RECOMMENDED GOOD PRACTICE

FIRE PROTECTION IN DIRECT CONTACT EVAPORATORS AND ASSOCIATED EQUIPMENT

THE BLACK LIQUOR RECOVERY BOILER ADVISORY COMMITTEE

April 2024

Notice and Disclaimer of Liability Concerning Recommended Guidelines and Procedures

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CHAPTER 1 INTRODUCTION

Historical data indicates that fires will normally not occur if all normally wetted surfaces in a direct contact evaporator (DCE) are continually "washed" with black liquor. In normal operation, the flue gas temperature drop across the DCE precludes the possibility of fires in equipment downstream of the DCE. The loss of black liquor flow, to or within the DCE, can result in evaporation of black liquor. Dry deposits can form and ignite due to the flue gas temperature being above the ignition temperature of the dried black liquor solids.

Proper equipment installation and system operation along with documented operating procedures will assist in preventing the over-concentration of the liquor, preventing lignin precipitation and assuring continuous wetting of the DCE surfaces, which are designed to be wet in order to avoid the accumulation of dried solids. Fires cannot develop without the presence of dried liquor deposits and high gas temperatures or other sources of ignition.

The facility personnel will be in the best position to determine the most appropriate fire prevention/suppression for the specific equipment they operate. Input from the equipment manufacturer or servicing group, awareness of design specifications and documentation, awareness of historical operational data, and other site specific information give the plant unique insight into the requirements of the operation.

CHAPTER 2 DEFINITIONS

Black Liquor - Aqueous liquid by-product resulting from the alkaline pulp manufacturing process and containing inorganic and organic substances.

Low Solids Black Liquor – Black liquor containing 58% or less total solids.
Heavy Black Liquor – Black liquor containing greater than 58% total solids.
Strong Black Liquor – Black liquor leaving multiple effect evaporators.
Weak Black Liquor - Black liquor before multiple effect evaporators.

Cascade Evaporator - A cylindrical bundle of tubes or plates attached to a hub and rotated by a horizontal axle. The horizontal elements and axle shaft form a wheel much like a paddle wheel, except that the elements provide lower resistance to the black liquor and flue gases. As the wheel rotates, the elements dip into and pass through the black liquor pool in the bottom. The rotation acts like a pump to lift the black liquor out of the pool. The hot flue gases heat the surface film, evaporating the moisture and concentrating the black liquor. The cascade evaporator is a direct contact evaporator because the hot flue gases directly contact the liquor being evaporated.

Cyclone Evaporator - An evaporator in the shape of a cylinder in which the flue gases enter tangentially near the bottom and exit at the center of the top. The black liquor is sprayed into the flue gases at the tangential entrance and around the top of the cylinder. The concentrated black liquor flows down the sides of the cyclone cylinder into a funnel and out the bottom. The evaporated moisture is carried out the top with the flue gases. A cyclone evaporator is a direct contact evaporator.

DCS: Distributed Control System - a control system whereby intelligent controllers and associated input/output hardware control different parts of the process, and are interconnected to each other by communication links.

Direct Contact Evaporator (DCE) - A heat exchanger in which hot flue gases are in direct contact with the black liquor. As the flue gases heat the liquor, water is evaporated. This is used to concentrate the black liquor up to a minimum of 58 percent total solids for firing.

Direct Contact Evaporator Outlet Temperature Interlock – A system that monitors direct contact evaporator outlet temperature, alarms at 100°F (55°C) above operating temperature and interrupts all fuel firing at 200°F (110°C) above operating temperature. It also terminates combustion airflow on trip and may actuate a fire extinguishing system.

Emergency Shutdown Procedure (ESP) System - The ESP system permits immediate termination of all fuel firing and rapid draining and depressurization of the boiler if water is suspected to be entering the recovery furnace.

Evaporator Outlet Temperature – Temperature of the flue gases leaving either the cyclone or cascade-type black liquor evaporator of a recovery boiler system.

Interlock - A device that senses a limit or off-limit condition or an improper sequence of events. It causes shutdown of the offending or related piece of equipment, or it prevents proceeding in an improper sequence, to prevent a hazardous condition. Direct signals rather than transmitted signals shall be used wherever possible to actuate interlocks.

Monitor – To sense and alarm a condition requiring attention, without initiating corrective action.

Precipitator -A means (usually electrostatic) of collecting dust in the flue gases just before they go up the stack. The flue gases pass through a high-voltage electric field and dust particles take on an electrostatic charge. The charged dust particles are then attracted to oppositely charged plates or wire in the chamber. The dust particles attach themselves to the plate or the wire and accumulate into clumps that are too heavy to be carried in the flue gas stream. These clumps fall into a hopper and are carried away.

Precipitator Outlet Temperature - Temperature of the flue gases leaving an electrostatic precipitator of a recovery boiler system.

Supervise - To sense and alarm a condition requiring attention. This may also automatically initiate corrective action.

Total Solids - All non-water constituents of the black liquor, which is the sum of dissolved and suspended material in the liquor.

