Standard Operating Procedures (SOPs) for Monitoring Wood Waste Temperature

COMPANY DETAILS AND RESPONSIBLE PERSON

1. Company name, address and telephone number

Glamorgan Recycling Limited,
Hollybush Farm, Warstone Road,
Shareshill, Wolverhampton, WV10 7LX.
Tel: 01922 417648

FIG. 1 Jack Moody Recycling Ltd

2. Recovery facility name, address and telephone number

Glamorgan Recycling Limited
Berth 31 Wimborne Road
Barry
Glamorgan
CF63 3DH

General items

1.1 General description of monitoring process

The process is to produce a Fuel for power stations and this document is produced for the temperature and moisture monitoring and quality management of the processed fuel prior to delivery.

The stockpiles are constructed to WISH guidance note and NRW FPMP 2017 guidance note 16.

2 Input materials

2.1 Types of input materials

Wood waste types accepted are Grade B and C (see table 1, for definition).

FIG. 2 Acceptable Wood Waste

FIG. 3 Wood Waste Delivery

G	Typical Markets	Typical Sources of Raw Material for Recycling.	Typical Materials	Typical Non – Wood Content Prior to Processing	Notes
Grade A. "**Clean"** **Recycled Wood**	A feedstock for the manufacture of professional and consumer products such as animal bedding and horticultural mulches. May also be used as fuel for renewable energy generation in non WID* installations, and for the manufacture of pellets and briquettes.	Distribution. Retailing. Packaging. Secondary manufacture e.g. joinery. Pallet Reclamation.	Solid softwood and hardwood. Packaging waste, scrap pallets, packing cases, and cable drums. Process off-cuts from manufacture of untreated products.	Nails and metal fixings. Minor amounts of paint, and surface coatings.	Some visible particles of coatings and light plastics will remain. Excludes grades below.
Grade B. **Industrial Feedstock** **Grade**	A feedstock for Industrial wood processing operations such as the manufacture of panel products, including chipboard and medium density fibreboard (mdf)	As Grade A, plus construction and demolition operations and Transfer Stations.	May contain up to 60% Grade A material as above, plus building and demolition materials and domestic furniture made from solid wood.	Nails and metal fixings. Some paints, plastics, glass, grit, coatings, binders and glues. Limits on treated or coated materials as defined by WID.	The Grade content is not only costly and difficult to separate, it is essential to maintain the quality of feedstock for chipboard manufacture, and for PRN revenues. Some feedstock specifications contain a 5 – 10% limit on former panel products such as chipboard, MDF, and plywood. Excludes Grade D
Grade C. **Fuel Grade.**	Biomass fuel for use in the generation of electricity and/or heat in WID** compliant installations	All above plus Municipal Collections, Recycling Centres Transfer Stations And Civic Amenity Recycling sites	All of the above plus fencing products, flat pack furniture made from board products and DIY materials High content of panel products such as chipboard, MDF, plywood, OSB and fibreboard.	Nails and metal fixings. Paints coatings and glues, paper, plastics and rubber, glass, grit. Coated and treated timber (non CCA or creosote).	Suitable only For WID installations**. Material coated and treated with preservatives as defined by WID may be included. Excludes Grade D

Table 1.

2.2 Sources of input materials

See Table 1.

The company has contract(s) with waste producers for the delivery of wood.

