 8.14.5:

Alternative fuel shall only be accepted if delivered in appropriate sealed, leakproof, covered containers

All deliveries will be scheduled in advance and will only be permitted on site in sealed, covered containers.

Condition 8.14.6:

Prior to commencement of the acceptance of each waste at the installation, the licensee shall establish and maintain detailed written procedures for the acceptance and handling of each. These procedures shall at least include the following:

a) inspection and sampling at the point of entry to the installation;
b) criteria to be met prior to acceptance;
c) rejection criteria and procedures;
d) material characterisation and profiling s from known customers or new customers prior to acceptance at the installation;
e) frequency of technical testing and analysis and methods to be employed by the licensee to demonstrate compliance with the technical specification;
f) recording of each load of material on arrival at the installation in accordance with Condition 1 1.10 of this licence;
g) handling procedures including unloading, transfer and cleaning of all plant.

The requirements necessary for acceptance of the fuel deliveries are as follows:

- Confirmation of conformity to the fuel specification will be provided by the supplier for all fuel supplied. This will be a requirement of the supply contract in place between Irish Cement and the selected supplier. This confirmation will declare that the material delivered meets the supply specification as contracted.
- Each delivery must be made by an approved driver. All drivers will be provided with appropriate safety training which will be refreshed on a regular basis. Each qualifying driver will be issued with a unique identification card. This identification card must be presented before the delivery will be permitted entry to the site. Deliveries of other externally sourced raw materials are controlled in ICL Limerick using this system at present.
- On arrival at the Irish Cement entrance, all deliveries will be verified by the automated delivery acceptance system. For all deliveries, suppliers must provide a valid certificate of conformity.
- Characterisation of the fuel will commence before any individual delivery reaches the site and will continue during the full extent of the contract with the supplier. The process will involve a number of site visits and random independently verified samples. Initially it is expected that more frequent monitoring will be practiced. The frequency of the sampling and testing will decrease as compatibility with the supply specification is demonstrated. Attempts to deliver incompatible material will result in a reversion to more frequent and onerous sampling and

testing. The characterisation of the fuel exercise to be completed by Irish Cement will determine the required sampling procedures.

- Sampling/visual inspection will be carried out as determined by the characterisation exercise. Supplier specific composite samples will be used for invigilation of the supplied fuels to the supply specifications. Testing of the samples can be carried out both in the internal Irish Cement laboratories and also at off-site accredited laboratories.

Subject to all of the foregoing steps being in order, unloading of the material will be commence and the offloading will be visually monitored using CCTV.
Detailed Material acceptance procedures for MBM in Limerick Works will be available for inspection by the Agency upon request.

Condition 8.14.7:

Waste arriving at the installation shall have its documentation checked at the point of entry to the installation and, subject to this verification, weighed, recorded and directed to the appropriate storage area or quarantine area as appropriate.

Each delivery must be made by an approved driver. All drivers will be provided with appropriate safety training which will be refreshed in line with site safety policy. Each qualifying driver will be issued with a unique identification card. This identification card must be presented before the delivery will be permitted entry to the site. Deliveries of other externally sourced raw materials are controlled in ICL Limerick using this system at present. Instructions will be provided to drivers as to the appropriate unloading location on site.

All deliveries will be scheduled in advance. Detailed delivery plans will be established with all suppliers in advance of arrival onsite. Vehicle and driver details along with supplier information will be entered into the automated delivery acceptance system. Individual driver identification tags will be provided. All hauliers delivering alternative fuels to site will be given full training in accordance with the CRH Code of Practice for Hauliers, as occurs for hauliers of other materials currently.