CHAPTER 3 PREVENTION

3.1 General

This section provides general guidelines and accepted procedures that assist in the prevention of fires involving DCE units and associated equipment. The guidelines that follow attempt to assist the facilities in determining possible steps to be taken to prevent fires.

3.2 Safe Operating Practices

3.2.1 General

Safe operating practices should be written and should be prepared for the DCE unit and associated equipment. Operators should be trained on these procedures with this training updated at least annually.

3.2.2 Normal Operations

Safe operating practices should include the monitoring of instrumentation that would indicate possible upset conditions that could lead to a DCE system fire. Instrumentation in the control room should be adequate to monitor:

- Cascade or Cyclone level
- Cascade wheel movement
- Cascade wheel drive amperage
- Temperature of flue gas at the outlet of the evaporator
- Pressure drop of flue gas across the evaporator
- Damper position
- Wall washer pressure/flow (for cyclones flow is more important as pressure might be maintained with plugged nozzles and no flow)
- Agitator operation

3.2.3 Upset Conditions

Safe operating practices should include procedures to follow in the event of upset or abnormal conditions. These should include but not be limited to the following:

- Cascade wheel stoppage or slow down
- Boiler trips
- ESP
- High Cascade Drive Amp Readings (suggestion: alarming at 30% above norm) (tripping the cascade is not recommended as that can create a greater fire potential)
- Coupling failure
- Loss of Black Liquor Flow or low flow
- Mechanical damage to the system
- Power Outages
- Start ups and Shutdowns
- Dumping vats while firing auxiliary fuel
- Agitator/Flow Box Scraper failure
- Strainer pluggage
- High and High/High Temperature in the DCE

3.2.4 Additional Considerations for responding to Upset Conditions

Actions taken at the time of an upset condition can reduce the chances for a fire to occur. Most fires are delayed and with an ongoing upset, there may be other issues being dealt with that can delay fire discovery. The following should be considered, but each mill needs to be sure these make sense for their operation:

- Automatic introduction of dilution water during an ESP event. (Also consider if there is a loss of circulation pumps, high amps on cascade drive, or other upsets)
- Maintain solids in operational range and adjust dilution as needed.
- Monitor cascade amps during upset conditions to ensure adequate dilution.
- Keep the cyclone recirculating and the cascade rotating during any upset.
- Monitor conditions for potential fire development. Can fire control functions be accomplished in the safety of the Control Room? This would include both fire system activation (steam and water) as well as damper closures. This might be especially important if the upset is an ESP.
- Monitor not just cyclone water wall wash pressure, but also the flow.
- Activation of steam smothering during loss of cascade rotation.
- If bypass ducting is provided around the DCE, consider opening it in upset conditions.

3.3 Physical Installation and Design

The following factors should be considered when designing or modifying a Direct Contact Evaporator. This list should not limit the designer from providing any appropriate passive or active fire prevention features.

- Eliminate rear shelves or other horizontal surfaces in areas where there is a possibility of accumulation of dried black liquor solids. Any necessary horizontal surfaces should be located below the normal liquid level, or be provided with agitators or liquor sprays.
- Liquor level indicators should be suitable for the environment, and be readily accessible for service. Provisions for steam cleaning may be advisable.
- Duct showers should be considered so as to maintain wetted surfaces.
- Temperature probes should be located where they will be most effective.
- Insulate ductwork expansion joints and doors to prevent cold side adhesion and corrosion.
- Provide complete access for cleaning and inspection, internally and externally. Inspection doors placed above the Cascade wheel would allow inspection and washout during shutdowns.
- Provide density measurement directly on the recirculation medium to allow for more consistent liquor quality and assure that wheel and/or wall wetting remains adequate.
- Provide a means to inspect and clean the fire protection nozzles on a routine basis (i.e. nozzle piping arrangement should allow for rodding out)
    - Fire protection nozzles should be placed in an area accessible for cleaning, maintenance and visual inspection or a means to access the nozzles should be provided.
    - Fire protection nozzles should be arranged in a way that they can be inspected and cleaned, such as in a T-configuration with a quarter turn valve to allow rodding out of the piping. The quarter turn valve should be located on the outside portion of the tee so that it does not impair the path of steam to the boiler. When the valve is opened, a rod can be used to open the piping obstructions. Proper safety measures should be established so the steam source is isolated during rodding procedures.
    - The steam system should be tested regularly by purging the steam lines to assure the piping is not compromised or plugged. The steam supply valve should be arranged in a way to flow steam without tripping the boiler. Infrared thermal imaging cameras are a good tool to verify steam flow through the nozzles and identify pluggage while steam is activated.

3.4 Electrical and Instrumentation

Instrumentation should be installed, maintained and classified as designated in the BLRBAC document “Instrumentation Checklist and Classification Guide for Instruments and Control Systems Used in the Operation of Black Liquor Recovery Boilers”.

Changes to any instrumentation system should be well communicated to all interested parties, including but not limited to engineering, maintenance and operations personnel. It is suggested that a "Management of Change" system be employed to provide for consistent communication of any changes.