2.3 Rejection or acceptance and storage of input materials

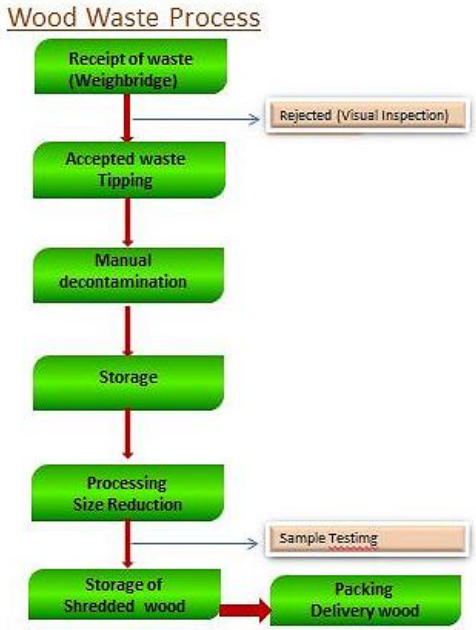

FIG. 4 Wood Waste Process

Input materials delivered for recycling shall enter the site via the weighbridge.

The description, nature and source of wastes that arrive at the site are verified prior to weighing. Details of the waste carrier, waste type, client/source and quantity (tonnes) of waste shall be recorded on a central computer and on a Waste Transfer Note.

The weighbridge operator shall then notify the driver to proceed to the offload pad/bay where a site operative shall ensure the wood waste carrier takes it to the input materials storage area which will be a numbered bay/stockpile system. Here, the waste carrier will deposit the waste wood so as not to merge it with any input materials already being stored.

A site operative shall spread and inspect each load deposited at the storage bay area.

Any load shall be rejected if subjective assessment of the surface of the waste deposited indicates that it contains more than 10% contamination by volume and moved to the quarantine area for rejected loads.

Each load for rejection shall be separated from loads awaiting inspection or those accepted for screening and then removed from the site prior to the waste carrier leaving the site.

If a load is less contaminated with litter/contrary items than the above limit, these shall be removed as far as practically possible and placed into a ‘rejects’ container stored on the impermeable pavement. The container’s contents shall regularly be removed for disposal and recycling.

Each accepted load shall be assessed to identify the processing requirements and any potential problems.

2.4 Traceability of input materials

A record system shall be maintained connecting sources of wastes with delivery dates and weights. This is achieved via the use of a weighbridge and bay system and the duty of care information collected for every load that arrives.

Wood waste arriving on site shall be directed to the weighbridge situated at the site entrance. Details of the waste carrier, waste type, source and quantity (tonnes) of waste shall be recorded at the site office (Waste Transfer Note). The weighbridge clerk shall notify the driver to proceed to the waste reception area where the load shall be tipped and inspected by available site operatives. After tipping in the allocated bay, the driver shall be directed back to the weighbridge, weighed off and issued with a weighbridge ticket.

FIG. 5 Weighbridge Entry

Wood batches are created one at a time, each being given a unique bay number and is clearly identifiable with a marked board with the unique bay number together with the probe set used in the bay (in processed material), this then stays with the bay during the monitoring process. Once formation of a bay is completed, and waste loads begin arriving to go into a new bay, the bay 'start' date is recorded (on the 'Bay Formation and Monitoring Record Sheet'). Once the formation of this bay is complete and ready to start the monitoring process (of processed material), the 'finish' date is recorded (on the "Bay Formation and Monitoring Record Sheet"). All wood loads that arrive at the weighbridge between these two dates therefore have gone into that bay, and thus can be traced back to source.

Each rejected load shall be recorded as well as action taken (e.g. load returned to sender or site audit required, etc).

FIG. 6 Rejected Material

3 Preparation of input materials

3.1 Screening

Input materials accepted and stored for this wood waste operation shall be stockpiled to quantities of no more than 1250m^3, typically over a period of 6 months depending on waste acceptance rates (as per the environmental management system). Screening shall be carried out on each working day, as required.

FIG. 4 Wood shredded to form a batch

3.2 Mixing

Mixing of material between old and newly defined bays will be done after screening as explained in section 4.1.

3.3 Moisture assessment prior to bay formation

Moisture evaluation of the screened material shall be carried out when using the hand-held probe and if indicates that moisture is different from existing materials then a new bay will be started for that batch/bay of materials and the information recorded on the bay record sheet. The hand-held probe will be updated to an i-TOM remote monitoring probe when the development of the probe and calibration has been completed.