Condition 8.14.8:

Any waste deemed unsuitable for processing at the installation or in contravention of this licence or the technical specification shall be immediately separated and returned to the location supply within 48 hours or a longer time period as may be agreed by the Agency due to weekend and bank/public holiday closures. Secure storage of such waste shall be provided in a dedicated waste quarantine area. Waste stored in the quarantine area shall be stored under appropriate conditions to avoid loss to the environment, putrefaction, odour generation, the attraction of vermin and other nuisances or objectionable condition. If the original supplier of rejected waste cannot take the material back, an appropriate alternative destination for the rejected waste shall be approved by the agency.

Non-conforming loads will be rejected where they fail to satisfy the fuel acceptance procedures. Any such rejected loads will be stored in the designated, signed areas adjacent to the MBM store until it can be returned directly to the supplier. Material will be quarantined for no longer than 48 hours on site. Following a non-conforming load, a more onerous sampling and testing requirements for MBM will be imposed on suppliers until demonstration of sustained compliance with the agreed fuel specifications is evident.

Condition 8.14.9:

The rejection of waste and any failure to demonstrate compliance with the technical specification shall be recorded and reported in the AER.

At any stage in the process a delivery can be rejected and returned to the supplier. The supplier will be contacted immediately to determine the status of other planned deliveries. A notification of non-conformance stating the details of the delivery and the reason/s for rejection will be forwarded to the supplier. Copies of sample analysis results, if available, will be provided to the supplier.

Details of non-conforming loads will be recorded and reported to the Agency in the AER.

Condition 8.14.10:

Waste shall not be accepted from a supplier of rejected material until such time as the reasons for rejection have been investigated and corrective actions agreed in writing between the licensee and the supplier have been implemented to the licensee's satisfaction. All such correspondence shall be provided to the Agency upon request.

Following a rejected or returned load to a supplier, Limerick Works will not accept further deliveries of MBM from the supplier until a report detailing the cause of the non-conformance and the corrective actions taken by the supplier to ensure that it is not repeated has been received and is to the satisfaction of Limerick Works.

Condition 8.15 (a):

Waste shall only be introduced to the kiln when the appropriate operating conditions have been achieved. There conditions shall, as a minimum, meet those set out in Schedule C: Emissions, Monitoring and Control of this licence.

Condition 8.15 (b):

Waste shall only be introduced to the kiln when cement clinker is being manufactured.

Introduction and continued firing of alternative fuels into the kiln process will be interlocked with stable process conditions and as such can only occur when the following conditions exist:

- Pet coke (or Coal) is being fed to the Kiln
- Raw meal is being fed to the Kiln system

- A minimum temperature of 855°C

During the start-up sequence, the use of MBM will not be permitted until the same conditions specified above have been achieved.

In effect, the kiln system will only be started up and stable operation established using Diesel Oil, Pet coke or Coal as the fuel input. Only when stable operation has been established will MBM be introduced. As the volume of alternative fuels increases, the volume of fossil fuels can be gradually reduced, maintaining stable plant operation at all times.