All instrumentation should be tested and inspected on a regular basis and calibrated as often as required to provide a reasonable level of reliability and accuracy in operation.

3.5 Operator Checks

Operator checks should be established based upon past operating conditions and be performed as directed by the unit manufacturer (OEM). Typically, these items are performed once every four hours. Experience will allow a modification of this frequency without sacrificing reliability of operator awareness. These checks should include, but not be limited to the following:

- Level indicator readings checked and verified
- Overflow
- Temperatures and trend, on DCS if possible
- Wall wash flow
- Strainers and Scrapers
- Draft differential across Cascade
- Field inspect evaporators for proper operation and build-up
- Verify that flow box bypass (Cascade low level drain valve) is closed.

3.6 Inspection and Cleaning

- Inspection and cleaning schedules should be developed as determined from past operating history and per manufacturers recommended practices.
- Inspection and cleaning should be performed during major outages.
- Boil outs should be performed based on past operational history of the unit.
- Inspect, and clean as necessary, nozzles, wall wash nozzles and system piping during evaporator shutdowns. Particular attention should be given to the removal of any dried solids left on vertical or horizontal surfaces.
- Wash ducts as often as experience deems necessary
- The results of inspection and washing operations should be documented. The scope and frequency of future inspections should be established based on these results.

- Ductwork and expansion joints should be surveyed periodically for structural integrity.

3.7 Maintenance Checks

The following maintenance checks must be done consistently to assure that conditions, which are favorable to combustion inside or outside the evaporator, are not allowed to develop. This is not a list of routine maintenance activities, but periodic checks to be made and documented by responsible and knowledgeable parties who will decide whether or not the equipment can be operated safely until the next inspection. It will be assumed for the purposes of this document that condition monitoring of electrical and mechanical equipment, including vibration monitoring, thermal scanning, and lubricating oil analysis is part of an overall maintenance program.

These checks should be frequent enough so that inoperative equipment or malfunctions will not go undetected for any period of time. Checks should be scheduled for regular intervals, which, it is recommended, should not exceed twelve (12) months.

3.7.1 Chain drive (Cascade)

- An insulation resistance test should be made from the contactor, which feeds the drive motor.
- A visual inspection of the bearings should be done to assure proper lubrication. This might consist of a document review or the confirmation of the presence and proper use of fixed lubricating units.
- Sprockets, large and small, should be visually examined for excessive wear or cracking.
- The chain itself should be visually examined for excessive wear or damage.
- A visual inspection of cage bearings or pillow blocks should be done to assure proper lubrication.
- A visual inspection of any hydraulic clutch should be made for any oil leakage or gross misalignment.
- A visual inspection of any magnetic clutch should be made for mechanical integrity and gross misalignment.

3.7.2 Dilution/Recirculation Pumps

- Pump drive motors should be insulation resistance tested from the contactor.
- Motor current draw should be observed and compared with design specifications.
- Couplings should be dismantled and examined for wear, unless the pump has a single solid shaft.
- Pump seals should be examined and evaluated for effectiveness.

- Pump performance should be evaluated to detect wear or damage of the pump impeller.

3.7.3 Dampers, Valves, and Piping

- Valves in the liquid circuits around the evaporator should be cycled to assure full and free movement.
- Valve controllers should be cycled through their entire range.
- Dampers or guillotine valves should be cycled to assure full and free movement.
- Damper controllers should be cycled through their entire range.
- Steam, liquor and dilution piping should be visually examined for damage or wear if feasible. If pipes are insulated, sufficient insulation should be removed to inspect areas where flow-accelerated corrosion may occur.
- Piping not normally used should be examined under pressure.
- Piping repairs should be examined under operating conditions before returning the evaporator to service where possible.

3.7.4 Agitators, Flow Box Scrapers and Strainer Systems

- An insulation resistance test should be made from the contactor, which feeds the agitator or strainer drive motor.
- A visual inspection of the bearings should be done to assure proper lubrication. This might consist of a document review or the confirmation of the presence and proper use of fixed lubricating units.
- The strainer or scraper element should be examined visually.
- A visual inspection of the agitator or scraper shaft should be made to look for gland leakage.

3.7.5 Instrumentation

Devices, which are part of control and/or alarm circuits, should be tested as part of the control loop to prove the entire loop. These would include temperature sensors, level sensors, liquid density sensors, motor ammeters and any other device that monitors conditions in or on the evaporator and initiates action on the part of the control device.

3.7.6 Structure

- Ductwork, expansion joints and inspection ports should be examined regularly and repaired as soon as practicable to eliminate air leakage.
- The Cyclone body or the Cascade casing should be visually inspected for damage or wear. Care should be taken to catch any sign of settling, distortion, or misalignment.