3.4 Records connecting delivery notes with shredding dates, mixing and wetting

Each wood waste bay that undergoes the screening operation at this site shall be given a unique batch/bay number.

As data for all waste wood arriving at the site shall be recorded on weighbridge software, and automatic bay data sheets provide details of the batches formed, a connection to the weighbridge ticket for each bay is achieved via date of bay formation.

Jack Moody Holdings PLC
Landscaping | Recycling | Civil Engineering

JM Tickets for **Batch** : JMCgWR1593

Printed Date:

Ticket No	Date	Company	Product	Nett Wtg
C300047	05/01/2015	DAVE THE PAVE		2580
C300096	05/01/2015	PAUL MCGOWAN		13460
C300098	05/01/2015	DAVE THE PAVE		2420
C300101	05/01/2015	BIFFA WASTE SERVICES LIMITED		11080
C300141	06/01/2015	PRIVATE CUSTOMER		16400
C300148	06/01/2015	Jones Skips Wolverhampton		16700
C300172	06/01/2015	SERCO		15280
C300184	06/01/2015	PRIVATE CUSTOMER		2180
C300186	06/01/2015	RANDLES BUILDING SOLUTIONS		2900
C300191	06/01/2015	TREEWAY FENCING LIMITED		8680
C300235	07/01/2015	BIFFA WASTE SERVICES LIMITED		10740
C300250	07/01/2015	FCC 2		16500
				118920

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FIG. 5 Tickets that form a Batch

The ‘Bay Formation and Monitoring Record Sheet’ shall also hold the results of the feedstock quality assessment (in particular any feedstock rejections), wetting/misting for dust. It shall also include the unique number of any other bays mixed with this bay (including oversize) material when added to the bay will also be recorded on the bay formation and monitoring recorded sheet. The weighbridge ticket will always identify the feedstock for the incoming wood material.

4 Wood activities – managing, monitoring.

4.1 Bay formation and monitoring

After receipt at the reception area, each accepted load will have been spread and litter picked if containing litter, and pre-treated (screened/mixed/watered) where required, ready for delivery to power station.

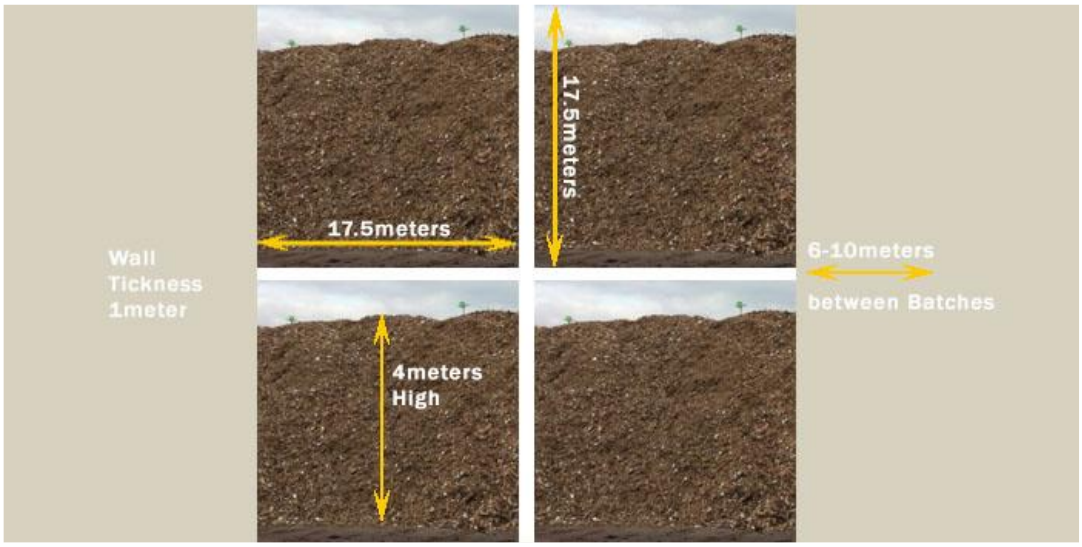


FIG. 6 Shredded Wood Storage and Probes (not to scale)

The dimensions of each batch shall be approximately 4 metres high, 17.5 metres square, organised in a Maltese cross, with a gap of typically 6-10 metre between each Maltese cross. This allows easy access for operational personal/Fire services (FRS).

