Recommendations Report

Babine Forest Products – Explosion and Fire – January 20, 2012

BC Safety Authority – Incident Investigation – Jurisdiction and Role

The BC Safety Authority administers the *Safety Standards Act* on behalf of the Province of British Columbia.[1] The *Safety Standards Act* and associated *Regulations* apply to the following products and persons doing regulated work on these products:

i. amusement devices;
ii. passenger ropeways;
iii. boilers and boiler systems;
iv. electrical equipment;
v. elevating devices and passenger conveyors;
vi. gas systems and equipment;
vii. pressure vessels;
viii. pressure piping;
ix. refrigeration systems and equipment; and
x. any other regulated product specified in the regulations.

Incidents involving products or work subject to the *Safety Standards Act* are required to be reported in accordance with Section 36 of the *Act*. The BC Safety Authority investigates these incidents in accordance with Section 37 of the *Act* and may appoint persons to assist with an investigation.

The role of the BC Safety Authority with respect to the investigation of incidents is to understand relationships between incidents, equipment and work that are subject to the *Safety Standards Act*. It is our aim for these investigations to prevent the recurrence of similar incidents and to initiate improvements toward the management of safety risks with regulated equipment and work. Often, these investigations are conducted in cooperation with other agencies including the Fire Officials, WorksafeBC, the Police and the Coroners Service.

This recommendations report is not a final investigation report. The purpose of this document is to advance hazard awareness and promote safe practices. This document outlines nine recommendations to improve the identification and management of combustible dust *hazardous locations* by wood processing facility owners and operators. Issues of enforcement action taken under the *Safety Standards Act* are not addressed in this document. Any regulatory compliance activities arising from this incident will be documented separately.

[1] Some municipalities administer portions of the *Safety Standards Act*.

Incident Synopsis

On January 20, 2012 at approximately 8:07pm, an explosion and fire occurred in the Babine Forest Products sawmill located at 19479 Highway 16 East, approximately 20 kilometers East of the town of Burns Lake, British Columbia.

The explosion and fire caused two fatalities and injured 20 people. The sawmill was destroyed by the explosion and fire.

Site Information

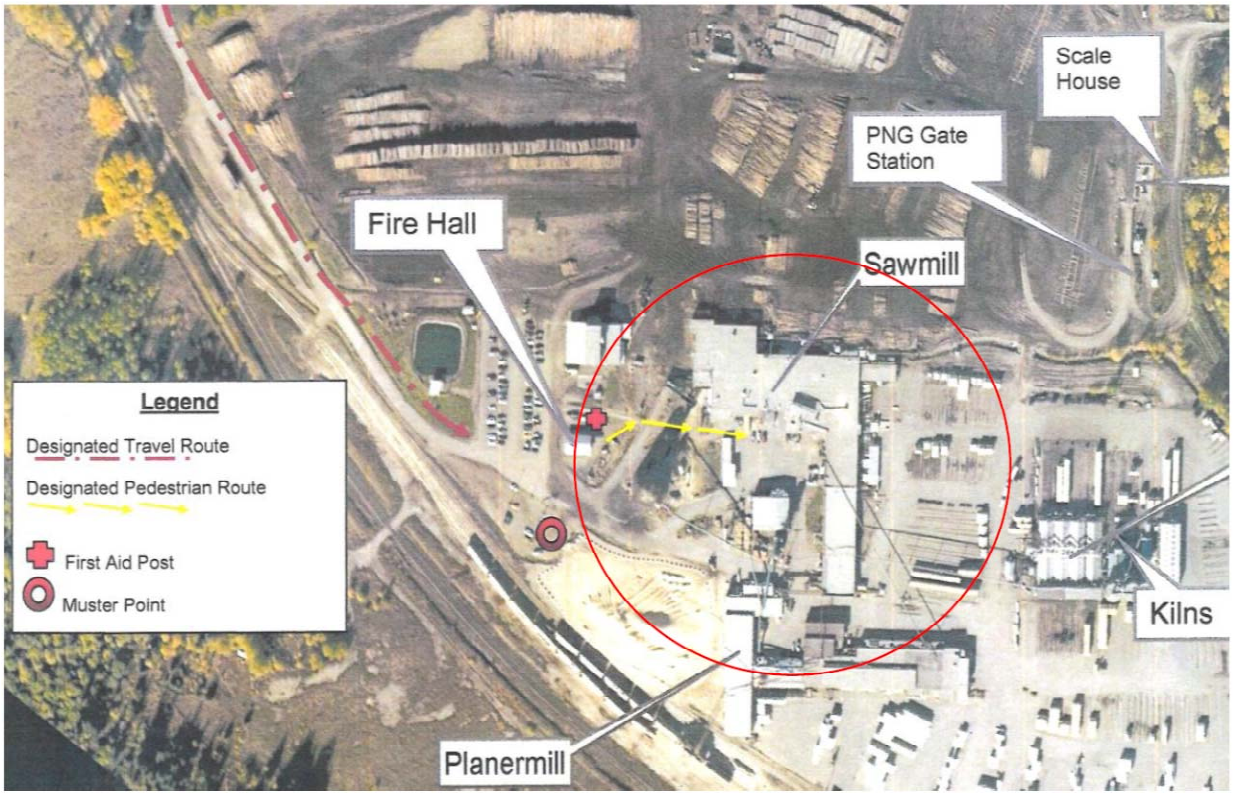
Safety Officers and a contracted certified fire and explosion investigator were dispatched by the BC Safety Authority to the sawmill site to identify equipment and systems subject to the *Safety Standards Act*, evaluate the role that this equipment, or its operation may have had regarding the incident and to identify non-compliances with the relevant *Regulations*. WorksafeBC assumed the role of lead investigating agency, responsible for overall control of the site and evidence removed for evaluation. While there was professional collaboration from all on-site investigating organizations, each organization was responsible for making findings and conclusions independently.

