SAFETY ORDER
No: SO-EL/GA 2013-02

COMBUSTIBLE DUST HAZARD IN WOOD PROCESSING FACILITIES

Date of Issue: May 7th, 2013

This safety order is issued pursuant to section 31 of the Safety Standards Act. A person affected by this safety order may appeal this order in writing to the Safety Standards Appeal Board within 30 days. The appeal process is set out on the Safety Standards Appeal Board's website at http://www.housing.gov.bc.ca/ssab/. This order may not be stayed during an appeal.

Failure to comply with a safety order is an offence under section 72 of the Safety Standards Act.

Purpose

This order requires owners and operators of wood processing facilities[1] to perform an assessment of facilities for hazardous locations, due to the presence of combustible dust. Where gas or electrical equipment is installed within a hazardous location, a plan to suitably mitigate the combustion risk must be documented.

The presence of combustible dust or fibre may create a hazardous location[2]. The installation or use of electrical or gas equipment within hazardous locations may require specific precautions to mitigate the risk of combustion. Both electrical equipment and gas equipment are regulated under the *Safety Standards Act and Regulations.* The standards adopted in those regulations, specifically the *BC Electrical Code* and the *BC Natural Gas and Propane Code*, contain requirements for the installation and operation of regulated equipment located in hazardous locations.

As a result of investigation findings collected from explosions and fires at two BC sawmills in 2012, the BC Safety Authority is issuing this Safety Order to help prevent, avoid or reduce the risk of personal injury or damage to property. The BC Safety Authority has previously issued two safety orders (*SO-EL 2012-01 Electrical Equipment Located in Sawmills* and *SO-EL2012-03 Electrical Equipment Located in Wood Pellet Manufacturing Plants*) intended to mitigate the risk posed by combustible wood dust. This safety order provides additional orders for all wood processing facilities and in no way reduces the obligation to operate the facilities in a safe manner consistent with all regulatory requirements and previous orders.

This safety order applies to all wood processing facilities utilizing regulated electrical or gas equipment. Some of the requirements of this safety order only apply to wood processing facilities that have electrical or gas installations of sufficient size to require an operating permit. Details on requirements for operating permits can be found in BC Safety Authority directive

[1] Wood processing facilities include all sites that cut, plane or otherwise mill wood, and all sites that handle wood cuttings, shavings, dust, or other wood byproducts. Examples of such facilities are sawmills, planer mills, pellet plants, pulp mills, chip handling facilities, wood products manufacturing plants such as plywood and OSB.

[2] BC Electrical Code defines a hazardous location, in part, as "premises, building, or parts there of, in which combustible dusts are present, or may be present, in the form of clouds or layers in quantities to require special precautions for the construction, installation, and operation of electrical equipment; or combustible fibres or flyings are manufactured, handled, or stored in a manner that will require special precautions for the construction, installation, and operation of electrical equipment."

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D-E3 070801 7 Electrical Operating Permit Requirements and in bulletin *B-G5-0411084 Gas Operating Permit Requirements.*

Required Actions

I. **Any owner or operator of a wood processing facility that utilizes regulated electrical or gas equipment** must take the following actions at any facility under its direction or control as soon as feasible, and in any case, no later than **31st December, 2013**:

1. Conduct an assessment of your wood processing facility to identify combustible dust hazardous locations:
   a. A *qualified professional*[3] shall conduct the assessment to identify combustible dust hazardous locations as defined in the BC Electrical Code
   b. The assessment shall be carried out in accordance with a recognized industry standard for combustible dust hazardous locations (refer to Appendix 'A' for guidance on recognized standards); and,
   c. The processes used in the assessment and the results of the assessment shall be documented in the records located at the wood processing facility.
2. Where combustible dust hazardous locations are identified and contain regulated electrical and/or gas equipment, prepare a plan, acceptable to a *qualified professional*, to either:
   a. Configure the equipment for safe operation given the presence of the combustible dust hazard. Safe operating configurations include:
      i. Replacement of equipment with equipment of a type suitable for operation in the identified hazardous location;
      ii. Approved modification of the existing equipment to be suitable for operation in the identified hazardous location; or
      iii. Permanent removal of the equipment from the identified hazardous location;

