Process Specification for Pouring Floor and Mould Shakeout Fume Extraction System

1. GENERAL

The purpose of the Pouring Floor (PF) and Mould Shakeout (MS) fume extraction system is to:

- Allow for the collection of odour and suspended particulate materials within the PF roof airspace. The roof airspace is to be ventilated continuously.
- Allow for the collection of odour and suspended particulate materials from the operation of the MS process. The MS process operates intermittently for no more than four hours per day.
- Maintain an adequate level of ingress of outside fresh air into the PF building airspace to ensure an acceptable level of worker comfort. Additional fresh air ingress will also occur with the operation of the Metal Casting Conveyor Fast Loop (MCCFL) fume extraction system that operates at worker level within the PF building.

Fumes and particulate materials within the PF building shall be collected via a manifold ductwork arrangement located at the apex of the PF roof. The ductwork runs the entire length of the PF building with collected fumes and particulate materials passing through a bag house filter before discharge to atmosphere.

The PF fume extraction system shall be designed to achieve a uniform degree of air extraction along the entire length of the collection manifold. The insertion of orifice plates within the ventilation ducting off-takes shall ensure that suction flows are balanced along the entire length of the ducting collection manifold.

2. SCOPE OF WORK

1. Specification of a suitable extraction fan/s to attain required suction and flow and provide:
   a) Balanced ventilation extraction flows along the entire length of the roof collection manifold; and
   b) Minimum duct velocities to prevent solid accumulation within the PF and MS ventilation system.
2. Specification of a bag house filter to achieve capture of particulate materials entrained in airflow.
3. Ensure geographical environmental impact in terms of odour and particulate materials of aerodynamic diameter greater than 10 µm (PM10) are within South Australian EPA environmental guidelines.
4. Supply of budget cost estimates for the provision of materials necessary to erect the PF and MS fume extraction system.

2.1 Ductwork

2.1.1 PF Fume Extraction System

The PF fume extraction system is intended to provide roof ventilation for 11 bays within the PF building. In total the PF fume extraction system will be approximately 65 metres in length excluding ducting associated with connection to bag house filter and fan assembly.

The preliminary design allows for 33 air collection off-takes spaced uniformly on each side the PF fume extraction system (total number of off-takes is 66). The suction flow through each fume extraction off-take shall be uniform. This will be achieved by the insertion of orifice plates in the duct.

Ventilation ductwork shall be mounted as close as possible to the apex of the roof cavity to avoid risk of crane collision and to remove buoyant hot air that will collect under the roof sheeting. Ductwork shall be positioned and mounted using existing building structural supports as shown in **Section 2.6**. Ductwork will run toward the northern end of the foundry building and exit the PF building to connect to bag house and extraction fan assembly.

Ventilation ductwork shall be as lightweight as possible and be of material suitable to resist corrosion and the thermal load that exist within foundry environments. Along the length of the duct work clean out hatches should be installed at regular intervals to assist in inspection and duct cleanout as required.

The designed PF fume extraction flow is 30.0 Nm^3/s.

2.1.2 MS Fume Extraction System

The MS fume extraction system is intended to provide ventilation for mould shakeout activities. The purpose of the MS fume extraction system is to convey captured particulate solid materials to the PF bag house.

Ventilation ductwork shall be as lightweight as possible and be of material suitable to resist corrosion and the thermal load that exist within foundry environments.

The required MS fume extraction flow is 14.2 Nm^3/s.

2.2 Bulkheads

Two bulkheads are required to contain hot fumes and suspended particulate materials within the roof airspace cavity. Bulkheads shall be positioned at bays located at Point 1 and Point 2 (refer to **Section 2.6**). The bulkheads shall be loosely air tight along the contact perimeter to the roof and PF building and descend as far as crane height.

2.3 Control System

2.3.1 Operation of MS Fume Extraction System

The MS fume extraction system is activated by means of a push button “Start” switch. Once the “Start” switch is activated the control system shall:

1. The damper valve that connects the MS duct system to the PF duct system fully opens. Airflow from the MS process enters the PF duct system upstream of the PF bag house filter.
2. A damper valve partially closes within the PF duct that temporarily restricts the PF roof airspace ventilation flow. When the damper valve partially closes the MS fume ventilation flow increases to the designed flow of 14.2 Nm^3/s.