Photograph 1 shows an aerial view of the Babine Forest Products site, which consisted of numerous buildings and structures including the sawmill. On January 20, 2012, the sawmill at Babine Forest Products site near Burns Lake utilized equipment that was subject to the *Safety Standards Act*.

Natural gas fuelled appliances, natural gas distribution components, propane storage, propane dispensing, portable propane cylinders and propane appliances were in use at the sawmill and are subject to the *Gas Safety Regulation*.

Boilers, pressure vessels and pressure piping systems were in use at the sawmill and are subject to the *Power Engineers, Boilers, Pressure Vessel and Refrigeration Safety Regulation*.

Electrically powered appliances, electrical equipment, electrical signal and power distribution components were in use at the sawmill and are subject to the *Electrical Safety Regulation*.



Photograph 1: Aerial view of the Babine Forest Products site prior to the explosion and fire of January 20th, 2012.

Incident Investigation Recommendations

Owners and operators of wood processing facilities are responsible for the safe use of regulated electrical and gas equipment at their facilities, including the proper configuration of equipment used in *hazardous locations*. The safe use of equipment involves maintaining an environment that is suitable for regulated equipment. As a result of this incident, the BC Safety Authority intends to order wood processing facility owners and operators to document an assessment of their facilities, specifically for *hazardous locations* and effective hazard management. The assessment under consideration would be completed:

- by a professional that is qualified to identify combustible dust *hazardous locations*, and
- in accordance with a recognized industry standard for combustible dust *hazardous locations*.

The BC Safety Authority therefore makes the following nine recommendations to improve the identification and management of combustible dust *hazardous locations* by wood processing facility owners and operators.

Recommendations to Owners and Operators of Wood Processing Facilities:

Recommendation #1:
Document a facility assessment to identify *hazardous locations* that is completed:

- by a professional that is qualified to identify combustible dust *hazardous locations*, and
- in accordance with a recognized industry standard for combustible dust *hazardous locations*.

Recommendation #2:
Where *hazardous locations* are identified and contain regulated equipment, document a plan to either:

- develop and implement auditable wood dust management practices for these locations that are accepted by a qualified person as an effective means to manage the combustion hazard, or
- configure the equipment for safe operation given the presence of the combustible dust hazard. Safe operating configurations include:
    a) obtaining approval for operation in the *hazardous location,* or
    b) permanent removal of the equipment from the *hazardous location*.