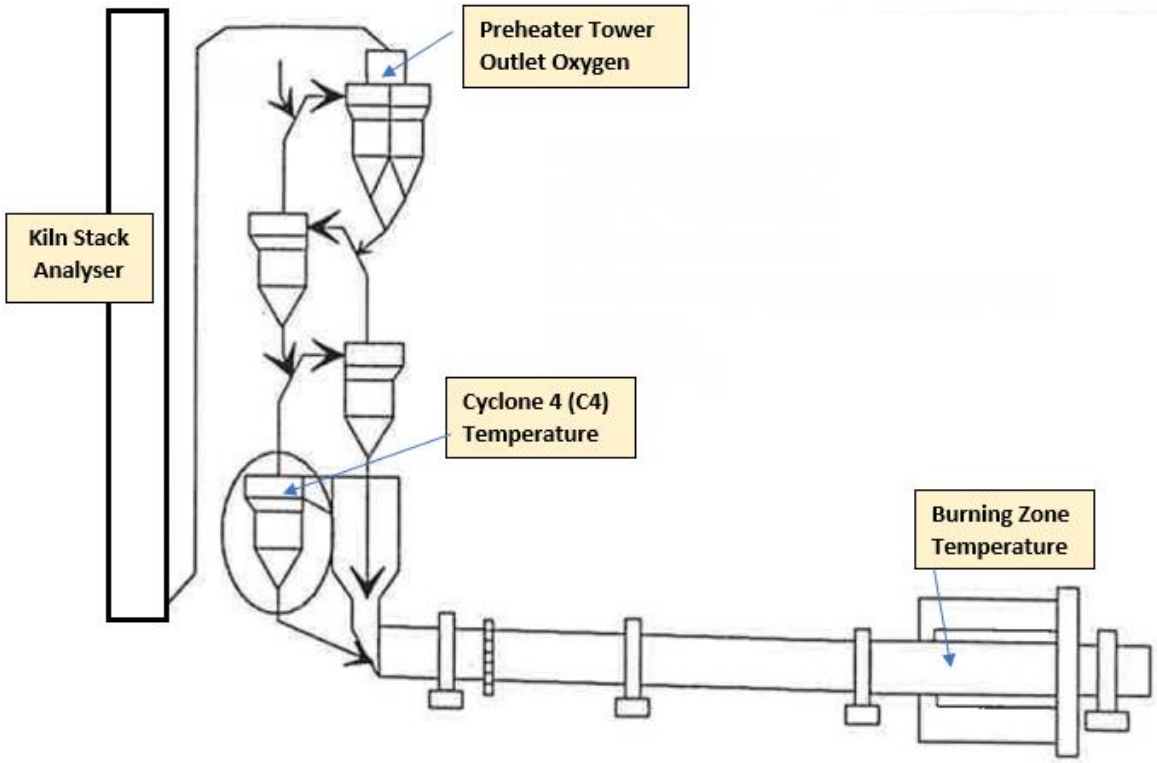
Should the kiln become unstable, the temperature in the fuel burning zone decrease below 855°C or the kiln stop, MBM injection will stop automatically. This will be controlled by means of a control system interlock.

Condition 8.16:
No odour-forming wastes shall be accepted at the installation

MBM will be subject to an odour assessment during the test programme and only materials which have passed the odour assessment and are deemed non odour forming will be accepted to the site.

APPENDIX 1

APPENDIX I SCHEMATIC OF MONITORING POINTS IN KILN 6


Preheater Tower Outlet Oxygen
Kiln Stack Analyser
Cyclone 4 (C4) Temperature
Burning Zone Temperature

APPENDIX 2

MEMO FROM FLSMIDTH REGARDING GAS RESIDENCE TIME MODELLING

Memo from FLSmidth regarding gas residence time modelling

Memo

To Eve Howard (Enviromental Manager, Irish Cement, Limerick Works),
Seamus Breen (Environmental Manager, Irish cement)

Copies to Shane Mc Carthy (Plant manager, Irish Cement, Limerick works),
Colin Murphy (Production manager, Irish cement, Limerik works)

From PRos (FLS)

Filing Report-34/ICL/Limerick/PRos/2023/08/21

Subject **Kiln system – gas and material retention times (in the complete kiln, kiln riser duct, ILC-E calciner and bottom stage cyclone) for an outlet temperature on 855 from the C4/cyclone. The simulations are only made for the scenarios where the kiln system is fired with petroleum coke, SRF and MBM.**

This report is an supplement to the previous reports:

- **Report-21/ICL/Limerick/PRos/2016/02/15**
- **Report 28/ICL/Limerick/PRos/2021/10/04**
- **Report-29/ICL/Limerick/PRos/2022/11/02**
- **Report-32/ICL/Limerick/PRos/2022/11/29**
- **Report-33/ICL/Limerick/PRos/2022/12/05**

Resume/Conclusion

Irish Cement Ltd. Limerick works is converting to burn different alternative fuels in there ILC-E calciner kiln system.