   or,

   b. Utilize auditable wood dust management practices for these locations as an effective means to manage the combustion hazard.
3. Record in a suitable facility document any identified combustible dust hazardous locations identified in item 1 and the chosen means to manage the combustion hazards identified in item 2.
4. Implement periodic re-evaluation and of the hazardous location assessment performed in item 1 and the wood dust management practices in items 2 to determine currency and effectiveness. At a minimum, the re-evaluation and subsequent changes must be done at least once every 5 years, or more frequently if modifications are made to the facility operations or equipment that could impact the hazardous area classification.

[3] Qualified professional is defined in Appendix 'A'

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II. **Any owner or operator of a wood processing facility** that utilizes regulated electrical or gas equipment and **that also requires a permit to operate** that equipment will take the following actions at each and any facility under its direction or control:

5. No later than **September 15th, 2013**, complete, for each facility, the Safety Order Response Form in Appendix 'B' and submit it to the BC Safety Authority. The attached form requires information about the assessment of hazardous locations required under this safety order.

6. No later than **September 15th, 2013**, documents referred to in item 3 of this safety order must be available at each facility for audit by the BC Safety Authority.

If you have any questions regarding this safety order, please contact your local electrical safety or gas safety officer through the BC Safety Authority call centre by phone at 1.866.566.7233 or by email at info@safetyauthority.ca .

Stephen Hinde, P.Eng

Provincial Safety Manager

References:

SBC 2003, c. 39	Safety Standards Act
B.C. Reg. 105/2004	Safety Standards General Regulation
B.C. Reg. 100/2004	Electrical Safety Regulation
B.C. Reg. 103/2004	Gas Safety Regulation
D-E3 070801 7	Electrical Operating Permit Requirements
B-G5-0411084	Gas Operating Permit Requirements

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APPENDIX A: Background and Guidance Information

Mechanics of a dust explosion

US National Fire Protection Association (NFPA) standard 921 - Guide for Fire & Explosion Investigations provides information on the mechanism of dust explosions.

> "*Dust explosions in industrial scenarios usually occur in a series. The initial ignition and explosion are most often less severe than subsequent secondary explosions. However, the first explosion puts additional dust into suspension, which results in additional explosions….In facilities such as grain elevators, these secondary explosions often progress from one area to another*".

Five conditions are generally required for a dust explosion to occur and these are represented as the dust explosion pentagon.

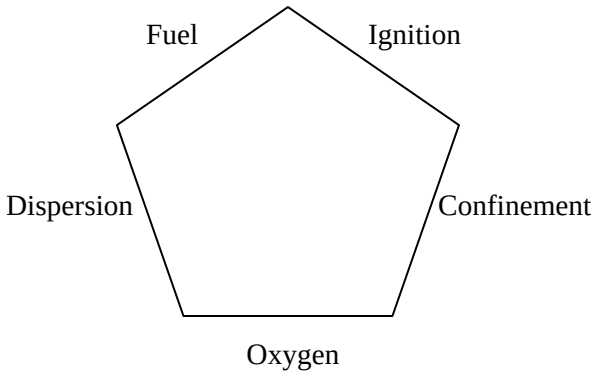

Figure 1: Dust explosion pentagon

Wood Dust as a Fuel

Several NFPA and other publically available industry standards illustrate the fire and explosion hazards presented by wood dust. Table 1 compiles published combustion and explosion characteristics of wood dust as well as other combustible dusts that are expressly identified by the Canadian Electrical Code as Group G atmospheres. Test data describing explosion and fire hazard characteristics can be sample specific; values presented in Table 1 are for general reference only.