- Consideration should be given to performing nondestructive examination of the areas where gas flow or liquid flow is likely to wash evaporator casing or body.
- The Cascade Wheel Shaft should be inspected and tested on a regular basis to assure structural integrity. Failure of a shaft can result due to fatigue over time and result in a cascade trip, possible fire situation, and long term interruption to operations until the shaft is repaired/replaced. Failure of wheel tube welds at an increased rate can be an indication of shaft failure
  - Ultrasonic Sheer Wave Testing has proven to be one effective means to test the shaft integrity. Any time the shaft is fully exposed, the recommendation is to perform MT (magnetic particle testing) or PT (dye penetrant testing) where other parts come in contact with the shaft.

3.7.7 Outage

Internal visual inspections should be performed to assure that there is no significant buildup of dried solids on the inside of the body or any horizontal surface within the body of the Cyclone or the casing of the Cascade.

Internal structures and fixtures, including all nozzles, sensing probes, the wheel, and ductwork into and out of the unit, should be visually inspected for wear or damage.

All conditions found should be documented. This documentation should be used to establish repair priorities for future outages.

CHAPTER 4 FIRE SUPPRESSION/DETECTION

4.1 General

Due to its ability to absorb heat, water is the preferred fire-fighting medium. Supplies of mill fire protection water are typically designed to be available regardless of plant condition. For these two reasons alone, a water spray system is the first choice for a suppression system protecting a Direct Contact Evaporator. Concern has been expressed about water spray initiating a smelt-water reaction during a fire. A properly designed system will initiate quickly enough, and bring the temperatures down far enough to preclude the formation of smelt. If molten smelt is not allowed to form, no reaction is possible.

Steam can be an effective fire-fighting medium, but loss histories indicate steam systems designed in the past were not effective because the limitations of the systems were poorly understood. Correct placement of steam injection nozzles and reliability of steam supply are crucial to a successful and effective installation.

Current and accurate drawings of any fire suppression system should be maintained on site, and be available to control room operators.

Regardless of the style of suppression system chosen, manual activation of any part of the system must not require operators or Emergency Response Team (ERT) members to enter an area deemed unsafe during a fire in the Direct Contact Evaporator.

Regardless of the means of activation, a manual reset should be required of the fire suppression system.

It is recommended that to provide adequate suppression capacity, with maximum flexibility, one of the following combinations of fire suppression systems should be installed:

- An automatic water spray suppression system, which can also be activated manually from a safe location.
- An automatic steam suppression system with no alternate steam supply, which can also be activated manually from a safe location. This system should be backed up by a manual, pre-piped water suppression capability.
- An automatic steam suppression system with an alternate supply of steam, which will provide steam flow at design capacity regardless of plant condition for the time required to reduce the temperature in the DCE below the High High Alarm temperature.

4.2. Design

4.2.1 Water

The following items should be considered when designing a water-based fire suppression system for a Direct Contact Evaporator:

- The system should be an automatic deluge type, with spray nozzles or open sprinklers.
- Any valves, which need to be manually operated to initiate fire fighting, should be located so that they are easily and safely accessed during a fire.
- The nozzles or open sprinklers should be installed at the inlet and outlet and within any cascade evaporator.
- The nozzles should be installed at the inlet and outlet of any ID fans located upstream of the precipitator.
- Nozzle orientation should be such that debris will not collect in or on them.
- Cyclone and separator protection can be provided by a secondary water supply to the wall wetting nozzles. A separate water supply flowing through the process

nozzles is another option. As pluggage of process nozzles is a possible cause for the presence of dried solids, and increases the risk for a fire, a separately piped system may provide the more reliable protection.

- At least one nozzle or sprinkler should be provided for every 10 ft. (3 m) of enclosure or duct width between the outlet of the DCE and the inlet of the precipitator. The horizontal area protected by each nozzle should not exceed 100 ft^2 (9.3 m^2) The systems should be designed to deliver at least 0.15 gpm/ft^2 (6mm/min) of horizontal area. Nozzle positions in other-than-horizontal runs of ducts, should be placed to provide proper protection based upon duct orientation and process conditions. Unlike horizontal ducts, 10 ft. (3 m) spacing of nozzles may not be required.
- Water flow alarms should be provided with an annunciator in the recovery control room.
- Sprinkler heads, nozzles, and piping should be suitable for the environment. Sprinklers could be non-corroding or coated. There should be consideration of the potential for plugging of sprinkler heads. Loose fitting caps tethered to prevent entering the liquor system or flexibly installed heads (braided hose with sprinkler head on a plate) would allow easy inspection of the condition of heads and replacement of plugged heads.
- Consideration should be given to any live load imposed on ductwork or casing framework by the discharge of a water-based system.

4.2.2 Steam

The following items should be considered when designing a steam-based fire suppression system for a Direct Contact Evaporator:

- Nozzles should be installed at the inlet and outlet of the evaporators, within the evaporator, within the ducts between the evaporator and precipitator, within the ID fan housing downstream of the evaporator, and within the inlet duct to the precipitator.
- Nozzles should be protected against plugging.
- Nozzles should have a minimum orifice of 1 inch (25 mm).
- Steam nozzles should be sized and positioned in order to assure proper distribution of steam throughout the volume to be protected. The steam application rate should be 2.5-lbs./100 ft^3/min (0.4 kg/m^3/min). The enclosure volume should include the inlet duct to the evaporator, the evaporator free volume, the outlet duct from the evaporator to the ID fan, the ID fan housing and the duct from the ID fan to the electrostatic precipitator.
- The steam supply should be available regardless of plant conditions. The recovery boiler being protected should not supply the suppression steam. Both the fire suppression supply and any process steam demands should be met simultaneously.