ICL, Limerick is currently planning to fire MBM in the main burner and this report comprise simulations of different scenarios at a production level of 3000 tpd clinker and a fourth stage cyclone exit temperature on 855°C, where FE=front end firing and BE=backend firing:

ICL, Limerick is installing a 0-12.000 Nm^3/h by-pass for the kiln exit gas and have requested the simulations 3.16A, 3.17A, 3.18A and 3.19A repeated with maximum by-pass rate. These simulations with maximum bypass are designated 3.16AB, 3.17AB, 3.18AB and 3.19AB.

The estimated retention times in the kiln, the calciner and total for the revised operational conditions are for the considered scenarios shown in the following table:

Based on Kiln output on 3000 t / day when co-firing with Solid refuse derived fuel (SRF)

Total retention time in kiln, calciner				Kiln heat	FE - whole kiln	Pre-calciner + Cil	Pre-calciner + Cil	
Scenario	By-Pass	Fuel Mix		Consumption	Residence time	Temperature	Residence Tir	Total
	%	FE	BE	Kcal/kg Clinker	Seconds	deg.C	Seconds	seconds
2A	0	80% PC	20% PC	841	3.77	855	3.42	7.19
3.12A	0	5% MBM&10%SRF-FE&85% PC	20% PC	846	3.75	855	3.36	7.11
3.13A	0	5% MBM&20%SRF-FE&75% PC	20% PC	850	3.70	855	3.32	7.02
3.14A	0	5% MBM&25%SRF-FE&70% PC	20% PC	852	3.69	855	3.29	6.98
3.15A	0	10%MBM&10%SRF-RE&80%PC	20% PC	847	3.73	855	3.35	7.08
3.16A	0	10%MBM&20%SRF-RE&70%PC	20% PC	851	3.70	855	3.30	7.00
3.17A	0	10%MBM&25%SRF-RE&65%PC	20% PC	854	3.68	855	3.27	6.95
3.18A	0	15%MBM&20%SRF-RE&65%PC	20% PC	853	3.69	855	3.30	6.99
3.19A	0	40%MBM&40%SRF-RE	20% SRF BE	878	3.56	855	3.08	6.64
3.16AB	7	10%MBM&20%SRF-RE&70%PC	20% PC	851	3.47	855	3.35	6.82
3.17AB	6.9	10%MBM&25%SRF-RE&65%PC	20% PC	854	3.44	855	3.32	6.76
3.18AB	6.9	15%MBM&20%SRF-RE&65%PC	20% PC	853	3.47	855	3.33	6.80
3.19AB	6.6	40%MBM&40%SRF-RE	20% SRF BE	878	3.35	855	3.12	6.47

The considered scenarios are made for estimating the corresponding retention times of the combustion gases at a production level on 3000 tpd clinker. The retention times at lower production levels can be estimated as:

Retention time(@X tpd clinker) =
Retention time(@3000 tpd clinker)*((3000 tpd)/(X tpd)