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Material	Deflagration Index, K_{st} (bar-m/s)		Explosion Pressure P_{max} (bar)	Dust Layer Ignition Temperature (°C)
	Value	Group[4]		
Aluminum	415[2]	3 (very strong explosion)	12.4[2]	320[1]
Coal (bituminous)	129[2]	1 (weak explosion)	9.2[2]	180[1]
Sugar	138[2]		8.5[2]	370[1]
Wheat flour	87[3]		8.3[3]	360[1]
Wheat starch	115[2]		9.9[2]	380[1]
Wheat grain dust	112[3]		9.3[3]	Not Available
Wood flour	205[2]	2 (strong explosion)	10.5[2]	260[1]
Wood bark (ground)	Not Available	Not Available	Not Available	250[1]

Table 1: Sample Explosion and Fire Hazard Characteristics – derived from referenced documents

[1] *NFPA 499 – Classification of Combustible Dusts and of Hazards (Classified) Locations for Electrical Installations – 2008 Edition* – Table 4.5.2.

[2] *NFPA 68 – Standard on Explosion Protection by Deflagration Venting – 2007 Edition* – Table E1(a)

[3] *NFPA 61 – Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities – 2008 Edition* – Table A.6.2.1

[4] *Hazard Communication Guidance for Combustible Dusts – Occupational Safety and Health Administration - OSHA 3371-08 2009. Four dust explosion classes are communicated for corresponding Kst ranges – 0 is assigned a "no explosion" characteristic. Values between 0 and 200 is assigned a "weak explosion" characteristic. Values between 200 and 300 are assigned a "strong explosion" characteristic and values above 300 are assigned a "very strong explosion" characteristic.*

Table 1 illustrates that wood dust can have explosion and fire hazard characteristics similar to other known dusts that are identified as combustible dusts in the *Canadian Electrical Code*. NFPA 499 classifies wood flour as a group G combustible dust and NFPA 68 assigns wood flour a hazard class of "2", which is identified as having "strong explosion" characteristics by the US Occupational Safety and Health Administration.

WorkSafeBC conducted tests of wood dust samples collected from a number of sawmills in British Columbia, and results were described in a WorkSafeBC Advisory dated August 16, 2012. These tests confirmed that the wood dust found in sawmills presented explosion and combustion hazards, consistent with the data available in the NFPA standards.

Hazardous Locations in relation to wood dust

Various codes and standards, some listed below, provide requirements for the classification of hazardous locations, particularly in relation to equipment that may present an ignition source.

- ***British Columbia Fire Code (2012)***[4]
  The *British Columbia Fire Code* refers to *hazardous locations* as areas in which flammable gases or vapours, combustible dusts or combustible fibres are present in quantities sufficient to create a hazard. Combustible dusts are defined as "dusts and particles that are ignitable and liable to produce an explosion".

[4] This code is not under the administration of the BC Safety Authority

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- ***Natural Gas and Propane Code Handbook (B149HB-05)***
  The *Natural Gas and Propane Code Handbook (B149HB-05)* contains the following 'note on hazardous environments':
  "Hazardous environments, in relation to gas appliance installations may be practically defined as any space containing concentrations of flammable vapours, combustible dust or fibres, or explosive mixtures which may be ignited by appliance operation. Technical information on hazardous environments is available from the National Fire Protection Agency (NFPA). Refer to NFPA 499: Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas…."
- ***Canadian Electrical Code, Part 1 (C22.1-12)***
  The *Canadian Electrical Code, Part 1 (C22.1-12)* defines a Class II hazardous location as "those which are hazardous because of the presence of combustible or electrically conductive combustible dusts". Class II combustible dust atmospheres are divided into Groups E, F or G. Group G atmospheres are comprised of those "*containing flour, starch, or grain dust, and other dusts of similarly hazardous characteristics."*
- ***NFPA 664 - Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities***[5]
  NFPA 664 - Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities generally refers to hazardous locations due to dust accumulation as a location where the presence of a deflagration hazard when deflagrable wood dust is present as a layer on upward facing surfaces at a depth greater than 3.2mm (1/8 in) over five percent of the area or 93m^2 (1000ft^2), whichever is less. (Deflagrable wood dust is generally referred to as wood dust that has explosive characteristics and is available to become suspended in atmosphere. Refer to NFPA 664 for further clarification.)