FIG. 7 Shredded Wood Dimensions

The New Probes sample the bay temperature every 15 minutes 24/7 remotely. It will automatically inform the operations manager (by email), if the temperatures rise above a predefined value (58^{o}C) or the temperature rises by 2^{o}C in a 24hour period.

Each formed batch's unique number shall be easily visible to any operative inspecting materials on site.

In the event that batches are combined during the monitoring process, the 'on-going' batch code(s) shall be recorded on each of the corresponding batch record sheets and the record for one of these batches shall be used as the ongoing record.

4.1.1 Monitoring equipment

I addition the wireless probes the site uses a hand-held probe (which is used once a day to record Batch temperatures). Handheld moisture probes will also be available for use when wireless probes are not available.

All monitoring equipment shall be maintained in a functional state by the site manager.

Equipment shall be calibrated at a frequency consistent with the manufacturer's instructions or at least every 12 months, whichever is sooner. If any problems are identified or suspected, the relevant item(s) of equipment shall be checked as a matter of urgency.

Calibration dates and outcomes shall be recorded in the 'Equipment Calibration Record Sheet' and any calibration certificates shall also be filed with this record.

4.1.2 Temperature monitoring and records

Temperature detected by the sensor when inserted in the batch shall be allowed to stabilise before a final reading is recorded.

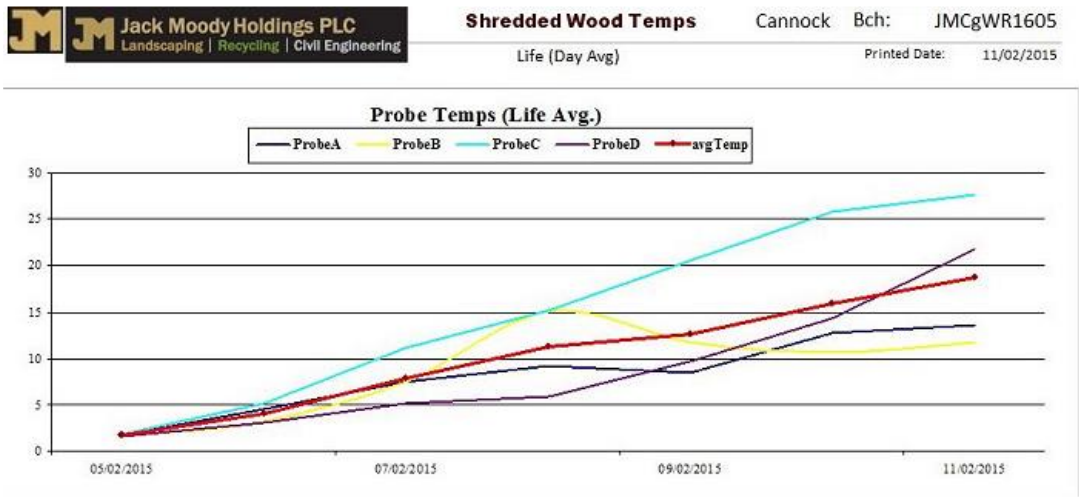


FIG. 11 Shredded Wood Temperature Monitoring

All Batch temperature monitoring results shall be recorded in the 'Batch Formation and monitoring Record Sheet'