- Steam from nozzles on the bottom or the sides of the enclosure may be more effective at suppressing the fire than nozzles placed only in the top of the casing.
- An appropriate pressure steam source should be chosen with due consideration to potential structural damages.
- Steam nozzles and piping should be suitable for the environment.
- Steam Smothering valves should alarm back to a manned control room indicating the steam valve is open.

4.2.3 Detection

The following items should be considered when designing a detection system capable of supervising and initiating a fire suppression system in the Direct Contact Evaporator:

- Temperature detectors should be provided at the outlet of the evaporator and the outlet of the electrostatic precipitator.
- Additional detectors may be needed for any multiple evaporators or precipitators.
- Additional detectors may also be warranted within ductwork, especially over areas where accumulations of combustibles might be expected.
- The detectors should activate a High alarm at the recovery control room at a temperature of 100°F (55°C) above normal and a High High Alarm should activate at 200º F (110°C) above normal operating temperature.
- The High High Alarm point should be interlocked to initiate a Master Fuel Trip and operate the fire suppression system. The ID fans should also trip, the inlet damper to the precipitator should close automatically or safely by operator action during upset conditions including ESP, and the FD fan inlet louvers should close automatically.
- The boiler should be prevented from restarting until the temperatures within the Direct Contact Evaporator are normal.

4.2.4 Additional Considerations

The restarting of the fans has the potential for causing an explosion, as it is likely that gases generated by bed pyrolysis will be present.

- Wash water should be available in the vicinity of the evaporator, to facilitate cleanup after a fire.

- The fire suppression systems should remain in operation until it has been determined that the fire is out and detectors are reading normal temperatures again. Manual reset should be based on a mill’s procedure defining the reset criteria.

- Opening the access ports has the potential for causing a flare-up of the fire. If the fire becomes significant again, the ports should be closed and fire suppression reactivated.

- Operators and fire brigade members should receive regular training in fire fighting procedures relating to the Direct Contact Evaporator. The procedures should be in writing and should include how and when to manually activate any fire protection systems.

4.3 Inspection/Testing

Upon installation, the fire suppression system must be given a full system check. This should be done before allowing liquor into the unit. All components of the fire detection and suppression system must be functionally tested as a unit insofar as is practicable. Both manual and automatic methods of discharge must be used when performing this check.

The applicable National Fire Prevention Codes, the local construction codes, the OEM, and the Authority Having Jurisdiction should be referred to when choosing the scope and frequency of inspection. In any case, the primary and secondary (or backup) components of the fire protection system including manual activation capability should be functionally tested at least every 12 months (every major outage). A program of alarm testing should be implemented that assures all relevant alarms are tested periodically. It is recommended that valve position checks be performed at least monthly, and water flow alarm tests be performed at least quarterly.

Procedures for boiler start-up should include steps to assure that the fire suppression system is available for service. This may include a visual examination of equipment, and a manual operation of the system, proving flow of the suppressing medium. Normally open block valves controlling the availability of medium should be locked open before firing liquor.

Where the discharge path of the suppressing medium could become obstructed by liquor solids, care should be taken to shield the discharge path or a weekly manual operation of the suppression system should be done sufficient to clear the discharge path.
Inspections and tests should be documented and reviewed by management. Drawings of the system should be updated whenever a change is made and be available for review.

CHAPTER 5 FIRE EMERGENCY RESPONSE

5.1 General

- Facilities should prepare written departmental and emergency response procedures to adequately respond to fire emergencies in Direct Contact Evaporators and associated equipment.

- Facilities should provide adequate type and amount of manual fire fighting equipment to respond to the anticipated fire emergency.

- Employees should be adequately trained to perform duties as outlined in written procedures. Training should include instruction in the hazards that are inherent to Black Liquor and Direct Contact Evaporators.

5.2 Operations - Preplanning

The department responsible for the operation of the Recovery Boiler and associated equipment should establish or be provided with written procedures for the proper handling of a fire emergency involving Direct Contact Evaporators and associated equipment.

These written procedures should include at least the following:

- Procedures to safeguard people and equipment during a fire emergency and control the operation of the boiler.

- Emergency notification procedures for department employees and visitors, the facility emergency response group, if one is provided, and off site emergency response agencies.

- The proper activation of fixed fire suppression systems or to ensure that automatic systems have activated.

5.3 Emergency Response - Preplanning

A written pre plan for fire fighting activities should be developed based on input from the operations department, the facility emergency response group, where provided, and responding off-site emergency response agencies.

Fire fighting activity is site specific and emergency response procedures should be based on many factors including but not limited to the following:

- Availability of fixed fire suppression systems.
- Availability of manual fire fighting equipment
- Building and equipment layout
- Capabilities and training of the operations employees, facility emergency response group, if provided, and responding off-site emergency response agencies.