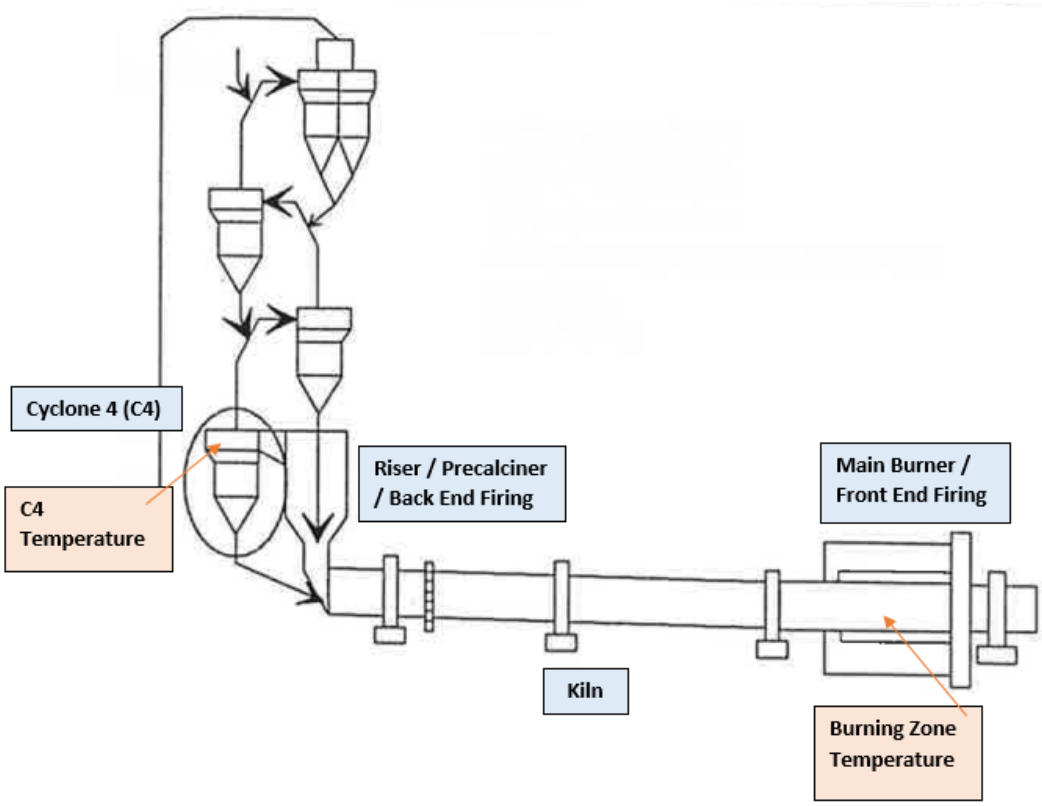
APPENDIX 3

MAINTENANCE AND CALIBRATION SCHEDULE FOR KILN 6 MONITORS

Operating Parameter	Measurement Device	Manufacturer	Instrument ID	Preventative Maintenance Frequency	Minimum Calibration Function Check Frequency	Complies to OEM's Instructions
BZT Temperature	Temperature Probe	Siemens	642XT01	Quarterly	Yearly	No requirements from OEM
C4 Temperature	Temperature Probe	ITS	641XT04	Quarterly	Yearly	No requirements from OEM
Stack Temperature	Temperature Probe	DURAG	64201	6 monthly	Yearly	Yes
Stack Pressure	Pressure Probe	ABB	64425	6 monthly	Yearly	Yes
Stack Sulphur Dioxide	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482	6 monthly	6 monthly	Yes
Stack Nitrogen Dioxide	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482	6 monthly	6 monthly	Yes
Stack Carbon Monoxide	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482	6 monthly	6 monthly	Yes
Stack Exhaust Volume	Gas Flowmeter	DURAG	64406	6 monthly	Yearly	Yes
Stack Humidity	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482	6 monthly	6 monthly	Yes
Stack Oxygen	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482	6 monthly	6 monthly	Yes
Stack Carbon Dioxide	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482	6 monthly	6 monthly	Yes
Stack Hydrogen Chloride	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482	6 monthly	6 monthly	Yes
Stack Hydrogen Flouride	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482	6 monthly	6 monthly	Yes
Stack Total Organic Carbon	ACF5000 Primary and Secondary Online Gas Monitors	ABB	64480/64482	6 monthly	6 monthly	Yes
Stack Total Dust	Online Particulates Monitor	PCME	64407	6 monthly	Yearly	Yes

APPENDIX 4

LOCATION OF THE TEMPERATURE MEASUREMENTS RELATIVE TO FUEL INJECTION


Cyclone 4 (C4)
C4
Temperature
Riser / Precalciner
/ Back End Firing
Main Burner /
Front End Firing
Kiln
Burning Zone
Temperature