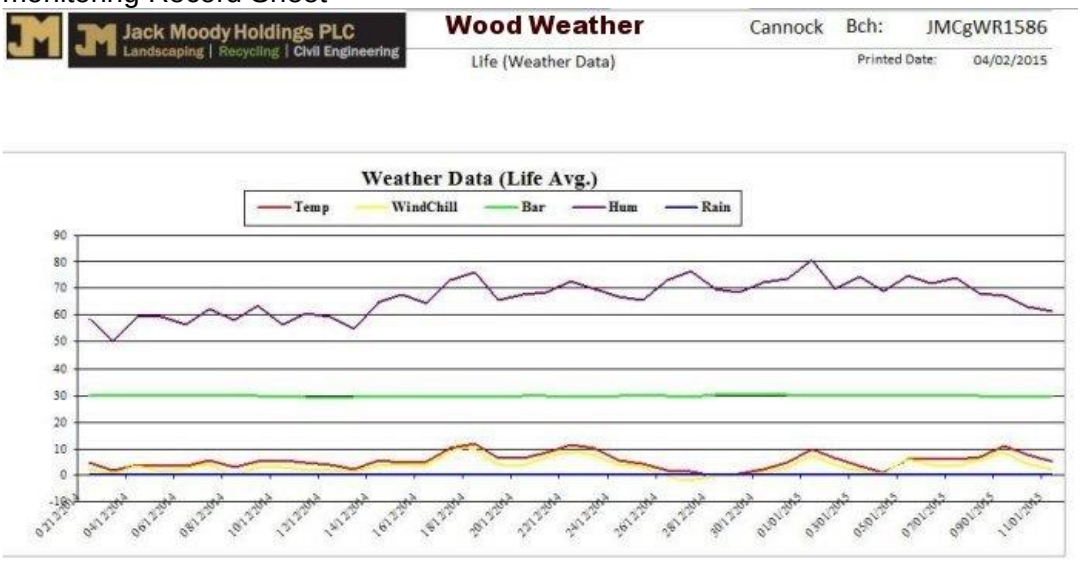


FIG. 11 Weather data during Windrow monitoring

4.1.4 Weather monitoring and records

The following weather conditions shall be monitored and recorded daily;

- Temperature,
- Wind Chill
- Pressure,
- Humidity and
- Rain Fall

FIG. 10 Weather data example

4.1.5 Monitoring records and corrective actions

Monitoring records for each Batch shall be checked every working day.

Corrective actions shall be carried out if stockpile/batch core zone temperature trends move out of the target range.

Corrective action to lower the batch/stockpile temperature may include:

- Additional or more frequent turning/mixing;
- Decrease batch size;
- Water addition if temperature conditions have become too dry; and/or
- Source dry input materials if weather conditions have become too moist.

Any corrective action taken to bring Batch core temperatures within the target ranges shall be recorded on the 'Batch Formation and Monitoring Record Sheet'.

4.2.1 Process validation phase
Monitoring Table using the hand-held probe

Parameter	Limits
Temperature Core decomposition zone	Once per working day. At 2 points per 1250m^3 bay/stockpile at a minimum of 1 m below surface.
Moisture content Core decomposition zone	At 2 points per 1250m^3 bay/stockpile at minimum of 0.5 m below surface.

The responsible person shall ensure the critical control points and critical limits of the monitoring process are recorded on the batch record sheet.