Applicable safety codes require operators to identify and manage fire and explosion hazards. Special precautions are required at locations where fire and explosion hazards are likely to exist in order to control potential fuel or ignition sources.

Compliance with these codes require designers and operators to exercise a degree of foresight related to the actual operating conditions which may be encountered in the future: equipment that is code compliant at the time of installation or inspection may become non-compliant if hazardous environments are permitted to develop.

[5] This code is not under the administration of the BC Safety Authority

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Identification of hazardous locations in relation to regulated equipment

An assessment of a facility to identify hazardous locations must be done by a *qualified professional* utilizing acceptable standards. Alternatively, a team of individuals may be considered a *qualified professional* provided that all required expertise is covered by the team.

Definition of *Qualified Professional*

Persons performing identification of hazardous locations must be a *qualified professional* with expertise due to training and experience in all of the following areas:

- the operation of the facility, including knowledge in possible failure modes that may cause a hazardous location to be created;
- the application and use of the appropriate standard(s) used to classify the hazardous location. These standards may include, but are not limited to:
    - *NFPA 499: Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*
    - *IEC 60079-10-2 – Explosive atmospheres – Part 10-2: Classification of areas;*
- the requirements of the appropriate installation or operational codes for the regulated equipment. Specifically, the qualified professional must be familiar with the following:
    - *BC Fire Code*, in particular Division B, Part 5 – *Hazardous Processes and Operations;*
    - *BC Electrical Code (Canadian Electrical Code, Part I, Safety Standard for Electrical Installations* CSA C22.1 as adopted under the *Electrical Safety Regulation*), in particular Section 18 *Hazardous Locations* when electrical equipment is located within the facility; and,
    - *BC Natural Gas and Propane Code (Natural gas and propane installation code* CSA B149.1 and *Propane storage and handling code* CSA B149.2 as adopted under the *Gas Safety Regulation*) when natural gas or propane equipment is located or used within the facility.

Management of hazardous locations in relation to regulated equipment

The previously referenced regulations, codes, and standards provide details on the management of combustible dust hazards. Hazardous locations are often managed through an appropriate combination of techniques. The key methods used in relation to regulated equipment are summarized below:

- **Perform an assessment of the facility to identify hazardous locations.** Some guidelines for performing the assessment have been outlined in the previous section “Identification of hazardous locations in relation to regulated equipment”
- **Control the dust at the point of creation to prevent the release into the surrounding area.** This is normally done by the installation of ventilation systems at the milling location. These ventilation systems would themselves be hazardous locations due to the presence of combustible dust. Note that the *BC Fire Code* (2012) *section. 5.3.1.8 Electrical Interlocks* requires that dust producing equipment be interlocked with dust removal equipment.

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- **Locate the regulated equipment in an area that is not subject to the combustible dust.** This is not usually possible for all equipment, as electrical controls or lighting are required to operate the milling equipment at the source of the dust. *CEC22.1 Appendix 'E' – Dust Free Rooms* provides useful information on the construction of dust free rooms for the housing of electrical equipment.
- **Install equipment that is suitable for operation in the hazardous location, in accordance with the applicable regulation or code.** If the equipment is modified to provide this suitability, approval for the modification will be required from a suitable certification agency (see Information Bulletin: Approved Certification Marks for Electrical Products).
- **Institute dust management practices to control the degree of hazard within the hazardous location.** These practices could include the use of secondary ventilation systems or regular cleaning routines to control the level of dust in or around regulated equipment. Compressed air should not be used to blow-down dust when an ignition source is present. WorksafeBC guideline *G4.42(1) Cleaning with compressed air - Hazards of combustible dusts* issued April 30, 2012 provides further information.
- **Document the results of the hazardous location assessment and the dust management practices implemented.** These documents should be available in a readily accessible location. It is strongly recommended that duplicate copies of these, and all other records, be kept in a secure location off-site.
- **Periodically evaluate the hazardous location assessment and effectiveness of dust management practices.** Conditions can change—process changes, new equipment, wear and tear on operating systems, clean-up and maintenance practices. A hazardous location assessment needs to be performed periodically to verify that hazardous locations are properly identified. It is also important to know that any plan is effective, so period audits of the facility to ensure that the dust management practices control the dust levels as designed.