Recommendation #3:
Incorporate any identified *hazardous locations* and the chosen means to manage the combustion hazards into the facility's *Fire Safety Plan*, or other suitable facility document(s).

Recommendations to the BC Office of the Fire Commissioner:

Recommendation #4:
Publish a list of professional qualifications suitable for individuals who identify wood dust combustion and explosion *hazardous locations* in an industrial environment.

Recommendation #5:
Identify suitable fire and explosion prevention guidance material to be used in BC for the identification and classification of *hazardous locations* due to combustible wood dusts.

Recommendation #6:
Add details of a qualified person and accepted guidance material related to *hazardous location* classification and management into the *Fire Safety Plan* requirements of the *BC Fire Code*.

Recommendations to the Canadian Standards Association:

Recommendation #7:
Specifically identify wood dust as a combustible dust belonging to group G dusts in section 18 of the *Canadian Electrical Code, Part 1*.

Recommendation #8:
Improve coordination between section 18 of the *Canadian Electrical Code* and referenced fire and explosion prevention standards for *hazardous location* identification and classification.

Recommendation #9:
Improve the natural gas and propane code requirements and accompanying guidance material relating to *hazardous location* identification and alignment with fire prevention standards.

Hazardous Locations

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 in respect of the actual operating conditions which may be encountered in the future: equipment which is code compliant at the time of installation or inspection may become non-compliant if hazardous environments are permitted to develop.

This discussion of *hazardous locations* and code material is being summarized to provide an understanding of the requirements in existence relative to combustible wood dust which is applicable to sawmill environments. This discussion also provides additional context for the recommendations made by the BC Safety Authority.

British Columbia Fire Code

The BC Safety Authority does not administer the *British Columbia Fire Code*; however, the code contains useful excerpts.

At the time of the incident, the 2006 edition of the *British Columbia Fire Code* was adopted by the Province of British Columbia. Division B, Part 5 – *Hazardous Processes and Operations* applies to "processes and operations that involve a risk from explosion, high flammability or related conditions that create a hazard to life safety". Section 5.3 – *Dust-Producing Processes* applies "…where *combustible dusts*[2] are produced in quantities or concentrations that create an explosion or fire hazard." The current 2012 edition contains similar requirements.

These sections of the *British Columbia Fire Code* require:

- Wiring or electrical equipment located in *hazardous locations*[3] to conform to the *British Columbia Safety Standards Act* and pursuant regulations for hazardous locations.
- The preparation of a *Fire Safety Plan* for hazardous processes or operations that includes (but not limited to) the control of fire hazards.
- Bonding and grounding of electrically conductive parts.
- Electrical interlocking of dust producing equipment to required dust removal equipment.

[2] Combustible dusts means dusts and particles that are ignitable and liable to produce an explosion. (British Columbia Fire Code – 2006 Edition)

[3] The British Columbia Fire Code (2006 edition) refers to hazardous locations as being areas in which flammable gases or vapours, combustible dusts or combustible fibres are present in quantities sufficient to create a hazard.

- Control or removal of equipment that may produce an ignition source and conformity to the hazardous locations requirements of the *British Columbia Safety Standards Act.*

Canadian Electrical Code

The *Electrical Safety Regulation* adopts the *Canadian Electrical Code* (with BC amendments) as the technical standard for most electrical equipment in the Province. BC Amendments to editions of the Code did not affect the requirements discussed below.

Section 18 of the Electrical Code applies to electrical equipment and wiring installed or used in *hazardous locations*. Rule 18-004 classifies *hazardous locations* according to the nature of the hazard, as follows:

(b) Class II locations are those that are hazardous because of the presence of combustible or electrically conductive combustible dusts;

(c) Class III locations are those that are hazardous because of the presence of easily ignitable fibres or flyings, but in which such fibres or flyings are not likely to be in suspension in air in quantities sufficient to produce ignitable mixtures.

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.*" Appendix B guidance material relating to Rule 18-008 of the *Canadian Electrical Code,* although not a binding requirement, includes wood flour in a list of combustible dusts. The group G definition and associated guidance material suggests a combustion hazard be considered when operating in the presence of wood flour or dust.