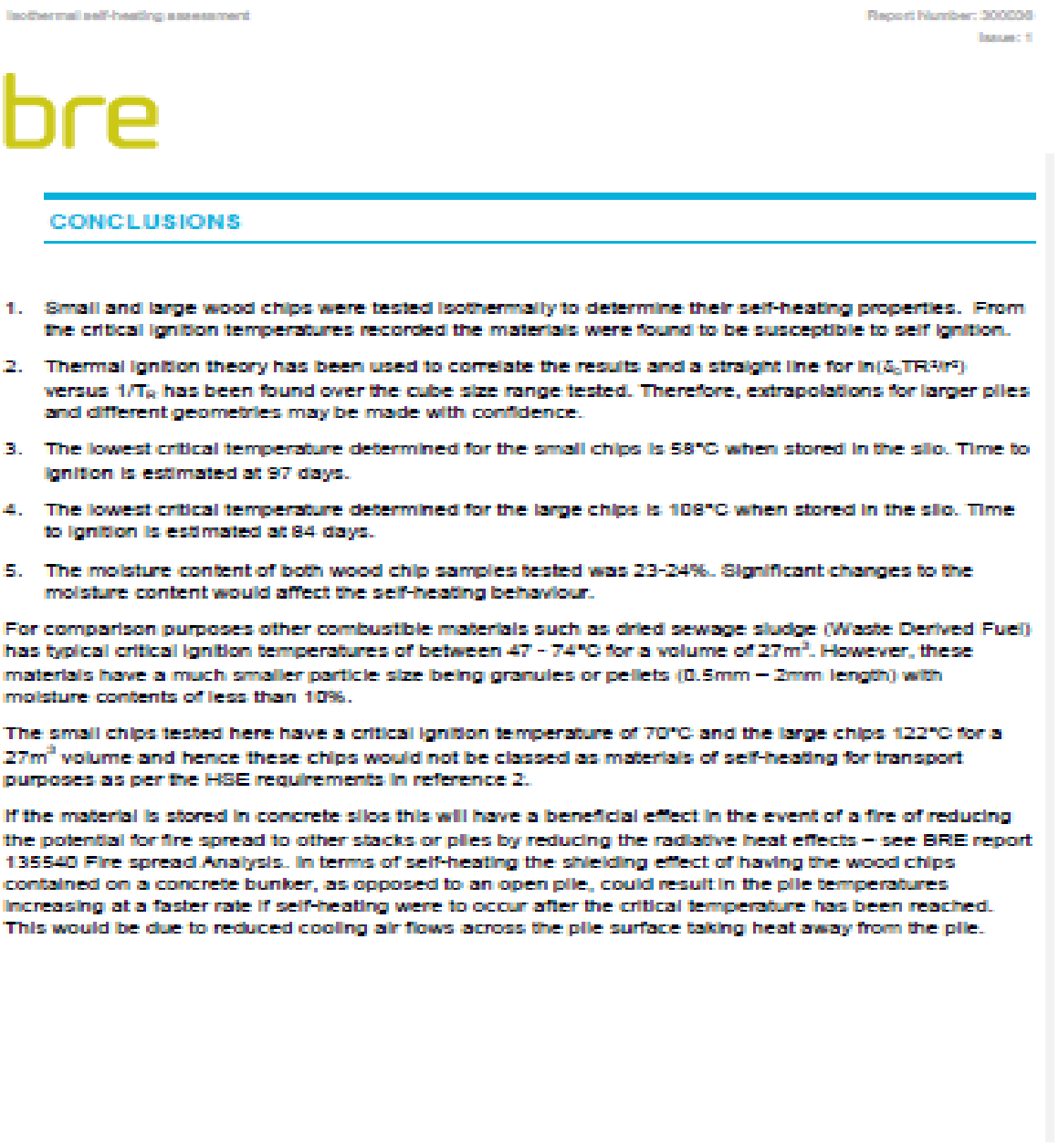
The site manager shall ensure that the critical control points and critical limits of the wood process continue to be effective in guiding process management. If for any reason, they are suspected or known to have become ineffective, a phase of Hazard Analysis and Critical Control Points evaluation and process validation shall be returned to (refer to the quality policy