If normal operating conditions produce dust that must be managed, the location is still considered hazardous, even if management practices maintain the level of dust below hazardous levels. Permission to operate the equipment in that hazardous location may be granted, under a variance, if the level of hazard is sufficiently reduced. For those operators who are submitting the Safety Order Response Form attached to this Safety Order, the response form can be utilized to apply for the necessary variance.

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SAFETY ORDER RESPONSE FORM

No: SO-EL/GA 2013-02

The information on this form is collected to administer the provisions of the BC Safety Standards Act, and is subject to section 26 of the Freedom of Information and Protection of Privacy Act. If you have any questions about the collection, use, or disclosure of this information, contact the Records, Information and Privacy Analyst for the BC Safety Authority at 1-866-566-7233.

The company, or designated representative, in receipt of a safety order must fill out and submit a completed copy of this Safety Order Response Form (pages 1 & 2) to the BC Safety Authority **before September 15th, 2013.**

Verify that the following items have been completed as required in the above safety order:

Yes	NA	Required Action:
☐	☐	1. an assessment to identify combustible wood dust hazardous locations has been completed for your wood processing facility;
☐	☐	2. the assessment to identify combustible wood dust hazardous locations has been carried out by a qualified professional;
☐	☐	3. the assessment to identify combustible wood dust hazardous locations utilized an appropriate industry standard;
☐	☐	4. the process used in the assessment to identify combustible wood dust hazardous locations, and the results of the assessment, have been documented in records located at your wood processing facility;
☐	☐	5. you have configured the equipment for safe operation given the presence of the combustible dust hazard, or that the auditable wood dust management plan has been accepted by a qualified professional as an effective means to manage the hazard;
☐	☐	6. facility documents have been updated to include identification of combustible dust hazardous locations and the chosen means to manage the combustion hazards in those locations;
☐	☐	7. a periodic evaluation process has been implemented to ensure that your hazardous location assessment and the wood dust management practices remain effective;
☐	☐	8. this safety order response form is your request for a variance to operate electrical equipment utilizing dust management practices;
☐	☐	9. if your wood processing facility requires an Electrical Operating permit and you do not currently hold an Electrical Operating permit for this facility, you have completed and submitted an application for an Electrical Operating permit to the BC Safety Authority. (*Directive D- E3 070801 7 Electrical Operating Permit Requirements provides further details on requirements for electrical operating permits*);
☐	☐	10. if your wood processing facility requires a Gas Operating permit and you do not currently hold a Gas Operating permit for this facility, you have completed and submitted an application for a Gas Operating permit to the BC Safety Authority. (*Information Bulletin B-G5-041108 4 Gas Operating Permit Requirements provides further details on requirements for Gas Operating permits.*)

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Response Form Completion Date: Month / Day / Year

Operating Company Name: _____

Facility Address: _____

Company representative signifying completion of Safety Order requirements: _____

(Please print name)

Position Title: _____

Signature: _____

E-mail: **Phone number:**

Qualified professional who conducted the Hazardous Location assessment: _____

(Please print name)

Position Title: _____

Signature: _____

Email: **Phone number:**

Valid Electrical Operating Permit Number: _____

Valid Electrical Field Safety Representative (FSR) named on Electrical Operating Permit. Name: _____

Valid Electrical Field Safety Representative (FSR) named on Electrical Operating Permit. Registration Number: _____

If applicable - Valid Gas Operating Permit Number: _____

Return both pages of this Safety Order Response Form by one of the following methods:		
By email: Safety.Order@safetyauthority.ca	By fax: 778-396-2064 Attn: Safety Order	By mail: Attn: Safety Order BC Safety Authority 505 Sixth St New Westminster, BC V3L 0E1
By web form: http://safetyauthority.ca/dust-safety-order		