Process Specification for Metal Casting Conveyor Fast Loop Fume Extraction System

1. GENERAL

The purpose of the Metal Casting Conveyor Fast Loop (MCCFL) is to:

- Allow for the collection of odour and suspended particulate materials resulting from the pouring of molten metal into conveyor loop sand moulds.
- Maintain an adequate level of ingress of outside fresh air into the PF building airspace to ensure an acceptable level of worker comfort. Additional ingress of outside fresh air will also occur with the operation of the PF and Mould Shakeout (MS) fume extraction system.

Fumes and particulate materials emanating from recently cast sand moulds shall be collected from either the first thirty meters or last thirty meters of the MCCFL. At any one time eight (8) of sixteen (16) sideways orientated capture hoods will collect fumes and particulate materials that shall pass through a bag house filter before discharge to atmosphere.

The MCCFL fume extraction shall achieve a uniform degree of air extraction between the eight side capture hoods. The placement of orifice plates within the ventilation ducting off-take shall ensure that suction flows are balanced across all side capture hoods.

2. SCOPE OF WORK

1. Specification of a suitable extraction fan to attain required suction and flow and provide:
   a) Balanced ventilation extraction flows along the entire length of the capture hoods; and
   b) Minimum duct velocities to prevent solid accumulation within the MCCFL ventilation system.
2. Specification of a bag house filter to achieve capture of particulate materials entrained in airflow.
3. Ensure geographical environmental impact in terms of odour and particulate materials of aerodynamic diameter greater than 10 µm (PM10) are within South Australian EPA environmental guidelines.
4. Supply of budget cost estimates for the provision of materials necessary to erect the MCCFL fume extraction system.

2.1 Side Capture Hood

At any one time only half of the length of capture hood shall be operating. The side capture hood shall be positioned and orientated as shown in **Section 2.6**. The hood shall be 60 metres in length and 1 metre high. The height of the capture hood and ventilation design flow ensures that the fume capture velocity 1.5 metres from the open hood face are equal or greater than 0.76 m/s (150 ft/min).

The estimated residence time for ventilated casting moulds is approximately 17 hours. This ventilation time should be sufficient for the side capture hoods to assist in the capture of most visible fumes (dust and particulates).

As the casting moulds move progressively along the MCCFL, any further emissions that are not captured by the fume extraction system will emit into the PF building airspace and be captured by the PF and MS fume extraction system.

2.2 Ductwork

The MCCFL fume extraction system is connected to the side capture hoods. The preliminary design allows for eight (8) air collection off-takes spaced uniformly along the length of the side capture hoods. The suction flow through each fume extraction off-take will be uniform by insertion of an orifice plate in the duct.

Ventilation ductwork shall be mounted as close as possible to the mould casting operations without interfering with metal pouring or worker access / activities to the MCCFL. Ductwork shall be positioned and mounted (where possible) using existing building structural supports as shown in **Section 2.6**. Ductwork will run toward the northern end of the foundry building and exit the PF building to connect to bag house and extraction fan assembly.

The close capture hoods and ventilation ductwork shall be of a thickness to endure low impact collision with the pouring ladle and crane arms and be of material suitable to resist corrosion and thermal load that exist within foundry environments. Along the length of the duct work clean out hatches should be installed at regular intervals to assist in inspection and duct cleanout as required.

The designed MCCFL fume extraction flow is 37.3 Nm^3/s.

2.3 Control System

2.3.1 Fan Failure

The MCCFL fume extraction system is physically connected to the PF and MS fume extraction system by a section of crossover ducting. A normally closed damper located within the crossover ducting isolates the two ventilation systems.

In the event of MCCFL fan failure the MCCFL fume extraction system shall be ventilated by the PF and MS fume extraction system. During the period of time that the MCCFL fan is disabled ventilation flows will be lower than the designed MCCFL fume extraction flow of 37.3 Nm^3/s.

Operators are required to manually adjust dampers to isolate the MCCFL fan and open the crossover isolation damper.

2.4 Fans

One centrifugal fan is proposed to ventilate the MCCFL fume extraction system. However in the event of fan failure the PF fan shall ventilate both the MCCFL, PF and MS fume extraction systems.

The MCCFL extraction fan must be able to extract at least 37.3 Nm^3/s under normal operations. Based on MCCFL system characteristics, the operational fan will be able to sustain an extraction flow rate of approximately 37.3 Nm^3/s with a duty pressure of approximately 610 mmH_2O. The fan duty pressure will need to be re-confirmed in subsequent technical engineering design.