Any emergency response planning, fire fighting activity, and emergency response group should comply with OSHA (USA), NFPA (USA) and other applicable local or federal requirements.

5.4 Training (Operations/ERT)

Persons responsible for the operation of the Recovery Boiler should be thoroughly trained in the function of the evaporator. All mechanical and electrical equipment and instrumentation should be explained in a training program. Updated reference material sufficient to refresh knowledge and keep responsible people current on all support systems should be available to equipment operators. (Use of AF&PA Training References should be considered.) Training should describe specific functions to be accomplished by each person.

All training activities should be documented. Documentation should indicate the scope and structure of the training program.

Operators and members of the Emergency Response Team, if provided, should both be familiar with the scope and operation of the fire suppression system(s). Training should be sufficient to acquaint ERT members with the hazards relating to black liquor, including but not limited to the combustibility of pyrolyzed gasses and the potential for smelt formation. Training should include provisions for demonstrating proficiency in the tasks assigned.

A fire pre-plan should document the resources available to ERT members, and be available to operators and ERT members. This document should be reviewed and used as a training aid at least annually.

5.5 Personnel Safety

- As outlined above, emergency procedures must take into account the safety of individuals in the affected areas during a fire situation. Employees expected to take actions in mitigating a fire must be properly trained and equipped.
- Appropriate evacuation plans and procedures must be prepared and exercised on a regular basis. Non-essential personnel should leave the area in the event of an emergency.

- The use of automatic fire suppression systems is preferred over manual fire fighting.

CHAPTER 6 FIRE INCIDENT REPORTING

The purpose of reporting fire incidents is to provide reliable information to BLRBAC on fires that occur in direct contact evaporators (cascades, cyclones, venturis) and associated equipment such as precipitators, duct work, ID fans, etc. An examination of this information by the subcommittee members will lead to strategies that avoid future losses, and assist in the continuous improvement of these guidelines.

As with any type of potential property loss exposure or an incident that might lead to a production interruption, an established method of assembling loss statistics can be used to assist in preventing future such incidents or reducing their effects. The subcommittee has established a procedure for reporting and recording these types of incidents. It requires the assistance of all facilities that operate DCE units to be successful. The procedures are as follows.

6.1 Reporting An Incident

Within a reasonable time period of an incident, the facility should complete a “Direct Contact Evaporator Unit Incident Questionnaire” and submit it, along with attachments, as directed on the form. The questionnaire is a separate file located in the Incident Reporting and Questionnaire section of the BLRBAC Web site and should be downloaded for this purpose. Any questions related to the completion of the form can be directed to the subcommittee chairperson by e-mail or phone call.

This questionnaire should be completed when any of the following occurs or other situations at the discretion of the location:

- Fire in units resulting in equipment shutdown and/or major equipment damage.
- Fire resulting in the automatic activation or manual activation of a fixed fire suppression system.
- Fire incident requiring a significant manual fire response.

6.2 Incident Recording

With the receipt of the questionnaire the report will be distributed to the Executive Committee Secretary and reviewed by the subcommittee members. Steps will be taken to assure that the report details are properly placed in the electronic database. Prior to the next BLRBAC meeting all reports will be tabulated and a generic report will be prepared to present at the Main Committee meeting of the BLRBAC members. All those sending in a questionnaire will be contacted to determine if they would present a brief summary of their incident during the Main Committee meeting. Facilities reporting incidents of specific interest will be encouraged to have a facility representative summarize the incident at the Main Committee meeting.

The Executive Committee will maintain an electronic database of incidents, in keeping with Article IX, 9.1 of the BLRBAC By-Laws. A non-facility specific version of this database will be accessible to BLRBAC members on the BLRBAC internet web page.