Parameter	Limits
Core Temperature Range parameters For iTOM monitoring System	Once per working day with a handheld probe or continuous with iTOM monitoring system. Temperature range for normal operating condition is between 0-45 degrees C Temperature range for Critical monitoring and piles requiring attention and moving or splitting to cool is 45-60 degrees C also time limit of 1 week before removal from site Temperature range for emergency action to be taken immediately and piles moved to the quarantine area and eventually off site and split up in quarantine area immediately are 60-75 degrees C over a 24 hour period
Moisture content Core zone Moisture Content Core Zone	At 2 points per 1250m^3 bay at minimum of 0.5 m below surface. Ideal moisture range is 15%-35% If moisture is outside of the range 15%-35% less than 15% - NO Action deliver to Power station If moisture is outside of the range 15%-35% More than 35% - Out of specification for fuel and requires drying or blending or moving to the quarantine area for windrowing, drying and aeration moving

4.2.2 Product storage and batch identification

Wood products batches shall be stored outdoors has described in section 4.1.

The graded wood batches shall be stored explained in section 4.1.



Isothermal self-heating assessment

Report Number: 300006
Issue: 1

bre

CONCLUSIONS

1. Small and large wood chips were tested isothermally to determine their self-heating properties. From the critical ignition temperatures recorded the materials were found to be susceptible to self ignition.
2. Thermal ignition theory has been used to correlate the results and a straight line for $\ln(\delta_c TR^2/r^2)$ versus $1/T_a$ has been found over the cube size range tested. Therefore, extrapolations for larger piles and different geometries may be made with confidence.
3. The lowest critical temperature determined for the small chips is 58°C when stored in the silo. Time to ignition is estimated at 97 days.
4. The lowest critical temperature determined for the large chips is 108°C when stored in the silo. Time to ignition is estimated at 84 days.
5. The moisture content of both wood chip samples tested was 23-24%. Significant changes to the moisture content would affect the self-heating behaviour.

For comparison purposes other combustible materials such as dried sewage sludge (Waste Derived Fuel) has typical critical ignition temperatures of between 47 - 74°C for a volume of $27m^3$. However, these materials have a much smaller particle size being granules or pellets (0.5mm – 2mm length) with moisture contents of less than 10%.

The small chips tested here have a critical ignition temperature of 70°C and the large chips 122°C for a $27m^3$ volume and hence these chips would not be classed as materials of self-heating for transport purposes as per the HSE requirements in reference 2.

If the material is stored in concrete silos this will have a beneficial effect in the event of a fire of reducing the potential for fire spread to other stacks or piles by reducing the radiative heat effects – see BRE report 135540 Fire spread Analysis. In terms of self-heating the shielding effect of having the wood chips contained on a concrete bunker, as opposed to an open pile, could result in the pile temperatures increasing at a faster rate if self-heating were to occur after the critical temperature has been reached. This would be due to reduced cooling air flows across the pile surface taking heat away from the pile.

After the wood has been loaded onto vehicles by site staff it will then be weighed at the weighbridge and a weigh bridge ticket is produced by the weigh bridge with the customer's name and weight of the wood being dispatched to the customer.

Executive Summary:

This procedure describes the activity, procedures and monitoring at the Glamorgan Recycling facility.

Reference has been made to the Natural Resources Wales guidance documents TGN7.01 and Fire Prevention Plans 2018, WISH and NRW FPMP Guidance Note 16 2017 along with Commissioned research for Fire Spread Analysis and Self-Heat Report (BRE Global Ltd).

Based on the information provided, the SOP concludes the following;

Item	**NRW (guidance)**	**BRE Global Ltd (test Data)**	**JMRL (site limits)**
Volume Unprocessed Wood (UP)	No volume limit	130^0C	3000m^2
Volume Processed Wood (PW)	No volume limit	105^0C	1250m^2
Storage Time (UP)	6 months	313 days	9 months
Storage Time (PW)	3 months	259 days	9 months
Temperature (UP) – Critical limit	Not detailed	130 degrees	45-60 degrees
Temperature (PW) – Critical Limit	Not detailed	105 degrees	45-60 degrees
Moisture – Critical limit	Not detailed	23-24%	35 %