Manual valve positioning before the inlet and after the fan outlet is required to ensure that operators can continue to operate the MCCFL fume extraction system in the event of mechanical breakdown of the fan unit.

2.5 Miscellaneous

Fumes extracted from the MCCFL fume extraction systems are to pass through a bag house filter and subsequently discharged via one stack of height 20 metres and a diameter of 1.4 metres.

2.6 Drawings

The MCCFL fume extraction system is described in **Appendix I** by drawing *5696028 RevA*.

3. COMMISSIONING

The budget cost does not include the following:

- Provision, supply and presentation of technical manuals;
- Full risk assessment of MCCFL fume extraction system with respect to foundry operations;
- System commissioning; and
- On-going environmental performance monitoring.

The worker de-activates ventilation at the MS process by pressing the “Stop” switch. Once the “Stop” switch is activated the control system shall:

1. Fully open the damper valve that restricts airflow from the PF roof ventilation system.
2. The isolating damper valve that connects the MS duct system to the PF duct system fully closes. Once closed the PF roof ventilation flow returns to the design value of 30 Nm^3/s.

2.3.2 Fan Failure on MCCFL Fume Extraction System

The PF fume extraction system is physically connected to the MCCFL fume extraction system by a section of crossover ducting. A normally closed damper located within the crossover ducting isolates the two ventilation systems.

In the event of MCCFL fan failure the crossover damper shall be opened to enable the MCCFL to remain ventilated. Operators are required to manually adjust dampers to isolate the MCCFL fan and open the crossover damper.

2.4 Fans

One centrifugal fan is proposed to ventilate the PF and MS fume extraction systems.

The extraction fan must be able to extract at least 30 Nm^3/s. Based on PF and MS system characteristics, the operational fan will be able to sustain an extraction flow rate of approximately 30 Nm^3/s with a duty pressure of approximately 590 mmH_2O. The fan duty pressure will need to be re-confirmed in subsequent technical engineering design.

Manual valve positioning before the inlet and after the fan outlet is required to ensure that operators can continue to operate the PF and MS fume extraction system in the event of mechanical breakdown of a fan unit.

2.5 Miscellaneous

Fumes extracted from the PF and MS fume extraction systems are to pass through a bag house filter and subsequently discharged via one existing stack of height 20 metres and a diameter of 1.4 metres.

2.6 Drawings

The PF and MS fume extraction system is described in **Appendix I** by drawing *5696028 RevA*.

3. COMMISSIONING

The budget cost does not include the following:

- Provision, supply and presentation of technical manuals;
- Full risk assessment of PF and MS fume extraction system with respect to foundry operations;
- System commissioning; and
- On-going environmental performance monitoring.

Process Specification for Cooling Conveyor Fast Loop Fume Extraction System

1. GENERAL

The Cooling Conveyor Fast Loop (CCFL) fume extraction system allows for the collection of odour and particulate materials. Fumes generated from mould castings will be collected via a close capture canopy hood (CCCH) arrangement that will cover the entire CCFL conveyor line. Fumes will be collected via collection ducting and conveyed to a discharge point (stack) using an axial fan arrangement.

The fume extraction system is designed to achieve a uniform degree of air extraction from all locations underneath the CCCH. The insertion of orifice plates within the ventilation ducting branches ensures that suction flows are balanced throughout the CCFL CCCH.

2. SCOPE OF WORK

1. Specification of a suitable extraction fan/s to attain required suction and flow and provide:
   a) Balanced ventilation extraction flows throughout the CCFL process; and
   b) Minimum duct velocities to prevent solid accumulation within the CCFL ventilation system.
2. Specification of the CCCH that covers the CCFL process.
3. Ensure geographical environmental impact in terms of odour and particulate materials of aerodynamic diameter greater than 10 µm (PM10) are within South Australian EPA environmental guidelines.
4. Supply of budget cost estimates for the provision of materials necessary to erect the CCFL fume extraction system.