APPENDIX A FIGURES AND DRAWINGS

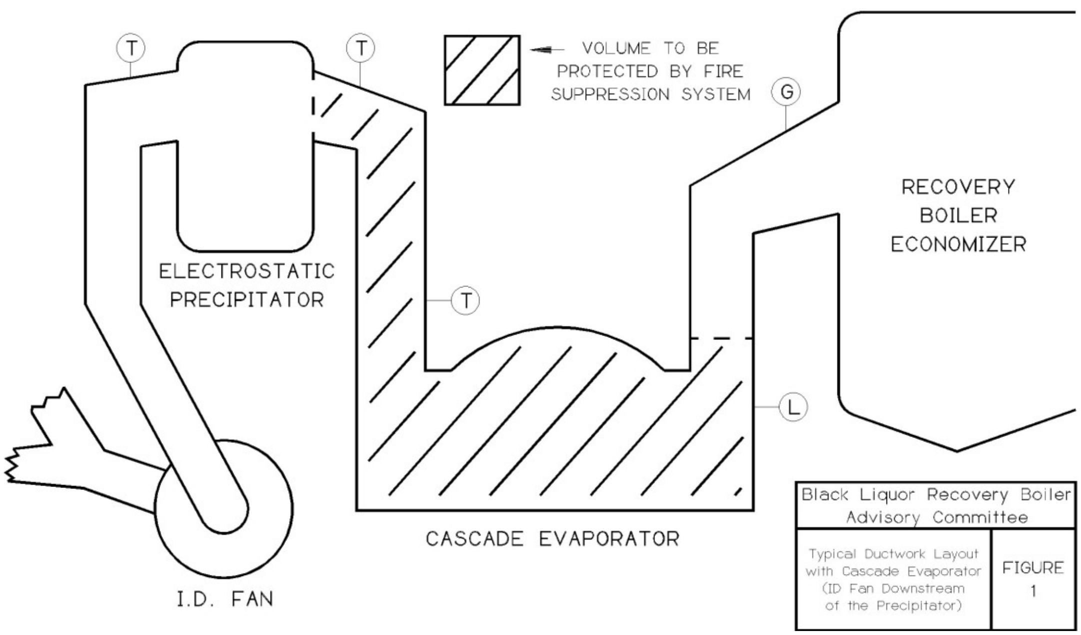

Fig. 1. Typical Ductwork Layout with Cascade Evaporator (ID Fan Downstream of the Precipitator).

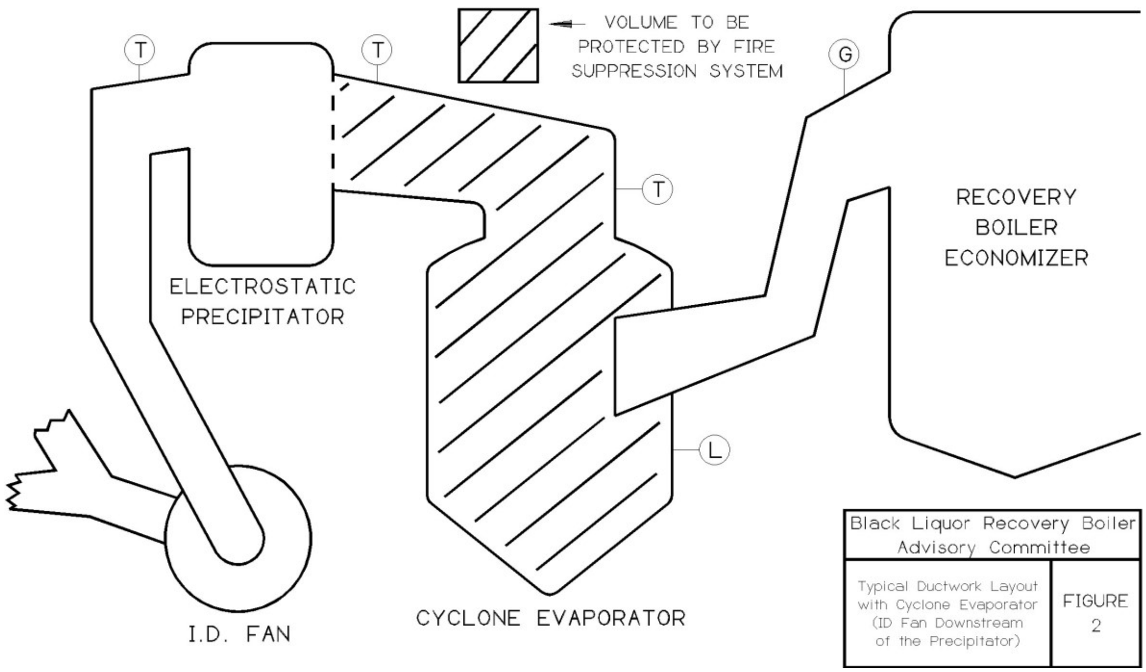

Fig. 2. Typical Ductwork Layout with Cyclone Evaporator (ID Fan Downstream of the Precipitator).