Section 18 prescribes installation techniques to separate the combustion hazards from potential electrical ignition sources in Class II and III *hazardous locations*, including:

- Use of metal conduits and sealed enclosures for wiring (18-202, 204, 252, 254, 302 & 352)
- Sealing and use of dust tight enclosures for switches, motor controllers etc (18-206, 256, 304 & 354)
- Use of outside clean air for electrical component ventilation (18-212, 262, 310 & 360)
- Use of luminaires and other equipment that is certified for the hazardous environment (18-216, 220, 264 and others)

Propane and Natural Gas Codes

At the time of the incident, the 2010 editions of the *Propane storage and handling code* (CSA B149.2-10) and the *Natural gas and propane installation code* (CSA B149.1-10) were adopted by the *Gas Safety Regulation*. Each code contains a section titled *hazardous locations* with the following requirement:

> *An appliance, unless certified for installation in a hazardous location, shall not be installed in any location where a flammable vapour, combustible dust or fibres, or an explosive mixture is present.*

The 2005 edition of 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….*

Fire and Explosion Prevention Standards

Several (US) National Fire Protection Agency (NFPA) and industry standards are publically available that illustrate the fire and explosion hazards presented by wood dust. Table 1 below 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.

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

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]

Notes:

[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 above 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. Given the above, wood dust and potential ignition sources exposed to wood dust are required to be managed. Locations where wood dust accumulates or is suspended in atmosphere are considered hazardous locations.

Testing of wood dust samples from BC sawmills was conducted by WorksafeBC and the results are described in WorksafeBC Industry Update dated August 16, 2012. This advisory confirms that wood dust types found in BC wood processing facilities present explosion and combustion hazards.

NFPA 664 - Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities identifies that "*portions of the facility where* [wood] *dust accumulations occur or where suspensions of wood dust in air could occur shall be equipped with electrical systems and equipment per Article 502 or 503 of NFPA 70, National Electrical Code*[4]". With respect to *hazardous locations* due to dust accumulation, the standard generally describes the presence of a deflagration hazard when deflagrable wood dust[5] 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.

[4] Article 502 or 503 of NFPA 70, National Electrical Code is similar to section 18 of the *Canadian Electrical Code* for *hazardous locations*. Article 500 is Hazardous (Classified) Locations while 502 is Class II [combustible dust] Locations and 503 is Class III [combustible dust] Locations.

[5] Deflagrable wood dust is generally referred to as wood dust that has explosive characteristics and is available to become suspended in atmosphere. NFPA 664 contains specific definitions for these terms.

Application of *Hazardous Location* Requirements

Areas of sawmills where accumulations of deflagrable wood dust may be present or areas where operations could generate a suspension of wood dust in the atmosphere should be considered as potential *hazardous locations* as described by the *Canadian Electrical Code*, propane and natural gas codes as well as other industry standards.

Industry professionals with the appropriate knowledge and experience necessary to evaluate the combustion risk of a potentially *hazardous location*, should be consulted to confirm the classification as hazardous, or not, and to evaluate the effectiveness of hazard management techniques. Classifications of *hazardous locations* and the evaluations of hazard management techniques should be conducted in accordance with accepted industry standards, such as NFPA 499 and NFPA 664.

Electrical and gas equipment installed within a classified *hazardous location* must comply with the applicable *hazardous location* requirements.

Compliance with the *Safety Standards Act*

The *Safety Standards Act* contains the following requirement:

> ***Operation and use of regulated products***
> *69 (3) A person must not use a regulated product in a manner that is unsafe or that creates a risk of personal injury or damage to property.*

During installation, assumptions are made to support the selection of appropriate configurations and use of electrical equipment. Any condition deemed necessary for a particular configuration to be compliant at the time of installation must be maintained during operation. If operational activity results in a drift away from assumed conditions necessary for the type of installation to remain safe, so that a residual byproduct of production creates or contributes to a hazardous environment or location, compliance should be re-evaluated.

If wood dust management activities fail to maintain a non-hazardous environment, equipment and installations in use at those locations that are not certified or configured for such a *hazardous location* fail to remain in a safe condition and are non-compliant to the *Safety Standards Act*.