2.1 Close Capture Canopy Hood

The CCCH shall fully enclose the CCFL except at the ends of the conveyor where mould castings are inserted or withdrawn from the conveyor. Drawing detail of the CCCH are shown in **Section 2.5**. The CCCH shall have the following attributes:

- Provide an air-tight environment about the entire CCFL except at the conveyor ends and the ground level perimeter of the CCCH. The air gap between the ground level and the CCCH shall be no more than 300 mm. Where practical air ingress at the end sections of the CCFL shall be minimised by means of flexible heat resistant curtains or equivalent.
- The CCCH will be 61 metres in length, 11.8 metres wide and 5 metres high.
- Altogether there shall be 60 fume extraction off-takes uniformly spaced and centrally positioned over each of the four parallel double storey CCFL conveyors. The suction flow through each fume extraction off-take will be the same everywhere by insertion of an orifice plate in the duct. Fumes will be conveyed into the connecting ventilation ductwork by means of suction pressure maintained by extraction fans located at the northern end of the foundry building.

2.2 Ductwork

Ventilation ductwork connecting the CCCH to the extraction fan assembly shall be mounted at a suitable height to avoid vehicle collision and minimise disruption to foundry work processes. Ductwork shall be positioned and mounted in-between the building structural supports as shown in **Section 2.5**. Ductwork will run to the northern end of the foundry building where the fan assembly and discharge stack will be situated.

Ventilation ductwork that connects the CCCH to the extraction fan assembly shall be as lightweight as possible and be of material suitable to resist corrosion and heat that exist within foundry environments.

Along the length of the main collection ventilation duct clean out hatches should be installed at regular intervals to assist in inspection and duct cleanout as required.

2.3 Fans

Two (2) existing Bradken Engineering axial fans AP1258CP9/30 are proposed to ventilate the CCFL. The extraction fan assembly must be able to extract at least 12.6 Nm^3/s. Based on AP1258CP9/30 fan characteristics, it is estimated that each axial flow will be able to sustain an extraction flow rate of approximately 6.3 Nm^3/s with a duty pressure of 45 mmH_2O.

Manual valve positioning before the inlet and after the fan outlet is required to ensure that operators can continue to operate the CCFL fume extraction system in the event of mechanical breakdown of a fan unit.

2.4 Miscellaneous

Fumes extracted from the close capture canopy hood by the AP1258CP9/30 fans are to be discharged via one existing stack of height 20 metres and a diameter of 1.4 metres.

2.5 Drawings

The CCCH and CCFL fume extraction system is described in **Appendix I** by drawing *5696013 RevC*.

3. COMMISSIONING

The budget cost does not include the following:

- Provision, supply and presentation of technical manuals;
- Full risk assessment of CCFL fume extraction system with respect to foundry operations;
- System commissioning and operator training; and
- On-going environmental performance monitoring.

Process Specification for Aftercast Building Ventilation

1. GENERAL

The purpose of the Aftercast Building (AB) fume extraction system is to provide an adequate level of outside air exchange to ensure an acceptable level of worker comfort.

Airborne fumes, vehicle emissions, heat and particulate materials that are generated within the AB shall be exhausted via a number of roof penetrating vertically orientated axial fan units. The fan units shall be as uniformly arranged within the entire AB roof structure. The air exhaust from each roof-mounted fan is discharged directly to atmosphere.

2. SCOPE OF WORK

1. Specification of a suitable extraction fan/s to attain an acceptable level of outside air exchange within the AB.
2. Supply of budget cost estimates for the provision of materials necessary to erect the AB fume extraction system.

2.1 Roof Fan Units

The AB fume extraction system is intended to provide an appropriate level of outside air exchange. In total there shall be fifteen roof penetrating vertically orientated axial fan units each with a design extraction air flowrate of 3120 L_{air}/s. The fan units shall be self-supporting and penetrate the roof through the existing clear polycarbonate sections. Where possible the fan units shall be positioned at the highest possible elevation.

The fan units shall be uniformly spaced along the length of the AB. The number of fan units per section of the AB shall be (refer to Sections Marking Plan):

- 4 fan units uniformly spaced along building sections 24a and 19b;
- 7 fan units uniformly spaced along building section 10; and
- 4 fan units uniformly spaced along building sections 11 and 14.

The designed total AB fume extraction flow is 47 m^3_{air}/s. This is approximately equivalent to an outside air exchange rate of 6 AB air changes per hour.

3. COMMISSIONING

The budget cost does not include the following:

- Provision, supply and presentation of technical manuals;
- Full risk assessment of AB fume extraction system with respect to foundry operations;
- System commissioning; and
- On-going environmental performance monitoring.