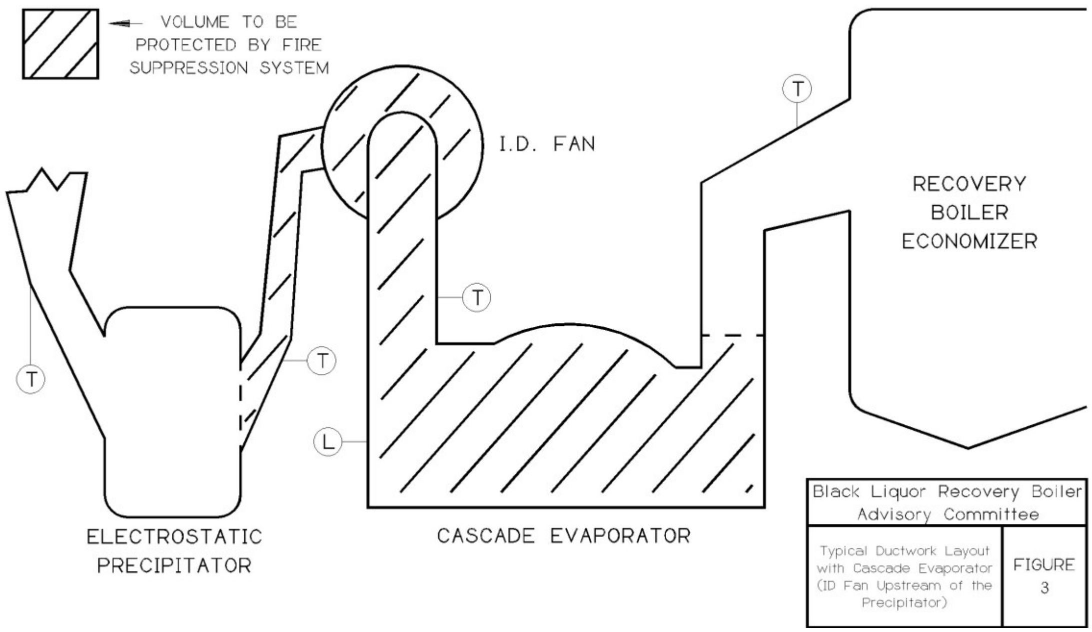

Fig. 3. Typical Ductwork Layout with Cascade Evaporator (ID Fan Upstream of the Precipitator).

APPENDIX B – DOCUMENT REVISION HISTORY

<u>April 2024</u>
Section 3.3 Physical Installation and Design added 3 new bullet points at the end to have language regarding routine testing, inspecting, and cleaning of fire protection nozzles and design of nozzle to allow such cleaning. Language also added regarding piping design to allow functional testing to prove nozzle open without tripping the boiler

Section 3.7.6 Structure added language regarding routine testing of cascade wheel shaft for potential failure and suggested frequency and method by which to test

Section 4.1 General added language that manual activation must be "from a safe location" as result of discussion on whether valve failure state should be specified. Team felt that manual capability from a safe location would suffice vs specifying a valve fail state.

Section 4.2.1 Water added language allowing loose fitting caps tethered to prevent entering liquor system as protection for fire protection nozzles

Section 4.2.2 Steam added language that Steam Smothering valves should alarm back to a manned control room indicating the steam valve is open

Section 4.3 Inspection and Testing added language to test primary protection as well as secondary and manual back up capability.
Section 4.3 Inspection and Testing added language to allow quarterly vs monthly testing of water flow alarms and retain monthly testing of valve position checks

April 2016

The following are the highlights of the changes:

- Section 3.2.2 deals with instrumentation that is monitored during normal operation. The key revision is that for cyclone style evaporators, pressure alone may be inadequate if nozzles are plugged. Flow should be monitored.
- Section 3.2.3 lists various upset conditions that need established procedures. The key addition is ESP. There has been a DCE fire related to an ESP event and we need people alert to that potential. Clarifications were added to several other upset conditions.
- Section 3.2.4 is entirely new. These are possible actions to take during upset conditions to reduce the potential for a fire. It is a fairly long list, but each mill will have site specific conditions that either make the possible actions practical or impractical for their operation.
- Section 3.3 has 7 current bullet points. The listed bullet would be added to that list. Fire protection nozzles can plug and become ineffective. The means for cleaning and rodding them out can assure these nozzles are ready to fight the fire.
- Section 4.2.3 relates to the detection system and what is interlocked to the detectors. The change relates to desired automatic operation of closing the inlet damper to the precipitator. It can also be by "safe" operator action. Issue here is that if the fire were to occur during an ESP, manual operation of the damper might not be possible if it required operators to go into the recovery boiler area.

April 2008

Added guidelines for manual reset of the fire suppression system to sections 4.1 and 4.2.4.

April 2007

Chapter 3, PREVENTION, Section 3.5, Operator Checks: Added checking of the flow box bypass to the list of routine operator activities.

Chapter 5, FIRE EMERGENCY RESPONSE, Section 5.4, Training: Deleted paragraph discussing the use of sodium bicarbonate or liquid carbon dioxide for smelt bed cooling.

Where not already done, metric equivalents to the English units were added.

April 2006

An item has been added to section 3.3 to consider the use of density measurement directly on the recirculation medium for the direct contact evaporator.

October 2004

The Direct Contact Evaporator Unit Incident Questionnaire has been removed from this document and relocated to the *Incident Reporting and Questionnaires* section of the BLRBAC Web site.

Non-Technical Changes

A number of minor revisions, shown in red, have been made to clarify text, but no changes to technical requirements have been made. One of these changes, Section 4.2.1, was made in response to two reports that the text was being misinterpreted to require water sprinklers every ten feet in vertical runs of ductwork. As this was never intended, text has been added to clarify.

April 2004

Section 4.2.2 – Steam 4th Bullet: Deleted "Provide one nozzle for every 10-ft. length of enclosure or duct." and replaced it with "Steam nozzles should be sized and positioned in order to assure proper distribution of steam throughout the volume to be protected."

October 2002

This revision is a complete rewrite replacing the original document published in October 1974.

October 1974

A document addressing fire protection in direct contact evaporators and associated equipment was published by BLRBAC in October 1974.